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# FORAGING BEHAVIOUR OF THE BEE *OSMIA APICATA* SMITH, 1853 (HYMENOPTERA: MEGACHILIDAE)

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**Abstract** – With observations and photography, the collecting of *Onosma* (Boraginaceae) pollen and nectar by *Osmia apicata* Smith, 1853 bees was studied. Pollen is collected by shaking the anther cone using the legs, an alternative method to the buzzing in this oligolectic bee species.

KEY WORDS: pollination, Hymenoptera, Megachilidae, Boraginaceae, *Onosma, Osmia*

**Izvleček** – NABIRALNO VEDENJE ČEBELE VRSTE *OSMIA APICATA* SMITH, 1853 (HYMENOPTERA: MEGACHILIDAE)
Opazovali in fotografirali smo nabiranje peloda in medičine rdečega korena (*Onosma*, Boraginaceae) čebel vrste *Osmia apicata* Smith, 1853. Pelod zbirajo s tresenjem prašničnega stožca z nogami, tehnike alternativne brenčanju, te oligolektične (malobralne) vrste čebel.

KLJUČNE BESEDE: opraševanje, Hymenoptera, Megachilidae, Boraginaceae, *Onosma, Osmia*

## Introduction

*Osmia apicata* Smith, 1853 is the only species of the subgenus *Monosmia* Tkalcu. Females are 12-12.5 mm long, males 10.5-12 mm. Superficially they look like species of the subgenus *Osmia* Panzer, but have a very long proboscis, almost as long as the body. When retracted this reaches far beyond the thorax. Such a character is found also in *O. maxillaris* Morawitz, 1875, the only species

of the subgenus *Orientosmia* Peters. *Osmia apicata* is an East Mediterranean species (Peters 1978, Ungricht et al. 2008). The Slovenian population is near the western edge of its distribution – it also populates the Italian part of the Kras/Carso/Karst near Triest (Ducke 1900, Graeffe 1902) and was seen by A. Müller in Gargano, Apulia (Teppner 1996). In Slovenia, it is found in the Kras plateau and the Kras edge in Istria, only on the limestone bedrock in the submediterranean region. According to Ducke (1900) and Graeffe (1902) it nests in crevices in stone walls, which are numerous in the Karst. The same authors mentioned *Onosma* (Boraginaceae)- 'Golden Drops', as its food plant. In Slovenia, *Osmia apicata* was only observed on *Onosma echioides*. The oligolecty was confirmed by Teppner (1996) and A. Müller (2011).

Although primarily an Asiatic genus with round 150 species (Wielgorskaya 1995), Europe hosts almost 50 species of *Onosma* (Ball 1972). In the Karst area, three taxa were recorded (Pignatti 1982, Martinčič 2007): *O. visianii* Clementi, *O. helvetica* Boiss. em Teppner ssp. *fallax* (Borbas) Teppner (=*O. pseudoarenaria* Schurr. ssp. *fallax* (Borbas) Jav.) and *O. echioides* L. (=*O. javorkae* Simonkai, *O. taurica* Willd. ssp. *dalmatica* (Scheele) Braun-Blanq.). *O. echioides* represents a taxonomically difficult group of taxa (see also Braun-Blanquet 1927) which is still not satistfactorily resolved and experimental investigation is much needed. Hence, there has been a considerable nomenclatural confusion and the following names have been widely misapplied (compare Ball 1975 and Braun-Blanquet 1927): *O. echioides* L., *O. setosa* Ledeb., *O. stellulata* Waldst. & Kit., *O. taurica* Wild., *O. pseudoarenarium* Schur, *O. lingulatum* Freyn. etc.

*Onosma echioides* is a caespitose perennial with several erect and simple flowering stems up to 30 cm high and flowers in terminal, usually branched, bracteate cymes. While flowering, calyx length is round 10 mm, and up to 15 mm when fruiting. The corolla (17-26 mm) is pale yellow, puberulent, about twice as long as the calyx, tubular and cylindrical at the apex (width 8-9 mm) but tapering towards the base (width 4-5 mm) with 5 short deflexed lobes. While the style is exserted, stamens are as long as the corolla or slightly exserted. They are inserted at about the middle of the corolla tube with a projecting connective at the apex. At their base, anthers (8-9 mm in length) are sagittated.

Since *Onosma* flowers have narrow corolla tubes and *Osmia apicata* bees cannot enter far into the corolla, the way they collect pollen grains and nectar needs to be explored. The anthers of *Onosma* species are bent towards the style forming an anther cone and end into a dry, membranous connective tip (Teppner 2011). Pollen can be collected by manipulations with mandibles and front legs or by buzzing (Teppner 1996). Teppner (1996) observed *Osmia apicata* on *Onosma helvetica, O. heterophylla* and *O. stojanoffii* in Greece. Females entered with their head, front side of the thorax and front legs into the corolla tube. Pollen was deposited on the underside of the thorax and front edge of the abdomen. Vibration ('buzz-pollination') was not used to release pollen from the flower.

Buzzing was used, however, by *Cubitalia morio* in Greece and by *Anthophora acervorum* (=*A. plumipes*) and *Bombus* species on cultivated *Onosma* plants in Central Europe. *Andrena symphyti* females also use buzzing when they collect *Onosma* pollen (Teppner 2011). When bees buzz-pollinate, they use flight muscles to shake their body and the vibration transmits to the anthers. It is usually performed in flowers with poricidal anthers, which emit pollen through small openings, allowing it to adhere to the bee's body. Buzz-pollination or sonication is performed by bumblebees and many other bee species, but not honeybees, for example (Willmer 2011). *Onosma* flowers do not have poricidal anthers, but the pollen is concealed within the anther cone.

## Materials and methods

In the end of April 2007 the first author observed and photographed *Osmia apicata* females foraging on *Onosma echioides* flowers at two localities near Komen in the Kras plateau. One is situated on the south-oriented slope between villages Brestovica pri Komnu and Sela na Krasu (45.8° N 13.6° E), the other near Brje pri Komnu (45.8° N 13.7° E). An analog SLR camera with a twin flash light was used. Additional observation was made in May 2011 at Gredina above Brestovica pri Komnu.

## Results

To reach nectar at the base of the hanging flowers, *Osmia apicata* bees use their extremely long proboscis. A female grabs the edge of the corolla tube with her legs, hanging upside down. When she reaches for nectar, the proboscis must be inserted through one of the five openings between the filaments. To collect pollen, she must scrape or shake it from the inside of the anther cone with legs or mandibles. As we cannot observe this behaviour directly, we can only reconstruct it from the consequences that can be seen. Fig. 3 shows a female with pollen on the underside of her head and thorax. Her front legs are also full of pollen, so she probably put them into slits in the anther cone. During this, she shakes the cone and pollen drops to her body. Some pollen grains are still seen in the air. The shaking is not performed by flight muscles, as no buzzing sound is heard. Instead, she shakes the flower with her legs. The sound heard during collecting is similar to the rustle of paper sheets and differs from buzzing.

The pistil of the *Onosma* flower protrudes far out of the corolla and the stigma can touch the bee hanging under the flower. It can be pollinated without the need of a bee entering the corolla tube.

**Fig. 1:** *Osmia apicata* has a very long tongue in comparison to body length. It uses it to reach nectar in long and narrow *Onosma echioides* flowers.

**Fig. 2:** Female grabs the edge of the corolla tube with legs, hanging upside down.

**Fig. 3:** The result of the bee's activity is the pollen dropping to her body.

## Discussion

Teppner (2011) described collecting of the *Onosma* pollen by *Andrena symphyti*. Besides buzzing, another sound was heard and described as a rustling noise. According to Teppner the sound is created by the dry membranous connecting tips of the anthers when manipulated by the bee. The rustling sound heard during the *Osmia apicata* collecting is probably produced by the same mechanism. As this species does not use buzzing, the shaking with legs must be efficient enough to fulfill the needs of the bee. The rustling sound, as well as the dynamic scene on fig. 3 speak in favor of fast movements during manipulation of the flower by *Osmia apicata*. Shaking with legs should be classified as an alternative collecting method of bees, different from buzz-pollination, but with similar results in flowers like *Onosma* and other Boraginaceae.

## References

**Ball, P.W.,** 1975: Onosma. In: Tutin, T.G., Heywood, V.H:, Burges, N.A., Moore, D.M., Valentine, D.H, Walters, S.M. & Webb, D.A. (eds.), Flora Europaea Vol. 3, 89-94 pp., Cambridge University Press, Cambridbe.

**Braun-Blanquet, J.,** 1927: *Onosma*. In Hegi, G. (ed.) Illustrierte Flora von Mittel-Europa (V. Band, 3. Teil), 2177-2186 pp., J.F. Lehmans Verlag, München.

**Ducke, A.,** 1900: Die Bienengattung Osmia Panz. *Ber. naturw.-med. Ver. Innsbruck*, 25: 1-323.

**Graeffe, E.,** 1902: Die Apiden-Fauna des österreichischen Küstenlandes. *Verh. k. k. zool.-bot. Ges. Wien*, 52: 113-135.

**Martinčič, A.,** 2007: Boraginaceae. In Martinčič, A., Wraber, T., Jogan, N., Podobnik, A., Turk, B., Vreš, B., Ravnik, V., Frajman, B., Strgulc Krajšek, S., Trčak, B., Bačič, T., Fischer, M.A., Eler, K. & Surina, B. (eds.) Mala flora Slovenije, 530-545, Tehniška založba Slovenije, Ljubljana.

**Müller, A.,** 2011: Palaearctic Osmiine Bees, ETH Zürich, http://blogs.ethz.ch/osmiini

**Peters, D.S.,** 1978: Systematik und Zoogeographie der west-paläarktischen Arten von *Osmia* Panzer, 1806 s. str., *Monosmia* Tkalcu, 1974 und *Orientosmia* n. subgen. (Insecta: Hymenoptera: Megachilidae). *Senckenbergiana Biologica*, 58: 287–346.

**Pignatti, S.,** 1982: Flora d'Italia. Vol. 2. Edagricole, Bologna, 732 pp.

**Teppner, H.,** 1996: Blüten und Blütenbesucher bei *Onosma* (Boraginaceae–Lithospermeae). *Feddes Repertorium,* 106 (5-8): 525-532.

**Teppner, H.,** 2011: Flowers of Boraginaceae (*Symphytum, Onosma, Cerinthe*) and *Andrena symphyti* (Hymenoptera-Andrenidae): Morphology, Pollen portioning, Vibratory pollen collection, Nectar robbing. *Phyton*, 50 (2): 145-180.

**Ungricht, S., A. Müller, S. Dorn,** 2008: A taxonomic catalogue of the Palaearctic bees of the tribe Osmiini (Hymenoptera: Apoidea: Megachilidae). *Zootaxa*, 1865: 253 pp.

**Wielgorskaya, T.,** 1995: Dictionary of generic names of seed plants. Columbia Universtiy Press, New York, 570 pp.

**Willmer, P.,** 2011: Pollination and floral ecology. Princeton University press, Princeton and Oxford, 778 pp.

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