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FIRST RECORD OF THE INVASIVE GIANT RESIN BEE *MEGACHILE* (*CALLOMEGACHILE*) *SCULPTURALIS* SMITH, 1853 (HYMENOPTERA: MEGACHILIDAE) IN THE CRIMEA

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Summary. *Megachile sculpturalis* Smith, 1853 was revealed nesting in a trap nest and a "bee hotel" in Simferopol. The nests were built of conifer resin with addition of mud and sawdust. Females visited inflorescences of *Eryngium campestre* L., *Inula helenium* L., and *Carduus acanthoides* L. while pollen samples taken from one foraging female contained only pollen of *Ballota nigra* L. Such a find of a newly established invasive species in the Crimea represents the easternmost point in its European range and possibly the most remarkable jump-dispersal event in its distribution (1,130 km from the nearest previously known point in Hungary). This is the first invasive megachilid bee species known to Russia.

Key words: megachilid bees, Russia, distribution, nesting biology, trap nests.

С. П. Иванов, А. В. Фатерыга. Первая находка гигантской инвазивной пчелы-смолевщицы *Megachile* (*Callomegachile*) *sculpturalis* Smith, 1853 (Hymenoptera: Megachilidae) в Крыму // Дальневосточный энтомолог. 2019. N 395. С. 7-13.

Резюме. Гнездование *Megachile sculpturalis* Smith, 1853 обнаружено в гнезде-ловушке и «гостинице для пчел» в Симферополе. Гнезда были построены из смолы хвойных деревьев с добавлением земли и опилок. Самки посещали соцветия *Eryngium campestre* L., *Inula helenium* L. и *Carduus acanthoides* L., однако пробы пыльцы, взятые с одной из фуражирующих самок, содержали только пыльцу *Ballota nigra* L. Находка данного инвазивного вида, впервые отмеченного для Крыма, представляет наиболее восточную точку европейской части его ареала и, возможно, наиболее крупный скачок в его распространении (1130 км от ближайшей ранее известной точки в Венгрии). Это первый инвазивный вид пчел-мегахилид, зарегистрированный в России.

INTRODUCTION

The number of bee species accidentally introduced outside their native range continues to increase. Cavity nesting species in the family Megachilidae are the main part of invasive bees worldwide due to the ease of inadvertent transport of their nests. It is important to monitor the invasive bee fauna to better understand its potential impacts on native bees (Portman *et al.*, 2019). The number of papers on the megachilid bee fauna of Russia is also increasing

(Byvaltsev *et al.*, 2018; Fateryga *et al.*, 2019; Proshchalykin & Müller, 2019; Byvaltsev & Proshchalykin, 2019) after the publication of the "Annotated Catalogue of the Hymenoptera of Russia" (see Proshchalykin & Fateryga, 2017). A total of 212 native species of Megachilidae have been reported from Russia up to day (see Fateryga *et al.*, 2019). The purpose of the present paper is to report the record of the first invasive megachilid bee species known to Russia. This is the record of so called giant resin bee, *Megachile* (*Callomegachile*) *sculpturalis* Smith, 1853 revealed in the Crimea.

Megachile sculpturalis is an eastern Palaearctic and Oriental species described from North China (Smith, 1853) and native to China (including Taiwan), Korean Peninsula, and Japan (Hinojosa-Díaz *et al.*, 2005). It was accidentally introduced into the United States of America and first collected from North Carolina in 1994 (Mangum & Brooks, 1997). Then, *M. sculpturalis* spread rapidly through North America reaching Kansas and Texas on the west as well as Canada on the north (Hinojosa-Díaz, 2008; Parys *et al.*, 2015). In Europe, the species was firstly detected in 2008 in France (Vereecken & Barbier, 2009). Further records of *M. sculpturalis* were made in 2009 in Italy (Quaranta *et al.*, 2014), in 2010 in Switzerland (Amiet, 2012), in 2015 in Germany (Westrich *et al.*, 2015) and Hungary (Kovács, 2015), in 2016–2017 in Slovenia and Austria (Gogala & Zadravec, 2018), and in 2018 in Spain (Aguado *et al*., 2018).

Females of *M. sculpturalis* nest in various preexisting cavities: hollow stems, particularly bamboo or reed ones, burrows in wood, especially abandoned nests of carpenter bees (Hymenoptera: Apidae: *Xylocopa*), etc. The main building material is resin collected from conifers or maple gum. This material is mixed with sawdust and often mud. Mud is used mainly for sealing the whole nest while it is unclear whether it is also used for the cells as well (see Hinojosa-Díaz *et al.*, 2005; Quaranta *et al.*, 2014; Westrich *et al.*, 2015). The species is largely polylectic with more than 25 known species of forage plants (Quaranta *et al.*, 2014). Three plant species were confirmed to be pollen sources in two different localities of Europe: *Ligustrum* sp. (Oleaceae) and *Castanea* sp. (Fagaceae) in Italy (Quaranta *et al.*, 2014) but *Sophora japonica* L. (Fabaceae) in Germany (Westrich *et al.*, 2015). It is also known that females can damage some flowers during foraging (Mangum & Sumner, 2003).

MATERIAL AND METHODS

A single nest of *M. sculpturalis* was first found in a trap nest in September, 2018 in south outskirts of Simferopol, 44°55′58″N 34°07′57″E. The nest was built in a reed stem [*Phragmites australis* (Cav.) Trin. ex Steud.] and contained a single cell with a prepupa. After overwintering, it pupated and then died. Thus, it was impossible to identify the species without additional material. Then, three nesting females were revealed on September 2, 2019 on an inset balcony on the fourth floor of a four-floor building of Taurida Academy of the V.I. Vernadsky Crimean Federal University, 44°56′13″N 34°08′07″E. There was a "bee hotel" on this balcony; it was made as shelves filled with sheaves of reed and pithy stems, sheaves of paper tubes, trunks with drilled holes, and other kinds of cavities (Fig. 1). The "bee hotel" was situated here since 1988. Sometimes, nests of several bee species were placed into the "hotel" and then bees emerged from them started nesting there. These nests were obtained from trap nests placed all over the Crimea (see Ivanov *et al.*, 2019). Five species of megachilid bees were nesting in the "hotel" each year since 2000: *Osmia bicornis* (Linnaeus, 1758), *O. cornuta* (Latreille, 1805), *O. bidentata* Morawitz, 1876, *Hoplitis manicata* Morice, 1901, and *Heriades crenulata* Nylander, 1856. However, the "hotel" itself also served as a big trap nest. Some years, other bee species such were *Hylaeus* spp. (Hymenoptera: Colletidae), *Osmia caerulescens* (Linnaeus, 1758), *Megachile rotundata* (Fabricius, 1787), *M. maritima* (Kirby, 1802), *Anthidium manicatum* (Linnaeus, 1758) (Hymenoptera: Megachilidae), and *Xylocopa valga* Gerstäcker, 1872 were revealed nesting there but neither of them were artificially placed into the "hotel" (Ivanov *et al.*, 2017).

Figs 1–6. Bionomics of *Megachile sculpturalis* Smith in the Crimea: 1 – "bee hotel" where the nesting was observed; 2 – female at her nest in a paper tube; 3 – female on an inflorescence of *Eryngium campestre* L.; 5 – females of *M. sculpturalis* (above) and *M. centuncularis* (Linnaeus) (below) on an inflorescence of *Inula helenium* L.; 5 – dissected reed stem with a nest of *M. sculpturalis* containing cells with young larva (left) and an egg (right); 6 – dissected reed stem with a nest containing cells with a prepupa (left) and a false pollen loaf (right).

The balcony was open eastwards and faced a large plot covered with ruderal vegetation. Twenty species of plants were still in flower there in September: *Hypericum perforatum* L. (Hypericaceae), *Diplotaxis tenuifolia* (L.) DC. (Brassicaceae), *Convolvulus arvensis* L. (Convolvulaceae), *Ballota nigra* L., *Salvia verticillata* L. (Lamiaceae), *Echium vulgare* L. (Boraginaceae), *Centaurea diffusa* Lam., *Inula britannica* L., *I. helenium* L., *Crepis foetida* subsp. *rhoeadifolia* (M. Bieb.) Čelak., *Achillea setacea* Waldst. & Kit., *Chondrilla juncea* L., *Cichorium intybus* L., *Carduus acanthoides* L. (Asteraceae), *Eryngium campestre* L. (Apiaceae), *Trifolium hybridum* L., *Medicago falcata* L., *Lotus corniculatus* L. (Fabaceae), *Verbascum phlomoides* L. (Scrophulariaceae), and *Malva sylvestris* L. s.l. (Malvaceae). Females of *M. sculpturalis* were observed not only at their nests but on this plot as well.

Besides three nesting females, four ones were found dead under the "bee hotel" (three specimens) and inside a lecture room bordering with the balcony (one specimen). The last one had completely "fresh" pubescence and intact wings and thus had been probably locked there at the beginning of the nesting period. Three nesting females finished their activity on September 6 (two specimens) and on September 9 (one specimen) and then were collected. Two nests were dissected and studied. Pollen samples were taken from one nesting female during her arrives to the nest. The samples were taken from the scopa using a bit of a sticky tape placed at the entrance of the nest (see Ivanov & Menzatova, 2016).

Bees were identified using descriptions in Sheffield *et al.* (2011). Specimens were deposited in the collection of the Taurida Academy of the V.I. Vernadsky Crimean Federal University, Simferopol, Russia [CFUS] and the collection of A.V. Fateryga (T.I. Vyazemsky Karadag Scientific Station – Nature Reserve of RAS – Branch of A.O. Kovalevsky Institute of Biology of the Southern Seas of RAS, Feodosiya, Russia) [CAFK].

RESULTS

***Megachile* (*Callomegachile*) *sculpturalis* Smith, 1853**
Figs 1–6

MATERIAL EXAMINED. **Russia:** *Crimea*: Simferopol, 44°56′13″N 34°08′07″E, dead in a lecture room, 2.IX 2019, 1 ♀, S.P. Ivanov; ibid., dead under a bee hotel, 2.IX 2019, 3 ♀, S.P. Ivanov; ibid., exhausted after nesting finish, 6.IX 2019, 2 ♀, S.P. Ivanov [CFUS]; ibid., natural death, 9.IX 2019, 1 ♀, S.P. Ivanov [CAFK].

DISTRIBUTION. China (including Taiwan), Korean Peninsula, Japan; introduced into USA, Canada, Spain, France, Switzerland, Italy, Germany, Austria, Slovenia, Hungary (see references in the Introduction), and Russia (*new record).

BIONOMICS. Females of *M. sculpturalis* made their nests in paper tubes (Fig. 2) and reed stems. One female observed on the morning of September 2 (from 8.15, solar time) was provisioning her nest while two other ones carried resin pellets with their mandibles. The resin was obviously taken from conifers as far as it had peculiar scent. Four species of conifers grew in the neighborhood of the balcony with the nests: *Pinus nigra* subsp. *pallasiana* (Lamb.) Holmboe, *P. brutia* var. *pityusa* (Steven) Silba, *Picea abies* (L.) H. Karst. (Pinaceae), and *Platycladus orientalis* (L.) Franco (Cupressaceae). It was impossible to establish which of them was used as the resin source. The resin was transparent and rather fluent. One of paper tube sheaves was nearly completely splashed with resin spread from just one nest plug.

The female provisioning her nest arrived each 20–25 min. in the morning and 30–45 min. in the evening. There was not much pollen in her scopa (Fig. 2). Females were observed visiting inflorescences of *Eryngium campestre* (Fig. 3), *Inula helenium* (Fig. 4), and *Carduus acanthoides* while pollen samples taken from the foraging female at her nest contained only pollen of *Ballota nigra*. Low rate of foraging behavior was obviously associated with the age of the bees: all of them had substantially damaged wings (Fig. 3). Forage recourses were also scarce due to the end of the season and the presence of competitive bee species such were *M. centuncularis* (Fig. 4) as well as *Apis mellifera* Linnaeus, 1758 (Apidae) and various sweat bees (Halictidae). Foraging flights were stopped at approximately 15.15.

Two dissected and studied nests were built in reed stems. The first one was dissected on September 3, directly after it had been sealed by the female. It was located in a stem which was 26 cm in length and 10.2–11.3 mm in inner diameter. The nest itself occupied 8.5 cm of the stem length and contained three cells. The cells were built of resin with adding of mud at least to some elements of their structure. First cell was located directly at the bottom of the cavity; the second one was separated from it with a partition which was 1.2 mm thick in its center. The third cell was separated from the second one by much thicker partition consisted of three layers. Two outer layers were 1.5 mm thick each and made of resin and mud. A space between them was filled with mud with much less proportion of resin (Fig. 5). Inner spaces of the cells were more or less ellipsoidal. Their sizes were 19.1×10.1, 19.0×10.2, and 18.0×10.3 mm. The origin of the mud used as the building material was unclear. It was impossible to establish whether it was brought by *M. sculpturalis* female or remained from an old nest of any another bee species nested in this cavity earlier. Pollen loaf occupied less than a half of each nest cell volume. It had thick consistency and shining surface. The first and the second cells contained feeding larvae while the third one contained an egg (Fig. 5). The size of the egg was 5.6×1.4 mm. Pollen loafs had distinctly different color in the second and the third cells. This difference was obviously caused by changing of a forage plant after provisioning of the second cell. All larvae finished their feeding and started cocooning by October 1.

The second nest was dissected two weeks after it had been sealed by the female. It was located in a stem which was 28 cm in length and 14.4 mm in inner diameter. The nest itself occupied 4.7 cm of the stem and contained two cells. This nest also contained mud used as building material in addition to resin. Particularly, the mud was used for lateral walls of the cells where it was mixed not only with resin but with sawdust as well. These walls were up to 3 mm thick. The inner sizes of the cells were 24.9×10.6 and 19.6×9.9 mm. The second cell was sealed with plug which was 2.6 mm thick in its center. The first cell contained a prepupa while the second one contained a false pollen loaf, a mass of pollen and nectar covering the cell wall by a 2–3 mm-thick layer, and no progeny (Fig. 6).

DISCUSSION

The most common way for cavity nesting bees and wasps to travel and colonize new areas is shipping of infested timber or other merchandise. Once a species reaches a new area via shipping, the fastest way for it to spread to other areas is again via transportation routes, including train traffic and road transport (Quaranta *et al.*, 2014). On the other hand, large bees like *M. scupturalis* seem to have a strong tendency for spreading naturally in a short time (Westrich *et al.*, 2015). The record of *M. sculpturalis* in the Crimea represents the easternmost known location in the European range of this species. The nearest previously known point was Gyöngyös in Hungary (Kovács, 2015) which was in 1,130 km from Simferopol (linear distance). Obviously, the species could not easily spread across the Carpathian Range lying in between. Thus, it must have crossed even larger distance in just three years. Such expansion rate is too rapid to be natural spreading, so the spread was most probably assisted by means of human transportation. Similar remarkable jump-dispersal event in spreading through central Europe was previously recorded for the invasive grass-carrying wasp, *Isodontia mexicana* (de Saussure, 1867) (Hymenoptera, Sphecidae) (Fateryga *et al.*, 2014).

It is also remarkable that the nesting of *M. sculpturalis* was revealed in the “bee hotel”. Females of this species are known to be nesting in carpenter bee nest holes (Laport & Minckley, 2012). It is possible that the species could be also attracted by nest aggregations of other bees which were represented in the “hotel” in large amount.

Further studies of *M. sculpturalis* in the Crimea can be dedicated to its forage plants and some aspects of nesting behavior (e.g., the origin of the mud presented in nests). It seems to be not highly probable that this species will spread broadly within the peninsula. *Megachile sculpturalis* is confined mainly to humid areas (Hinojosa-Díaz *et al.*, 2005) while the most part of the Crimea has rather dry climate.

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