Ball-shaped nests of *Chalicodoma parietina* (Hymenoptera: Megachilidae) in Italy

G. G. M. Schulten & H. Wiering

SCHULTEN, G. G. M. & H. WIERING, 2001. BALL-SHAPED NESTS OF *CHALICODOMA PARIETINA* (HYMENOPTERA: MEGACHILIDAE) IN ITALY. – *ENT. BER., AMST.* 61 (4): 45-51.

Abstract: The occurrence is reported of ball-shaped nests of *Chalicodoma parietina* at a locality near Rome (Italy). A description is given of the nests and their location in the field. The likely construction method is discussed and data are provided on the time of emergence, sex, number of adults and natural enemies, which emerged from 39 nests.This type of nest was constructed by both females with a partially red or a black scopa.
Keywords: Chalicodoma parietina, ball-shaped nests, Italy, nest construction method, adult emergence, natural enemies.

Zoölogisch Museum, sectie Entomologie, Plantage Middenlaan 64, 1018 DH Amsterdam, The Netherlands.

Introduction

The nests of *Chalicodoma parietina* (Geoffroy) (Hymenoptera: Megachilidae) and related bee behaviour have been described in more or less detail since the eighteenth century by many authors. For details and literature references, see in particular Friese (1923) and Westrich (1989). Nests are made of mortar consisting of sand and tiny pieces of stone glued together with saliva and nectar. They are constructed against south or east vertical surfaces of walls, rocks or stones. A nest may consist of up to sixteen cells. First a cell of approximately 20-25 mm long and 10-12 mm wide is constructed against the vertical surface of the substrate. The length axis of the cell is vertical or somewhat inclined. One of the vertical cell walls consists of the outer surface of the substrate. This cell is gradually stocked with pollen and nectar. When the cell is half to two-thirds full, one egg is deposited on top of the pollen/nectar mixture and the cell is closed. Additional cells are constructed against the initial cell and provided with pollen, nectar and an egg. The cells are closed with a thin lid (Primärverdeckelung, sensu Westrich, 1989) and finally the cells are given an additional coating of mortar that covers them all.

Chalicodoma parietina is widely distributed in southern, eastern and central Europe, the Caucasus, the central Asian part of the former USSR and North Africa (Banaszak & Romasenko, 1998). The vestiture of males and females is completely different: males have a light brown to yellow pubescence while females are black. However, two colour forms of the females occur, one with a scopa that is red in the middle and black along the sides and another form with a totally black scopa. Some authors consider these two forms to be subspecies: *C. parietina parietina* (Geoffroy) in the western part of the distribution area and *C. parietina nestorea* (Brullé) in the eastern part (Balkan, eastern Europe and Asia). However, specimens with a totally black scopa have been collected in the western area and specimens with a partly red scopa in the eastern area. In Italy, the form with the partly red scopa is the most common one. Specimens with a totally black scopa have been collected in central and south Italy (Pagliano, 1994), including Rome (Zapparoli, 1997), and are reported in the literature as *C. parietina nestorea*.

Several Italian researchers have studied aspects of the biology of *C. parietina*. Bonelli & Campadelli (1991) gave a brief overview of these Italian observations. These authors also described an as yet unknown nest building of *C. parietina* in natural tunnels inside stones, which was observed for the first time in Sardinia.

Between 1991 and 1998, the first author found near Rome constructions of the size of a

Fig. 1. Ball-shaped nest of *Chalicodoma parietina* (Italy, Rome, 1.i.1996) on *Acer* spec.

golf ball, made of mortar which had been built on twigs of various bushes or trees. They appeared to be nests of *C. parietina*. Since only scant information on this type of nest can be found in the literature, observations were made as far as time permitted. Figure 1 shows a ball-shaped nest as can easily be seen in certain bushes during the winter. "Normal" nests of *C. parietina* are very common in the same area. These nests are mainly found on the inner side of triangular iron fence poles or in round openings of concrete fence poles.

Observations

The area

The nests were found in hedges or bushes along the natural drainage system of the farming area near the Via Falcognana (Località: Divino Amore), SE of Rome, about halfway between the centre of Rome and Albano Laziale. The drainage system is a partly natural, partly artificial system of some rivulets that only contain water in the winter. The stream beds are about two to five meter wide and run in rather deep gullies of two to five meter deep, cut through the somewhat undulating fields. The depth of the water, when present, varies but is not more than thirty to forty centimetres. The streambeds normally dry out during the summer. Crops cultivated in rotation are winter wheat, lucerne and colza, but regularly parts of the fields lay fallow. The vegetation along the watercourses is a mixture of *Ulmus* spec., *Acer* spec. and *Prunus spinosa* L. with some *Evonymus europaeus* L. The weed cover consists of many Poaceae, Boraginaceae (*Borago officinalis* L.), Asteraceae (*Taraxacum* spp.), Fabaceae (*Medicago* spp.), Lamiaceae, and Apiaceae. Efforts were made to find such nests outside the described area (some square kilometres) but none were found near Rome or elsewhere in Italy. These searches were, however, ad hoc and not systematic. In 1998 the drainage system was cleaned, which led to a considerable destruction of the vegetation on the banks. This activity may have had a negative impact on the bee population.

Nest trees or bushes

From a sample of 39 nests, collected between 1992 and 1997, 13 had been constructed in *Ulmus* bushes or trees, 18 in *Prunus spinosa*, six in *Acer*, one in *Malus*, and one on the chicken wire grid of a fence.

Location of the nests

The nests are constructed within the bushes on horizontal twigs with a diameter of on average 4.2 mm (range 3.5-9.0 mm, n=12) at an average distance of 4.9 cm (range 2.5-8.1 cm, n=12) from the tip of the branch. On *Acer*, however, the distance between the nest and the tip of the branch is sometimes much larger (figure 1). These exceptions (n=2) have not been included in the above averages. Sometimes, the nest is built where two twigs form a "fork". In summer time the nests are well hidden by the leaves and difficult to find. The compass orientation of the used twigs is variable. N or NE seems to be the most common but other orientations such as SE, W and WSW have also been found. The height at which the nests are built is mostly between 1.5 to 2.5 metres, but nests were also seen high in the *Acer* or *Ulmus* trees. Mostly the nests had been built widely separated from each other and not in colonies as is found for "normal" nests.

The nests

The materials used for the construction of the nest appear to be similar to materials used by *Chalicodoma parietina* which construct "normal" nests. The average weight of a nest was 67 g. (range 20-110 g., n=16) with an average maximum height of 40 mm, an average maximum width of 45 mm and an average maximum depth of 40 mm.

Nest construction

Building activities start in May and continue in June. In July no bees were seen in the field collecting materials for nest building. Only on three occasions nests under construction were found but no continuous record could be taken due to frequent absence from the area during the building period. These nests were located by observing hedges with a binocular for bees that regularly visited a particular part of the bush. Nest construction apparently starts by coating and enlarging the selected twig area with mortar. This was observed once. On it a vertical, free standing or somewhat inclined cell is constructed with the opening at the top. Such a cell was found while being stocked by the female but it broke during the observation. The dimensions of the cells, measured in nests from which the adults had emerged are approximately 21-23 mm long and 8-8.5 mm wide. Another nest under construction consisted of four cells, three of which had been closed and completely covered with mortar while the bee apparently had just closed the last cell with the "Primärverdeckelung." We therefore assume that when the first cell is ready, it is stocked, provided with an egg, closed and covered with mortar. Thereafter additional cells are constructed in about the same plane against the first cell and in general in the direction of the base of the twig. Additional cells may be constructed on top of or partly parallel (at a higher or a lower plane) to the first layer of cells. Finally, all the cells are covered with a coating of mortar.

To better understand the sequence of the cell construction, eight horizontal slices of half a centimetre were sawn off one by one from a nest from which the adults had emerged. When a slice is sawn off, it breaks and a cross-section of the remaining nest is obtained. Photographs were taken of each cross-section in the direction of the base of the nest. The photographs had to be taken by hand and are therefore not standardized. Figure 2a & 2b show the nest that has been studied and the numbered sections that have been photographed, starting with section 8. Figure 3a & 3b show the outlines of cells in the first section (the base of the nest). The cells 1, 3, 4, and 10 are considered to be the oldest cells, since their base is in about the same plane. Cell 1 is considered to be the first cell, as it is situated right on the twig. Note that cell 10 has its emergence hole at the bottom of the cell. Normally all adults emerge from the top of the cell. Cell 2 has supposedly been constructed after the above-mentioned cells since its basis is in a slightly higher plane. For the same reason cells 5, 6, and 9 have been constructed after cell 2, followed by cells 7 and 8. The third section showed all mentioned cells but cell 10. In the fourth section the bottoms of additional cells (11-16 and 19-22) start to show up, indicating that a second layer of cells had been added. These cells are more clearly shown in the fifth section (figure 4a & 4b), showing cells 11-22. The sixth section showed that one additional cell had been constructed. This is clearly shown in section 7 (figure 5a & 5b). On figure 6a & 6b the emergence holes of this nest are shown. Nineteen adults emerged from ten holes at the top and one hole at the bottom, showing that some adults had used the same emergence hole. Two adults failed to emerge and two cells were apparently empty, since no adults or signs of larval development could be found. Studies of other nests showed a similar sequence in the construction of the cells. After the construction of the first cell, in general three to five cells are added in about the same plane. Thereafter other cells are added partly parallel or on top of the first layer.

The total number of adults that emerged from a nest generally varied between six to

Fig. 2a. Lateral view of the studied nest (collected Italy, Rome, 5.iii.1995).

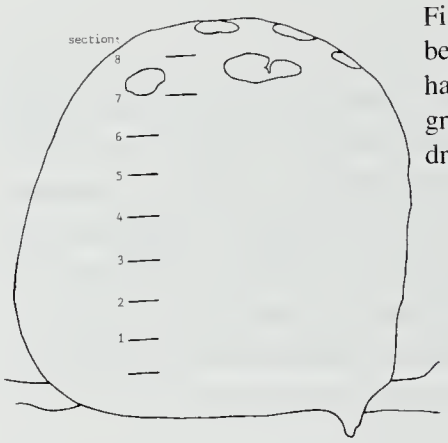

Fig. 2b. The numbered sections that have been photographed and drawn.

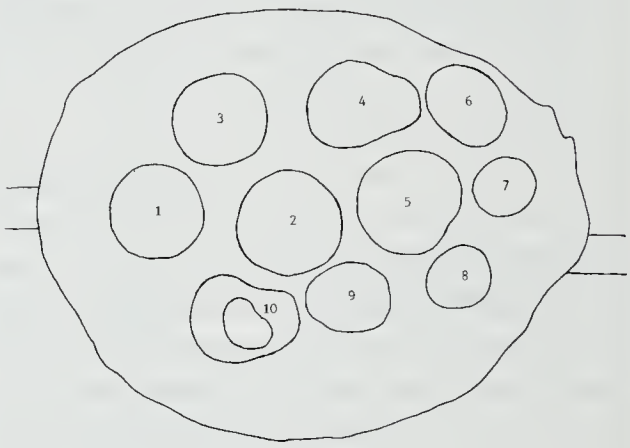

Fig. 3a & 3b. Section 1.

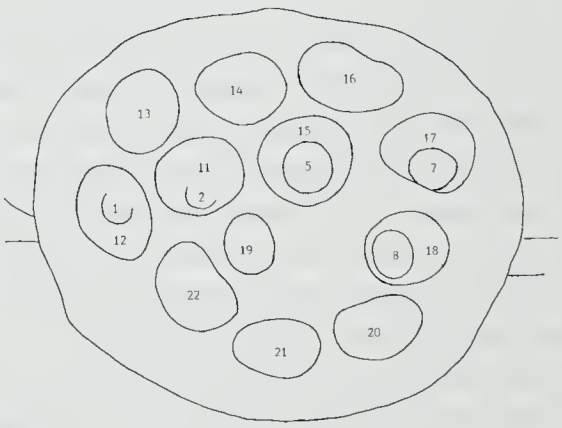

Fig. 4a & 4b. Section 5.

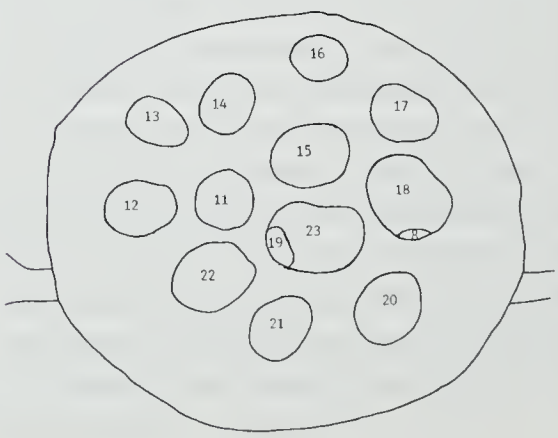

Fig. 5a & 5b. Section 7.

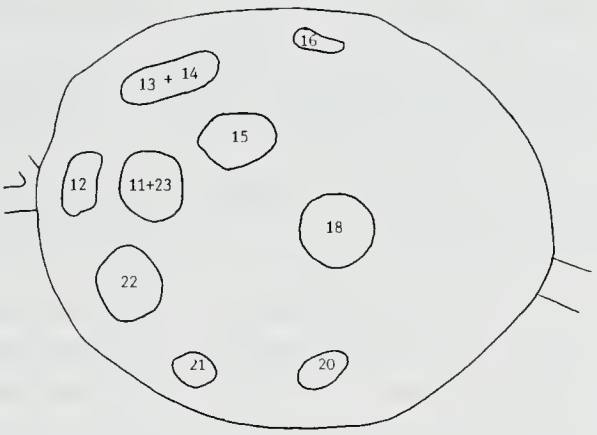

Fig. 6a & 6b. View of the top of the ball-shaped nest.

twelve, but larger numbers were found as well (7 ♂ and 12 ♀, 8 ♂ and 8 ♀, and 10 ♂ and 6 ♀). Parasitoids and mould disease may have had an impact on these numbers. Also, adults sometimes do not succeed in emerging, as was found for two adults in the nest mentioned above. In this nest 23 cells were identified, but only 21 adults were found. This finding suggests that either two cells remained empty or that the egg or larva died at a very early stage. The large number of cells in this nest is considered to be an exception. Nests normally consist of up to 16 to 20 cells (Banaszak & Romasenko, 1998; Westrich, 1989). It might be possible that this exceptional nest is the result of the activities of two females. Two nests gave male bees (7 and 7) only. Since there were no other cells, the nests likely had been constructed by unfertilized females.

Development and emergence

Adults were found in nests in November/ December of the same year that the nests had been constructed. However, in some nests that had been opened in February/March the year following construction, adults and some larvae or pupae were found. The same has been reported in the literature for "normal" nests. From nests that had been collected during the winter and kept at room temperature, adults started to emerge around the third week of April. At that time the first adults are also observed in the field. Emergence of adults may continue till around mid May. Most of the males emerge first, making their own emergence holes. Later emerging adults appear to often use the exit holes of early emerging adults since in most cases the number of exit holes is less than the number of emerged bees.

Partly red scopa versus totally black scopa

In the area *Chalicodoma parietina* females occur with a partly red or with a totally black scopa. From 17 ball nests females emerged with a partly red scopa and from 14 of such nests females with a totally black scopa. All females from the same nest are uniform in the colour of their scopa. Sometimes, however, the red in the scopa is reduced to a small number of red hairs. From "normal" nests both types of females emerge as well but there are no quantitative data due to the difficulty of detaching individual nests. It is our impression, however, that the females with a partly red scopa are the most common. In one case a female with a partly red scopa continued the construction of a "normal" nest that had been initiated by a female with a black scopa, after the latter had been collected. Both females with a red or a black scopa were seen collecting building material from the same square metre of soil. No other morphological differences between both types of females could be found.

Predators, parasitoids and cuckoo bees

The most common predators that were frequently found in or near "normal" nests were:

Trichodes apiarius Linnaeus and *T. alvearius* Fabricius (Coleoptera: Cleridae). The parasitoids *Monodontomerus aeneus* (Fonscolombe) (Hymenoptera: Torymidae), and *Spogostylum trinotatum* (Dufour) (Diptera: Bombyliidae), and the cuckoo bees *Stelis nasuta* (Latreille) and *Dioxys cincta* (Jurine) (Hymenoptera: Megachilidae) were collected once and *Leucospis gigas* Fabricius (Hymenoptera: Leucospidae) was collected several times from "normal" nests. *Dioxys cincta* and *Leucospis gigas* are very common in the area and were frequently observed near "normal" nests.

Leucospis gigas parasitized eight out of 32 ball nests from which emerged respectively 1, 1, 3, 4, 5, 6, 8, and 8 female wasps and various numbers of *C. parietina*. In four nests some of the females had left the nest through exit holes made at the underside of the nest. *Chalicodoma parietina* normally emerges through exit holes at the top of the nest. Two nests had been parasitized by *M. aeneus*. From one nest emerged 80 *M. aeneus* and two ♂ and two ♀ *C. parietina* and from the other nest 24 *M. aeneus* and one ♂ *C. parietina*.

Discussion

There are two previously published reports of ball-shaped nests of *Chalicodoma parietina*, both from Italy. Rebmann (1969) gave a very brief description and two photographs of a similar nest of *C. parietina* that had been collected on the Monte Argentario peninsula (Grosseto province), approximately 120 km NNW of Rome. He identified the bees as *C. parietina* without further comments and so we assume that the females had a partly red scopa. The photographs were sent to him by the Staatliches Museum für Naturkunde, Stuttgart. They show the nest, seen from above and attached to a vertical branch. This is a wrong presentation. Apparently he had no information on the orientation of the nest in nature. Comba (1964) reported a ball-shaped nest of *C. parietina* from Sacrofano (Lazio province), but gave no further details. Fabre (1879, translated in Friese, 1923) described in some detail how *Chalicodoma pyrenaica* Lepeletier var. *rufescens* Perez constructs a ball-shaped nest. There is a great similarity to the construction method of *C. parietina* as described in this paper. The occurrence of nests around a branch has been mentioned by Lichtenstein (1879) for *Chalicodoma sicula* Rossi and *Chalicodoma perezi* Lichtenstein. Muche (1938) presented a drawing of a nest of *C. sicula* that had been collected near Tripoli (Libya) in October 1937. The nest is shown as attached to a more or less horizontal twig, but it gives the impression that the adults had emerged from the side of the nest and not from the top. This seems very unlikely in the light of our observations. The drawing shows eight exit holes, which had been used by four ♀ and six ♂. A photograph of a similar nest ascribed to *C. sicula* was presented in Grandi (1961). This nest had been collected in Sorso (Sassari province, Sardinia). As on Rebmann's photographs, the nest is shown from above, in an unnatural position on a vertical twig. Grandi also mentioned the presence of such nests in Libya (Tiguira). A series of photographs of ball-shaped nests of *C. sicula* that had been collected in France (Corsica), Italy (Sicily and Sardinia) and Spain (Menorca) were given in Mader (2000). Some of these photographs also suggest that the bees had emerged from the side of the nest.

The available data suggest that in four species of *Chalicodoma* nests are normally constructed against vertical surfaces such as rocks, stones, walls or poles with some differences in the construction method between the species. Nests may, however, also be constructed on thin branches. This means a complete change from the normal construction method, as in particular the first cell is freestanding and not supported by a vertical surface. Considering the few published observations and the rather intensive coverage of the Mediterranean area by entomologists, this alternative construction method seems to be more an exception rather than the rule. This type of nest is, however, only obvious during winter. It may well be that the occurrence of this type of nest has been overlooked, winter not being the active period for field collecting hymenopterists.

The question arises why the bees occasionally change their construction methods. An obvious explanation could be a lack of breeding sites. However, in the described area, poles, rocks, walls, etc. for the construction of "normal" nests were abundant and the same pertains for the other localities where this type of nest has been found. We therefore assume that there are certain strains in the mentioned species that use a different nest construction technique. A discussion on the possible biological advan-tages of this alternative construction technique would be very speculative, because of lack of data. For this reason we will not further elaborate on this aspect. There appears to be no relation between the two types of nests and the scopa colour variants of *C. parietina*. Both females with a partly red scopa or a totally black scopa used the alternative construction method, while "normal" nests were constructed by both colour variants as well.

Acknowledgements

Thanks are due to Theo Gijswijt for the identification of *Monodontomerus aeneus* and for comments on the manuscript and to Ben Brugge for the identification of the bombyliid.

References

Banaszak, J. & L. Romasenko, 1998. *Megachilid bees of Europe:* 1-230. Pedagogical University of Bydgoszcz.

Bonelli, B. & G. Campadelli, 1991. Note biologiche su Chalicodoma parietina (Geoff.) (Hymenoptera – Megachilidae). – *Bollettino dell' Istituto di Entomologia "Guido Grandi" dell' Università degli Studi di Bologna* 44: 1-9.

Comba, M., 1964. Su alcuni generi di imenotteri melliferi dell' Italia centrale. – *Memorie della Società Entomologica Italiana* 43: 21-57.

Friese, H., 1923. *Die europäischen Bienen:* i-vi, 1-456. Walter de Gruyter and Co., Berlin & Leipzig.

Grandi, G., 1961. Studi di un entomologo sugli imenopteri superiori. – *Bollettino dell' Istituto di Entomologia dell' Università di Bologna* 25: 1-659.

Lichtenstein, M. J., 1879. Nidification de Chalicodoma. – *Bulletin de la Société Entomologique de France* 9: XXXV.

Mader, D., 2000. Nistökologie, Biographie und Migration der synanthropen Delta- Lehmwespe Delta unguiculatum (Eumenidae) in Deutschland und Umgebung. – *Erweiterter Sonderabdruck aus Dendrocopos* 27: i - xiv, 1-245. Logabook GmbH, Köln.

Muche, H., 1938. Die Kinderstube von Chalicodoma sicula Rossi. – *Entomologische Rundschau* 55: 420.

Pagliano, G., 1994. Hymenoptera Apoidea. In: *Checklist delle specie della fauna italiana* (A. Minelli, S. Ruffo, & S. La Posta, eds.) 106: 1-25. Calderini, Bologna.

Rebmann, O., 1969. Zur Nestbauweise von Megachile (Chalicodoma) parietina Fourcroy (Hym., Apidae). – *Entomologische Zeitung* 79: 138-139.

Westrich, P., 1989. *Die Wildbienen Baden-Würtembergs* 1: 1-431. Eugen Ulmer GmbH, Stuttgart.

Zapparoli, M. (ed), 1997. Gli insetti di Roma. *Comune di Roma, Dipartimento politiche dell' qualità ambientiale. Area risorsa suolo e tutela ambiente, Quaderni dell' ambiente* 6: 1-360. Fratelli Palombi Editori, Roma.

Accepted 9.i.2001.