

Observations on the sweat bee *Lasioglossum mandibulare* (MORAWITZ, 1866) (Hymenoptera: Apidae) in Austria

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Abstract

The sweat bee *Lasioglossum mandibulare* (MORAWITZ, 1866) was observed at Zicklacke, Illmitz, Burgenland. This locality is the habitat of the only known Austrian population of this species. In June 2023, the bee populated small soda pans in surprisingly high numbers. Nesting behaviour was observed and photographed. At this site, the females collect pollen of *Lepidium cartilagineum* (Brassicaceae). The females exhibit a strong size polymorphism. Despite this fact, so far our observations do not support eusociality of *Lasioglossum mandibulare* in Central Europe.

Key words. Bees, ecology, behaviour, habitat, polymorphism, Burgenland, National Park Neusiedlersee-Seewinkel.

Zusammenfassung

Die Kiefer-Schmalbiene, *Lasioglossum mandibulare* (MORAWITZ, 1866), wurde an der Zicklacke, Illmitz, Burgenland, beobachtet und untersucht. Dort lebt die einzige bisher aus Österreich bekannte Population dieser Spezies. Im Juni 2023 besiedelte diese Bienenart kleine Salzpfannen im Randbereich der Zicklacke in erstaunlich großer Anzahl. Das Nistverhalten wurde beobachtet und fotografiert. An diesem Standort sammeln die Weibchen für ihre Brut den Pollen der Salzkresse, *Lepidium cartilagineum* (Brassicaceae). Die Weibchen zeigen einen starken Größenpolymorphismus. Trotz dieser Tatsache konnten unsere Beobachtungen die Theorie einer eusozialen Lebensweise von *Lasioglossum mandibulare* in Mitteleuropa bisher nicht stützen.

Introduction

Lasioglossum mandibulare (MORAWITZ, 1866) is a small species of sweat bees (Apidae: Halictinae). This steppe species is widely distributed in the southern Western Palearctic (EBMER 2014, SCHEUCHL & WILLNER 2016). Most records are from the Mediterranean zone of South-eastern Europe, especially from Greece, but the species reaches Central Asia. In Greece, it is frequently found in salty habitats like sea coasts (own observations). *Lasioglossum mandibulare* was unknown for all of Central Europe (in a narrow sense) until 2012: The first report for Burgenland, Austria, goes back to GUSENLEITNER et al. (2012), but without naming a specific locality. The clarification of the exact locality at the Zicklacke near Illmitz as well as important information on the ecology at this site are due to HÖZLER (2021). In 2023, the authors visited the site to see how this population, which is perhaps unique in Austria, might have survived the extreme drought year 2022. During the process, some surprising observations were made that we think are worth sharing.

Material and methods

Locality. Two close sites at the eastern banks of Zicklacke in the west of the village Illmitz (Burgenland, Neusiedl am See District) were visited five times: N 47°46.1', E 16°47.6', 117 m a.s.l., on 2 June 2023; N 47°46.25', E 16°47.83', 117 m a.s.l., on 3 June 2023, 28 June 2023, 22 July 2023, and 10 August 2023. The species-specific nesting habitats were salt pans on Solonchak soil. In June, the only plant flowering in the close vicinity of the salt pans was *Lepidium cartilagineum* (Brassicaceae).

Sampled specimens. 18 females from Zicklacke were collected for indoor photography, measuring size variability, and documentation. The specimens are deposited in the Biologiezentrum Linz, the Natural History Museum Vienna, and the authors' collections. For morphometric comparison we studied 14 females from Greece.

Material from Greece examined and measured. 1 ♀ (#GR01 in Table 1) from Crete, E of Chania, Kalivas, coastal area (N 35°27.1', E 24°10.8'), 3–5.VI.2010; 2 ♀♀ (#GR02–03) from Crete, W of Chania, Kamisiana (N 35°32.0', E 23°48.6'), 18–25.VI.2011; 7 ♀♀ (#GR04–10) from Peloponnese, Argolis, Kranidhi Bay, S Petrothalasa (N 37°19.65', E 23°10.8'), 23.V.2019; 3 ♀♀ (#GR11–13) from Peloponnese, Argolis, Kabari Bay, SW Ermoni (N 37°21.9', E 23°13.8'), 23.V.2019; 1 ♀ (#GR14) from Peloponnese, Arkadia, Paralio Astros (N 37°25.5', E 22°45.8'), 22.V.2014, all leg. & coll. Herbert Zettel det. A.W. Ebmer.

Measurements. Body size of specimens ($n = 32$) is characterized by mesonotum width (MW; maximum width in front of tegulae). Head width (HW; maximum width including eyes) and gaster width (GW; maximum width near posterior margin of gaster tergite 2) were set in relation to MW. A Wild M10 binocular microscope was used at magnification of 50× (accuracy 0.01 mm). Numbers are given in millimetres. Calculation of means and preparation of diagrams were performed in Microsoft Excel.

Colour of gaster. Specimens were classified into specimens with totally black tergites and such with orange-reddish parts on tergites. The pale hind margins of tergites – present in all specimens – were not considered. Two specimens could not be properly classified as their orange parts were indistinct.

Results

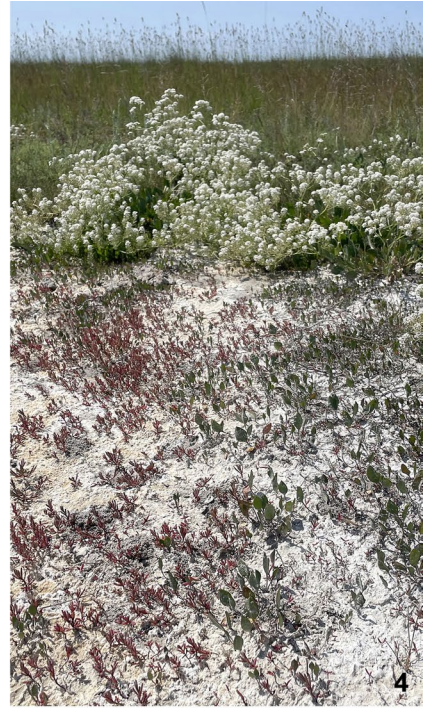
Observations on *Lasioglossum mandibulare* (MORAWITZ, 1866)

Observations by Herbert Zettel. On 2 June 2023 there was brilliant pre-summer weather. We arrived at the site at about 10:30 CEST and looked especially for open Solonchak soda pans, the edges of which were richly fringed by flowering *Lepidium cartilagineum*. Interestingly, at this time of day, the flowers were visited by numerous Diptera, but apparently not by a single bee. Even when I swiped the flowers with the hand net to “not miss anything” I was unsuccessful in finding bees.

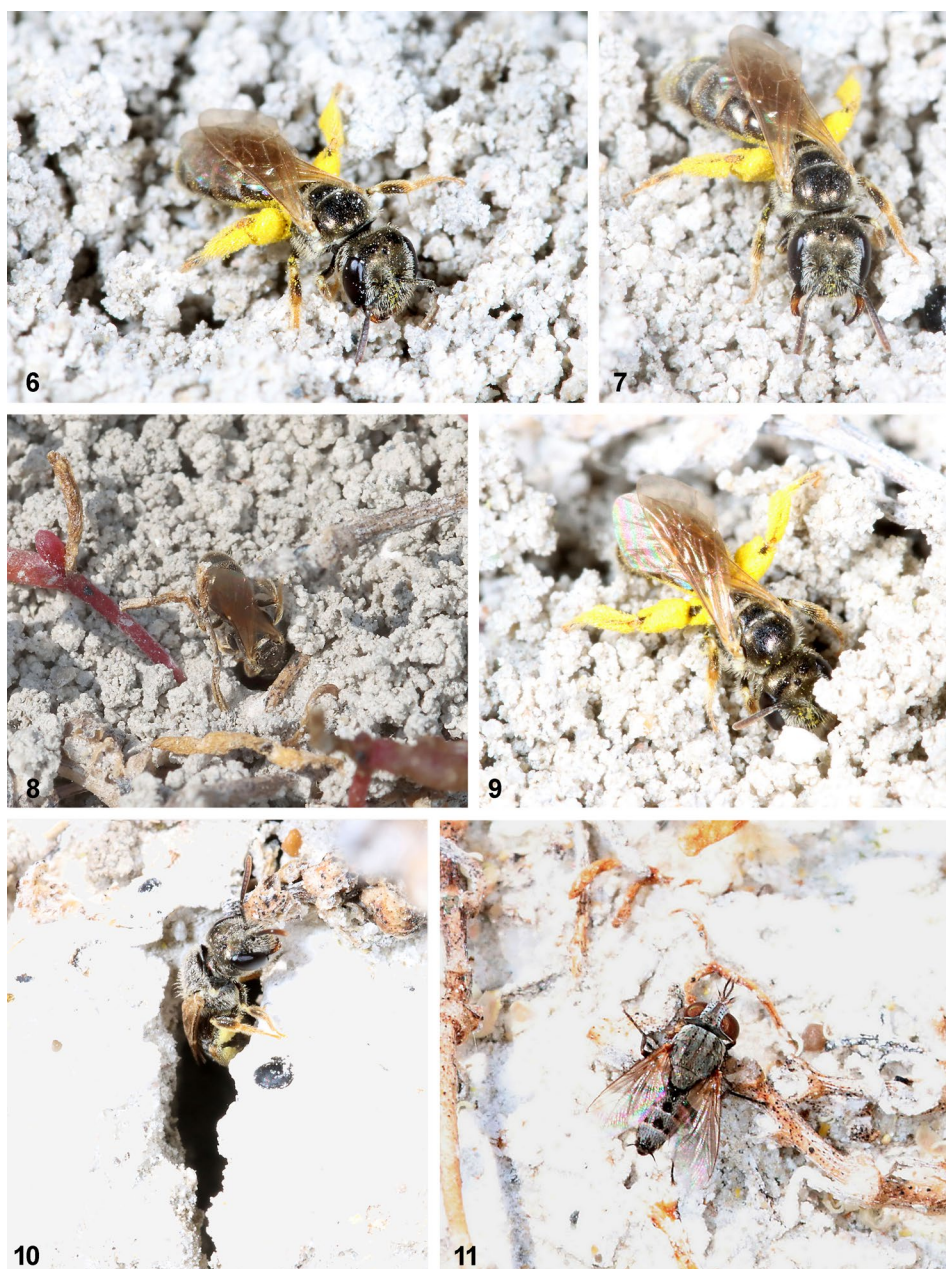
After a short time, I observed a small *Lasioglossum* female sitting on the ground of one of these soda pans, warming up in the sunlight. I caught it and, upon closer inspection, suspected *L. mandibulare* from the shape of its head. After that, other individuals gradually appeared at the same spot. The specimens were of very different sizes and it seemed somewhat unclear whether they were all conspecific, especially the smallest individuals with rather “normal” heads. Later at home, however, when I identified the specimens under the microscope, it turned out that all of them were *L. mandibulare* females. The animals sat and basked or flew just above the ground, some disappeared into small burrows concentrated in a few very open spots on the ground. We were at this spot for about an



Figs 1–2. Habitat of *L. mandibulare*: (1) Soda pan at the eastern bank of Zicklacke (in the background), 2 June 2023; (2) Detail showing *Lepidium cartilagineum* at margins, same day. © F. Seyfert.



Figs 3–5. (3) Another soda pan at the eastern bank of Zicklacke, 3 June 2023. (4) Fully flowering *Lepidium cartilagineum*, same day. (5) A large female of *L. mandibulare* on flowers of *Lepidium cartilagineum*, same day. © H. Wiesbauer.



Figs 6–11. Observations of large females of *L. mandibulare*, 3 June 2023. (6) A pollen-laden female resting on the ground. (7) This female has opened its powerful mandibles. (8) A female enters its nest for excavation work. (9) A pollen-laden female tries to enter the blocked entrance. (10) This female obviously used a dry crack in the soil as a nest site. (11) A flesh fly, *Taxigramma heteroneura* (Sarcophagidae), observes a nest entrance (not on photo) to find an occasion for oviposition. © H. Wiesbauer.



Figs 12–13. Small females of *L. mandibulare*, 22 July 2023. (12) Flower visit on *Achillea* cf. *millefolium asplenifolia*. (13) On nesting ground. © H. Wiesbauer.

hour, and in the end, I estimated the population on this one salt pan of a few square metres to be about three dozen individuals. I could not observe any flower visit until the very end.

Observations by Heinz Wiesbauer. One day later I also visited the eastern edge of the Zicklacke to photograph and observe *L. mandibulare*. I arrived at about 13:00 CEST and stayed at the salt pans for about two hours.

On a particularly individual-rich area of about one square metre, I counted approximately 60 nests of *L. mandibulare*. With this high concentration, I could only observe individually nesting animals. However, other comparable areas with Solonchak soil were not so densely populated (e.g. about 100 females on 4 m²), or they were obviously unsuitable as nesting sites over large areas. On the one hand, places at the transition to vegetation, which were still largely unvegetated, and on the other hand, the vegetation-free area in the Solonchak appeared to be particularly desirable as nesting sites.

As I wanted to get the bees to stay at the nest entrance for better photography, I briefly closed about ten nest entrances with soil, one after the other, after a female had flown out and then observed the entrance. It was noticeable that in all cases only a single returning female cleared its entrance. No hypothetical nest mate that may have stayed in the nest tried to fly out, nor did a second female arrive from outside. At the same time, I observed about 20 other single females building their nests; I was able to capture these activities photographically.

As brood parasites, two flesh fly species, *Metopia argyrocephala* (MEIGEN, 1824) and *Taxigramma heteroneura* (MEIGEN, 1830) (Sarcophagidae) occur very massively at the nest sites. If the nest entrance is not open, they burrow into the soil. Otherwise they drop their eggs or larvae at the open nest exit.

Lepidium cartilagineum was probably the only pollen source for *L. mandibulare* on this day, although only few flower visits were observed. There are hardly any other flowering plants in the biotope at this season. I have made numerous observations of pollen-bearing females with their clearly visible yellow pollen packets. The females also dig when loaded with pollen. Three pollen-carrying females were caught on *L. cartilagineum*.

On 28 June 2023, only very few females were present, almost all nest entrances were closed. *Lepidium cartilagineum* flowers had already withered by this time. Only one female could still be observed at its nest entrance.

In the afternoon of 22 July 2023, I spent three hours in the area (13:00–16:00). The flight season of *Camptopoeum friesei* MOCSÁRY, 1894 had just begun, so that hundreds of males of this species were flying at the site. This circumstance made the observations of *L. mandibulare* difficult.

In total, only five females of *L. mandibulare* were found during the entire observation period at this day. Their smallness (ca. 5 mm) and the strong reddish colouration of their gaster and antennae were striking. No male was observed. The females disappeared into very small nest entrances where no excavated soil was visible. After I had caught one female at a nest entrance, I could not observe another specimen at the same nest within the next one hour.

I observed pollen-bearing females that probably collected on yarrow (*Achillea* cf. *millefolium asplenifolia*); a sample of the yellow pollen was taken for later identification. *Lepidium cartilagineum* had long since flowered off by this time. There were no other plants flowering in the immediate vicinity. At some distance *Inula ensifolia*, *I. britannica*, *Spergularia maritima* as well as thistles and umbellifers (with white pollen) were flowering.

On 10 August 2023, no specimens of *L. mandibulare* could be observed at the site.

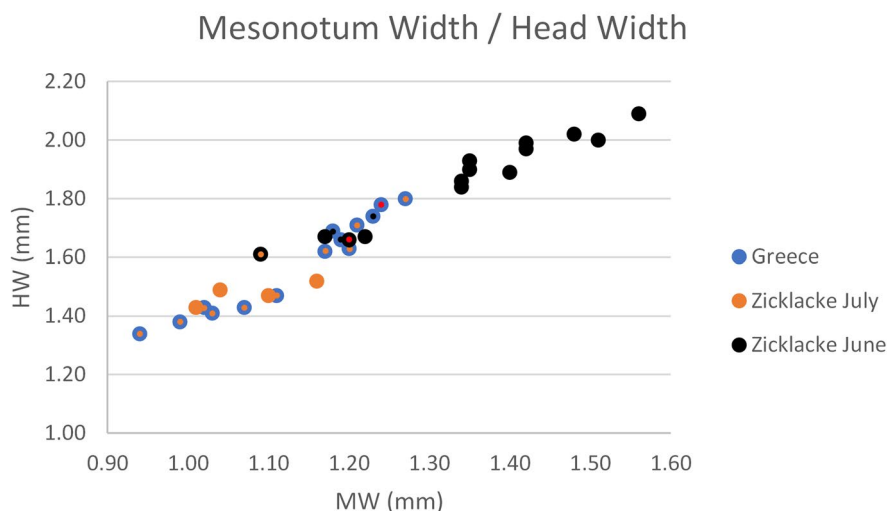


Fig. 14. Ratio of mesonotum width vs. head width of *L. mandibulare*, shown for specimens from Greece (blue), and Zicklacke from June (black) and July (orange). Colour of centres indicates colour of gaster tergites: partly reddish (orange centre), blackish brown (black centre), intermediate (red centre).

Size polymorphism

Lasioglossum mandibulare shows a considerable variation in size. Mesonotum width (MW) ranges from 0.94 to 1.56 mm, the specimens from Greece and the specimens collected at Zicklacke in July cluster together and are on average and in their range smaller (n = 18; MW 0.94–1.27; mean = 1.12) than those from Zicklacke collected in June (n = 14; MW 1.09–1.56; mean = 1.35).

Colour of gaster tergites is obviously related with size: Females with partly orange coloured tergites (n = 15; MW 0.94–1.27; mean = 1.09) are smaller than those with black tergites (n = 15; MW 1.17–1.56; mean = 1.34), with little overlap. The two specimens (one from Zicklacke, one from Greece) with indistinct colouration were intermediate in size (MW 1.18 and 1.20).

Lasioglossum mandibulare is characterized by a large head and powerful mandibles. It can be shown by measurements that the ratio of head width (HW) and mesonotum width (MW) is almost linear (Fig. 14), i. e., larger females do not obviously have disproportionately large heads.

Gaster width (GW) is also in linear proportion to mesonotum width (MW) (Fig. 15). There is no indication that large females keep more eggs in their gaster than small females.

Discussion

Phenology. Our observations at Zicklacke were made mostly in the beginning of June 2023; numerous specimens of the larger, dark morph of *L. mandibulare* populated some soda pans. On June 28, the studied population has almost stopped its activity. However, on June 22 the species could be observed again in low numbers, this time in the smaller,

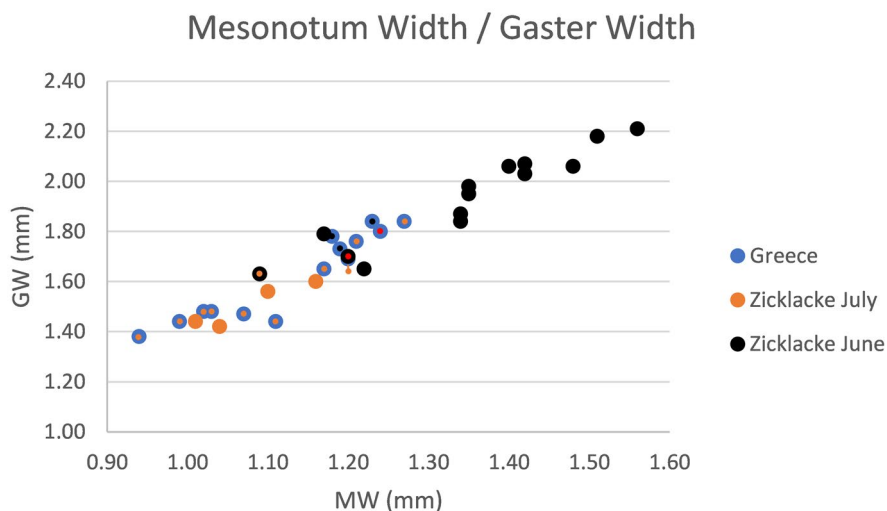


Fig. 15. Ratio of mesonotum width vs. gaster width of *L. mandibulare*, shown for specimens from Greece (blue), and Zicklacke from June (black) and July (orange). Colour of centres indicates colour of gaster tergites: partly reddish (orange centre), blackish brown (black centre), intermediate (red centre).

lighter coloured morph. The collections from Zicklacke reported by HÖLZLER (2021) are slightly later than our observations: 21 July 2007 (1 ♀, 1 ♂), 6 July 2020 (4 ♀♀). The difference suggests a high flexibility in breeding behaviour, possibly depending on the flowering season of *Lepidium cartilagineum*. Remarkably, Hölzler reported on a male in July.

When we compare the Austrian data with those from the island of Crete, Greece (EBMER 2014) and other females from Greece (see above), we can recognize that the Greek specimens were collected somewhat earlier, which appears to be normal in a warmer climate: April 17 – June 18; the record of a single female on October 5 suggests the possibility of a second generation in the Mediterranean. The collection data of males on Crete are heterogeneous (EBMER 2014): There is one sample together with females on June 18, and there are two samples from autumn (October 8 and 17). EBMER (1988) provides two data sets from Hungary: females from June and July 28. Considerable amounts of data from the collections of the Biologiezentrum in Linz and the Ebmer Collection still require analysis.

Eusociality. Eusocial behaviour, i. e., task sharing of an egg-laying queen and sterile workers inhabiting the same nest, was postulated for *L. mandibulare* by several authors (EBMER 2014, SCHEUCHL & WILLNER 2016, HÖLZLER 2021); they deduce eusociality from the strong size polymorphism of females. HÖLZLER (2021) states that “the assumption does not seem improbable, as the individuals collected for the first time in 2007 at the same site are clearly smaller [...], have narrower heads and fly somewhat later (3rd week of July) [= July 21, compared to those collected on July 6, 2020], which would also speak for workers.” Although this statement was based on very few individuals (five females), the phenology of larger and smaller females largely corresponds with our observations of many larger nest-digging females at an early stage of the breeding season.

All observations at the nest entrances at Zicklacke indicated that the females were nesting solitarily, each building and provisioning its own nest. In order to make a reliable state-

ment on the lack of eusocial behaviour in the Seewinkel, a longer series of observations at different times and with more refined methodology would certainly have been necessary. Also, to reduce disturbance, chiefly the marginal areas of the salt pans were surveyed. Therefore, an occurrence of nests with social individuals in the centre of the nesting site cannot be completely excluded.

The lack of socially nesting females at the Zicklacke would also not allow a statement about the social behaviour of this species in its entire distribution range. Climatic influence on social behaviour is known for several species of Halictinae. For example, *Lasioglossum calceatum* is a primitive eusocial bee species in large parts of Central and Southern Europe, with two castes, the fertile sexual bees and the workers, which do not reproduce but help with the rearing (e.g., KNERER 1987). In colder climates and short activity periods, however, *L. calceatum* (SCOPOLI, 1763) nests solitarily (SCHEUCHL & WILLNER 2016). In another socially polymorphic congener, *L. baleicum* (COCKERELL, 1937) from Japan, variations in sociality between solitary and eusocial were also found to depend on environmental factors such as temperature (CRONIN & HIRATA 2003, HIRATA & HIGASHI 2008).

Size dimorphism. Size of females (measured by MW) can be divided into two clusters: the majority of specimens from Zicklacke collected in June on the one hand, the specimens from Greece (collected in May and June) and the specimens collected at Zicklacke in July on the other hand.

The size largely corresponds with the colour of the abdomen, with the largest individuals having exclusively black tergites without orange markings. This corroborates the results by HÖLZLER (2021) based on a small sample.

The ratio of head width (HW) and mesonotum width (MW) is approximately linear, i. e., larger females do not have disproportionately developed heads; there is no indication of morphological castes.

The fact that gaster width (GW) is in linear proportion to mesonotum width (MW) across the entire size range does not indicate the presence of a specialized caste dedicated to laying eggs.

Endangerment. The critical situation of the only population of *L. mandibulare* in Central Europe (in a narrow sense) was broadly discussed by HÖLZLER (2021): He observed that in recent years, there has been a noticeable “overgrowth” of the soda pans around the Zicklacke, especially on its eastern side, resulting in a reduction in the area of nesting sites for obligate halobiont wild bees, other wild bees, and other Hymenoptera. The salt efflorescence on the ground has decreased dramatically, indicating a drop in the groundwater level and the breaking off of the capillary action that brings dissolved salts to the surface. Although we surveyed the margin of several astatic soda pans, further populations of *L. mandibulare* could not be detected yet. It seems possible that the species is only represented in Austria by this single population at Zicklacke, which would increase the extinction risk. On the other hand, for the first time we can report on the large size of this population – despite the drought year 2022 –, which nourishes the hope that *L. mandibulare* will survive in the area at least for the near future.

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