

Rapid Communication**First record of adventive species *Monoxia obesula* Blake, 1939 in Greece**Jan Bezděk^{1,*}, Lucie Maděrová¹ and Eva Hrudová²¹Mendel University in Brno, Department of Zoology, Fisheries, Hydrobiology and Apiculture, Zemědělská 1, 61300 Brno, Czech Republic²Mendel University in Brno, Department of Crop Science, Breeding and Plant Medicine, Zemědělská 1, 61300 Brno, Czech Republic

*Corresponding author

E-mail: bezdek@mendelu.cz

Citation: Bezděk J, Maděrová L, Hrudová E (2023) First record of adventive species *Monoxia obesula* Blake, 1939 in Greece. *BioInvasions Records* 12(2): 609–614, <https://doi.org/10.3391/bir.2023.12.2.23>

Received: 5 October 2022**Accepted:** 14 February 2023**Published:** 16 March 2023**Handling editor:** Alejandro Zaldívar-Riverón**Thematic editor:** Stelios Katsanevakis**Copyright:** © Bezděk et al.

This is an open access article distributed under terms of the Creative Commons Attribution License ([Attribution 4.0 International - CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)).

OPEN ACCESS**Abstract**

Monoxia obesula, a species native to the U.S.A. and adventive in western Mediterranean, is recorded in Greece for the first time. In 2022, one female specimen was collected on Théra Island (Santorini Archipelago, Aegean Sea), becoming the easternmost Mediterranean record. Host plants are Amaranthaceae species, particularly *Atriplex halimus* occurring in saline habitats. The presence of *Monoxia obesula* in Greece is alarming because it spreads its occurrence towards the eastern Mediterranean and may therefore pose a significant danger for *Atriplex halimus* stands.

Key words: Coleoptera, Chrysomelidae, Galerucinae, *Atriplex halimus*, Europe, Santorini**Introduction**

The genus *Monoxia* LeConte, 1865, distributed in North America, Mexico, and Guatemala, comprises 15 species (Viswajyothi and Clark 2022) but the generic placement of one old species from Guatemala warrants reevaluation (Riley 2020). The entire genus was revised and keyed by Blake (1939), who also described *Monoxia obesula* from Texas. Later, this species was also recorded in Maryland and Nebraska, but Maryland is probably not within the native range (Santiago-Blay and Virkki 1996; Clark et al. 2014). Clark et al. (2014) redescribed *Monoxia obesula* and corrected the shape of the aedeagus, which was inaccurately published in the original description.

The first European record of *Monoxia obesula* came from the Italian island of Sardinia (Clark et al. 2014). Since then, the species has been observed in Malta (Mifsud 2016), mainland Spain (Montagud Alario and Rodrigo Coll 2017; Lencina and Miñano 2018; Vela et al. 2019; Molina Molina et al. 2022), Balearic Islands (Petitpierre et al. 2017; Iannella et al. 2019), mainland France and Corsica (Alonso and Lefebvre 2022), and mainland Italy and Sicily (Iannella et al. 2019). The accidental introduction into Sardinia was probably by agricultural products or ornamental plants (Clark et al. 2014).

Monoxia obesula is associated with the plant family Amaranthaceae (including the former family Chenopodiaceae) both in its primary (North

America) and secondary (southern Europe) range (Iannella et al. 2019). The entire life cycle is completed on *Atriplex* spp., mainly *Atriplex halimus* L., and, to a lesser extent, on other plants in saline habitats, such as *Chenopodium album*, *Chenopodium* cf. *murale* or *Salsola oppositifolia* (Clark et al. 2014; Iannella et al. 2019; Vela et al. 2019). The larvae are leaf miners, which is quite unusual among the Galerucinae (Clark et al. 2014; Vela et al. 2019). *Monoxia obesula* can cause serious damage as many plants become almost completely devoid of their leaves (Clark et al. 2014; Iannella et al. 2019). So far, natural enemies of the invasive insect have not been observed (Clark et al. 2014).

The main morphological features of adults (based on Clark et al. 2014): body length 2.4–3.7 mm; form elongate oval, slender; surface densely punctate, densely covered with white pubescence; color pale brown, each elytron with 10–20 small, darker brown spots, tending to be arranged in 3 or 4 longitudinal rows (spots can be reduced or completely missing), metasternum, tarsomere 3 and distal portion of tarsomere 5 of each leg, and all tarsal claws darker brown; antennae extending slightly beyond elytral humeri; pronotum 1.7 times as broad as long, broadest near middle; scutellum triangular, densely covered with appressed pubescence; elytra together 1.8 times as long as broad, subparallel in basal three fourths; humeri well developed; punctation nearly uniform throughout; pubescence dense, short, appressed; legs densely pubescent; tarsomere 3 strongly bilobed; tarsal claws bifid (males) or simple (females); aedeagus dorsoventrally flattened, in lateral view very narrow, rather abruptly bent near basal fourth, thereafter nearly straight, except slightly bisinuate towards apex.

Monoxia obesula can be distinguished from its congeners by the combination of the following characters: aedeagus long and slender, with a dorsoventrally flattened apex, smaller body (2.4–3.7 mm), pronotum with lateral margins arcuate, elytra finely and shallowly punctate. The identification keys to *Monoxia* species by Blake (1939) and Wilcox (1965), supplemented by the redescription of *Monoxia obesula* by Clark et al. (2014), can be used.

This study reports the first record of *Monoxia obesula* in Greece. Implications of its presence on *Atriplex halimus* stands are discussed.

Materials and methods

This study was based on one specimen (female, Figure 1), with the following collection data: Greece, the Santorini Archipelago, Théra Island, sitting on the wall of Assumption of the Virgin Mary Holy Chapel, 36.4623358N; 25.4036892E, 4 September 2022, L. Maděrová leg. (Figure 2C). The specimen is deposited in the collection of Jan Bezděk (Brno, Czech Republic).

Specimen photographs were taken with Canon 800D digital camera with a Canon MP-E 65 mm lens. Images of the same objects at different focal

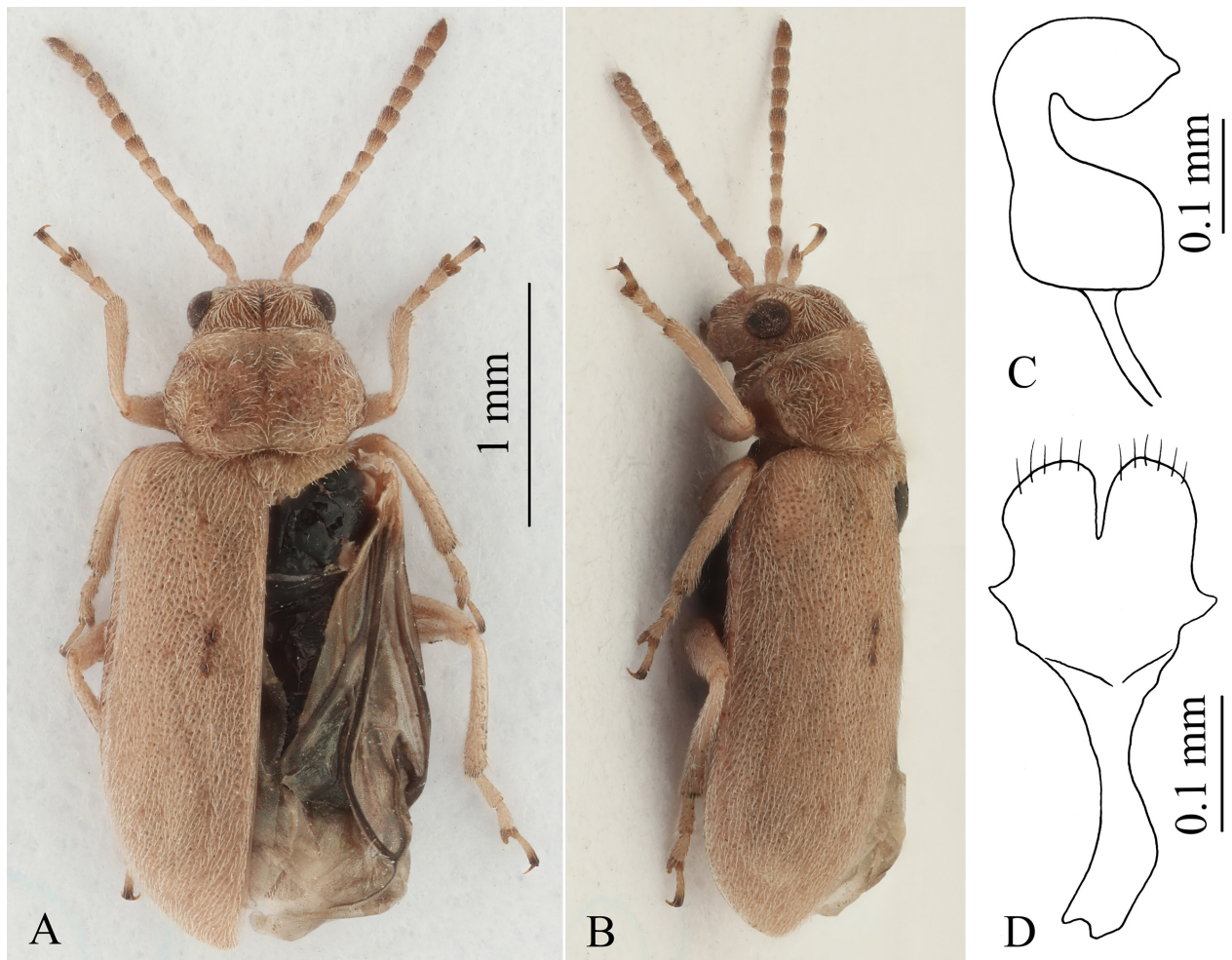


Figure 1. Adult female of *Monoxia obesula*. Dorsal (A), lateral view (B), spermatheca (C), gonocoxae (D). Photographs and drawings by Jan Bezděk.

planes were combined using Helicon Focus 7 software. The maps of the Mediterranean and Greece were downloaded from <https://d-maps.com/> and the map of Santorini from <https://commons.wikimedia.org/>. The pictures were edited with Corel Photopaint 12.

Results and discussion

Atriplex halimus is a shrub typical of the maritime and saline areas of southern Europe and northern Africa, usually found near the sea and on nitrophilous soils. Because of its gray leaves, it is often planted as an ornamental plant. It is also used for the reclamation of saline areas and as fodder (Montagud Alario and Rodrigo Coll 2017). The introduction of *Monoxia obesula* in the Mediterranean area is alarming because it causes serious damage to *Atriplex halimus*, sufficient to cause death, through heavy defoliations (Iannella et al. 2019). As adults of this beetle are good fliers and, in addition, ornamental plants can aid dispersal between two distant natural populations of *Atriplex halimus*, each locality is a source of adult beetles with great dispersal ability (Montagud Alario and Rodrigo Coll 2017). Severely damaged stands in the secondary range have already

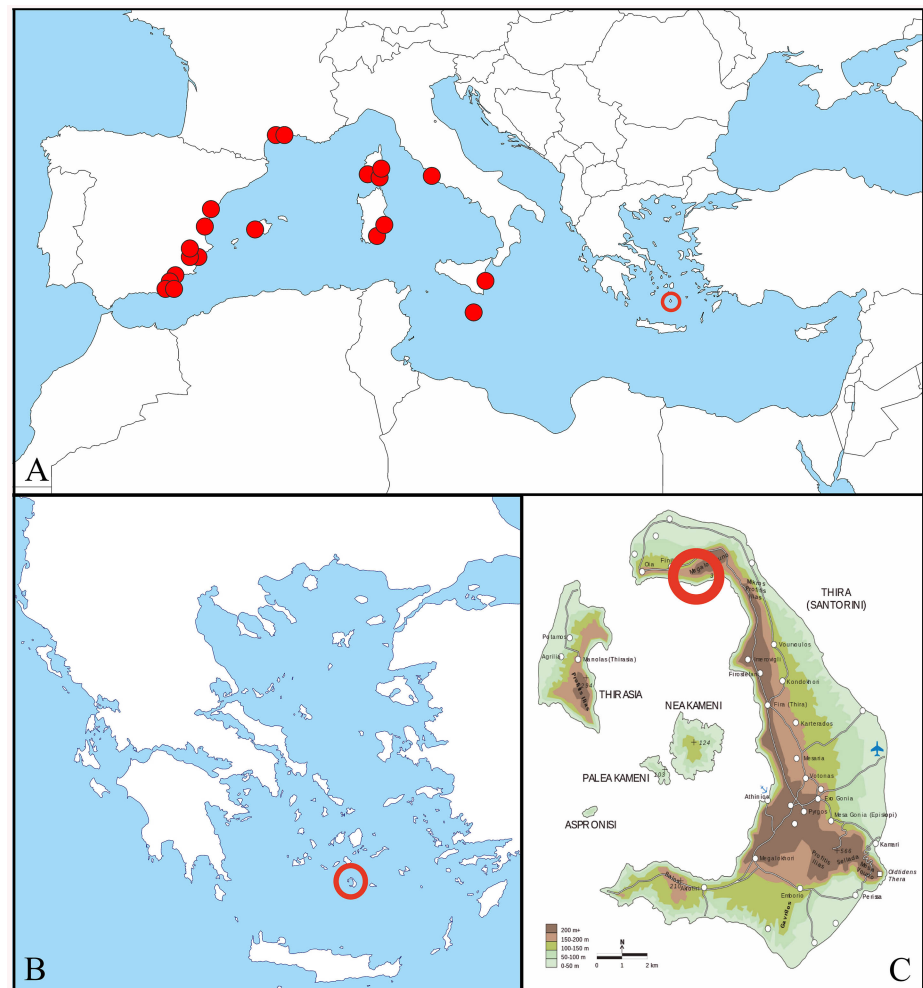


Figure 2. Maps with distribution of *Monoxia obesula* in Mediterranean (A), Greece (B) and Santorini Archipelago showing previously published localities (red dots) and new record (red ring) (see Supplementary material Table S1 for details).

been observed in Spain (Montagud Alario and Rodrigo Coll 2017; Vela et al. 2019) and France (Alonso and Lefebvre 2022). It is, therefore, a premise that this species can spread very quickly in the Mediterranean (Montagud Alario and Rodrigo Coll 2017).

Iannella et al. (2019) used Ecological Niche Modeling analysis to estimate the potential distribution of *Monoxia obesula* in its invaded range by assessing the habitat suitability. The expected distribution is limited in the Mediterranean region, with high suitability in coastal areas in southern Spain, Sardinia, Sicily, southern peninsular Italy, Tunisia, and Egypt. This prediction largely concurs with the currently known distribution of *Monoxia obesula* in the Mediterranean region (Spain, France, Italy, Sardinia, Corse, Sicily, and Malta). Nevertheless, the models for future climatic conditions predict an expansion from the currently suitable territories to coastal areas of the whole Mediterranean region.

Although the specimen of *Monoxia obesula* from Santorini was not found on the host plant but on a wall, the occurrence of its primary host plant *Atriplex halimus* is confirmed on all seven islands of Santorini

Archipelago (Dimopoulos et al. 2010; Raus et al. 2019). The discovery of *Monoxia obesula* in the Santorini Archipelago represents the easternmost record in the Mediterranean so far (Figure 2A, B, Supplementary material Table S1). Findings on other Greek islands can be expected in the near future. The presence of *Monoxia obesula* in Greece is alarming because it spreads its occurrence towards the eastern Mediterranean and may therefore pose a significant danger for *Atriplex halimus* stands in the near future.

Acknowledgements

The authors thank the reviewers for their stimulating comments that significantly improved the manuscript.

Authors' contribution

Jan Bezděk: writing – original draft; Lucie Maděrová: field collecting, writing – editing; Eva Hrudová: writing – editing.

References

- Alonso C, Lefebvre V (2022) Découverte en France continentale et en Corse de *Monoxia obesula* Blake, 1939 (Coleoptera Chrysomelidae Galerucinae) [Discovery of *Monoxia obesula* Blake, 1939 in mainland France and Corsica]. *L'Entomologiste* 78(1): 29–32
- Blake DH (1939) A study of LeConte's types of the beetles in the genus *Monoxia*, with descriptions of new species. *Proceedings of the United States National Museum* 87: 145–171, <https://doi.org/10.5479/si.00963801.87-3072.145>
- Clark SM, Rattu A, Cillo D (2014) *Monoxia obesula* Blake, 1939, a species native to the U.S.A. and adventive to Sardinia, Italy (Coleoptera: Chrysomelidae: Galerucinae: Galerucini). *Zootaxa* 3774: 83–89, <https://doi.org/10.11646/zootaxa.3774.1.6>
- Dimopoulos P, Raus T, Mucina L, Tsiripidis I (2010) Vegetation patterns and primary succession on sea-born volcanic islands (Santorini archipelago, Aegean Sea, Greece). *Phytocoenologia* 40: 1–14, <https://doi.org/10.1127/0340-269X/2010/0040-0426>
- Iannella M, D'Alessandro P, Longo S, Biondi M (2019) New records and potential distribution by Ecological Niche Modeling of *Monoxia obesula* in the Mediterranean area. *Bulletin of Insectology* 72(1): 135–142
- Lencina JL, Miñano J (2018) *Colaphellus sophiae* (Schaller 1783) primer registro para España continental y nuevos datos de *Monoxia obesula* Blake 1939 (Coleoptera: Chrysomelidae) [*Colaphellus sophiae* (Schaller 1783) first record for Spain continental and new data of *Monoxia obesula* Blake 1939 (Coleoptera: Chrysomelidae)]. *Revista Gaditana de Entomología* 9(1): 13–16.
- Montagud Alario S, Rodrigo Coll I (2017) *Monoxia obesula* Blake, 1939 (Coleoptera: Chrysomelidae) en Europa continental [*Monoxia obesula* Blake, 1939 (Coleoptera: Chrysomelidae) in continental Europe]. *Arquivos Entomológicos* 18: 43–48
- Mifsud D (2016) A second Palaearctic record of *Monoxia obesula* (Coleoptera Chrysomelidae Galerucinae). *Bulletin of Insectology* 69(1): 159–160
- Molina Molina D, Escuer Murillo C, Cerdà Moles J (2022) Nuevos registros de *Monoxia obesula* Blake, 1939 para España (Coleoptera: Chrysomelidae). *Revista Gaditana de Entomología* 13: 95–98
- Petitpierre E, Sacarés A, Jurado-Rivera JA (2017) Updated checklist of Balearic leaf beetles (Coleoptera: Chrysomelidae). *Zootaxa* 4272: 151–177, <https://doi.org/10.11646/zootaxa.4272.2.1>
- Raus T, Karadimou E, Dimopoulos P (2019) Taxonomic and functional plant diversity of the Santorini-Christiana island group (Aegean Sea, Greece). *Willdenowia* 49: 363–381, <https://doi.org/10.3372/wi.49.49308>
- Riley EG (2020) A new species of *Monoxia* LeConte, 1865 (Coleoptera: Chrysomelidae: Galerucinae: Galerucini) from the coast of southern Texas, USA. *Pan-Pacific Entomologist* 96: 189–196, <https://doi.org/10.3956/2020-96.3.189>
- Santiago-Blay JA, Virkki N (1996) Evolutionary relationships within *Monoxia* (Coleoptera: Chrysomelidae: Galerucinae): chromosomal evidence for its intrageneric classification. *Caryologia* 49: 257–265, <https://doi.org/10.1080/00087114.1996.10797370>
- Vela JM, Rodríguez Navarro ME, Gómez de Dios MÁ (2019) Primeros registros de la especie invasora *Monoxia obesula* Blake, 1939 (Coleoptera, Chrysomelidae, Galerucinae) en Andalucía (España), con datos sobre su morfología y biología asociada a la quenopodiácea *Atriplex halimus* L. [First records of the invasive species *Monoxia obesula* Blake, 1939

- (Coleoptera, Chrysomelidae, Galerucinae) in Andalusia (Spain), with data on its morphology and biology associated with the Mediterranean saltbush *Atriplex halimus* L.]. *Boletín de la Sociedad Andaluza de Entomología* 29: 115–135
- Viswajyothi K, Clark SM (2022) New World genera of Galerucinae Latreille, 1802 (tribes Galerucini Latreille, 1802, Metacyclini Chapuis, 1875, and Luperini Gistel, 1848): an annotated list and identification key (Coleoptera: Chrysomelidae). *European Journal of Taxonomy* 842: 1–102, <https://doi.org/10.5852/ejt.2022.842.1945>
- Wilcox JA (1965) A synopsis of the North American Galerucinae (Coleoptera: Chrysomelidae). *New York State Museum and Science Service Bulletin* 400: 1–226

Supplementary material

The following supplementary material is available for this article:

Table S1. Geo-referenced record data of *Monoxia obesula* collected in Greece, Santorini Archipelago.

This material is available as part of online article from:

http://www.reabic.net/journals/bir/2023/Supplements/BIR_2023_Bezdek_etal_SupplementaryMaterial.xlsx