Ecologica Montenegrina
ISSN 2336-9744 (online) | ISSN 2337-0173 (print)

Ecologica Montenegrina 81: 43-53 (2025)
This journal is available online at: www.biotaxa.org/em
https://dx.doi.org/10.37828/em.2025.81.6

Article

https://zoobank.org/urn:lsid:zoobank.org:pub:B0E048C2-33DE-4956-90DC-360B6BA894D7

Leucochlaena labrys, a new species from Crete, Greece (Lepidoptera: Noctuidae, Xyleninae, Episemini)

LUCA SATTIN[1,*], GABRIELE FIUMI[2], ALESSANDRO FLORIANI[3] & GUIDO GOVI[4]

[1] *Via E. Toti 27/B, I-30034 Mira (Venezia); https://orcid.org/0009-0002-9554-4213*
[2] *Via Decio Raggi 167, I-47121 Forlì. E-mail: gabfium@tiscali.it; https://orcid.org/0000-0002-8466-4263*
[3] *Via Panfilo Castaldi 41, I-20124 Milano.*
E-mail: alessandro.floriani@outlook.it; https://orcid.org/0009-0009-2306-6786
[4] *Via F. Rossi 23, I-47121 Forlì, Italy.*
E-mail: guidogovi@gmail.com; https://orcid.org/0000-0002-1874-8354
** Corresponding author. E-mail: sattin.luca@gmail.com*

Received 16 December 2024 | Accepted by *V. Pešić*: 21 January 2025 | Published online 23 January 2025.

Abstract
A new species of the genus *Leucochlaena* Hampson, 1906 has been observed in the island of Crete (Greece). After a morphological examination of the *habitus* of the species, together with the examination of the genitalia and the DNA barcoding performed on a single specimen, we have identified a new species of *Leucochlaena* which is considered endemic to the island of Crete. We describe here this new species as *Leucochlaena labrys* **sp. n.** and we illustrated adults, male and female genitalia.

Key words Taxonomy, new species, DNA barcoding, Crete.

Introduction

Leucochlaena Hampson, 1906 is a Paleartic genus belonging to the tribe Xyleninae Guenée, 1837. As noted by Ronkay *et al.* (2001) and Fibiger *et al.* (2011), this genus presents significant taxonomic complexity and is currently subdivided into two subgenera: *Leucochlaena*, and *Furcochlaena* Ronkay et al, 2001. Within the subgenus *Leucochlaena* there are two philetic lineages: *L. oditis* (Hübner, [1822]) and *L. muscosa* (Staudinger, 1892). In their recent book, Ronkay *et al.* (2023) classified *Furcochlaena* as a distinct genus and, after a detailed investigation on abundant samples from North Africa, in the *L. oditis* species-group, the authors upgraded to species status the taxon *L. machilum* Turati, 1924 and described three new species: *Leucochlaena caillezi* Ronkay, Ronkay & Landry, 2023, *Leucochlaena jeanhaxairei* Ronkay & Ronkay, 2023 and *Leucochlaena antonioortizi* Ronkay & Ronkay, 2023. Thus, according to this work, in North Africa there should be four or five species of *L. oditis* group. After the revision of the group, the presence of *L. oditis* in North Africa requires confirmation.

The species-group taxon *jordana* Draudt, 1934 is either considered in the range of bona species by some authors (Hacker 2001; Kravchenko *et al.* 2007) or as a subspecies of *L. oditis* (Ronkay

et al., loc. cit.). In the present paper we follow the latter opinion but the clarification of the status of the taxon requires further extensive integrative studies, which are out of the scope of the present research.

In autumn 2023 in Crete, three specimens of an unidentified species of *Leucochlaena,* supposedly of the *oditis* group, were observed. This *L. oditis* species-group was so far not reported for the island and the only species of the genus *Leucochlaena* up to date known from the island was *L. muscosa*, a species well differentiated also in the external morphology. Only a male specimen was thus collected for further morphological and genetic analysis.

The male specimen was worn and therefore did not allow an accurate analysis of the external morphology. The copulatory apparatus was prepared and found to be peculiar compared to specimens of *L. oditis* of certified identity (Ronkay *et al.* 2001). DNA barcoding was also performed, indicating a significant divergence from the other haplotypes of the species of the *L. oditis* group. At this point, in October 2024, a second and third expeditions to the island of Crete were performed to collect other specimens that could allow to complete the taxonomic study. In total 2 females and 67 males were collected. The morphological analysis of those newly collected specimens has made it possible to confirm the belonging of these individuals to a new taxon that is believed to be endemic to the island of Crete and hereby described.

Material and methods

The only specimen of *Leucochlaena* collected in 2023 in Crete was subjected to DNA barcoding analysis. DNA barcoding was performed at the Canadian Centre for DNA Barcoding (CCDB) following standard protocols (e.g., Ivanova *et al.* 2006). The sequence of this identified new species, *Leucochlaena labrys,* is deposited in the public BOLD dataset *Leucochlaena labrys.*

In this study we used the single sequence obtained from our specimen and for comparison we added sequences of *Leucochlaena* (a total of 19 sequences) available on BOLD as common data from various European countries and from North Africa, Jordan and Turkey (Table 1). These were used to create a maximum likelihood tree running Mega 11 (Kumar *et al.* 2018).

Seven of the specimens collected in Crete in 2023 and 2024 were dissected. All are embedded in DMHF and mounted on permanent microscope slides for further comparison. These seven specimens were compared with other dissected specimens of the *Leucochlaena oditis* species-group from Europe and North Africa. Male and female genitalia illustrated in literature and websites were also examined for comparison (Ronkay *et al.* 2001, 2023; https://lepiforum.org; https://britishlepidoptera.weebly.com). For identification of external morphological characters several other specimens of the *Leucochlaena oditis* species group from Europe and North Africa were examined, as well as many others visible in publications or on websites.

For photos of the entire adult specimen a Nikon D300 digital camera with a Nikkor AF-S 18-70 mm lens was used. Photos of the genitalia were taken with a Nikon D300 digital camera connected to a Leitz Dialux 20 EB trinocular microscope, using Leitz Wetzlar 4/0.12 and 10/0.25 objectives.

The male and female genitalia terminology follows Fibiger (1997) and Kononenko (2010).

Studied specimens are preserved in the following collections:

Research collection of Guido Govi, Forlì, Italy; GG

Research collection of Alessandro Floriani, Milano, Italy; AF

Research collection of Gabriele Fiumi, Forlì, Italy; GF

Research collection of Giuseppe Longo Turri, Quinzano (Verona), Italy; GLT

Results

***Leucochlaena labrys* sp. n.**

https://zoobank.org/urn:lsid:zoobank.org:act:AC0170A3-EC69-42B9-8AB9-F9BF002B0CCE

Type material. **Holotype** (Figs 1a, 4a): male, Greece, East Crete, surroundings Agios Nikolaos, m 1000, Lassithi Mountain, 3–4.X.2024, legit L. Sattin, dissected by G. Fiumi, (temporally in coll. G. Govi, will be deposited in a public museum).

Paratypes: 1 male, Greece, East Crete, Surroundings Agios Nikolaos, m 1000, Lassithi Mountain, 18.X.2023, legit L. Sattin, dissected by G. Fiumi, BOLD ID: BC ZSM Lep 119595, coll. GG; 1 female, 52 males, same locality, 3–4.X.2024, legit L. Sattin, in colls GG, GF, AF, GLT (Fig. 1B-O); 1 female, 15 males, same locality, 11–13.X.2024, legit A. Floriani, in coll. AF.

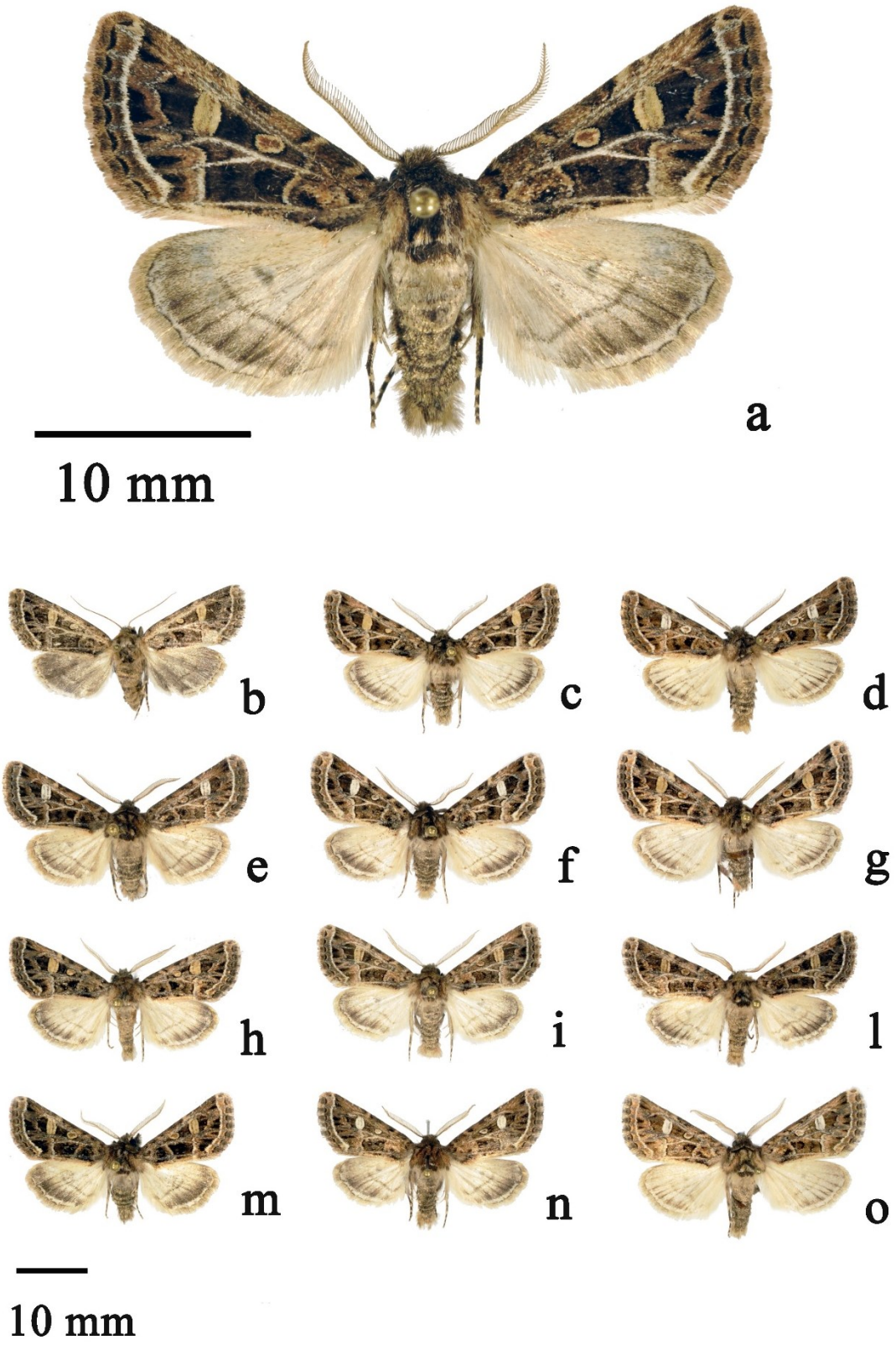

Figure 1. Imagoes of *Leucochlaena labrys* sp. n.: a, holotype, Greece, East Crete, surroundings Agios Nikolaos, 1000m, Lassithi Mountain, 3–4.X.2024, legit L. Sattin; b, paratype, female, ditto; c–o, male paratypes, ditto; all the specimens are in coll. G. Govi.

Diagnosis. The new species (Figs 1–3) is externally reminiscent of *L oditis* but differs in the postmedial line of the forewing, which is most defined but not clearly double as in *L. oditis,* and in the terminal band of the hindwing always clearly visible surrounded by a thin white line towards the edge of the wing.

Moreover, the male genitalia of *L. labrys* are distinctive for the medial diverticulum with 4–5 parallel and straight cornuti about twice the length of the bulbed cornutus present at the end of the dorsal digitiform diverticulum, as also observed in *L. caillezi*. This is the most evident differential character compared to all other species of the *oditis* group except for *L. caillezi*. Female genitalia are characterised by the appendix bursae utricular and apically rounded and well sclerotized, distinguishable from any other species of the group except for *L. jeanhaxairei*, which has a similar appendix bursae.

Figure 2. *Leucochlaena labrys* sp. n., males in nature: Greece, East Crete, surroundings Agios Nikolaos, m 1000, Lassithi Mountain, 3–4.X.2024, photos by L. Sattin.

Description.

External morphology of adults (Figs 1–3). Wingspan: 29–34 mm in males. The only two females known are slightly smaller than males (29–32 mm), as in *L. oditis*. Forewing length 15-17 mm in males and 15-16 in female. Male antenna bipectinate, filiform in female. Body and forewing dark brown. Antemedial line light brown and not clearly defined, in comparison to the rest of the wing. Postmedial line most defined but not clearly double as in *L. oditis*. Whitish subterminal line regularly arched and well-marked. Blackish terminal line bordered internally by dark lunules. Orbicular little evident and very variable in colour and in size from less than 1 to 1.5 mm. Reniform very variable from ochreous to whitish (about 15% of the specimens collected). Veins of the forewings whitish to ochreous as in *L. oditis*. Male hindwing whitish, with discal spot almost absent in the majority of specimens. Medial band recognisable. Terminal band always distinct and surrounded by a thin white line towards the edge of the wing. Female hindwing uniformly dark with medial band barely visible against the background of wing and trace of thin white line on wing edge.

Figure 3. *Leucochlaena labrys* sp. n., female in nature: Greece, East Crete, surroundings Agios Nikolaos, m 1000, Lassithi Mountain, 3–4.X.2024, photo by L. Sattin.

Male genitalia (Figs 4A, 5).

General configuration of genitalia similar to that of *L. oditis* described in Ronkay *et al.* (2001).

Aedeagus: at the base of vesica with one triangular subbasal *cornutus* variable in size. Dorsal digitiform diverticulum ending in a long and thin bulbed cornutus like in all other species of the *oditis* group. Median diverticulum covered with numerous very fine spines and 4–5 parallel and straight cornuti about twice the length of bulbed cornutus present at the end of dorsal digitiform diverticulum as also observed in *L. caillezi*.

Female genitalia (Fig. 4B).

Ductus bursae shorter than that of *L. oditis*. Appendix bursae utricular and apically rounded and well sclerotized, distinguishable from any other species of the group with the exception of *L. jeanhaxairei* which has a similar appendix bursae. Corpus bursae globular with two oval signa.

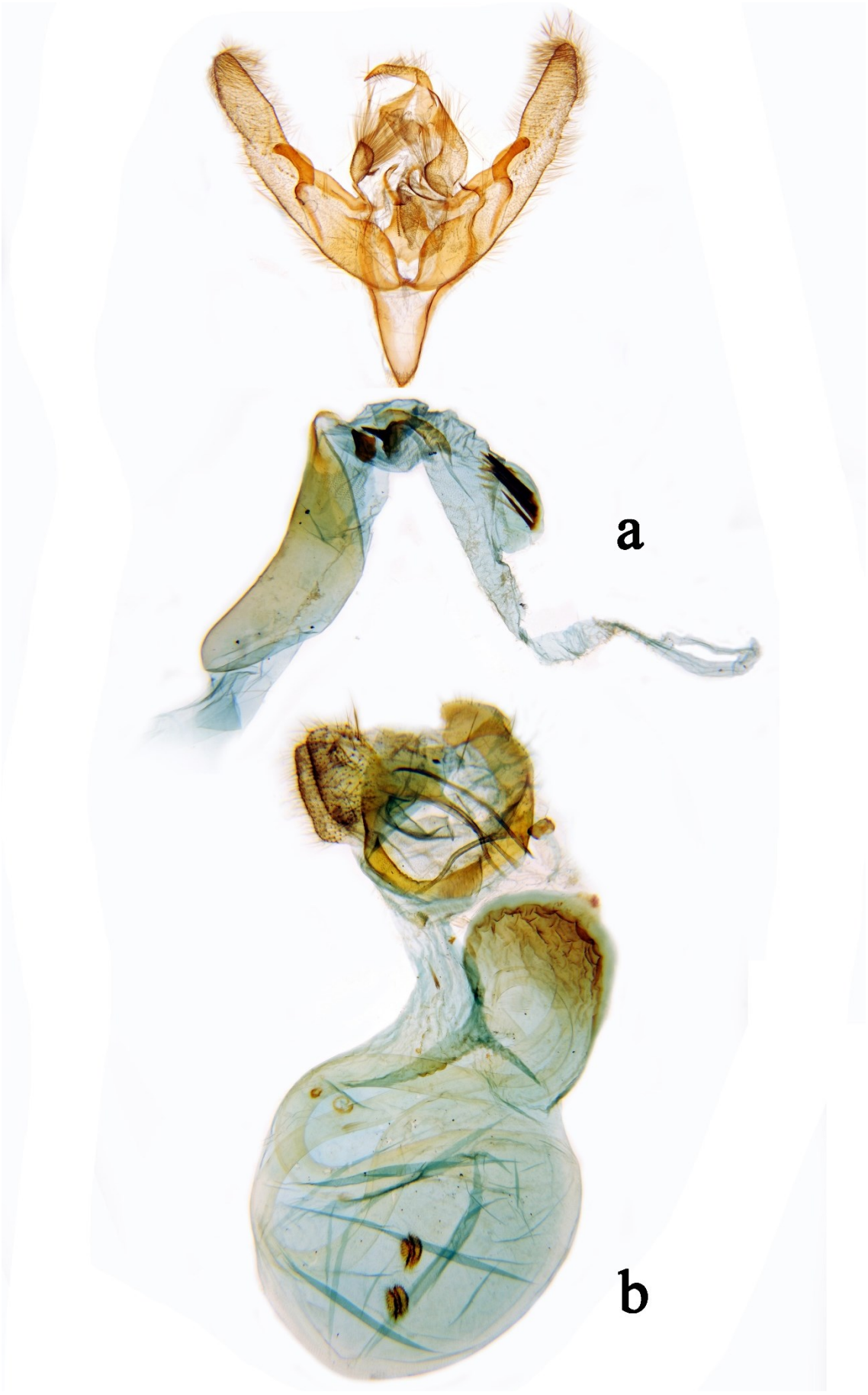

Figure 4. Genitalia of *Leucochlaena labrys* sp. n.: a, male holotype; b, female paratype.

Figure 5. *Leucochlaena labrys* sp. n.: genitalia of male paratypes.

Distribution and bionomics. The new species is known only from its type locality in Crete (Greece) and probably is endemic to the island. The moths were collected in the landscape typical of medium altitude in the island with low shrubland, high shrublands (mainly *Juniperus phoenicea*), and small evergreen and semi-evergreen oaks (*Quercus coccifera* and *Quercus brachyphylla*; Fig. 6). In the flight period, the new species shares the habitat with the following species: *Axia nesiota* Reisser, 1962, *Isturgia berytaria* (Staudinger, 1892), *Dyscia crassipunctaria* (Rebel, 1916), *Crocallis helenaria* Ruckdeschel, 2006*, Episema gozmanyi* Ronkay & Hacker, 1985*, Leucochlaena muscosa, Tiliacea cypreago ulriki* Fibiger, 1992*, Polymixis culoti* (Schawerda, 1921).

Figure 6. The habitat of *Leucochlaena labrys* sp. n.: Greece, East Crete, surroundings of Agios Nikolaos, 1000m, Lassithi Mountain.

Etymology. The species name is derived from lábrys (λάβρυς in ancient Greek) a two-bladed axe, sacred symbol of Minoan religion and power. Several labrys have been found in the palace of Knossos; it is hypothesized that the noun labyrinth derives precisely from labrys, and that therefore the palace of Knossos was the "palace of the labrys".

DNA Barcoding. We used the only sequence obtained from our specimens and we compared it to all the sequences of the subgenus *Leucochlaena* (totally eighteen) available on BOLD as common data from various European countries and from North Africa, Jordan and Turkey.

Barcoding analysis (Fig. 7) showed that the single examined specimen of *Leucochlaena labrys* has a 1.4 % distance from *Leucochlaena* of the *oditis* group from North Africa (the closest species), a 2.3 % distance from *Leucochlaena oditis jordana* from Turkey and about a 3,2 % distance from *Leucochlaena* of the *oditis* group from Europe. By the way *L. turatii* Schawerda, 1931, another island endemic, has less than 1 % distance from *Leucochlaena* of the *oditis* group from Europe.

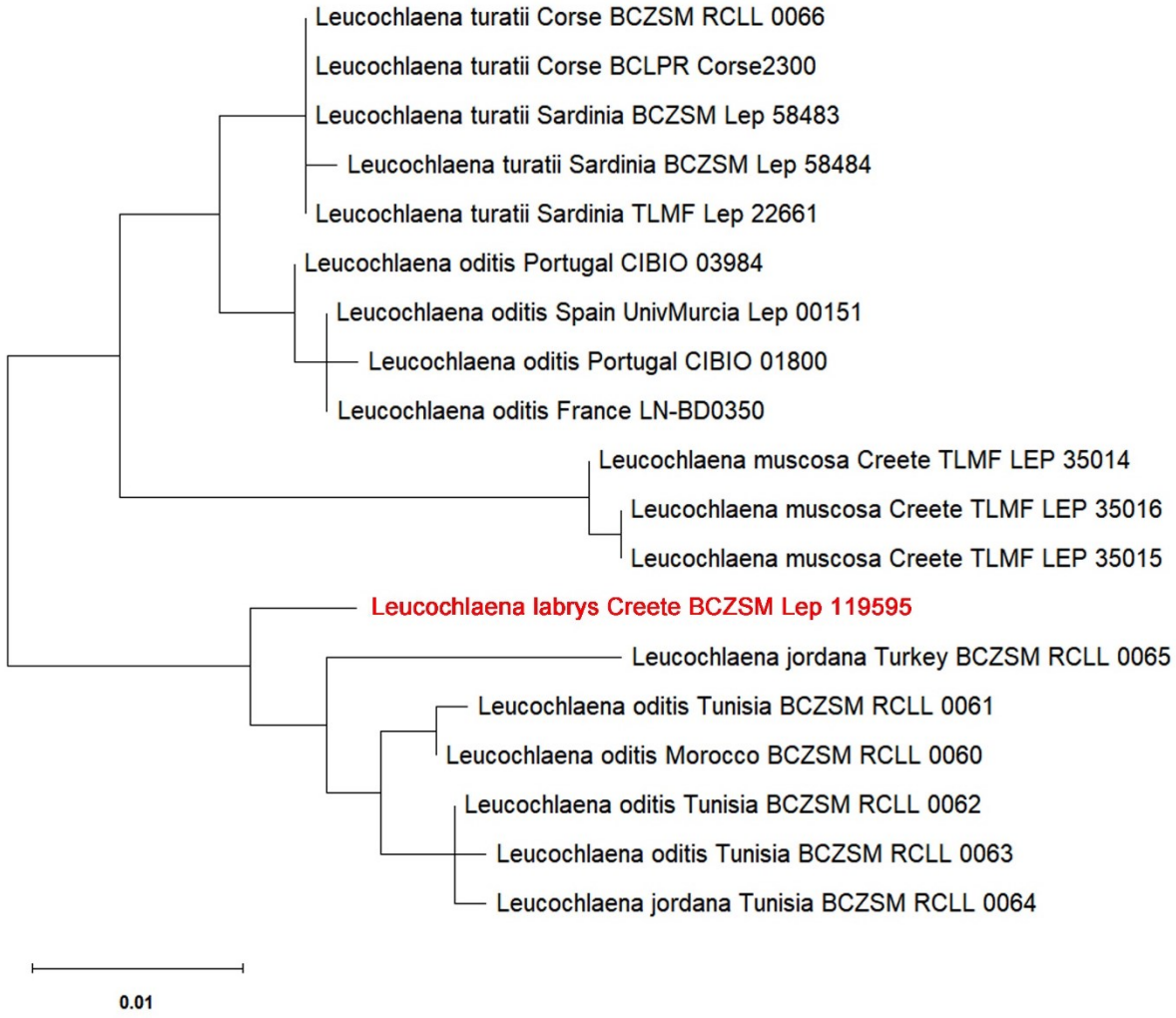

Figure 7. The maximum likelihood tree of the *Leucochlaena oditis* species-group.

It is necessary to note that the sequences have been inserted in the table and figure 7 with the name with which the sequences were inserted in the BOLD System. However, these North African specimens were later differentiated into more species (Ronkay *et al.* 2023) and probably the specimen from Tunisia indicated as *L. jordana* is one of the latter species. A detailed examination of the genitalia of the specimens, whose sequences are inserted in BOLD, is necessary in the future, just as a genetic examination of the various recently described taxa from North Africa would be highly appropriate.

Table 1. List of specimens with DNA barcodes (COI).

Taxon	Sequence page	Country, region	Collection	Specimen ID
L. jordana	GWOSQ847-11	Tunisia, Kebili	BC ZSM	RCLL0064
L. jordana	GWOSQ848-11	Turkey, Sanliurfa, Urfa	BC ZSM	RCLL0065
L. muscosa	LPALE1230-23	Greece, Crete, Lakki	TLMF	Lep35014
L. muscosa	LPALE1231-23	Greece, Crete, Lakki	TLMF	Lep35015
L. muscosa	LPALE1232-23	Greece, Crete, Lakki	TLMF	Lep35016
L. turatii	GWOSQ849-11	France, Corsica, Col de Bacinu	BC ZSM	RCLL 0066
L. turatii	GWOTA007-12	Italy, Sardinia, Gennargentu	BC ZSM	Lep 58483
L. turatii	GWOTA008-12	Italy, Sardinia, Gennargentu	BC ZSM	Lep 58484
L. turatii	LEASS1108-17	Italy, Sardinia, Meana Sardo	TLMF	Lep 22661
L. turatii	LPALE4174-23	Italy, Sardinia, Meana Sardo	TLMF	Lep 37958
L. turatii	LPRCL907-21	France, Corsica, Col de Vergio	BC-LPR	Corse2300
L. oditis	GWOSQ843-11	Morocco, Oriental Region, Jerada	BC ZSM	RCLL 0060
L. oditis	GWOSQ844-11	Tunisia, El Kef	BC ZSM	RCLL 0061
L. oditis	GWOSQ845-11	Tunisia, Kasserine	BC ZSM	RCLL 0062
L. oditis	GWOSQ846-11	Tunisia, Gabes	BC ZSM	RCLL 0063
L. oditis	IBILP1280-19	Portugal, Guarda, Gouveia	CIBIO Porto	INV03984
L. oditis	IBILP533-19	Portugal, Bracanca	CIBIO Porto	INV01800
L. oditis	IBLAO056-11	Spain, Murcia	Universidad de Murcia	Lep 00151
L. oditis	LENOA350-11	France, Pays de Loire	Coll. Bernard Dardenne	LN-BD0350
L. labrys		Greece, Crete	Coll. G.Govi	Lep 119595

Conclusion. Europe is undoubtedly the most explored continent from an entomological point of view. Despite this, in recent decades, even in a well-known group such as the Macrolepidoptera, many new species have been described: in most cases, however, they are cryptic species, whose differentiation has been revealed by detailed taxonomic studies. It was therefore a great surprise to discover on the island of Crete, a place much explored from an entomological point of view, a new species of the genus *Leucochlaena*, an entity so different from all the other species of *Noctuidae* reported so far for the island.

Acknowledgements

This work would not have been possible without the help and continuous support of Axel Hausman (Zoologische Staatssammlung München, Germany), whom we warmly thank for the DNA barcoding.

Many thanks to Aidas Saldaitis (Nature Research Centre, Vilnius, Lithuania) for the gift of some specimens of *Leucochlaena oditis jordana* from Jordan. We are thankful to Chiara Morosinotto (Padova, Italy) for commenting on the manuscript.

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