



New species of *Kyklioacalles* Stüben, 1999 from Majorca (Curculionidae: Cryptorhynchinae) and a first attempt to expand the Integrative Taxonomy to include the 3D Scanning

by
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with 8 figures

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Abstract. A new Cryptorhynchinae, *Kyklioacalles* (s.str.) *majoricensis* sp.n. is described from the Balearic island of Majorca (Spain) and distinguished morphologically and molecularly from its sister taxon *Kyklioacalles characivorus* Stüben, 2005 from Sardinia (Italy). A Neighbour Joining tree for the mtCO1 gene is presented and a p-distance matrix in percent is compiled for 10 related species of the *K. teter-barbarus* group from the western Mediterranean region. For the first time, a 3D scan is introduced into a first description of a Palaearctic Curculionidae (Cryptorhynchinae), allowing the reader to view the holotype from all angles. Some introductory considerations would like to give an impulse to change and reconsider some of the International Rules for Zoological Nomenclature.

Keywords. New species, morphology, molecular analysis, integrative taxonomy, barcoding, Neighbour Joining trees, 3D scan, 3D print, Spain, Majorca.

Nomenclatural acts

Kyklioacalles majoricensis sp.n.: urn:lsid:zoobank.org:act:9015CA7C-3889-42D3-93E1-6886615A28B7

Electronic Supplement

URL: <https://www.curci.de/?wnsupplement=112>

Size: 26.8 MB, the ZIP file includes:

- 1) Fig 1. as single page PDF file;
- 2) 3D image file from Fig. 1 in *.u3d format
- 3) 3D printer file in *.obj format to use with 3D printer



Fig. 1 (Internet version). It's a first step! 3D scan of the new species *Kyklioacalles majoricensis* from Mallorca (holotype). Note: Please click into the picture and allow 3D content if your PDF reader is asking you for permission (see info bar under the menu).

Introduction

Access to type material should be an indispensable prerequisite for the endeavour to describe a new species. However, a difficulty exists in borrowing type material from European museums, leading to this work (Stüben 2023). Customs regulations for sending insect specimens can be restrictive in some recipient countries, perhaps even completely banned. Additionally, unreliability of the postal service may be used as an excuse to not send museum specimens. This may be coupled with loaned material not being handled carefully due to underfunding and lack of staff. These were never a reason for complaint many decades before. Increasingly, museums are starting to issue 'summonses' to our now ageing taxonomists, with availability of appropriate expertise for a given taxonomic group variable, to make their way to Paris, Madrid or Milan for one or another type of comparison. It is obvious that this will soon no longer be possible due to staff shortages, financial bottlenecks in the local authorities and restrictive collection bans when creating comparative collections. The closure of a beetle collection in a museum is much more likely these days than the high-profile closure of an outdoor swimming pool or an opera house. However, if maintenance is no longer carried out in a morphological collection, the specimens and types are quickly threatened with decay - then a great epoch of taxonomy and morphology lasting over two hundred years may come to an end. But do we just want to watch?

The timely digitisation of museum collections, especially type material, could therefore become the most important task in this transformation process. In addition to focus stacking 2D photography (Stüben, A.

2011), largely automated 3D insect scanners are becoming increasingly important. They were developed several years ago by a team led by Michael Heethoff at the TU Darmstadt (Germany) and have been in use (almost ready for series production) at numerous museums in Germany for 1-2 years (Heethoff 2023). I visited such a scanner (Fig. 2) and the small team around Benjamin Wipfler and Christoph Braun at the Morphology lab of the Leibniz Institute for the Analysis of Biodiversity Change (LIB) at the location Museum Koenig (ZFMK, Bonn) at the end of 2023 and brought back the first 3D scan of a new *Kyklioacalles* species, the holotype (Fig. 1). This was more exciting than the discovery of the beautifully marked new Cryptorhynchinae on the Spanish holiday island of Majorca itself. I am very grateful to both colleagues for their help and commitment.

But what is really happening? You could call it a combination of the well-known focus stacking photography (approx. 100 individual images that are stitched together almost simultaneously to form a depth-of-field image) and the all-round 3D capture of a specimen on two rotatable axes (with further overlapping images stacked from 400 positions). These approx. 35,000 to 40,000 individual shots are then combined. The scan of the specimen, in this case a weevil, placed in a light globe on a needle, is fully automated. The beetle offers its "most beautiful sides" on an automatically rotating, horizontal and vertical axis to an automatically focus-stacking, high-quality camera, which is permanently installed on a macro slide - of course, overlapping in terms of image technology, so that no empty spots remain on the later photogrammetrically calculated 3D model (only the tip of the needle leaves a 'final hole'; this can also be seen in the scan Fig. 1 upon closer inspection).

Technical specifications of the Scanner

The 3D scanning of the holotype was done using a DISC3D Scanner (Ströbel et al. 2018) and the associated control software provided by the manufacturer Small World Vision (<https://small-world-vision.com/>). For the optical configuration, the pre-set "XS" was used. Scanning was done with the standard pose program of 360° and a

step size of 10° for the azimuth and the elevation. With these settings, 89 images were taken for each individual stacked image and in total 396 stacked images from different perspectives were taken. The images were then used for 3D reconstruction of a digital model of the holotype in Agisoft Metashape Professional (Version 2.0.4) to create a 3D-PDF file and a scaled Wavefront file (.obj), allowing for digital measurements of the model in millimetres.

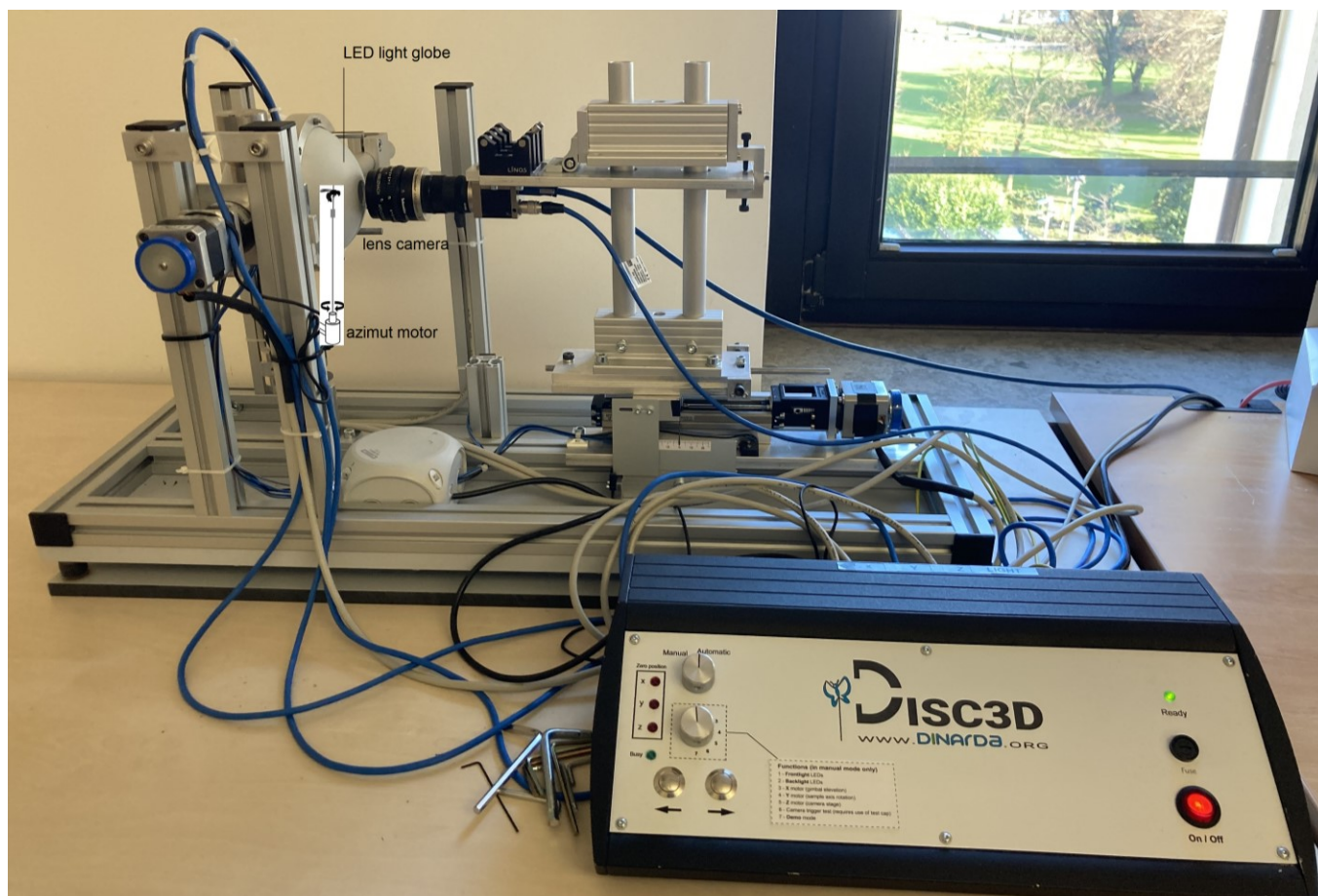


Fig. 2. Fully automatic DISC3D Scanner at the Morphology lab of the Leibniz Institute for the Analysis of Biodiversity Change (LIB) at the location Museum Koenig (ZFMK, Bonn); see also: Ströbel et al. 2018.

With the DISC3D scanner we used at the ZFMK, which dates back to the early days (2020), the lower size of the insect specimen was 'only' 3 - 3.5 mm. The texture applied after processing also needs to be better, both more colourful and sharp. In addition to this limitation, detailed shots of protruding hairs, very fine bristles and body parts covered by limbs pose a small problem. But you don't need a lot of technical imagination to visualise the most impossible things in the near future. For example, remote-controlled micro-drones and cameras with integrated focus stacking hardware and software, which already exist, could 'illuminate' all of the insect's nooks and crannies at centimetre intervals, orbit it remotely and log far more image data.

While such innovations should be left to inventors and engineers, the taxonomist's confrontation with a largely fictitious opponent takes place elsewhere. The central questions here are: How and where do we present such initial descriptions, in which the morphology largely takes place in "moving pictures"? What role does the user/reader take on, because after all, he / she somehow intervenes manually in the scientific publication with the cursor - without, of course, changing it? This means that both a 360°-verification of the initial description text on the 3D image is possible at any time as well as, of course, the falsification of morphological assertions, which were previously either not possible at all or only possible subsequently through the detour of precise knowledge of the type material. Should such 3D models be accepted by the scientific community as a replacement for the fragile, often already unattainable type material? Incidentally, such questions about the medium of presentation are not entirely new. They also affect the presentations of molecular taxonomists, whose species descriptions consist mainly of a nucleotide sequence and perhaps an accompanying

photo (a controversial example is the "minimalist revision" by Sharkey et al. 2021, see Ahrens et al. 2021).

No matter how you feel about it, it is an illusion to believe that you can avoid such innovations with the old-fashioned "International Code of Zoological Nomenclature" (ICZN 1999, 2017) under your arm. This is a naive attempt to control the scientific community, as naive as the decades-long attempt to ban first descriptions on the Internet and, in return, to oblige the first describing author to use "ink and toner" (ICZN: 2012, 8.4.1). It is up to the scientific community (and only it) to continue to pursue new approaches in practice and to skip 'bad' approaches.

More importantly, however, would be an 'International Commission of Taxonomists' legalised by us, which accompanies and supports scientific progress with binding **ethical rules** (instead of getting bogged down again and again in dogmatic guidelines on procedural issues). And there is certainly no lack of tasks: How do I behave as a taxonomist if I am denied access to the type material, if public institutions, such as museums, block scientific work or if state institutions deny us the right to expand our scientific base, if we are refused collecting permits or even if we are no longer allowed to create collections for bogus reasons of species protection?

Then the self-reproducing (from within its own ranks) "International Commission on Zoological Nomenclature", which we taxonomists have not even chosen, would finally have a meaningful task, would have to work hard to create a future-proof taxonomy and would also be a great help for species protection. The change from controller to defender of taxonomy would be such a milestone!

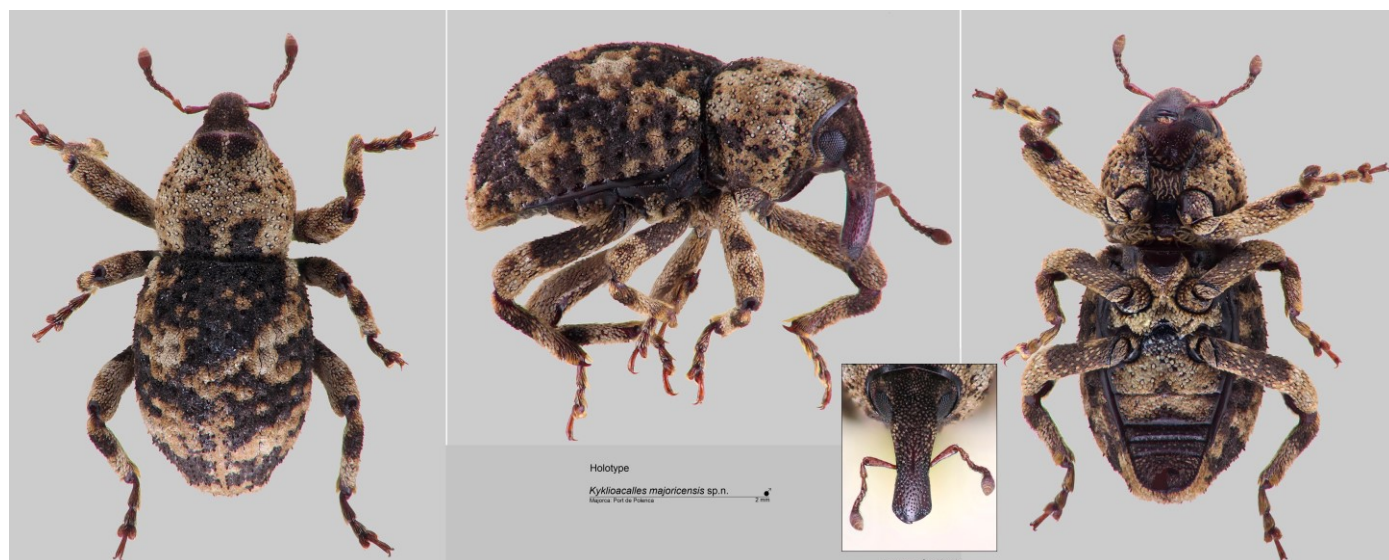


Fig. 3. Holotype of *Kyklioacalles majoricensis* sp.n., male (2D scan using focus stacking).

Description of *Kyklioacalles majoricensis* sp. n. (Fig. 1, 3-4a, 6-8)

Family: Curculionidae
Subfamily: Cryptorhynchinae
Genus: *Kyklioacalles* Stübgen 1999
Subgenus: *Kyklioacalles* s.str.
Group: *Kyklioacalles teter-barbarus*

Holotype: 1M, " E(spaña), Majorca, 1 km S Port de Polença, 39°52'39.91"N 3°4'52.20"E, 1 m, on *Beta vulgaris*, 28.3.2023, leg. Stübgen (7)", coll. Museum Koenig, Bonn (ZFMK); DNA (CO1), collector's number: 3854-PST, CO1 sequence: see Appendix 1 (deposited in Senckenberg Deutsches Entomologisches Institut, Müncheberg (SDEI)).
Specimens of females still unknown.

Length: 4.5 mm (without rostrum)

Head: Seen from above, the narrow, predominantly laterally placed eyes are slightly teardrop-shaped and tapering towards the underside; the dark brown coloured rostrum measures approx. 2/3 of the pronotum length, has scales only in the upper part and is strongly, deeply and extensively punctured from the antenna insertion to the apex. The antennae are located approximately in the middle of the rostrum; the first two antennomeres of the funicle approx. 2x longer than wide, the 5

following antennomeres rather spherical to the short-oval club increasingly broad-oval.

Pronotum: 1.08x wider than long; widest point immediately behind the centre; from there to the anterior margin long oval to straight (with a very weak lateral depression in front of the apex), but more rounded towards the base; pronotum disc slightly convex, free of furrows; the vestiture consists of round, beige (predominantly) and black, finely grooved scales overlapping like roof tiles; the latter form two elongated spots in front of the base, two smaller, triangular spots on the anterior margin and two small spots on the anterior, somewhat lowered disc of the pronotum; a short, light-coloured (black on the darker patches), vertically protruding bristle emerges from each small hole.

Elytra: 1.3x longer than wide; widest point slightly in front of the centre; from there to the base and to the apex evenly oval-rounded; with a very faint lateral depression immediately in front of the apex; without protruding humeri; elytral base almost straight. When viewed laterally, the elytral vertex line forms a uniform (circular) arc. The vestiture here consists mainly of larger black, narrow brown-beige framed scale patches, which are followed by almost white patches positioned in the centre. These spots are clearly demarcated from each other and rich in contrast, but leave an overall mixed impression (a spot pattern that is

likely to vary from individual to individual); the elytra surface is densely covered with tiny, strongly overlapping scales, which completely cover the intervals and the heavily punctate striae; the latter are as wide or even wider than the intervals in front of the centre, but become increasingly narrow towards the apex.

Legs: Short; the predominantly light scaled front femora reach the centre of the eye, the hind femora reach the elytral apex; the femora and tibiae, which are covered with long oval, raised scales, have a dark brown banding in places.

Underside: With a deep rostrum channel whose mesosternal receptaculum is semicircular and ends well in front of the mid-coxae; underside covered with predominantly closely fitting, beige, overlapping round **and** protruding, long-oval (rod-shaped) scales (Fig. 3).

Aedeagus: The short median lobus of the aedeagus with an angular taper and with the endophallus typical of *Kyklioacalles* species, whose basal hole structure appears more or less 'square' (Fig. 4a).

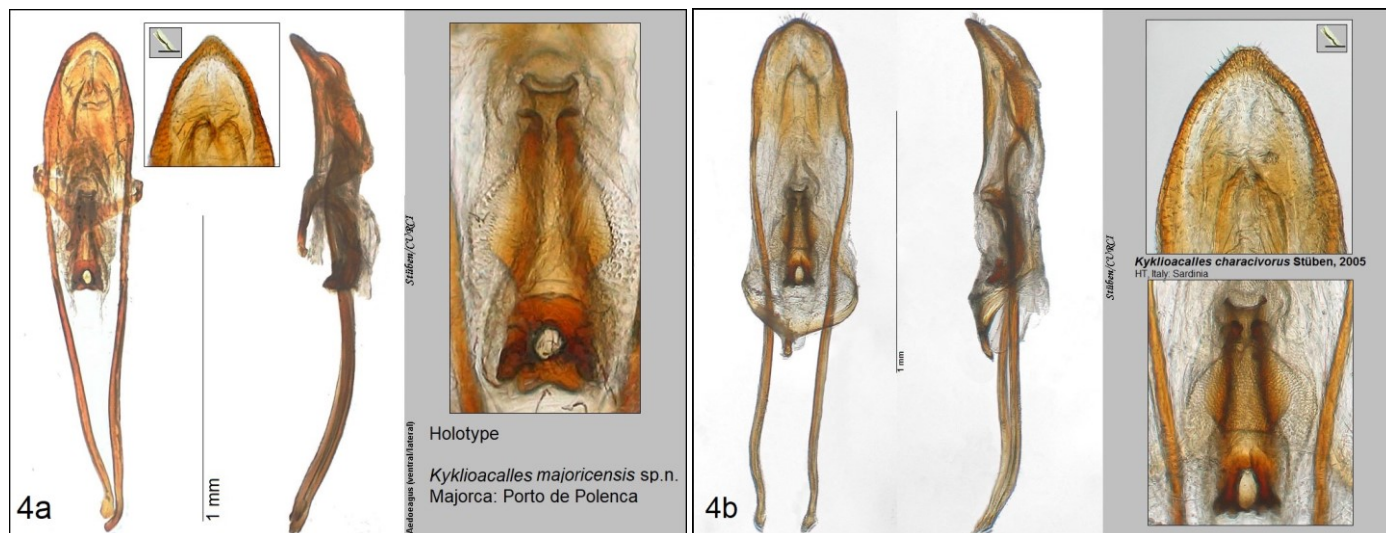


Fig. 4. Aedeagi by comparison (focus stacking): 4a. *K. majoricensis* (HT) and 4b. *K. characivorus* (HT).

Morphological differential diagnosis

Only a single comparative species fulfils a large part of the characteristics listed above for the new species: *Kyklioacalles* (s.str.) *characivorus* from *Euphorbia characias* in Sardinia, which I already described in 2005. However, this species, which belongs to the *K. teter-barbarus* group, has straight, subparallel elytra up to the centre (Fig. 5), whereas the new species has uniformly long-oval elytra (Fig. 3). The entire integument of *K. characivorus* is rougher, the elytra and pronotum are much more strongly punctured, while the pronotum of the new species from Majorca in particular has a finer punctation (Fig. 5). The aedeagus of this species also has an angular tip, but it is much narrower. Particularly striking is the almost 'square', basal structure of the endophallus (Fig. 4a), which appears 'oval' in *K. characivorus* after maceration of the aedeagus in a low-dose KOH solution (Fig. 4b).

Molecular differential diagnosis

The morphological comparison is also extensively confirmed by the molecular NJ-tree to the directly related *Kyklioacalles* (s.str.) species described by the author [except for *K. teter* (Boheman, 1844)] in the last two decades from the southwestern Mediterranean region. In this tree the new species appears as an adelphotaxon to the species *Kyklioacalles* (s.str.) *characivorus* described from Sardinia (Fig. 6, left). The p-distance is (corrected) 6.2% (Fig. 6, right) and thus lies within the interspecific spectrum for sister species among the genus *Kyklioacalles*; still well above the minimum distance (of 4.3 %) to the nearest 'mainland congener' (Schütte, Stüben & Astrin 2023).



Fig. 5. *Kyklioacalles characivorus* (PT, male) deep at the root-neck of *Euphorbia characias* on pastureland, Sardinia. The search for this species is very labour-intensive during the day.

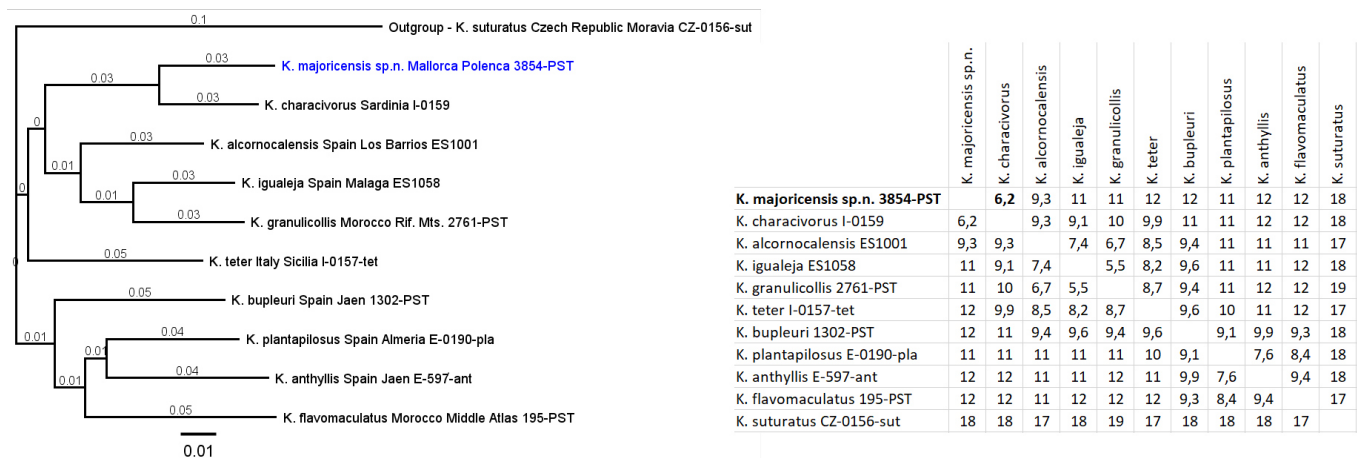


Fig. 6. Right side. Molecular Neighbour Joining tree (mtCO1, 658bp, Follmer region) for 10 Mediterranean *Kyklioacalles* (s.str.) species - including the new species *K. majoricensis* with the corrected p-distances according to Tamura-Nei, 1993 (substitution model); *K. suturatus*, an Eastern European forest species, rooted as outgroup. Left side. Distance matrix of the *Kyklioacalles* species listed in the NJ tree. Laboratory routine see: Stüben & Kramp (2019).



Fig. 7. In the root collar of sea beet (*Beta vulgaris* subsp. *maritima*), I found *Kyklioacalles majoricensis* sp.n. a few metres from the sea. *Tamarix* trees and the tuberous roots of asphodel are not suitable for the development of *Kyklioacalles* species (but the latter are suitable for Cryptorhynchinae: Tourneumatini); if asphodel plants occur in large concentrations, this is often a sign of overgrazing in the Mediterranean region.

Bionomics. I found the new open land species [similar to its sister species in Sardinia, which lives during the day on tree-free pastures and on roadsides in the rootstock of *E. characias*] by the roadside in a largely forest-free, flat area, and tapped it together with *Dichromacalles dromedarius* (Boheman, 1844) with a frisbee disc from the lower woody stems of *Beta vulgaris* subsp. *maritima* (L.) Arcang. (Fig. 7). Apart from

the tamarisk trees planted like espaliers along the drainage ditches, there were no natural woodland areas or scattered deciduous trees in the wider surroundings. The sea beet is native to the coasts of Europe, northern Africa, and southern Asia. The Amaranthaceae is a perennial herbaceous plant and is considered the original parent form of cultivated beetroot varieties such as sugar beet, fodder beet, beetroot or

chard. However, it may be difficult to detect the new *Kyklioacalles* species on annual fields that are probably contaminated with insecticides - unless on agricultural land that has been abandoned for years. As with all *Kyklioacalles* species of open habitats, only perennial plants that are woody, at least in the lower stem area, are preferred (for the differentiation of landscape species and forest species among the species of *Kyklioacalles* with their respective host plant preferences see: Stüben 2003). However, *Kyklioacalles* species on ruderal areas, embankments and in extensive pastures only ever attack dying plants and not vital plants in their optimal locations. It is therefore sufficient to select such recently and partially dead plants (often on the periphery of their respective locations) and examine them more closely - as was undoubtedly the case with *Beta vulgaris* subsp. *maritima* near the sea. A final note: Boulder clay, drifting or fluviially drifted soils, filled root necks or even plants on slopes that are often far too steep at the end of

erosion gullies - in short: "plants on erosion soils" - should be avoided at all costs when sieving! They are avoided by all Cryptorhynchinae just as much as branches and sticks washed into forests or streams. Flowing, moving or even accumulating wood, debris or soil elements do not guarantee the larvae undisturbed development and do not protect them from moisture and fungi in the last larval stage (Stüben 2018). Our own collections and siftings have shown this time and again: Where slope stability is lost due to climate change, Cryptorhynchinae populations and endemics disappear very quickly.

Distribution & Derivatio nominis. The species was named after its occurrence on the Spanish island of Majorca, where I have so far found only one specimen, a male, in the north-east near Port de Pollença directly by the sea.

Acknowledgement

As so often in the past, my special thanks go to Eva Kleibusch of the Senckenberg German Entomological Institute (SDEI, Müncheberg) for the sequence analyses and to André Schütte (ZFMK, Bonn) for the distance matrix. I would also like to thank Benjamin Wipfler and Christoph Braun from the Museum König (ZFMK) for their help and technical information on the 3D scan and my son Alexandre Stüben for the 3D printing of holotype. Finally, my thanks go to Peter Sprick (Hannover) for a critical review of the manuscript and Joshua Clarke (Belfast) for the language corrections in English.

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Appendix 1

Molecular barcode (mtCO1, 658bp, Follmer region) of the holotype of *Kyklioacalles majoricensis* sp.n. from Polenca (Spain, Majorca), collector-no. 3854-PST

TACTCTATATATTATCTTTGGTTCTTGATCAGGAATAATGGGCACCTCTTTTAGAATATTAATTCGAACCGAAGTAGGCAATCCYGGCACATTAATTGGAATGACCAGGTCTATAAYTCAATTGTAACAGCCCATGCTTTTATTATAATTTTTTTATAGTAATACCAATTATAATTTGGAGGTTTGGTAATTGACTAATCCCTTTAATATTAGGAGCCCTGATATAGCATTCCTCCCGATYAAATAATATAAGTTTCTGACTTTTACCTCCTTCAATTAATTTTACTTTCTAATAAGTAGAATTATTGATMAAGGAGTAGGAACTGGCTGAACAGTTTATCCCTTTATCAGCCAATATTGCTCAYGAAGGTATTCTGTAGATTAGCTATTTTTCAGTTTACACATAGCAGGAATTTCTCARTTCTYGGAGCCATCAATTTTATTTCTACTATCATTAATATACGACCAACAGGAATAAAATTAGACCAAAATACCCCTATTTTATTTGAGCAGTGAATAATACGGCAATTTTACTCCTTCTATCACTACAGTTTATGCTGGAGCAATACAACTATTTTAAACAGCCGAATATCAATACATCAKTTTGTATCTTGACGAGGGGAGATCCTATCTTATATCAACATTTATGT

Appendix 2

With the attached scaled model, measurements can also be carried out on the model using suitable programs. The unit of measurement is in millimeters (mm). *Kyklioacalles majoricensis* can also be printed via the OBJ file (which can also be converted into an STL file) to get a first impression of the holotype and in order to use it for further morphological studies (Fig. 8). Link to the electronic supplement (ZIP-file): <https://www.curci.de/?wnsupplement=112>



Fig. 8. A first step: Highly magnified 3D model as a printout of the holotype of *Kyklioacalles majoricensis* (in comparison with the original). 3D printing and photo by Alex Stüben.

Call for co-operation

Entomological research does not only take place at universities and in our museums, but has been carried out since ancient times by the many Entomological Societies in Europe. As a rule, they cannot afford expensive equipment - beyond landing nets and light microscopes - neither in macro photography nor costly 3D scanners such as those used in this article for 75,000 euros. So the question may be asked at this point: Who has the time and desire to build a similar scanner, partially print it and perhaps make it available to our members in the Curculio Institut for a small fee?

Or 3D scan for holotype - is another option and an offer to a museum.

Everything is possible!

Peter E. Stüben



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On January 1, 2024, the Curculio Institute presented the new encyclopedia on the **Nanophyinae** by the two members Peter E. Stüben (Germany) & Karel Schön (Czech Republic) in the internet journal '**Le Charançon**': www.nanophyinae.curci.de

Nanophyinae of the Western Palearctic - Part A: Presentation and Image key of the Corimaliini

by Peter E. Stüben & Karel Schön



Stüben, P.E. & Schön, K. (1.1.2024):
Nanophyinae of the Western Palearctic - Part A:
Presentation and Image key of the Corimaliini. - Le
Charançon. Catalogues & Keys No. 7, Curculio-
Institute, Mönchengladbach, Germany.
ISSN 1864-0699. [accessed: dd-mm-yyyy]

***The current image key to the Corimaliini can also
be viewed directly:***

[https://nanophyinae.curci.de/pdf_key/corimaliini-
key.pdf](https://nanophyinae.curci.de/pdf_key/corimaliini-key.pdf)

Nanophyinae of the Western Palearctic - Part B: Presentation and Image key of the Nanophyini

by Peter E. Stüben



Stüben, P.E. (1.1.2024):
Nanophyinae of the Western Palearctic - Part B:
Presentation and Image key of the Nanophyini. - Le
Charançon. Catalogues & Keys No. 7, Curculio-
Institute, Mönchengladbach, Germany.
ISSN 1864-0699. [accessed: dd-mm-yyyy]

***The current image key to the Nanophyini can also
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key.pdf](https://nanophyinae.curci.de/pdf_key/nanophyini-key.pdf)

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