



Araştırma Makalesi / Research Article

**Morphological Examination of the Fine Structure of the Mouthparts and Head
Structure of *Cantharis livida* Linnaeus, 1758 and *Ancistronycha erichsonii* Bach, 1854
(Coleoptera: Cantharidae) Species Under SEM Microscope**

***Cantharis livida* Linnaeus, 1758 ve *Ancistronycha erichsonii* Bach, 1854 (Coleoptera:
Cantharidae) Türlerinin Ağız Parçaları ve Baş Yapısının İnce Detaylarının SEM
Mikroskobu Altında Morfolojik Olarak İncelenmesi**

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Öz

Amaç: Bu çalışmada, Türkiye'de yaygın olarak bulunan *Cantharis livida* Linnaeus, 1758 ve *Ancistronycha erichsonii* Bach, 1854 (Coleoptera: Cantharidae) türlerinin ağız parçaları ve baş yapısının ultra yapıları ilk kez taramalı elektron mikroskobu (SEM) ile incelenecektir. Cantharidae familyası Türkiye'de 206 türle temsil edilmektedir. 206 türden ikisinin ağız parçaları ve baş yapısının morfolojisi incelenecek olup, Türkiye'de bu kapsamda bir çalışmaya rastlanmamıştır.

Gereç-Yöntem: Bu çalışma ile iki türün baş yapısı ve ağız parçaları (mandibula, maksiller palp, labium, labial palp) karşılaştırılacaktır. SEM ve stereo mikroskop ile çekilen fotoğraflar da çalışmaya dahil edilecektir.

Bulgular: Bu çalışmada labial ve mandibular palplerin kenarları boyunca yer alan duyuşal tabakaların dizilimi ve sayısında belirgin farklılıklar gözlemlendi.

Sonuç: Bu yapıların detaylı incelenmesi, yeni tanısal karakterler elde etmek için çok önemlidir. Bu yeni tanısal karakterler, türler arasındaki farklılıkları ve önemli karakterleri, özellikle benzer türlerin ayrımının yapılabilmesi için önermekteyiz.

Anahtar Kelimeler: *Ancistronycha erichsoni*, *Cantharis livida*, Cantharidae, SEM, Türkiye.

Abstract

Objective: The study presents the ultrastructural mouthparts and head structures of the species *Cantharis livida* Linnaeus, 1758, and *Ancistronycha erichsonii* Bach, 1854 (Coleoptera: Cantharidae), which are widely distributed in Türkiye and have been observed using a scanning electron microscope (SEM) for the first time. The Cantharidae family is represented by 206 species in Türkiye. The mouthparts and head morphology of two of the 206 species will be examined using an SEM To date, no study has been found in Türkiye that examines the morphology of the mouthparts and head structure in this scope.



Materials and Methods: This study will compare the head structure and mouthparts (mandible, maxillary palp, labium, labial palp, and gena structure) of the two species

Results: In this study, notable differences were observed in the arrangement and number of sensillar layers located along the margins of the labial and mandibular palps.

Conclusions: A detailed investigation of these structures is crucial for obtaining new diagnostic characters. These new diagnostic characters will be used to identify the differences and key characteristics among species, particularly in distinguishing between similar species. Photographs taken with the SEM and the stereo microscope will also be included in the study.

Keywords: *Ancistronycha erichsoni*, *Cantharis livida*, Cantharidae, SEM, Türkiye.

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INTRODUCTION

Türkiye has a vibrant fauna and flora compared to the countries in the same climate zone. It is among the world's advanced countries in terms of natural resources and hosts a diverse array of living species due to its zoogeographic suitability. Insects constitute an important part of the living world. Anatolia, in particular, is one of the world's most important gene centers in terms of biological richness. Since it was connected to the continents of Asia, Europe, and Africa at different times, it has more species than the European continent. Cantharidae is a cosmopolitan family, comprising 5,100 species across 130 genera worldwide. The number of species found in the Western Palearctic region is about 870. Two hundred six of these species are found in Türkiye, and a large part of this number consists of species specific to Türkiye, that is, endemic¹. According to Brancucci, the Cantharidae family is divided into 5 subfamilies. This is the current one today. There are species belonging to only 3 subfamilies in the Western Palearctic Region². Studies conducted in Türkiye are few and have a very narrow scope. Foreign researchers have recorded the vast majority of the known species. Brancucci (1980) conducted a study on the systematics and morphology of the Cantharidae family³. In this study, the anatomy of cantharids and detailed pictures of the species are included for comparison. Additionally, all subfamilies and genera included in this subfamily have been examined in detail, and detailed figures are provided to explain each body part. Distinctive characters between subfamilies, tribes, and genera are expressed with figures³. The information provided in the source will be used to compare the features of the specific species. In addition, the literature is quite limited for the *Cantharis livida* Linnaeus, 1758 and *Ancistronycha erichsonii* Bach, 1854 species. Furthermore, there is almost no information available, and no studies have been conducted using the SEM microscope on these species. The Cantharidae family is distinguished from the families close to it by the structure of the elytra. The elytra are not remarkable. They have a soft body. In both sexes, the functional wings are well developed. There are no light organs, pores on the abdominal tergite, and no ovipositor. They are abundant on the leaves and flowers, where other insects also live and feed

on nectar and pollen. The Cantharidae are better known than other families of Coleoptera by the characters they carry: The head is not completely hidden under the pronotum; the antennae are 11-segmented, mostly filiform, serrate, and pectinate. The labrum is membranous and usually hidden under the clypeus; the middle thoracic is adjacent to the coxa or nearly so; the tarsal formula is 5-5-5; the abdomen is 7 or 8 segmented, and the abdominal tergites have pores belonging to the paired lateral glands on the 1st-8th segments^{3,4}. When we look at the general head structure in the Cantharidae family that will be studied with SEM, the width of the head is greater than 1 mm, 1 mm or less than 1 mm, except for the eyes. The width of the head is greater than its length. The head is narrowed at the back. The head is prognathous (especially *Chauoglinathus*, *Podaprus*), semi-hypognathous, or rarely hypognathous. (*Ichthyurus*) It can rotate to some extent. (for example, *Silica*) The head is not completely hidden by the pronotum and is partially seen from above. Compound eyes are present. The width of the eyes is 2 times the length. The eyes are strongly protruding, protrude to some extent, or may not be protruding. It typically exhibits sexually dimorphic features, with females being smaller in size. There is no simple eye. The eyes are finely faceted; the inner surface is setaeless. The sacculs are not distinct. The frontoclypeal suture is often absent, incomplete, or in the form of a visible trace; straight, curved, or angular (simple in *Chauliognathinae*). The anterior margin of the clypeus is of various shapes. The anterior margin of the clypeus is slightly indented or flat, convex, segmented, lobed, or toothed in the middle. The labrum is visible, free, and membranous. It may be separated by a suture, partially or completely fused with the clypeus or frontoclypeus, or it is usually hidden under the clypeus or absent. The labrum is widened transversely and square. The terminal margin of the labrum may be of various shapes. Blunt, convex, narrow, rounded, sharp, deeply indented, or bilobed. The mandibles are mostly elongated. It narrows from the base to the tip and has a curved and acute tip. The mandibles do not have the mola and prostheca, which are related to the mouth in the larva. In most cases, the mandibles are simple. Sickle-shaped (*Podaprus*) or have a single tooth on the inner

edge. (Some *Malthodes* species). The maxilla has densely setose galea and lacinia. Lacinia may be fused with apical lobes or absent. Maxillary palps are 4-segmented and variable. Apical segment is axe- or blade-shaped, ending in an oval or blunt point (Malthiniinae). Labium is not divided by a ligule, thinly or deeply bilobed. Labial palps are 3-segmented and variable. The apical segment may be slightly expanded or strongly expanded. Gular suture is widely separated (Cantharini), narrowly separated, absent, or partially fused (Podaprini)⁴⁻⁶. No detailed study has been conducted in Türkiye other than the studies that contributed to the fauna and zoogeographic distribution of Cantharidae^{2,7}. In this study, the head structure and mouthparts (mandible, maxillary palp, labium, labial palp, and gena structure) of the two species will be compared. This study will be given to the Cantharidae family for the first time from Türkiye. In addition, although research on *Cantharis livida* and *Ancistronycha erichsonii* has intensified recently, as there is no comparative study between them, it is planned to make a significant contribution to the literature and lead to further studies on this subject.

MATERIAL AND METHOD

Selection phase of materials to be used: The species to be studied were selected from habitats with different vegetation and altitudes, as well as from regions with varying geographical and climatic characteristics, typically by sweeping with a net or through direct observation.

Sample preparation stage using a stereo microscope: For this study, specimens of *Cantharis livida* and *Ancistronycha erichsonii*, collected from various provinces, were used. The head of the specimens was dissected, and the remaining tissue was cleaned with fine tweezers. The part of the specimen to be extracted was cleaned under a stereomicroscope; the remaining structure was first washed with water and then kept in 70% ethyl alcohol. The head and mouth pieces of the two species were processed separately without mixing. The removed mouth structure can either be glued to a separate small piece of cardboard or placed in a small plastic tube (bim capsule) with glycerin and pinned next to the specimen. Olympus SZX7 and Leica Z-16 APO

stereomicroscopes will be used during the studies.

Sample preparation stage for SEM: For scanning electron microscopy examinations, samples fixed in glutaraldehyde will be washed in sodium phosphate buffer. Then, they were passed through an increasing series of ethanol (70%, 80%, 90% and 100%), and dehydration steps were performed. After dehydration, the samples were placed on standard aluminum SEM stubs to which previously prepared double-sided tape was glued (Figure 1). After this, all samples were imaged using the JEOL JSM 6060 SEM at 5kV and 10kV at the Hacettepe University HUNITEK Center, following gold coating with a Polaron SC 502 Sputter Coater.



Figure 1. Coated samples before SEM examination

Interpretation of SEM photographs and taxonomic evaluation (Figures 2A-2C): While the head and mouthparts of the *Cantharis livida* Linnaeus, 1758, and *Ancistronycha erichsonii* Bach, 1854 species show limited differences under the stereo microscope, the ultrastructure can be seen more clearly under the SEM microscope. The mouth parts (mandible, maxillary palp, labrum, labial palp), which are significant distinguishing characters in this family, and the structure of the head have

been examined, and the fine structure will be described in detail. Morphological features in diagnosis enable the distinction of many species; however, there may be cases where morphological features are not understood and are insufficient for species distinction. In such cases, fine structure details obtained with the SEM microscope will provide additional information, facilitate diagnosis, and also confirm the species.

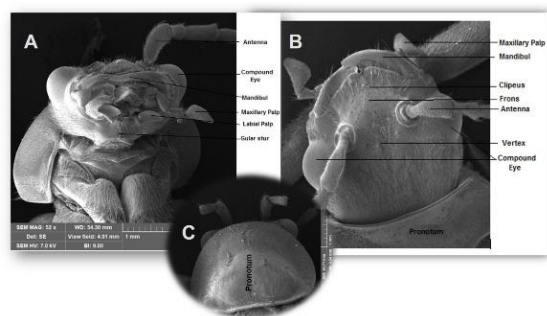


Figure 2. The head structure and mouthparts (mandible, maxillary palp, labium, labial palp, gena structure) of *Cantharis livida* Linnaeus, 1758. (A: Ventral view of the head; B: Dorsal view of the head; C: Pronotum).

RESULTS

Cantharidae, also known as soldier beetles or cantharids, are common beetles often found as adults on foliage and leaves, where they feed on insects, nectar, and pollen. Several species have been reported to prey on aphid populations infesting plants, shrubs and trees⁸⁻¹⁰, but they can also attack other groups of insects. Most species emerge in spring or summer, and adults are short-lived. They are among the most active flying beetles. They are predominantly active during the day, but they may stop activity if the temperature becomes too hot.⁴ Many species are also active at night, as they were collected in much higher numbers in pitlight traps than in passive pitfall traps.¹¹ Being more exposed to predators on the surface of vegetation, they have developed an effective system of chemical defense. Adults and larvae possess paired tergal glands that secrete repulsive compounds, serving to reduce their palatability to predators. Feeding habits are one of the most important criteria that determine the mouth structure of insects. Both larvae and adults have strong jaws.¹³ Some of the adult cantharids with known feeding habits hunt other insects, while others

feed on nectar or pollen. Cantharini and podaprini generally feed on liquids with high nutritional value. They obtain these liquids with high nutritional value from other insects they eat or from flowers that provide rich nectar (Apiaceae, Asteraceae). *Dicheotarsus* and *Podaprus* adults are the first predators of aphids (Hemiptera: Aphididae). Although they are insects that visit plant leaves to hunt other small, soft insects, they are nectar-feeding insects. Pollens constitute the solid part of the diet of members of the Chaliognathinae subfamily—adults of *Chaliognathus* feed on nectar and pollen. *Chaliognathus* species are commonly found in the flowers of a wide variety of plants and are important native pollinators. As a result of this feeding preference, cantharids are the most active flying Coleoptera. The feeding habits of many groups are not known with certainty (Silinae, Malthininae, Ichthyurini). Little is known about the associations of cantharid plants. It is suspected that there is little specificity.⁴ The differences observed in this study, which will examine the head and mouth parts, will provide information on this subject as well.

The head capsule of insects is one of the well-studied parts. Researchers such as¹⁴⁻²³ have made descriptive studies of the head and have described the various parts that make up the head.³ The width of the head, excluding the eyes, is greater than 1 mm, 1 mm, or less than 1 mm. The width of the head is greater than its length. The head is narrowed at the back. The head is prognathous (especially *Chauoglinathus*, *Podaprus*), semi-hypognathous, or rarely hypognathous. (*Ichthyurus*) It can rotate to some extent. (For example: *Silica*) The head is not entirely hidden by the pronotum and is partially visible from above. (See Figure 1.2.b) Compound eyes are present. The width of the eyes is twice the length. The eyes are strongly protruded, protruded to some extent, or may not be protruded. It is usually sexually dimorphic, and females are smaller. Simple eyes are absent. Eyes are finely faceted; the inner surface is without setae. Temples are not distinct. Frontoclypeal suture is mostly absent, incomplete, or in the form of a visible trace; straight, curved, or angular. (Simple in

Chauliognathinae) The anterior margin of the clypeus is of various shapes. The anterior margin of the clypeus is slightly indented in the middle or straight, convex, segmented, lobed, or toothed. The labrum is visible, free, and membranous. It may be separated by a suture, wholly or partially fused with the clypeus or frontoclypeus, or it is usually hidden under the clypeus or absent. The labrum is expanded transversely and square. The terminal margin of the labrum may be of various shapes. Blunt, convex, narrow, rounded, sharp, deeply indented, or bilobed. Mandibles are mostly elongated. They are narrow from the base to the tip and have a curved and acute tip. Mandibles do not have the mola and prostheca, which are related to the mouth in larvae. Mandibles are simple in most. They are sickle-shaped (*Podaprus*) or have a single tooth on the inner edge. (Some *Malthodes* species). Maxilla has galea and lacinia with dense, stiff setae. Lacinia may be fused with apical lobes or absent. Maxillary palps are 4-segmented and variable (See Figure 2A). Apical segment is axe- or knife-shaped and ends with an oval or blunt point. (Malthinae). Labium is not divided by a ligule, thin or deeply bilobed. Labial palps are 3-segmented and variable. The apical segment may be slightly expanded or significantly expanded. Gular suture is widely separated (Cantharini), limitedly separated (Figure 2.A), or absent or partially fused (Podaprini).⁴⁻⁶

One of the most important structures used in species distinctions is the mouth parts and head structure. Our primary objective is to elucidate and characterize the subtle differences between the mentioned parts of these species within the same subfamily. However, no SEM microscope study has been conducted for this group. Therefore, this study to be undertaken is a first for the Cantharidae family from Türkiye. In addition, this SEM microscope examination may reveal distinct characteristics in the mouth and head structure that will enable species to be distinguished from one another.

DISCUSSION

The differences between the two genera are quite distinct and are clearly indicated in the key below.

1. The antennal segments vary in length, with only the 2nd segment being approximately 2.5 times shorter than the 3rd segment.....*Ancistronycha*
-The antennal segments are of varying lengths. In both sexes, the bases of the outer claws are lobed, sharply toothed, or simple. The pronotum is semicircular or broader than it is long (Figure 3C). The aedeagus is significantly narrowed at the tip. The parameres may vary in shape.....*Cantharis*

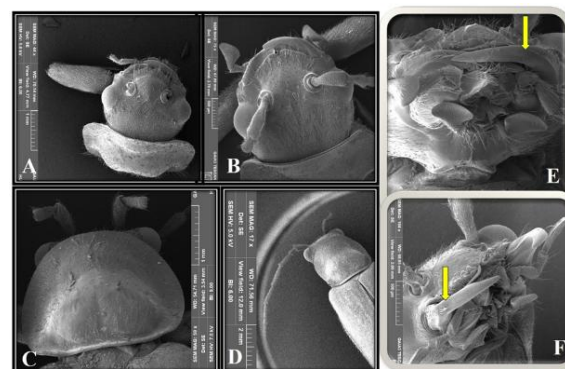


Figure 3 A. The prominent frontal projection structure between the antennae in *Cantharis livida* Linnaeus, 1758; B. The structure of the frons in *Ancistronycha erichsonii* Bach, 1852; C. The semicircular pronotum structure in *Cantharis livida* Linnaeus, 1758; D. The nearly square-shaped pronotum structure in *Ancistronycha erichsonii* Bach, 1852; E. The sensilla structures on the mandible of *Cantharis livida* Linnaeus, 1758; F. The sensilla structures on the mandible of *Ancistronycha erichsonii* Bach, 1852.

Genus: *Ancistronycha* Märkel, 1852

The head is flat with small punctures behind the eyes. There is a weakly developed longitudinal elevation above the clypeus. The mandibles are simple. The maxillary palp is twice as long as it is wide, with the final segment being broader than the others, axe-shaped, and bilaterally symmetrical. The clypeus is generally convex. The glenoid sutures are widely separated.

Indistinct spots are present on the frons. The antennae are long. In males, antennal segments 4-10 have a hairless groove on the lateral sides of the apices, while in females, the segments are simple.

***Ancistronycha erichsonii* Bach, 1852 (Figures 4A-4F).**

The final segment of the maxillary palp is swollen, forming an axe-like shape, and unlike the other segments, it bears dense, short, yellow setae. The labium pair is divided in the middle, heart-shaped, and shiny yellow in color. The last segment of the labial palp is triangular or axe-shaped and is covered with short, dense, yellow setae. The eyes are large, copper-colored, and convex in shape. The antennae are thin and long. The first antennal segment has very short setae, curved toward the tip, and is densely covered with coarse, long hairs. The 1st and 2nd antennal segments are shiny yellow, darkening toward the tip. From the junction of the 2nd and 3rd antennal segments onward, the color becomes distinctly dark brown. The 2nd antennal segment is about 2/5 the length of the 3rd segment. Segments 4 to 10 have a hairless groove along the lateral margins of their apices.

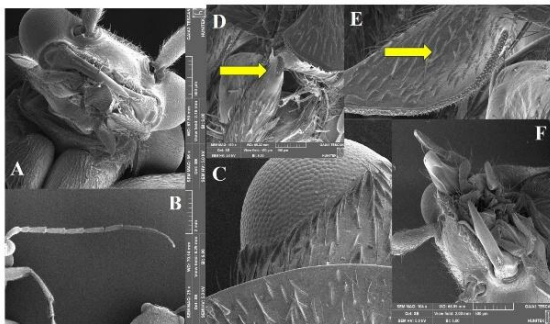


Figure 4. In *Ancistronycha erichsonii* Bach, 1852: **A.** Frontal view of the head and mouthparts; **B.** Antennal structure; **C.** Eye and surrounding area; **D.** Structure of the labial palp; **E.** Structure of the maxillary palp; **F.** Sensilla located on the mandible.

Genus: *Cantharis* Linnaeus, 1758 (Figures 5A-5E).

The head is short with a broad base. The temples

are short. The mandibles are simple. The terminal segment of the maxillary palp is bilaterally symmetrical, mostly axe-shaped or knife-like.

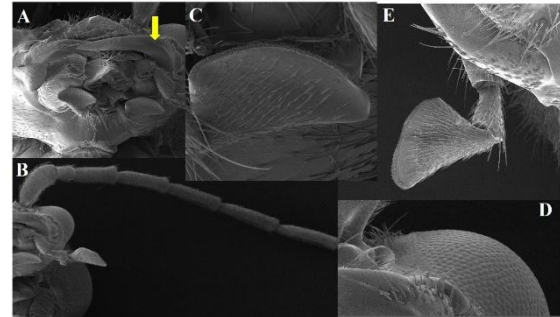


Figure 5. In *Cantharis livida* Linnaeus, 1758; **A.** Frontal view of the head and mouthparts and Sensilla located on the mandible; **B.** Antennal structure; **C.** Structure of the maxillary palp; **D.** Eye and surrounding area; **E.** Structure of the labial palp.

***Cantharis livida* Linnaeus, 1758**

The head is short and dorsally flattened. Its width is equal to its length. The head narrows at the base and bears a distinct oval projection on the clypeus. The eyes are round, and the anterior margin of the clypeus is slightly notched. The mandibles are yellow at the base and brown at the tip. They narrow from base to apex and become spear-shaped. The maxillae also narrow toward the tip and are a shiny, yellow color. The maxillary palps widen toward the apex, with the final segment being axe-shaped and yellow; however, the tip of the last segment has a brown stripe-like marking. The terminal segment is short and covered with dense yellow setae. The joints between the segments bear long, sparse, yellow hairs. The labium is shiny yellow and narrows from base to tip. The final segment of the labial palps is triangular and yellow in color.

CONCLUSION

In the SEM images taken from species belonging to two different genera within the subfamily Cantharinae, several striking differences were observed. While the two species can be morphologically distinguished

with ease based on prominent features, SEM analysis revealed subtle characteristics hidden in finer structural details. Sensilla located on the fully chitinous mandibles vary in both position and density between the two species (Figures 6A-6B), highlighting species-specific distribution patterns not readily visible under light microscopy

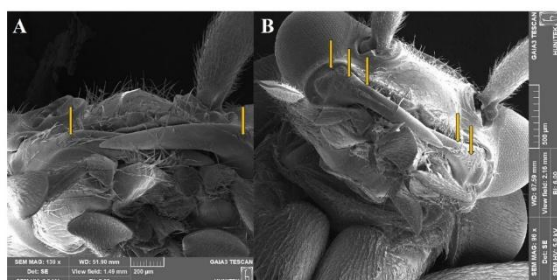


Figure 6 A. Sensilla on the mandible structure in *Cantharis livida* Linnaeus, 1758; B. Sensilla on the mandible structure in *Ancistronycha erichsonii* Bach, 1852.

In *Cantharis livida* Linnaeus, 1758, the sensilla structures appear grouped and become more prominent around the midsection (Figure 7). In contrast, in *Ancistronycha erichsonii* Bach, 1852, the sensilla are more widely distributed and noticeably longer.

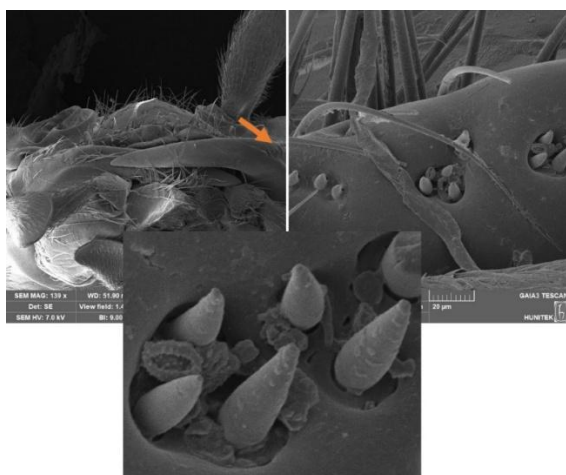


Figure 7. Sensilla on the mandible structure in *Cantharis livida* Linnaeus, 1758.

In this study, notable differences were observed in the arrangement and number of sensillar

layers located along the margins of the labial and mandibular palps. In *Cantharis livida* Linnaeus, 1758, the sensilla appear sparser and organized in fewer layers, whereas in *Ancistronycha erichsonii* Bach, 1852, they are denser and arranged in multiple distinct layers. In addition to these differences, several other micro-morphological characteristics were identified, including variation in the punctuation pattern on the head capsule; differences in the edge morphology, dentition, and mandibular grasping mechanisms of the mandibles and maxillae; distribution patterns of setae on the labrum and clypeus; the presence and arrangement of sensory setae and surface microstructures around the antennal sockets; and distinct reticular and micro-pitted formations on the head capsule.

RECOMMENDATIONS

These micro-morphological features, particularly when examined through Scanning Electron Microscopy (SEM), offer valuable taxonomic resolution in separating morphologically similar or closely related species within the Cantharidae family. Thus, the findings contribute significantly to the understanding of fine-scale diagnostic characters, supporting accurate species identification and delimitation in taxonomically challenging groups

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Ethical Approval: Not applicable

Conflict of Interest: The authors declare that there is no conflict of interest regarding the publication of this paper.

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