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Short communication

Case report of mite infestation of the external ear in Carollia perspicillata: Histological features of the ear.

Santiago Duque Arias[1], Sebastian Cifuentes-Acevedo[2], Danny Zurc[3], Sergio Solari [2], Daisy Alejandra Gómez Ruiz[1*], Leidy Laura Lopez Sepúlveda[2]

[1]*Grupo de investigación GINVER, Facultad de Medicina Veterinaria, Corporación Universitaria Remington, Calle 51 N° 51-27, Medellín, Colombia - CO*
[2]*Grupo de Mastozoología, Instituto de Biología, Universidad de Antioquia, Medellín 050010, Colombia - CO*
[3]*Museo de Ciencias Naturales de La Salle, Instituto Tecnológico Metropolitano, Medellín, Colombia - CO*

[*]*Corresponding author at: Grupo de investigación GINVER, Facultad de Medicina Veterinaria, Corporación Universitaria Remington, Calle 51 N° 51-27, Medellín, Colombia - CO*

E-mail: daisy.gomez@uniremington.edu.co

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Abstract

Bats host a diverse assemblage of ectoparasites that occupy specific anatomical microhabitats, yet the histological effects of these associations remain poorly documented. Here, we report a case of mite infestation of the external ear in the Neotropical bats species *Carollia perspicillata* and *Carollia brevicauda*, with a detailed histological characterisation of the auricle and inner ear of *C. perspicillata*. Bats were captured during biodiversity monitoring programmes in Antioquia, Colombia, and mites were collected and identified morphologically. Histological and histochemical analyses of ear tissues were conducted using haematoxylin and eosin, periodic acid–Schiff, and Masson's trichrome staining. Mites were identified as *Spelaeorhynchus praecursor* (Spelaeorhynchidae), occurring exclusively on the external ear with infestation frequencies of 6.6% for *C. perspicillata* and 5.8% for *C. brevicauda*. Histological examination of the auricle revealed a thin keratinised stratified squamous epithelium, abundant sebaceous glands, well-developed striated skeletal muscle, elastic cartilage, and prominent white adipose tissue at the auricular base. Only minimal focal leukocytic infiltrates were observed, with no evidence of severe pathological alterations associated with mite attachment. The inner ear displayed preserved cochlear architecture, with eosinophilic fibrillar and granular material in the scala vestibuli and scala tympani, interpreted as perilymphatic content or processing artefacts. This study provides baseline histological data on ear tissues in *C. perspicillata* and documents a localised mite–host association with limited tissue response, contributing to the understanding of bat ectoparasitism and ear morphology in Neotropical chiropterans.

Keywords

Carollia perspicillata, Ear hystology, Mite infestation, Spelaeorhynchus praecursor

Bats (Mammalia: Chiroptera) host a high diversity of ectoparasites, including insects and arachnids that have developed close and, in many cases, highly specialised associations with their hosts (Marshall, 1982; Dick & Patterson, 2006; Whitaker et al., 2009; Muñoz, 2025). Bat ectoparasites mainly include insects of the order Diptera, such as bat flies of the families Streblidae (e.g., *Trichobius joblingi*, *Aspidoptera phyllostomatis*) and Nycteribiidae (e.g., *Nycteribia kolenatii*), but also include representatives of Siphonaptera (e.g., *Ischnopsyllus* spp.) and Hemiptera (e.g., *Cimex* spp.). In addition, arachnids of the order Acari, especially members of the families Spinturnicidae and Macronyssidae, exhibit different degrees of host specificity and infestation strategies.

These ectoparasites occupy well-defined anatomical microhabitats of the host, including the fur, skin, wing membranes, patagium, face, nasal cavities, and the external ear (Marshall, 1982; Frank et al., 2013; Muñoz, 2025). Ectoparasite infestations have been associated with localised tissue responses and, under conditions of high intensity or persistent parasite loads, may be related to changes in host health status, including effects on body condition and physiological stress (Szentiványi et al., 2019). These effects are especially relevant when ectoparasites are associated with anatomical structures involved in specialised sensory functions, such as the ear, an organ that is fundamental for hearing in mammals and plays a critical role in echolocation in bats (Fenton et al., 2012). Although the diversity and ecology of bat-associated ectoparasites have been widely documented, most studies have focused on taxonomic characterisation and host–parasite interactions, whereas histological analyses of specific host tissues have been scarcely addressed (Frank et al., 2013; Muñoz, 2025). In this framework, the present study evaluates the histology of the external ear structures of bats infested by mites, with the aim of exploring potential local tissue changes associated with this interaction and contributing to the understanding of the histology of this complex sensory organ.

Bats were captured using standardised mist-netting protocols as part of biodiversity monitoring programmes associated with small-scale hydroelectric company dam projects operated by ISAGEN across five municipalities in the department of Antioquia, Colombia (Figure 1). The handling of bats was carried out in accordance with ethical principles of animal care and use in research (Sikes et al., 2016). The bat collected for histological examination was obtained in the municipality of San Rafael, Antioquia, in January 2023. After a careful examination of captured bats, observed mites were manually removed using forceps and preserved in vials containing 70% ethanol prior to laboratory processing for taxonomic identification. Bats were examined alive, without visual aids (i.e., without magnification), and released afterwards.

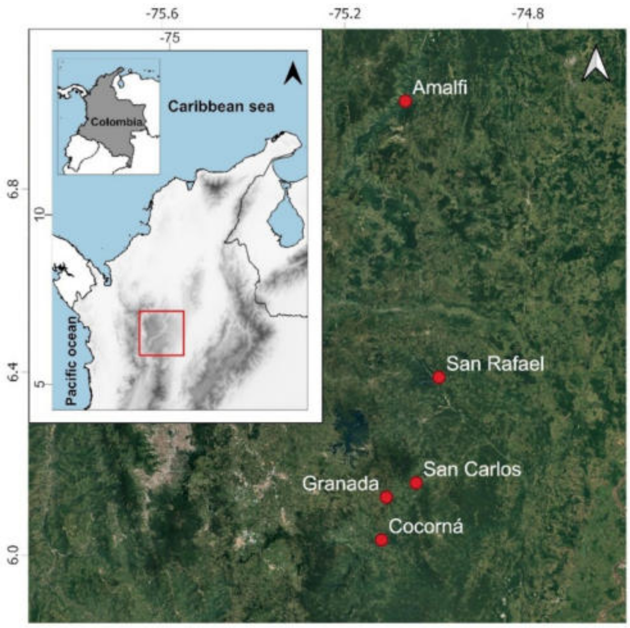

Figure 1. Map of sampling localities in the Cordillera Central (Antioquia, Colombia) showing new distribution records for *Spelaeorhynchus praecursor*.

Permanent slides of mites were prepared according to Wenzel and Tipton (1966), with species identifications conducted using established taxonomic keys and current descriptions (Fain et al., 1967; Martyn, 1988; Gettinger et al., 2020) under a microscope. Histological and histochemical processing of ear tissue was performed to identify lesions associated with mite infestation and to characterise the affected tissues. Tissue samples were fixed in 10% neutral buffered formalin and processed at the Animal Pathology Laboratory of the University of Antioquia, Colombia, using routine histological techniques, including dehydration through graded alcohols, clearing in xylene, and paraffin embedding. Subsequently, 3-µm-thick histological sections were obtained, mounted on glass slides, and deparaffinised.

For general histopathological evaluation, sections were stained with haematoxylin and eosin H & E following conventional protocols. In addition, special histochemical stains were applied: periodic acid–Schiff (PAS) to identify carbohydrates, glycoproteins, and basement membranes, and Masson's trichrome to differentiate connective tissue and collagen fibres. The slides were examined and photographed using an Olympus BX43 light microscope.

Mites of the species *Spelaeorhynchus praecursor* (Spelaeorhynchidae) (Figure 2) were recorded exclusively parasitising the external ears of *Carollia perspicillata* (with a frequency of 6.6% (14/212)) and *Carollia brevicauda* (with a frequency of 5.8% (6/104)) (Phyllostomidae) across all sampled localities. The mean intensity of infestation was one female mite per infected host. This mite species has been previously reported to parasitise both *Carollia* species throughout its geographic distribution (Dantas-Torres et al., 2014; Muñoz, 2025). However, in Colombia, the species had only been documented from a single locality in the department of Valle (Tamsitt & Fox, 1970). The present study expands the known distribution of *S. praecursor* in the country by adding five new localities in the department of Antioquia. Consistent with previous reports, the ear region appears to represent a preferred attachment site for members of this family, with the tragus identified as a microhabitat in other host species (Bassini-Silva et al., 2025).

From a histological perspective, the auricle is lined by a thin keratinised stratified squamous epithelium (Figures 3A and 3B), which becomes markedly thicker toward the base of the auricle (Figure 3F), where an increased number of epithelial cell layers is evident. Histopathological examination of the external ear revealed few pathological changes, characterised by a focal area of mononuclear inflammatory infiltrate in the dermis, predominantly composed of lymphocytes with a few mast cells (Figure 3C, thick black arrow). This mild inflammatory pattern is consistent with that described in mite infestations, where mononuclear infiltrates (lymphocytes and macrophages) predominate and are associated with chronic and delayed hypersensitivity responses (Salvadori et al., 2016). In this context, the low intensity of the infiltrate and the absence of eosinophils may reflect a low-pathogenic host–parasite interaction or a limited local immune response.

The dermis contains abundant scattered sebaceous glands (Figure 3E), embedded within dense connective tissue associated with bundles of smooth muscle (Figure 3H, thick black arrow). Additionally, a thick layer of elastic cartilage is observed (Figures 3C and 3G), as well as skeletal striated muscle fibres (Figures 3D, 3E, and 3H, thick white arrow). White adipose tissue is abundant throughout the auricle, showing greater development at its base (Figure 3F), and gradually decreasing toward the apex (Figures 3A and 3B). Two distinct glandular regions were identified in the auricle: one area characterised by the presence of abundant sebaceous glands (Figures 4A and 4B), and a second region corresponding to a compound serous acinar gland (Figure 4C).

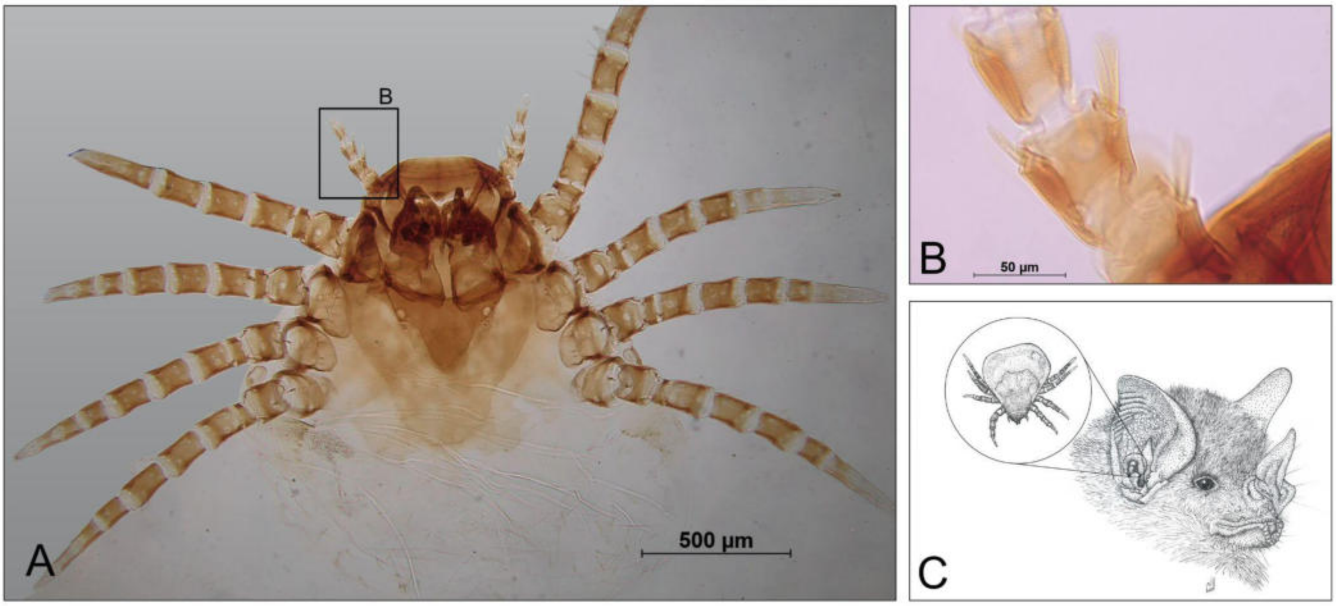

Figure 2. *Spelaeorhynchus praecursor* on the external ear of *Carollia perspicillata*: (A) whole mite at 10× magnification. (B) Detail of the pedipalp at 40× magnification showing anterolateral setae of trochanter, femur, and genu blunt and flattened. (C) Schematic illustration of the mite attached to host tissue.

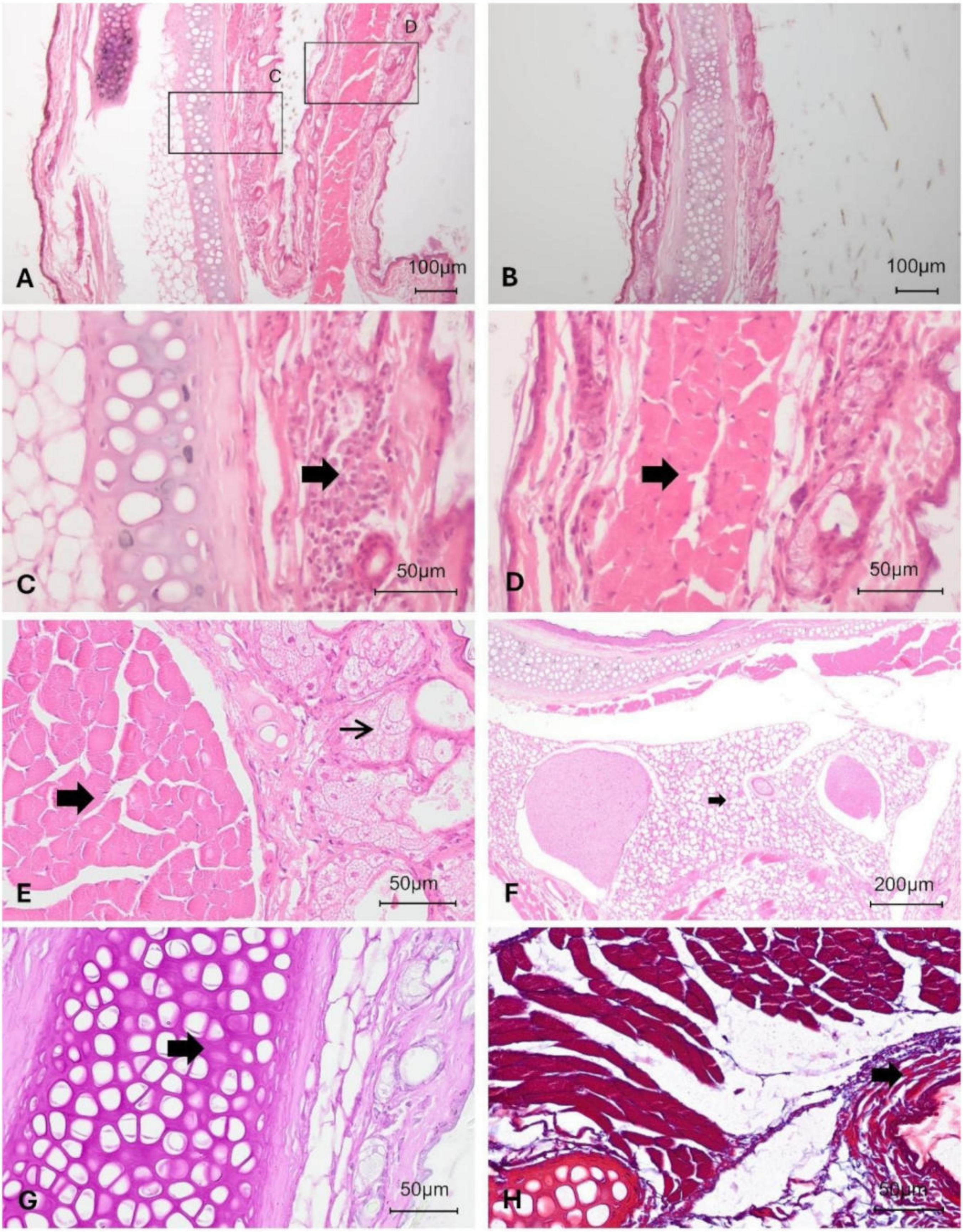

Figure 3. Photomicrographs of the auricle of *Carollia perspicillata*. (A) Auricle showing bifurcation; higher magnification areas are shown in panels C and D. 100×, H&E. (B) Auricle composed of two laminae separated by cartilage. 100×, H&E. (C) Auricle showing a focal leukocytic infiltrate (black arrow), an elastic cartilage layer, and white adipose tissue on the left. 400×, H&E. (D) Auricle showing skeletal striated muscle fibres (thick black arrow). 400×, H&E. (E) Auricle showing scattered sebaceous glands in the dermis (thin arrow) and skeletal striated muscle fibres (thick black arrow). 400×, H&E. (F) Base of the auricle with abundant white adipose tissue (black arrow) and a thick cartilage layer (blue arrow) 100x, H&E. (G) Auricle with elastic cartilage, highlighting elastic fibres within the cartilaginous matrix. 400×, PAS. (H) Auricle showing bundles of smooth muscle in the dermis (thick black arrow) and a prominent layer of skeletal striated muscle (thick white arrow) 400X, Masson's trichrome.

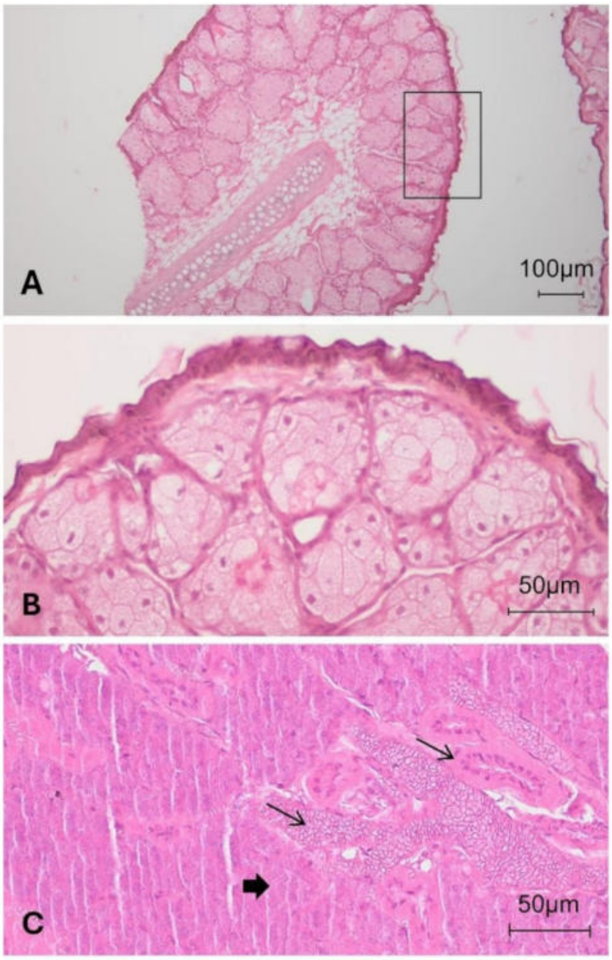

Figure 4. Photomicrographs of glandular structures in the auricle of *Carollia perspicillata*. (A) Auricular area containing abundant sebaceous glands; higher magnification is shown in panel B. 40×, H&E.(B) Auricular area with abundant sebaceous glands. 400×, H&E.(C) Compound auricular gland showing serous acini (thick black arrow), intralobular ducts (thin arrow), and blood vessels (arrowhead). 400×, H&E.

The presence of well-developed skeletal striated muscle within the auricle suggests a high capacity for auricular mobility. In bats, auricular movements play a key role in the directional control of acoustic reception and have been associated with echolocation, particularly in species that rely on fine-scale orientation adjustments during navigation and foraging (Fenton et al., 2012). White adipose tissue, which is more abundant at the base of the auricle, likely serves a structural role. In the mammalian auricle, adipose deposits have been described as supportive and cushioning components that contribute to mechanical protection and tissue flexibility during movement (Gefen & Haberman, 2007; Standring, 2021).

Additionally, the identification of two well-defined glandular regions suggests protective functions related to the maintenance of the cutaneous microenvironment. Sebaceous glands contribute to skin lubrication and barrier function, whereas serous secretions may play a role in local defence through protein components with antimicrobial activity, as described for mammalian exocrine glands (Madison, 2003; Nakatsuji & Gallo, 2012).

A general overview of the inner ear is presented in Figure 5, illustrating its anatomical location and relationship with adjacent brain structures, including the cerebellum and cerebral cortex. Additionally, the eighth cranial nerve is observed exiting the temporal bone through the internal auditory meatus and subsequently entering the brainstem. This approach allows contextualisation of the inner ear within the cranial cavity. At higher magnification, the detailed architecture of the cochlea is clearly observed (Figure 6A), with clear delineation of its compartments, the cochlear duct, and associated tissue structures. The vestibular membrane was not preserved in the section and is therefore indicated by a dotted line. A panoramic view of the cochlea at lower magnification is presented in Figure 6B, allowing recognition of the structural continuity and the distribution of connective and cartilaginous tissues. Trichrome staining highlights stromal components, facilitating visualisation of the extracellular matrix and the general tissue organisation, without evidence of significant structural alterations. Eosinophilic fibrillar and granular material is observed within the lumen of both the vestibular and tympanic scalae.

Despite the functional relevance of the auditory system in bats, the literature providing detailed descriptions of inner ear histology in this group is limited, and most available studies have focused on functional aspects related to echolocation rather than conventional histological descriptions of the ear (Neuweiler, 2000; Fenton et al., 2012). In this context, the present study provides a baseline morphological characterisation of the inner ear of *Carollia perspicillata*, documenting the general organisation of the cochlea.

The presence of eosinophilic fibrillar and granular material within the lumen of the vestibular and tympanic scalae was not associated with structural alterations of the cochlear epithelium or stroma. This finding may correspond to proteinaceous content associated with perilymph or endolymph, as well as post-mortem changes or artefacts derived from histological processing, phenomena that have been previously reported in histological studies of the mammalian inner ear (Salt & Plontke, 2009; Bohne & Harding, 2012). Given the descriptive nature of this study and the absence of associated lesions, this finding is interpreted conservatively and highlights the need for further comparative histological studies of the inner ear in chiropterans.

This study documents the occurrence of *Spelaeorhynchus praecursor* in *Carollia perspicillata* and *C. brevicauda*, expanding its known distribution in Colombia by adding five localities in the department of Antioquia. We report basic parasitological parameters, including prevalence and mean intensity, and provide morphological support for species identification based on diagnostic characters. Histopathological examination of the attachment site revealed a mild, localised mononuclear inflammatory response, consistent with low infestation intensity. Histological analysis of the auricle of *C. perspicillata* revealed a thin keratinised epithelium, abundant sebaceous glands, well-developed skeletal muscle, and basal adipose tissue, as well as two distinct glandular regions suggesting protective and homeostatic functions. The inner ear displayed cochlear architecture, with eosinophilic fibrillar and granular material observed within the scala vestibuli and scala tympani, likely corresponding to perilymphatic contents or histological processing artefacts, and without evidence of associated tissue alterations. The presence of well-developed auricular musculature and organised adipose and glandular tissues suggests functional adaptations related to ear mobility and protection, while the documentation of cochlear and perilymphatic structures establishes a reference framework for future comparative histological studies in chiropterans. Together, these findings provide baseline information on the distribution, morphology, and host tissue response associated with *S. praecursor*, and highlight the need for future studies incorporating molecular approaches and broader sampling.

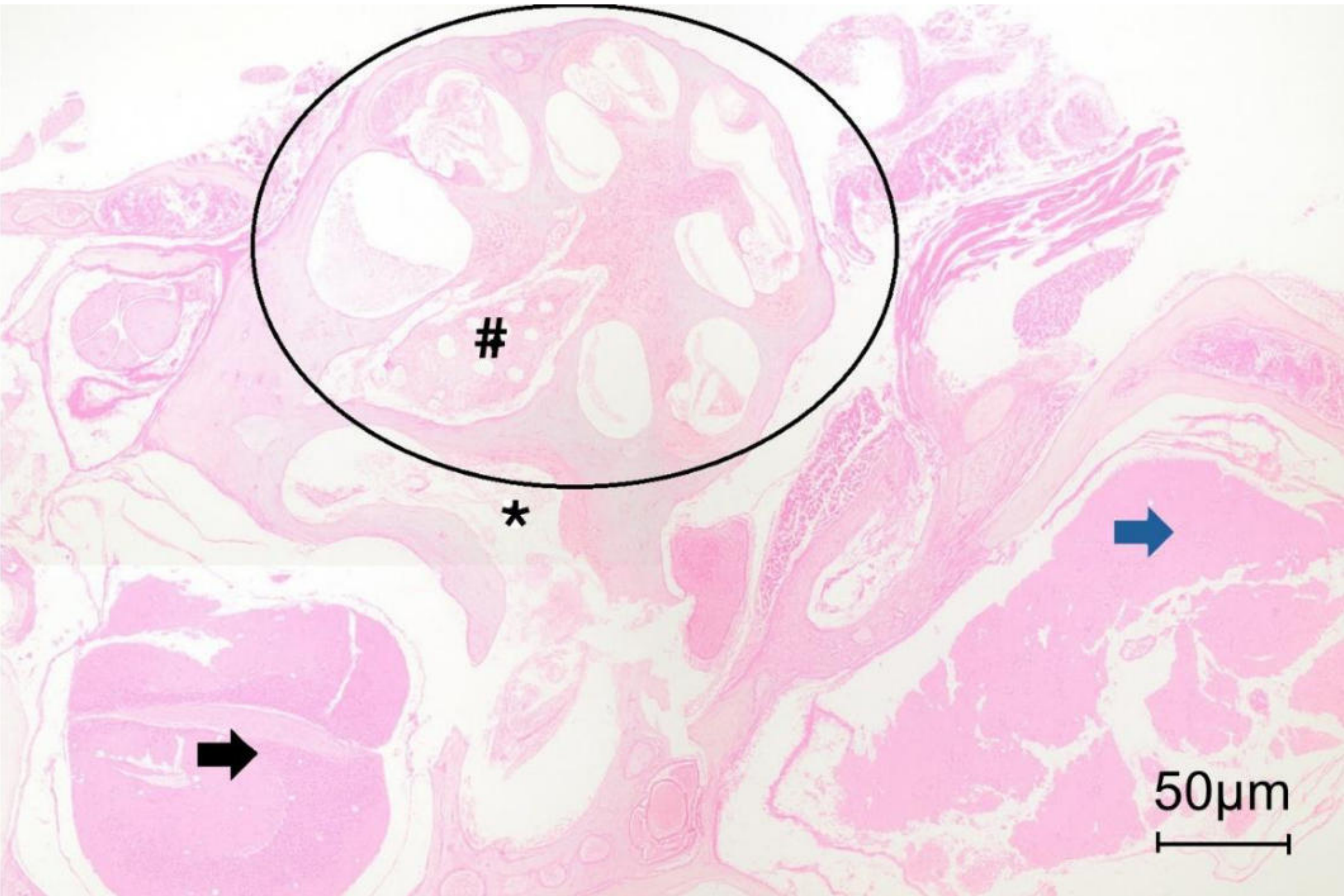

Figure 5. Inner ear and adjacent brain structures of *Carollia perspicillata*. Cochlea (outlined by circle), the axons of the spiral ganglion cells form the eighth nerve (#), auditory meatus (*), cerebellum (black arrow), and cerebral cortex (blue arrow). 40×, H&E.

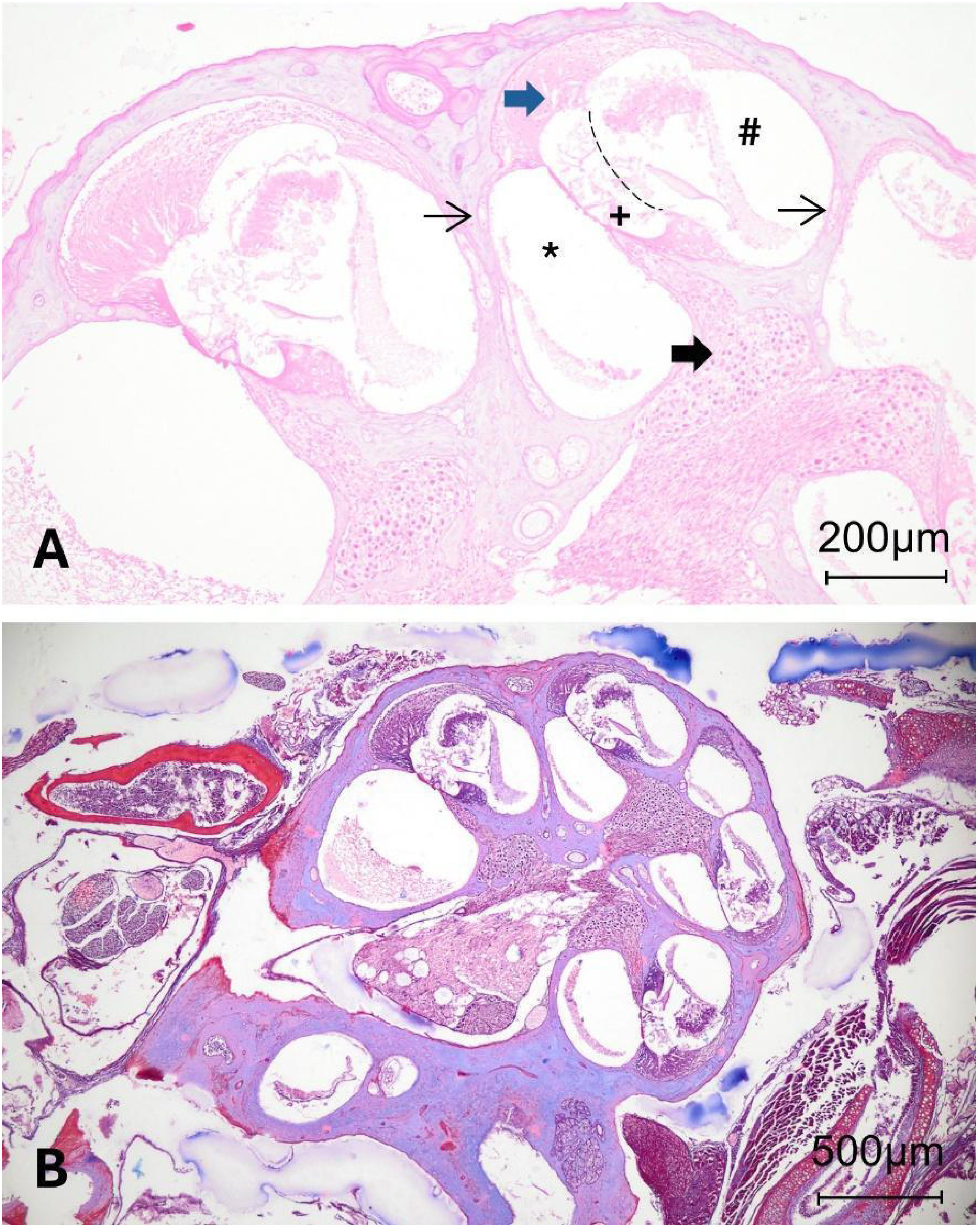

Figure 6. Cochlea of *Carollia perspicillata*. (A) High-magnification view showing the scala tympani (*), scala vestibuli (#), cochlear duct (+), spiral ganglion (thick black arrow with filled background), stria vascularis (thick blue arrow with filled background), and vestibular membrane (indicated with a dotted line), interscala septum (thin arrow). 100×, H&E.(B) Low-magnification view of the cochlea. 40×, Masson's trichrome.

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Ethical approval

All specimen capture and mite collection were granted by Resolution No. 112-0780-2020 issued in March 2020 by the Corporación Autónoma Regional de las cuencas de los ríos Negro y Nare (CORNARE), granted to ISAGEN S.A. E.S.P. (NIT 811.000.740-1). Conflict of interest

The authors declare no conflicts of interest.

Author Contributions

Conceptualisation: LLL, DAG, SDA; Methodology: SDA, DAG; Formal analysis: SDA; Investigation: LLL, SC; Writing original draft preparation: SDA; Writing, review and editing: SDA, DAG; Visualisation: SS, DZ, LLL, SC; Supervision: SS, DZ; Project administration: LLL, DAG; Funding acquisition: SC, DAG, LLL.

All authors have read and agreed to the published version of the manuscript.

Data availability

The data supporting the findings of this study are available within the article. The permanent histological and mite slides are preserved at the Faculty of Veterinary Medicine, Corporación Universitaria Remington, and are available for public consultation.

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