

# Structures of the Preantennal Region of Several Species of *Damalinia* (Phthiraptera: Trichodectidae)

M. D. SOLER CRUZ<sup>1</sup> AND M. P. MARTÍN MATEO<sup>2</sup>

J. Med. Entomol. 38(6): 802–808 (2001)

**ABSTRACT** A comparative study was made of the structures of the preantennal region of nine species of *Damalinia* Mjöberg, 1910 (Phthiraptera: Trichodectidae). Variability in the form of the head, ventral carina, pulvinus, mandibles, and labrum was observed by light and scanning electron microscopy. According to previous studies, the form of the head is possibly influenced by the density and texture of the hair of the host. The ventral carina, which may be sharp or blunt, and the pulvinus, a membranous lobe, of these parasite species of different hosts, were studied. Photographs of the mandibles and labrum show a high variability according to species.

**KEY WORDS** *Damalinia*, Phthiraptera, scanning electron microscopy, preantennal region

SEVERAL PREVIOUS STUDIES have described the structures of the preantennal region of Trichodectidae related to the louse clinging to the hairs of the host. These modifications of the Mallophagen head appear to be adaptations to environment (feather or hair structure).

Snodgrass (1935) defined the clypeus as “the facial area of the cranium just above the labrum, usually separated from the frons by an epistomal (*clypeo-frontal*) suture and sometimes divided into an ante-clypeus and postclypeus” (see pp. 412–414 in Symmons 1952). Keler (1938) (Fig. 1A; see p. 423 in Symmons 1952) referred to it “as a pair of soft-skinned bladders (physemae) which serve to clasp a hair contained in the mouth channel so that it could not slip out. A curved strip of chitin between the clypeo-labral suture and the mouth cavity has been identified as the labrum and the area in front of it as the clypeus” (see p. 417 in Symmons 1952). “The clypeo-labral suture is a thick, bi-lobed pad of soft, more or less unsclerotized cuticle called the pulvinus by Cope (1940), who thought it was a unique structure in Ischnocera” (see pp. 416–417 in Symmons 1952).

The ventral carina (vc) (see p. 181, Clay 1951) (Fig. 1B see p. 177, Clay 1951) “is continuous with the marginal carina (mc) and the mandibular framework and is the thickening to which the pulvinus (pul) is attached. The form of the ventral carina seems to be closely correlated with that of the pulvinus.”

Symmons (1952) (Fig. 1C; see p. 424) said that “the anterior margin of the head may form an unbroken arc (‘circumfasciate head’) but in most Trichodectidae it is interrupted medially by the pulvinus or the osculum” (see p. 191 in Lyal 1985).

The pulvinus (see p. 191 in Lyal 1985) (Fig. 1D, see p. 190) “is a thick bilobed pad of unsclerotised tissue developed from the clypeolabral suture. The osculum is a median indentation of the anterior margin of the head. When the insect is at rest, the pulvinus and osculum have been observed to be applied to the hair of the host. In cases where the pulvinus fails to reach the anterior margin of the head, a small ventral sulcus (ventral preantennal sulcus of Clay 1951) may connect it to the margin or osculum. Sclerotisation along the margin (‘forming the clypeal marginal carina’) may be minimal or heavy.”

The mandibles (see p. 417 in Qadri 1936) (Fig. 1E) “are inserted at right angles to the head and they are more or less triangular. They are in many cases provided with two apices, those of the right mandibles being slightly more developed. The apices of the mandibles in most of the cases are dorsally striated and produced inward. Toward the base of the cutting surface, the left mandible has a long and posteriorly concave process, the basal process (BP). In the right mandible at the corresponding position is not a very prominent protuberance, the quadrangular process (QP).”

The mandibles of Trichodectidae “are asymmetric (see p. 192 in Lyal 1985) (Fig. 1F). There are three apical teeth on the right mandible and two on the left. On the right, the center tooth is generally longest, while on the left the posterior tooth is normally the better developed. The ‘interior’ face of the right or both mandibles may be ridged, so that when the mandibles are folded closed, the ridges of one mandible are not covered by the other, and all or most of the exposed mandibular area is ridged. In some species the right mandible has a basal notch on the anterior margin, which receives the tip of the left mandible.”

According to Lux et al. (1997), *Damalinia* (*Tricholipeurus*) *zaganseeri* Lux, Mix & Zedev, 1977 has a

<sup>1</sup> Department of Parasitology, Faculty of Pharmacy, University of Granada, 18071 Granada, Spain. (E-mail: mdsoler@ugr.es).

<sup>2</sup> Museo Nacional de Ciencias Naturales, CSIC, C. José Gutiérrez Abascal, 2, 28006 Madrid, Spain.

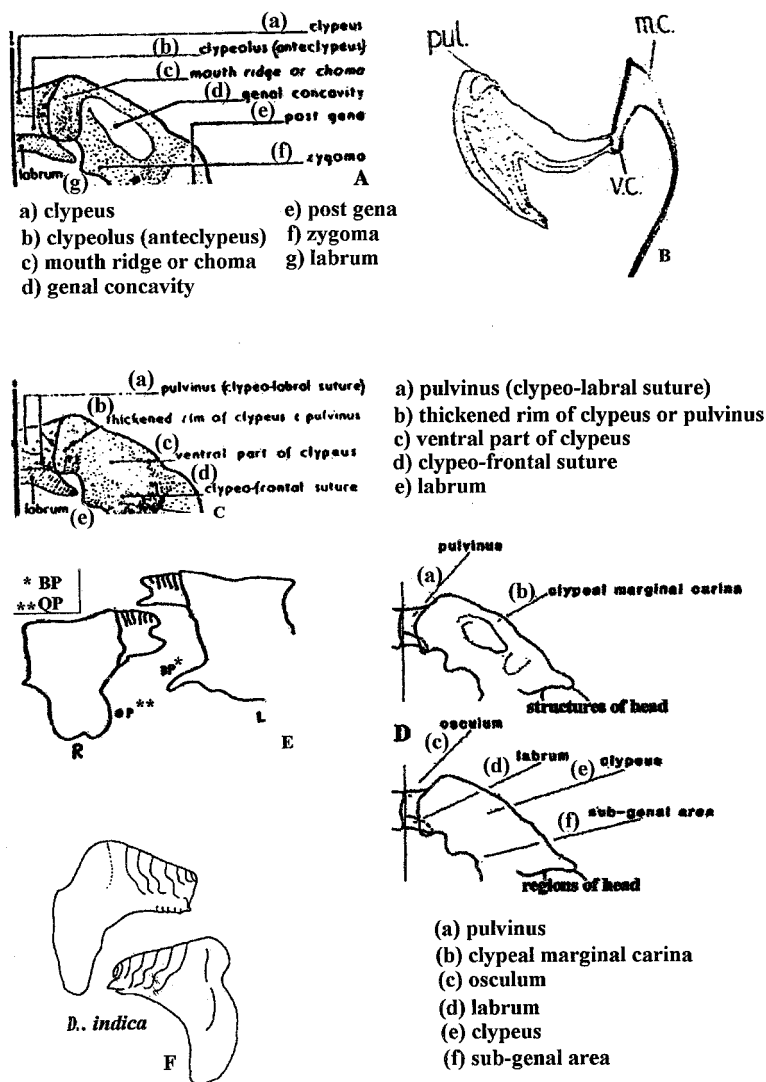


Fig. 1. Structures of the preantennal region. (A) Keler 1938, (B) Clay 1951, (C) Symmons (1952), (D) Lyal (1985). Mandibles. (E) Qadri (1936), (F) Lyal (1985). Original lettering of the authors.

labrum with eight fine setae and antero-medially another two.

In the current study the variability, according to species, and possible function of preantennal structures, marginal carina, pulvinus, and labrum, of nine species of *Damalinia* (Trichodectidae), were studied using light and scanning electron microscopy. Other related structures such as the mandibles and cuticle of the ventral part of clypeus were also observed.

#### Materials and Methods

Heads of five adult specimens, of nine species of *Damalinia*, *D. (Tricholipeurus) liperoides* (Megnin, 1884), *D. (T.) indica* (Werneck, 1936), *D. (Cervicola)*

*redunca* (Bedford, 1929), *D. (C.) martinaglia* (Bedford, 1936), *D. (C.) forficula* (Piaget, 1880), *D. (C.) meyeri meyeri* (Taschenberg, 1882), *D. (C.) meyeri sika* (Dobroruka, 1975), *D. (Damalinia) hilli* (Bedford, 1934), and *D. (D.) crenelata* (Piaget, 1880) were studied. The hosts are cited in Table 1. The material was taken from collections of the Natural History Museum (London) and placed in vials containing 70% ethyl alcohol.

Photographs of the heads were made using light and scanning electron microscopy (Zeiss DSM SEM 950), and routine methodology (Soler Cruz and Martín Mateo 1995, 1996, 1998).

Original micrographs were used to obtain computer images. A scanner was used to improve the quality,

Table 1. Host of the species of *Damalinia* studied (Hopkins and Clay 1952)

Parasite	Host	
	Scientific name	Common name
<i>Damalinia</i> ( <i>Tricholipeurus</i> ) <i>liperoides</i>	( <i>Cervus mexicanus</i> ) = <i>Odocoileus mexicanus</i> (Gmelin)	Deer
<i>D. (T.) indica</i>	<i>Muntiacus muntjak</i> (Zimmermann)	Muntjac
<i>D. (Cervicola)</i> <i>reduncae</i>	<i>Redunca (a.) arundium</i> (Bodxdaert)	
<i>D. (C.) martinaglia</i>	<i>Onotragus leche</i> (Gray)	
<i>D. (C.) forficula</i>	( <i>Cervus porcinus</i> ) = <i>Axis porcinus</i> (Zimmermann)	Deer
<i>D. (C.) meyeri meyeri</i>	<i>Capreolus capreolus</i> (L.)	Roe-deer
<i>D. (C.) meyeri sika</i>	<i>Cervus nippon</i>	Deer
<i>D. (Damalinia)</i> <i>crenelata</i>	( <i>Antilope albifrons</i> ) = <i>Damaliscus pygargus albifrons</i> (Burchell)	Antelope
<i>D. (D.) hilli</i>	<i>Kobus (e.) ellipsiprymnus</i> (Ogilby)	

brightness, and contrast of the original photographs (ScanJet 4c Hewlett-Packard, Avondale, PA). Moreover, if original photographs were clear, partial areas of the images could be magnified by scanner zoom. Fig. 3 includes scanner images where only the brightness and contrast were modified. Figs. 4 and 5 include partial areas of the images obtained by scanner zoom. The scanner was also used to include old drawing information together with text, maintaining the original lettering of the authors.

Results and Discussion

Previous drawings by several authors are shown in Fig. 1 A-D. Table 2 includes the terms used to name the structures of the ventral preantennal region.

Photographs (Figs. 2 and 3 A-I) show the ventral preantennal region of nine species of *Damalinia*. This region may be shallowly or broadly convex, sinuate, or straight (Lyal 1985). The form of the head adopted a pattern (Figs. 2 A-F and 3 A-H), but some species such as *D. (D.) crenelata* were very different (Figs. 2G and 3I).

According to Lyal (1985), this variation is possibly influenced by the density and texture of the hair of the host. In the figures mentioned above, the ventral carina (a), pulvinus (b), labrum (c), mandibles (d), and clypeus (e) can be observed.

**Ventral Carina and Pulvinus.** The ventral carina (vc) (Fig. 1B) (Clay 1951) is continuous with the marginal carina and the mandibular framework, and is the thickening to which the pulvinus is attached. The form of the ventral carina seems to be closely correlated with that of the pulvinus (ventral anterior plate or signature clypeal). The pulvinus is a membranous

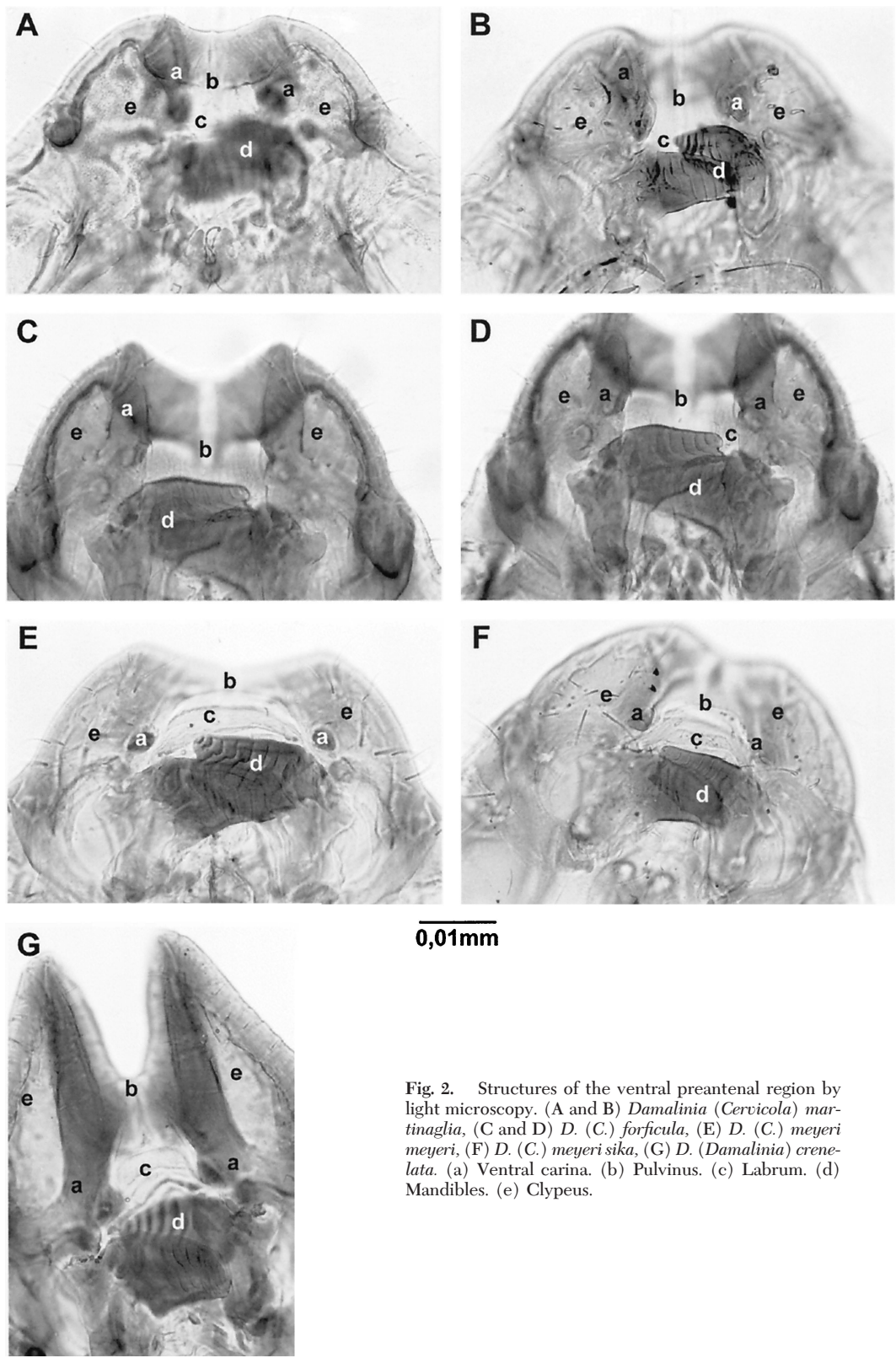
lobe of characteristic structure that seems to have the function of grasping the feather and directing it toward the mandibles for attachment and feeding. The pulvinus is an efficient holding organ. Its surface may be smooth or slightly sculptured, and it can be interrupted medianly with a suture, the ventral preantennal suture (Clay 1951). This region is shown in Fig. 2 A-G (a, b), Fig. 3 A-I (a, b), and Fig. 4 A-I. The different morphology of the ventral carina, according to species, can be observed, and toward its posterior part it is sharp (D, H) or blunt (A). The pulvinus may be more or less sculptured and is medianly divided by a suture (Fig. 2 C and D; Fig. 3 D and E, G, H). This suture and a sculptured pulvinus can also be observed in the photograph of *D. (T.) zaganseeri*.

**The Cuticle of the Clypeus.** The cuticle of the clypeus was scanned from original photographs (Fig. 4 J-R). The shape of the clypeal scales varied according to species. *D. (C.) martinaglia* and *D. (D.) hilli* did not shown clypeal scales (M, Q), the cuticle being smooth, whereas *D. (T.) zaganseeri* did present these scales.

**Mandibles.** Previous drawings based on light microscopy (Fig. 1E-F) show that the apices of mandibles are dorsally striated. (Qadri 1936, Lyal 1985). Lyal (1985) observed that the right mandible of *D. indica* (Fig. 1F) has three apical teeth, the center tooth generally being the longest and the “interior” face may be ridged. Details of the right mandibles of the species studied can be observed in Fig. 3 J-P. According to the pattern, there is a high variability between related species, but photographs confirm Qadri (1936) and Lyal (1985). The ridged “interior” face observed in Figs. 3 L, N, P (b) prevents the mandibles slipping on a hair when clasping it. A secondary cutting surface seems to ap-

Table 2. Terms used by various authors in their drawings of the structures of the ventral preantennal region in *Damalinia*

Keler 1938 (Fig. 1A)	Clay 1951 (Fig. 1B)	Symmons 1952 (Fig. 1C)	Lyal 1985 (Fig. 1D)	Soler and Martin 2000 (Fig. 2A-G)
Clypeus		Palvinus (Clypeo-labral suture)	Pulvinus	Pulvinus (b)
Clypeolus (Anteclypeus)	Pulvinus			
Labrum		Labrum	Labrum	Labrum (c)
Mouth ridge (Choma)	Marginal carina	Rim of clypeus	Clypeal marginal carina	Ventral carina (a)
Genal concavity	Ventral carina	Ventral part of clypeus	Clypeus	Clypeus (e)



**Fig. 2.** Structures of the ventral preantennal region by light microscopy. (A and B) *Damalinia (Cervicola) martinaglia*, (C and D) *D. (C.) forficula*, (E) *D. (C.) meyeri meyeri*, (F) *D. (C.) meyeri sika*, (G) *D. (Damalinia) crenulata*. (a) Ventral carina. (b) Pulvinus. (c) Labrum. (d) Mandibles. (e) Clypeus.



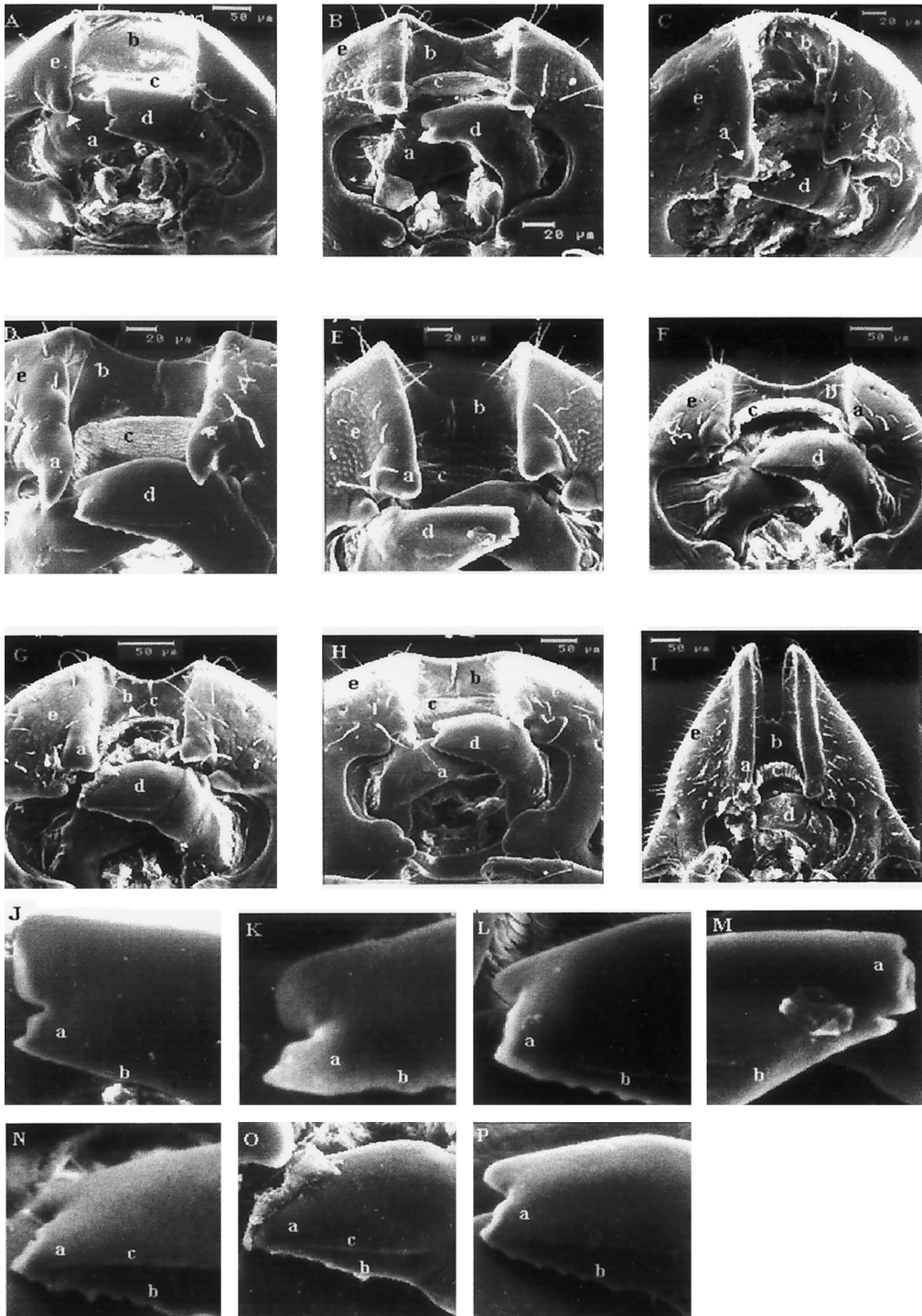
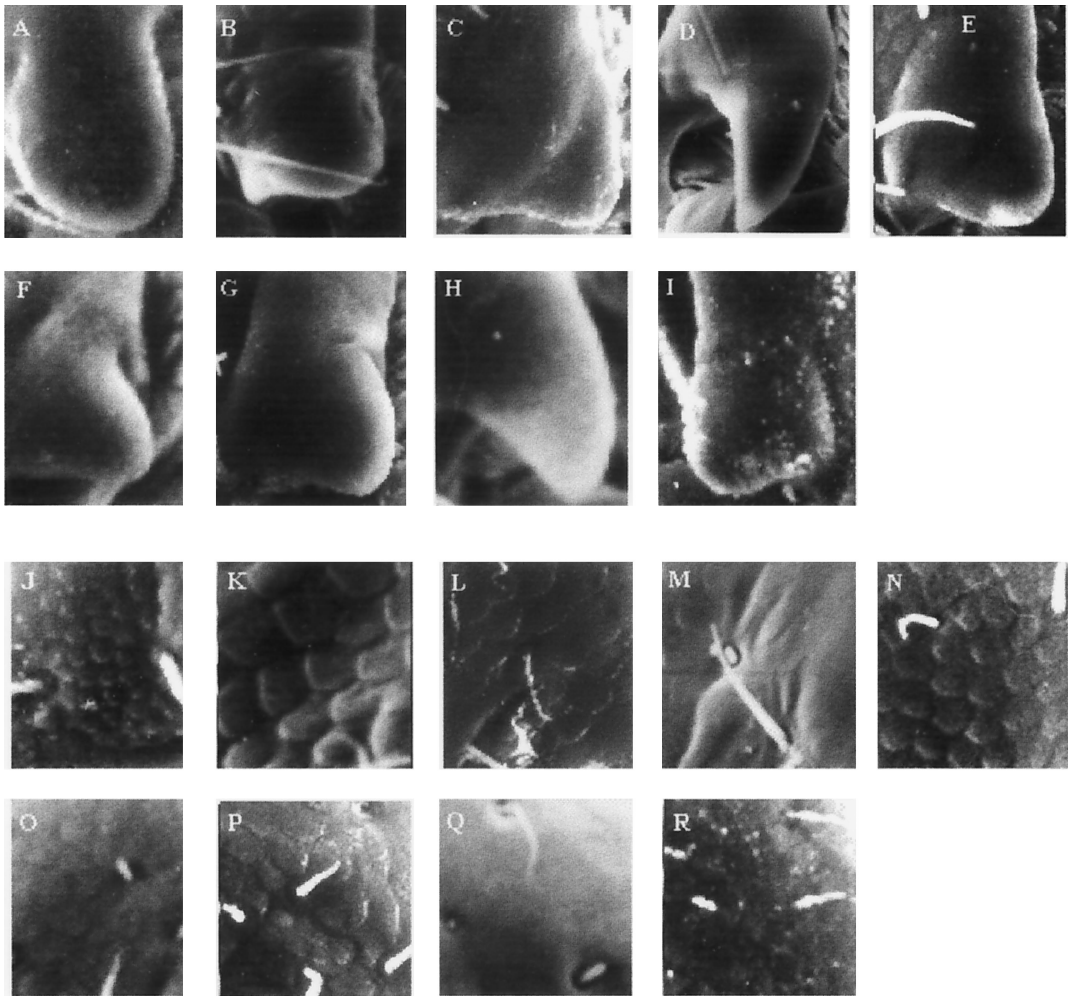


Fig. 3. Structures of the ventral preantennal region. (A) *Damalinia (Tricholipeurus) liperoides*, (B) *D. (T.) indica*, (C) *D. (Cervicola) reduncae*, (D) *D. (C.) martinaglia*, (E) *D. (C.) forficula*, (F) *D. (C.) meyeri meyeri*, (G) *D. (C.) meyeri sika*, (H) *D. (Damalinia) hilli*, (I) *D. (D.) crenelata*. (a) Ventral carina. (b) Pulvinus. (c) Labrum. (d) Mandibles. (e) Ventral part of clypeus. Figures obtained from original by scanner to improve brightness and contrast. Mandibles. (J) *Damalinia (Tricholipeurus) liperoides*, (K) *D. (T.) indica*, (L) *D. (Cervicola) martinaglia*, (M) *D. (C.) forficula*, (N) *D. (C.) meyeri meyeri*, (O) *D. (C.) meyeri sika*, (P) *D. (Damalinia) hilli*. Images obtained from original by scanner zoom.



**Fig. 4.** Detail of ventral carina. (A) *Damalinia (Tricholipeurus) liperoides*, (B) *D. (T.) indica*, (C) *D. (Cervicola) reduncae*, (D) *D. (C.) martinaglia*, (E) *D. (C.) forficula*, (F) *D. (C.) meyeri meyeri*, (G) *D. (C.) meyeri sika*, (H) *D. (Damalinia) hilli*, (I) *D. (D.) crenelata*. Detail of the cuticle of the ventral part of clypeus. (J) *Damalinia (Tricholipeurus) liperoides*, (K) *D. (T.) indica*, (L) *D. (Cervicola) reduncae*, (M) *D. (C.) martinaglia*, (N) *D. (C.) forficula*, (O) *D. (C.) meyeri meyeri*, (P) *D. (C.) meyeri sika*, (Q) *D. (Damalinia) hilli*, *D. (D.) crenelata*. Images obtained from original by scanner zoom.

pear (Fig. 3 N and O [c]). Only the striated apices of the mandibles, cited above, were not observed. There did not appear to be any striated apices in the photograph of *D. (T.) zagaseeri*. The mandibles are used for anchoring the insect to the host (Lyal 1985). According to this author, some mandibles are blunt and broad, as in Fig. 3M (a), suggesting an adaptation to grinding and chewing, and others are slender and pointed, suggesting a piercing function and possible hematophagy (Fig. 3N [a]).

**Labrum.** The labrum (c) is a curved strip of chitin situated below the pulvinus (b) (Figs. 2 and 3). A chitinous bar or thickening of the clypeal edge on either side of the pulvinus serves to support the lateral lobes of this pad (Symmons 1952). The labrum of these species is shown in Fig. 5. Several rows of scales form the surface of the labrum. Photographs scanned of five

species of *Damalinia* showed that the form of labrum, arrangement of the rows of scales, and scales (shape and presence [F] or absence [Q] of spines on the edge) differed according to species.

#### Acknowledgments

We are grateful to C.H.C. Lyal of the Natural History Museum (London) for his assistance during a visit by M.D.S.C. We thank the Junta de Andalucía who awarded a grant for the visit. We also express gratitude to the Electron Microscopy Unit (Granada) and the Photography Unit of the Museo Nacional de Ciencias Naturales (Madrid). This work has been supported by a grant from the Dirección General de Investigación Científica y Técnica (DGICT, Proyecto no. PB98-1307).

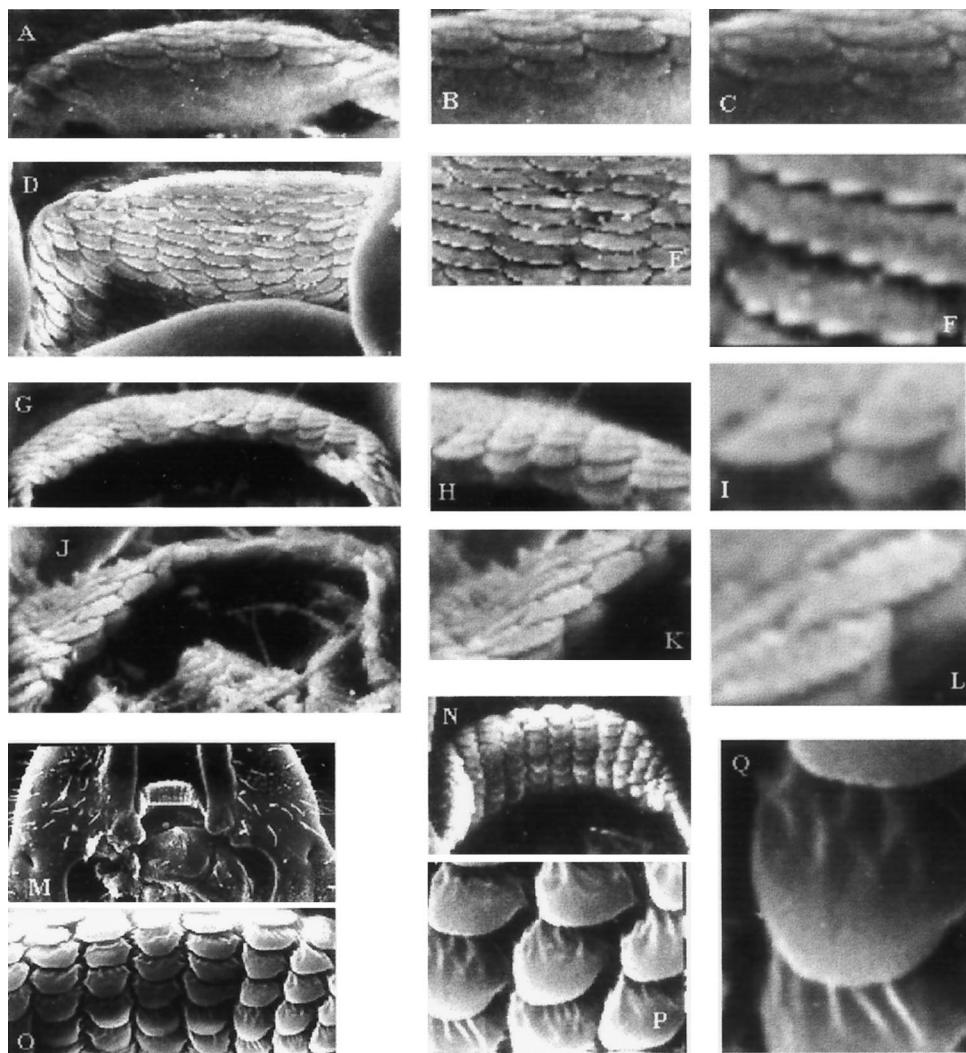


Fig. 5. Detail of labrum. (A-B) *Damalinia (Tricholipeurus) indica*, (D-F) *D. (Cervicola) martinaglia*, (G-I) *D. (C.) meyeri*, (J-L) *D. (C.) meyeri sika*, (M-Q) *D. (Damalinia) crenelata*. Images obtained from original by scanner zoom.

### References Cited

- Clay, T. 1951. An introduction to the classification of the avian Ischnocera (Mallophaga): part I. Trans. R. Entomol. Soc. Lond. 102: 171-194.
- Cope, O.B. 1940. The morphology of *Esthiopterum diomedae* (F Mallophaga) Microentomology. 5: 117-142.
- Hopkins, G.H.E., and T. Clay. 1952. A check-list of the genera and species of Mallophaga. Br. Mus. (Nat. Hist.) 1-361.
- Lyal, C.H.C. 1985. A cladistic analysis and classification of trichodectid mammal lice (Phthiraptera: Ischnocera). Bull. Br. Mus. (Nat. Hist.) 51: 1-346.
- Lux, E., H. M. Mix, and B. Zeden. 1997. *Damalinia (Tricholipeurus) zaganseeri*, n. sp. (Phthiraptera: Trichodectidae), a parasite from *Procavia gutturosa* (Artiodactyla: Bovidae) in Mongolia. J. Med. Entomol. 34: 599-604.
- Qadri, M.A.H. 1936. Studies on the mouth-parts of Mallophaga infesting north-indian birds. Proc. Ind. Acad. Sci. 3: 411-423.
- Snodgrass, R.E. 1899. The Anatomy of the Mallophaga. Occas. Pap. Calif. Acad. Sci. 6: 145-224 (cited in Qadri, 1936).
- Soler Cruz, M. D. 1995. Antennal sense organ of Phthiraptera (Insecta). Scanning electron microscopy of several species of Anoplura. Micron 26: 7-14.
- Soler Cruz, M. D., and M. P. Martín Mateo. 1996. Antennal sense organ of Phthiraptera (Insecta). Scanning electron microscopy of the "Pit Organs" of several species of *Bovicola*. Micron 27: 11-15.
- Soler Cruz, M. D., and M. P. Martín Mateo. 1998. Sensory Equipment of the Antennal Flagellum of Several Species of *Damalinia* (Phthiraptera: Trichodectidae). Micron 29: 431-438.
- Symmons, S. 1952. Comparative anatomy of the mallophagan head. Trans. Zool. Soc. Lond. 27: 349-436.

Received for publication 22 June 2000; accepted 15 March 2001.