



Description of life history stages of chicken louse, *Menacanthus cornutus* (Phthiraptera: Amblycera) infesting domestic fowl

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ABSTRACT: Amblyceran as well as ischnoceran lice species exhibited hair like structure known as setae. Setae are species specific and vary in number, length and arrangement on particular body regions from one lice species to other. The present study was undertaken to describe the correct position and arrangement of setae on taxonomically important body parts of life history stages of amblyceran louse, *Menacanthus cornutus* infesting domestic fowl. All stages of *M. cornutus* vary to each other in body shape, dimensions, colour and sclerotisation of different body parts. The first instar nymph has less number of tergal and sternal setae as compared to the second instar nymph. The gular plate of first instar nymph wanting of setae but second instar nymph has four setae. The anterior tergal setae in second instar nymph found absent but 2-3 anterior sternal setae are recorded on IV-VII segment whilst in third instar nymph sparsely beset anterior tergal and sternal setae was recorded. The gular plate of second instar nymph has 4 setae but gular plate of third instar nymph bear 6 setae. The gular plate in adult has 8 setae but the gular plate of third nymph instar showed 6 setae. The numbers of setae in sternal ctenidial patches remained less in third instar nymph in comparison to adults. The sexual dimorphism limited to male with smaller dimensions, less number of abdominal chaetotaxy and differences associated with genital features of posterior abdomen. The sexual dimorphism has shown by female as more elliptical and long abdomen, densely beset abdominal chaetotaxy and anal fringe with dorsal and ventral setae. A row of setae on subgenital plate of female was also present.

Key words: Chaetotaxy, chewing lice, *Menacanthus cornutus*, *Gallus gallus domesticus*

INTRODUCTION

The external body dimensions and characteristic morphological features are generally used in systematic studies of amblyceran as well as ischnoceran phthirapteran ectoparasites rather than the host species it parasitized.

The lice species of related taxa looked alike and their identification is a challenging task. The three-instar nymphs of any lice species appear to be quite similar (except size) and it is very hectic to differentiate each other.

The workers like Martin (1934), Wilson (1939), Conci (1956) and Agarwal (1967) have occasionally described the nymph morphology, while studying the biology of certain lice species. The publication of Kessel (1942), Eichler (1948, 1963), Keler (1952) and Conci (1952) are quite valuable regarding morphological features of selected phthirapteran species. Mey (1994) has made comprehensive attempt to deduce the phylogeny of ischnoceran bird biting lice (86 species of 51 genera) by comparing the adult and nymph morphological features. Price & Hellenthal (1996), Saxena *et al.* (1998), Smith (2000), Beg *et al.* (2004) and Rajput (2009) have also discussed the significance of nymph morphology. Crystal (1949) and Piotrowski and Kadulski (1970) have described the morphology of nymph instars of two mammalian lice species, *Tricodectes canis* and *Cervicola eyeri*.

The eminent workers have done exhaustive work to record the morphological features of avian as well as mammalian lice and provided key for the identification of species and cleared doubts about the specific characters of members of certain taxa. They have also given neotype of some species (e.g. Price and Werneck 1948; Clay 1970; Lakshminarayana and Price 1980; Lyal 1985).

Recently, some workers reported new species of genus *Myrsidea* and *Picicola* from avian hosts and have also described their morphological features and provided identification key. For instance, Price and Weckstein (2005) have described five new species from jacamars and puffbirds, Meyer *et al.* (2008) one new species from rufous-sided broadbill of genus *Picicola*, Dalgleish and Price (2005) reported two new species from contingas, Price and Johnson (2006) four new species from Malagasy warblers, Sychra *et al.* (2007) two new species from buntings, cardinals and tanagers, Price and Dalgleish (2007) thirteen new species from emberizidae and Price *et al.* (2008) five new species from antshrikes and antbirds of genus *Myrsidea*. Few workers like Zlotorzycska (1990), Zlotorzycska and Modrejewska (1992) and Zlotorzycska *et al.* (1995) have recorded the surface ultra structure of selected phthirapteran species with the help of SEM.

Herein the present work, attempt has been made to describe the morphological features of three instar nymphs, adult male and female *Menacanthus cornutus* (Schömmmer 1913) (Insecta, Phthiraptera, Amblycera) parasitizing domestic fowl, *Gallus gallus domesticus*.

MATERIALS AND METHODS

The feathers loaded with fresh eggs of *Menacanthus cornutus* (Schömmmer 1913) have been gently cut from oviposition sites of louse over the body of domestic fowl to avoid the injury caused by plucking the feathers. The fresh egg looks glistening white due to the reflection of light and having turgid surface. Thereafter, the collected feathers were carefully trimmed and placed in petridish lined with filter papers. In addition to feather diet, lice were also offered blood diet by soaking the cotton wool in anticoagulant added chicken blood. The mouth of petridish covered with muslin cloth and tied with rubber band, the culture dishes then placed in desiccators maintained at $35\pm 1^{\circ}\text{C}$ and 75% R.H. The first instar nymphs were hatched on the 4-6 day of incubation. The second and third instar nymphs were obtained by rearing the fresh looking healthier first and second instar nymphs respectively under similar aforesaid conditions. The three categories of nymphs have been separately preserved in 70% alcohol.

The miniature lice (nymphs) treated with 10% KOH for 12 hours and then washed thrice with water. The specimens were then passed through 10% acetic acid (30 minutes). Few of them were stained (aqueous fuchsin/eosine), dehydrated in different grades of alcohol (ascending series), cleared in xylene and mounted in DPX.

Furthermore, the glycerol mounts of all life stages (nymphs as well as adult male and female) of *M. cornutus* have been prepared. First of all specimens were kept in mixture of glycerol and alcohol for 5-6 days in cavity blocks at $35\pm 1^{\circ}\text{C}$ in incubator. Thereafter, the specimens were mounted on glass slides in pure glycerol solution. The slides were double sealed with nail polish. The glycerol mount further helped in recording the correct position of setae over the body of different stages.

The mounted specimens were studied under the light microscope to record the morphology and chaetotaxy. The drawing of each stage has also been made to illustrate the right position of setae of *M. cornutus* with the help of picture tube attached with trinocular research microscope (Nikon Made).

OBSERVATION

Male of *M. cornutus* (Fig.1):

The male is smaller (1.59 mm) than female and the body appears narrower (0.49 mm) however, slightly broader than the width of temples portion (0.40 mm). The colour is straw yellowish seldom

louse gives darkish appearance. The head is rounded having shallow lateral head notch and temples are rounded in shape. The occipital region laterally angulated and central portion is convex towards prothorax. The prothorax is acutely angulated from lateral angles and posterior region is convex with long marginal setae. The mesothorax is small and fused with metathorax. Metathorax is quite clear with angulated lateral angles and narrower anterior end. The tergal segments are undivided and abdomen is broadest at Vth segment. The antennae are four segmented and remained concealed in the antennal sinus and do not exhibited sexual dimorphism. The male

genitalia feebly sclerotised and extended from terminal segment up to succeeding three abdominal segments. Prosternal, mesosternal, metasternal and gular plates are well-developed and bearing marginal setae. The ctenidial (group of small setae) patches are pronounced on the lateral end of sternal plates from segments III-VIIth. The abdominal sternal anterior setae are present between the ctenidial patches and row of marginal setae remained undisturbed and passing below the ctenidial patch. The legs are stout and having mixed type setae (e.g. long, medium, small and minute). The spiracles are present on the lateral ends of tergal plates on III-VIIIth segments.

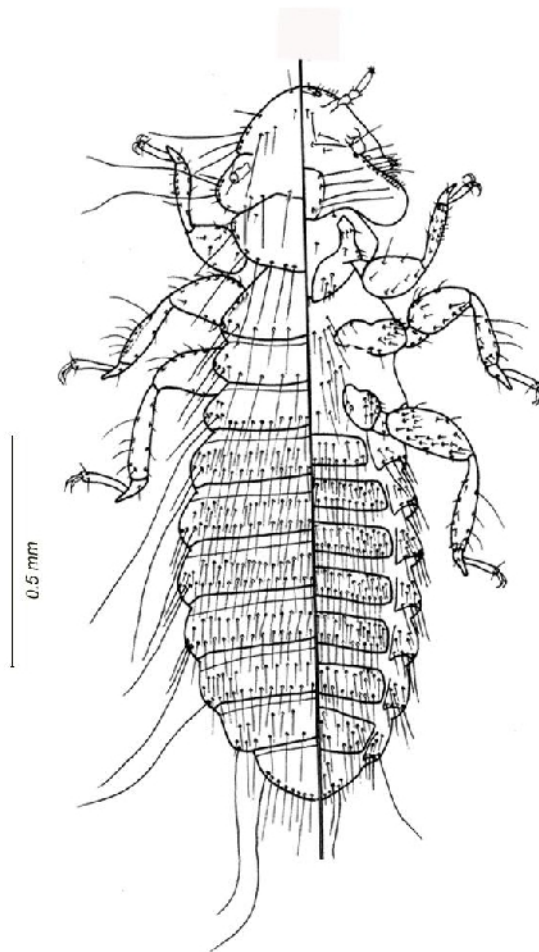


Fig. 1. Diagrammatic representation of chaetotaxy of male *Menacanthus cornutus*.

Chaetotaxy- Head (Fig.1): Marginal carina, 1; anterior and mid-dorsal head setae, 4 (minute); lateral anterior head setae, 4 (1 long and 3 short); subocular (comb), 16; postocular, 3 (1 long and 2 short); anterior subocular, 2. Marginal temporal, 7

(2 very long, 1 long, 2 short and 2 small); occipital, 4 on each half. Labrum, 4; ventral carina, 3; sub marginal, 2 (1 minute and 1 short); hypopharyngeal setae, 6; gular plate, 8 (anterior smaller than the posterior setae).

Thorax (Fig.1): Marginal prothorax setae: 10; prothorax central minute setae, 2; the lateral angel bears 3 setae (1 short and 2 small); marginal metathorax, 4 on each half; lateral angels of metathorax bears 7 setae (2 long, 1 anterior minute and 4 minute along with the lateral sides); prosternal plate, 4 minute; mesosternal plate, 10; metasternal, 10.

Abdomen (Fig.1): Marginal tergal setae: I, 12; II, 14; III, 20; IV, 21-22; V-VI, 24-25, VII, 18-19, VIII, 10. Anterior tergal setae: II, 9; III-V, 23; VI, 21; VII, 19; VIII, 12. Postspiracular setae: 1 (I-II, short; III, long; IV-VIII, very long). Dorsal portion of pleurites: I-II, 5 (2 long marginal and 3 anterior minute); III-V, 4 (2 long and 2 minute); VI, 3 (2 short marginal and 1 minute); VII, 2 marginal; VIII, 1 marginal small. Terminal segment: 3 marginal setae (1 very long and 2 small); subterminal, 2 on each half. Marginal sternal setae: I, 2; II, 12; III, 22; ctenidial setae, 11; IV, 24; ctenidial, 19; V, 23; ctenidial, 26; VI, 19; ctenidial, 17; VII, 17; ctenidial, 11; VIII, 9; ctenidial, 8. Terminal segment, 4 marginal (two long and two small); sub terminal, 2 (short) on each half. Ventral Pleurite setae: II, 6 (4 marginal and 2 anterior); III, VI-VII, 8 (4 marginal and 4 anterior); IV, 10 (4 marginal and 6 anterior); V, 9 (4 marginal and 5 anterior); VIII, 7 (1 long, 3 short marginal and 3 anterior).

Dimensions in mm (Fig. 1): Head length, 0.29; Head Width, 0.40; Prothorax Length, 0.17; Prothorax Width, 0.32; Metathorax Length, 0.14; Metathorax Width, 0.38; Abdominal Length, 0.84; Abdominal Width, 0.49; Genitalia length, 0.35; Genitalia width, 0.09; Total Length, 1.59.

Female *M. cornutus* (Fig. 2):

The female is larger in size (1.77 mm) than to male and having flat and broader abdomen. The colour of female is somewhat more darkish than male. The rest of characters like temporal margins, occipital region, metathorax and antennae are similar to those of male. The abdominal sternal plate and pleurites are more pronounced comparatively to male. The body is broadest at abdominal segment IVth (0.77 mm). The terminal segment of female bears anal fringe (comb) consisting of large number of ventral and dorsal setae. The abdominal sternal plates exhibited ctenidial patches (group of setae) more distinct on III-VIIth segments. However, the size of setae in ctenidial patches remains similar to the anterior sternal setae. Postspiracle setae of abdominal on IInd tergal plate is very long. The female are quite visible on host body due to its large size and darkish colour. The number of

tergal and sternal setae are densely beset in female than do exhibited by male.

Chaetotaxy- Head (Fig. 2): Marginal carina, 1; mid-dorsal head setae, 1; latero anterior head setae, 3 (1 long and 2 short); postocular, 3 (1 long, 1 short and 1 small); anterior subocular, 2 long. Marginal temporal, 7 (3 long, 1 short and 3 small); occipital, 4 on each half. Labrum: 3; ventral carina, 1; submarginal, 1; hypopharyngeal plate, 6; gular plate, 8 (posterior longer than the anterior setae).

Thorax (Fig. 2): Marginal prothorax, 5 on each half; antero lateral angel prothorax setae, 3 (1 long, 1 spine like at the angle region and 1 minute along the lateral side of prothorax); marginal metathorax, 4 on each half; antero lateral angel metathorax setae, 7 (1 long, 1 spine like at angle, 1 minute and 4 minute along the side). Prosternal plate, 4; mesosternal plate, 10; metasternal plate, 10.

Abdomen (Fig. 2): Marginal tergal setae, I, 8-9; II, 18; III, 21; IV, 24; V, 26; VI, 23; VII, 20; VIII, 7. Anterior tergal setae: III, 22; IV, 25; V, 34; VI, 26; VII, 24-25; VIII, 10. Postspiracular: 1 (II segment bears very long; I, IV, VI, of medium length and III, VII-VIII have long setae). Terminal segment setae: 1 long and 7 marginal of mixed length type on each half. Dorsal pleural setae: I, 4 (1 marginal short and 3 anterior minute); II-III, 5 (1 marginal and 4 minute anterior); IV, 4 (2 marginal and 2 anterior minute); V, 5 (2 marginal and 3 anterior minute); VI, 5 (3 marginal and 2 anterior); VII-VIII, 2 (1 marginal and 1 anterior).

Sternal setae: marginal sternal setae, I, 4; II, 17; ctenidial, 4; III, 24; ctenidial, 23; IV, 28; ctenidial, 35; V, 27; ctenidial, 32; VI, 30; ctenidial, 20; VII, 19; ctenidial, 19; VIII, 10; ctenidial, 10. Anterior sternal setae: II, 9; III, 14, IV, 15; V, 14; VI, 13; VII, 14; VIII, 6. Ventral pleurites: II, IV, VII, 8 (4 marginal and 4 anterior); III, V, VI 9 (4 marginal and 5 anterior setae); VIII, 7 (4 marginal and 3 anterior). Terminal segment: The remainders of the sub genital plate bear 16-19 marginal setae; the anal fringe also present with 45-50 ventral setae and 50-55 dorsal fringe setae. The lateral side of terminal segment bears 1, long setae on each side.

Dimensions in mm (Fig. 2): Head length, 0.31; Head Width, 0.48; Prothorax Length, 0.19; Prothorax Width, 0.37; Metathorax Length, 0.17; Metathorax Width, 0.49; Abdominal Length, 0.98; Abdominal Width, 0.77; Total Length, 1.77.

First instar nymph (Fig. 3):

The first instar nymph has large head as compared to rest proportion of the body. The colour of the body is creamy white. The shape of

head has appeared to be triangular and having more width than to its length. The head notch is present but not very distinct. The temples are less rounded. The occipital and anterior carina is not well developed.

The maxillary palps and antennae are quite visible with three segments and fourth remained in developing stage. Out of four segments of antennae first is not fully developed, second is somewhat squares in shape.

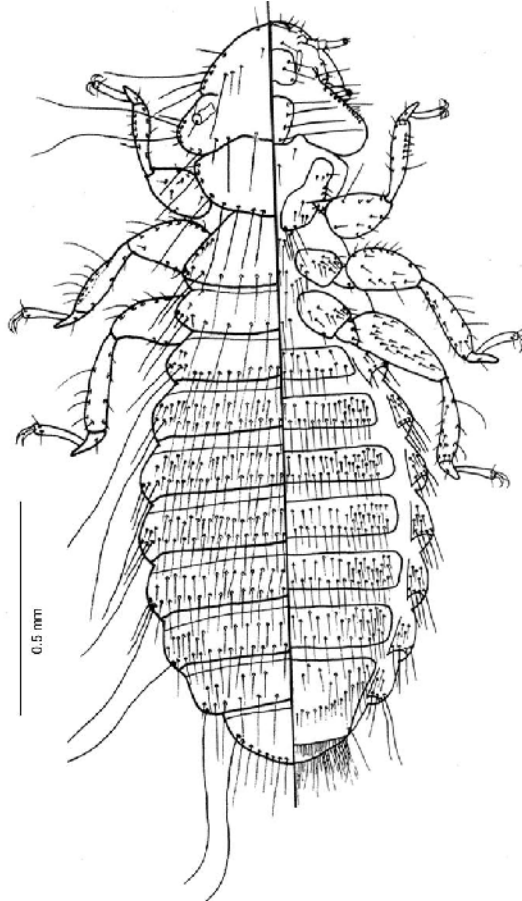


Fig. 2. Diagrammatic representation of chaetotaxy of female *Menacanthus cornutus*.

The proximal portion of third narrower and distal end flattened to accommodate the last segment which is cylindrical and bearing some sensory hairs at the distal end. Both the maxillary palp and antennae are projected out from the margins of head. The prothorax laterally rounded and convex posterior end overlapping the mesothorax. Metathorax plate is not well sclerotised and having narrower anterior and broader posterior end. The metathorax lateral angles are not acutely angulated. The gular plate appear but feebly sclerotised and devoid of any setae. The chitinous frame work for supporting the mandible is also visible. Oesophageal sclerites are lightly sclerotised. The tergal plates are very light and can not be demarked separately. The ctenidial patches on the abdominal sternal plates are absent. The legs are strong and bear two claws on

each leg. The spiracles are very small and present on III-VIIIth segments.

Chaetotaxy (Fig. 3): Head marginal carina, 3; latero anterior head setae, 2 (1 long and 1 minute); anterior subocular, 2 (short); postocular, 1 (long); subocular, 5 (comb); marginal temporal, 5 (2 long and 3 short); marginal occipital, 3 (2 long and 1 small) on each half. Labrum: 3; ventral marginal carina, 1; submarginal, 2 (1 long and 1 minute).

Thorax (Fig. 3): Marginal prothorax, 4 on each half; lateral angel prothorax, 2 (1 short and 1 minute); marginal metathorax, 4 on each half; lateral angel metathorax, 3 (1 long and 2 minute); central metathorax, 2; prosternal plate, 2 minute; metasternal plate, 2.

Abdomen (Fig. 3): Marginal tergal setae, I-VII, 8; VIII, 6; post spiracular, 1 (I-III short, IV-VIII very

long); dorsal pleurites, I-III, 3 marginal and 1 anterior minute; IV-VIII, 2 marginal and 1 minute anterior; terminal segment, 1 very long with 3 short marginal; sub marginal, 2 on each half. Marginal sternal setae: I, 2; II-VI, 6; VII-VIII, 4. Terminal

segment, 5 (2 long and 3 minute); anterior submarginal, 2 (long) on each half. Ventral pleurites: II-IV, 1; V-VIII, 3.

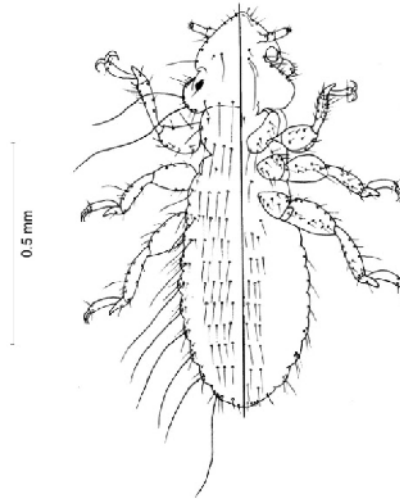


Fig. 3. Diagrammatic representation of chaetotaxy of first instar nymph of *Menacanthus cornutus* male.

Dimensions in mm (Fig. 3): Head length, 0.23; Head Width, 0.31; Prothorax Length, 0.11; Prothorax Width, 0.23; Metathorax Length, 0.09; Metathorax Width, 0.26; Abdominal Length, 0.47; Abdominal Width, 0.34; Total Length, 0.97.

Second instar nymph (Fig. 4):

The second instar nymph has elongated body with oval shaped abdomen. The colour of second instar nymph is yellow. The anterior margin of head became rounded as compared to first instar nymph. The head lateral slit or notch became more distinct. The temples rounded and are broadest portion of head. The occipital are angulated laterally and convex centrally. The maxillary palps and antennae are four segmented and still remained projected from the margins of head region. The oesophageal sclerites and gular plate are lightly pigmented. The chitinous frame work supporting the mandibles has developed and gives quite visibility. The abdomen is broadest at fourth segment (0.54 mm). The lateral angels of prothorax and metathorax are more angulated comparatively to first instar nymph. The tergal plates are still feebly sclerotised and very lightly delimited. The prosternal, mesosternal and metasternal plates are developed and bear setae at margins. The abdominal sternal plates are feebly sclerotised and provided very fade demarcation between them. The ctenidial patches are also absent.

Chaetotaxy (Fig. 4): Head marginal carina, 3; mid-dorsal head setae, 1; latero anterior head setae, 2 (1 long and 1 short); subocular, 7 (comb); postocular, 2 (1 long and 1 medium); anterior subocular, 2; marginal temporal, 5 (3 long and 2 small) on each half; marginal occipital, 3 on each half (outer are small and inner setae long); labrum, 3; ventral marginal carina, 1; hypopharyngeal plate, 4 (short); gular plate, 4.

Thorax (Fig. 4): Marginal prothorax, 5 on each half; central minute, 1; lateral angel prothorax, 2 (1 short and 1 spine like on the angel); marginal metathorax, 4 on each half; lateral angel, 3 (2 short and 1 small); prosternal plate, 4-5; mesosternal plate, 4-5; metasternal plate, 6.

Abdomen (Fig. 4): Marginal tergal, I, 8; II-VII, 10; VIII, 6; post spiracular, 1 (I short; II-IV medium length; V-VIII very long); dorsal pleurites, I-III, V, VII, 3 (2 marginal and 1 anterior minute); IV, VI, 5 (4 marginal and 1 anterior minute); terminal segment, 1 very long with 2 short marginal and 2 short subterminal on each half. Marginal sternal setae: I, 2; II, 6; III-IV and VI, 10-11; V, 11-12; VII, 8; VIII, 6. Anterior sternal setae, IV-VII, 2. Ventral pleurites: II-IV and VI-VIII, 2; V-VI, 3. Terminal segment, 6 marginal (1 long, 2 short, 3 small); subterminal, 2 short.

Dimensions in mm (Fig. 4): Head length, 0.30; Head Width, 0.40; Prothorax Length, 0.16; Prothorax Width, 0.32; Metathorax Length, 0.10;

Metathorax Width, 0.35; Abdominal Length, 0.73, Abdominal Width, 0.54; Total Length, 1.32.

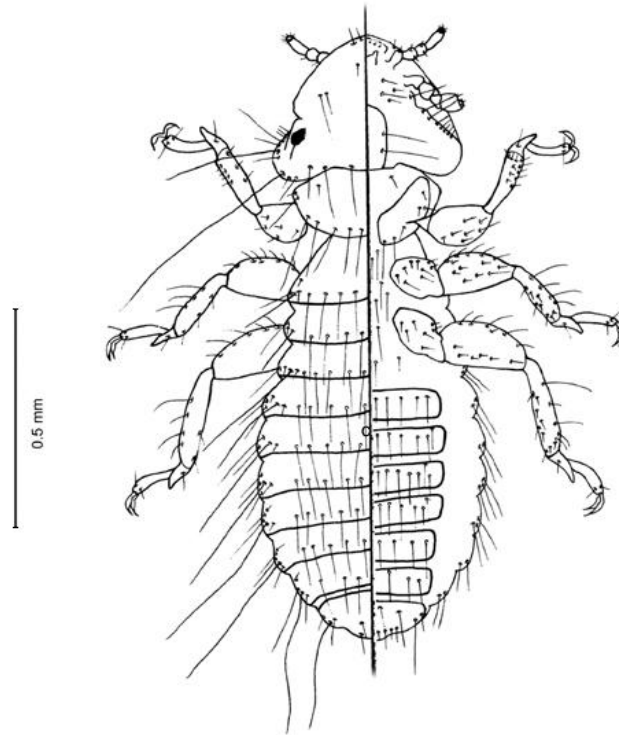


Fig. 4. Diagrammatic representation of chaetotaxy of second instar nymph of *Menacanthus cornutus*.

Third instar nymph (Fig. 5):

The third instar nymph gives the appearance almost of adult lice except bit light sclerotisation of body parts. The colour of nymph remained yellowish. The head is rounded anteriorly and become wider at ocular region. Temples are broader and more rounded comparatively to the second instar nymph. Prothorax and metathorax are acutely angulated at the lateral angles. The fourth abdominal segment gives the broadest abdominal width (0.66 mm). However, the body appears straight at III-Vth segments. The anterior tergal and sternal setae appeared in the present stage but are sparsely occurred. The ctenidial patches on the sternal plates have given their manifestation but the numbers of setae are less as compared to adult. The tergal and sternal plates are still feebly pigmented. The maxillary palps and antennae are fully developed and become larger than to the second instar nymph.

Chaetotaxy (Fig. 5): Marginal carina, 2; mid-dorsal head setae, 2; latero anterior head setae, 4 (1 long, 2 short and 1 minute); subocular comb, 10; postocular, 4 (1 very long, 1 short and 2 minute); anterior subocular, 2; marginal temporal, 7 (2 very long, 1 medium length, 1 short and 3

small); ventral marginal carina, 1, labrum, 3; anterior submarginal, 4 (2 short and 2 small); gular plate, 6 (posterior are longer than anterior setae); marginal occipital, 4 (inner longer than outer setae) on each half.

Thorax (Fig. 5): Marginal prothorax, 5 on each half; lateral angel prothorax, 3 (1 long, 1 spine like at lateral angel and 1 minute); central minute prothorax, 2; marginal metathorax, 4 on each half; lateral angel metathorax, 4 (1 long, 1 short and 2 minute); prosternal plate, 2; mesosternal plate, 8; metathorax plate, 8.

Abdomen (Fig. 5): Marginal tergal setae, I, 10-11; II-III and VI, 14-15; IV-V, 16; VII, 13; VIII, 8. Anterior tergal: II, 2; III, 6; IV, 12; V-VI, 10; VII, 8; VIII, 2. postspiracular: 1 (I-III, medium length and VI-VIII, very long), segment IV has longer setae than V segment. Dorsal pleurites: I, 3 (1 marginal and 2 anterior minute); II, 4 (2 marginal and 2 anterior minute); III, 5 (2 marginal and 3 anterior); IV-V and VII, 6 (3 marginal and 3 anterior); VI, 4 (2 marginal and 2 anterior); VIII, 5 (3 marginal and 2 anterior). Terminal segment: marginal, 7 (1 long and 6 small), subterminal, 3 on each half.

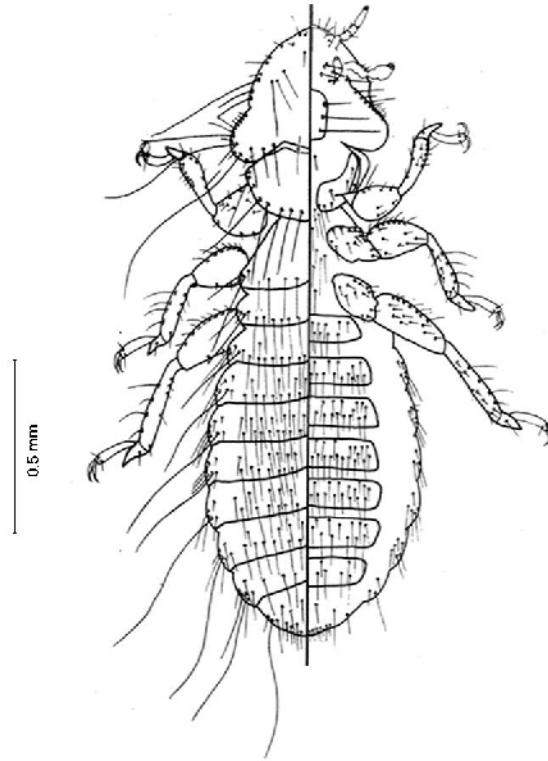


Fig. 5. Diagrammatic representation of chaetotaxy of third instar nymph of *Menacanthus cornutus*.

Marginal sternal setae: I, 2; II, 8; ctenidial, 4; III, 17; ctenidial, 6; IV, 17; ctenidial, 9; V, 16; ctenidial, 10; VI, 14; ctenidial, 11; VII, 11; ctenidial, 6; VIII, 8; ctenidial, 2. On the segments II-VIII ctenidial patches are present at the lateral ends of sternal plates therefore anterior setae are present between the patches. Sternal anterior: II, 5; III, 7; IV, 7; V, 6; VI, 5; VII, 5; VIII, 2. Ventral pleurites: I-III, 5 (3 marginal and 2 anterior minute); IV, 6 (3 marginal and 3 anterior); V, 4 (3 marginal and 1 anterior); VI, 6 (4 marginal and 2 anterior); VII, 6 (2 marginal and 4 anterior); VIII, 3 (1 marginal and 2 anterior). Terminal segment: terminal/marginal, 1 long; subterminal, 2 (1 long and 1 short) on each half; the anal fringe also visible with having only 20 setae.

Dimensions in mm (Fig. 5): Head length, 0.31; Head Width, 0.45; Prothorax Length, 0.17; Prothorax Width, 0.36; Metathorax Length, 0.14; Metathorax Width, 0.39; Abdominal Length, 0.81, Abdominal Width, 0.66; Total Length, 1.53.

DISCUSSION

In the present study it has been recorded that nymph instars of each molting stage of *M. cornutus* vary to each other in respect of body

dimensions, colour and number and arrangement of setae over body. However, the pronounced differences are lies in the body size, length and in the dimensions of body parts. The similar differences in external morphology of phthirapteran nymph stages have been reported by Martin (1934), Kessel (1942), Eichler (1948, 1963), v Keler (1952), Clay (1958), Conci (1952, 1956), Modrzejewska and Zlotorzycza (1987) and Mey (1994).

Some closely related lice species like *Hoplopleura intermedia* complex, *H. captiosa*, *H. intermedia*, *H. thurmonae* and *H. johnsonae* have exhibited quite similarity in their morphological structure and yet the nymphs are distinctly different from each other (Kim 1966; Johnson 1972). The occurrences of spiracular opening have also varied in some species and seldom showed sexual dimorphism. For instance, *Felicola subrostratus* normally has three pairs of abdominal spiracles; the respective species is widely spread and parasitized many host but in Madagascar the species occurred on *Eupleres goudoti* host and has three or two pairs of spiracles and specimens had also manifested asymmetry (Lyal 1985). The lice species *Tricodectes potus* female has three pairs of abdominal spiracles and male has two, it is so far

the only known example of lice sexual dimorphism manifested by spiracle numbers. In the present work except size, no other characteristic features in nymph instars have been recorded which could be quite unique to adult. The phenomenon like spiracular sexual dimorphism had also found absent in *M. cornutus*. Furthermore, the nymphs of more specialized group can be characterized by peculiar modifications of setae (gradual modification in to adult). For instance, the lice species *Eulaemobothrion cubense* in successive instars the number of setae transform into thick thorns on osculum (successively grow to create definite sets in adult) (Eichler 1963). The workers like Clay (1958), Eichler (1963) and Mey (1994) have been recommended the diagnosis of individual nymph instars through progression of chaetotaxy.

In the present study, it has also been recorded that first instar nymph of *M. cornutus* differ from second and third instar nymphs regarding demonstration of less number of tergal and sternal marginal setae. The first instar nymph has creamy white colouration whilst, second and third have yellow body colour. The shape of head in first nymph is triangular wherein second and third it became semilunar. The gular plate in first instar nymph has been poorly sclerotised and wanting of setae whereas gular plate of second instar nymph bear two setae but still very light in sclerotisation. The abdomen of first instar nymph is straight and narrower in appearance, which became flat and elliptical in second instar nymph. The antennae of first instar nymph are not fully developed since the first segment remained indistinct while in second instar nymph, antennae become large and segments are easily distinguishable. The prothorax of first instar nymph has somewhat rounded at lateral angels but prothorax is angulated in second instar nymph.

The nymph instars of *Menopon gallinae* the other menoponid louse usually co-existed with *M. cornutus* have also varied from miniature lice (nymph instars) of *M. cornutus*. The first instar nymph of *M. gallinae* is smaller in size (length, 0.80-0.84 mm; width, 0.30-0.36 mm) (Saxena *et al.* 1998) comparatively to *M. cornutus* (length, 0.97 mm; width, 0.34 mm). Prothorax of first instar nymph of *M. gallinae* has acutely angulated with three marginal setae while in *M. cornutus* the prothorax is somewhat rounded at lateral angels and having four marginal setae. The gular plate of first instar nymph of *M. gallinae* has 3-4 setae while the gular plate of first instar nymph of *M. cornutus* devoid of setae (Saxena *et al.* 1998).

The second nymph instar of *M. cornutus* is almost similar in shape and colour to third instar nymph but vary in the possession of less number of tergal and sternal setae and also in body dimensions. The lateral prothorax angels in third instar nymph are more angulated and bear longer spine setae comparatively to second instar nymph. The gular plate of third instar nymph has three and hypopharyngeal plate with four setae wherein in second instar nymph the number remained two respectively. The anterior tergal and sternal setae are present in third instar nymph but second instar nymph exhibited anterior sternal setae on III-VI segments but number limited to 2-3 on each. The number of setae on the pro, meso and metasternal plates almost similar in second and third instar nymphs. The second instar nymph of *M. gallinae* has 6 and 8 marginal setae on occipital and prothorax respectively while second instar nymph of *M. cornutus* bear 8 and 10 marginal setae on respective regions. The size of second instar nymph of *M. gallinae* is smaller (length, 0.91-0.95 mm; width, 0.40-0.46 mm) than to second instar nymph of *M. cornutus* (length, 1.32 mm width, 0.54 mm) (Saxena *et al.* 1998).

The third instar nymph of *M. cornutus* is differing in size (length, 1.53 mm; width, 0.66 mm) than to adult (length, 1.77 mm; width, 0.77 mm). The sclerotisation of third instar nymph is feeble and colour remained still yellowish. The anterior tergal and sternal setae are sparsely beset and less in number to exhibit by adult *M. cornutus*. The gular plate of adult has 10 setae in contrast to 6 setae on gular plate of third instar nymph. Unlike to the adult hypopharyngeal plate in third instar nymph it has been still feebly sclerotised. The rest of body character like head shape, elliptical abdomen, legs, occipital region, temples, antennae and maxillary palps, prosternal, mesosternal and metasternal plates are similar to adult *M. cornutus*. The third instar nymph of *M. gallinae* has also showed differences comparatively to third instar nymph of *M. cornutus* regarding body dimension and arrangement of setae. The third instar nymph of *M. gallinae* measures 1.50-1.54 mm in length and 0.60-0.64 mm in width (Saxena *et al.* 1998) whereas, the length of third instar nymph of *M. cornutus* is 1.53 mm and 0.66 mm width. The anterior tergal and sternal setae are absent in third instar nymph of *M. gallinae* but herein *M. cornutus* has been recorded. In third instar nymph the gular plate of *M. gallinae* has eight while *M. cornutus* bear six setae.

The male and female of *M. cornutus* are easily distinguishable to each other. The male is smaller (length, 1.59 mm; width, 0.49 mm) as

comparatively to female (length, 1.77 mm; width, 0.77 mm). The abdomen of male is somewhat narrower and straight in appearance while female abdomen is more elliptical and densely sclerotised than to male. The male genitalia is visible but poorly sclerotised and female has anal fringe with large number of ventral and dorsal setae of medium length. The subgenital plate in female has also bear a row of marginal setae. The sexual dimorphism limited to male with smaller dimensions, less number of abdominal chaetotaxy and differences associated with genital features of posterior abdomen.

Thorough look on literature has revealed that during the course of transformation of miniature lice into adult generally followed a common pattern. For instance the colouration of young molted lice always remained yellow. The body size on each molting increases and some time overlapping between third instar nymph and adult. The dark colorations of body with succeeding stage is determined by the degree of sclerotisation. However, by now feeble sclerotisation of some body parts (e.g. legs, marginal carina, ventral carina and mandibular framework) of first nymph instar has exhibited dark colorations. The antennae are always 4-5 segments. The progression of setae with each transformation stage from first nymph instar to adult is general trend during the development. In the majority of cases, the abdominal tergal plates of first instar hardly ever delimited and wanting of sclerotisation. The sclerotisation of tergal, sternal and pleural plates have been documented almost in all cases with each molting stage.

The present work is agree with Smith (2000) who had noted the ontogenic transformation in shapes of head of three instar nymphs of four avian lice and recommended the use of nymph morphology to establish phylogeny and taxonomy of avian lice. Since in present study, the shape of head of first instar nymph vary to all other stages which might be informative regarding the phylogeny of respective lice.

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