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## CHEWING LICE (ORDER MALLOPHAGA, SUBORDERS AMBLYCERA AND ICHNOCERA) FAUNA OF DOMESTIC CHICKEN (*GALLUS GALLUS DOMESTICUS*) IN UKRAINE

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**Chewing Lice (Order Mallophaga, Suborders Amblycera and Ischnocera) Fauna of Domestic Chicken (*Gallus gallus domesticus*) in Ukraine.** Yevstafieva, V. A. — Fauna of chewing lice parasitizing *Gallus gallus domesticus* Linnaeus, 1758 (domestic chicken) in the Poltava Region was studied. Four species of chewing lice belonging to Menoponidae, Amblycera and Gonioididae, Ischnocera were identified. Of them, *Menopon gallinae*, Linnaeus, 1758 and *Menacantus stramineus* Nitzsch, 1818 are dominant, and *Menacantus cornutus* Schömmer, 1913 and *Goniocotes hologaster* Nitzsch, 1838 are rarer. The prevalence and intensity of infestation of chewing lice on chickens and their localization on the host's body were studied. Ratio of body lengths is proposed as a character that can facilitate parasites' identification.

Key words: domestic chicken, chewing lice, distribution, differential diagnosis, *Menopon gallinae*, *Menacanthus stramineus*, *Menacanthus cornutus*, *Goniocotes hologaster*.

**Фауна пухоедов отряда Mallophaga подотрядов Amblycera и Ischnocera домашней курицы (*Gallus gallus domesticus*) в Украине.** Евстафьева В. А. — Изучена фауна маллофагов, паразитирующих на домашних курах (*Gallus gallus domesticus* Linnaeus, 1758) в хозяйствах Полтавской области. Выявлено четыре вида маллофагов семейства Menoponidae (Amblycera) и Gonioididae (Ischnocera). Доминирующими видами были *Menopon gallinae*, Linnaeus, 1758 и *Menacantus stramineus* Nitzsch, 1818, реже регистрировали *Menacantus cornutus* Schömmer, 1913 и *Goniocotes hologaster* Nitzsch, 1838. Выявлены экстенсивность и интенсивность маллофагозной инвазии кур и локализация пухоедов разных видов на теле хозяина. Предложен коэффициент соотношения длины тела выделенных в исследуемом регионе видов пухоедов, который можно использовать для облегчения идентификации маллофагов, паразитирующих на *G. domesticus*.

Ключевые слова: домашняя курица, пухоеды, распространение, дифференциальная диагностика, *Menopon gallinae*, *Menacanthus stramineus*, *Menacanthus cornutus*, *Goniocotes hologaster*.

### Introduction

Lice of the order *Mallophaga* Nitzsch, 1818 are among the most common wingless insects parasitizing wild and domestic birds on all continents. This wide geographical range is closely related to, among other human activities, transportation of poultry that leads to long-distance dispersal of parasites. Lice infection causes significant economic losses, especially in floor-brooding poultry farms (Volskie, Panavaite, 1965; Clay, Moreby 1970).

The chewing lice species list changed a lot in long-term parasitological and faunal studies of this group. The first classification by V. Kellogg (Kellogg, Paine, 1944) included about 1250 lice species. D. Harrison's study listed 2395 of them (Harrison, 1969). O. Lyakhova estimates that there are more than 2500 *Mallophaga* species in the world (Lyakhova, 2005). Of them, 140 species are registered in Ukraine (Fedorenko, 1980). In the USSR, *Mallophaga* parasites of mammals and birds were studied by the renowned scientist D. I. Blahoveshchenskyi (Blahoveshchenskyi, 1950, 1959).

Studies (Blahoveshchenskyi, 1940; Akbaiev, 2010) show that domestic chicken *Gallus gallus domesticus* Linnaeus, 1758 (Galliformes Temminsk, 1820) can be infected by lice of Menoponidae Mjoberg, 1910, genus *Menopon* Nitzsch 1818 (*Menopon gallinae*, Linnaeus, 1758; *Menopon cornutum* Schommer, 1913) and *Menacanthus* Neumann, 1912 (*Menacantus stramineus* Nitzsch, 1818; *Menacantus cornutus* Schömmer, 1913), as well as by representatives of *Goniocotes* Burmeister, 1838 of Gonioididae Mjoberg, 1910 (*Goniocotes hologaster* Nitzsch, 1838; *Goniocotes gigas* Taschenberg, 1789) and *Goniodes* Nitzsch, 1818 (*Goniodes dissimilis*

Nitzsch, 1818; *Goniodes truncatus* Giebel, 1861), and by *Lipeurus* Nitzsch 1818 of Philopterae Burmeister, 1838 (*Lipeurus caponis* Linne, 1758; *Lipeurus heterographus* Nitzsch, in Giebel, 1874).

In India, chickens appeared to be significantly infected (prevalence of infection (P) 86.67 %). Overall diversity included 6 species of chewing lice, two of which (*M. stramineus*, P 74 % and *M. gallinae*, P 63%) were dominant. Other 4 species (*L. caponis*, P 48 %, *Cuclotogaster heterographus* Nitzsch, 1866, P 25 %, *G. gigas*, P 18 % and *Goniocotes gallinae* De Geer, 1778, P 14 %) were found rarer (Surman, 2013). Similar results were obtained in South Asia (Shanta et al., 2006). In North America, chickens were infected by 4 chewing lice species: *Lipeurus maculosus* Clay, 1938 (P 70.8 %), *Goniocotes chrysocephalus* Giebel, 1874 (P 16.15 %), *Goniodes colchici* Denny 1842 (P 7.65 %) and *Amyrisidea megalosoma* Overgard, 1943 (P 5.38 %) (Emerson, 1972). Fauna of chewing lice parasitizing Galliformes in Bulgaria is represented by 4 species: *M. gallinae* (P 35.9 %), *G. gallinae* (P 25.8 %), *Eomenacanthus stramineus* Mönnig, 1934 (P 23.3 %) and *M. cornutus* (P 15.0 %) (Prelezov, Koinarski, 2006), in Africa by 3 species: *M. gallinae* (P 37.4 %), *L. caponis* (P 38.9 %) and *G. gigas* (P 23.7 %) (Kopij, Price, 2011).

The range and species composition of chewing lice of domestic chicken in Ukraine were studied by L. V. Nahornaia (Nahornaia, 2008). In an epizootic survey of poultry farms she found a 100% infection of chickens by *M. gallinae*, *M. stramineus*, and *Anaticola crassicornis* Scopoli, 1763 (Nahornaia, 2008).

In order to identify both the species and the sexes of *Mallophaga* lice, researchers are recommend to take into account a number of morphological features: color, size, shape and structures of body (features of head, chest, abdomen, legs, presence or absence of antennae, setae, etc.) (Blahoveshchenskyi, 1940).

Thus, it remains urgent to study species composition and distribution of chewing lice on poultry as well as to improve their differentiation diagnoses for understanding the current state and forecasting future parasitological situation in Ukraine.

## Material and methods

The study was conducted in the laboratory of the Subdepartment of Parasitology and Veterinary Examination of the Department of Veterinary Medicine of Poltava State Agrarian Academy in 2012–2014. Lice were identified in the I. I. Schmalhausen Institute of Zoology, NAS of Ukraine.

Epizootic assessment of lice infection was carried out on farms and small private holdings in Poltava region, in Zenkovsky, Pyryatynsky, Gadyachsky and Karlovsky districts.

Initially, we investigated the distribution of lice on crossbred chickens (“High Line”, “Tetra-SL”, “Lohman White”, “Lohman Braun” and “Brown Nick”). Altogether 31 poultry farms were surveyed, 3 of which belonged to farmers and 28 to private owners. In conducting the epizootic survey, the key indicators were the prevalence and the intensity of infection (P and II) of chewing lice.

Collection and further treatment of arthropods including identification of species and genera were done by standard methods (Blahoveshchenskyi, 1959).

Further research was aimed at improvement of lice identification using body lengths ratios for different species. In this analysis, 1479 specimens (670 males and 809 females) were used.

Mounted slides were photographed using a Zeiss Axio Lab microscope equipped with a Canon Power Shot A540 camera (Japan). General morphology, taxonomy and selected features of lice were examined at different magnifications (×40, ×100, ×200, ×300, and ×400).

The data were statistically processed by determining the arithmetic mean (M) and its standard error (m).

## Results and discussion

In 4 districts of Poltava region chickens were found to be infected by lice of 4 species: three of the suborder Amblycera Kellogg, 1896, family Menoponidae (*Menopon gallinae*, *Menacanthus stramineus*, *M. cornutus*) and one of the suborder Ischnocera Kellogg, 1896, family Gonioididae (*Goniocotes hologaster*).

The species were recorded in all surveyed farms (table 1).

As can be seen from table 1, on average 53.14 % of all chickens were infected, II was  $4.13 \pm 0.11$  insects/10 cm<sup>2</sup> of the bird's body surface. Dominant chewing lice species were *M. gallinae* (P 48.2 %) and *M. stramineus* (P 22.7 %). Other species, *M. cornutus* (P 17.8%) and *G. hologaster* (P 11.22 %), were less frequent.

Infestation prevalence fluctuated widely in different districts: *M. gallinae* — from 18.18 to 58.05 %, *M. stramineus* — from 17.40 to 35.83 %, *M. cornutus* — from 15.09 to 24.61 %, *G. hologaster* — from 7.17 to 38.38 %.

We found different species on different parts of the chicken's body (table 2).

Lice of *M. gallinae* were localized mainly between grooves of secondary and tertiary contour feathers, on skin, in the plumage of truncal region. *M. stramineus* and *M. cornutus* were found on skin and feathers on the ventral surface of the wings, downy feathers in the

**Table 1. Species composition of chewing lice of chicken (*G. gallus domesticus*) in the central part of Ukraine**

District of the Poltava Region	Number of insects	Species of chewing lice								II spec./10 cm <sup>2</sup> (M ± m)
		<i>Menopon gallinae</i>		<i>Menacanthus stramineus</i>		<i>Menacanthus cornutus</i>		<i>Goniocotes hologaster</i>		
		spec.	%	spec.	%	spec.	%	spec.	%	
Zenkovsky	615	357	58.05	107	17.4	95	15.45	56	9.11	5.25 ± 0.15
Gadyachsky	444	234	52.7	94	21.17	67	15.09	49	11.04	2.36 ± 0.4
Pyryatynsky	321	104	32.4	115	35.83	79	24.61	23	7.17	3.73 ± 0.15
Carlovsky	99	18	18.18	20	20.2	23	23.23	38	38.38	3.27 ± 0.32
Total	1479	713	48.2	336	22.7	264	17.9	166	11.22	4.13 ± 0.11

**Table 2. Localization of some of the chewing lice species on the chicken's body (*G. gallus domesticus*)**

Species of chewing lice	Localization	Insect abundance	
		Number	P, %
<i>Menopon gallinae</i>	Skin, contour feathers of the 2nd and 3rd orders, plumage	713	48.2
<i>Menacanthus stramineus</i>	Skin, ventral feathers of the wings, chest and abdominal feathers	336	22.7
<i>Menacanthus cornutus</i>		264	17.9
<i>Goniocotes hologaster</i>	Skin, feathers around the cloaca and the ventral surface of the body, small down feather	166	11.2

chest and abdominal region. *G. hologaster* infested the skin of truncal region, near cloaca, on the ventral surface of the body in small downy feathers.

Morphological comparison showed that the species differed in size, shape and structure of the body and also confirmed the sexual dimorphism.

Table 3 includes the features, which to our understanding facilitate the identification of the Mallophaga species.

**Table 3. Differential characteristics of Mallophaga lice parasitic on *G. gallus domesticus* in farms in central part of Ukraine**

Species of chewing lice	Body length, M ± m, mm		Head shape	Abdomen shape
	♂	♀		
<i>Menopon gallinae</i>	2.23 ± 0.01	2.5 ± 0.02	Triangular, short and wide, forehead with flatly curved sides and in the middle with a vague angle, temporal lobe extends as rather narrow, rounded blades	Elongated, conically narrowed posteriorly
<i>Menacanthus stramineus</i>	2.88 ± 0.03	3.12 ± 0.03	Significantly wider than long, forehead parabolically rounded	Oblong-oval, the last segment of the dorsal and ventral angular rear rounded, covered with fine hairs, with two large bristles
<i>Menacanthus cornutus</i>	2.28 ± 0.03	2.5 ± 0.03	Parabolic, significantly wider than long, forehead rounded parabolically	Round-oval (♀) and elongated-oval (♂), the last segment rounded (♀) and elongated (♂), covered with a fringe of long hairs that form a beam on each side
<i>Goniocotes hologaster</i>	1.44 ± 0.023	1.54 ± 0.01	Wide, rounded forehead, temporal edge almost parallel, occipital angles appear more acute, with spines	In the form of a regular oval, the back of the abdomen wider; last abdominal segment has a mild fissure (♀) in the form of blades (♂)

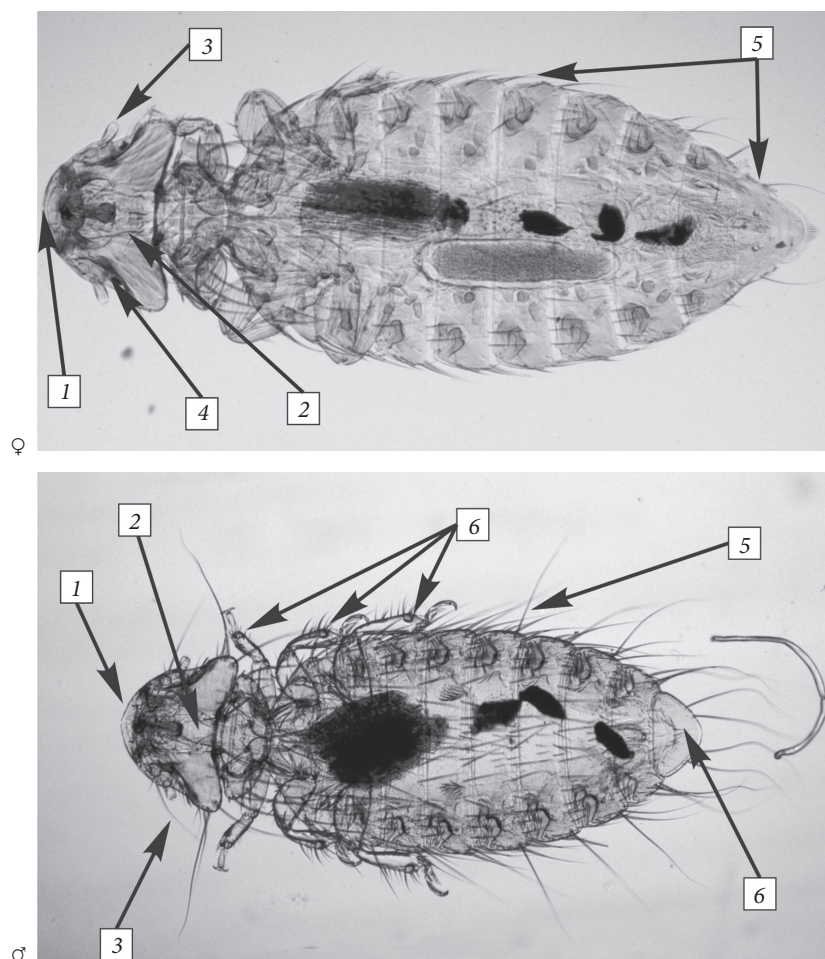


Fig. 1. *Menopon gallinae*: ♀: 1 — forehead; 2 — temporal lobe; 3 — antenna; 4 — eyes; 5 — abdomen ( $\times 400$ ); ♂: 1 — forehead; 2 — temporal lobe; 3 — antenna; 4 — foot; 5 — bristles; 6 — abdomen posterior ( $\times 300$ ).

The characteristic features of *M. gallinae* given in table 3 and fig. 1 are:

1) head — triangular, wider than it is long, forehead with flatly curved sides in the middle vaguely angular, temporal lobe extends as narrow, rounded blades;

2) abdomen — elongated, conically narrowed posteriorly;

3) body length — on average  $2.23 \pm 0.01$  mm (♀  $2.5 \pm 0.02$  mm, ♂  $1.96 \pm 0.01$  mm).

Also to differentiate between female and male specimens of *M. gallinae* it is advisable to take into account not only the genital organs but also the shape of the abdomen, its last segment, and presence or absence of hairs or bristles. In females, the last abdominal segment tapers away, edged with fine hairs. In males, it is parabolically rounded, has long lateral bristles. Egg chambers are quite visible on slides, while testes and ejaculatory ducts are much less defined.

To identify *M. stramineus*, consider the following morphological characteristics (table 3, fig. 2):

1) head — much wider than long, parabolically rounded forehead;

2) abdomen — oblong-oval, the last segment with angular dorsal and rounded ventral surfaces, covered with fine hairs and with two large setae;

3) body length —  $2.88 \pm 0.03$  mm (in ♀  $3.12 \pm 0.03$  mm, in ♂  $2.62 \pm 0.03$  mm).

Also to differentiate ♀ from ♂ in *M. stramineus* we advise to take into account the genitals and the shape of the abdomen that in ♀ is more rounded than in ♂. The abdomen of ♀ is elongated, the last segment narrowed. Ovaries and testes are well-visible on slides.



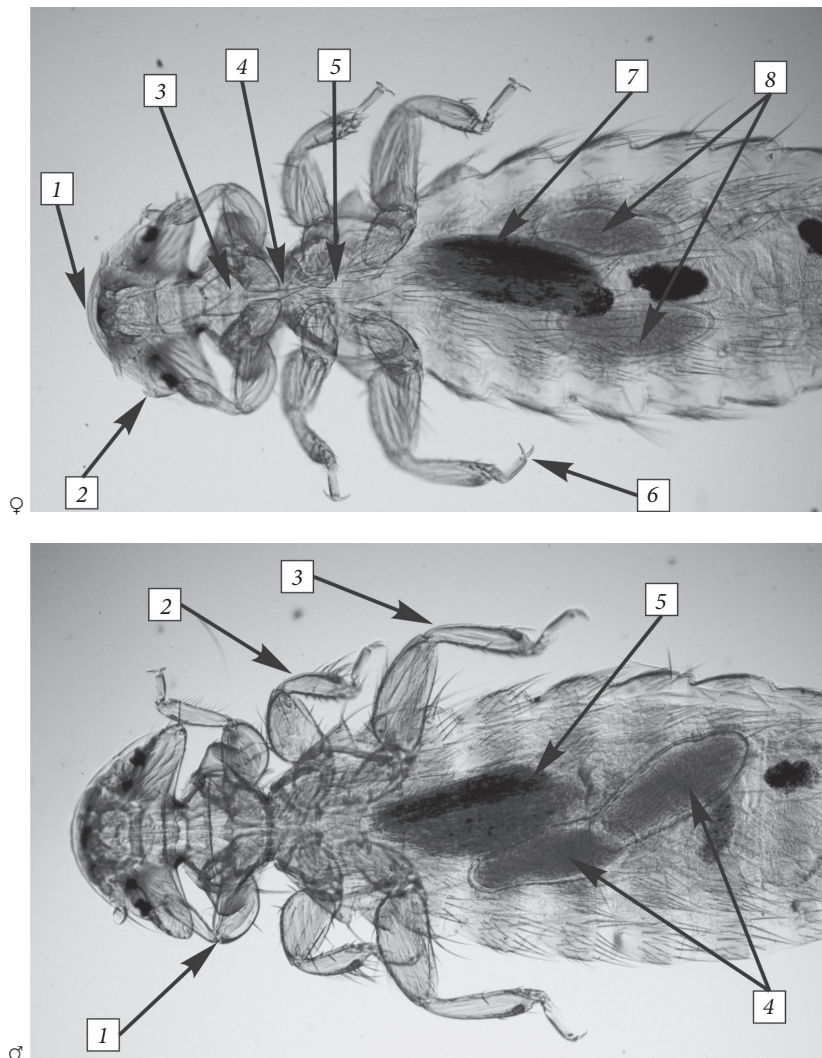


Fig. 2. Morphology *Menacanthus stramineus*: ♀: 1 — forehead; 2 — temporal lobe; 3 — prothorax; 4 — mesothorax; 5 — metathorax; 6 — tarse; 7 — crop; 8 — the egg chamber; ♂: 1 — prothorax foot; 2 — foot mesothorax; 3 — foot metathorax; 4 — testes; 5 — crop ( $\times 400$ ).

To identify *M. cornutus*, consider the following features (table 3, fig. 3):

- 1) head — parabolic, much wider than long, parabolically rounded forehead;
- 2) the shape of the abdomen — rounded-oval (♀) and oblong-oval (♂), the last segment rounded (♀) and elongated (♂), with a fringe of long hairs that form a beam on each side;
- 3) body length on average  $2.28 \pm 0.03$  mm (♀  $2.5 \pm 0.03$  mm, ♂  $1.92 \pm 0.02$  mm).

To differentiate ♀ from ♂ *M. cornutus* it is advisable to take into account the size of the thorax and genital structures. In ♀ the thorax is longer than the head, in ♂ it is shorter. Both the egg chamber and the ejaculatory tracts are well-visible.

To identify *G. hologaster* consider the following features (table 3, fig. 4):

- 1) head — broad, rounded forehead, temporal edge almost parallel, occipital angles appear more acute, contain a spine each;
- 2) abdomen and thorax — oval, the end of abdomen broader;
- 3) body length —  $1.44 \pm 0.023$  mm (♀  $1.54 \pm 0.013$  mm, ♂  $1.32 \pm 0.04$  mm).

Also to differentiate ♀ from ♂ in *G. hologaster* it is advisable to analyze the shape of the abdomen and genital structure: in ♀ the last abdominal segment has mild fissures, in ♂ it

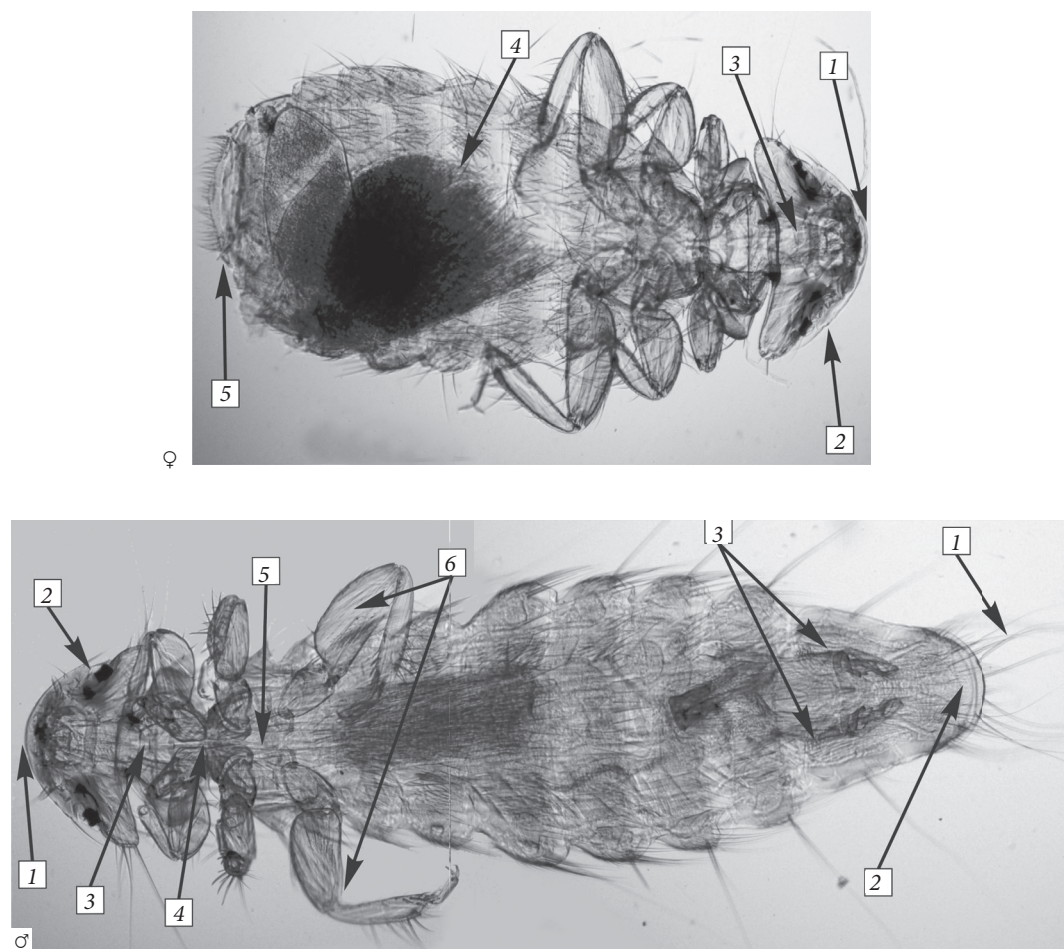


Fig. 3. Morphology of *Menacanthus cornutus*: ♀: 1 — forehead; 2 — temporal lobe; 3 — sternal plate; 4 — crop; 5 — posterior part of the abdomen with bristles; ♂: 2 — eye; 3 — prothorax with feet; 4 — mesothorax; 5 — metathorax; 6 — abdominal bristles; 7 — oval shape of the rear of the abdomen; 8 — ejaculatory ducts ( $\times 400$ ).

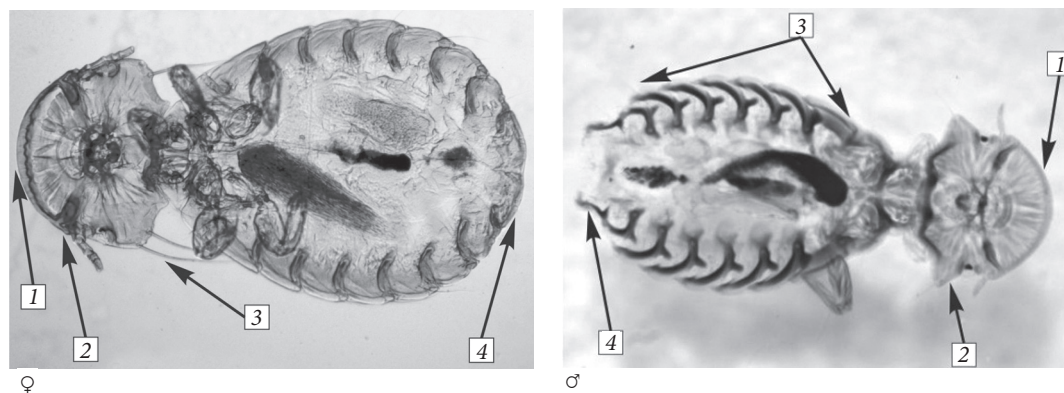


Fig. 4. Morphology of *Gonicotes hologaster*: ♀: 1 — forehead; 2 — eyes; 3 — bristles on head; 4 — the rear of the abdomen ( $\times 300$ ); ♂: 1 — head; 2 — temporal edges; 3 — overall oval body; 4 — the last segment of the abdomen blade-shaped ( $\times 250$ ).

**Table 4.** The ratio of body length of *Menopon gallinae* to other lice species registered in farms in the central part of Ukraine

Species order Mallophaga	Ratio (coefficient)		
	M	♂	♀
<i>Menacanthus stramineus</i>	0.77	0.75	0.8
<i>Menacanthus cornutus</i>	0.98	1.02	1
<i>Goniocotes hologaster</i>	1.55	1.48	1.62

is blade-shaped. Females on slides have quite visible egg chambers, while male genitals are not visible.

Since we found only four species of lice, we propose, for the first time, a ratio (coefficient) of body lengths that can facilitate their identification.

As the dominant species on the territory of Poltava region is *M. gallinae* (P 48.2 %), the other species can be identified by the ratio of their bodies' lengths to that of *M. gallinae* (table 4).

Our data confirm the results of most scientists (Kopij, Price, 2011; Surman, 2013) that *Menopon gallinae* (P 48.2 %) is the most common species infesting chickens (*G. domesticus*) in the Poltava Region. There, the diversity of Mallophaga lice of birds is comparatively small (four species: *M. gallinae*, *M. stramineus*, *M. cornutus*, *G. hologaster*). In our opinion, this is due to the climate of the central part of Ukraine where the conditions are favorable only for certain species.

According to literature, the lice can be identified using various features. Our results can facilitate the identification, making it a more effective procedure. We recommend considering the following morphological features: the shape of the head, abdomen, body size and the proposed ratio of body length to already identified *M. gallinae*.

## Conclusions

1. In the floor-brooding poultry farms of Poltava region the average prevalence of chickens' infection by chewing lice is 53.14 %, the intensity of infection is  $4.13 \pm 0.11/10 \text{ cm}^2$  of bird's body surface.

2. The dominant species among chewing lice of chickens in Poltava Region are *Menopon gallinae* (P 48.2 %) and *Menacanthus stramineus* (P 22.7 %). *Menacanthus cornutus* (P 17.8 %) and *Goniocotes hologaster* (P 11.22 %) are less common.

3. Each species of Mallophaga lice has specific localization on the body of chickens.

4. The proposed ratio (coefficient) of body length of other Mallophaga lice to *M. gallinae* allows faster and more effective diagnosis of infestation of chickens in the Poltava Region.

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