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SPECIES VARIETY AND POPULATION STRUCTURE OF MALLOPHAGA (INSECTA: PHTHIRAPTERA) ON CHICKENS IN THE REGION OF STARA ZAGORA

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Summary

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A study on the species variety of the Mallophaga on domestic chickens in the region of Stara Zagora was performed. In the period of 1994–2003, a total of 647 birds from both genders from breeds prevalent in the region were studied, in 64 small private farms utilizing extensive rearing technologies. Biting lice infestation was found out in 589 birds. A total of 21 462 individuals of the Mallophaga group were collected and identified. They were determined to belong to 4 species of the Phthiraptera order: *Menopon gallinae* (Linné, 1758), *Eomenacanthus stramineus* (Mönnig, 1934), *Menacanthus cornutus* (Schömmer, 1913), and *Goniocotes gallinae* (De Geer, 1778). Dominating among them was *M. gallinae* (35.9 % of all identified Mallophaga), followed by *G. gallinae* (25.8 %), and *E. stramineus* (23.3 %), while *M. cornutus* had the lowest share of occurrence (15.0 %). The population structure of each proven species of biting lice was established. The species variety of Mallophaga on chickens was relatively poor, constant, and not varying in time, which can be explained with the absence of considerable climatic differences within the boundaries of the tested region.

Key words: biting lice, chewing lice, chickens, Mallophaga, Phthiraptera

INTRODUCTION

According to Hiepe & Ribbeck (1982), until the publication of their data, more than 2600 Mallophaga species were known. Bowman *et al.* (2003) informed that the totality of described biting lice species amounts to 4000. Their hosts, according to Smith (2001) are more than 2300 avian species.

The species of biting lice, whose host are domestic chickens, are a relatively small part of all Mallophaga. Zunker (1928) published a morphological description of 9 species of Mallophaga in chickens (5 from Ischnocera and 4 from the Amblycera suborders). Hohorst (1939) reported 16 Mallophaga species, which can parasitize on chickens. In 1956, Emerson described 11 species of biting lice in domestic chickens. Emerson's data are considered to be valid today, and they are still used and cited by contemporary researchers (Lancaster & Meisch, 1986).

The newest published list of Mallophaga species in domestic chickens is that of Ribbeck (1992). He listed 10 species from both above mentioned suborders.

A question closely related to the species variety of biting lice is that of their population structure, defined by the ratio and balance of the two genders and the different stages of development within the population of a specific species. By calcu-

lating coefficients providing a numerical expression of the mentioned ratios, Kumar *et al.* (1994), determined the population structure of the Mallophaga.

Biting lice in domestic chickens are quite endemic (Arends, 1997), while their spread is cosmopolitan (Smith, 2001) and genetically-based in type (Johnson *et al.*, 2002).

Until now, the species variety and the population structure of the Mallophaga on domestic chickens in Bulgaria has not been studied. This motivated our scientific interest in the performance of one such study, whose intial part was done on the territory of the Stara Zagora region.

MATERIALS AND METHODS

During the 10-year period between 1994 and 2003, a total of 647 birds of the *Gallus gallus domesticus* (L.) subspecies were studied. Birds at ages ranging from 3 and 36 months, from both genders, belonging to the locally reared breeds were included in the research. The study comprised 64 small private farms utilizing extensive rearing technologies. The chosen farms were from 44 different settlements in the Stara Zagora region – 24 of them located in the plains, and 20 – in mountainous/semi-mountainous areas.

After determining a presence of biting lice, we gathered the insects in non-sterile conditions, using the method of Derylo (1974) modified by us. To this end, we soaked a tennis ball-sized cotton pad with diethyl ether, rubbed it in the donor bird's feathers, and then left it at the bottom of a polyethylene bag, in which the bird itself was put afterwards, with the head outside. Holding the bag's opening tightly closed round the bird's throat, we waited for 7 minutes, after which we pulled the bird out of the bag, and ruffled its feathers energetically, onto a large sheet of white paper, with subsequent shaking out of the polyethylene bag and the cotton pad. Individual materials were used for each bird. The Mallophaga collected in this manner were put in separate Petri dishes, sized in accordance with the collected material.

The insects were processed by conservation and dehydration for 24 hours in 70^{o} ethanol. After being removed from the alcohol, the Mallophaga were dried on sheets of filter paper, put in xylene for clearing for 30–60 min, depending on the individual parasite's size. Following that, the Mallophaga were embedded in Canadian balm, and put on standard laboratory glass slides, and covered with cover glasses. The samples were marked and dried in horizontal position at room temperature.

Microscopic observations and measurements were performed by a Laboval 4™ (Zeiss, Jena) microscope and Stemi 2000-C™ stereoscope (Zeiss, Jena).

The photographic material was prepared with Axioskop™ (Zeiss, Jena) using a Canon A40™ digital camera (Canon, Japan).

The species, gender, and life cycle stage identification of the Mallophaga was performed by the methods of Zunker (1928); Neveu-Lemaire (1938); Hohorst, (1939), Eichler (1963); Zlotorzycka *et al.* (1974); Furman & Catts (1982); Weidner, (1982); Lonc & Modrzejewska (1989), and Smith (2001). To determine and differentiate the different Mallophaga species, we used the following indicators: total body length; length, width, and shape of the head, thorax and abdomen; body colouring; structure of the antennae; presence or absence of tergite spots; peculiarities of the chaetotaxy.

To determine the population structure of the four species of Mallophaga, we calculated the following ratios, suggested by Kumar *et al.* (1994): male:female imago (M:F); adults:nymphs (A:N); male imago:nymphs (M:N); female imago: nymphs (F:N).

RESULTS AND DISCUSSION

From a total of 647 studied birds, 589 (91.04 %) were infected with 1 or more species of Mallophaga. A total of 21 462 individuals were collected and identified. It was determined that they belonged to 4 species of the Phthiraptera order – 3 from the Amblycera suborder and 1 from the Ischnocera suborder:

Amblycera suborder, Menoponidae family - *Menopon gallinae* (Linné**,** 1758) (Fig. 1a and 1b) – synonyms: *Pediculus gallinae* (Linné, 1758), *Nirmus trigonocephalus* (Olfers, 1726), *Menopon pallidum* (Nitzsch in Burmeister, 1838), *Menopon trigonocephalum* (Neumann, 1909), *Neumania pallidum* (Sugimoto, 1929); ***Eomenacanthus stramineus*** (Mönnig**,** 1934) (Fig. 2a and 2b) – synonyms: *Pediculus meleagridis* (Panzer, 1793), *Menacanthus stramineus* (Nitzsch, 1818), *Menopon stramineum* (Nitzsch in Giebel, 1874), *Menopon biseriatum* (Piaget, 1980), *Menacanthus biseriatum* (Neumann, 1912); *Eomenacanthus biseriatum* (Uchida, 1926); ***Menacanthus cornutus*** (Schömmer**,** 1913) (Fig. 3a and 3b) – synonyms: *Menopon cornutum* (Schömmer, 1913), *Eomenacanthus cornutus* (Schömmer, 1913), *Gallacanthus cornutus* (Schömmer, 1913).

Ischnocera suborder, Goniodidae

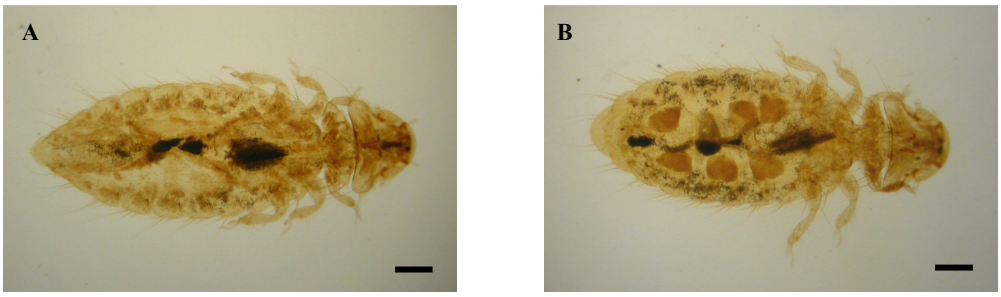

Fig. 1. *Menopon gallinae* (dorsal view): A. female; B. male. Bar = 0.250 mm.

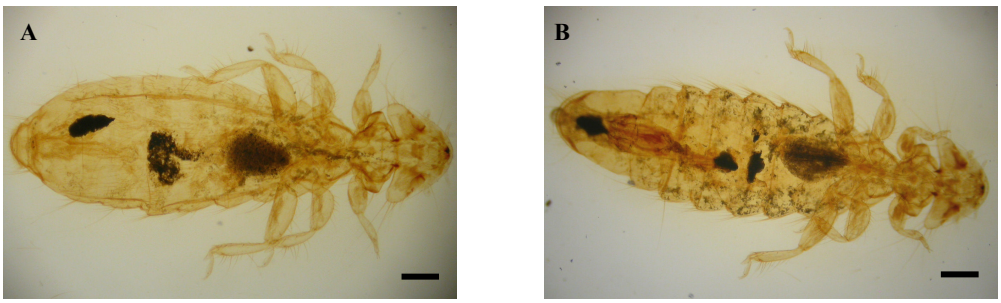

Fig. 2. *Eomenacanthus stramineus* (dorsal view): A. female; B. male. Bar = 0.250 mm.

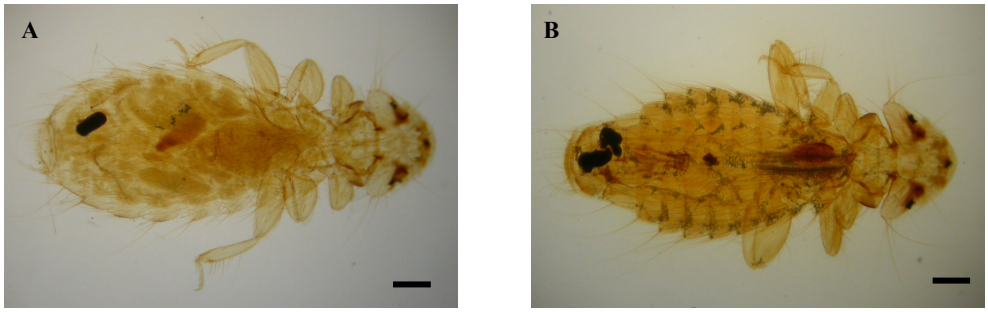

Fig. 3. *Menacanthus cornutus* (dorsal view): A. female; B. male. Bar = 0.250 mm.

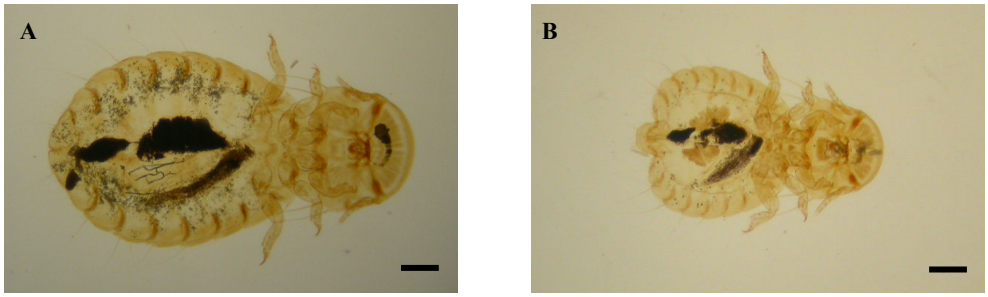

Fig. 4. *Goniocotes gallinae* (dorsal view): A. female; B. male. Bar = 0.250 mm.

family - *Goniocotes gallinae* (De Geer, 1778) (Fig. 4a and 4b) – synonyms: *Ricinus gallinae* (De Geer, 1778), *Goniocotes hologaster* (Nitzsch in Burmeister, 1838), *Goniocotes maculatus* (Taschenberg, 1882).

Our research showed that the listed species were evenly spread, and could be encountered in all settlements and subregions of the Stara Zagora region. The number and relative share of each discovered species, compared to the total number of identified insects are given in Table 1 and Fig. 5. From the data, it is apparent that the *M. gallinae* species (35.9 %) was dominant for the region. On the second place stood *G. gallinae* (25.8 %), followed by *E. stramineus* (23.3 %). The lowest share belonged to *M. cornutus* (15.0 %).

The results of our study were highly indicative for the fact that, in the studied region, the species variety of biting lice, parasitizing on domestic chickens as hosts, was relatively poor, and only included 4 of the 10 Mallophaga species listed in Ribbeck's 1992 catalogue. A probably cause for that is the relatively constant climatic geographic conditions in the various subregions of the Stara Zagora region.

The discovered species are cosmopolitan and, apparently, highly adaptive for various geographic regions and climatic conditions (Lancaster & Meish, 1986). Some species of Mallophaga on chickens, such as *Menacanthus pallidulus, Lipeurus lawrensis tropicalis, Oxylipeurus dentatus, Goniodes gigas* inhabit more limited areas. They are primarily found in

Table 1. Percentage of Mallophaga species in naturally infected chickens in the region of Stara Zagora (n = 21 462)

Species	% of the total number	Confidence limits
Menopon gallinae	35.9	35.3 ÷ 36.6
Eomenacanthus stramineus	23.3	23.1 ÷ 23.5
Menacanthus cornutus	15.0	14.5 ÷ 15.5
Goniocotes gallinae	25.8	25.2 ÷ 26.4

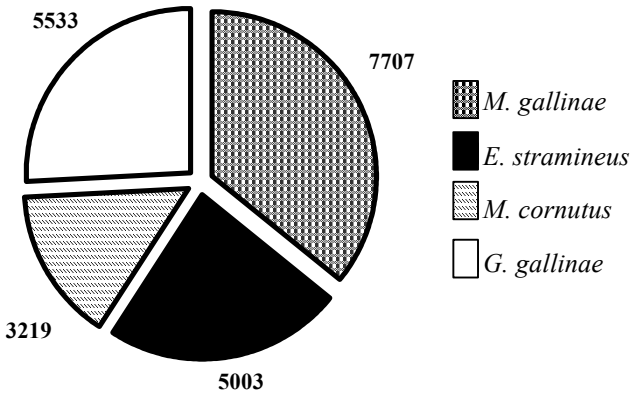

Fig. 5. Number and distribution of the four Mallophaga species in chickens from the region of Stara Zagora (n = 21 462).

lands of tropic and subtropic climate (Lancaster & Meish, 1986; Trivedi *et al.*, 1991; Gabaj *et al.*, 1993), which explains their absence in our study region.

Among our neighbouring countries, the biting lice we identified can also be encountered in Serbia (Pavlovic & Nesic, 1991). The same 4 species were found by Okursoy & Yılmaz (2002) in Turkey. They also proved the same percentages among them, as the ones that we got.

Since the mentioned 4 Mallophaga species remained the same for the region throughout the whole 10-year study, our results were also indicative for the stability of the species variety of biting lice in local chickens populations.

Table 2 presents our results for the ratio between the genders and life cycle stages of each Mallophaga sp. in chickens within the Stara Zagora region. With some insignificant differences, the population structures of the species were similar. For nearly all species, the females dominated over the males. This tendency was the strongest for *G. gallinae*. Only for *M. gallinae*, the two genders were nearly equally represented. Table 2 shows also that the numbers of imago individuals were higher than those of nymphs, both as a total number (A), and as gender distribution (M, respectively F). The number of

Table 2. Population structure of Mallophaga species in naturally infected chickens in the Stara Zagora region

Species	M : F	A : N	M : N	F : N
M. gallinae	1 : 1.0	1 : 0.4	1 : 0.9	1 : 0.9
E. stramineus	1 : 1.1	1 : 0.4	1 : 0.8	1 : 0.7
M. cornutus	1 : 1.4	1 : 0.2	1 : 0.5	1 : 0.4
G. gallinae	1 : 1.6	1 : 0.3	1 : 0.9	1 : 0.6

M – male imago; F –female imago; A – adult; N – nymph.

Menopon gallinae nymphs was the highest, with the number of individuals in pre-imago stages being nearly equal to the individual number of male and female imago (M:N = 1:0.9; F:N = 1:0.9).

According to Eichler (1963), the normal M:F ratio for *E. stramineus* is 1:10 in favour of females. According to our results, within the population of identified species, the ratio of male to female individuals was 1.0 to 1.6. Our results, for the most part, confirmed to a large extent the data published by the cited author. It is our opinion, however, that the established coefficients gave a more realistic representation of the situation, because for most living organisms, the number of female and male individuals is fairly balanced, with a moderate domination of the females. This should also be valid for ectoparasites' communities, since both genders are equally threatened with destruction during the host's hygiene procedures. Having in mind the insufficiency of information on the population structure of biting lice on chickens throughout the scientific literature, we assume that the results of our research give some light on the problem.

Studying the population structure of the *Bovicola caprae* species (biting lice on goats), Kumar *et al.* (1994), too, proved that female imago numbers surpass the male imago numbers. For this species, however, according to information from cited authors, depending on the method of collection of insects, the quantities of nymphs can be equal or even greater compared to the number of insects in the imago stage. The dominance of the imago over nymphs, established in our research, we explained not as much with the manner of collecting the insects, as with the assumption that pre-imago stages are more vulnerable to hygiene actions performed by birds.

CONCLUSION

During our research, it was found out that there were 4 species of Mallophaga among domestic chickens of the Stara Zagora region: *Menopon gallinae*, *Eomenacanthus stramineus*, *Menacanthus cornutus*, and *Goniocotes gallinae*. Among them, *M. gallinae* dominated with a share of 35.9 % of the total. The four species were widespread and were encountered in all studied settlements within the target area. Studying the population structure of the identified species of biting lice, it was proven that the number of females was equal or greater than the number of males, and the imago stage dominated over the nymphs.

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