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Population characteristics of louse *Columbicola columbae* Linn. 1758 (Phthiraptera: Insecta) on pigeons in Uttar Pradesh, India

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ABSTRACT: Population characteristics of the pigeon louse, *Columbicola columbae* were recorded on 360 pigeons in the district Meerut, Uttar Pradesh during 2017. Parasitic infestation was 70 per cent with mean intensity of 58.5, with a range of 1-200. The louse exhibited skewed distribution on host body (variance/ mean = 44.5; index of discrepancy = 0.54; exponent of negative binomial = 0.34), however the frequency distribution pattern could not conform to negative binomial model. Sex ratio and adult nymph ratio of the louse were also skewed (M: F = 1: 1.3; A: N = 1: 1.2). Mean monthly prevalence and mean intensity of infestation exhibited significant positive correlation with the environmental temperature and photoperiod but not with relative humidity.

KEY WORDS: Ischnoceran louse, infestation, prevalence, intensity, seasonal variation

As many as nine species of Phthiraptera are known to infest the blue rock pigeon *Columba livia* (Price *et al*., 2003). Singh *et al*. (1998, 2000), Khan *et al*. (2009) and Rana *et al*. (2019) have given information on the population characteristics of a few species on Indian pigeons. Elsewhere Naz *et al*. (2010), Radfar *et al*. (2012), Copoka and Chiopehko (2013), Amaral *et al*. (2017), Boyd *et al*. (2017) and Djelmoudi *et al*. (2017) have tried to furnish information about the population levels of related phthirapteran species on pigeons belonging to different parts of world. An attempt has been made to supplement the information on the prevalence, frequency distribution pattern, population structure and the seasonal variation in the population of most common ischnoceran louse, *Columbicola columbae* Linn. 1758 (Phthiraptera: Insecta) on pigeons in Meerut region of Uttar Pradesh, India.

Thirty birds were subjected to delousing every month in the year 2017. Delousing was performed by modified fumigation method (with chloroform) adopted by Gupta *et al*. (2007). As many as 80 per cent louse load becomes recovered within 10-12 minutes. Plumage of bird was further examined under magnascope to take out the remaining louse load. The deloused pigeons were released to lead healthier life. The louse load was then separated stage wise (adults/nymphal stages) and then adult lice were further separated sex wise (under Stereozoom Trinocular Microscope). The software offered by Rozsa *et al*. (2000) was used to determine the prevalence, intensity of infestation,

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exponent of negative binomial distribution (k), index of discrepancy (D) as well as the goodness of fit between the observed and the expected frequency distribution (negative binomial). The nature of frequency distribution curve was noted by plotting the curve between the frequencies expected by the negative binomial distribution and the observed frequencies

Seventy percent of the examined pigeons (n= 360) carried the louse, *C. columbae* (Plate 1) with a mean intensity of 58.5/ pigeon; median intensity 50.0/ pigeon and sample mean abundance 40.9/ pigeon. Range of infestation was 1-200. The values of three measures of aggregation indices were - variance to mean ratio = 44.5, index of discrepancy (D) of Poulin = 0.536 and the exponent of negative binomial (k) = 0.344. The pattern of the frequency distribution was aggregated/ skewed but somehow it failed to conform the negative binomial model (Table 1).

In overall ratio, the females outnumbered the males in the natural population (M: F - 1: 1.3). The sex ratios in different months of year 2017 varied from 1: 1.2 to 1: 1.4, remained almost consistent throughout the year. The overall adult nymph ratio remained at 1: 1.2 (nymphal population slightly exceeded the adults). The adult nymph ratio varied from 1: 0.7 to 1: 1.4 in different months of the year. Interestingly, the adults dominated the nymphal population during the cooler months, January to March (adult nymph ratio (A:N) - 1: 0.7 to 1: 0.8) but thereafter the nymphal population dominated over the adults from April to December 2017 (1: 1.1 - 1: 1.4). The ratio of three nymphal instars was 1:1: 1 in April and 1: 1.4: 1.6 in November (Table 2).

The prevalence of infestation was minimum (60.0%) in January and February and gradually rose to 76.6% during July to September and returned to lower level (60.0%) in December (Fig. 1). Similarly, the mean intensity of infestation remained minimum in January (33.3/ pigeon) but gradually rose to 71.9/ pigeon in July, decreased to 56.2 in August, but reached the maximum 100.4 in September. The mean intensity of infestation decreased thereafter to 40.6 levels in December (Fig. 2). There was significant correlation between mean monthly prevalence of *C. columbae* and the mean monthly temperature ($r = 0.96$; $df = 10$; $p < 0.05$) and the photoperiod ($r = 0.845$; $df = 10$; $p < 0.05$) but not to the relative humidity ($r = 0.075$; $df = 10$; $p < 0.05$).

Table 1. Population characteristics of pigeon louse

Parameters	louse
Sample size	360
Infested	252
Range	1-200
Prevalence	70%
Mean intensity/ pigeon	58.5
Median intensity/ pigeon	50
Mean abundance/ pigeon	40.92
Variance/mean/ pigeon	44.45
Sample abundance/ pigeon	85.24
Index of discrepancy	0.536
K (negative binomial)	0.344
df	39
χ^2	324.51

Table 2. Population composition of pigeon louse during different months

Month	**M: F**	**A: N**	**I: II: III**
January	1:1.3	1:0.7	1:1.5:1.5
February	1:1.2	1:0.8	1:1.3:1.6
March	1:1.3	1:0.8	1:1.3:1.8
April	1:1.2	1:1.3	1:1:1
May	1:1.3	1:1.2	1:1.2:1.4
June	1:1.2	1:1.4	1:1.1:1.2
July	1:1.3	1:1.4	1:1.4:1.5
August	1:1.2	1:1.1	1:1.1:1.1
September	1:1.3	1:1.2	1:1.1:1.4
October	1:1.3	1:1.1	1:1.2:1.5
November	1:1.4	1:1.2	1:1.4:1.6
December	1:1.4	1:1.1	1:1.2:1.7
Over all	1:1.3	1:1.2	1:1.4:1.4

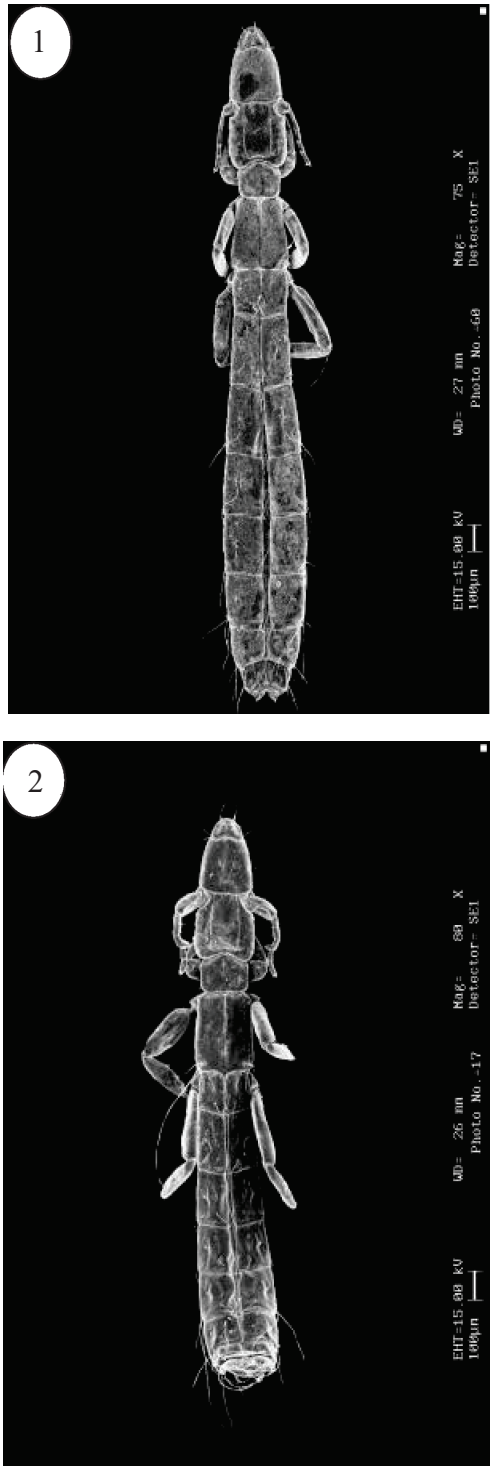

Plate I - SEM photographs of pigeon louse *C. columbae*: 1. Adult female; 2. Adult male

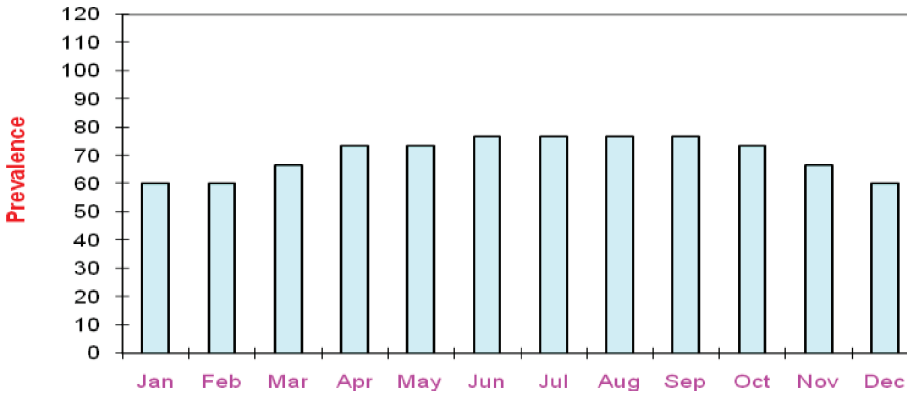

Fig.1. Mean monthly prevalence of *C. columbae* on 360 pigeons in district Meerut in the year 2017

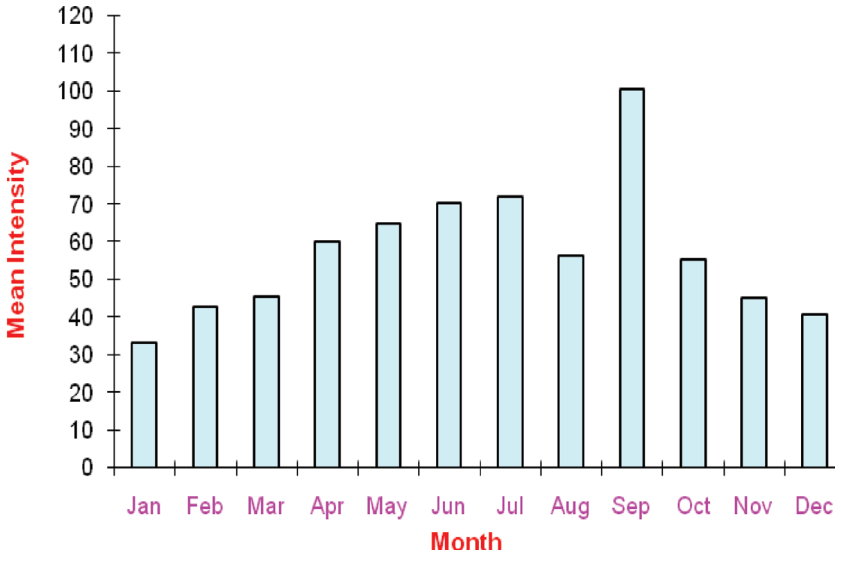

Fig. 2. Mean intensity of *C. columbae* on 360 pigeons in district Meerut in the year 2017.

In the same way, the mean monthly intensities were also significantly correlated with mean monthly temperature ($r = 0.772$; $df = 10$; $p < 0.05$) and photoperiod ($r = 0.646$; $df = 10$; $p < 0.05$) but not to relative humidity ($r = 0.44$; $df = 10$; $p < 0.05$, Table 3; Fig. 2).

Few phthirapterists (Naz *et al*., 2010; Radfar *et al*., 2012; Copoka and Chiopehko, 2013; Amaral *et al*., 2017; Boyd *et al*., 2017 and Djelmoudi *et al*., 2017) described the population characteristics of selected lice species of the pigeons from different parts of world. Singh *et al*. (1998) identified the presence of four species of pigeon lice on 50 pigeons in Dehradun. They observed the prevalence of *C. columbae* as 100 percent with mean intensity

Table 3. Correlation (r) between the mean monthly prevalence and infestation intensity of the pigeon louse with mean monthly temperature, relative humidity and photo period

Population	Temperature	R H	Photoperiod
Prevalence	$+0.957^{**}$	$+0.075^{NS}$	$+0.845^{**}$
Intensity	$+0.772^{**}$	$+0.0444^{NS}$	$+0.646^{**}$

of 141 lice/ bird. On the other hand, Khan *et al*. (2009) found the prevalence of this louse as 61.0% (mean intensity 53.4/ bird; ranges, 5-184; n = 205). During the present study, the prevalence of *C. columbae* on 360 pigeons in Meerut district of U.P. was 70.0 per cent (mean intensity - 58.5 per bird).

Bird lice are known to exhibit "skewed" clumped/ aggregated distribution on the body of their hosts (Marshall, 1981). In fact, the bird lice are not randomly distributed among their hosts (most of the infested hosts carry few lice but a few hosts harbor most of the louse load). Rekasi *et al*. (1997) have recommended the use of negative binomial distribution to describe the pattern of abundance of lice. During the present study, it was observed that the frequency distribution pattern of *C. columbae* was skewed but it could not be confirmed as negative binomial model.

Review of literature indicated that most of the phthirapteran species exhibit bias in sex ratio, with the female predominance in the population (Marshall, 1981). During the present study also the male, female ratio remained 1: 1.3, while nymphal population dominated over adult population (adult nymph ratio - 1: 1.2).

The avian lice generally peak in summers (Marshall, 1981). Several factors affect the seasonal variation in the population of avian lice. Singh *et al*. (2000) recorded the seasonal variation in the population of two pigeon lice on five birds (by *in situ* counts) and found positive correlation between the mean monthly live lice index and mean monthly temperature. Present study also indicated significant positive correlation between the mean monthly prevalence/intensity and monthly temperature, however, the correlation between the prevalence/ intensity of *C. columbae* and the relative humidity remained insignificant.

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