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November 1, 1995

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Rishikesh

Dear Dr. Adesh Kumar,

Your article entitled "Biometrical studies on goat biting louse, Bovicola caprae (Gurlt) (Phthiraptera : Ischnocera)", has been accepted for publication in Hexapoda, Vol.7, 1995 issue. Your paper has — tables, — graphs and 3 plates which has to be charged. Therefore kindly send by DD Rs. 500 towards the cost of extra tables, graphs etc. In addition, you have to pay Rs.250 towards the cost of twenty five reprints, which is compulsory. since we are not receiving any financial assistance from any agencies. The membership fees collected is not sufficient to meet the printing cost of the journal.

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BIOMETRICAL STUDIES ON GOAT BITING LOUSE, BOVICOLA CAPRAE (Gurlt) (PHTHIRAPTERA : ISCHNOCERA)

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ABSTRACT

Twelve morphometric characters of the goat biting louse, B. caprae have been described by the statistics of location and dispersion. The departure from normality has also been tested by skewness and kurtosis. Certain characters exhibited identical values for three measures of central tendency. The dimensions of prothorax length, pterothorax length and genitalia/terminalia length exhibited higher values of coefficient of variation. On the other hand, dimensions of head have been found most useful for statistical measurement of biting louse. The present studies furnishes information on biometrical analysis of measurements in case of a mammalian Ischnocera.

Key words : Biometry, Bovicola caprae, goat biting louse, Phthiraptera.

1. INTRODUCTION :

The knowledge on variations within a species is valuable not only for taxonomist but any one dealing with its biology. The evolutionist in particular as also the ecologist and population biologist are interested in nature and extent of variation within and between populations of species. Even in

early taxonomic descriptions of Mallophaga body measurements have been recorded by the workers. Certain workers have used the quantitative characters of biting lice to establish relationship among and within certain taxa or populations (Eichler, 1970; Eveleigh & Amano, 1977; Klockenhoff et al.,1979). However, in majority of biting lice taxonomy, the data are usually tabulated and at the most arithmetic means estimated. According to Sokal (1965), a typical species description should include a standard error of means, range, standard deviation and coefficient of variations for each measured character, in addition. The statistical treatment of morphological data has been recommended by authors like Sokal & Rohlf (1969) and Mayr (1969).

Certain workers have paid attention to biometrical studies on few avian Phthiraptera. Variation coefficients of some measurements of Degeeriella aguelarum have been studied by Tjonneland (1955); Martin-Mateo (1984) on three phthirapteran species infesting Picus viridis; variability of the two species of Columbicola has been recorded by Lonc (1985); this author (Lonc, 1990) analysed four phthirapteran species of poultry. The impact of variation on morphometry of lice have also been discussed (Lonc & Maslej, 1986). Recently, Lonc et al.(1992) compared the morphometric variability of mallophagan population (5 species) from Polish and Indian poultry birds. However, a look on literature reveals that studies on morphometric variability of mammalian Ischnocera have escaped the attention of workers. Recently, Rawat (1992) made preliminary attempt to

perform biometrical analysis of goat and sheep biting louse using 9 common characters. The present study is further extension of biometrical analysis of 12 characters of B. caprae, taking certain additional parameters like skewness and kurtosis.

2. MATERIAL AND METHODS :

Specimens used in the present study were randomly selected from collections obtained in and around Rishikesh. 30 adult males and females each of goat biting louse, Bovicola caprae were used during present investigations. After 12 hours treatment in 10% KOH and subsequent treatment with 5% Acetic Acid (after washing), the lice were dehydrated and mounted by routine method. On each individual, twelve somatic characters: head length (HL), head width (HW), antenna length (ANL), prothorax length (PL), prothorax width (PW), pterothorax length (PTL), pterothorax width (PTW), abdomen length (AL), abdomen width (AW), genitalial length (GL), genitalial width (GW)/terminalia length (TRL), terminalia width (TRW), and total length (TL), were measured using occular micrometer. All measurements were given in millimeters. Certain common statistics of location and dispersion like arithmetic mean ($\bar{Y}$), median (M), mode (m), standard deviation (S), standard error (SX), range (min. -max.) and coefficient of variation (V%) were computed. The departure from normality have been expressed by the value of skewness (g1) and kurtosis (g^2).

3. RESULTS :

Certain characters (PL, PW, PTW, AW, GW, and ANL in case of male B. caprae, HL, PL and PTL incase of female B. caprae) exhibited measures of central tendency ($\bar{Y}$.M.m) at the same point which is required for the normal distribution. In few instances for example abdominal width in case of male B. caprae, prothorax width, abdominal width and total width of female B. caprae , the mean and median of dimensions were almost identical. Similarly, few characters (head length, pterothorax length in case of male B. caprae, head width, abdominal length, total length and antennal length in case of female B. caprae) exhibited same value for median and mode. Bimodal conditions have been observed in case of head length of female B. caprae and prothorax length and abdominal width of male B. caprae. Pterothorax width and abdominal length of females exhibited trimodal condition. Thus, except six characters in male and three characters in female, the other characters presented typical asymmetrical distribution. The departure from normality has been noted by recording the skewness (g^1). In a normal frequency distribution value of g_1 is supposed to be zero (as exhibited by prothorax length, prothorax width, pterothorax width, abdominal width, genital width and antennal length of male B. caprae and head length,prothorax length, pterothorax length in case of female B. caprae). The minus value of g_1 for the characters indicate skewness towards left while the positive value indicates skewness towards right side. In case of males minus value of g_1 have been recorded for pterothorax length, abdominal length,

genitalial length and total length, while positively skewed distribution has been recorded for head length and head width respectively. Similarly, in case of females negative values for g_1 have been recorded for head width, prothorax width, abdominal length, terminalia length and total length, while pterothorax width, abdominal width, total width and antennal length exhibited positive value of g_1. In case of male B. caprae maximum value of g_1 have been recorded for pterothorax length (-0.83) while minimum value for genitalial length (-0.58). Likewise, in case of female maximum value of g_1 have been recorded for total length (-1.43) while minimum for pterothorax width (+0.05).

The values of standard deviation for each character have also been recorded (as shown in Fig.1 to 3). The dimension of total length exhibited maximum value of S.D. in both sexes (.07 in case of male B. caprae and .084 of female B. caprae). Minimum value of S.D. has been recorded for pterothorax length (0.012) in case of males while prothorax length (0.013) in case of females. However, the numerical value of S.D. is meaningful only in relation to mean value of same samples. In order to compare the degree of variability, it is often recommended to calculate the coefficient of variation which expresses the percentage of mean. The numerical value of CV depends upon the measured character and on particular taxonomic group. The calculation of C.V. is particularly useful when the comparable samples of same species found in different localities are

investigated. The value of C.V. of each character has been indicated in Figure (1 to 3) in form of (%). In present case maximum value of CV has been recorded for prothorax length (14.17%) in case of male and pterothorax length (12.22%) in case of female. Likewise, minimum value of CV has been obtained for head length in case of male (3.78) as well as female (3.64). Prothorax width (in both sexes) pterothorax width (in case of male) and total length in case of female are the other characters which have shown the value less than 5%. However, for other characters, a value higher than 5% has been recorded.

Kurtosis is yet another measure which tell us about the form of a distribution. It indicates whether the distribution, when plotted on graph paper would give us normal curve, a curve more flat than the normal curve or a curve more peaked than the normal curve. Kurtosis is measured by coefficient on its deviation (Y_2). In the present studies the value of g_2 and Y_2 have been recorded for each character. In case of males prothorax length, abdominal width and total length exhibit Leptokurtic condition while head length, prothorax length and pterothorax width exhibit Platykurtic condition. For other characters, condition is more or less Mesokurtic. In case of females Leptokurtic condition has been exhibited by prothorax length, pterothorax length, abdominal width, total length, and total width while head length pterothorax width, abdominal length and antennal length exhibited platykurtic condition. The other characters exhibited more or less Mesokurtic condition.

4. DISCUSSION :

Statistical analysis gives us important information as to weight which we should assign to certain characters. Highly variable characters are given low weight in classification. Experiences have shown that morphological measurements usually show a normal distribution. A strong deviation from normality requires, that we shall examine the matter with bias and possibility of heterogenity.

However, considering the application of mathematical tests in mallophagan taxonomy, based on selected morphometric data, Lonc (1990) stated that the distributions of these variables are more or less asymmetrical. She also analysed the measurements of nine (9) characters of four species occuring on poultry (viz. Eomenacanthus stramineus, Menopon gallinae, Goniocotes gallinae and Lipeurus caponis). None of the characters of these species had similar value for three measures of central tendency ($\bar{Y} = M = m$). However, in present case such condition occurred in the measurement of at least 6 characters of male B. caprae (PL, PW, PTW, AW, GW and ANL) and 3 characters of female B. caprae (HL, PL and PTL). But for other characters, the values were either positively or negatively skewed similar to phthirapterans occuring on pigeon and poultry)(Lonc; 1985,90).

In insects which reach imago stage through moult or metamorphosis, a small C.V. of linear measurement might be expected, since there is no further growth after sclerotisation of exoskeleton ~~has hardened~~. However, the final size of imago

depend to some extent on feeding conditions of larvae or nymph and as a result there is usually considerable variability in size of imago. The linear measurements are extremely variable in all animals that continue to grow throughout life. Tjonneland (1955) regards 5%, a smaller value of CV for comparative purpose (in case of mallophagans). In present case, the value of CV is more than 5% in the measurements at least 8 characters of male and 9 of female B. caprae. More or less similar results have been obtained for other species by Tjonneland (1955), Lonc (1985 and '90). For instance, Lonc (1985) found highest value of CV for the dimensions of abdominal width (CV-6.7% for male and 8.3% in case of female of C. columbae) and pterothorax width (11.5% in male and 17.5% in female of C. claviformis). Likewise, Lonc (1990) found the highest value of CV for the measurements of prothorax length and pterothorax length in case of Goniocotis gallinae (CV-13.0 and 12.6% respectively). In the present case (mammalian species) dimensions of prothorax length, pterothorax length, genitalial length and genitalial width have been found to be most variable characters in case of male B. caprae, but in case of female B. caprae prothorax length, pterothorax length, terminalia length and abdominal width are most variable characters. They should be given low weight during classification. Thus, it seems that dimensions of head are most reliable characters for the statistical measurements of mammalian lice.

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