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Research Paper

Population Composition of Three Phthirapteran Ectoparasites Infesting Sheep

Ashok Kumar and Adesh Kumar
Parasitology Laboratory,
Department of Zoology,
Pt. P.D.B. Himalayan Government P.G. College, Kotdwara,
Uttarakhand-246149, India

ABSTRACT: *Information regarding the population composition of phthirapteran ectoparasites affecting birds and mammals has always attracted the parasitic entomologists. Population of Phthiraptera remains confined to the body of host and is highly variable, ranging from absence to many thousands per host. Heavy and very heavy Population have affected the productivity and vitality of the host. So, Study of population must be considered for the development of an effective method for monitoring pest and establishing economic threshold on which the pest management should be based. In the present study, the population structure of three phthirapteran (viz. Bovicola ovis; Schrank, 1781, Linognathus ovillus, Newman; 1907 and Linognathus pedalis, Osborn, 1896) on sheep has been recorded by examining the four sheep hide. In case of B. ovis the male-female ratio was 1:1.5, adult-nymph ratio was 1:1.94 and the ratio between three instars of nymph was 1.12:1.95:1. The ratio between the male-female of L. ovillus was 1:4.1, the adult nymph ratio was 1:2.66 and the ratio between first, second and third nymph instars were 1:1.08:1.15. In case of L. pedalis the male female ratio was 1:2.94, the adult nymph ratio was 1:2.9 and ratio between three instars of nymph was 1:1.04:1.28. The female population was outnumbered in all the cases. The number of male and female follow similar pattern throughout population and were found to exhibit a high degree of correlation. However, study of population these parasites give clue for the need of eradication programme required at any places (India). Furthermore, there is no need of eradication measures because population levels of these parasites have not as much high to cause significant loss.*

KEYWORDS- *Phthiraptera, Mallophaga, Anoplura, Population composition, Bovicola ovis, Linognathus ovillus, Linognathus pedalis*

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I. INTRODUCTION

Population of Phthiraptera remains confined to the body of host and is highly variable, ranging from absence to many thousands per host. From mammals, maximum numbers of lice recorded is 19,000 *Damalinia jellisoni* from Dall's sheep (Kim, 1977) and 20,000 *Trichodectis canis* from injured dog (Hopkins, 1949). The size and composition of ectoparasite population are also highly variable, both spatially and temporally. Information regarding the population levels and composition of phthirapteran ectoparasites affecting birds and mammals has always attracted the parasitic entomologists. Only few workers like Hopkins (1949), Rawat *et al.* (1991), Kumar *et al.* (1993) and Kumar *et al.* (1996) have provided information on the population of Phthiraptera on domestic mammals. However, few other aspects of population of Phthiraptera on domestic mammals have been studied from time to time (by direct observation of live hosts) by certain workers. For instance, seasonal variations in the population of Phthiraptera (on domestic mammals) have been recorded on cattle by Matthysse (1946), Craufurd-Benson (1941), Jensen and Roberts (1966), Lewis *et al.* (1967) and Rawat and Saxena (1990); on sheep by Scott (1952), Murray (1963a, b, c, d, and 68) and Murray and Gordon (1969); on horses by Pafadt (1971); on pigs by Melnikova (1960) and Rawat *et al.* (1991); on dogs by Amin and Madbouly (1973) and Goel *et al.* (1990); on buffaloes by Blagovestchensky and Serdukove (1935), Chauduri and Kumar (1961) and Rawat *et al.* (1992); on deer by Samuel and Trainer (1971). The above said workers casually discussed about the impact of different factors (i.e. climate, host age, sex, health, nutrition, behaviour, hair density, nature of hair coat etc.) on population levels of Phthiraptera on mammals. Few other workers like

Ward (1957), Beer and Cook (1958) and Mohr and Stumpf (1964) have discussed the impact of inter species interaction in lice population. On the other hand, few workers like Hoyle (1938), Woodman and Dicke (1954), Boyd (1951), Baum (1968), Kalamarz (1963), Saxena *et al.* (1995), Eveleigh and Threlfall (1976), Fowler and Williams (1985), Chandra *et al.* (1988), Ash (1960), Klokenhoff and Wink (1973), Foster (1969), Agarwal and Saxena (1979) and Trivedi and Saxena (1991) have made valuable studies on population composition of avian Phthiraptera. Recently, workers like Ahamad *et al.* (2015), Kumar *et al.* (2013), Kumar and Kumar (2014) and Rashmi and Saxena (2017) have studied the population levels and composition of avian Phthiraptera. Workers like Nelson, Keirans *et al.* (1975) and Marshall (1981) have made attempt to review the work done in this field.

In the present study, an attempt has been made to furnish information on the population composition of three phthirapteran species viz. *B. ovis*, *L. ovillus* and *L. pedalis* infesting sheep.

II. MATERIALS AND METHODS

As many as four sheep were examined to obtain the data relating of population composition. In the different season of year 2002, heavily infested sheep were selected for slaughtering by the butchers. The fresh hide, head and feet were placed separate in large polythene bags and they were brought to the laboratory. A wad of cotton wool soaked in chloroform or ether were placed in the bags to anesthisize the lice. The hide was spread over large white plastic sheet. The hide was arbitrarily divided in 8 regions (i.e. neck, nape, back, brisket, sides, abdomen, legs and tail). Head and legs (lower parts) were also examined separately. Then the hide was cut into pieces according to the region. Each region was vigorously rubbed, brushed and combed over a large white plastic sheet. The debris, which falls on the sheet, consisting of hair, dirt and parasites were carefully collected in separate cavity block/petridishes containing 70% alcohol. The process was repeated many times until no more debris was obtained. Furthermore, each brushed piece was then subjected to search (by hair parting method) with the help of magnifying torch. The lice from head and foot were also removed separately by the same procedure. Finally, the lice collected from different region of the body were classified according to sex and stage of development (male, female and nymph instars).

III. Results

The population composition of three sheep lice was recorded by examination of four sheepskins. It was noted that sheep sacrificed in winter months shows higher level of population while that of sheep sacrificed in summer months. The population structure of three species is as follows:

***Bovicola ovis*:** An examination of Table-1 indicates that total 37,798 lice have been obtained from four sheepskins. The maximum 17,600 lice were obtained from sheep no. 1 and minimum 1456 lice were obtained from sheep no. 3. An average of 1,285.8 male, 1,925.8 female and 6,238 nymphs were obtained from four sheep. It was noted that female population was outnumbered than male population and adult population was outnumbered than nymph population. The male-female ratio was 1:1.5, adult nymph ratio was 1:1.94 and the ratio between three instars of nymph was 1.12:1.95:1 (first, second and third instar nymph respectively).

Table-1: Showing the population composition of *Bovicola ovis* on four hides of sheep.

Months of Slaughtering	Male	Female	Adult	1N	2N	3N	Total Nymph	Total lice	♂:♀	1N:2N:3N	A:N
Hide no. 1	2195	3226	5421	3105	6281	2793	12179	17600	1:1.46	1.11:2.44:1	1:2.24
Hide no. 2	2036	3121	5157	2503	3841	2314	8658	13815	1:1.53	1:1.65:1	1:1.67
Hide no. 3	207	295	502	263	477	214	954	1456	1:1.42	1.22:2.22:1	1:1.9
Hide no. 4	705	1061	1766	931	1404	826	3161	4927	1:1.50	1.12:1.69:1	1:1.79
Total	5143	7703	12846	6802	12003	6147	24952	37798			
Mean X	1285.8	1925.8	3211.5	1700.5	3000.8	1536.8	6238	9449.5	1:1.50	1.12:1.95:1	1:1.94

***Linognathus ovillus*:** A total 10,853 lice were recovered from four sheep hide at an average of 2,713.3 lice per sheep. Study of Table-2 indicates that the average number of males, female and nymph were 145.3, 595.3 and 1,972.8 lice per sheep respectively (table-2). The maximum (6824) lice were obtained from sheep no. 1 and minimum (678) lice from sheep no. 3. The female population of *L. ovillus* was higher than male population at all

level of infestation. However, their number varies considerably at different level of infestation. The male-female ratio was 1:4.1. Similarly, adult population was outnumbered than nymph population. The adult nymph ratio was 1:2.66. The numbers of three nymph instars were showed more or less similar count and the ratio between first, second and third nymph instars were 1:1.08:1.15.

Table-2: Showing the population composition of *Linognatus ovillus* on four hides of sheep.

Months of Slaughtering	Male	Female	Adult	1N	2N	3N	Total Nymph	Total lice	♂:♀	1N:2N:3N	A:N
Hide no. 1	383	1565	1948	1522	1632	1722	4876	6824	1:4.08	1:1.07:0.88	1:2.5
Hide no. 2	59	229	288	234	273	311	818	1106	1:3.88	1:1:1.32	1:2.84
Hide no. 3	37	148	185	154	171	168	493	678	1:4	1:1.11:1.09	1:2.66
Hide no. 4	102	429	541	534	568	608	1704	2245	1:4.2	1:1.06:1.13	1:3.14
Total	581	2381	2962	2444	2644	2803	7891	10853			
Mean X	145.3	595.3	740.5	611	661	700.8	1972.8	2713.3	1:4.10	1:1.08:1.15	1:2.66

***Linognathus pedalis*:** An examination of Table-3 indicates that population structure of *L. pedalis* were showed similar pattern as in case of *L. ovillus*. An average of male, female and nymph on each sheep were 159.8, 469.8 and 1,823.5. The female population was more or less three times higher than male. The male and female ratio was 1:2.94. It may vary considerably at different level of infestation. The nymph population was also more or less three times higher than adult population. The adult and nymph ratio were 1:2.9. The average ratio between three instars of nymph was 1:1.04:1.28 (first, second and third instar nymph respectively). The ratio of nymph instars was varying at different levels of infestation.

Table-3: Showing the population composition of *Linognathus pedalis* on four hides of sheep.

Months of Slaughtering	Male	Female	Adult	1N	2N	3N	Total Nymph	Total lice	♂:♀	1N:2N:3N	A:N
Hide no. 1	346	1079	1425	1147	1213	1748	4108	5533	1:3.11	1:1.08:1.52	1:2.88
Hide no. 2	94	244	338	353	369	282	1004	1342	1:2.59	1.25:1.3:1	1:2.97
Hide no. 3	23	57	82	62	70	101	233	313	1:2.47	1:1.12:1.62	1:2.84
Hide no. 4	176	499	675	632	635	682	1949	2624	1:2.78	1:1:1.07	1:2.88
Total	639	1879	2518	2194	2257	2813	7294	9812			
Mean X	159.8	469.8	629.5	548.5	571.8	703.3	1823.5	2453	1:2.94	1:1.04:1.28	1:2.90

IV. DISCUSSION

A thorough survey of literature reveals that any exhaustive attempt to furnish information on population structure (except few instances) of phthirapteran occurring on domestic mammals has never been made. Leaving out occasional counts of lice obtained by searching and brushing, there is hardly any published information on numbers of lice found on different hosts. Population of lice is highly variable ranging from absence to many hundred or even thousands per hosts. From birds, maximum number recorded is 10,000 amblycerans, *Austromenopon* species from common gull, *Larus canus* (Ash, 1960). Likewise, 8,000

amblyceran, *Menacanthus stramineus* have been recorded from domestic chicken (Pfadt, 1971) and 7,000 lice from wild cormorant, *Phalacrocorax migrogulasis* (Rothschild and Clay, 1952). From mammals, maximum numbers of lice recorded is over a million, *Bovicola ovis* from domestic sheep (Murray, 1965); 19,300 *B. jellisoni* from Dall's sheep (Kim, 1977) and 20,000 *Trichodectes canis* from an injured dog (Hopkins, 1949). However, in present case the maximum count obtained by brushing cum searching the sheepskin remained 12,179 *B. ovis*, 4,876 *L. ovillus* and 4,108 *L. pedalis* from sheepskin no. 1 (total 21,163 lice).

In all the cases (*B. ovis*, *L. ovillus* and *L. pedalis*) the female outnumbered the males. Other workers have noted the predominance of female in phthirapteran population also. In all groups of lice for which figures likely to be a rapidly increasing population. The same was noted by Eveleigh and Threlfall (1976) for lice on six species of auks. In the present case, the percentage of nymph of *B. ovis*, *L. ovillus* and *L. pedalis* were 66.0, 72.7 and 74.3% respectively.

Factors like temperature host reproductive cycle and host grooming behaviour may influence the population. Apart from climate, a number of other factors may also influence the lice population. For instance, age of host reportedly influences population level. Craufurd-Benson (1941) noted that calves are more susceptible than older cattles to three cattle lice (*Bovicola bovis*, *Linognathus vituli* and *Solenopotes capillatus*) but less to *Haematopinus eurysternus*. However, in case of bird lice, Baum (1968), Foster (1969a and b) and Kettle (1977) noted that age of host does not determine the level of mallophagan population. However, host species (variety) and health may affect the lice population. Most of the workers feel that weaker hosts are lousier than healthier ones. The host body size may also play a significant role in population size of lice e.g. small species of rodents support fewer lice than do closely related larger species (Mohr and Stumf, 1964). In the ungulates there are apparent correlations between sizes of host (or some factors associated with size and louse population). Hopkins (1949) also noted that smaller ungulates are usually heavily infested than the bigger ones. The host sex does not seem to affect the lice population as noted in case of avian Phthiraptera by Samuel and Trainer (1971), Eveleigh and Threlfall (1976), Kettle (1977) and Trivedi (1991). However, the differences do occur and males are generally more infested but in case of certain anopluran females carry greater population. Another important factor, which influences the population of lice, is the host behaviour. The grooming behaviour of host is considered as important factor determining louse level on host, at least in case of cattle lice (Lewis *et al.* 1967). Furthermore, host population density may also influence the population since the lice are mostly transferred form one host to another host by bodily contact or phoresy. The domestic mammals living in high densities on sometimes bear heavy infestation of lice. For example, on wild bird infestation are generally greater on colonial than solitary species (Dogiel, 1964). The impact of certain other factors like density of host hair coat and host nutrition remains inconclusive due to conflicting reports. Apart from host factors discussed above inter specific factors may also play their role. Since single species of host harbour a variety of ectoparasites at one time and place and thus the possibility of interaction among species of ectoparasites exists. Although, a positive correlation existed between pairs of lice has occasionally been noted (Beer and Cook, 1958; Ward, 1957; Trivedi, Rawat and Saxena, 1991). Furthermore, the density may also affect fitness of any individual to survive adverse weather condition (e.g. creating stress or lowering the quality of its environment). Thus, individual lice in high population may be fully exposed than those in low population to excessive sun or rain on large mammals due to damage caused by lice to the host coat. However, during present studies it was not feasible to note the impact of above said factors on the population of *B. ovis*, *L. ovillus* and *L. pedalis* as our studies were primarily designed to obtain population structure by studying the goatskin obtained from butchers. But aspect still remains open and further work may be done by housing statistically adequate numbers of sheep and examining them from above said point of view. Such a work may fill the lacunae of the field.

V. CONCLUSION

The present study has utilized brushing cum searching method for obtaining data relating to population structure of sheep lice. Any full proof method to take out the complete ectoparasite load from animals as bigger as sheep is not available. As far as brushing cum searching technique is concerned, it is likely to give lesser counts certain number of lice leave the skin before it reaches the hands of examiner. Few may be lost during preparation and examination. Furthermore, certain number of lice escapes notice among debris especially when this is large in quantity. Moreover, the smaller lice (first and second instars of nymph and also males) can easily be overlooked. Thus, the data obtained by brushing cum searching techniques gives lower counts especially for nymph. The female population was outnumbered in all the cases. The number of male and female follow similar pattern throughout population and were found to exhibit a high degree of correlation. However, study of population these parasites give clue for the need of eradication programme required at any places (India). Furthermore, there is no need of eradication measures because population levels of these parasites have not as much high to cause significant loss.

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Author's Profile

 First Author- **Dr. Ashok Kumar** did his D.Phil. from HNB Garhwal University. He has published three research papers. He is popularising science among school children.

Second Author

 **Dr. Adesh Kumar** has more than 30 years of expertise in teaching and research. At the beginning of his research career, he received numerous fellowships including Project Assistant, Senior Research Fellow, Research Associate, and Research Scientist for different projects of UGC ICMR, CSIR, DST. With over fifty research papers published across National and International Journals, he supervised four Ph.D. students and four research projects of DST, UCOST and UGC. Dr. Kumar is known for his energetic and intensive research work. It is due to his hard work, dedication and keen interest towards the subject, he has been awarded with several scientific awards and achievements. Author has delivered several lectures on his research work in National and International conferences, seminars and workshops.

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