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POPULATION COMPOSITION OF *CAMPANULOTES BIDENTATUS COMPAR* (BURMEISTER, 1838) INFESTING PIGEONS

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ABSTRACT

A study was undertaken to determine the population dynamics of phthirapteran ectoparasite Campanulotes bidentatus compar infesting pigeons. An average of 80.14% of C. bidentatus compar has been encountered on 50 pigeons of Kumaun regions. In overall composition female population was slightly higher to that of the male. The male-female ratio remained 1:1.07. Likewise, the nymphs outnumber the adults in the natural population. The male-nymphs ratio and the female-nymphs ratio was found to be 1:2.74 and 1:2.54 respectively. The overall I, II and III nymphs ratio was 1:0.82:0.75.

KEYWORDS: *Phthirapteran ectoparasite, Campanulotes bidentatus, Compar Infesting Pigeons*

INTRODUCTION

Population composition of any phthirapteran species differs considerably from a few two hundreds or even thousand on a single host. Such information about population parameters of these ectoparasites tends to attract the attention of phthirapterists. Though, only selected workers have furnished the information on population dynamics of phthirapteran ectoparasites on avian hosts. Eveleigh and Threlfall (1976) reported the population composition of four phthirapteran species occurring on auks. Likewise, information on population characteristics of *Brueelia* species on certain Indian finches has been given by Saxena *et al*. (2011). Ahmed *et al.* (2015) recorded the population levels of phthirapteran species on domestic ducks. Moreover, Ash (1960) noted the 10,000 amblyceran *Austromenopon* species from common gull, *Larus canus* while 8,000 amblyceran species of *Menacanthus stramineus* have been recorded by Pfladt (1971) on common chicken. Rothschild and Clay (1952) reported 7,000 lice on wild cormorant (*Phlalacrocorax nigrgularis*). However, under normal condition lice species do not reach such high level of infestation. Woodman and Dicke (1954) noted 3 lice (*Brueelia vulgata*) per bird on sparrows (*Passer domesticus*). Klockenhoff and Wink (1973) found 5 lice of different species per host from 696 birds belonging to various species. Nelson (1972) reported that the population of *Ricinus* never exceeds 35 per bird on different hosts.

Population characteristics of phthirapteran ectoparasites of certain common Indian birds viz. Common myna (Chandra *et al*. 1990), pigeons (Singh *et al*. 1998; Khan *et al.* 2009), red avadavats (Gupta *et al.* 2007), Indian parakeets, house sparrows, common myna and white breasted kingfishers (Saxena *et al*. 2007), house crows (Beg *et al.* 2008), poultry (Khan *et al*. 2008), bank myna (Rajput *et al*. 2009), cattle egret, striated babblers, snipe, green pigeon

(Ahmad *et al*. 2010, 2011, 2012a and 2012b), common hoopoe (Agarwal *et al.* 2011), common baya (Arya *et al*. 2011), finches (Saxena *et al*. 2011), European bee eater (Kristofix *et al*. 2007), blue rock pigeon (Singh, 1998), poultry bird (Kumar *et al*. 2004), red whisked Bulbul (Arya *et al*. 2010) and keep Gull and franklin's gull (Gonzalez-Acuna *et al.* 2011) and Fowl (Kumar and Hassan, 2015) have been provided by workers during the past two decades. The patterns of abundance of Mallophagans on avian hosts have been discussed by Rekasi *et al*. (1997), Rozsa (1997) and Reiczigel *et al.* (2005).

Likewise, different workers have also furnished information regarding population composition while dealing with another aspect of phthirapteran ectoparasites with avian hosts (Spellerberg *et al*. 1971; Saxena *et al*. 2004 and 2007; Gupta *et al.* 2007a and b; Beg *et al*. 2008; Khan *et al*. 2008; Agarwal *et al*. 2011; Ahmed *et al*. 2012a; Dochtermann and Gienger, 2012; Lamb *et al*. 2012; Galloway and Lamb, 2014 and 2015a and band Stenkenwitz *et al*. 2016). Some workers have given information regarding population levels of different phthirapteran species while dealing with prevalence and intensity of these ectoparasites on various host birds such as Sparrows (Hoyle, 1938; Woodman and Dicke, 1954), starlings (Boyd, 1951), chaffinches, robins, blackbirds, blue tits, great tits and some other birds species (Ash, 1960), black birds (Baum, 1968), alcids (Eveleigh and Threlfall, 1976), petrels (Fowler *et al*. 1984a), procellariform (Fowler *et al*, 1984b) reed bunting (Fowler and Williams, 1985) and common myna (Chandra *et al*. 1988 and 90). Workers like Foster (1969a and b), Agarwal and Saxena, (1979), Chandra *et al.* (1988 and 90) and Surman *et al*. (1996) have given clues about natural population level in the papers of seasonal variations in population of selection avian Phthiraptera while talking about the distribution of pigeon lice. Nelson and Murray (1971) have also noted the population level of four species of Phthiraptera. While investigating the economic effects of parasitism, Derylo (1974a and b) also made some remark on concern subject. Moreover, Eveleigh and Threllfall (1976), Trivedi and Saxena (1991) and Saxena *et al*. (1996 and 2011) have furnished information on population levels of avian Phthiraptera. Few other workers also describe the population structure of some phthirapteran species. For instance, Arya *et al*. (2011) studied population ecology of phthirapteran species on common baya. Population level of different type of lice on graylag goose and domestic ducks has been reported by Kumar *et al*. (2013) and Ahmed *et al*. (2015) respectively. Reiczigel *et al.* (2005) has given the method for analysis of crowding data.

Likewise, Hopkins (1949) studied population composition of certain phthirapteran species occurring on wild birds and mammals. Some workers have also provided information regarding the population of phthirapteran ectoparasites affecting different mammals such as Blagovestchensky and Serdukove (1935), Craufurd-Benson (1941), Matthysse (1946), Eichler (1948), Scott (1952), Ward (1957), Beer and Cook (1958), Chaudhuri and Kumar (1961), Scharff (1962), Murray (1963b, c, d and 1968), Mohr and Stumpt (1964), Jensen and Roberts (1966), Lewis *et al*. (1967), Murray and Gorden (1969), Henry and Conley (1970), Pfladt (1971), Samuel and Trainer (1971), Amin and Madbouly (1973), Kadulski (1974), Kim (1977), Goel *et al* (1990), Rawat and Saxena (1990), Rawat *et al*. (1991), Aznar *et al*. (2009), Rashmi and Saxena (2017) and Dik and Uslu (2018).

The present study has been undertaken to determine population composition of *Campanulotes bidentatus compar* occurring on pigeons of Kumaun.

MATERIALS AND METHODS

Different techniques have been put forward by workers for gathering Collecting the lice from infected birds. Beer and Cook (1957) put forward dissolving techniques in which all feather was dissolved in hot KOH and trypsin, followed by staining. But this method has been found quit extensive and troublesome (due to the practical difficulties involved in dissolving all feathers) (Stock and Hunt, 1989). However, Dusting technique of Floyd and Tower (1950) in which each feather was fluffed after dusting with pyrethrum, and brushing technique of Dunn (1932) in which individual feather of anesthetized bird were brushed, were also tried but did not obtain suitable results. Clayton and Drown (2001) has deliberated the efficacy of different method for quantifying the avian lice. For the present study, fluffing technique (Harshberger and Raffensperger, 1959) was found most appropriate. In this method, each feather was fluffed after fumigation with methyl bromide. Each bird was placed in fumigation chamber or plastic bag along with large cotton was soaked with chloroform (instead of methyl bromide, chloroform is used). Wings were locked over the back and legs were tied with thread to prevent loss of lice by movement of birds. After 30 minutes, the bird was removed from the chamber and hanged through legs with the wire. A large polythene bag with a large hole in the bottom (previously attached with a wire) was dragged over the bird. Feathers were fluffed with hand so anesthetized lice fell through the polythene bag with a large white paper/plastic sheet placed on table just below the head of the bird. More than 80% of lice load was obtained at 10 min. Furthermore, after removing the polythene bag, feathers were plucked out and skin was carefully examined with the help of magnifying lens for the presence of lice. Each feather was further examined under stereo zoom trinocular microscope for collecting any remaining lice and eggs. Collected lice were placed in a 70% alcohol.

Later on, lice and eggs obtained by above methods were sorted out on the basis of species, sex and developmental stage (nymphal instars). In the present study, an attempt has been made to record adult-nymph ratio, male-female ratio and different nymphal instars ratio of *C. bidentatus compar* on the body of pigeons. Population structure was also analysed after completion of study.

RESULTS

A total of 4007 *C. bidentatus compar* (nymphs as well as adult) were collected from 50 pigeons of Kumaun. Maximum number of given louse collected from birds was 235 while minimum 11, thus, the mean number of lice per infested bird i.e. lice index was found to be 80.14 (range 11-235 lice) (Table 1). Analyses of data shows that 22 birds carried 1-25 lice (mean:- 2.23♂, 3.59♀, 4.73 N, ♂:♀-1:1.61, A:N-1:0.81), 10 bird were placed in 25-50 lice category (mean:- 8♂, 10.5♀, N-15.9, M:F-1:1.31, A:N-1:1.21), 2 birds in 51-75 lice category (mean:- 17♂, 11♀, N-20.5, M:F-1:1.29, A:N-1:0.52), 3 in 76-100 lice category (mean:- 23.6♂, 26.33♀, N-33.33, M:F-1:1.11, A:N-1:0.62) and lastly, remaining 13 birds had more than 100 lice category (mean:- 46♂, 45.38♀, N-144.15, M:F-1:0.99, A:N-1:1.58). Thus, overall an average of 80.14 lice were collected (n=50, mean: - 16.64♂, 17.94♀, N-45.56, M:F-1:1.07, A:N-1:1.32) (Table 1 and 2, Figure1 and 2).

An examination of table 1 and 2 indicates that the overall male-female ratio remained 1:1.07. Thus the proportion of male and female remained almost similar. It was noted that in case of low infestation (i.e. 1-25, 26-50 and 51-75 lice category) female population had an edge over adult population. As the level of infestation increases (in 76-100 and >100 categories) the proportion become nearly equal to 1 (Figure 1).

The proportion of different instars in nymphal population (i.e. IN: IIN: IIIN) has also been recorded (Table 2, Figure 2). The results so obtained were found to be inconsistent. Population of III instars remained lowest in all mention class intervals. Population of II nymphal instars was reported higher than III nymphs (except one where II and III instars population become almost equal to one) and lowers than I nymphal instars (except in one category where II instars outnumber population of I instars) in almost all categories. The overall ratio of different instars remained 1:0.82:0.75.

Moreover, the proportion of adult and nymph was also recorded. Overall adult-nymph ratio was reported 1:1.32. However, irregularities in their proportion was observed. It was found that in some cases (such as 1-25, 26-50, 51-75 and 76-100 lice category) adult population outnumber nymphal population, while in other (such as 26-50 and >100 category) nymphal population showed dominancy over adult population (Table 2).

On the other hand, the overall male-nymphal ratio remained 1:2.74. In lower categories (1-25 and 26-50) population of nymphal was twice to that of adult male, as the level of infestation increases (51-75) the proportion of adult male becomes higher than nymphal population. But a further increase in infestation cause domination of nymphal population over adult male population (nymphal population was three times higher to that of the adult population in >100 lice category). Likewise, the overall proportion of female-nymphal population was found more than double (i.e. 1:2.54). Nymphal population outnumbered the female population in almost all categories (except in one category where nymphal and female population become nearly equal).

DISCUSSIONS

Population of phthirapteran species varies considerably (from nil to thousands per host) (Marshall, 1981). The higher population of these ectoparasites affects the productivity and vitality of their host. They can also act as reservoirs and a transmitter of pathogens (Saxena *et al*. 1985). Moreover, Rothschild and Clay (1952) recorded 7000 lice from wild cormorant, *phlalacrocorax nigrgularis* while 10,000 lice have been reported from common gull, *Larus canus* (Ash, 1960). Pfadt (1971) counted 8,000 *Menacanthus stramineus* from a common chicken. However, population of avian lice rarely reaches alarming level due to several defense mechanisms applied by hosts (i.e. preening, grooming, dusting, molting etc) (Price and Graham, 1997).

The infestation intensity of different phthirapteran species of birds has been recorded by some workers. For instance, 7 to 36 of lice per host on three varieties of auks (Eveleigh and Threlfall, 1976), 1 to 42 on Guillemot, rajor bills and storm petrels (Fowler *et al*. 1984), 21 to 76 on wood ducks (Thull, 1985), 6.6 on wilsons petrels (Fowler and Price, 1987), 3.2 per host on house martins (Clark *et al*. 1994), 1.3 to 3.9 to 5 varieties of shore birds (Hunter and Colwell, 1994), 1.9 on swifts (Lee and Clayton, 1995), 0.66 on flycatchers (Potti and Merino, 1995), 0.5 to 7.3 on bee eaters (Kristofik *et al*. 1996), 48.7 to 178.3 on peacocks (Stewart *et al*.1996) and 0.96 to 37.4 on mallards, 0.75 to 21.27 on collard dove rocks and 1.03 to 3.85 on hooded crows (Rekasi *et al*. 1997) and 5.14 lice on graylag goose (Kumar *et al*. 2013), 80.2 per bird on common Myna (Chandra *et al*. 1990), 18.4–182.5 per bird on domestic pigeons (Singh *et al*. 1998), 1.5–3.4 per bird on red avadavats (Gupta *et al*. 2007), 7.6–13.3 on house sparrows, 13.8–21.8 per host on parakeets, 17.7 per bird on kingfishers (Saxena *et al*. 2007), 11–27 on house crows (Beg *et al*. 2008), 6.8–16.6 per host on bank myna (Rajput *et al*. 2009), 52.8–103.2 per host on cattle egret, 13.2–16.4 per host on green pigeon,13.4 per host on babblers, 220.2 per host on snipes (Ahmad *et al*. 2010, 2011, 2012a and 2012b) and 13.97 per host on common baya (Arya *et al*. 2011).

The maximum number of lice collected on domestic ducks remained 60 for *Anaticola crassicornis*, 36 for *Anatoecus dentatus* and 75 for *Holomenpon leucoxanthum* (Ahmad *et al.* 2015).

Moreover, Chandra *et al*. (1990) reported the lice index on common Myna as 80.2 per bird. Trivedi and Saxena (1991) record the population composition of *Menacanthus Stramineus* on 27 domestic fowls of Dehradun and found its infestation index as 206.7 lice per birds while the infestation index of *Menopon gallinae* on poultry birds has been noted as 702.2 lice per birds by Saxena *et al*. (1996). Singh *et al*. (1998) noted the infestation intensity of four lice (*Columbicola columbae*, *Campanulotes bidentatus compar*, *Colpocephalum turbinatum* and *Hohorstiella lata*) as 141.02, 45.53, 182.5 and 18.93 lice per birds respectively.

In estimating population growth of any species, the age structure helps in determining whether the population is increasing (when there will be fewer adults) or decreasing (when there will be relatively more adults) or stable (Marshall, 1981). Examination of literature provides information on variation in age structure and temporal stability of the population. Some workers indicate that nymphs generally outnumber the adults in population of avian lice (Eveleigh and Threlfall, 1976; Chandra *et al*. 1990; Trivedi and Saxena, 1991, Kristofik *et al*. 1996, Saxena *et al*. 1996, Singh *et al*. 1998 and Ahmed *et al*. 2010 and 2015) while Singh *et al*. (2007) recorded the lower infestation intensity of nymphal population than adults. However, Gupta *et al*. (2007) reported considerable variation in proportion of adults-nymphs population and different nymphal population among different level of infestation. Such inconsistency was also reported in the present investigation (Table 1 and 2). Though, the percentage of nymphal instars are highly variable and is dependent upon several factors. Moreover, phthirapteran species exhibit seasonal variation in population, hence the age structure is bound to vary with time. Overall adult, nymph ratio of *C. bidentatus compar* on pigeons was found to be 1:1.32.

CONCLUSIONS

Generally, phthirapteran female outnumber the males in natural populations (Eveleigh and Threlfall, 1976; Chandra *et al*. 1990, Trivedi and Saxena, 1991; Kristofik *et al*. 1996, Saxena *et al*. 1996, Singh *et al*. 1998, Gupta *et al*. 2007, Singh *et al*. 2007, Arya *et al*. 2009 and Ahmed *et al*. 2010 and 2015). On the other hand, in case of mammalian lice, males are rare in natural population (Marshall, 1981). Rashmi and Saxena (2017) also noted that female dominated over the male population while nymphs outnumbered adult in natural population of goat lice (*Bovicola caprae and Linognathus africanus*). However, it is indicated that the sex ratio in natural population may alter because of various factors such as season, climate, host species population density and nutritional status. Asymmetrical sex proportion could be either due to uneven longevity of the two sexes (males are short lived than females) or due to sampling bias (Marshall, 1981). Possibilities of sampling errors are quite remote because of marginal difference in size of the two sexes of different phthirapteran species. In case of *C. bidentatus compar*, there is a marginal difference in size of male and female. In spite of this, the male-female ratio of this species remained 1:1.07.

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APPENDICES

Table: 1: Showing Population Dynamics of *Campanulotes bidentatus compar* on 50 Pigeons

Class Interval	Frequency	TL	Male	Female	TA	IN	IIN	IIIN	TN
1 - 25	22	10.54	2.23	3.59	5.82	2.55	1.32	0.86	4.73
26 - 50	10	34.4	8	10.5	18.5	6.2	5.5	4.2	15.9
51 - 75	2	59.5	17	11	39	7.5	11	2	20.5
76 -100	3	83.33	23.66	26.33	50	22.66	8.66	2	33.33
101<	13	235.53	46	45.38	91.38	52.69	45.84	45.62	144.15
Total	**50**	**80.14**	**16.64**	**17.94**	**34.58**	**17.72**	**14.56**	**13.28**	**45.56**

Abbreviations: TL - Total Lice; TA – Total Adults; IN – First Nymphal Instars; IIN – Second Nymphal Instars; IIIN – Third Nymphal Instars.

Table 2: Showing Population Dynamics Ration of *Campanulotes bidentatus compar* on 50 Pigeons

Class Interval	M:F	A:N	M:N	F:N	IN:IIN:IIIN
1 – 25	1:1.61	1:0.81	1:2.12	1:1.32	1:0.52:0.34
26 – 50	1:1.31	1:1.21	1:1.99	1:1.51	1:0.89:0.68
51 – 75	1:1.29	1:0.52	1:0.31	1:0.93	1:1.47:0.26
76 – 100	1:1.11	1:0.62	1:1.41	1:1.26	1:0.38:0.09
>100	1:0.99	1:1.58	1:3.13	1:3.18	1:0.87:0.86
Total	1:1.07	1:1.32	1:2.74	1:2.54	1:0.82:0.75

Abbreviations: M – Male; F – Female; A – Adult; N – Nymphs; IN – First Nymphal Instars; IIN – Second Nymphal Instars; IIIN – Third Nymphal Instars

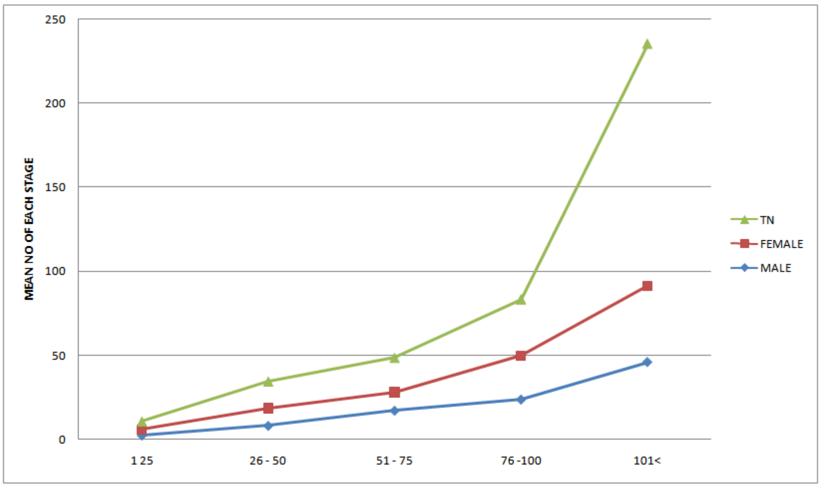

Figure 1: Showing Population Structure of *Campanulotes bidentatus compar* in Relation to Total Population on Pigeons

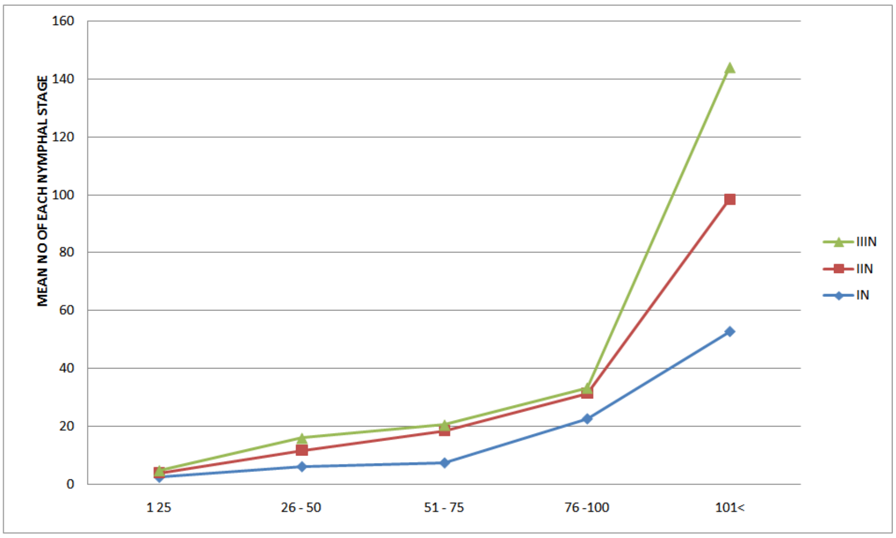

Figure 2: Showing Population Structure of Different Instars of Nymph of *Campanulotes bidentatus compar* in Relation to Total Population