



Prevalence of *Campanulotes Bidentatus Compar* Infesting Pigeons of Kumaun Region

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Abstract:- Prevalence of *Campanulotes bidentatus compar* has been investigated on the body of pigeons belonging to twelve localities of Kumaun region. Out of total pigeons (1080) examined 65.37% were found to be infested with *C. bidentatus compar*. The most prevalent place was Kashipur (86.33%) followed by Haldwani (84.46%), Ramnagar (84.16%), Pantnagar (73.63%), Rudrapur (70.75%), Chaukhutiya (63.63%), Ranikhet (52.7%), Almora (52.11%), Champawat (40.57%), Pithoragarh (36.06), Bageshwar (24.56%) and Someshwar (20%). Intensity of infestation was also determined by the coding system. As many as 45.09% of pigeons bore very light infestation followed by light infestation. While only few birds exhibited moderate, heavy and very heavy infestation. Moreover, some host factors which reportedly affect the prevalence and intensity rate was also observed. Certain factors are found considerable affect the louse prevalence. For instance, prevalence rate was significantly higher on larger flocks and older aged birds. Birds having poor plumage are also found to be more prevalent with *C. bidentatus compar*. On the other hand, few other factors such as host sex, health and hygienic condition barely affect the louse prevalence rate. Furthermore, mean monthly intensity was reportedly higher in summer and rainy months. Most of birds bore moderate, heavy and very heavy infestation during these months.

Keywords - Prevalence, *Campanulotes Bidentatus Compar*, Phthiraptera.

1. INTRODUCTION

Heavy infestation of phthirapteran ectoparasites affects meat, egg and feather productivity of host birds (Kumar and Kumar, 2012 and 2016). So, to develop any method for eradication of these ectoparasites, one must have complete knowledge about their prevalence and intensity of infestation on their avian hosts.

Some workers have provided valuable information about prevalence and intensity of selected phthirapteran species. On some avian hosts namely Starlings (Boyd, 1951), domestic hen (Kalamarz, 1963b; Derylo, 1974; Trivedi *et al.* 1992; Saxena *et al.* 1995 and 2004; Oliveira *et al.* 1999; Dik *et al.* 1999; Kumar *et al.* 2004; Goel *et al.* 2005; Sychra *et al.* 2008; Kumar, 2010; Ahmed *et al.* 2015 and Kumar and Kumar, 2016), pigeons (Rakshpal, 1959; Brown, 1970; Clayton, 1991; Singh *et al.* 1998; Singh, 1999; Clayton and Walther, 2001 and Khan *et al.* 2009), common Myna (Chandra, 1986), house crow (Beg *et al.* 2008), red avadavat (Gupta *et al.* 2004), house sparrows, parakeets, common myna, white breasted kingfisher (Saxena *et al.* 2007), brown partridges grey quails, turkeys, mallard ducks and helmeted guinea fowls (Khan *et al.* 2008), black birds (Baum, 1968), auks (Eveleigh and Threlfall, 1976), procellariiformes birds (Fowler *et al.* 1984), wood ducks (Thul, 1985), reed buntings (Fowler and Williams, 1985), Wilson's petrels and storm petrels (Fowler and Price, 1987),

leach's petrels (Fowler and Hodson, 1988), manx shearwaters (Fowler and Shaw, 1989), five shorebird species (Hunter and Colwell, 1994), house martins (al. 1996, Hoi *et al.* 1998 and Darolova *et al.* 2001), spanish raptors (Perez *et al.* 1996), rock ptarmigan (Skirnisson *et al.* 2012) and common mallard (Naz *et al.* 2016).

Time to time certain workers furnish information about prevalence rate and intensity of infestation of phthirapteran on birds. For instance, Hoyle (1938) and Woodman and Dicke (1954) recorded the incidence of different species on sparrows. Touleshkov (1965) examined the incidence of phthirapteran species on *Sturnus vulgaris* and also describe seasonal changes in natural population buildup. Agarwal and Saxena (1979) noted prevalence and intensity of *Lipeurus lawrensis tropicalis* in 551 poultry birds of Varanasi. Chandra (1986) and Chandra *et al.* (1989 and 1990) studied 646 common myna of Varanasi. Ahmed *et al.* (2012) discussed the prevalence of phthirapteran ectoparasites infesting yellow-legged green pigeon while Lamb and Galloway (2016) reported the seasonal change in prevalence and mean intensity of phthirapteran species invading three species of woodpeckers.

Workers like Lee and Clayton (1995), Sharma (1995), Darolova *et al.* (2001), Beg *et al.* (2008), Kumar (2010) and Ahmed *et al.* (2011) also furnish information on prevalence and intensity of infestation of phthirapteran species on different avian host.



Recently some workers also described the prevalence and intensity of avian Phthiraptera. For instance, Audi and Asmau (2014) recorded the prevalence of *Menacanthus cornutus* in four selected poultry farms in Nigeria. Singh *et al.* (2015) discussed the prevalence and intensity of phthirapteran ectoparasites invading euroasian collard dove. While Fabiyi *et al.* (2017) reported the prevalence and seasonal change of ectoparasites infesting backyard turkey.

Survey of literature indicates that information about prevalence and intensity of infestation of Phthiraptera has not well documented on Indian pigeons. Present study have been made to record the prevalence of *Campanulotes bidentatus compar* (Burmeister, 1838) on pigeons belonging to twelve localities of Kumaun region.

2. MATERIAL AND METHOD

Data for this study was collected from twelve different localities of Kumaun region (Ranikhet, Chaukhutiya, Bageshwar, Someshwar, Almora, Haldwani, Pantnagar, Rudrapur, Ramnagar, Kashipur, Pithoragarh and Champawat). Birds investigated were belongs to both domestic as well as wild blue rock pigeons. Pigeons were examined by following two methods: -

- i). In first method, legs of birds were tied with thick thread and each feather was deflected with finger/forceps to note the prevalence of lice with the help of magnifying torch.
- ii). While in second method, bird were put into the polythene bag along with cotton wool soaked in chloroform. The head of bird were kept outside the polythene bag to save bird. After ten minutes the feathers were fluffed over the large white plastic/paper sheet. The complete lice load were collected from plastic/paper sheet and collected lice were placed in properly labelled culture vials contain 70 % alcohol as preservatives (Kumar, 1994).

Information regarding each host such as host sex, health, feather colour, feather condition, host age, hygienic condition and mode of captivity were also recorded in data register. The permanent slide were prepared by a routine procedure and examined under trinocular research microscope. The phthirapteran species were identified and classified according to species, sex and stage of development (adult and nymph). Negative host were also recorded.

Prevalence and intensity of infestation were recorded by counting numbers of lice collected from host body. Intensity of infestation has been reported by coding system. Coding system is necessary to measure louse population on live birds which often cause problems to workers. In present work, Hershberger and Raffensperger (1961) coding system was used along with some modification of Derylo (1974). The intensity of infestation was recorded by subjecting infested bird to five minute observation for each species and then placing them under following categories: -

Negative	-	Devoid of lice (0 lice)
0 – 10	-	Very Light (VL)
11 – 25	-	Light (L)
26- 50	-	Medium (M)
51 – 100	-	Heavy (H)
>100	-	Very Heavy (VH)

Data obtain through above experiments were summerised and analysed.

3. OBSERVATION

A total of 1080 pigeons belonging to twelve localites (Shown in map, e.g. Ranikhet, Chaukhutiya, Bageshwar, Someshwar, Almora, Haldwani, Pantnagar, Rudrapur, Ramnagar, Kashipur, Pithoragarh and Champawat) were examined for recording prevalence and intensity of infestation of *Campanulotes bidentatus compar*. Localites for survey work for present work are selected on the basis that it covers all six districts of Kumaun. Most of the examined birds were blue rock pigeons. Out of total birds, 65.37% (n= 703) were found to be infested with *C. bidentatus compar*.

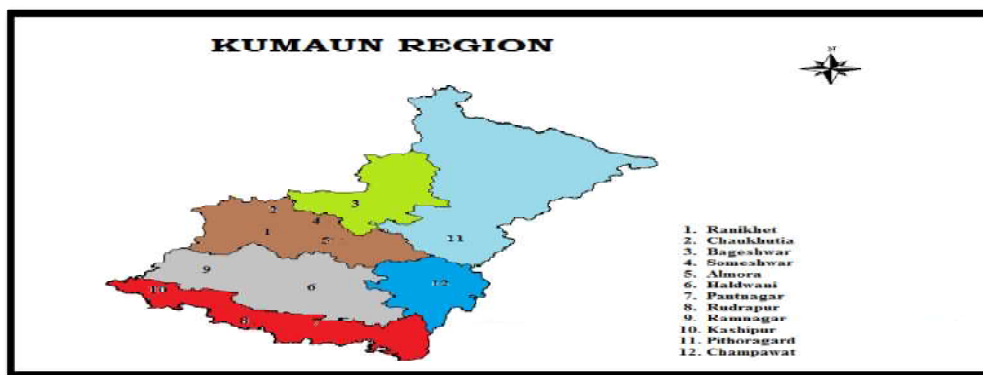


Figure 1: Kumaun Region

TABLE: 1. Showing Prevalence Rate (%) of *Campanulotes bidentatus compar* on Pigeons of Kumaun Region

LOCALITIES	TOTAL BIRDS EXAMINED	INFESTED BIRDS (%)	VL%	L%	M%	H%	VH%
RANIKHET	74	52.7	64.1	35.89	0	0	0
CHAUKHUTIA	77	63.63	53.06	42.85	4.08	0	0
BAGESHWAR	57	24.56	85.71	14.28	0	0	0
SOMESHWAR	45	20	88.8	11.11	0	0	0
ALMORA	71	52.11	54.05	43.24	2.7	0	0
HALDWANI	129	84.16	39.44	42.2	8.25	6.42	3.66
PANTNAGAR	110	73.63	43.21	41.97	7.41	4.93	2.46
RUDRAPUR	106	70.75	44	41.3	6.66	5.33	2.66
RAMNAGAR	120	84.16	41.58	39.6	9.9	4.95	3.96
KASHIPUR	161	86.33	40.28	37.41	10.79	7.19	4.31
PITHORAGARH	61	36.06	63.63	31.81	4.54	0	0
CHAMPAWAT	69	40.57	50	46.42	3.57	0	0
TOTAL	1080	65.37	46.6	39.09	8.78	4.24	2.54

Abbreviations: - VL - Very Light, L - Light, M - Moderate, H - Heavy and VH - Very Heavy.

An examination of table 1 indicates that *C. bidentatus compar* was found in all twelve selected localities. Prevalence rate in these areas were found in following order: -

Kashipur > Haldwani > Ramnagar > Pantnagar > Rudrapur > Chaukhutiya > Ranikhet > Almora > Champawat > Pithoragarh > Bageshwar > Someshwar.

Overall, highest intensity of *C. bidentatus compar* were found in Kashipur (86.33%). Prevalence

rate in Haldwani and Ramnagar were found to be nearly same (84.46% and 84.16% respectively). While, prevalence rate in Pantnagar and Rudrapur were 73.63% and 70.75% respectively followed by Chaukhutiya 63.63%. Marked difference in prevalence of *C. bidentatus compar* in Ranikhet, Almora, Champawat, Pithoragarh and Bageshwar were recorded as 52.7%, 52.11%, 40.57%, 36.06% and 24.56% respectively. Furthermore, lowest prevalence was reported in Someshwar 20% (Fig.2).

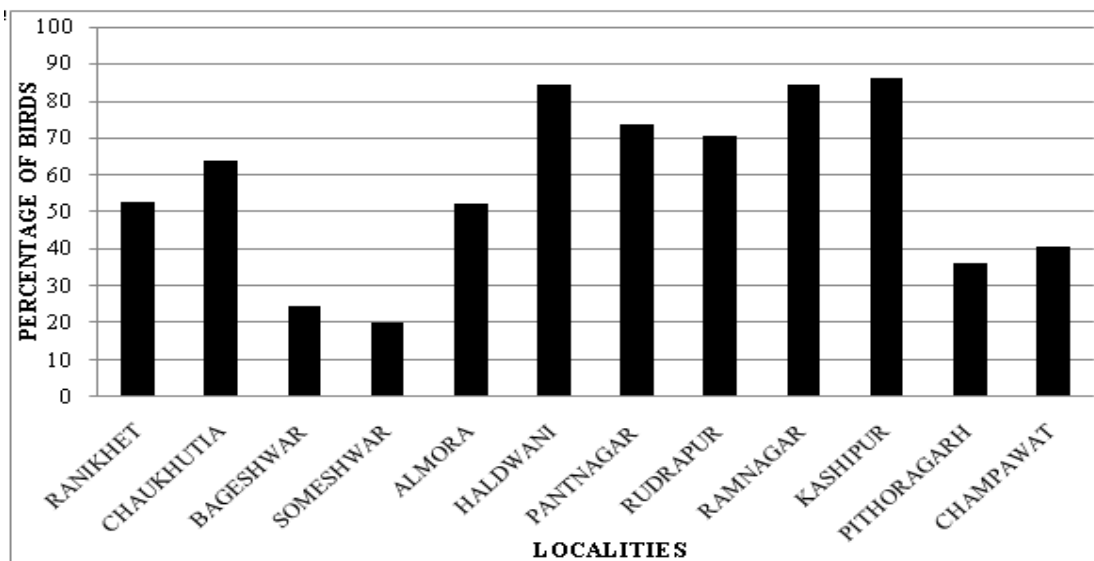


Figure 2

As many as 1080 pigeons were investigated. 676 of total birds examined were male and 584 female. Prevalence rate of *C. bidentatus compar* on two sexes of host were found to be nearly similar (i.e.

64.9% in male and 65.3% in female) (Fig.3). Hence, host sex exerted negligible effect on intensity of referred louse. Therefore, it may state that host sex do

not play any significant role in influencing prevalence rate of *C. bidentatus compar* in pigeons.

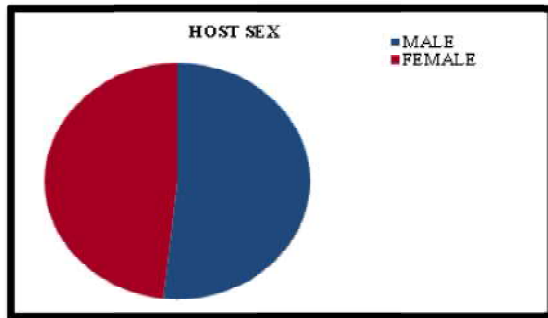


Figure 3: Showing Impact of Host Sex on Prevalence Rate of *Campanulotes bidentatus compar* on Pigeons.

An attempt was also made to mark the effect of host feather colour on prevalence of given louse. Examined birds were divided into four categories. About 42.77% of pigeons had white feathers, 6.1% black, 3.6% grey and rest 47.5% were put in miscellaneous category (mixed type). Prevalence rate of *C. bidentatus compar* seems to be higher in white category (75.4%) than other three categories. Miscellaneous and black feathered birds had prevalence rate of 61.75% and 37.67% respectively. While, grey feathered pigeons had lowest prevalence rate i.e. 20.51% (Fig. 4).

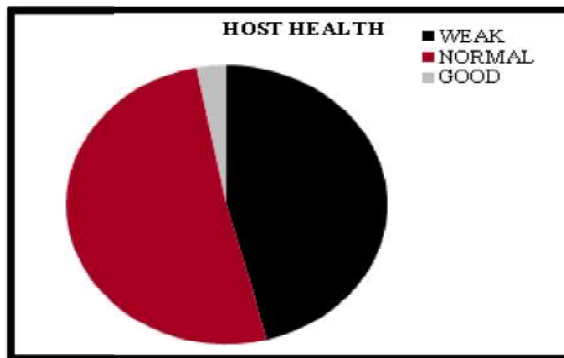


Figure 4: Showing Impact of Host Health on Prevalence Rate of *Campanulotes bidentatus compar* on Pigeons.

Furthermore, an effort has also been made to observe the impact of feather condition on prevalence rate of *C. bidentatus compar*. Investigated birds was placed in one of following mentioned categories: - Good, Normal and Poor. Pigeons having damaged ruffled feather were placed in poor category. It may be due to continuous scratching and preening by host, to get rid of lice. On the other hand, host with glossy plumage were placed in good category while rest were put in

normal one. About 14.16% of total birds examined were considered to have good plumage while 45.27% were placed in normal categories and rest of 40.55% were found to have poor feather (ruffled). Prevalence rate of mentioned louse was considerably higher on poor feathered birds (81.05%) in comparison to normal (59.31%) and good (37.9%) plumage birds (Fig. 5).

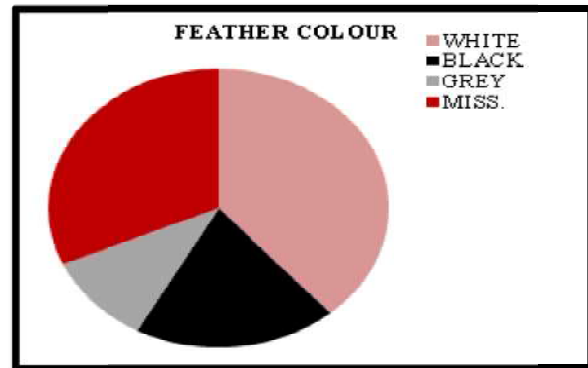


Figure 5: Showing Impact of Feather Colour on Prevalence Rate of *Campanulotes bidentatus compar* on Pigeons.

On the basis of general experience an attempt was also been made to record the general health of investigated birds under one of three categories: - good (Healthy), normal (average) and weak (poor). Categorization made was entirely arbitrary. 55.27% of total birds were found to be weak, 10.27% was appeared good (healthy) while 34.4% birds were placed in normal (average) category. Prevalence rate of *C. bidentatus compar* were reported to be slightly higher in normal birds (76.86%) than weaker birds (69.01%). On the other hand healthier (good) birds had only 4.5% of prevalence rate (Fig. 6).

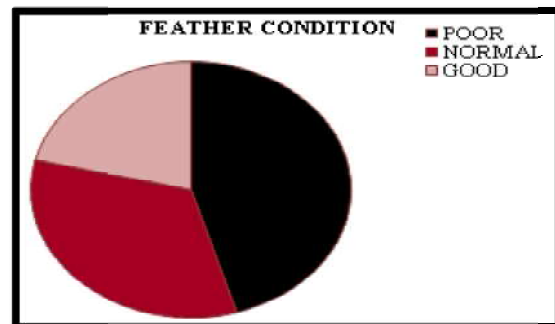


Figure 6: Showing Impact of Feather Condition on Prevalence Rate of *Campanulotes bidentatus compar* on Pigeons.

Hygienic condition (degree of cleanness) predominant around the site of rearing of examined birds was also been considered by placing them in under mentioned categories: - good, normal and bad. Most of birds examined were found to be maintained in bad condition (58.61%, n=633). While 35% (n=378) were kept in normal hygienic condition and only 6.38% (n=69) were found in good condition. Prevalence rate of *C. bidentatus compar* was reported to be slightly higher in birds placed in normal condition (69.57%) then bad category birds (68.32%) (Fig.7). Hence, hygienic condition does not seem to show much influence on prevalence rate.

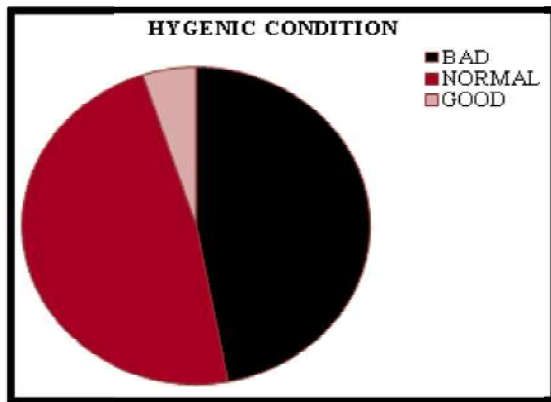


Figure 7: Showing Impact of Hygienic Condition on Prevalence Rate of *Campanulotes bidentatus compar* on Pigeons

Likewise, an effort has also been made to remark the age related difference in prevalence rate. All examined birds were assigned in five categories to which various aged birds / hosts belongs e.g. 0-6M, 6M-1Y, 1Y-1.5Y, 1.5Y-2Y and more than 2Y. Pigeons examined lies in five mentioned categories was 2.5%, 25.27%, 33.88%, 33.05% and 5.27% respectively. Prevalence rate of *C. bidentatus compar* on 0 – 6M, 6M – 1Y and 1Y – 1.5Y categories was reported to be 33.33% (n = 9), 36.26% (n = 99) and 75.41% (n = 276) respectively. While 1.5Y – 2Y and >2Y category birds have 77.87% and 71.9% respectively. Basically, prevalence rate of *C. bidentatus compar* was observed relatively higher on older birds (above 2Y) than younger age categories birds (below 1Y) and lower than adults (between 1Y – 2Y) (Fig. 8). Hence, discrete prevalence rate was noticed in relation to various host age categories.

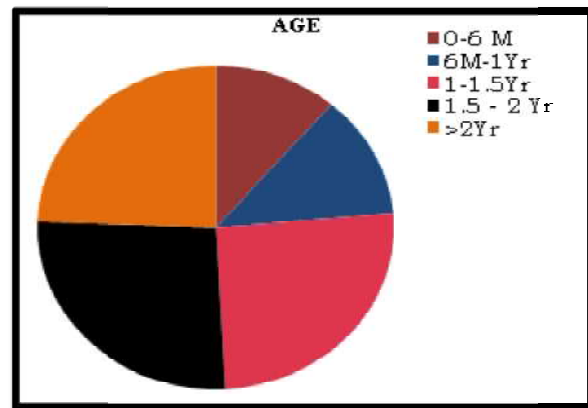


Figure 8: Showing Impact of Age on Prevalence Rate of *Campanulotes bidentatus compar* on Pigeons.

Effect of host captivity (number of birds in single cage/house/pens) on prevalence rate was demonstrated by recording the mode of captivity of examined birds. During survey work, 2–3 birds have been sampled arbitrarily from each group/house/pen. About 0.5% birds were being reared singly, 47.22% in group of 2–5, 16.11% in group of 6–15, 65.83% in 16–25 group and 12.77% of birds were found in bigger groups (having more than 25 birds). Only 6.6% of prevalence rate of given louse was reported on singly reared birds. However, prevalence of *C. bidentatus compar* was subsequently increases with increasing number of birds in flocks. Especially it was higher in larger grouped birds (more than 25 birds) (75.36%) than the other smaller group birds (Fig. 9).

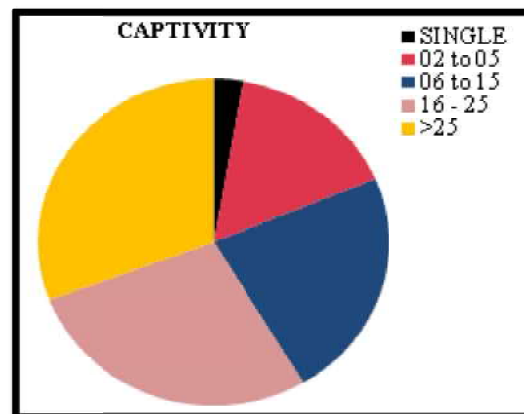


Figure 9: Showing Impact of Captivity on Prevalence Rate of *Campanulotes bidentatus compar* on Pigeons.

Intensity of infestation of *C. bidentatus compar* has been noted in coding categories as VL (very light), L (light), M (medium), H (heavy) and VH (very heavy). As many as, 65.37% of total investigated birds (n = 1080) have infestation of *C. bidentatus compar*. Most of the infested birds have

displayed very light (46.6%) infestation followed by light (39.09%). Furthermore, moderately, heavy and very heavy categories have comparatively lower infestation rate i.e. 8.78%, 4.24% and 2.54% respectively (Fig. 10).



Figure 10: Showing Overall Relative Intensity of *Campanulotes bidentatus compar* on Pigeons of Kumaun Region

Abbreviation: - VL - Very Light, L - Light, M - Moderate, H - Heavy and VH - Very Heavy.

Lastly, mean monthly intensity of *C. bidentatus compar* has also taken into consideration. Minimum intensity was recorded in January (13%). Intensity of *C. bidentatus compar* increases gradually in February and March (25% and 33.33% respectively) but it explode in succeeding two months (April – 76.66% and May – 80.5%) and reaches in extreme in June (92.25%). Afterwards, prevalence rate was gradually decreasing in the following months. A thorough examination of data shows that very heavy infestation

of *C. bidentatus compar* were reported during April to August while heavy infestation was found in months of march to August. Moderately infestation was noted from March to October (Fig. 12). However, maximum number of birds bore light and very light infestation of *C. bidentatus compar* throughout the year (Fig. 11). Hence, above data indicates relation with environmental factors as most of the moderate/ heavy/ very heavy infested birds were recorded during warmer and rainy months.

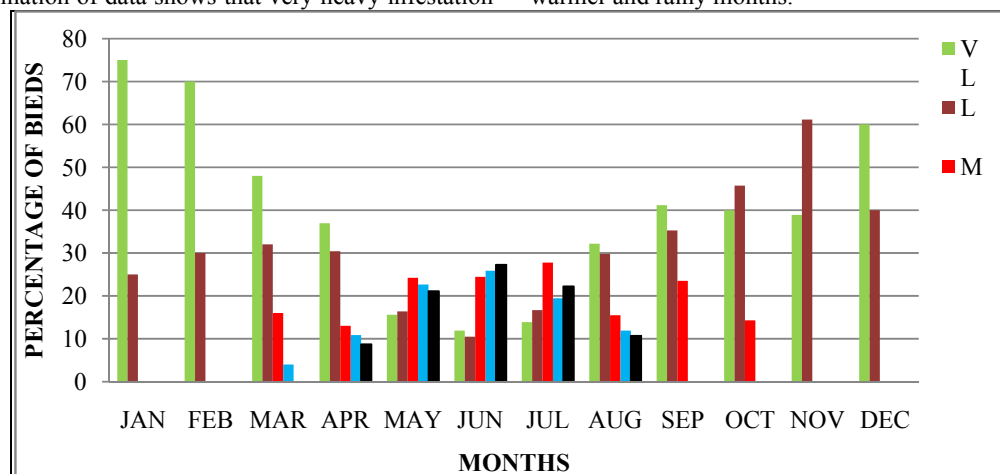


Figure 11: Showing Mean Monthly Intensity of *Campanulotes bidentatus compar* on Pigeons

Abbreviation: - VL - Very Light, L - Light, M - Moderate, H - Heavy and VH - Very Heavy

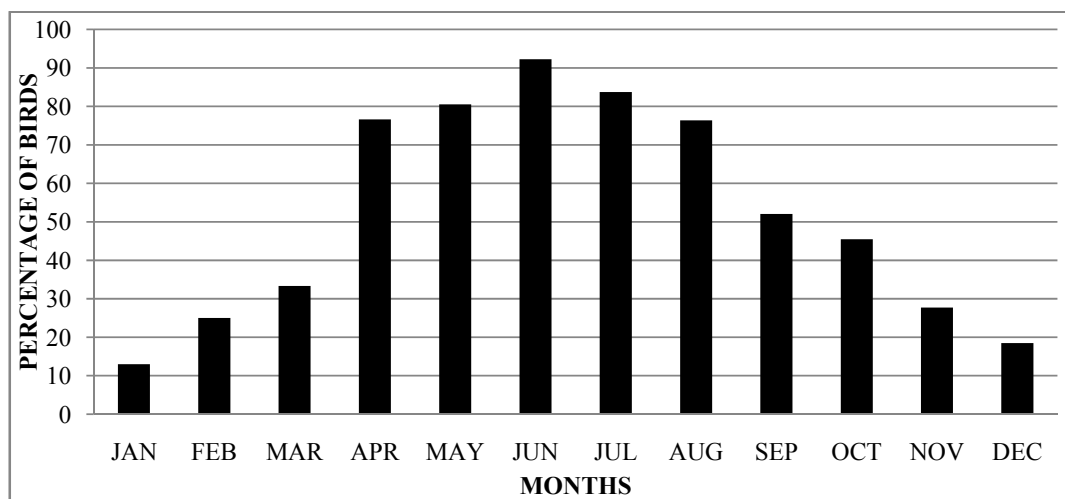


Figure 12: Showing Overall Mean Monthly Intensity of *Campanulotes bidentatus compar* on Pigeons

4. DISCUSSION

During last 20 years, only certain workers studied the prevalence of phthirapteran species on few Indian birds. Workers like Trivedi et al. (1992), Saxena et al. (1995 and 2004) and Goel et al. (2005) have recorded prevalence of phthirapteran species infesting domestic fowls from different Indian localities. Trivedi et al. (1992) studied the prevalence of eight phthirapteran species on 1249 domestic fowls of Dehradun (*Menopon gallinae* – 44.7%, *Menacanthus cornutus* – 40.4%, *Menacanthus stramineus* – 26.2%, *Goniocotes gallinae* – 19.2%, *Goniodes dissimilis* – 14.3%, *Lipeurus caponis* – 13.8%, *Lipeurus lawrensis tropicalis* – 9.2% and *Goniodes gigas* – 4.8%). Saxena et al. (1995) reported prevalence of poultry shaft louse *Menopon gallinae* on 1000 domestic of Garhwal Region (prevalence – 67.6%). Saxena et al. (2004) noted the prevalence of seven phthirapteran species on domestic fowls of Rampur (*Menopon gallinae* – 51.3%, *Menacanthus cornutus* – 8.1%, *Goniocotes gallinae* – 25.4%, *Goniodes dissimilis* – 7.9%, *Lipeurus caponis* – 11.5%, *Lipeurus lawrensis tropicalis* – 15.8%, *Goniodes gigas* – 4.48%, *Lipeurus heterographus* – 6.9%). Goel et al. (2005) also reported prevalence of six phthirapteran lice on domestic fowls of Meerut (*Menopon gallinae* – 65%, *Menacanthus cornutus* – 1%, *Menacanthus stramineus* – 3%, *Goniocotes gallinae* – 15%, *Goniodes dissimilis* – 8%, *Lipeurus lawrensis tropicalis* – 20 % and *Lipeurus heterographus* – 6.9%). 68.4% prevalence of *Menacanthus eurytenuis* on 646 common myna in Varanasi has been recorded by Chandra et al. (1990). Prevalence of four pigeon lice has been reported by Singh et al. (1998) on pigeons of Dehradun.

Moreover, Gupta et al. (2007) have noted the prevalence of lice on 130 red avadavats in district Rampur (*Brueelia amandavae* – 36.2%, *Myrsidea amandava* – 20.8%). Saxena et al. (2007) evaluated the prevalence of lice on 100 house sparrows (*Brueelia subtilis* – 31%, *Echinophilopterus chapni* – 14%, *Myrsidea quadrifasciata* – 20%) 100 indian parakeets (*Neopsittacus indicus* – 34%, *Echinophilopterus chapni* – 17%), 100 common myna (*Myrsidea invadens* – 31%, *Menacanthus eurytenuis* – 13%, *Brueelia chayanh* – 24%, *Sturnidoecus banno* – 42%) and 30 white breasted kingfisher of Rampur (*Meropoeus species* – 40%). Furthermore, Khan et al. (2008) recorded prevalence of phthirapteran species on 30 brown partridges (*Goniocotes jirufti* – 63.3%, *Uchida kalatitar* – 6%) 30 grey quails (*Lipeurus cinereus* – 50%, *M. abdominalis* – 3%), eight turkey (*Lipeurus tropicalis* – 65%), 60 mallard ducks (*Anaticola crassicornis* – 61.7%, *Holomenopon maxbeiesi* – 23.3%), 30 helmeted guinea fowl (*Menopon gallinae* – 33.3%, *Lipeurus caponis* – 13.3%, *Lipeurus lawrensis tropicalis* – 13.3%) in Rampur. Beg et al. (2008) have also provided information on prevalence of phthiraptera on 70 house crows (*Philopterus lahorensis* – 51.45%, *Allocolpocephalum fragilis* – 34.3%, *Corvonirmus saliemii* – 30%, *Menopon ganophoeus* – 18.6%, *Myrsidea backtititar* – 11.4%).

Literature on prevalence of phthirapteran ectoparasites from Kumaun has never been appeared. Hence, present study provides first information on the prevalence of *Campanulotes bidentatus compar* on pigeons belonging to twelve localities of Kumaun. Prevalence of *C. bidentatus compar* was found to be



65.37% while Singh (1999) recorded only 36% of prevalence rate of *C. bidentatus compar* in Dehradun.

Earlier workers furnish information on intensity of infestation of phthirapteran ectoparasites from distinct region of India. For instance, Ansari (1943) gave remark on intensity of certain species while making taxonomic record on phthirapteran ectoparasites of domestic fowls of Punjab. Infestation rate of Phthiraptera on some common Indian birds namely domestic fowls, grey quails, turkeys, mallard duck and guinea fowls have been reported by phthirapterist (Trivedi et al. 1992, Saxena et al. 1991 and 2004 and Khan et al. 2008). Range of infestation of different species on domestic fowl in proportion to maximum number of lice have been reported by Trivedi and Saxena (1992), Saxena et al. (1996) and Kumar et al. (2004) (*Menopon gallinae* -4017, *Menacanthus stramineus* - 578, *Menacanthus cornutus* - 357, *Lipeurus lawrensis tropicalis* - 206, *Goniocotes gallinae* - 385, *Goniodes dissimiles* - 1158).

Moreover, maximum number of phthirapteran species on avian hosts like pigeons (*Coloumbicola columbae* -828, *C. bidentatus compar* - 316, *Colpocephalum turbinatum* - 1759 and *Hohorsteilla lata* - 212), red avadavats (*Brueelia amandavae* - 32 and *Myrsidea amandava* - 27), house sparrows (*Brueelia subtilis* - 41, *Echinophiloaterus chapini* - 21, *Myrsidea quadrifasciata* - 28), Indian parakeets (*Neopsittaconirmus elbeli* - 46, *Echinophiloaterus chapini* - 28), common myna (*Myrsidea invadens* - 63, *Menacanthus eurytenuis* - 32, *Brueelia chayan* - 82, *Sturnidoecus* species - 106) and 30 white breasted kingfishers (*Meropoeus* species - 44) has given by different workers (Singh et al. 1998; Saxena et al. 2007; Gupta et al. 2007 and Khan et al. 2008 respectively). Rajput (2009) has also recorded maximum number of lice on bank myna (*Menacanthus eurytenuis* - 17, *Brueelia ginginianus* - 53 and *Sturnidoecus banno* - 23).

Some workers like Chandra et al. (1990), Singh et al. (1998), Saxena et al. (2007), Gupta et al. (2007), Khan et al. (2008) and Rajput (2009) have furnish information regarding mean intensity of phthirapteran species on different avian hosts such as 130 red avadavat (*Brueelia amandavae* - 9.9, *Myrsidea amandava* - 7.4), 100 house sparrow (*Brueelia subtilis* - 13.3, *Echinophiloaterus chaipni* - 7.6, *Myrsidea quadrifasciata* - 9.7), 50 pigeons (*Columbicola columbae* - 141.02, *Campanulotes bidentatus compar* - 45.53, *Colpocephalum turbinatum* - 183.5 and

Hohorsteilla lata - 18.9), 100 indian parakeet (*Neopsittaconirmus elbeli* - 21.08, *Echinophiloaterus chapini* - 13.08), 100 common myna (*Myrsidea invadens* - 16.3, *Menacanthus eurytenuis* - 37.5, *Brueelia chayan* - 28.9, *Sturnidoecus banno* - 37.7) and 147 bank myna (*Menacanthus eurytenuis* - 6.8, *Brueelia ginginianus* - 16.6 and *Sturnidoecus banno* - 8.16) and 30 white breasted kingfishers (*Meropoeus* species - 17.75).

During present studies maximum number of infested birds bore very light infestation (46.6%) of *C. bidentatus compar* followed by light (39.09%) and medium (8.78%) infestation while percentage of heavy and very heavy infested pigeons was considerably low (2 to 5 %).

Some host factors which reportedly affect prevalence rate was also taken into consideration during present studies. Certain workers have discussed the effect of host sex on prevalence of lice. In case of avian phthirapteran species, workers have provided conflicting reports on consulting subject. For instance, Eveleigh and Threlfall (1976) noted that infestation of three species did not vary with sex and weight in alcids (auks). Some workers recorded that lice were more prevalence on female birds namely sparrows (Woodman and Dicke, 1954), black birds (Baum, 1968) and 45 species of variety of birds (Ash 1960). Derylo (1968) noted that cocks are more prevalent than hens. Moreover, in case of orange crowned warble (Foster, 1969), domestic hens (Saxena et al. 1995) and european bee eaters (Hoi et al. 1998) insignificant difference in lice prevalence rate with respect to host sex has been noted. Singh et al. (1998) found negligible difference in prevalence rate of different species on two sexes. In bank myna, prevalence was found to be marginally higher on female (Rajput, 2009). Sharma (1995) found similar incidence rate on two sexes while recently Kumar (2010) recorded marginally higher prevalence rate of *Menacanthus cornutus* on male poultry birds. Recently, Galloway and Lamb (2015) also reported that females of all species of Phthiraptera invading flickers and sap sucker significantly outnumber male. Furthermore, in case of domestic ungulate prevalence of phthirapteran species has been recorded to be higher on female (Marshall, 1981) while Kumar (1993) recorded incidence of *Bovicola caprae* and *Linognathus africanus* was more or less similar on both sexes. On the other hand, Rawat (1992) furnish information on prevalence of domestic mammals. He noted that influence of *Haematopinus tuberculatus*



(buffaloes), *Linognathus ovillus* (sheep) and *Haematopinus suis* (Pigs) was higher on females than males. While prevalence of *Bovicola ovis* (Sheep has been found to be more on male than females). In present study, prevalence of *Campanulotes bidentatus compar* showed negligible difference on two sexes.

Saxena *et al.* (1995) has not found any influence of feather colour on incidence rate of *Menopon gallinae*. Sharma (1995) also did not record any relation of feather colour with incidence rate, while Saxena *et al.* (2004) and Singh (1999) have recorded slight difference in prevalence rate of different species with respect to feather colour of pigeons, which might be circumstantial. Moreover, Kumar (2010) also reported higher prevalence rate on red coloured poultry birds. In present case, marked difference in prevalence rate of *C. bidentatus compar* in different feather coloured pigeons was recorded. Prevalence rate was higher on white coloured birds than other three categories birds. It may be due to invisibility of these louse as feather colour provide background colour (*C. bidentatus compar* is dirty white in colour). It was difficult to detect them on light coloured host than dark one. So they may prefer to live on light feathered birds. But, most of workers do not found any correlation with feather colour and prevalence of phthirapteran ectoparasites.

An effort has also made to observe the relation between host feather condition and prevalence rate. For instance, Rajput (2009) recorded higher prevalence of lice on myna with poor feather condition had higher prevalence rate (Saxena *et al.* 1995). While Sharma (1995) found that incidence rate of *Goniodes dissimilis* remained almost similar on all three categories birds. Singh (1999) found that pigeons with poor feather show higher prevalence rate of all four species. Stenkewitz *et al.* (2017) reported the correlation between number of phthirapteran species and presence of feather holes in ptarmigan. In present work, prevalence of *C. bidentatus compar* found to be higher on pigeons possessing poor plumage than those carrying normal and good plumage. Although it was difficult to ensure that, birds having poor plumage are more prone to lice infestation or sustained infestation of Phthiraptera resulted in poor feather condition. As a matter of fact, the infestation birds continuously preen their feather with the help of their beak and claws in order to get rid of lice. In these circumstances, feather feeding Ischnocera causes huge destruction to feather of host birds (Kumar and Kumar, 2009). Consequently,

preening frequency often correlated to louse infestation. Moreover, it has been recorded that debeaking provokes louse progress in case of domestic hens (Brown, 1970), ducks (Eichler, 1971) and pigeons (Clayton and Tompkins, 1995).

Impact of host health on prevalence of phthirapteran species has also been recorded. Singh (1999) reported higher prevalence in weaker pigeons. Generally, it was assumed that unhealthy animals are more prone to infestation. Yet, Sharma (1995) noted numerically higher prevalence rate of *Goniodes dissimilis* in healthier birds. In present study also, prevalence of *C. bidentatus compar* was found to be higher in normal birds than weaker one. Related data shows that host health barely affected the prevalence rate of phthirapteran species.

Obstinated to general expectation, that unhygienic condition favour to explode infestation of phthirapteran species. Data reveals that hygienic condition around the maintenance site of birds barely affected the prevalence of *C. bidentatus compar*. In fact, pigeons kept in normal condition showed more prevalence than bad condition birds. However, Saxena *et al.* (1995) found that neatly maintained host has lesser prevalence of *Menopon gallinae* than poorly/normally maintained birds.

Conflicting reports have been provided by earlier workers on effects of host age on prevalence rate of phthirapteran. Some lice species were found to be more prevailing on juveniles in case of black birds (Baum, 1968), alcids (Eveleigh and Threlfall, 1976), wood ducks (Thul, 1985) and rock ptarmigan (Stenkewitz *et al.* 2016) while in domestic fowls, incidence rate gradually increases with age and remained higher on older birds (above 1Y) (Saxena *et al.* 1995a). Sharma (1995) also clearly marked the impact of host age on prevalence rate of *Goniodes dissimilis*. On the other hand, in case of orange crowned warbler (Foster, 1969), pigeons (Brown, 1970) and european bee eater (Hoi *et al.*, 1998) host age was not seemed too correlated with louse prevalence rate. Kumar (2010) also reported that prevalence of *Menacanthus cornutus* exhibited no distinct difference of age categories on prevalence rate. Hence, it may consider that host age does not have considerable effect on louse prevalence rate. Yet, in some domestic mammals (e.g. buffaloes, sheep and goats etc.) prevalence rate of lice was found to be slightly higher on adult than young ones (Rawat, 1992). However, in present case, prevalence rate of *C. bidentatus compar* was reported to be higher on adult



birds (above 1Y) than young while it was slightly lesser on older birds (above 2Y) than adult.

Modes of captivity or crowding have much impact on prevalence rate (aspected by few workers in case of mammalian lice). Lice transfer from one host to another through direct contact because of this in large groups, lice gets its full opportunity for its transmission from one host to another. As per expectation, prevalence rate was noted higher on birds which are reared in larger groups than singly reared and smaller grouped birds. Sharma (1995) recorded more or less similar incidence rate in all flocks. Moreover, Stenkewitz *et al.* (2016) recorded significant relation of prevalence of phthirapteran species with host population size.

Certain workers like Boyd (1951), Ash (1960), Touleshkov (1965), Baum (1968), Eveleigh and

Threlfall (1976), Agarwal and Saxena (1979), Chandra *et al.* (1990) and Saxena *et al.* (1995) reported that the avian lice generally peak in summer. Present studies also revealed that prevalence rate hit the highest point in months of June while it goes on decreasing thereafter. In winter months most of the birds bore light and very light infestation on the other hand some host are found with moderate, heavy and very heavy infestation during summer and rainy months. Therefore, it seems that high temperature and high humidity together offers favourable environment for blooming lice population.

From above discussions, it may be concluded that some host factors may occasionally affect louse prevalence in some cases while in others there is no significant difference in prevalence rate was noted.

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