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Original Research Paper

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SEASONAL VARIATION IN NATURAL POPULATION OF *CAMPANULOTES BIDENTATUS COMPAR*

Nisha Dhoundiyal Parasitology laboratory Government P. G. College, Ranikhet, Almora, Uttarakhand, India

Adesh Kumar* Parasitology laboratory Government P. G. College, Ranikhet, Almora, Uttarakhand, India. *Corresponding Author

ABSTRACT Seasonal variations of small pigeon louse, *Campanulotes bidentatus compar* population on *Columba livia*, were investigated from 2016 to 2017. Four pigeons (two males and two females) infested with *C. bidentatus. compar* were maintained in laboratory throughout the year. All demarcated regions of bird were carefully examined with help of magnifying torch for 5 minute fortnightly. Adult of both sexes and all nymphal instars show fluctuation in their population in different months of year. *C. bidentatus compar* reaches at their peak in late summer and early rainy months while remain quit low during winter months. Correlation between mean monthly lice index and four environmental factors (i.e. mean monthly temperature, relative humidity, rainfall and daylight) has also been analyzed. Strong positive correlation has been existed between lice index and daylight while temperature, relative humidity and rainfall exhibited moderate positive correlation with lice index.

KEYWORDS : *Columba livia, Campanulotes bidentatus compar,* seasonal variation

Phthiraptera species are perfectly adapted to microhabitat developed by their host. Even mallophagans species which prefer relatively constant environment offered by host feather or hair or coat in wooly mammals are appeared to react to climate change like other animals. Change in environmental factors (e.g. temperature, relative humidity, rainfall and daylight etc.) is speculated by population development on infesting host body (V. Keler, 1969).

Many phthirapterist examine seasonal change in mammalian and avian lice on their respective host. For instance, Derylo (1975) has cited the effect of environmental factors on intensity of avian Mallophaga. Moller *et al*. (2003) shows a close relation of seasonal change in immune response and parasitic impact on host. Gillbert and Mullens (2008) give a note on climate change and avian influenza. Bush *et al*. (2009) discovered that factors affecting geographic specificity can better describe the distribution of lice than does relatedness of their hosts. Seasonal variation in ectoparasites of rock ptarmigan have been recorded by Þórarinsdóttir *et al*. (2010). Lamb and Galloway (2016) presented the seasonal dynamics of chewing lice invading three species of woodpecker. While Stenkewitz (2017) described the influence of parasites on ptarmigan population change over a period of seven years (2000-2007). Moreover seasonality of avian phthirapteran population have been documented by certain workers like Boyd (1951), Woodman and Dick (1954), Ash (1960), Touleshkov (1965), Baum (1968), Foster (1969), Watson and Anderson (1975), Eveleigh and Threlfall (1976), Agarwal and Saxena (1979), Chandra *et al*. (1988 and 90), Surman *et al*. (1996), Singh (1999) and Kumar (2010). On the other hand, workers like Craufurd-Benson (1941), Cowan (1946), Matthysse (1946), Allen and Dicke (1954), Murray (1957, 1960, 1963 and 1968), Samuel and Trainer (1971), Amin and Madbouley (1973), Rust (1974), Rawat and Saxena (1990 and 1992) and Kumar et al. (1993) discussed the seasonal change in mammalian lice population.

In last few years certain workers like Kumar and Kumar (2012), Vastveit (2013), Kumar and Kumar (2014), Kumar *et al*. (2015) and Galloway and Lamb (2015) well documented the seasonal changes in population of avian Phthiraptera.

Through analysis of literature reveals that avian lice peaks in summer Boyd (1951) Woodman and Dick (1954), Ash (1960), Touleshkov (1965), Baum (1968), Agarwal and Saxena (1979a), Chandra *et al*. (1988 and 90), Surman *et al*. (1998) and Kumar (2010) while mammalian lice reaches in maxima in winters (Craufurd-Benson (1941), Cowan (1946), Matthysse (1946), Scott (1952), Allen and Dicke (1954), Murray (1957), 1960, 1963 and 1968), Murray and Gordon (1969), Samuel and Trainer (1971), Amin and Madbouley (1973), Rust (1974), Rawat and Saxena (1990 and 1992) and Kumar *et al*. (1993). Though, population of amblyceran louse, *Heterodoxous spiniger* parasitizing dog peaks in summer instead of winter months (Amin and Madbouly, 1973).

Furthermore, literature on seasonal variation in population of pigeons lice are seldomly displayed. Singh (1999) reported the seasonal dynamics of two pigeons lice. However, seasonal variation in population of *C. bidentatus compar* remained unexplained so far. Furthermore, an attempt has also been made to analyse the population fluctuation of *C. bidentatus compar* on pigeons. Lice index was also correlated with ecofactors (i.e. temperature, relative humidity, rainfall and daylight).

Material and Methods

For present experiment, four adult pigeons (two males and two females) infested with *C. bidentatus compar* were brought and reared in laboratory. Birds were maintained in laboratory throughout the year in simple portable shed cage. Selected birds were of local breed *Columba livia domestica* aging 6-9 months in beginning of experimentation. Proper nutritional feed (wheat, rice, grinded maize and oat etc.) water and hygienic condition were maintained till the ending of experiment.

Each bird was carefully observed in every fifteen days for 5 minute with the help of magnifying torch, to note lice index by deflecting individual feather, usage of magnifying torch was proven very useful to evaluate the lice numbers on host body. Each body part of birds was seeked out for lice which were inflicted by *C. bidentatus compar*. Hence, whole visible lice were considered, as it was hard to distinguish between two sex of adults and nymphal instars in *in vivo* examination. Moreover, any authentic method for counting accurate number of lice on live birds is unavailable. Furthermore, an effort has also been made to register the correlation between mean monthly Lice index and four ecofactors (e.g. temperature, relative humidity, rainfall and daylight).

Observation

Small pigeon louse, *Campanulotes bidentatus compar* is a small, slow moving and prefers to live on ventral fluffy feather. An experiment on seasonal variation in population of *C. bidentatus compar* has been set out from November 2016 to October 2017. The average lice index was found to be 7.12 in November but gradually it starts declining in succeeding four months (table- 1, fig.1). Thereafter, lice index arises in next two months (April- 13.12 and May – 23.87) when maximum daylight duration was reported. They reached at their peak in months of June when humidity and daylight seems to be optimum for lice. Furthermore, lice index displayed decreasing tendency in following four months. *C. bidentatus compar* found to be very sensible to daylight period. As minimal lice index was noted in months of January when lowest day light period and temperature was reported. Infact, there is slight difference in lice index in January and December (3.12 and 3.75 respectively) (Table-1).

From above observation, it may consider that louse population varying seasonally. Population of *C. bidentatus compar* rises in late springs reaching in maxima in last summer and early rainy months. Thereafter, it goes on decreasing and continues lowering throughout the winter months (Table-1, Fig. 1).

An attempt has also been made to ascertain the correlation between the mean monthly lice index and four ecofactors (i.e. mean monthly temperature, relative humidity, rainfall and daylight) (Fig.1). An examination of table-2 reflected the strong positive correlation between lice index and daylight (r_{14} = +0.87) (Fig.5). While moderate positive correlation was registered between lice index and temperature (r_{12} = +0.54) (Table-2, Fig.2). Likewise, relative humidity and rainfall exhibited considerably positive correlation with lice index (r_{13} = +0.68 and r_{15} = + 0.67 respectively) (Table-2, Fig.3 and 4). In Ranikhet, huge fluctuation of some environmental factor has been reported. Because of this reason *C. bidentatus compar* might exhibited such variation in their population structure. Moreover, temperature of hilly areas of Kumaun remains quit low throughout the year may be due to this reason lice population shows slow growth rate.

Discussion

Phthirapteran ectoparasites show significant fluctuation in population on the birds of Ranikhet. Mammalian lice rose in winter while avian lice peak in summer. However, there are considerable conflicts over the reasons responsible for such variation in their population. Several factors reportedly determine the population structure of avian lice. In spite of environmental factors (e.g. temperature, humidity, rainfall and daylight), many host factors (i.e. host grooming, moulting, nestling activity, breeding, transfer of lice after hatching, host crowding, skin secretion, hair/feather condition etc.) also affect the lice population (Craufurd-Benson, 1941; Lancaster, 1957; Jensen and Roberts, 1966; Lewis *et al*. 1967; Ely and Harvey, 1969; Gibey *et al*. 1985; Rawat and Saxena, 1992 and Kumar *et al*. 1993). Baum (1968) noticed that there is no difference in population density of amblyceran as well as ischnoceran species with change in environmental factors while Keler (1969) reported the seasonal change in mallophagan population density.

Season may directly or indirectly stimulate morphological, physiological and behavior change in hosts. In summer, birds and mammals favor bathing with water which might have delousing effects. Felso and Rozsa (2006 and 2007) have pointed out that birds and mammals dividing behaviour limit genera richness of phthirapteran species. Hair/wool/feather may also alter the host physiology (i.e. mobility, migration, grooming etc.). For instance, Zekhhov (1949) have documented that season may also affect lice population by altering host grooming behaviour. Brown (1974) studied effect of louse infestation on wet feather and relative humidity on grooming behaviour. Birds preening activity also have some impact on lice population (Brown, 1972 and Clayton *et al*. 1999). Birds which cannot preen have immense risk of increasing their louse population (Moyer *et al*. 2003). Brown (1970) also documented the impact of preening behaviour of birds through debeaking experiment. Kumar and Kumar (2010) also reported the impact of allopreening on controlling amblyceran species on domestic fowls. Villa *et al.* (2016) found that allopreening was a better predictor of louse loads than self preening. Pomerey (1962) and Clayton *et al*. (1999) notice that birds having deformities in their beak bore clumsy lice load than birds with normal beak. Scratching activity of mammals also play important role in shaping population buildup of lice. Bell *et al*. (1962) and Bell and Clifford (1964) recorded that front parts of mice have higher lice density because of ineffective scratching due to lost hind legs. James *et al*. (1998) also noted that a lame lamb represent as major source of lice on a particular property.

Moreover, role of environmental temperature in inducing seasonal change in population of avian lice documented by Ash (1960), Baum (1968), Derylo (1974), Agarwal and Saxena (1979b), Chandra *et al*. (1988 and 90) and Surman *et al*. (1996). Few workers like Woodman and Dicke (1954) for *Brueelia vulgata* infesting sparrows, Eveleigh and Threlfall (1976) on several species of *Saemundssonia cummingsiella* and *Astromenopon* invading auks and Agarwal and Saxena (1979a) on *Lipeurus lawrensis tropicalis* infesting *Gallus gallus domesticus*, Touleshkov (1965) on few mallophagan species parasitizing *Sturnus vulgaris* and Kumar (2010) on *Goniodes dissimilis* intruding on domestic fowls have also reported more or less similar pattern of lice fluctuation with seasonality. Recently, Galloway and Lamb (2015) studied the seasonal variation on feral pigeons. He noticed that *Campanulotes compar* population was low in springs and peaks in September.

Singh (1999) reported the seasonality of one amblyceran and one ischnoceran species infesting pigeons. He noted a huge degree of correlation between lice population and mean monthly temperature and photoperiod. However present investigation reflects moderate correlation of lice index with temperature and optimum relation with daylight period.

Moreover, present observation also shows that daylight period exhibited more prominent effect on increasing louse population than other three factors. Yet, accurate assumption cannot be made until the experiments are executed under highly restricted condition (room equipped with thermostatically controlled unit) after nursing enough number of hosts. Such investigation may provide significant data about role of environmental factor in causing seasonal variation of *C. bidentatus compar*.

Table- 1: Showing Estimated Mean Monthly Lice Index of *Campanulotes bidentatus compar* Count on Four Pigeons (*Columba livia*).

MONTH	MEAN LICE INDEX
NOVEMBER	7.125
DECEMBER	3.375
JANUARY	3.125
FEBRUARY	4.5
MARCH	6.75
APRIL	13.13
MAY	23.88
JUNE	25.38
JULY	19.25
AUGUST	17
SEPTEMBER	14.5
OCTOBER	10.13

Table-2: Showing Correlation between Mean Monthly Lice Index of *Campanulotes bidentatus compar and four ecofactors.*

r_{12}	0.5432
r_{13}	0.6828
r_{14}	0.8719
r_{15}	0.6748

Abbreviations:

r - Karl Pearson's Correlation Coefficient;
1 - Mean Monthly Lice Index;
2 - Mean Monthly Temperature;
3 - Mean Monthly Relative Humidity;
4 - Mean Monthly Rainfall;
5 - Mean Monthly Day-light.

Figure- 1: Showing Seasonal Changes in Population of *Campanulotes bidentatus compar* in Relation To Four Ecofactors During 2016-17.

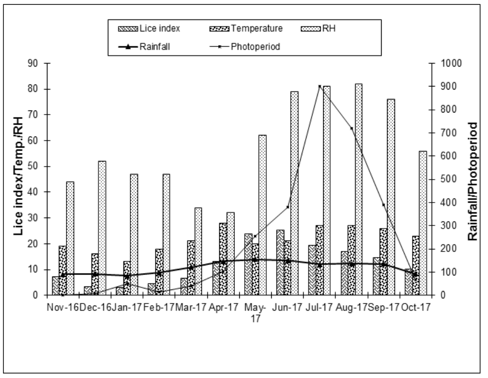


Figure- 2: Showing Linear Regression between Mean Monthly Lice Index of *Campanulotes bidentatus compar* and Mean Monthly Temperature during 2016-17

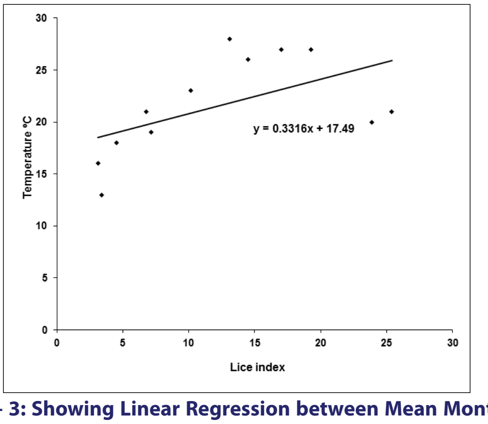


Figure- 3: Showing Linear Regression between Mean Monthly Lice Index of *Campanulotes bidentatus compar* and Mean Monthly Relative Humidity during 2016-17

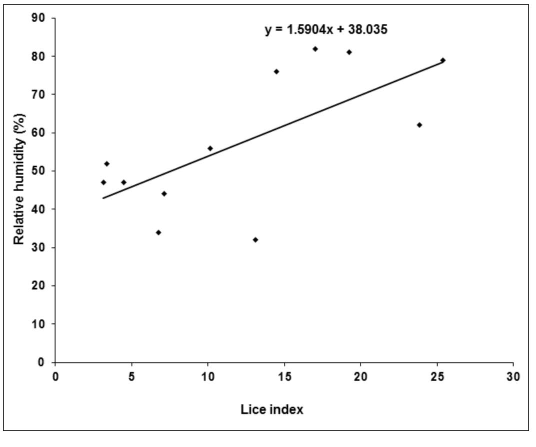


Figure- 4: Showing Linear Regression between Mean Monthly Lice Index of *Campanulotes bidentatus compar* and Mean Monthly Rainfall during 2016-17

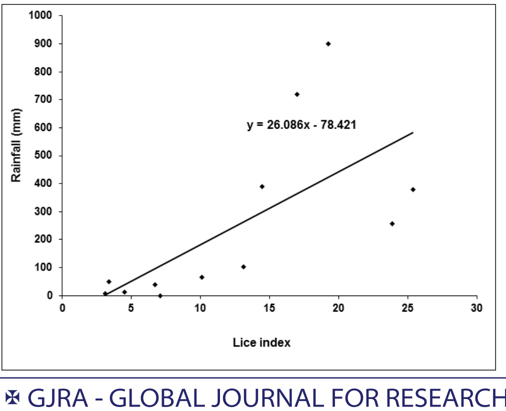
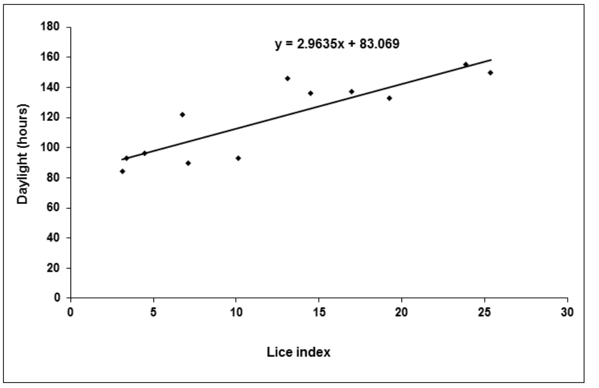


Figure- 5: Showing Linear Regression between Mean Monthly Lice Index of *Campanulotes bidentatus compar* and Mean Monthly Daylight during 2016-17



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