Studies on Patterns of Budgeting of Daily Life Schedule Activities by Little Brown Doves (Streptopelia Senegalensis Senegalensis) and Their Interrelationships with Fluctuating Independent Variables

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Abstract: **The present study reveals the quantification of time activity budget of Little Brown Doves, Streptopelia senegalensis senegalensis carried out in Jammu region of Jammu and Kashmir from June 2009 to May 2010. Night roosting was recorded to be the major nocturnal activity of Little Brown Doves (40.80%), followed by the diurnal activities like feeding (26.27%), breeding activities (14.25%), preening (7.77%), locomotion (4.03%), resting (3.98%) and lastly miscellaneous activities (2.75%). Moreover, the relationship between the fluctuating abiotic factors (maximum temperature, relative humidity in morning and afternoon and rainfall) and changes in the daily life activities of Little Brown Doves was also pondered upon using scattergrams which reflected six types of impacts by abiotic factors on the daily activities; low positive, moderate positive, high positive, low negative, moderate negative and high negative.**

Keywords: Activity Budget; Feeding; Breeding; Preening; Relative Humidity; Locomotion.

I. INTRODUCTION

The time and amount of energy the bird devotes to different activities must inevitably influence its survival [1]. Time-activity budget of birds vary greatly according to the type of habitats they inhabit and food they eat [2], individual physical condition, social structure and environmental conditions [3].The present paper deals with daily time activity budget of Little Brown Doves (*Streptopelia senegalensis seneglensis*) in different seasons with respect to the existing abiotic factors influencing them. In India, not many studies have been conducted for the budgeting of the daily life schedule activities of columbids in general and Little Brown Doves (*Streptopelia senegalensis senegalensis*) in particular. Little Brown Doves (*Streptopelia senegalensis senegalensis*) belongs to the family Columbidae of order Columbiformes and is a small slender, long tailed, brown and grey dove with a small "chessboard" in black and rufous on either side of fore-neck. The present communication encompasses the main objective to gather firsthand information pertaining to the various patterns of allocation of time in the different activities by Little Brown Doves and their subsequent relationships with the fluctuations in abiotic factors like maximum temperature, relative humidity in the morning and afternoon and rainfall as virtually nothing has been reported before pertaining to the aforementioned aspects of the bird from the study area.

II. MATERIALS AND METHODS

A. Study Area

The study was conducted in Jammu (Fig.1), winter capital of the state of Jammu and Kashmir (India) which lies between 32° 27' and 33° 50" North latitudes and 74° 19" and 75° 20" east longitudes with an altitude of 250 to 410 m above the mean sea level. The study period extended from 2009 to 2010.The study area was dominated by dominant plant species like *Acacia nilotica* (Babul), *Acacia modesta* (Kramishatrav), *Dalbergia sissoo* (Sheesham), *Morus alba* (Shahtoot), *Eucalyptus tereticornis* (Safeda), *Mangifera indica* (Aam), *Zizyphus spp*.(Ber), *Butea monosperma* (Pallash), *Adhatoda vasica*, *Grewia optiva* (Dhamin), *Emblica officinalis* (Amla), *Cannabis sativa* (Bhang), *Ficus bengalensis* (Barghad), *Ficus religiosa* (Peepal), *Calotropis procera* (Akvan)

etc. Agriculture included predominantly of *Oryza sativa* (Rice), *Triticum aestivum* (Wheat), *Zea mays* (Maize), vegetables and fruit trees.

B. Methodology

Data were collected monthly from June 2009 to May 2010 for a period of one year by conducting periodic surveys in the area under inquisition from 0630 to 1200 h in the morning and 1300 to 1900 h in evening during summer and 0730 to 1200 h in morning and 1400 to 1830 h in evening during winter. In addition to it, several erratic excursions were also conducted during different hours of the day, before sunrise to sunset. The birds were observed with naked eye and through binoculars (Bushnell 7 X 50 U. S. A. made) whenever found necessary to record the data from quite a long distance in order to avoid any interference to birds due to the presence of observers. Photographic evidence was collected with the aid of Canon EOS camera fitted with 300 mm zoom lens, Digital Camera (Sony) fitted with 14.1 megapixel lens with an optical zoom of 4X. Besides, videos recordings were done with the aid of 800 X Digital 200M/Optical 20 X video camera. The observations were taken on their activity patterns using "Focal Animal Sampling" technique [4].

The data was collected when Little Brown Doves were active in their habitats. During the study period, a total of 250 individuals were selected randomly by pointing the binoculars towards the birds under observation and by selecting birds closest to eye distance. Activities of each individual bird were monitored every 15 seconds up to 15 minutes. Activities were categorized as feeding (searching, procuring /handling food, grit and pecking at the substances), preening (scratching, stretching, feather shaking, head shaking, wing flapping, bill cleaning, bill scratching, body-shaking and tail shaking), resting(sleeping or dozing i.e. inactive with the head retracted and eyes closed), locomotion (walking on ground and perch, running, and flying), breeding activities (courtship displays in breeding season, copulation, vocalisations, incubation, feeding the young ones and rearing them up or brooding), night roosting (resting at night) and miscellaneous activities (flying, drinking and scanning, vocalisations other than courtship and agnostic behaviour).To study seasonal variation in activity patterns, the study period was divided into four seasons viz. Summer (March-June), Monsoon (July-September), Autumn (October-November) and Winter (December-February).

C. Statistical Analysis

Scattergrams, resulting from plotting changes in overall daily life schedule activities of Little Brown Doves (dependent variable) against corresponding changes in the abiotic factors like maximum temperature, relative humidity (morning and afternoon) and rainfall (independent variables), and the fitted regression lines ($y = a + bx$) were computed to predict any change in the quantitative relationship between the dependent (daily activities of Little Brown Doves) and independent variables [5].

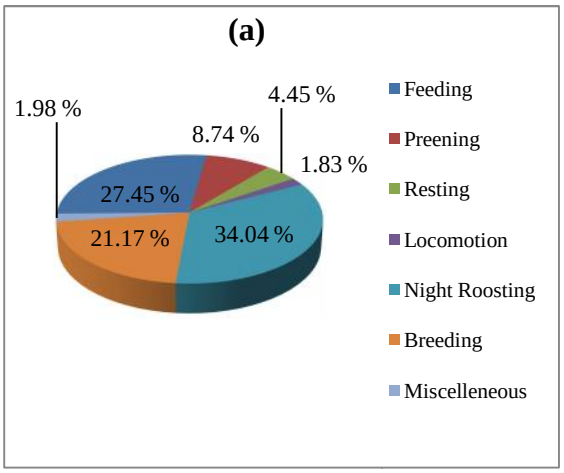
III. RESULTS AND DISCUSSION

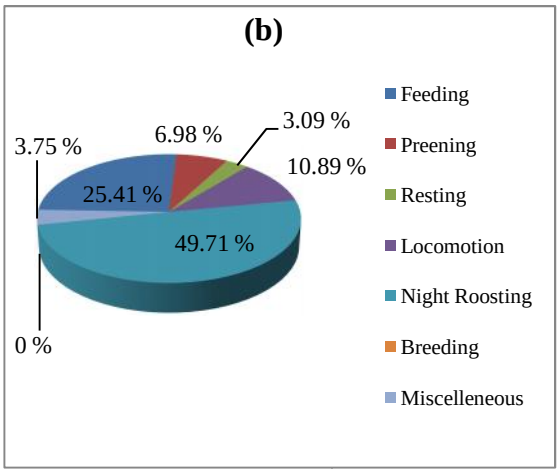
Major activities like feeding, preening, resting, locomotion, breeding, miscellaneous and night roosting were taken into consideration while sketching the daily activity budget of Little Brown Doves in the study area. The time spared by the Little Brown Doves in accomplishing all the vital activities was recorded to differ among the seasons. It was observed during the study period that Little Brown Doves nearly spent 27.45 % of their time in feeding, 8.74% (preening), 4.45% (resting), 1.83% (locomotion), 34.04% (night roosting), 21.17% (breeding activities) and 1.98% (miscellaneous activities) in summer [Fig. 2(a)]. On the other hand, in winter, the percentage of the various activities was recorded to be 25.41% (feeding), 6.98% (preening), 3.09% (resting), 10.89% (locomotion), 49.71% (night roosting) and 3.75% (miscellaneous activities) [Fig. 2(b)]. Autumn season witnessed 26.03% of total time of Little Brown Doves in feeding, 7.85% in preening, 2.95% in resting, 2.24% in locomotion, 39.92% in night roosting, 16.45% in breeding activities and 4.53 % in miscellaneous activities [Fig. 2(c)]. However, in case of monsoon season, 25.58 % of the total day time was reflected by Little Brown Doves in feeding, 7.13% in preening, 4.89% in resting, 1.53 % in locomotion, 42.24 % in night roosting, 17.02 % in breeding activities and 1.66% in miscellaneous activities[Fig. 2(d)]. Overall, night roosting was recorded to be the most frequent nocturnal activity contributing 40.80% to the total activity budget whereas among the diurnal activities, feeding represented the maximum contribution (26.27%) to the activity budget, followed by breeding activities (14.25%), preening (7.77%), locomotion (4.03%), resting (3.98%) and lastly miscellaneous activities (2.75%). The observed trend of the diverse activities season wise is expressed in Table 1.

TABLE 1. SEASONAL TREND OF DAILY LIFE ACTIVITIES.

Name of the activity	**Trend of the execution of a particular activity season wise**
Feeding	Summer>Autumn> Monsoon> Winter.
Preening	Summer>Autumn>Winter> Monsoon.
Resting	Monsoon > Summer> Autumn > Winter
Locomotion	Winter> Autumn> Summer>Monsoon
Night Roosting	Winter>Monsoon>Autumn>Summer
Breeding Activities	Summer >Monsoon> Autumn
Miscellaneous	Autumn >Winter > Summer> Monsoon

Figure 1. Map of study area (Courtsey: Google Earth)





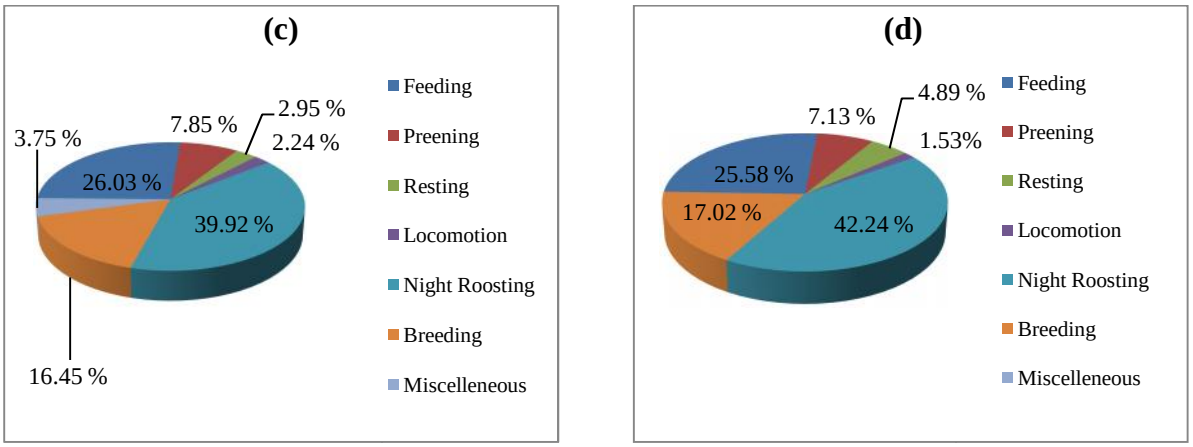


Figure 2. Percentage of different activities in the activity budget of Little Brown Doves in (a) Summer (b) Winter (c) Autumn and (d) Monsoon.

Feeding was the most prevalent diurnal activity among Little Brown Doves and it was detected to be the maximum in summer followed by autumn, monsoon and winter (Table 1). This activity was found to be related to the breeding period of Little Brown Doves in the study area. As the breeding period of Little Brown Doves was found to extend from March to October i.e. through summer, monsoon and autumn, thus, the dietary requirements were seen to be more during these periods to feed the youngones thereby resulting in frequent feeding trips in these seasons and less feeding trips in winter season. In addition to this, the activity of preening by Little Brown Doves was mostly exhibited while resting, although, it was also viewed while feeding, locomotion and courtship. This activity was maximally observed during the summer season as during summer, there is more prevalence of ectoparasites on the bird's body. Efficient preening is critical for the straightening and oiling of feathers and removal of dirt and debris from the body surface [6] whereas ineffective preening leads to rapid increases in ectoparasite load [7,8], thereby leading to reduced survival [9] and mating success [10] . Level of infestation greatly governs the amount of time birds spend in grooming. Time spent to this kind of body maintenance activities were recorded in several bird species [11, 12, 13].

The resting was discerned to be the maximum in monsoon season because of the intermittent spells of rain and it was the minimum in winter due to the devotion of maximum time by Little Brown Doves in winters in searching the food as the availability of food was affected in winters. The activity of resting was deduced to be inversely related to feeding and locomotion as increase in the percentage of resting caused a decline in the percentage of the other two activities in the total activity budget of Little Brown Doves whereas this activity was directly proportional to preening as the more Little Brown Doves were discerned to rest on the wires and perches, the more they were found to be involved in the act of preening or grooming their body. Earlier many researchers found the resting to be a major mid day activity of birds [14, 15]. [16] suggested that an increase in resting in summer acts as a mechanism to minimize the heat load on the bird at high environmental temperatures. In addition to it, the activity of locomotion aided in increasing the chances of Little Brown Doves to spend more time in feeding but other activities like drinking water, taking a flight were also observed to be related to locomotion.

A. Relationship amongst correlates studied

Figures 3, 4, 5, 6, 7, 8 and 9 revealed scattergrams with fitted regression lines showing linear relationships between changes in all the abiotic variables i.e. maximum temperature, relative humidity (morning), relative humidity (evening) and rainfall (mm) and feeding activities of Little Brown Doves, all the abiotic variables and preening activities of Little Brown Doves, all the abiotic variables and resting activities of Little Brown Doves, all the abiotic variables and locomotion activities of Little Brown Doves, all the abiotic variables and night roosting activities of Little Brown Doves, all the abiotic variables and breeding activities of Little Brown Doves and all the abiotic variables and miscellaneous activities of Little Brown Doves for the

study year 2009-2010. Fluctuations in the maximum temperature had a moderate positive impact on percentage of feeding (y=0.057x + 24.58, R^2=0.127), low positive impact on preening (y=0.035x + 6.814, R^2=0.054), moderate positive effect of resting (y=0.092x + 1.153, R^2=0.442) and high positive effect on breeding (y=0.983x - 15.45, R^2=0.732) but a high negative impact on locomotion (y= -0.428x +16.81, R^2=0.720), moderate negative impact on night roosting (y= -0.636x + 60.08, R^2=0.568) and miscellaneous (y= -0.098x + 5.727, R^2=0.334). On the other hand the impact of relative humidity in the morning effected the percentage of feeding (y=-0.043x + 29.61, R^2=0.276) and percentage of breeding(y= -0.042x + 11.13, R^2=0.301) in a highly negative manner whereas a low negative relation (y= -0.367x +42.22, R^2=0.397) was observed to exist between relative humidity in the morning and percentage of preening along with percentage of resting also (y= -0.031x + 6.364, R^2=0.205). Besides, relative humidity in the morning also reflected a highly positive impact on percentage of locomotion (y=0.125x - 5.648, R^2=0.238), a moderate positive relation with the percentage of night roosting (y= -0.328x + 15.86, R^2=0.586) and miscellaneous activities (y= -0.032x + 0.307, R^2=0.142).The relationship between relative humidity in the afternoon and feeding (y=-0.044x + 28.22, R^2=0.315) and breeding activities (y=-0.270x + 25.66, R^2=0.228) was highly negative while it was moderately negative(y= -0.050x + 10.03, R^2=0.445) in case of preening activities and low negative(y= -0.002x + 4.023, R^2=0.001). There was a high positive relation between the independent variable i.e. relative humidity in afternoon and locomotion (y= -0.077x + 0.635, R^2=0.096) whereas it shared a moderate positive correlation with the night roosting (y= -0.292x + 28.42, R^2=0.495). In addition to it, a neutral relationship was deduced between relative humidity in afternoon and miscellaneous activities (y= 0.000x + 2.731, R^2=0.000). Similarly, the another independent variable rainfall depicted a moderate negative relationship with the dependent variables i.e. feeding (y= -0.016x + 26.53, R^2=0.121), preening (y= -0.025x + 8.231, R^2=0.330), locomotion (y= -0.044x + 4.561, R^2=0.094) and miscellaneous (y= -0.021x + 3.070, R^2=0.201) accompanied by a moderate positive relation with resting (y=0.013x + 3.731, R^2=0.118), low positive with night roosting (y=0.032x + 40.52, R^2=0.017) and breeding (y=0.057x + 13.26, R^2=0.031).

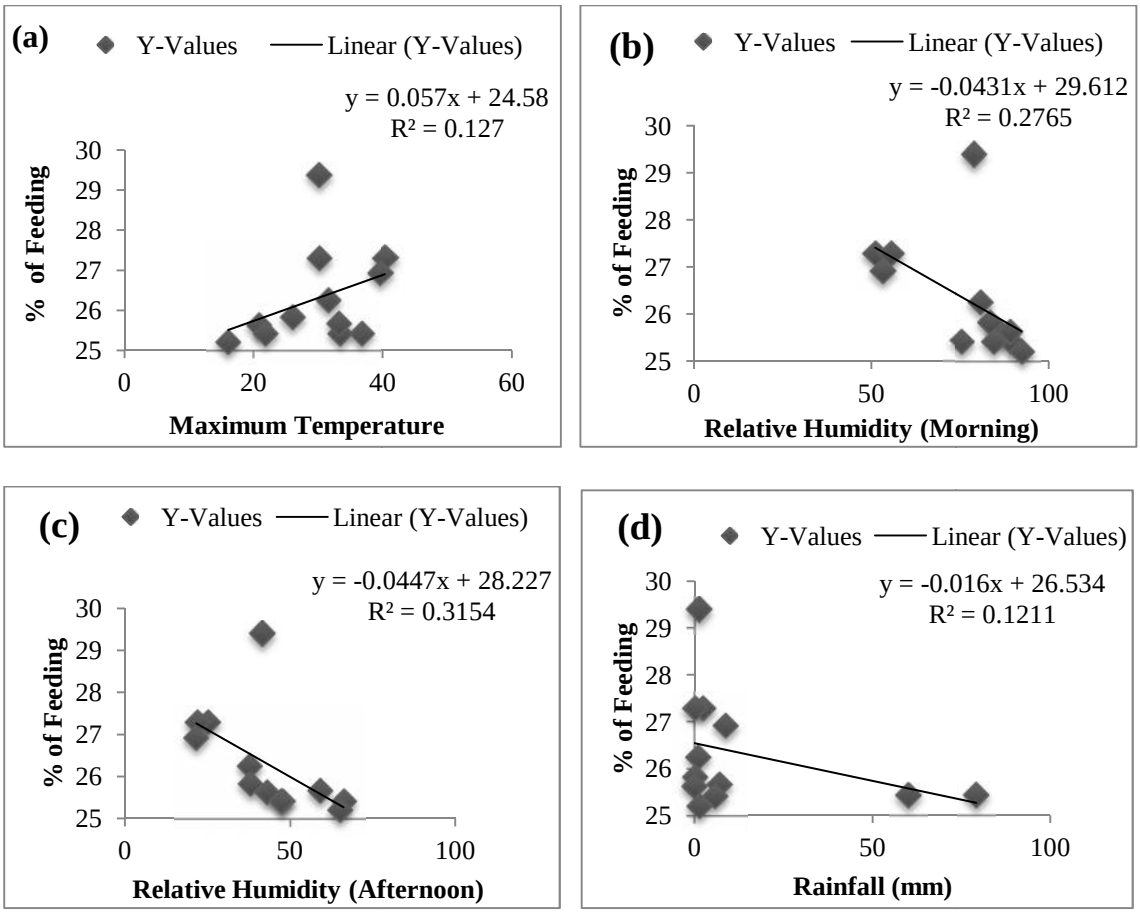


Figure 3. Scattergrams with fitted regression lines showing linear relationships between changes in (a) maximum temperature and Percentage of feeding activities (b) Relative humidity (morning) and percentage of feeding activities (c) Relative humidity (afternoon) and percentage of feeding activities and (d) Rainfall (mm) and percentage of feeding activities for the study period.

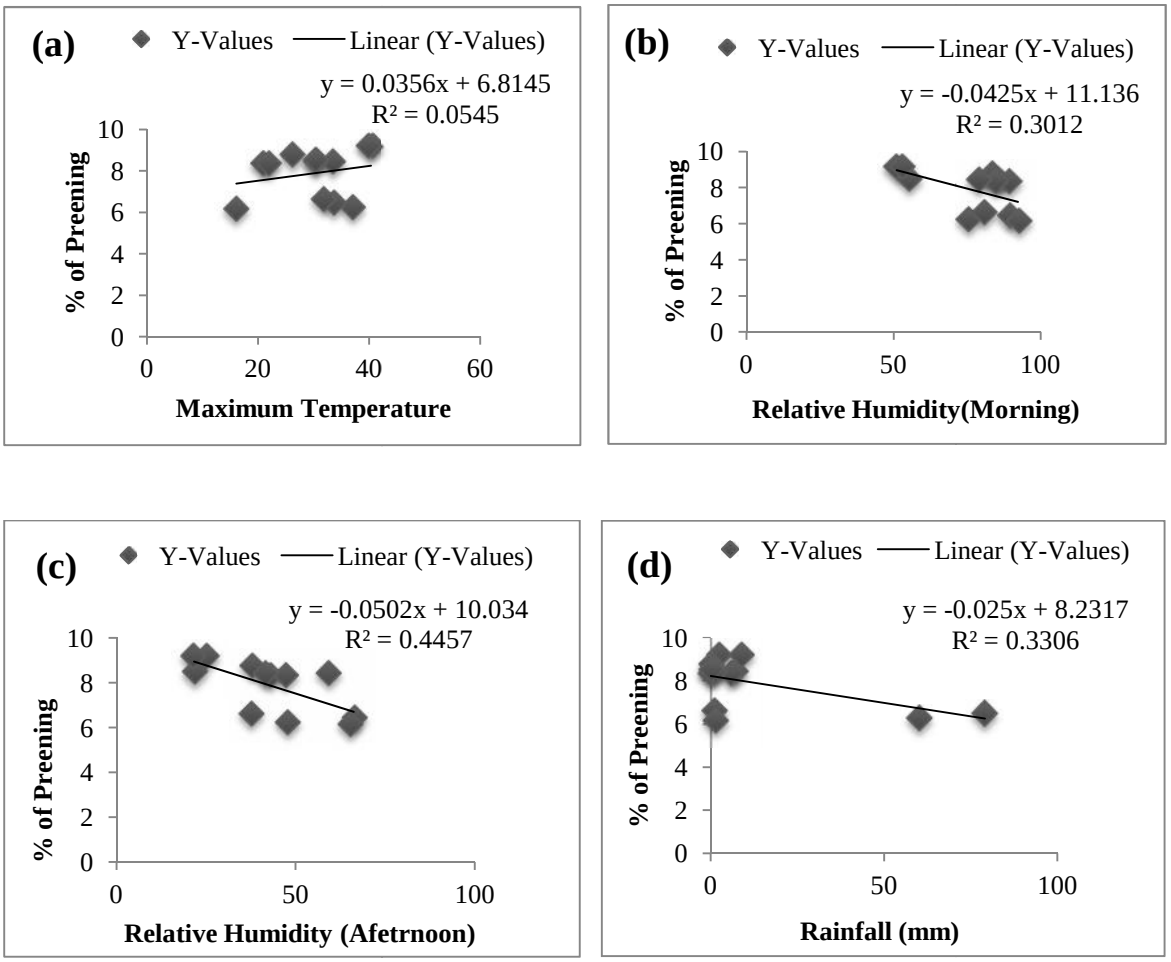
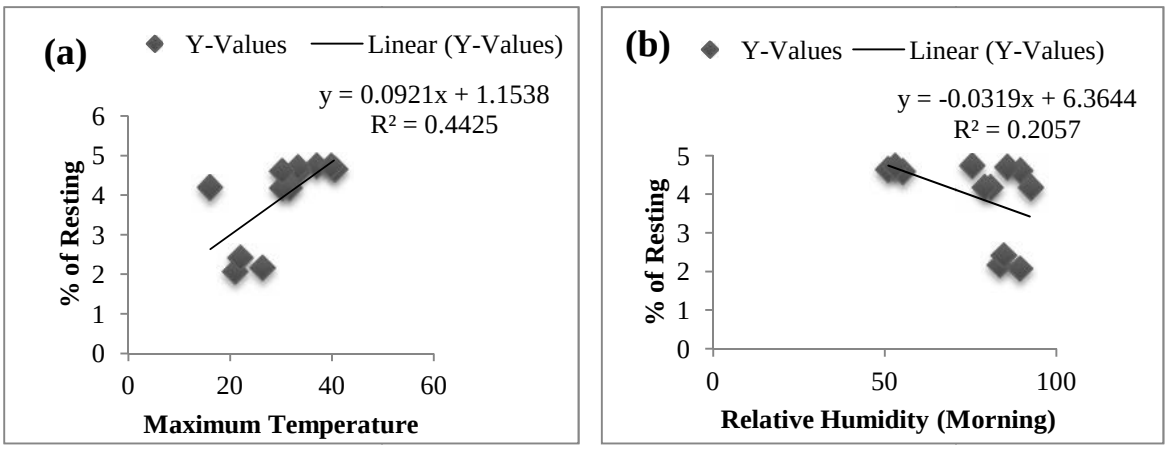


Figure 4. Scattergrams with fitted regression lines showing linear relationships between changes in (a) maximum temperature and Percentage of preening activities (b) Relative humidity (morning) and percentage of preening activities (c) Relative humidity (afternoon) and percentage of preening activities and (d) Rainfall (mm) and percentage of preening activities for the study period.



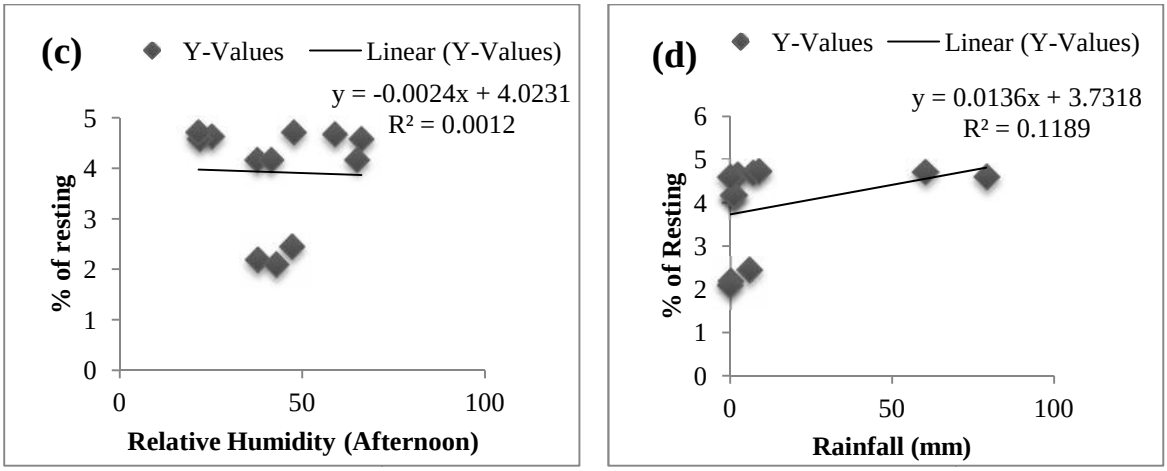


Figure 5. Scattergrams with fitted regression lines showing linear relationships between changes in (a) maximum temperature and percentage of resting activities (b) Relative humidity (morning) and percentage of resting activities (c) Relative humidity (afternoon) and percentage of resting activities and (d) Rainfall (mm) and percentage of resting activities for the study period.

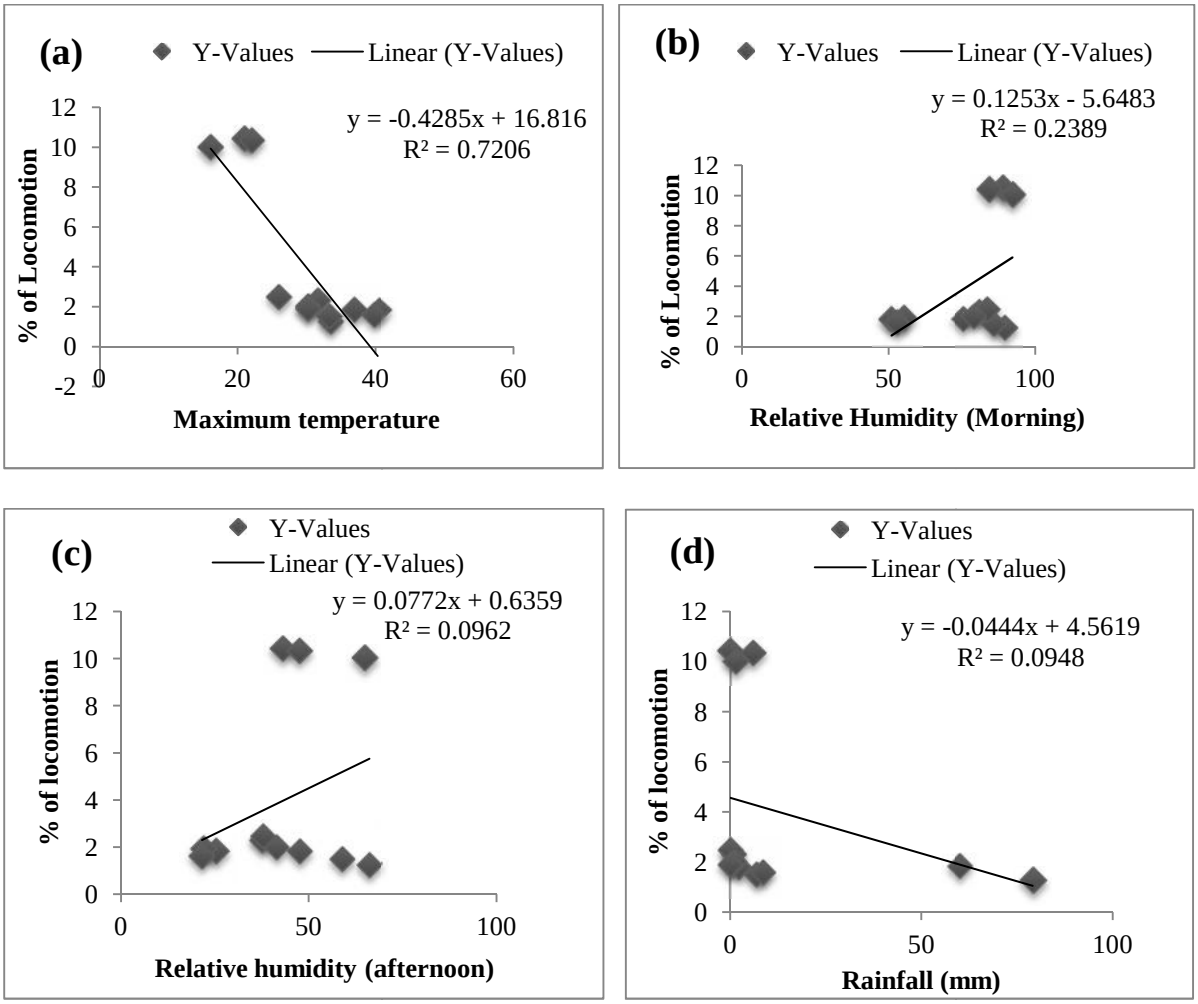


Figure 6. Scattergrams with fitted regression lines showing linear relationships between changes in (a) maximum temperature and Percentage of locomotion activities (b) Relative humidity (morning) and percentage

of locomotion activities (c) Relative humidity (afternoon) and percentage of locomotion activities and (d) Rainfall (mm) and percentage of locomotion activities for the study period.

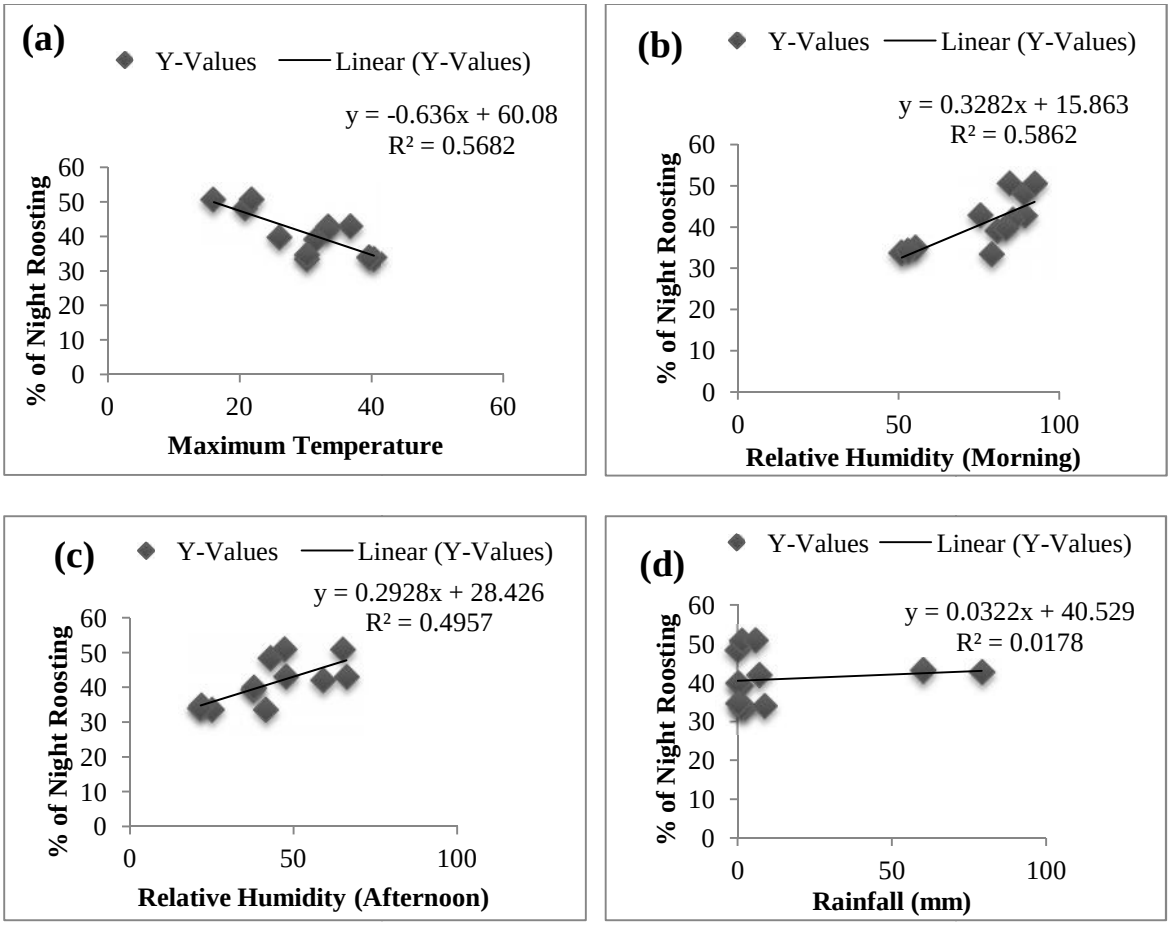
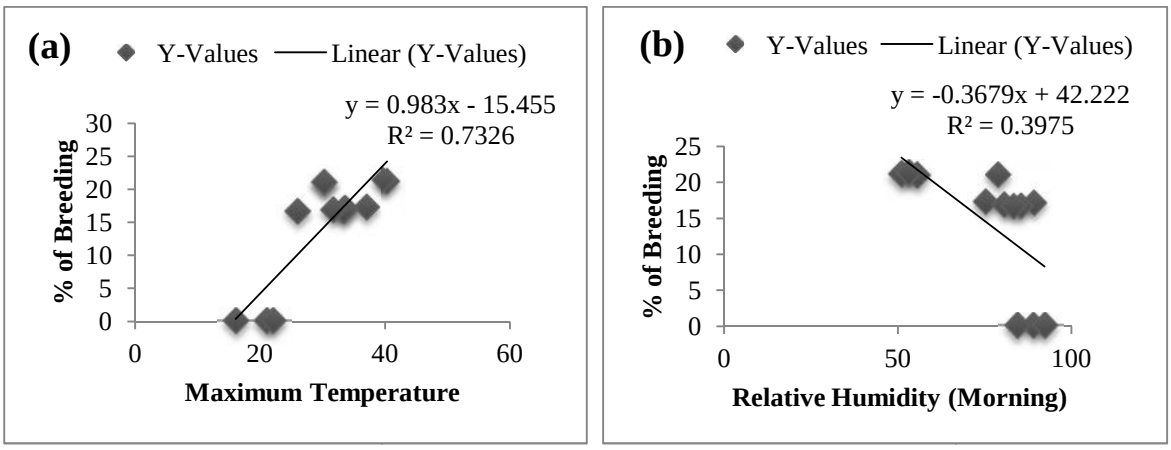


Figure 7. Scattergrams with fitted regression lines showing linear relationships between changes in (a) maximum temperature and percentage of night roosting activities (b) Relative humidity (morning) and percentage of night roosting activities (c) Relative humidity (afternoon) and percentage of night roosting activities and (d) Rainfall (mm) and percentage of night roosting activities for the study period.



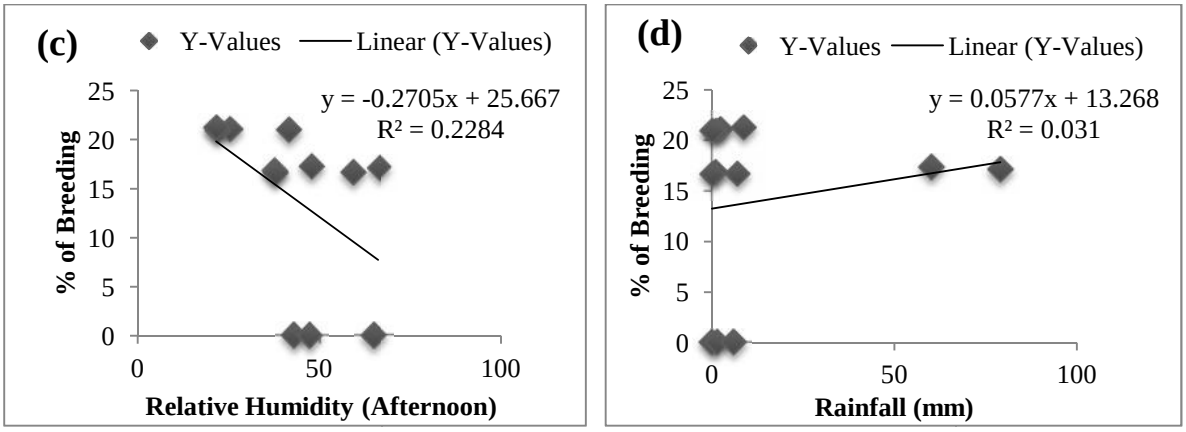


Figure 8. Scattergrams with fitted regression lines showing linear relationships between changes in (a) maximum temperature and percentage of breeding activities (b) Relative humidity (morning) and percentage of breeding activities (c) Relative humidity (afternoon) and percentage of breeding activities and (d) Rainfall (mm) and percentage of breeding activities for the study period.

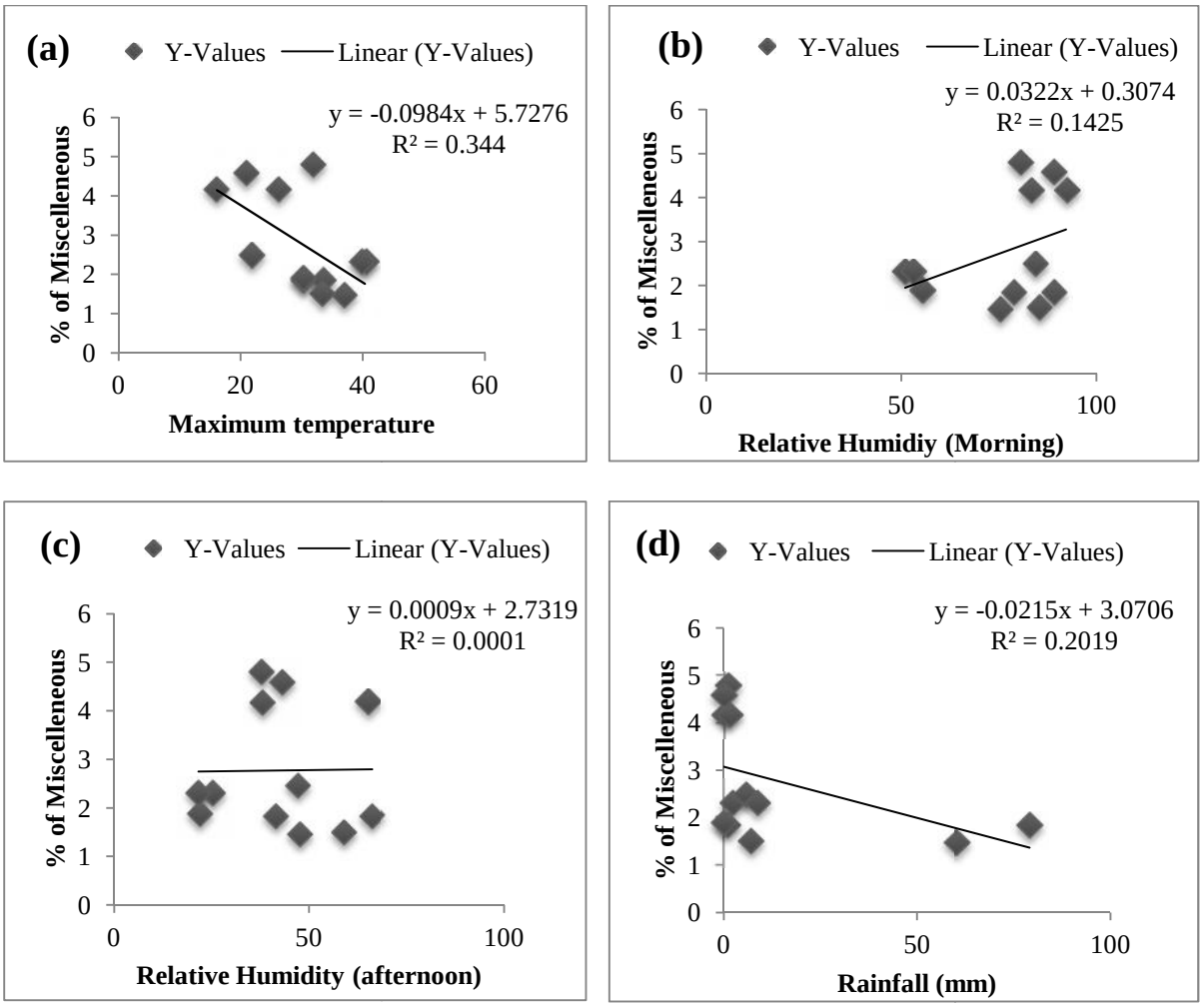


Figure 9. Scattergrams with fitted regression lines showing linear relationships between changes in (a) maximum temperature and percentage of miscellaneous activities (b) Relative humidity (morning) and percentage of miscellaneous activities (c) Relative humidity (afternoon) and percentage of miscellaneous activities and (d) Rainfall (mm) and percentage of miscellaneous activities for the study period.

IV.CONCLUSIONS

The amount of time allocated to various behaviours is critical in understanding the species' ecological needs and the pressures acting upon individuals. Therefore, the accurate time budgets of Little Brown Doves can provide valuable clues about how foraging trips are organized with respect to the conflicting constraints of provisioning offspring and self-feeding. The findings of the present study on the Little Brown Doves provide an understanding of the relationship between the daily activities of this common columbid species and the diverse fluctuations in the independent variables exercising their presence around. The results also indicated that the Little Brown Doves exhibited great flexibility in adjusting time budget to maintain their daily requirements. The present study is the first of its kind in the study area which can aid in redefining the conservation value of the diverse habitats utilised by this columbid species to execute the various activities, thereby going a long way in devising the conservation and management strategies for the bird in the study area.

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