Interdisciplinary Journal of Environmental and Science Education
2020, 16(2), e02210
ISSN 2633-6537 (Online)
https://www.ijese.com

The Environmental Influence on the Social Activity of Birds in Buea University Campus, Southwest Region, Cameroon

Melle Ekane Maurice [1]*, Nkwatoh Athanasius Fuashi [1], Roy Lyonga Mbua [1], Ndzelen Salome Mendzen [1], Obassi-Anaman Okon [1], Nkongho Stanley Ayamba [1]

[1] Department of Environmental Science, Faculty of Science, University of Buea P. O. Box 63, Southwest Region, CAMEROON
***Corresponding Author:** melleekane@gmail.com

Citation: Maurice, M. E., Fuashi, N. A., Mbua, R. L., Mendzen, N. S., Okon, O.-A., & Ayamba, N. S. (2020). The Environmental Influence on the Social Activity of Birds in Buea University Campus, Southwest Region, Cameroon. *Interdisciplinary Journal of Environmental and Science Education, 16*(2), e02210. https://doi.org/10.29333/ijese/6446

ARTICLE INFO

Received: 8 Sep. 2019
Revised: 23 Sep. 2019
Accepted: 23 Sep. 2019

ABSTRACT

In the next decade, urban sprawl might reach such a magnitude that several natural areas surrounding cities will give way to buildings and residential areas. Although some long-term efforts to understanding wildlife dynamics in cities are under way, very little has been done in understanding the influence of urban expansion on wildlife and developing a management strategies aimed at diminishing these impacts. There is a need to study urban biodiversity and include ecological knowledge in urban planning. However, this study was focused on assessing the environmental influence on the social activity of birds in Buea university campus. The data was collected on check-sheets for a period of 2 months, 6 days a week, from 7:00am – 6:00pm. The spot-count data collection method used witnessed 616 bird observations during the study. Simultaneously, data was collected on environmental condition, day-period, bird species, bird location, and bird number. The results of this study showed a significant link between bird activity and bird species, χ^2 = 171.953 df=48 P=0.000. Similarly, activity of birds showed association on bird number, χ^2 = 120.254 df=40 P=0.000. The environmental conditions associated significantly with bird number, χ^2 = 35.669 df=30, P<0.05. Also, bird species associated significantly with the day-period, χ^2 = 171.953 df=48, P=0.000. Additionally, environmental conditions associated with bird location, χ^2 = 7.921 df=6 P<0.05. Moreover, the environmental condition associated significantly with bird activity, χ^2 = 28.925 df=12 P=0.004.

All the bird species observed during the survey displayed a significant activity state, however, species such as village weaver (*Ploceus cucullatus*), little weaver (*Ploceus luteolus*), and black-headed weaver (*Ploceus melanocephalus*), recorded 17.86%, 11.36%, and 7.31% respectively, and were observed with a higher activity frequency as compared to other bird species. The environmental role on wildlife species such as birds significantly determines their geographical distribution and endemism on the earth planet.

Keywords: wildlife dynamics, urban biodiversity, environmental condition, geographical distribution

INTRODUCTION

Birds are considered as excellent bio-indicators of the effects urbanization has on ecosystems since they are highly diverse and conspicuous elements of the ecosystems. Also they respond rapidly to changes in landscape configuration, composition and function (Hobson & Rempel, 2001). Comparitive studies on avian community structure in different habitats can improve our knowledge of the general patterns and processes that characterize the bird species and communities. Recent studies comparing bird communities across rural urban gradients found that both species richness and total avian abundance peaked at moderate levels of urban development in temperate areas and the number of low nesting species increased with urbanization (Blair, 2004). With the encroachment of urban areas into rural habitats and the decrease of rural habitat quality owing to agricultural intensification, urban green spaces are becoming an increasingly important refuge for native biodiversity (Gatson, 2007). Birds are most important key species of different ecosystems because they are highly distributed, easily visible and evocative to us. Bird species richness is influenced by the urban environment, landscape, floral diversity, degree of anthropogenic disturbances, invasion as well as predation, yet they are major part of urban biodiversity. Resident birds can be seen frequently the whole year and the migratory birds arrive annually during winter and summer seasons (Prakash, 2012).

Birds are important to humanity in many ways; they have considerable tangible and intangible values in our day-to-day

lives (Dunning, 2007). Birds fill material needs for food, tools and enjoyment (direct benefits). They also perform services useful to humans, without which the world would be less healthy (indirect benefits). We are therefore supposed to have a sense of stewardship and responsibility to protect the wild birds in return for their financial, food, physical, aesthetic, spiritual, religious, symbolic and sports service we receive in return. Many of these benefits are widely recognized already but others certainly remain to be identified by future generations (Bibby, 2001). One of the most intriguing aspects of bird biology is the ability to migrate exceptional distances. Birds possess highly specialized directional senses for orientation, navigation, homing and migration including the ability to detect the earth"s magnetic field. These uncanny abilities permit birds to occupy distinctive wintering and nesting grounds, thus expanding their usable habitats. The avifauna of India include 1300 species of which 42 are endemic and 26 are rare or accidental (Mennechez, 2006). Birds are highly visible and sensitive to alterations in habitat structure and function, consequently they serve as excellent indicators of changes in stresses in urban ecosystems. Several studies have examined the influences of urbanization on bird communities and it was concluded that bird species richness, abundance and community structure are indeed affected by urbanization (Mills et al., 1989). The concept of an urban gradient of highly developed urban centres to less developed surrounding areas have shown that low levels of development can actually promote species richness by increasing resources such as food availability and shelter in the forms of ornamental vegetation, nest boxes and bird feeders. Areas of intense urbanization often result in communities dominated by a few species (Cam et al., 2006).

With the global high rate of urbanization and the rapid loss of wild habitat, cities are now viewed as challenging ecosystems for sustaining biotic communities and rich diversity (Warren et al., 2006). During the last decade research on urban populations is focused on global recognized patterns as well as processes and mechanisms that lead to the increased overall population densities. Birds adapt to the urban ecosystems both physiologically and behaviorally (Collins et al., 1976). The increase in population density is related to the increase in food abundance. Knowledge of the patterns of urban bird populations and communities started emerging in the seventies (Emlen, 1974). Compared with adjacent, more natural ecosystems, urban ecosystems normally have higher bird abundances. Urban bird communities have higher densities and biomass than non urban communities. Although the study of urban birds has a fairly long history, urban ecosystems have been largely ignored throughout many decades of ecological research (Walsh, 2006).

Diversity of avifauna is one of the most important ecological indicators to evaluate the quality of habitats. Random destruction of natural habitats by cutting nesting trees and foraging plants for commercial use of woods and lands are the main factors responsible in narrowing down the avian foraging habitat and nesting sites. Urban bird densities are normally extremely high (Walsh, 2006). Increase in bird densities may be the result of high food density, low predation pressure or combination of both (Shochat, 2004). Birds are essential animal group of an ecosystem that maintain a trophic level. Therefore, a detail study on avifauna and their ecology is important to protect them (Sruti, 2008). During the last decade, urban ecosystems have become ecological challenges in conservation, restoration and reconciliation ecology. Designing sustainable urban ecosystems that support species rich bird communities also includes maintaining key ecosystem services such as clean air and water, waste decomposition and pest control (Fitzpatrick, 1981). Species diversity is an important component of the health of an ecosystem. Birds have an important place in species diversity because they are visible and highly valued by humans. Birds, furthermore, play an informational role in attracting public attention to natural habitat. The abundance and diversity of avian species, therefore, in a specific habitat could serve as a useful barometer of the ecological status of that habitat (Rolstad, 1991). Wild-lands are continuously converted to agricultural fields and urban areas. Consequently, urban environments can no longer be viewed as lost habitat for wildlife but rather as a new habitat, that with proper management has the potential to support diverse bird communities (Miller & Hobbs, 2002).

The longstanding history of conflict between humans and wildlife especially in the agro-industry has been one of the areas which most research has been focused. Avifauna studies in ecology have been well documented in Cameroon forest ecosystem, except for the urban environment where birds are commonly seen. This study was aimed at examining the influence of environmental conditions on the social activities of birds in university of Buea campus. The level landscape of the university harbors about 13 species of birds, buildings, human population, fruit and flower trees, and crop-farms.

MATERIALS AND METHODS

The Description of Study Area

Buea municipality is situated between longitude 9^0 16' E and latitude 4^0 9' N (**Figure 1**) (Tanjong 2014; Fitton et al., 1983). The municipality is bounded to the north by tropical forest on the slope of mount Cameroon (4100m above sea level). The population is estimated at about 300,000 people of whom two-thirds live in the city of Buea, while the rest in villages. The settlement pattern forms a closed ring around the foot of the mountain with no permanent settlements on altitudes above 1500m. The indigenous people in the area are Bakweri, Bomboko, Balondo and Bakolle (Ekane, 2000). With an equatorial climate, temperature is moderate with a slight seasonal variation (rainy and dry season) (Tanjong, 2014). The region is also very diverse in fauna with over 370 species of wildlife recorded. The sub-montane and montane habitats are part of Cameroon mountain endemic bird area. So far, 210 species of birds have been recorded, out of which 8 are threatened and 2 strictly endemic mount cameroon francolin (*Francolinus camerunensis*) and mount cameroon speirops (*Speirops melanocephalus*) Ekane (2000). Agriculture is the most important source of livelihood in the area accounting for about 80% of household income in most villages. Other sources of income include hunting, timber and non timber forest products (NTFP) exploitation, petty trading, and cattle rearing (Tanjong, 2014).

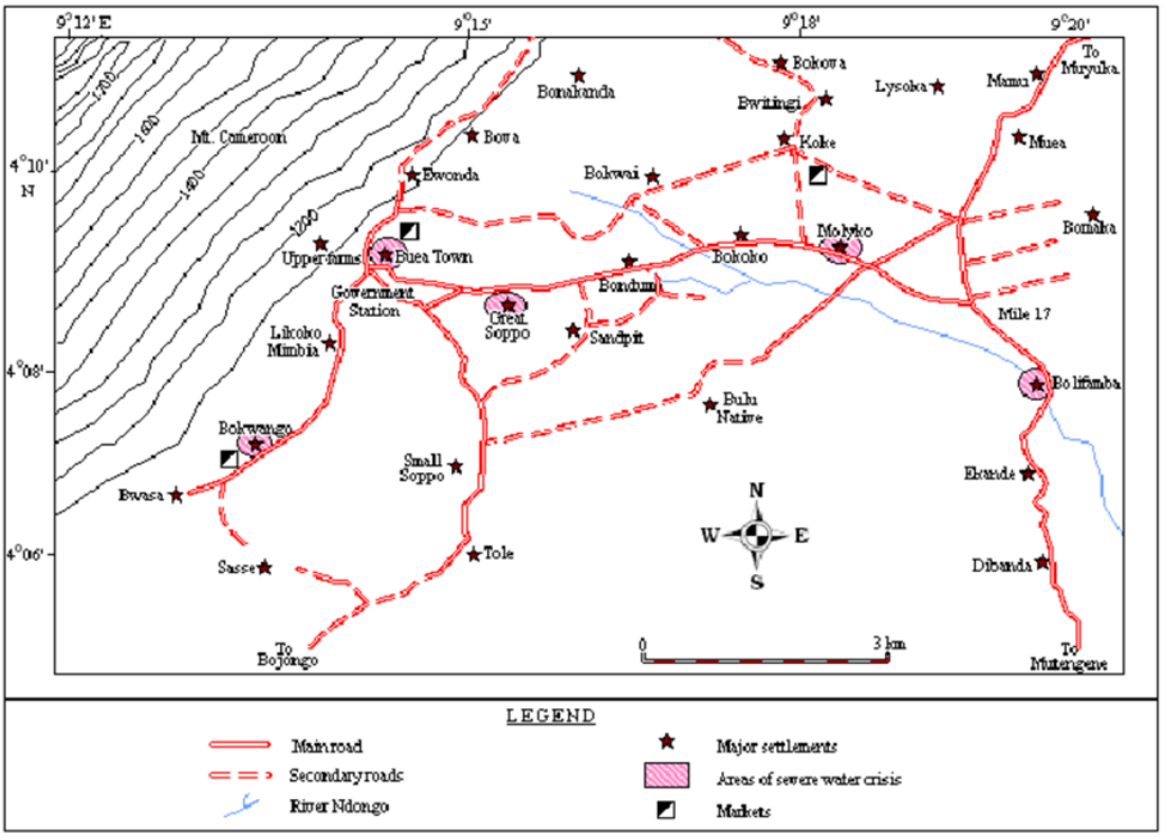

Figure 1. Map of Buea Municipality

Data Collection Method

The research data collection program was done by a research team made up of four persons, the principal investigator and three other student colleagues. The two-month study was carried out in the campus of university of Buea. The research data was collected between 7:00am – 6:00pm each day of the study, and was done 6 days each week, Monday – Saturday. The team visited all the locations of the university campus on a daily bases to record observations on bird species, their activity, locations, day-period, and human activity. A five-minute-spot-count method was used throughout the data collection period. Point counts (where the observer is sedentary at one place), is among the most frequently used techniques for monitoring terrestrial birds (Rosenstock et al., 2002). Bird population monitoring programs vary in how they are conducted. The Breeding Bird Survey (BBS), for example, is run in Britain and variants of it are used by 18 other European countries (Spurr, 2005). Five-minute point-based distance counts are used in France that specify the area of the sampling site and the distance bands used around each point, (<25m, 25-100-m, and >100-m) (Spurr, 2005).

In the United States the BBS uses three-minute counts of all birds seen and heard within a 400m radius around the point. The BBS programs monitor the trends in terrestrial bird populations and all results are published on-line (British Trust for Ornithology, 2008). Still other research (Bolger et al., 1997; Melles et al., 2003) used point counts to monitor either the abundance of breeding birds or to assess urban bird biodiversity in urbanizing landscapes. In New Zealand the five-minute bird count (FMBC) was adopted as the standard method of avian community monitoring, particularly in forests (Dawson & Bull, 1975). It has persisted as the most widely used means of determining the status and trend of bird populations within forested populations (Hartley & Greene, 2008). The FMBC is an index measure only because it detects just a proportion of all birds present while some remain hidden in surrounding vegetation (Hartley & Greene, 2008). It is attractive because it is cheap and requires minimal effort while still allowing large numbers of controlled counts to be conducted. The method is suited for use in densely vegetated habitat, because the observer is standing still, for detecting birds that are more inconspicuous or cryptic (Hartley & Greene, 2008).

Data Analysis

The research data collected on check-sheets was analyzed by the use of SPSS version 20. And the main statistical model used was chi-square to test the relationships existing between the variables such as bird species, bird activity, bird number, environmental conditions, day-period and the bird location. Exploratory analysis was used to further examine the frequency of variables like bird activity, environmental condition, and bird species.

RESULTS

The results of this study showed a significant link between bird activity and bird species, χ^2 = 171.953 df=48 P=0.000 (**Figure 2**). The involvement of all the bird species in individual and social activities was observed in the study area.

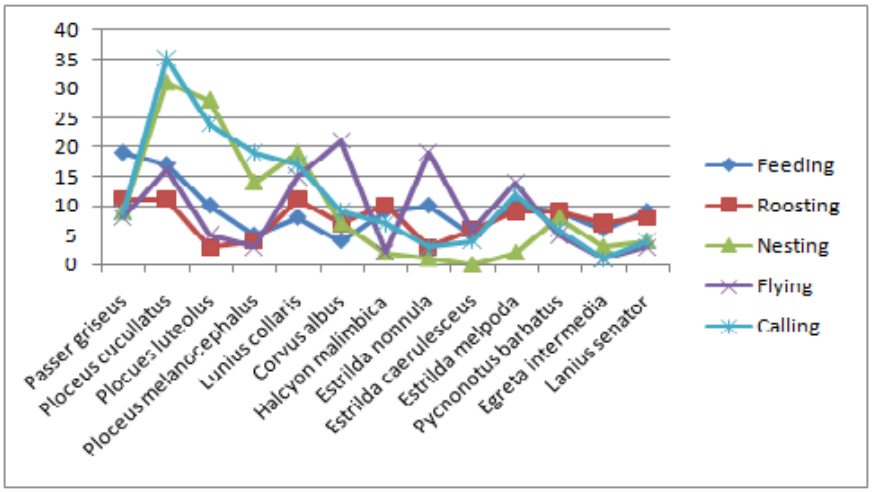

Figure 2. Bird activity and species

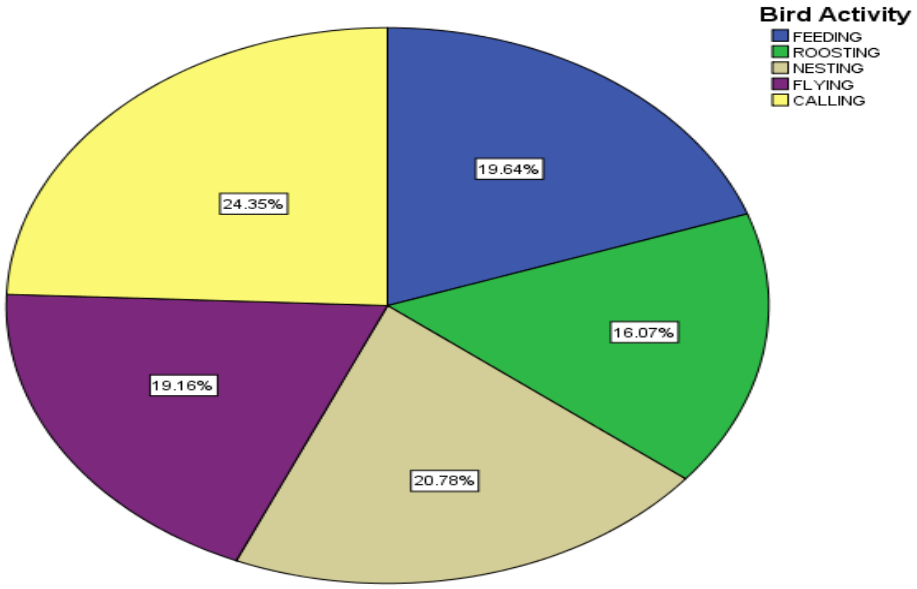

Figure 3. Bird activity

Birds are ecologically important not only in environmental indication but their diverse feeding behaviors on many species of plants have contributed in enhancing the plant communities in the wild. Birds are also known to be among the most successful wildlife species due to their distance flight ability, migrating to areas with abundant food availability, ability absent in most other wildlife. During this study, a spectrum of five behavioral activities was observed on the bird species in the university campus of Buea. Feeding, roosting, nesting, flying, and calling recorded 19.64%, 16.07%, 20.78%, 19.16%, and 24.35% respectively (**Figure 3**). However, vocalizing calls and songs on feeding sites recorded a significant higher behavior (24.35%). Birds were observed feeding and vocalizing, especially during high human activity periods in the campus. Vocalization behavior in wild animals such as birds is a communication tool used to mark territories, attract mating partners, indicate predator presence, and location of food sources. The frequent vocalizations on these feeding sites might also be considered as panic especially with human activity very close to areas where the birds feed.

The activity of birds showed another association on bird number, χ^2 = 120.254 df=40 P=0.000 (**Figure 4**). The high significant relationship might be due to the high population of birds in the study area believed to generate a lot of noise especially during the morning periods of the day. In most wildlife species, population correlates with activity increase, involving various forms of competition on feeding sites, courtships, and territorial marking. The crop-farming activity of the inhabitants of the university of Buea neighborhood in the university campus seems to have attracted the bird population such as the *Ploceus spp* that feed predominantly on cereal crops like maize and beans, also farmed in the campus.

The environmental conditions associated significantly with bird number, χ^2 = 35.669 df=30, P<0.05 (**Figure 5**). Environmental or ecological conditions are known to contribute significantly in wildlife activity; however, the state of environment can influence wild animal activity positively or negatively. The important role played by the environment in wildlife species endemism is the main determinant in wildlife species distribution in the world. Wild animals such as birds are known to be associated to environmental conditions that

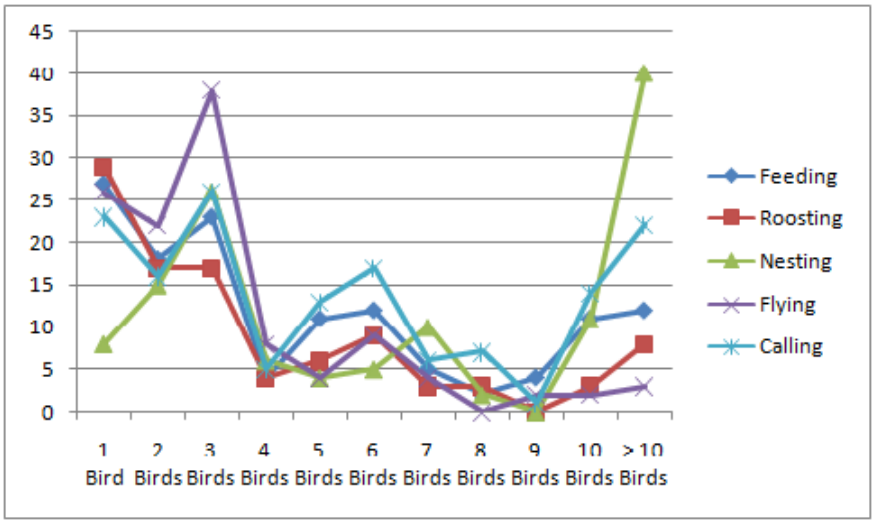

Figure 4. Bird number and activity

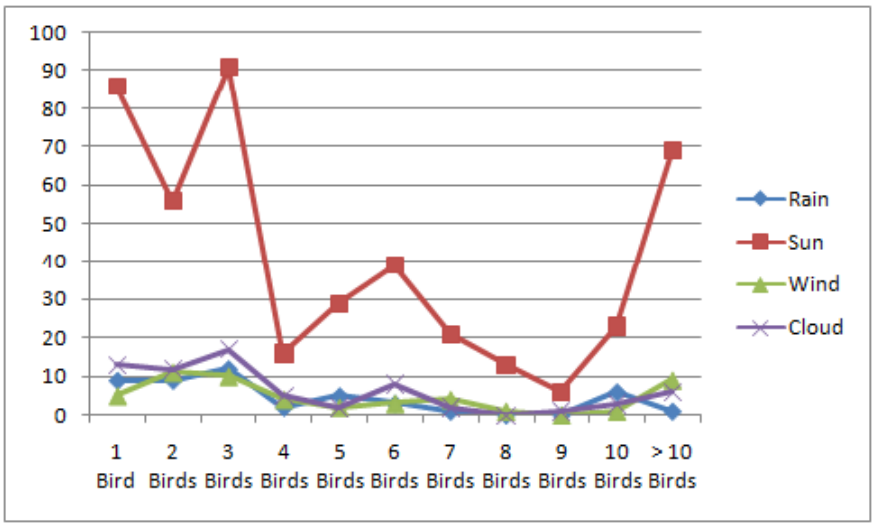

Figure 5. Bird number and Environmental condition

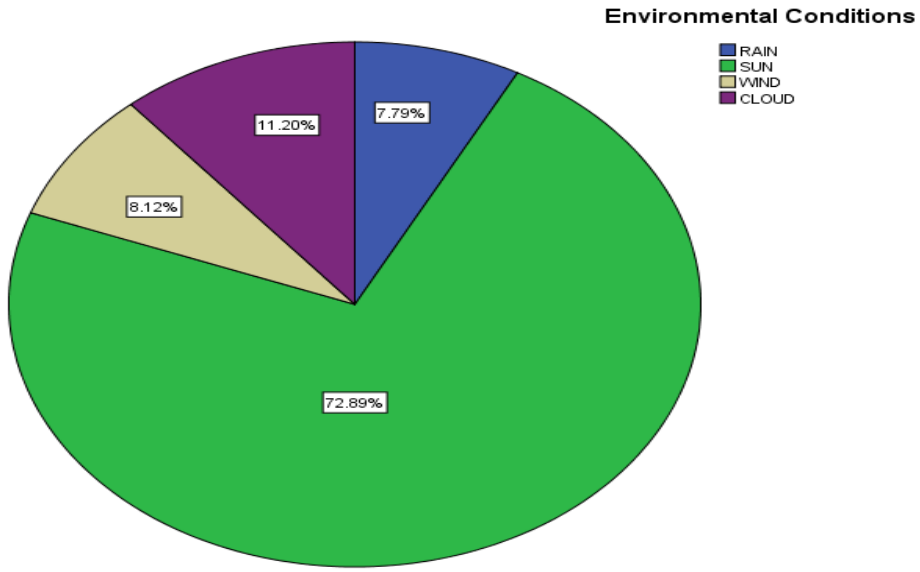

Figure 6. Environmental conditions

would favor their habitation, the reason for which they migrate to areas with favorably healthy environmental conditions. This study observed a significant favorable environmental condition for the birds at all population levels. The rain, sun, wind, and cloudy environmental conditions recorded 7.79%, 72.89%, 8.12%, and 11.20% respectively (**Figure 6**). The sunny environmental condition witnessed the highest bird activity state. The tropical rainforest, with its moderate solar condition

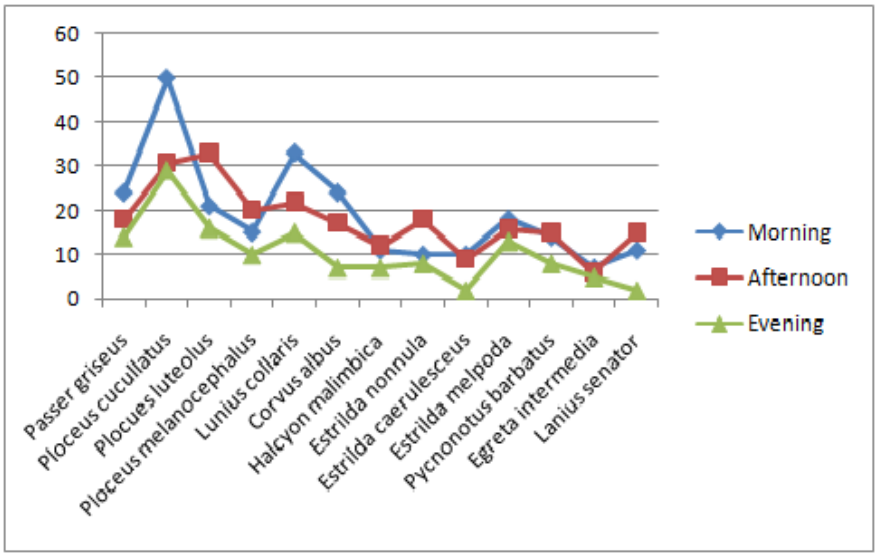

Figure 7. Bird species and day-period

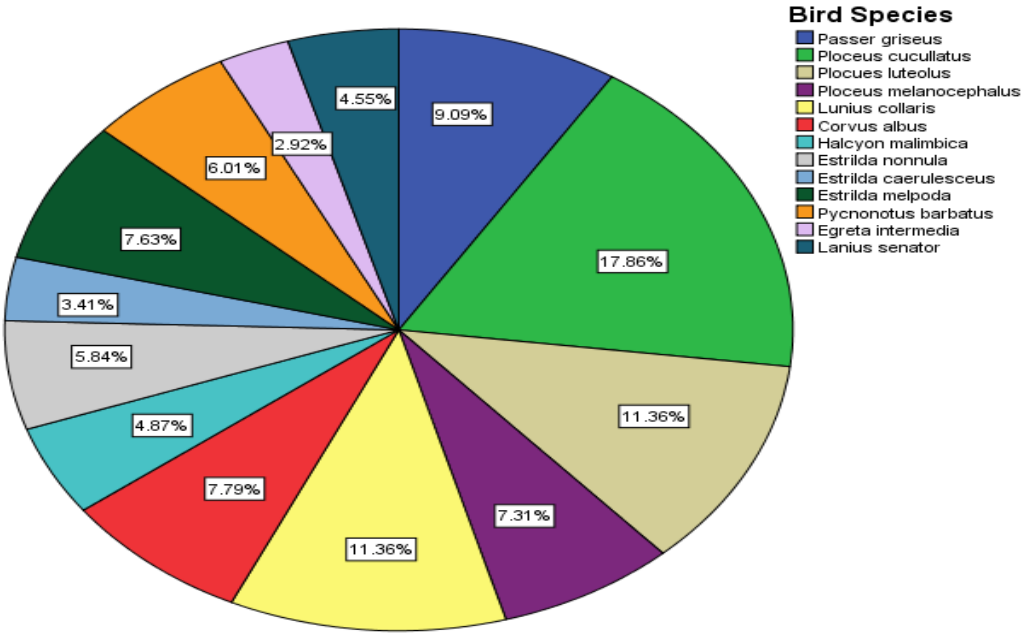

Figure 8. Bird-species frequency observation

is a well known contributor to wildlife activity. The rainforest in the southern part of Cameroon is rich in biodiversity due to the moderate solar condition as compared to the sahel savanna ecosystem in the north, arid in temperature conditions. Though wildlife poaching behavior in the southern belt of Cameroon is heavy, the vegetation is still significantly healthy because of the moderate temperature condition.

Also, bird species associated significantly with the day-period, χ^2 = 171.953 df=48, P=0.000 (**Figure 7**). All the bird species observed during the survey displayed a significant activity spectrum, however, species such as village weaver (*Ploceus cucullatus*), little weaver (*Ploceus luteolus*), and black-headed weaver (*Ploceus melanocephalus*), recorded 17.86%, 11.36%, and 7.31% respectively, and were observed with a higher activity frequency as compared to other bird species (**Figure 8**). These weaver-birds were observed in the university campus crop-farms feeding and nesting. However, the high population of these weaver-bird species in the university campus and neighborhood is influenced and attracted by the crops. Weaver-bird population increase has been one of the main contributors to poor crop-yields in most parts of Cameroon. The birds feed on crop-grains such as maize and they use the leaves to build their nests. The principal niche choice for weaver-birds is believed to be the crop-land, a source of food, nesting materials and breeding location. Crop-farmers have devised manual strategies to handle the population of weaver-birds to restrain them from farmlands, but the results are believed to be insignificant.

Environmental conditions associated significantly with bird location, χ^2 = 7.921 df=6 P<0.05 (**Figure 9**). A moderate temperature during a sunny atmospheric condition was observed with the highest activity of birds. A sunny atmosphere in the mountain slope of Buea is needed by wildlife such as birds to help them increase activities like flying, feeding, roosting, nesting, and vocalization. A mountainous height of more than 4000 meters above sea level

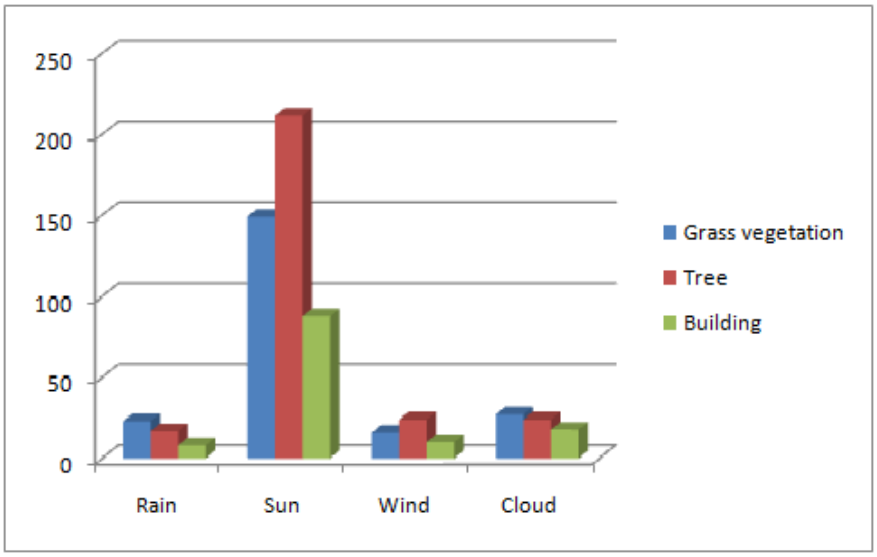

Figure 9. Bird location and environmental conditions

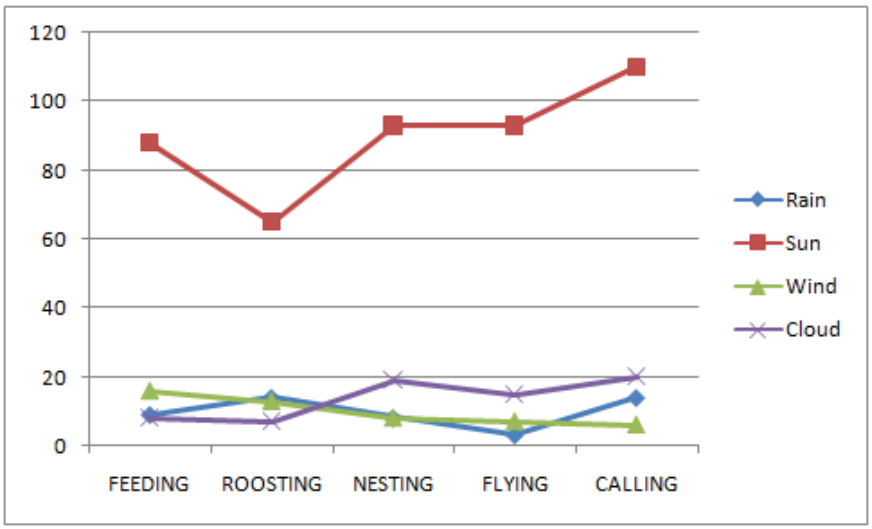

Figure 10. Bird activity and environmental condition

generates a cold and cloudy environment throughout the year, a condition believed to be the major cause of a cold temperature at its slopes. Hence, a sunny atmospheric environment is an opportunity for these wildlife species to increase activity in all their locations.

Moreover, the environmental condition associated significantly with bird activity, χ^2 = 28.925 df=12 P=0.004 (**Figure 10**). The environment determines wildlife niche geography; nonetheless, this survey observed a link between the environmental condition and the activity of birds in the university campus. There was an elevation of social activity of the birds during the moderate sunny weather than any other. Feeding, nesting, flying, and vocalizations increased in the sunny weather condition while roosting decreased. The rain, wind, and cloudy environmental conditions witnessed a low activity state.

DISCUSSION

The conditions that make cities unique include: (1) the occurrence of local conditions of extirpation, dispersal and migration (Rebele, 1994) and (2) localized climatic conditions. Because remnant unmodified habitats (patches) are often small and embedded within a highly disturbed matrix (the surrounding urban landscape), they are continually open to colonization by non-native species. This compromises their ability to sustain native species that find it more difficult to compete and so they become extirpated (McKinney, 2002). The higher population density of the urban core increases the importation of non-native species and exacerbates the process. Thus, more widespread weedy species of plants, and human dependent, commensal species of birds replace natives (McKinney, 2002). Because cities globally tend to reflect similar conditions, the same urban adapted species are present in almost all cities. This results in homogenization of species across cities with fewer species being present overall. The increase in surface area of impervious materials such as concrete, glass, metal and brick change ambient conditions locally (Berry, 1990). In cities temperature, precipitation, cloudiness and pollution increase (Landsberg, 1981). Also, wind speed and radiation are less than the surrounding rural areas (Berry, 1990). The heat island that results from these altered conditions alters city ecosystems. Together with the increased productivity (in the form of subsidized water and

fertilizer regimes), as well as the increased availability of food (human refuse and supplementary feeding) this makes cities generous and often less harsh ecosystems for a wide array of individuals that includes more urban tolerant birds coined 'urban exploiters'. Urban exploiters comprise a small subset of the world's species that are highly adapted to the altered urban conditions. They are generally commensals that have become largely dependent on human subsidies or the increased productivity that accompanies human settlement (McKinney, 2002).

Cities are the hotspots of species diversity, harboring more species than rural landscapes (Walters, 1970). The import of food and materials, the patchiness and existence of early and mid succession habitat stages, the often high geological diversity associated with cities and the introduction and invasion of alien species contribute to this high species richness. However, not only alien species richness is increased in urban areas, but also native species richness (Kuhn et al., 2004). On the other hand there are taxa that increase in species numbers along urban-to-rural gradients, a pattern that also depends upon scale: the positive relationship between species richness and urban land-use is especially strong at coarse scales and gets weaker the smaller the scale of study is (Pautasso, 2007). It can even turn negative but there are examples of positive relations on small scales as well (Wania et al., 2009). The taxa with usually increasing numbers along urban-to-rural gradients especially birds seems to be sensitive to urban land use (Seaward, 1982).

The composition of urban flora and fauna may be determined by the biotic and abiotic factors associated with the available species pool in the region (Rothery, 1999). Surrounding habitat features affecting bird community structures and bird diversity in urban areas has been linked to peril urban landscape (Fuchs, 1998). However Erz (1996) suggested that bird species do not colonize newly urbanized areas from surrounding countryside, but immigrate from already urbanized populations. Thompson (1993) compared garden birds between several European countries and found that bird species richness in urban, suburban and rural gardens was similar in countries of northern Europe, but not in western or southern Europe. In the next decade, urban sprawl will reach such a magnitude that several natural areas surrounding cities will give way to buildings and residential areas. Although some long-term efforts to understanding wildlife dynamics in cities are under way, very little has been done in order to foretell the influence of urban expansion on wildlife and to develop management strategies aimed at diminishing these impacts (Hadidian et al., 1997). There is a need to study urban biodiversity and to include ecological knowledge in urban planning (Savard et al., 2000). There are several special features of urban ecosystems like mosaic phenomena, specific disturbance regimes, and the "heat island" phenomena that are expected to influence the dynamics and structure of urban populations and communities (Rebele, 1994).

Most studies on urban wildlife have focused on birds, and the information gathered up to now allows the comparison of different cities in relation to bird abundance (Clergeau et al., 1998). At the community level, the study of urban birds has been approached from different perspectives. The most used approach has been the application of the gradient paradigm, whereby environmental variation is assorted spatially, and these spatial patterns are supposed to affect the structure and function of ecological systems (McDonnell, 2006). Comparisons have generally included variations in community attributes (richness, diversity, evenness) between low and highly urbanized areas. Temporal changes in urbanization levels were successfully used to determine variations in urban bird populations in periods greater than 10 years. Other studies have tried to evaluate structural differences in communities (guilds, food consumption, etc.) between urban and non-urban settings. Another interesting approach, unfortunately not usually employed, included the comparison of urban communities at different latitudes and even in different continents, thereby improving our knowledge of the general processes that affect urban bird species (Matthews, 1999).

Urbanization generally leaves natural settings transformed into fragmented landscapes, with urban parks, gardens etc. Urban parks are more isolated from their surroundings by an „urban ocean" of buildings (urban matrix) than woodlots surrounded by clear cuts or farmland, but less isolated than real islands. Nevertheless, the overall difference between urban parks and their surroundings is quite sheer. The island approach allows focusing on the patterns and processes underlying bird distributions in urban parks as well as deriving a series of strategies for the management of urban birds (Adams & Dove, 1989). Comprehensive projects have been conducted in the cities of Madrid to study urban birds under the umbrella of the habitat island theory. These projects have generated a great deal of information that can improve our knowledge of habitat selection processes of different bird species in urban settings (Fernández-Juricic, 2000).

The continued expansion and growth of cities in the near future could bring about the conversion of large swaths of natural habitats to urban areas, resulting in general decreases in bird species richness and diversity (Walsh, 2006). The negative effects of urbanization on birds could be even worse in biodiversity rich locations, such as developing countries in tropical latitudes where the highest growth of human population is expected (Marzluff et al., 2001). Therefore, it is important to better understand the relationships of birds to urban habitats, research on habitat characteristics is needed for developing landscape planning and management methods to enhance biodiversity in urban environments by creating or maintaining suitable habitats for birds (Jokimaki, 1999). The increase in urbanization has raised concerns regarding impacts on avian populations. At community level, the number of species that use multiple brood breeding strategies increased with urbanization. Furthermore, birds identified as high-nesting species reached their highest proportion at the most natural sites and decreased in number with urbanization. In contrast, low nesting species exhibited the reverse trend. These findings suggest that nesting success determined by nest site availability and the ability to produce multiple broods may drive the distribution of avian species along an urbanization gradient. It was examined that the distribution and abundance of birds along an urban gradient in Ohio has increased the spectrum of habitat types created by urbanization, ranging from a pristine nature reserve to a highly developed urban center (Blair, 1996, 2001). Individual species

displayed patterns of abundance along the gradient that reflect their level of tolerance for human impact. For example European starlings (*Sturnus vulgaris) were* labeled as "urban exploiters" based on their high abundance at the urban end of the gradient. On the opposite end, ovenbirds (*Seiurus aurocapilla)* were labeled as "urban avoiders" based upon their high abundance at the natural end of the gradient (Blair, 1999).

Nevertheless urban environments with artificial habitats also comprise patches of rich and diverse natural vegetation as well as unmanaged abandoned sites. Like other less modified environments, these areas settle and undergo succession. Careful planning can ensure that distant patches of less disturbed habitat are connected through corridors, such as tree-lined streets, areas of lawn, and suburban gardens. The same criteria that govern the effectiveness of corridors in wild landscapes seem to apply. For example, birds in urban landscapes wooded streets are transitional in their suitability as habitats for movement, feeding and nesting (Fernandez-Juricic, 2000). Likewise research on the role of patch size indicates that the size of remnant habitat patches does matter. For introduced birds larger patches support a greater richness and have quite different communities of birds than smaller remnants (Antos et al., 2006). In fact, the comparison of urban landscapes with its mix of habitat loss and fragmented remnant habitats to island of patch size indicates that the size of remnant habitat patches does matter. For introduced birds, larger patches support a greater richness and have quite different communities of birds. Larger patches support a greater richness and have quite different communities of birds than smaller remnants (Antos et al., 2006). In fact, the comparison of urban landscapes with its mix of habitat loss and fragmented remnant habitats to island biogeography seems appropriate, thus arguably a habitat island approach to conservation of birds in these landscapes would be plausible.

CONCLUSION

The global importance of avifauna is well known in ecological seed dispersal, pollination, agriculture, scavenging, and environmental indication. However, the pest behavior of some wild birds in crop-farmland has been one of the negative impacts controversial to their conservation. During this study, 13 bird species were observed in the university campus, and all their activities, feeding, roosting, nesting, flying and vocalization were influenced by environmental conditions such as rain, sun, wind, and cloud. Their social activities were prominent during the morning period than the afternoon and evening that witnessed a lower activity state. Nevertheless, the mid-day period was observed with more resting behavior, a situation experience by most terrestrial wildlife species especially in the tropics mainly due to increase in environmental temperature. Wildlife social and individual activities are also known to increase towards the evening period when the temperature reduces considerably and the food consumed in the morning period digested. Diurnal wildlife species are believed to consume enough food in their feeding sites in the evening period to help provide the necessary body energy requirements during the night period.

REFERENCES

Adams, C. J., & Dove, E. S. (1989) Designing nature reserves: traditional criteria may act as misleading indicators of quality. *Biodives Conserv, 16*, 223-233. https://doi.org/10.1007/s10531-006-9139-1

Antos, M. J., Fitzsimons, J. A., Palmer, G. C., & White, J. G. (2006). Introduced birds in urban remnant vegetation: Does remnant size really matter? *Austral Ecology, 31*, 254-261. https://doi.org/10.1111/j.1442-9993.2006.01572.x

Berry, B. J. L. (1990). Urbanisation. In: Turner II BL, Clark WC, Kates RW, Richards JF, Matthews JT, Meyers WB (eds.), *The earth as transformed by human action*. Cambridge, Cambridge University Press. pp. 103-119.

Bibby, C. J. (2001). *Bird Census Techniques*. Academic Press. London.

Blair, R. B. (1996). Land use and avian species diversity along an urban gradient. *Ecological Applications, 6*, 506-519. https://doi.org/10.2307/2269387

Blair, R. B. (1999). Birds and butterflies along an urban gradient: Surrogate taxa for assessing biodiversity? *Ecol Appl, 9*, 164-170. https://doi.org/10.1890/1051-0761(1999)009[0164:BABAAU]2.0.CO;2

Blair, R. B. (2001). Creating a homogenous avifauna. In: J. M. Marzluff, R. Bowman, & R. Donnelly (eds.), *Avian ecology and conservation in an urbanising world*. Boston, Kluwer. Pp. 461-488.

Blair, R. B. (2004). The effects of urban sprawl on birds at multiple levels of organization. *Ecol Soc, 9*(5), 2. https://doi.org/10.5751/ES-00688-090502

Bolger, D. T., Scott, T. A., & Rotenberry, J. T. (1997). Breeding bird abundance in an urbanizing landscape in coastal southern California. *Conservation Biology, 11*, 406-421. https://doi.org/10.1046/j.1523-1739.1997.96307.x

British Trust for Ornithology (n.d.) Retrieved from http://www.bto.org/birdtrends

Cam, J. I., Schwabl, I., & Gwinner, E. (2006). Stress and the city: Urbanization and its effects on the stress physiology in European blackbirds. *Ecol, 87*, 1945-1952. https://doi.org/10.1890/0012-9658(2006)87[1945:SATCUA]2.0.CO;2

Clergeau, P., Savard, G., & Mennechez, G. (1998). Bird abundance and diversity along an urban- rural gradient: a comparative study between two cities on different continents. *Condor, 100*, 413-425. https://doi.org/10.2307/1369707

Collins, R. N., Miller, O. K., & Adkisson, C. S. (1976). Woodpecker dependence on trees infected by fungal heart rot. *Wilson Bull, 88*, 575-558.

Dawson, D. G., & Bull, P. C. (1975). Counting birds in New Zealand Forests. *Notornis, 22*, 101-109.

Dunning, J. B. (2007). *CRC Handbook of Avian Body Masses*, 2nd edn. Boca Raton, FL, USA: CRC Press. https://doi.org/10.1201/9781420064452

Ekane, N. B. (2000). *The Socio Economic Impact of Pronus Africana Management in the Mount Cameroon Region. Case study of the Bukwango Community* (M Sc. Thesis), Department of Urban Planning and Environment, Royal Institute of Technology Stockholm

Emlen, J. T. (1974). An urban Bird community in Tucson, Arizona: derivation, structure, regulation. *Condor, 76*, 184-97. https://doi.org/10.2307/1366729

Erz, S. V. (1996). Song post height in relation to predator diversity and urbanization. *Ethol, 117*, 529-538. https://doi.org/10.1111/j.1439-0310.2011.01899.x

Fernandez-Juricic, E. (2000). Avifaunal use of wooded streets in an urban landscape. *Conservation Biology, 14*, 513-521. https://doi.org/10.1046/j.1523-1739.2000.98600.x

Fitton, J. D., Kilburn, C. R. J., Thirwall, M. F., & Hughes, D. J. (1983). 1982 eruption of Mt. Cameroon, West Africa. *Nature, 306*, 327e332. https://doi.org/10.1038/306327a0

Fitzpatrick, J. W. (1981). Search strategies of tyrant flycatchers. *Anim Behav, 29*, 810-821. https://doi.org/10.1016/S0003-3472(81)80015-2

Fuchs, W. (1998). Impact of predation by domestic cats (Felis catus) in an urban area gradient. *Ecol Appl, 6*, 506-519.

Gatson, A. (2007). Does urbanization filter birds on the basis of their biological traits? *Condor, 110*, 223-240. https://doi.org/10.1525/cond.2008.8409

Hadiadian, J. K., Reynaud, P. A., & Sandstorm, W. A. (1997). Use of native and exotic garden plants by suburban nectarivorous birds. *Biol Conserv Biol, 2*, 219-224.

Hartley, L., & Greene, T. (2008). *Five minute bird count*. Department of Conservation draft report January 2008.

Hobson, E., & Rempel, K. (2001). Designing research to advance the management of birds in urbanizning areas. *Proceedings of the Fourth International Urban Wildlife Symposium*, pp. 114-122.

Jokimaki, T. (1999). Artificial nest predation and abundance of birds along an urban gradient. *Condor, 102*, 838-847. https://doi.org/10.1093/condor/102.4.838

Kuhn, I., Brandle, R., & Klotz, S. (2004). The flora of german cities is naturally species rich. *Evol Ecol Res, 6*, 749-764.

Landsberg, H. E. (1981). The urban climate. *International Geophysics Series, 28*, 275.

Marzluff, J. M., & Kern, E. (2001). Restoration of fragmented landscapes for the conservation of birds: A general framework and specific recommendations for urbanizing landscapes. *Restoration Ecology, 9*, 280-292. https://doi.org/10.1046/j.1526-100x.2001.009003280.x

Matthews, R. H. (1999). On bird species diversity. *Ecology, 42*, 594-598. https://doi.org/10.2307/1932254

McDonnell, K. M. (2006). Spatiotemporal changes of landscape pattern in response to urbanization. *Landsc Urban Plan, 81*, 341-353. https://doi.org/10.1016/j.landurbplan.2007.01.009

McKinney, M. L. (2002). Urbanisation, biodiversity, and conservation. *BioScience, 52*, 883-890. https://doi.org/10.1641/0006-3568(2002)052[0883:UBAC]2.0.CO;2

Melles, S., Glenn, S., & Martin, K. (2003). Urban bird diversity and landscape complexity: species - environment associations along a multiscale habitat gradient *Conservation Ecology, 7*, 5. https://doi.org/10.5751/ES-00478-070105

Mennechez, K. (2006). Riparian bird response to vegetation structure: a multiscale analysis using LiDAR measurements of canopy height. *Ecol Appl, 19*, 1848-1857. https://doi.org/10.1890/08-1124.1

Miller, J. R., & Hobbs, R. J. (2002). Conservation where people live and work. *Conserv Biol, 16*, 330-337. https://doi.org/10.1046/j.1523-1739.2002.00420.x

Mills, A. J., McCain, C. M., & Palmer, M. (1989). Could temperature and water availability drive elevational species richness patterns? A global case study for bat. *Global Ecol Biogeogr, 8*, 13-20.

Pautasso, S. K. (2007). Intersepcific variation in avian blood parasites and haematology associated with urbanization in a desert habitat. *J Avian Biol, 39*, 300-310. https://doi.org/10.1111/j.0908-8857.2008.04248.x

Prakash, M. K. (2012). Ecology diversity of birds in relation to the structure of urban green space. *Landscape Urban Plan, 77*, 39-53. https://doi.org/10.1016/j.landurbplan.2005.01.004

Rebele, F. (1994). Urban ecology and special features of urban ecosystems. *Global Ecology and Biogeography Letters, 4*, 173-187. https://doi.org/10.2307/2997649

Rolstad, J. (1991). Consequences of forest fragmentation for the dynamics of bird populations: conceptual issues and the evidence. *Biol J Linn Soc, 42*, 149–163. https://doi.org/10.1111/j.1095-8312.1991.tb00557.x

Rosenstock, S. S., Anderson, D. R., Giesen, K. M., Leukering, T., & Carter, M. F. (2002). Landbird counting techniques current practices and an alternative. *The Auk, 119*, 46-48. https://doi.org/10.1093/auk/119.1.46

Rothery, D. K. (1999). Bird communities and the structure of urban habitats. *Can J Zool., 57*, 2358-2368. https://doi.org/10.1139/z79-307

Savard, S. (2000). Relative abundance in bird populations. *Am Nat., 112*, 695-699. https://doi.org/10.1086/283311

Seaward, M. K. (1982). Responses of songbirds to magpie reduction in an urban habitat. *J Wildll. Manage., 71*, 2624-2631. https://doi.org/10.2193/2006-105

Shochat, A. (2004). What is the form of animal-species-richness relationship? A critical review and meta analysis. *Ecology, 93*, 2241-2252. https://doi.org/10.1890/11-1861.1

Spurr, E. B. (2005). Monitoring bird populations in New Zealand: a workshop to assess the feasibility of a national bird population monitoring scheme. In C. Bezar (ed.), *Landcare Research Science Series No 28*. Lincoln.

Sruti, N. (2008). *Ecological studies on house sparrow, Passer domesticus in the bharadvati town, Karnataka state, India* (M.Sc. Dissertation), Kuvempu University, Shankarghatta, Karnataka, India.

Tanjong, E. (2014). Socio-economic survey of the villages of Mount Cameroon National Park (MCNP). *Program for Sustainable Management of Natural Resources Cameroon – South-West Region, Buea, Cameroon, 117*, 529-538.

Thompson, P. J. (1993). Bush, bugs and birds; interdependency in a farming landscape. *Open J Ecol, 1*(2) 9-23. https://doi.org/10.4236/oje.2011.12002

Walsh, S. A. (2006). New penguin remains from the Pliocene of Northern Chile. *Hist Biol, 18*(2), 115-126. https://doi.org/10.1080/08912960600640796

Walters, R. J. (1970). Responses of songbirds to magpie reduction in an urban habitat. *J Wildll Manage, 71*, 2624-2631. https://doi.org/10.2193/2006-105

Wania, J. M., Valacarel, A., & Fernandez-Juricic, E. (2009). Antipredator strategies of house finches: Are urban habitats safe spots from predators even when humans are around? *Behav Ecol Sociobiol, 63*, 673-685. https://doi.org/10.1007/s00265-008-0701-6

Warren, P. S., Katti, M., Emran, M., & Brazel, A. (2006). Urban Bioacoustics: Its not just noise. *Anim Behav, 71*, 491-502. https://doi.org/10.1016/j.anbehav.2005.07.014