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Changing Climate: A Risk Factor for Declining Avian Fauna in Peshawar City

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Article Details

Keywords: Avian Diversity, Changing Climate, Temperature, Rainfall, Urban Green Areas

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ABSTRACT

The purpose of this study was to find impact of climate change on selected avian fauna in Peshawar city. Total ten sampling sites were included to study the current status of Passer domesticus, Acridotheres tristis and Zenaida macroura through point count method. The most abundant species was Passer domesticus with a relative abundance (Pi) of 0.695 followed by Acridotheres tritis with relative abundance (Pi) of 0.175 and Zenaida macroura with relative abundance (Pi) of 0.129. 20 years of climatic data were taken from Peshawar meteorological department. Average temperature was recorded as 29.10C from 2000 to 2010 and 31.00C from 2010 to 2020, which shows increase since 2000, average rainfall was recorded as 37.3 mm from 2000 to 2010 and 35.2 mm was recorded from 2010 to 2020 which shows a decreasing trend in rain fall. It is suggested that irregular rainfall and temperature of Peshawar city negatively affect bird species. It is recommended to increase urban green areas by planting more native species in order to overcome the increasing level of carbon which is the ultimate cause of rising temperature. If these changes continue in future it will decreases the bird diversity in residential areas of Peshawar. Shannon wainer diversity index was calculated as 3.4949. It is recommended to increase urban green areas by planting more native species. Residential areas should be integrated into urban planning and there should be specific percentage of open space for plantation in housing societies to sustain bird diversity. Proper land use planning and green planning should be made part of all the developmental planning including housing societies. Every initiative regarding development should be subjected to approve land use plan of the concerned district and most importantly green zones identified in the land use plans should be implemented in true spirit in order to achieve the planned outcomes in the shape of sustainable development. These practices will decrease the negative impacts of changing climate on bird's population.

DOI: Availability

INTRODUCTION

Pakistan is extremely susceptible to the climate change **(Krishnamurti, 1987).** For bird's population changing climate is a multidimensional challenge **(Tesfahunegny and Mulualem, 2017)**. Birds are affected due to changing climate globally. It has been alleged that changing climate variables including temperature, humidity, and rainfall have role in the extinction of avian population. Rise in temperature, Irregular rainfall which may be too high or too low have negative impact on bird diversity **(Hole et al. 2009**). Climate change is driving many populations of bird to local extinctions. Species once considered common, are now declining as a result of factors such as habitat loss, disintegration, hostile environmental conditions and contamination **(Butcher, 2007).** Changing patterns of Temperature, rainfall and humidity are also affecting birds either directly through heat loss or heat gain **(Petit and Vezina, 2014)**. The diversity of birds is changing due to unpredictable weather condition (**Robinson et al. 2007).** The nesting season timing of avian population is changing, in response to warmer springs the size of eggs and hatching success are also changing **(Sparks et al. 2002)**. The patterns of climate are affected due to increase in temperature which have negative effect on bird's diversity **(Chettri and Acharya 2012)**. Birds indicate the changes in environment of specific area. Level of population, success of breeding, density of bird population should be observed to check the changes in environment and to decide conservation strategies for birds (**Rad, 2014).** There is strong relation between Rainfall and avian reproductive success in semi arid environment **(Dean et al. 2009)**. The rainfall system is most essential factor for availability of high quality of food for birds **(Houston, 2013)**. The relation between changing climate and loss of habitat is most important factor for declining of avian diversity **(Thomas et al., 2006).**

Passer domesticus is a little bird and has a considerable value because it is an indicator of balanced ecosystem. It lives both in urban and rural areas and closely connected with human territory. *Passer domesticus* is dependent on seed, grains and weeds for food but also eat insects. The population of Passer domesticus has reduced significantly in many parts of the world specifically in urban areas **(Chamberlain, et al., 2007).** The Acridotheres tristis has brown color, on the lower side of the tail feathers and along the sides of flight feathers have white patches. It feeds on seeds and insects and act as biological pest control. Its population can be

drastically affected by climate change and human made changes to the landscape. Dependency of this species on fruit and nectar gives it the ecological role in dispersal of seed, which is one of the valuable ecosystem services **(Feare and Craig, 1998).** In our environment *Acridotheres tristis* play an integral role to maintain ecosystem but it has been vanishing nearly for two decades and is placed in IUCN red list of endangered species **(Balwan and Saba, 2020).** Genetic variations plays vital role in the existence of bird species, fragmentation of natural habitat results in the loss of genetic diversity of *Zenaida macroura.* **(Imtiaz. et al., 2011).**

MATERIAL AND METHOD

STUDY AREA

Peshawar is the capital of Khyber Pakhtunkhwa. Peshawar is located at an altitude of 315 m; total area of Peshawar is 1,257 km². The coordinates of Peshawar is 34.0167° N, 71.5833° E (Khatak, *et al.*, 2015).

STUDY METHOD

So keeping in view the research topic point count method was used to investigate the current status of selected bird species in ten sampling points in Peshawar city,

PRIMARY DATA

I. POINT COUNT METHOD

It is suitable for estimating the diversity and richness of birds in residential areas. In the early morning through point count method birds watching will be done for 10 minutes in a circle with 20 meter radius. The distance between the stations of point count will be at least from 200 to 250 meter (**Herzog, et al., 2016 and Bibby et al., 2000).**

Field visits were carried out for identification and distribution of selected avian species. The bird's survey was done in 2020 for four months i.e March, April, May and June, were done in the morning from 6:00 to 8:00 am. Total 10 sampling points each with a circle of 20 meter radius was selected, given in table 1.

ii. BIRD CENSUS: The FAO guidelines for bird's survey and the protocol for point count method given by **(Herzog *et al.,* 2016 and Bibby *et al.*, 2000)** were followed.

iii. STATISTICAL ANALYSIS

Diversity indices **(Stiling, 1999)** were used for analysis of bird's relative abundance, Shannon-wiener diversity index of species and evenness of species.

1. RELATIVE ABUNDANCE

Relative abundance (Pi) Pi = Ni / N

Where, Ni is the number of Individuals of a species, and N is total population of birds.

2. SHANNON-WIENER DIVERSITY INDEX

Shannon-wiener diversity index (H')

$$H' = - [\sum Pi \ln Pi]$$

Where, Pi is proportion of species i relative to the total number of species, and ln Pi is natural logarithm of this proportion.

3. PEARSON CORRELATION COEFFICIENT

Correlation measures the relationship involving two variables, which ranges between −1 and 1 by using the following formula (**Asuero et al., 2006).**

$$r = \frac{\sum(X-\overline{X})(Y-\overline{Y})}{\sqrt{\sum(X-\overline{X})^2}\sqrt{(Y-\overline{Y})^2}}$$

Where, $\overline{X}$ = mean of X variable

$\overline{Y}$ = mean of Y variable

SECONDARY DATA: Data of last 20 years from 2000 to 2020 related to Temperature and rainfall of Peshawar city was obtained from meteorology department Peshawar.

RESULTS

STATUS OF SELECTED BIRD SPECIES IN PESHAWAR CITY

BIRDS POINT COUNT METHOD

Field visits were carried out to find the density of birds in residential areas Peshawar city. Four months data from March to June were collected about the selected bird's species that is Passer domesticus, myna and Dove species. Total 10 sampling points were selected each sampling point was a circle with 20 meter radius. The selected points were visited once in a week in the early morning from 6:00 AM to 8:00 AM. The Passer domesticus was abundantly found in residential areas of Peshawar city followed by common myna and dove; these species were abundant during March, April and May but less abundant during the month of June, shows in figure 1.

TABLE 1. LOCATION OF SELECTED SAMPLING POINTS

Study area	Latitude	Longitude
Wazir colony	71° 35'22.16" E	34°02'01.71" N
Latif Abad	71° 35'12.71" E	34°02'05.07" N
Afghan colony	71° 34'51.50"E	34°01'37.53" N
Momin Town	71° 36'15.50"E	34°01'42.95" N
Faqir Abad	71° 35'00.73" E	34°01'09.98" N
Zaryab colony	71° 35'09.06" E	34°01'12.71" N
Sardar colony	71° 34'46.90" E	34°02'22.58" N
Bashir Abad	71° 33'32.35" E	34°01'37.62" N
Ittehad colony	71° 35'14.00" E	34°01'44.82" N
Sardar Ahmad Jan colony	71° 35'00.71" E	34°01'48.75 "N

TOTAL BIRD SPECIES RECORDED IN THE ENTIRE STUDY AREA

Total 909.32 three bird species were observed during four months survey. Passer domesticus recorded in March were 16.00097 %, in April 18.80746 %, in May 18.88664 % and in June 12.17943 %, Acridotheres tristis species recorded in March were 4.01 %, in April 4.89 %, in May 5.6 % and in June 4.45 %. Zenaida macroura recorded in March were 2.96 %, in April 5.25 %, in May 3.88 % and in June 3.05 %. Over all total birds species recorded during four months were 65.8 % Passer domesticus, 18.97 % were Acridotheres tristis and 15.15 % were Zenaida macroura.

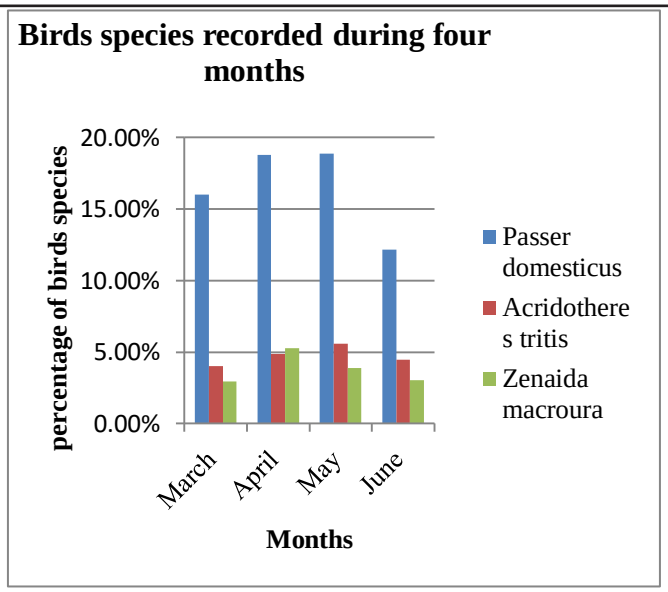


FIGURE 1. BIRD SPECIES RECORDED DURING FOUR MONTHS

BIRDS SPECIES DIVERSITY

The most abundant species was Passer domesticus with a relative abundant (Pi) of 0.695 followed by Acridotheres tristis with relative abundance (Pi) of 0.175 and Zenaida macroura with relative abundance (Pi) of 0.129. Shannon-waver Diversity index was calculated as 3.4949.

CLIMATIC CONDITION OF PESHAWAR CITY

Annual data of minimum and maximum temperature, humidity and rainfall from 2000 to 2020 was provided by Pakistan metrological department. According to (Ahmed and Siddiq.,2014), Peshawar maximum temperature shows increasing trend, in early period the maximum temperature of Peshawar was below 30 °C, however with the passage of time a systematic increase in its maximum temperature from 2°C to 3°C. This rise in temperature indicates warmer climatic condition of Peshawar; this rise may be due to global warming. Both maximum temperature and minimum temperature graph of Peshawar reveals that as the time passes climate of Peshawar become warmer.

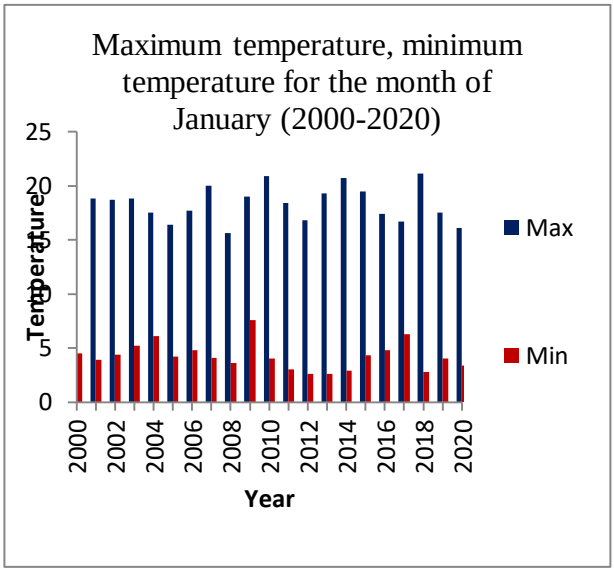


FIGURE 2. MAXIMUM TEMPERATURE, MINIMUM TEMPERATURE

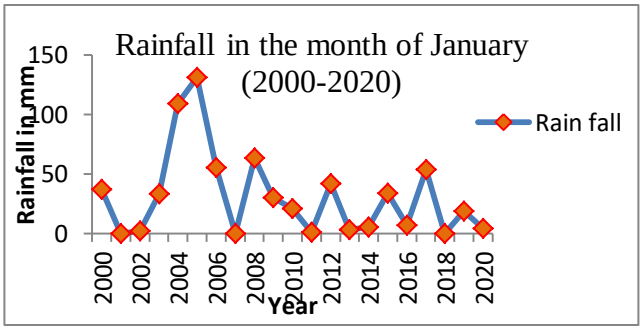


FIGURE 4 AVERAGE RAINFALLS IN THE MONTH OF JANUARY FROM 2000 TO 2020

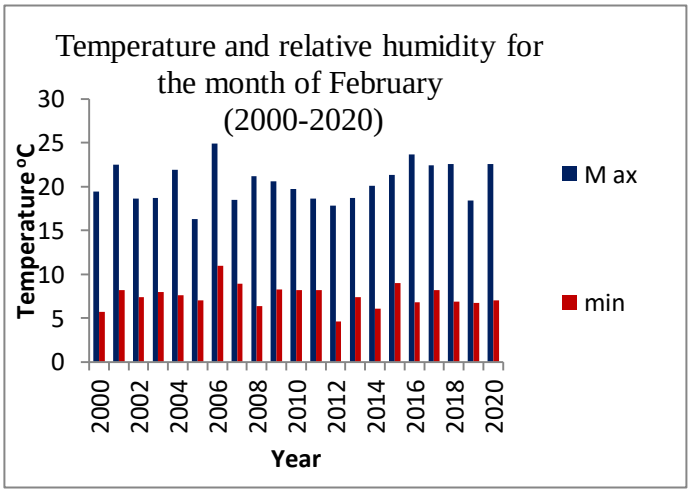


FIGURE 3 SHOWS MAXIMUM TEMPERATURE, MINIMUM TEMPERATURE.

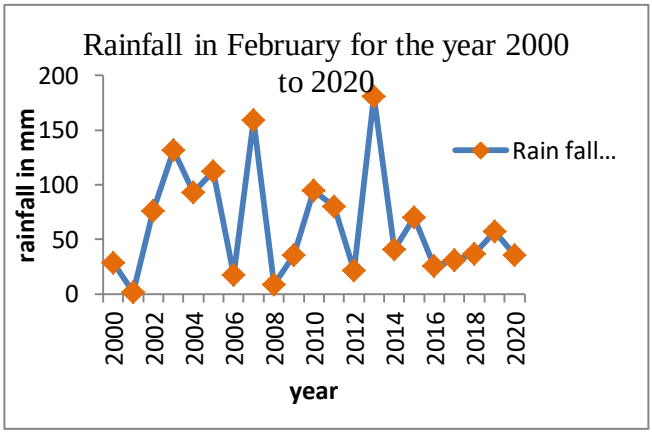


FIGURE 5 AVERAGE RAINFALLS IN THE MONTH OF FEBRUARY FROM 2000 TO 2020

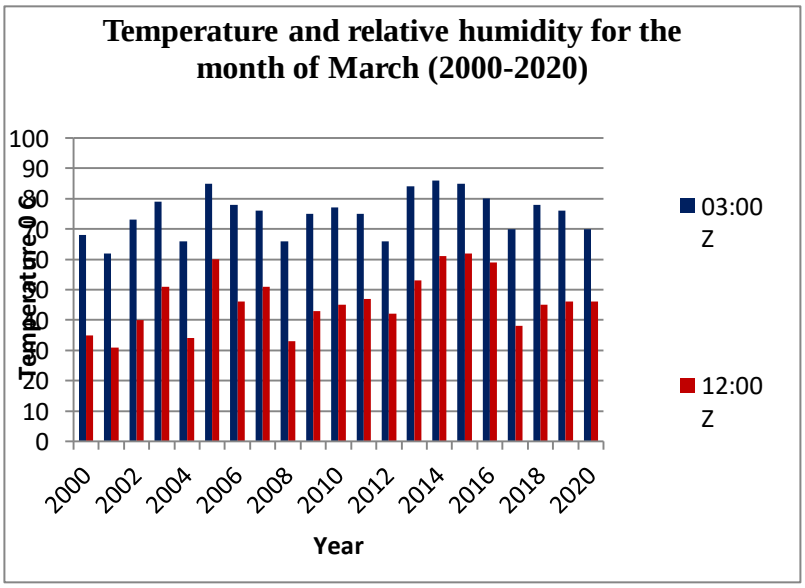


FIGURE 6 MAXIMUM TEMPERATURE, MINIMUM TEMPERATURE AND RELATIVE HUMIDITY.

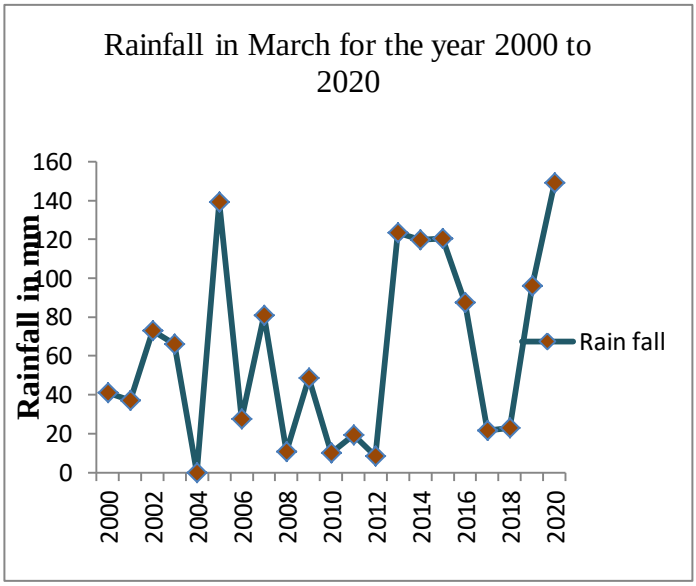


FIGURE 8 AVERAGE RAINFALLS IN THE MONTH OF MARCH FROM 2000 TO 2020

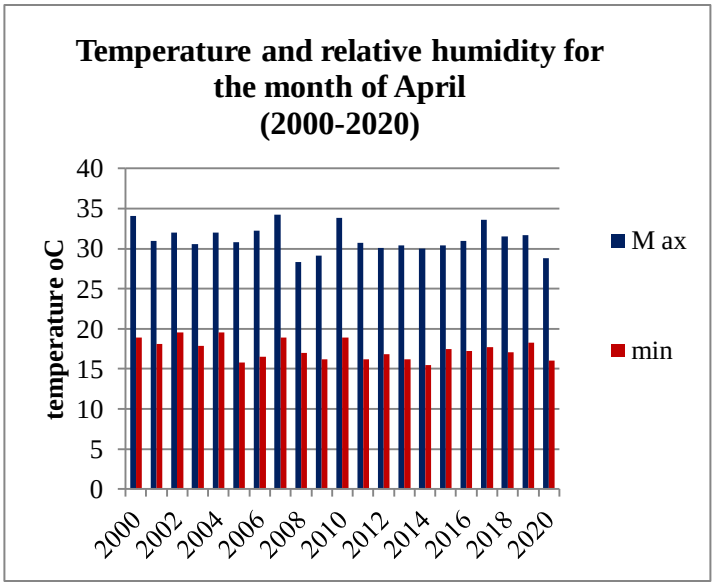


FIGURE 7 MAXIMUM TEMPERATURE, MINIMUM TEMPERATURE AND RELATIVE HUMIDITY.

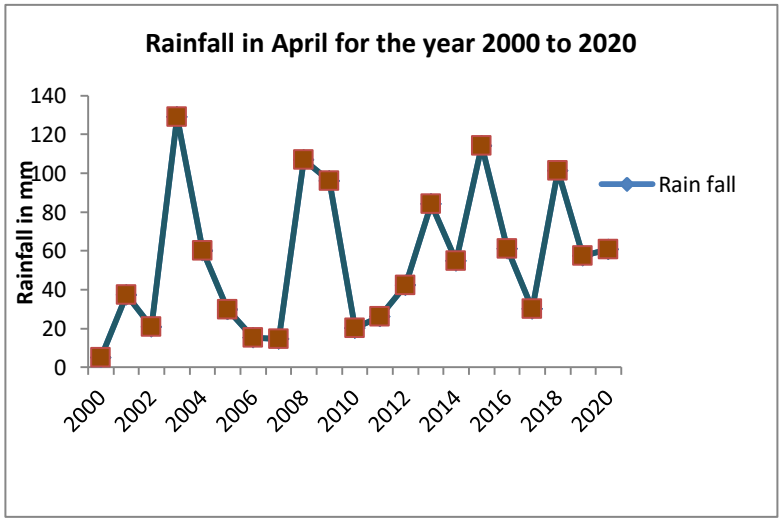


FIGURE 9 AVERAGE RAINFALL IN THE MONTH OF APRIL FROM 2000 TO 2020

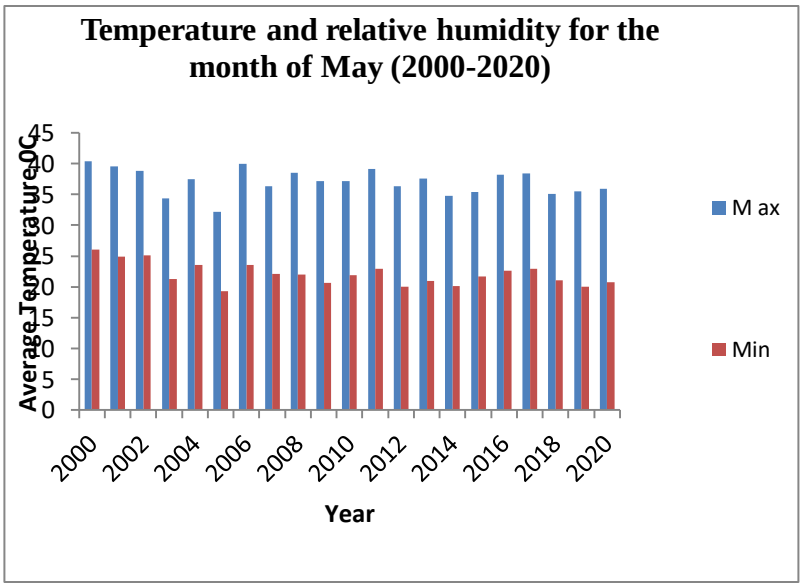


FIGURE 10 MAXIMUM TEMPERATURE, MINIMUM TEMPERATURE AND RELATIVE HUMIDITY.

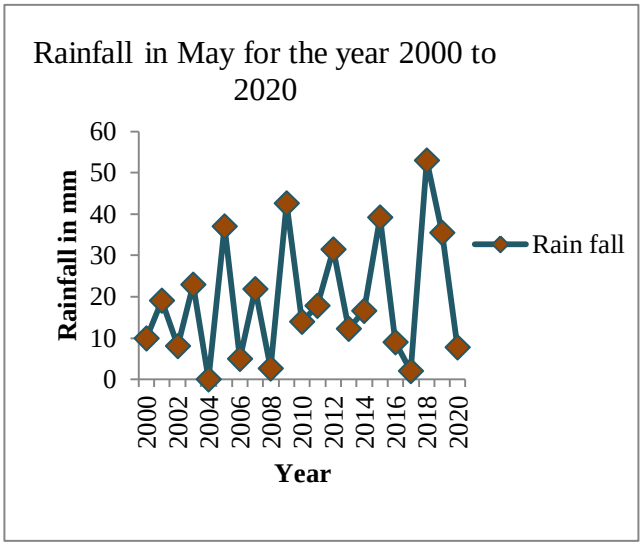


FIGURE 12 AVERAGE RAINFALL IN THE MONTH OF MAY FROM 2000 TO 2020

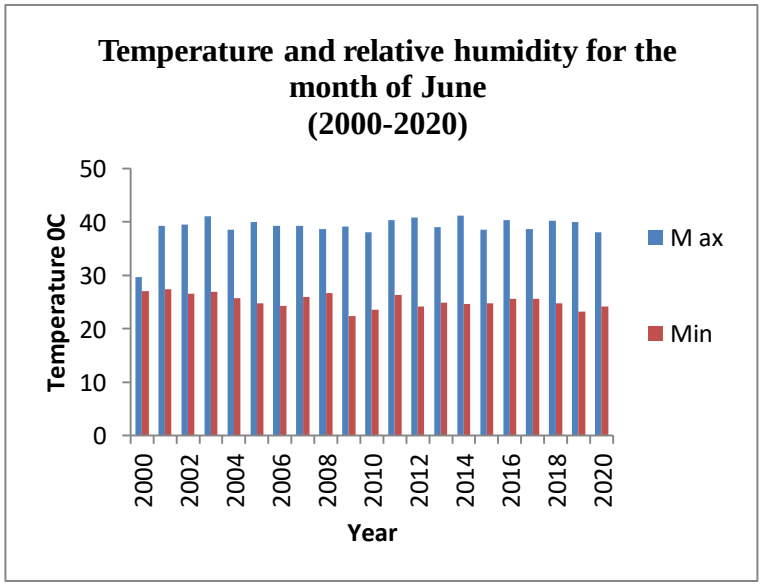


FIGURE 11 MAXIMUM TEMPERATURE, MINIMUM TEMPERATURE AND RELATIVE HUMIDITY.

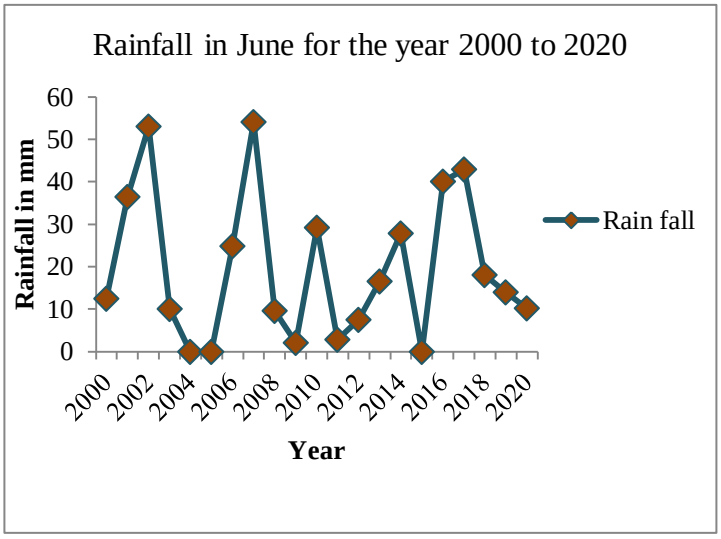


FIGURE 13 AVERAGE RAINFALL IN THE MONTH OF JUNE FROM 2000 TO 2020

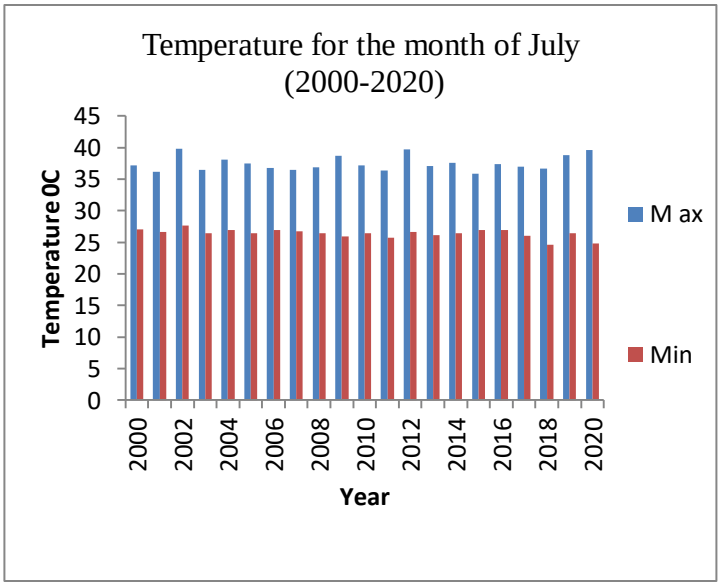


FIGURE 14 MAXIMUM TEMPERATURE, MINIMUM TEMPERATURE AND RELATIVE HUMIDITY.

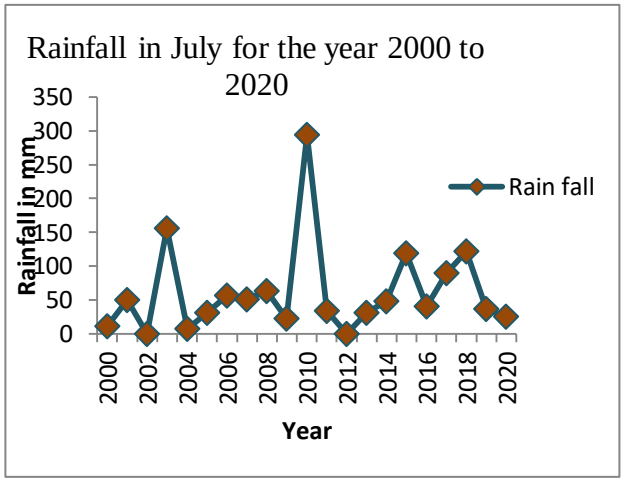


FIGURE 16 AVERAGE RAINFALL IN THE MONTH OF APRIL FROM 2000 TO 2020

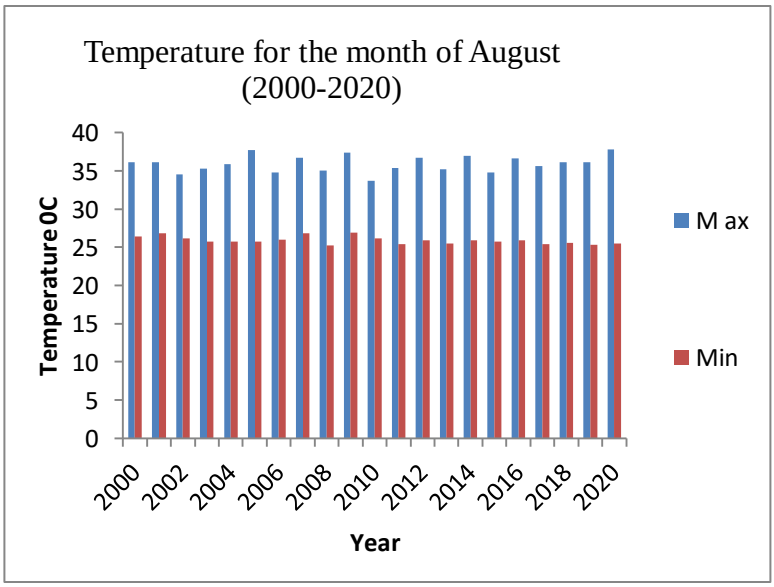


FIGURE 15 MAXIMUM TEMPERATURE, MINIMUM TEMPERATURE AND RELATIVE HUMIDITY.

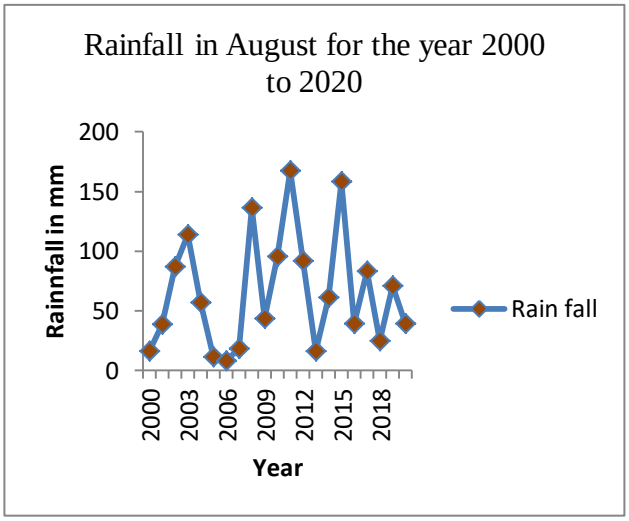


FIGURE 17 AVERAGE RAINFALL IN THE MONTH OF AUGUST FROM 2000 TO 2020

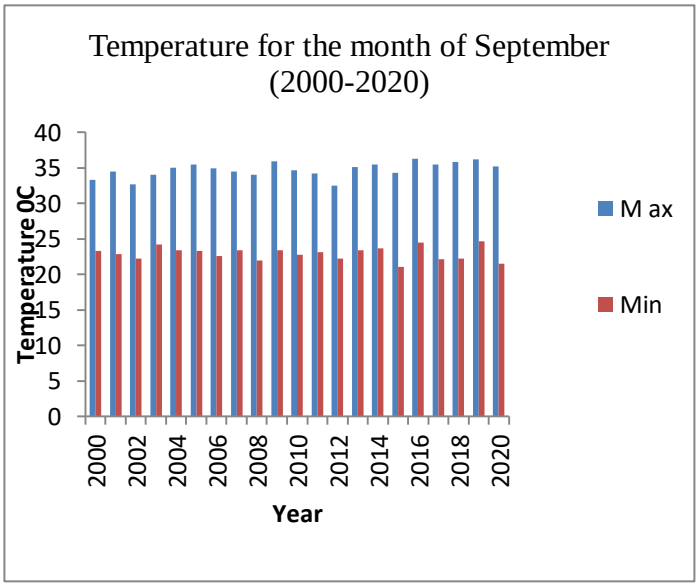


FIGURE 18 MAXIMUM TEMPERATURE, MINIMUM TEMPERATURE AND RELATIVE HUMIDITY.

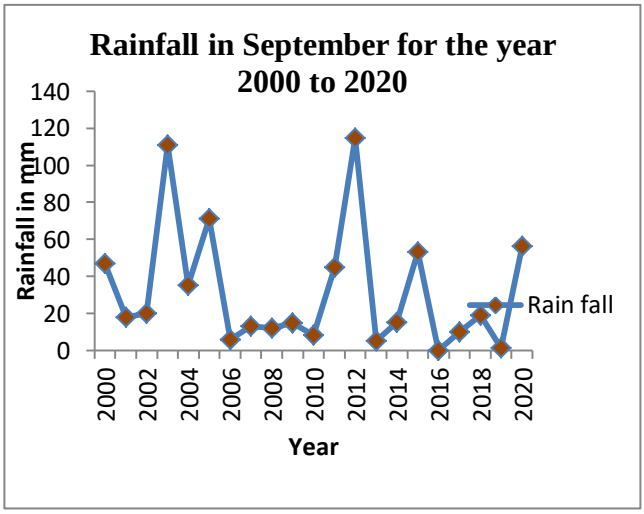


FIGURE 20 AVERAGE RAINFALL IN THE MONTH OF SEPTEMBER FROM 2000 TO 2020

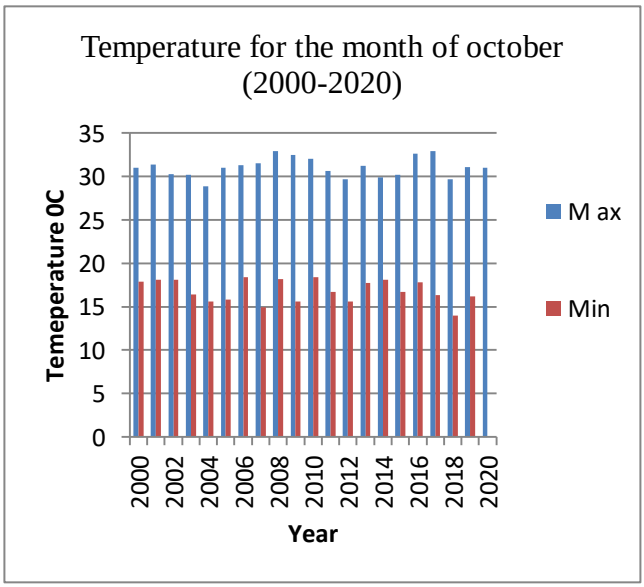


FIGURE 19 MAXIMUM TEMPERATURE, MINIMUM TEMPERATURE AND RELATIVE HUMIDITY.

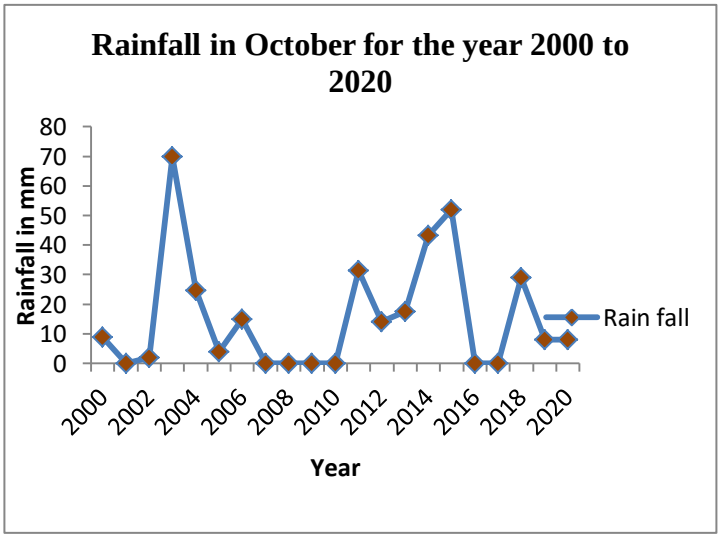


FIGURE 21 AVERAGE RAINFALL IN THE MONTH OF OCTOBER FROM 2000 TO 2020

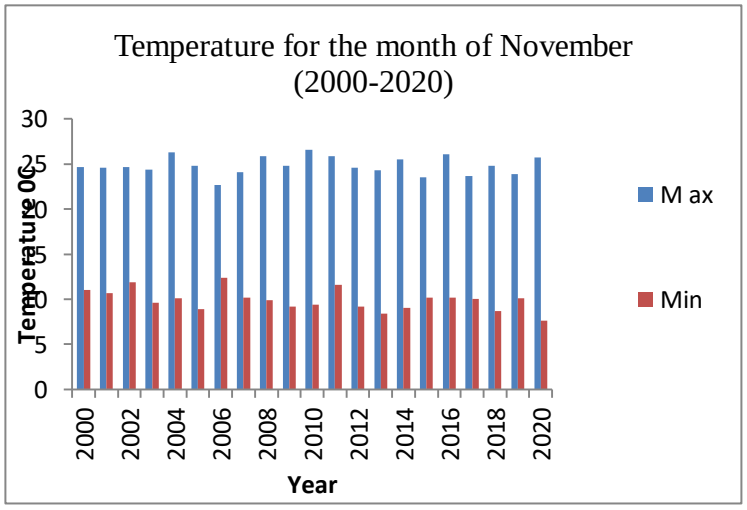


FIGURE 22 MAXIMUM TEMPERATURE, MINIMUM TEMPERATURE AND RELATIVE HUMIDITY

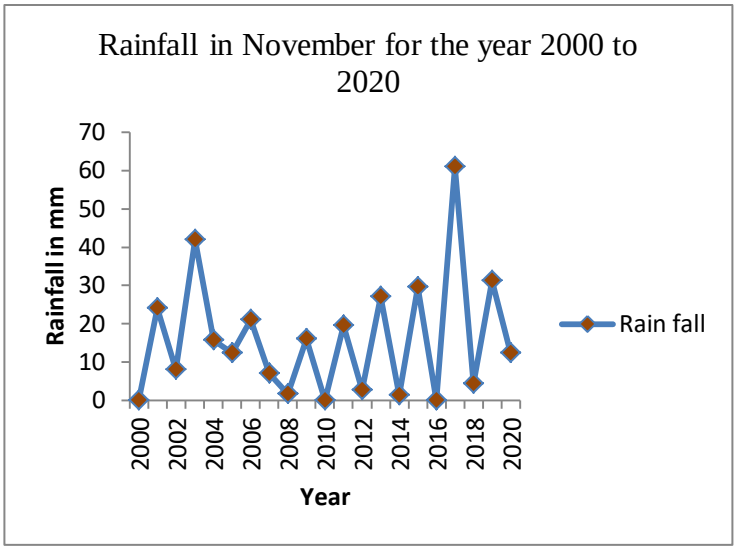


FIGURE 24 AVERAGE RAINFALL IN THE MONTH OF NOVEMBER FROM 2000 TO 2020

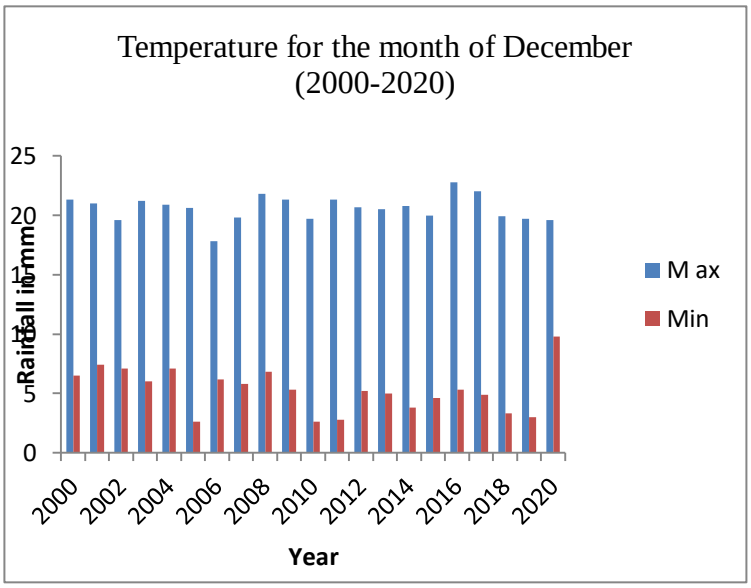


FIGURE 23 MAXIMUM TEMPERATURE, MINIMUM TEMPERATURE AND RELATIVE HUMIDITY

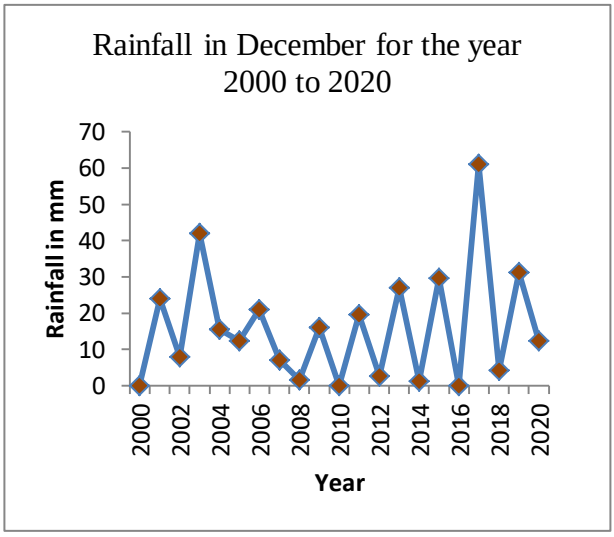


FIGURE 25 AVERAGE RAINFALL IN THE MONTH OF DECEMBER FROM 2000 TO 2020

PEARSON CORRELATION COEFFICIENT OF BIRD POPULATION WITH CLIMATIC VARIABLES

A significant positive correlation exist between temperature and birds species that is Passer domesticus (r = 0.7216), Acridotheres tristis (r = 0.4427) and Zenaida macroura (r = 0.3773). Moderately negative correlation exist between Rainfall and birds species that is Passer domesticus (r = -0.00765), Acridotheres tristis (r = -0.0676) and Zenaida macroura (r = -0.11854).

TABLE 4.28 CORRELATION COEFFICIENT OF BIRD POPULATION WITH CLIMATIC VARIABLES

Temperature			**Rainfall**		
Passer domesticus	Acridotheres tristis	Zenaida macroura	Passer domesticus	Acridotheres tristis	Zenaida macroura
0.721661	0.442726	0.377349	-0.00765	-0.0676	-0.11854

CONCLUSION

This study concludes that Peshawar city was once a home to large number of bird species. Urbanization in Peshawar city is rapidly increasing which leads to decrease in vegetation cover and ultimately results in rise in temperature and irregular rainfall. The rise in temperature and irregular rainfall change the climatic condition of Peshawar city that results in declining of avian diversity.

RECOMMENDATION

Residential areas should be integrated into urban planning and there should be specific percentage of open space for plantation in housing societies to maintain bird diversity. Climate change strategy should be adopted in city areas. Environmental awareness education system should be introduced at school and college level in order to keep the students updated related to environmental condition. Environmental Laws should be enacted to reduce the overuse of Natural resources. Proper land use planning and green planning should be made part of all the developmental planning including housing societies. Every initiative regarding development should be subjected to approve land use plan of the concerned district and most importantly green zones identified in the land use plans should be implemented in true spirit in order to achieve the planned outcomes in the shape of sustainable development. These practices will decrease the negative impacts of changing climate on bird's population.

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