IMPACT OF CLIMATE CHANGE ON BUTTERFLY POPULATION OVER A METROPOLIS OF INDIA

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ABSTRACT

Evidences are accumulating that climatic change in recent decades (IPCC, 2015) has had a major effect, leading to species declines and extinctions. Literature reveals that the impact of the expected future changes on the populations and distribution of butterflies will be huge, and action is urgently needed. The butterflies in Kolkata are facing enormous changes in their environment. In this study butterflies and their diversity in different locations of the urban city, Kolkata is attempted.

Diversities in the butterflies is estimated in three different locations -Jadavpur University (South), Victoria Memorial (Central) and Rabindra Bharati area (North) of Kolkata metropolis in the winter of **2017**. Analysis on diversities and species abundance of butterflies over these three locations reveals that Rabindra Bharati possesses healthier environment than other two sites. The bio-diversity and species abundance is good and balanced. Assessments of air quality index also suggest that Rabindra Bharati University area is less vulnerable in comparison to other two sites.

Keywords: Air Quality Index, Butterflies, Biodiversities etc.

SAMPLING SITES

In this study ,three sites were selected

Site 1:Campus of Jadavpur University (South Kolkata) **Site 2**:Victoria Memorial (Central Kolkata) **Site 3**:Campus of Rabindra Bharati University (North Kolkata)

SAMPLING PERIOD AND TIME

The butterflies were observed in the sampling site for a period of 8 weeks between the month of January 2017 and March 2017. Each study site was visited twice a week and the transect were observed from Morning (9:00 am) to Afternoon (1:00 pm) during good weather.

AIR POLLUTION DATA

The pollution data viz. Particulate Matter (PM10), Oxides of Nitrogen (NO_x), Sulfur Dioxide (SO₂), Carbon Mono Oxide (CO) and Ozone (O₃) for the Site 2 and Site 3 were collected from the West Bengal Pollution Control Board and for Site 1, the pollution data was collected from School of Environmental Studies, Jadavpur University.

RESULTS AND DISCUSSION

In Figure 5 and Figure 6, the butterflies that are observed during the study period are shown and the colour and decoration of butterflies indicate variability in wing pattern which almost remain constant for all the three study sites.



he representative butterfly species encountered in the present study

- A:Graphium agamemnon; B:Graphium doson; C:Papilio polytes;
- D:Papilio demoleus ; E:Chilasa clytia ; F:Eurema brigitta ; G:Eurema hecabe ; H:Catopsilia pyranthe ; I:Appias libythea ;J:Delias hyparete ;K:Leptosia nina L:Tirumala liminiace : M:Dumaus genutia : N:Danaus chrysippus



Figure 6.

The representative butterfly species encountered in the present study: A:Elymnias htpermnestra ; B:Junonia atliites ; C:Junonia almana ; D:Hypolimnas Bolina ; E:Ariadne merione ; F:Acraea terpsicore ; G: Ypthima huebneri ; H: Neptis hylas ; I: Lampides boeticus ; J: Zizula hylax K:Pseudozizeeria maha ; L:Catochrysops strabo

RESULTS AND DISCUSSION

During this study, 32 different butterfly species were observed in the study sites and these belonged to four families Papilionidae, Pieridae, Nymphalidae, Lycaenidae. Family Hesperidae was not observed during the study period.

Table 1

It is seen that **Nymphalidae** showed the maximum species richness, comprising of (15 species 46.87%), followed by Pieridae (7 Species 21.87%), Papilionidae (6 species 18.75%) and Lycaenidae (4 species 12.5%).



AIM OF THE STUDY

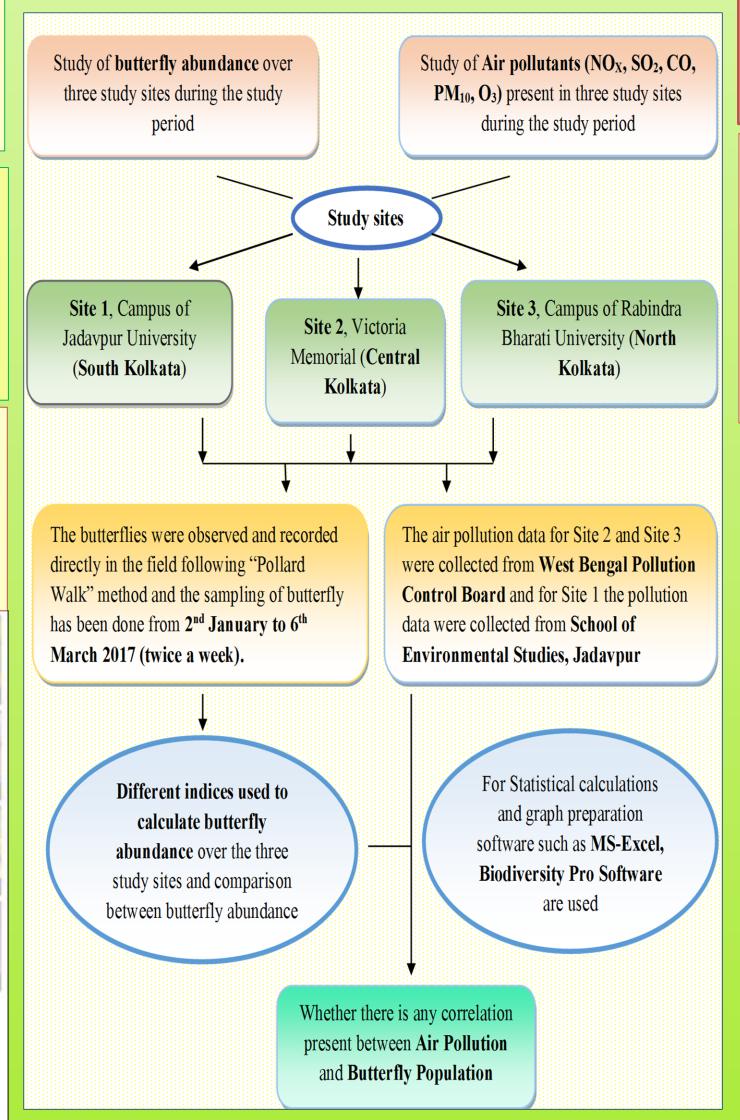
The principle objective of this study is to establish a relationship between air pollution and butterfly diversity. The detailed objectives are as follows

- To study the **butterfly abundance** in the three study sites by sampling of the butterflies.
- To analyze the present condition of butterfly population over the three point sources of Kolkata (Campus of Jadavpur University, Victoria Memorial and Campus of Rabindra Bharati University).
- To assess the correlation between air pollution and butterfly population.
- Determine whether air pollution is an influential factor for butterfly diversity.

TECHNIQUE OF BUTTERFLY SAMPLING

The butterflies were observed and recorded directly in the field following the Pollard Walk method (Pollard, 1977; Pollard and Yates, 1993) with necessary modifications.

IMPLEMENTATION PROCEDURE (FLOW CHART)



METHODOLOGY

INDICES FOR STATISTICAL ANALYSIS OF BUTTERFLY SAMPLING

Shannon index: Species diversity was calculated using the Shannon Index, which combines the number of species within a site with the relative abundance of each species.

$$H' = -\sum p_i \ln p_i$$

Shannon Evenness: Shannon evenness was calculated using

$$J = H' / H_{max}$$
 where $H_{max} = log_{10}(S)$

where S is the number of species (richness)

Air Quality Index(AQI)

To compute this at first, Air Quality Rating (AQR) of all the pollutants is estimated.

$$AQR = \frac{V}{Vs} \times 100$$

where **V** is the **observed value** of that pollutant and **V**_s is the standard value recommended by Central Pollution Control Board.

$$g = anti\log\frac{(\log_x + \log_y + \log_z)}{n}$$

g stands for the geometric average of the AQR and 'x', 'y' and 'z' are the AQR of pollutants.

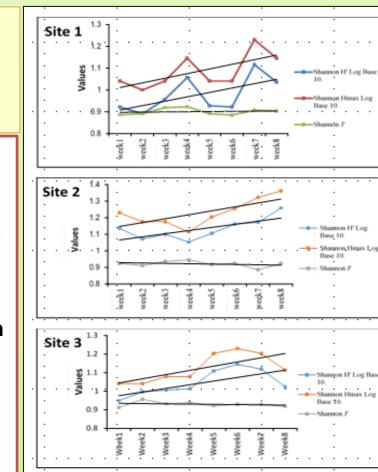
INTRODUCTION

Butterflies are considered as good indicators of the health of any specified terrestrial ecosystem as well as in reflection of human disturbance and habitat feature with greater sensitivity than many other taxonomic groups. Butterfly populations are influenced by the climate change and also increase in temperature can extend the geographic range of many temperate region butterflies.

In various research studies regarding urban air pollution, species of butterfly present in different areas of Kolkata and the direct and indirect impact of air pollution on butterfly are made. From the reviews, we can say that industrial sector and transport sector are the two major sources of air pollutants in an urban area and not directly but indirectly the **deposition of air pollutant on plant can deteriorate** plant food quality which can negatively affect butterflies.

RESULTS AND DISCUSSIONS

In Figure 7, the graph is showing the **change** in butterfly diversity and evenness.It is observed that, the **Shannon Diversity Index** Value is high in Site 2 compared to the other two study sites. The change in butterfly diversity is estimated on weekly bases and shows the fluctuation in butterfly diversity in Site 1 and in Site 2 but the Shannon index value seems to increase from the 5th week. In Site 3 the graph shows a decline in the **Shannon index value** at the ending period of the study.



In Figure 8 shows the comparison of Shannon index H' between three study sites. A similar pattern is observed and it is found that the butterfly diversity is high in Site 2 but the evenness in value is high in the Site 3. In Site 2, the butterfly diversity is high and it is decreasing followed by Site 3 and Site 1. Butterflies in Site 3 are more equitably distributed.

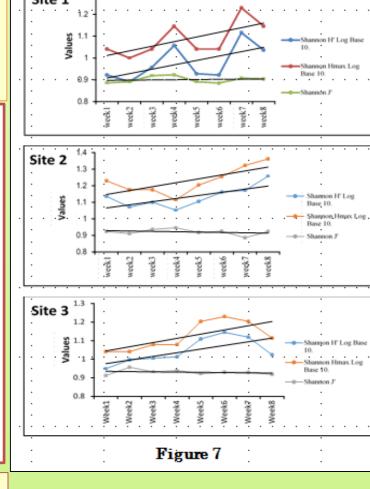
Figure 9 shows the comparison of Simpson's diversity index value for the different Study.

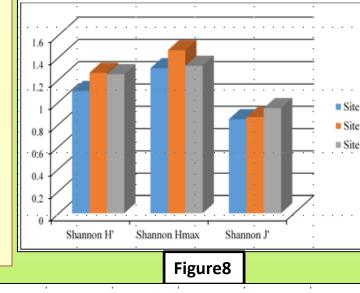
The species dominance is much more in Site 1 than other two sites.

As from previous figure, it is **observed** butterfly diversity is high in the case of **Site 2** compare to other two sites, species dominance has decreases a little but in Site 3 species dominance is less than other study sites.

The air pollution data which were collected from the WBPCB were used to prepare the box plot graph for different air pollutants to check the variability. In figure 10 (a & b) it can be clearly seen that PM₁₀ concentration is high in Study site 3 compare to other two sites and also throughout the PM₁₀ concentration in study site 3 was much high than other two sites. Both the range and variability NO_x and SO_x are lesser over Site 3 than that of other two sites. SO_x and O_3 are in their reasonable range over all the sites.

Figure 11 shows the time progression of AQI over the three sites with the weekly progression. It shows that AQI is higher over Site 1 and is decreasing with time.AQI is increasing over Site 2 and among three of them it is way less than other sites in six weeks out of eight. AQI is semi-stagnant over site 3 with a slight decreasing trend.





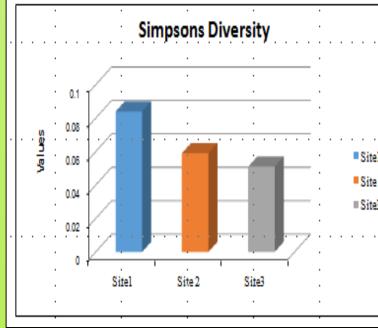
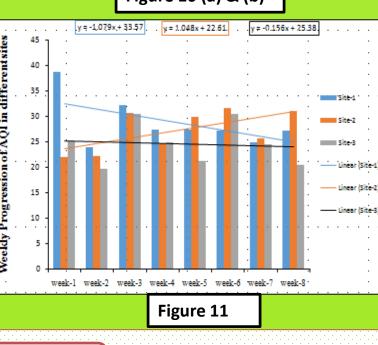


Figure 9 中立 Figure 10 (a) & (b)



CONCLUSION

The main purpose of this study lies in finding the more vulnerable and healthier locations in Kolkata in the winter of 2017 by taking real time observations.

We can conclude that the Rabindra Bharati area is healthier than other two sites i.e., Victoria Memorial and Jadavpur.

In terms of pollution, if overall result is taken into account then it can be said, that the rest of the pollutants are at their lower range over Site 3 except PM_{10} , and also AQI is stable and less over Site 3. Thus, there is a possible correlation between air pollution and butterfly diversity and we can infer that air pollution can be an influential factor in influencing butterfly population.

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and many others.

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