RELATION BETWEEN AIR QUALITY INDEX (AQI) AND BUTTERFLY RICHNESS: A STUDY FROM ENVIRONMENTAL AUDIT OF RAMMOHAN COLLEGE

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Abstract: Butterflies are a crucial component of the environment due to their role in pollination,. They are also regarded as reliable ecological indicators because to their sensitivity to climatic and environmental changes. The characteristics that make these species so-called "bio-indicators of the area" include their great sensitivity to environmental changes, the relative ease with which they may be seen, and knowledge of their natural history. An important indicator of air pollution is the Air Quality Index (AQI). Considering that Rammohan College is located in the centre of Kolkata, AQI may have an impact on butterfly mortality, reducing the number of species (species richness) or individuals within a species (species abundance). After 5 year survey, we found that, 21 species of butterfly are present in the Rammohan College campus but there is no significant correlation between butterfly species richness and AQI ($PM_{2.5,10,O3}$).

Key words: AQI, Butterfly, Rammohan College, Environment, Audit

1.   INTRODUCTION

Butterflies are a crucial component of the environment, for their pollination activities (Daily, 1997; Scobel, 1998). They are also regarded as effective ecological indicators because to their sensitivity to climatic and environmental changes (Lawtan, 1998; Venkataramana, 2010). The characteristics that make these species so-called "bio-indicators of the area" include their great sensitivity to environmental changes, the relative ease with which they may be seen, and knowledge of their natural history. Approximately, 18,768 species of butterflies have been recorded worldwide and recent findings suggest that India hosts 1318 species in its subcontinent, out of which 89 species belong to Papilionidae, 277 species belong to Hesperiidae, 92 species belong to Pieridae, 19 species belong to Riodinidae, 380 species belong to Lycaenidae, and 461 species belong to Nymphalidae (Samal *et al*, 2021).

According to Blair and Launer (1997) and Stefanescu et al. (2004) the richness, diversity, and abundance of butterfly species decline as urban elements such as roads, buildings, and lawns increase. Natural biodiversity suffers as a result of the quantity and quality of natural habitat being reduced due to urban development (Clark et al., 2007). The replacement or reduction of natural and semi-natural habitats by buildings and other concrete constructions is likely to have a negative effect on butterfly populations. Additionally, it is anticipated that different types of pollution will have a negative impact on the quality of residual habitats (Pocewicz et al., 2009). Apart from the habitat loss, the widespread use of insecticides has drastically reduced the numbers of butterflies. The clouds of butterflies that used to fly past as one walked through wild places can no longer be taken for granted.

Nowadays, it is more widely acknowledged that biological variety is a crucial factor in determining the sustainability of development efforts as well as local and global environmental changes. However, few metropolitan areas in West Bengal have seen a thorough study of invertebrates, notably butterflies. It is useful as a tool for making decisions related to butterfly management and conservation. Therefore, it is crucial to create a zone-by-zone database or checklist of the diversity of butterflies in our nation, particularly in our state of West Bengal (Malagrino et al., 2008; Pollard and Yates, 1993; Chowdhury and Das, 2007).

Concerns over poor air quality in India have increased over the past few years with increasing evidence of the adverse impacts on health, agricultural yields and the economy. Rapid growth and industrialization in India have resulted in some of the most polluted air in the world. Projections forecast further decreases in air quality and a 24% increase in $PM_{2.5}$ associated premature mortalities of HUMAN by 2050 relative to 2015. According to recent estimates based on the Global Exposure Mortality Model (GEMM), total premature mortality due to ambient PM2.5 exposure in India increased approximately 47% between 2000 and 2015 (Sharma and Mauzerall, 2021).

Institutional campuses with undisturbed natural vegetation and seasonal flowering plantation provide potential habitat for butterfly population as they are usually devoid of any developmental, anthropogenic activities and pollution (Chowdhury and Soren, 2011; Dennis and Willams, 1986). Air Quality Index (AQI) is an important index of air pollution. As Rammohan College is situated in the heart of city of Kolkata, AQI may play a role on mortality of butterfly, thus decreasing the species number (Species richness) or individual number of a species (Species abundance).

II. MATERIALS AND METHODS

Rammohan College is located in the heart of the city of Kolkata, West Bengal, India. This area is approximately 300 years old and highly urbanized with little or almost no greenery (22.582952ºN & 88.370997ºE). The college has got a small garden, where butterflies frequently visit and sometimes complete their life cycle. The survey has been carried out for a period of five years (10/10/2018 –10/04/2023 except lock down period), in college working days, October to February, the post monsoon season when maximum greenery is available in the campus. The roads inside the college campus were used as fixed transects. Monthly observations were carried out during morning hours (08:00 hrs to 10:00 hrs, 10th Day of selected month) and butterflies were recorded based on direct sighting. Some small butterflies were caught using butterfly net and were observed closely after placing them in clear glass container. Then they were released to the same habitat from where they were captured. Photographs of butterfly species in natural habitats were also taken for further references. Later the butterflies were identified from photographs by using standard literatures (Nair *et al,* 2014, Tiple, 2012, Evans, 1932). Butterflies were broadly categorized into four groups namely – abundant, common, uncommon and rare based on their sighting records and relative abundance (Wynter,1957). The host plants were identified from Department of Botany, Gurudas College for confirmation of butterfly identifications. AQI index of Kolkata has been found from the AQI Bulletin of Central Pollution Control Board, Government of India.

III.   RESULT

Table I: The common butterflies found in Rammohan College campus are listed below with their relative abundance

	Species	Common Name	Relative Abundance
I. Family: Papilionidae			
a. Sub-family: Papilioninae			
1	*Graphium agamemnon (*Linnaeus)	Tailed Jay	Uncommon* (2021)
2	*Papilio polytes* Linnaeus	Common Mormon	Abundant
3	*Atrophaneura aristolochiae* (Fabricius)	Common Rose	Uncommon* (2021)
II. Family: Pieridae			
a. Sub-family: Coliadinae			
4	*Eurema hecabe* (Linnaeus)	Common Grass Yellow	Abundant
5	*Catopsilia pyranthe* (Linnaeus)	Mottled Emigrant	Uncommon* (2021)
b. Sub-family: Pierinae			
6	*Cepora nerissa* (Fabricius)	Common Gull	Common
7	*Appias libythea* (Fabricius)	Striped Albatross	Common
8	*Leptosia nina* (Fabricius)	Psyche	Abundant
III. Family: Nymphalidae			
a. Sub-family: Danainae			
9	*Danaus chrysippus* (Linnaeus)	Plain Tiger	Common
10	*Euploea core* (Cramer)	Common Crow	Uncommon
b. Sub-family: Satyrinae			
11	*Melanitis leda* (Linnaeus)	Common Evening Brown	Uncommon
12	*Mycalesis perseus* (Fabricius)	Common Bush brown	Uncommon*

			(2021)
13	*Ypthima huebneri* Kirby	Common Four-ring	Uncommon
e. Sub-family: Biblidinae			
14	*Ariadne ariadne* (Linnaeus)	Angled Castor	Uncommon* (2021)
15	*Ariadne merione* (Cramer)	Common Castor	Uncommon
f. Sub-family: Nymphalinae			
16	*Junonia atlites* (Linnaeus)	Grey Pansy	Common
17	*Tarucus nara* Kollar	Rounded Pierrot	Common
18	*Zizeeria karsandra* (Moore)	Dark Grass Blue	Abundant
19	*Euchrysops cnejus* (Fabricius)	Gram Blue	Uncommon* (2021)
20	*Chilades lajus* (Stoll)	Lime Blue	Uncommon
IV. Family: Hesperiidae			
a. Sub-family: Hesperiinae			
21	*Borbo cinnara* (Wallace)	Rice Swift	Abundant

*Post Lockdown Occurrence

Table II: List of Host Plants where the butterflies were found most frequently

Name of plants	Name of Butterflies
Lantana camara L. (Family Verbenaceae)	*Zizeeria karsandra* *Borbo cinnara* *Junonia atlites* *Papilio polytes*
Tridax procumbens L. (Family Asteraceae)	*Eurema hecabe* *Zizeeria karsandra* *Leptosia nina* *Cepora nerissa*
Vernonia cineria (L.) Less. (Family Asteraceae)	*Eurema hecabe*
Ageratum conyzoides L. (Family Asteraceae)	*Zizeeria karsandra* *Danaus chrysippus*
Bryophyllum pinnatura (Lam.) Oken (Family Crassulaceae)	*Borbo cinnara*
Roja cinensis Jacq. (Family Rosaceae)	*Junonia atlites* *Danaus chrysippus*

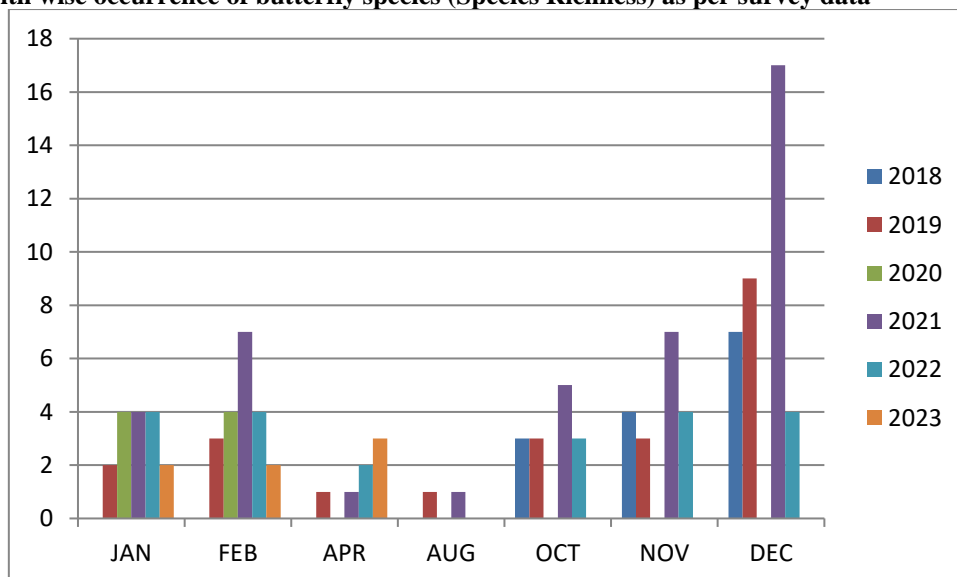**Figure I: Month wise occurrence of butterfly species (Species Richness) as per survey data**

Figure II: AQI index of Kolkata (PM$_{2.5}$, PM $_{10}$, O$_3$) in the month of survey of butterfly species (From AQI Bulletin, Govt. of India)
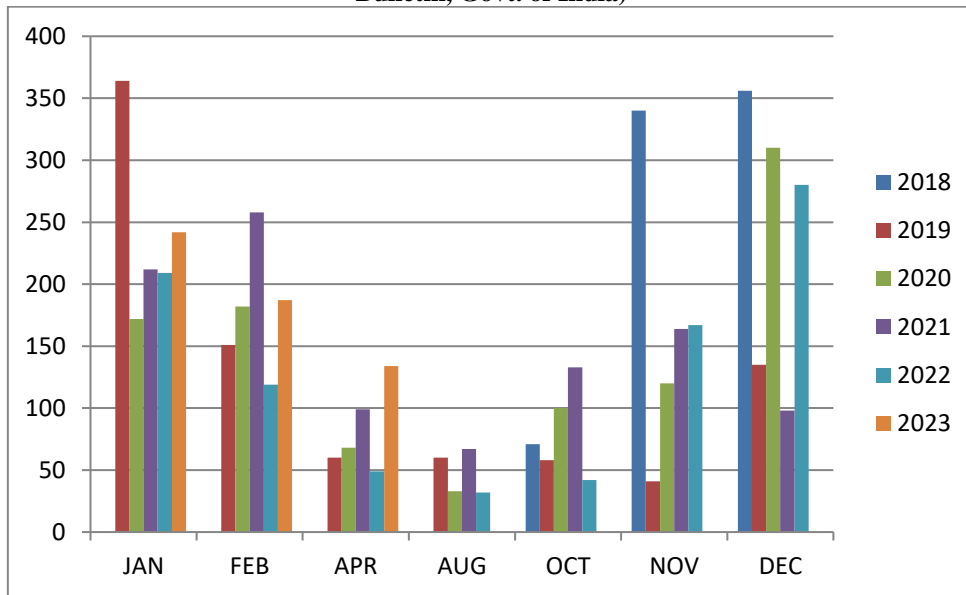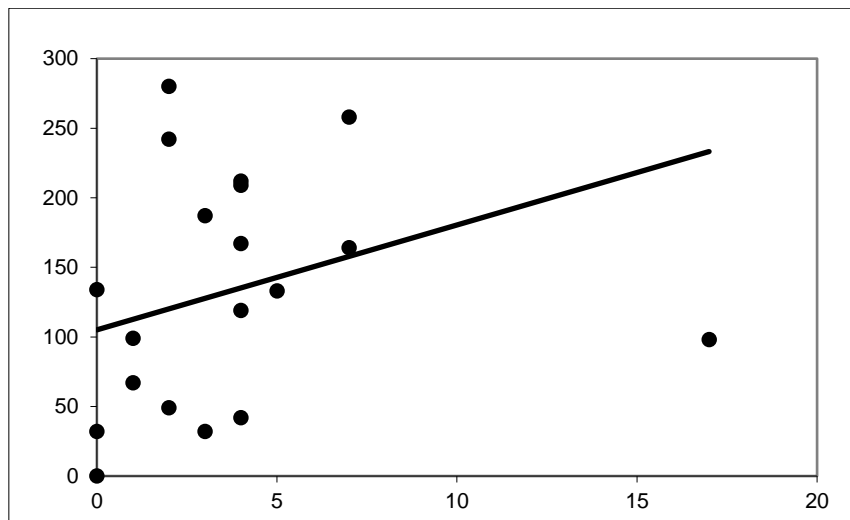

Figure III: Calculation of Correlation of AQI and Butterfly Species Richness

IV DISCUSSION

Recent studies have highlighted the importance of institutional campuses as a preferred habitat for butterflies (Roy *et al*, 2007). Among the insects, butterflies occupy a vital position in the ecosystem and their occurrence and diversity are considered as good indicators of the health of any given terrestrial biotope (Kehimkar, 2008; Rajsekhar, 1995). In Rammohan College campus 21 species of butterflies belonging to 4 families and 8 subfamilies were found more or less throughout these years (Table I). 15 butterflies are common and found to visit 6 host/nectar plant frequently (Table II). Maximum number (17species) were observed in the month of December, 2021 (Fig. I). 6 uncommon butterfly species has been observed in post lockdown months. AQI of Rammohan College (Kolkata) has been found to be highly variable, sometimes "very poor" in status, which may affect all living organisms. Apparently, by comparing Fig I & Fig II, it seems that AQI has influence on butterfly richness. But, by comparing data of Figure I & Figure II, statistically, it has been found that the AQI has no correlation with the butterfly species richness of Rammohan College (Figure III).

CONCLUSION

The P value is highly insignificant (0.504), although highest number of butterfly species has been found in low AQI but it has been concluded that AQI has no influence on the butterfly occurrence in the campus. Further study is required on determination of influence of AQI on life cycle of butterfly.

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