A STUDY ON THE IMPACT OF INDUSTRIALIZATION AND AIR POLLUTION ON BUTTERFLIES IN KANPUR, U.P.(INDIA).

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ABSTRACT

Kanpur city is well known for its industrial value as well as historic and cultivation/biodiversity conservation values. Butterflies dominantly flourish in the natural environment having nectar, flowering, or cropping plants. Butterflies are attractive, beautiful, efficient pollinators and work as a bio-indicator species of various environmental health status. Their high diversity and abundance represent good quality of environment and a healthy ecosystem for wildlife survival. They are the as indicators of ecosystem health because they are very sensitive to changes in microclimate, habitat, and pollution. There are dominantly season changes found as Winter, Summer, and Rainy, and butterflies were found good enough with rich densities as well as species diversities in July, August, September, October, mid-November, February, March, and April. In December, January, May, and June, Butterfly occurrence is negligible qualitatively as well as quantitatively. Air quality parameters depend on whether so they are highly influenced by changes in climatic conditions (Jacob, D.J., Winner D.A. 2009, Greg A. Breed 2013).

The present study is based on the impact assessment of various butterfly species regarding the climatic change of various sites of Kanpur. The current investigation demonstrated the richness of several butterfly species that encompass a wide range of types. There were 21 different kinds of butterflies, grouped into 5 families. Hesperiidae (1), Papilionidae (2), Lycaenidae (4), Pieridae (6), and Nymphalidae (8). Their abundance depends upon the various parameters of Air Quality as well as floral diversity which enhances their growth.
It was found that due to high dust particles and various pollutants released due to the establishment of industries. Automobile extraction is also responsible for Air Pollution. Greenhouse, global warming, acid rain, and oxygen depletion also negatively affect butterfly's survival and growth. Apart from this various physical environmental factors were also responsible for butterfly abundance regarding pollution.

Keywords- butterfly, bio-indicator, industrialization, pollutant, Limiting Factor

INTRODUCTION

The composition of natural vegetation plays important and significant role in butterfly's survival and completing of their life cycle in particular habitat (Uniyal and Mathur, 1998). The main reason of biodiversity decline on earth was expansion of urbanization, industrialization and habitat alteration due to excessive anthropogenic activities in the ecosystem. Anthropogenic and civilization lead to habitat alteration and expansion of techno ecosystems and shrinkage of natural habitats (Kinney 2002, 2006; Pocewicz *et al.,* 2009). Butterflies are very susceptible to changes in climatic conditions, availabilities of host plants for egg laying, developing of various larval stages, and completing of their life cycles (Thomas *et al.,* 1998; Kunte, 2000; Fordy, 2003).

Some environmental variables, such as afforestation, intensive agriculture, habitat loss and degradation, and climate change, pose a threat to Lepidoptera worldwide. The level of vulnerability exhibited by Butterfly species depends on their susceptibility to both internal and external stresses.

Kanpur's well-known historical, religious, industrial, and agricultural characteristics make it an important global location. However, as a result of urbanization, the scenarios for land use have changed significantly. Kanpur has a substantial amount of land that is covered in vegetation. There has been very little research done on butterfly population densities in the past, and the current consensus is that it is not a good environment for wild species, especially butterflies. These two elements demonstrate the sustainability of the ecosystem and the habitat of butterflies. They are called ecological indicators or bio-indicators.

High diversity and abundance of butterflies represent the good quality of habitat and they play an efficient role in pollination and genetic variation among wild flowering plants and as well as in crop plants, they also play role in a crucial role in the establishment of equilibrium between various food web and chains (Gay *et al.,* 1992). Butterflies pollinating plants show co-evolutionary mechanisms and butterflies represent host specificity mechanisms with plants (Ehrlich and Raven, 1964). The butterfly diversity and abundance are continuously declining due to habitat loss, modification and expansion of urban areas, and reduction of vegetation and industrialization also limiting factors for butterfly's survival (Blair and Launer, 1997; Groombridge, 1992; Laurance and Bierregaard 1997; Jhon, 1997).

The objective of the study was to analyze the diversity and abundance of butterflies in various industrial areas of the Kanpur district and the study also gave details observations of limiting factors for inhibiting butterflies' growth and survival in the study area.

RESEARCH METHODOLOGY

Situated in the middle of Uttar Pradesh State, the Kanpur Nagar district occupies a position between 25°55’ and 27° North latitude and 79°30’ and 80°35’ East longitude. Kanpur Industrial areas contain low floral vegetation diversity and abundance due to expansion and vanishing of trees. Kanpur industrial area scrub comprises members predominantly belonging to the families, Annonaceae, Araceae, Asteraceae, Aponcynaceae, Rutaceae, Verbenaceae, Apocynaceae, and fewer are seasonal flora that are cultivated. These invasive species also cause adverse effects on native ecosystems.

The present study was based on fieldwork in industrial areas like Nawabganj, Kidwai Nagar, and Ramadevi by using line transect and quadrate methods. Observational data were collected from March 2023 to February 2024. For observation, the study sites were visited twice a month in daytime periods between 8:00 am - 11:00 am and 4:00 pm - 7:00 pm. Different study sites were divided into almost equal sizes of three lines transects and two quadrates. The length of the transect was kept approximately 200 meters long and 5 meters wide where butterflies were easily identified without capturing the specimen. Onsite capture by a digital camera is also performed for primary identification. Observation and identification of butterflies in the study area were undertaken with high accuracy through visual observation and some confusingspecies were identified with the help of the capture and released method (Sutherland, 1996). Identification of butterflies was done by using a standard field guide- butterflies of India and Suburbs (Peter Smetacek, 2017). A vast literature and photographs are available on the Web (Blyth, 1957; Haribal 1992; Kunte and Petersmetesk, 2000; Kunte, 2000). The observed butterflies were categorized in five categories on the idea of their abundance as VC-very common (> 100 sightings), C-common (50-100 sightings), NR–not rare (15-50 sightings), R–rare (2-15 sightings), VR-very rare (1-2 sightings).

RESULT AND DISCUSSION

Butterflies are very sensitive to slight changes in an ecosystem; they are highly negatively affected by air pollution, industrial activities, and urban development in natural habitats. High butterfly richness andabundance represent good health quality of the ecosystem and are suitable for other wildlife survival while low richness and abundance indicate polluted and poor quality of habitat and are not suitable for environmentally sensitive species including invertebrates and vertebrates. Industrialization leads to desertions and decentralization of natural and semi-natural habitats, due to the rapid expansion of industrial and various products like leather, food products, etc. processing sites in study areas.

The diversity and richness of butterflies mainly depend upon types of vegetation, availability of food, and host flora in particular habitats (Manoj R.B. and Komarpant, N., 2004). Natural habitat contains a high biodiversity of flora and fauna as compared to anthropogenic influence areas.

Analysis of diversity in the study area maximum was reported in Nymphalidae (38.09%) followed by Pieridae (28.57%), Lycaenidae (19.04%), Papilionadae (9.52%), and minimum relative diversity was recorded in Hasperiidae family (4.76%). During the study maximum species were recorded in the Nymphalidae(8) family followed by Pieridae (6), Lycaenidae (4), Papilionidae (2), and the minimum belonging to the Hesperiidae family contained only single species throughout the study periods. Based on the Sighting status of the Butterfly by which the different species are grouped into the following categories. From this categorization, it is also acknowledged about their approximate population size of the particular species.

According to sighting status five species frequently sighted these were classified into (Table 1) –

- Very common sighted- Common evening brown, Common baron, Common jezebel, Cabbage white, Common grass yellow.
- Common sighted- Common crow, Striped tiger, Chocolate pansy, Common caster, painted lady, Common wanderer, Psyche, Common gull, Dark grass blue, Plain cupid, Forget me not, Lime butterfly.
- Not rare- They are Less commonly sighted butterflies (Plain tiger, Pea blue).
- Very rarely sighted- Common Mormon, Small branded swift

Study indicates industrial area activities and air pollution cause adverse effects on butterfly diversity and its growth in various stages. As previously discussed, butterflies are the ecological indicator for the health quality of the area. They are most sensitive to Air quality parameters which are highly responsible for Butterfly abundance, density, growth, and existence.

Air quality parameters like temperature, humidity, PMx, CO_x, NOx, SOx, and fewer volatile hydrocarbons directly or indirectly regulate and affect the butterflies at the study sites. From the present study, it is very clear that the Plantation of flowering plants and proper management & disposal mechanism of industrial waste are very necessary for sustained high butterfly diversity and also needed for other species to survive in industrial areas.

Table 1– Check list of butterfly's species recorded in industrial area of Kanpur district

S.No.	Family	Scientific Name	Common Name	Local Sight status
1	Nymphalidae	*Euploea core*	Common crow	C
2		*Melanitis leda*	Common evening brown	VC
3		*Danaus chrysippus*	Plain tiger	LC/NR
4		*Danaus genutia*	Striped tiger	C
5		*Junonia iphita*	Chocolate pansy	C
6		*Euthalia aconthea*	Common baron	VC
7		*Ariadne merione*	Common caster	C
8		*Venessa cardui*	Painted lady	C
9	Pieridae	*Delias eucharis*	Common Jezebel	VC
10		*Pieris rapae*	Cabbage white	VC
11		*Eurema hecabe*	Common grass yellow	VC
12		*Pareronia*	Common wanderer	C
13		*Leptosia nina*	Psyche	C
14		*Cepora nerissa*	Common gull	C
15	Lycaenidae	*Zizeeria karsandra*	Dark grass blue	C
16		*Luthrodes pandava*	Plain cupid	C
17		*Lampides boeticus*	Pea blue	LC/NR
18		*Catochrysops strabo*	Forget me not	C
19	Papilionidae	*Papilio polytes*	Common Mormon	R
20		*Papilio demoleus*	Lime butterfly	C
21	Hesperiidae	*Pelopidas mathias*	Small branded swift	R

** Very Common- VC
Common - C
Less Common/ Not Rare - LC/NR
Rare - R
Very Rare - VR

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