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# Butterfly diversity of the Gangetic Plain (Doaba) at Allahabad (U.P.) India

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**Abstract**
A total twenty five butterflies were observed during the survey period which represent the diversity of Gangetic plain of India. *Acraea violae*, *Chilades parrhasius*, *Danaus C. chrysippus*, *Danaus genutia*, *Euploea sylvester coreta*, *Hypolimnas bolina jacintha*, *Junonia hierta hierta*, *Junonia lemonias lemonias, Junonia orithya swinhoei*, *Phalanta phalantha* were common to the habitats. The maximum diversity was observed in winter and minimum in summer season. The more richness (Simpson Index diversity= 0.78) of butterflies were present. Their presence was influenced by the vegetation pattern of campus and seasons. Their diversity was found closer to the North-eastern region than Western Ghat region of India.

**Keywords:** Butterfly, diversity, Gangetic plain, vegetation pattern, North-eastern and Western Ghat

## Introduction
The study area represents almost the climatic condition of lower Gangetic plain (Doaba). The microclimatic variations of study area (ECC campus) observed more than seasonal variations of Uttar Pradesh due to its situation at the bank of river Yamuna and persistence of vegetations. The seasonal variation of vegetations provides more butterfly diversity at a concentric point inside the campus. For this butterfly diversity has been explored.
Butterflies and moths belong to order Lepidoptera of class Insecta of phylum Arthropoda. Kunte (2012) [3] reported that India harbored total 1504 butterfly species which accounted 8.74% of the world's butterfly and 285 species found in southern India. The peninsular India and Western Ghats have 351 and 334 species, respectively. But the Doaba of Gangetic plain has not been explored for it. Estimates prove that their numbers are consistently increasing through evolution because they have noticed as efficient adapters to the changing environments. Conversely many butterflies are influenced by slight seasonal variations, preferring only a narrow range of habitats. There is a need for documentation of butterflies from this region under the issues of environment changes.

## Study area and sampling site
The study area was the campus of Ewing Christian College (25°25′36.96″N -44.77″N; 81°50′38.66″E to 51.48″E), Gau Ghat, Allahabad, Uttar Pradesh, India. The campus is well known for the maintenance of vegetations. The campus also represents the humid tropical climate of Eastern Uttar Pradesh. The contributing factors are seasonal variation, vegetation patterns, and its location at the bank of Yamuna River. These influence the micro habitats of the campus. The sampling sites were department gardens of the campus. These are situated within a distance of hundred meters approximately to each other. The conservational values of butterfly were regarded during the sampling.

## Material and Methods
Only photography was done for the sampling of butterflies. The photographs of butterflies have been taken alive from their natural habitats with the aid of Nikon made digital camera (L23, No.77038850). The photographs were recorded in their consequent months. The theoretical values of Simpson Index were calculated.

## Survey Method
The butterflies were surveyed by the line transect methods (Kunte 1997) [1] from the period of One year (July, 2015- June 2016). Their numbers were counted arbitrarily within a range of 25 Feet (in range of eye resolving power) in the morning to afternoon weekly.

The route of survey was fixed and specific in movement and time. Usually the survey was conducted in good weather whereas rainy, cloudy, stormy and extreme hot weather were ignored.

**Identification of butterfly species**

The photograph was used in the identification of butterflies. The colour, colour patterns and design were compared in identification of species. They were identified according to Bingham, (1905 and 1917) [5, 6]. Their present Taxonomic values have been updated from Kunte *et al.* (2016) [2] and Hoskins (2016) [4]. The habitat, season, and associated plants have also been considered in the identification and characterization of species.

**Result and Discussion**

Twenty five species of butterflies were reported during the study period inside the campus of Ewing Christian College, Allahabad. Those are listed in Table 1 and Plate 1. The Simpson Index and Simpson Index diversity were calculated as 0.22 and 0.78 (Figure 2).

Species belonging to the family Nymphalidae were dominant (36%) over Pieridae (28%), Lycaenidae 12%, Papilionidae, 12% and Hesperiidae, 12% (Figure 1). *Acraea violae*, *Danaus C. chrysippus*, *Danaus genutia*, *Euploea sylvester coreta*, *Hypolimnas bolina jacintha*, *Junonia hierta hierta*, *Junonia lemonias lemonias*, *Junonia orithya swinhoei*, *Phalanta phalantha* (Image No. 1, 9, 10, 11, 15,16, 17, 18, 22) were the most commonest to the microhabitat of Study area. *Papilio polytes romulus* (Indian Common Mormon) was noticed maximum in size whereas *Azanus jesous gamra*, *Barbo cinnara*, *Pelopidas conjuncta narooma* and *Suastus gremius* were the smaller butterflies. The number of butterflies was observed maximum in winter than rainy and summer season. The Simpson Index diversity was 0.22 over all study periods (Figure 2) which shows the more richness (Simpson Index diversity= 0.78) of butterflies present. The theoretical values show that micro environment of study area supported the diversity of butterflies.

The diversity is more influenced by seasonal changes and vegetation patterns. They were more associated to the vegetations of microhabitats such as *Lantana camera*, *Sida cordifolia*, *Tagetes erecta*, *Tabernaemontana divaricata*, *Hibiscus rosa sinensis*, *Wedelia chinensis*, *Rosa indica*, *Phlox paniculata*, *Cynodon dactylon*, *Dichanthium indica*, *Tridax procumbens*, *Boerhavia diffusa*,. But few of them were found throughout the year.

Some of the investigated butterflies were common to north-eastern Indian (Kunte 2012) [3]. These were *Danaus chrysippus chrysippus*, *Danaus genutia* sp., *Euploea sylvester* sp., *Hypolimnas bolina jacintha*, *Junonia hierta hierta, Junonia lemonias lemonias*, *Junonia orithya* sp. *Chilades* spp., *Spindasis* spp., *Appias* spp., *Eurema* spp., *Eurema hecabe* sp., *Graphium doson axion*, *Papilio demoleus*, *Pelopidas* spp., Among them species of Nymphalidae were more common to North-eastern butterflies. Some of them were also closer to the species of Western Ghat (Kunte, 1997) [1]. These were *Danaus chrysippus* sp., *Junonia hierta* sp., *Junonia orithya* sp., *Phalanta phalantha*, *Catopsilia Pomona*, *Catopsilia pyranthe* sp., *Eurema brigitta* sp., *Azanus* spp., *Chilades* spp.

Moreover the Nymphalidae was maximum in number among all reported species from Doaba region of India during survey periods. The observed species represents the butterflies of North-eastern region and Western Ghat of India. Therefore, the butterfly diversity of Gangetic region represents the common species of North-eastern region and Western Ghat region but they are closer to the North- eastern region.

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**Table 1:** List of observed butterflies inside the campus of Ewing Christian College, Allahabad during 2015-2016

| Image No. | Scientific Name | Common Name | Family |
|---|---|---|---|
| 1. | *Acraea violae*, *Fabricius* 1793 | Tawny Coster | Nymphalidae |
| 2. | *Appias albina swinhoei*, Boisduval 1836 | Sahyadri Common Albatross | Pieridae |
| 3. | *Azanus jesous gamra*, Lederer 1855 | Syrian Babul Blue | Lycaenidae |
| 4. | *Belenois aurota*, Fabricius 1793 | Indian Pioneer | Pieridae |
| 5. | *Barbo cinnara*, Wallace 1886 | Rice Swift | Hesperiidae |
| 6. | *Catopsilia pomona spp.*, Fabricius 1775 | Lemon Emigrant | Pieridae |
| 7. | *Catopsilia pyranthe pyranthe*, Linnaeus 1758 | Oriental Mottled Emigrant | Pieridae |
| 8. | *Chilades parrhasius*, Fabricius, 1793 | Small Cupid | Lycaenidae |
| 9. | *Danaus chrysippus chrysippus*, Linnaeus 1758 | Oriental Plain Tiger | Nymphalidae |
| 10. | *Danaus genutia*, Cramer 1779 | Oriental striped tiger | Nymphalidae |
| 11. | *Euploea sylvester coreta*, Godart 1819 | Double-branded Black Crow | Nymphalidae |
| 12. | *Eurema brigitta rubella*, Stoll 1780 | Red line small Grass Yellow | Pieridae |
| 13. | *Eurema hecabe hecabe*, Linnaeus 1758 | Oriental Common Grass Yellow | Pieridae |
| 14. | *Graphium doson axion*, Felder & Felder 1864 | Common Jay | Papilionidae |
| 15. | *Hypolimnas bolina jacintha*, Drury 1773 | Oriental Great Egg fly | Nymphalidae |
| 16. | *Junonia hierta hierta*, Fabricius 1798 | Oriental Yellow Pansy | Nymphalidae |
| 17. | *Junonia lemonias lemonias*, Linnaeus 1758 | Chinese Lemon Pansy | Nymphalidae |
| 18. | *Junonia orithya swinhoei*, Butler 1885 | Pale Blue Pansy | Nymphalidae |
| 19. | *Papilio demoleus*, Linnaeus 1758 | Lime butterfly | Papilionidae |
| 20. | *Papilio polytes romulus*, Cramer 1775 | Indian Common Mormon | Papilionidae |
| 21. | *Pelopidas conjuncta narooma* | Sahyadri Conjoined Swift | Hesperiidae |
| 22. | *Phalanta phalantha*, Drury 1773 | Oriental Common Leopard | Nymphalidae |
| 23. | *Rapala varuna lazulina*, Moore, 1879 | Lazuli Flash | Pieridae |
| 24. | *Spindasis vulcanus vulcanus*, Fabricius, 1775 | Indian Common Silverline | Lycaenidae |
| 25. | *Suastus gremius*, Fabricius, 1798 | Oriental Palm Bob | Hesperiidae |


**Plate 1:** The photographs of observed butterflies inside the campus of Ewing Christian College, Allahabad during 2015-2016

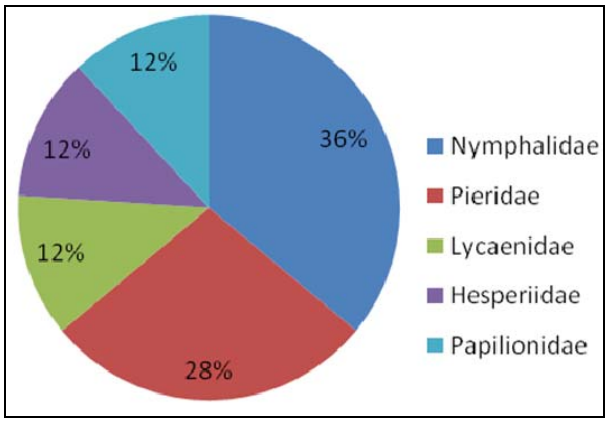


**Fig 1:** Pie chart diagram represent the percentage of observed species in families of butterflies at Ewing Christian College, Allahabad during, 2015-2016.

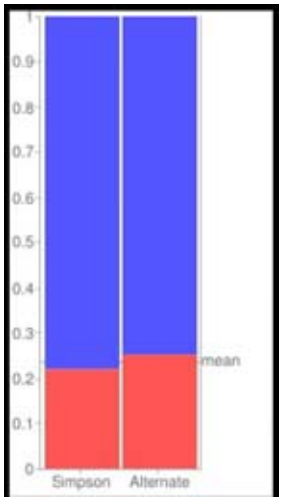


**Fig 2:** Simpson Index graph of the observed species of butterflies at Ewing Christian College, Allahabad during, 2015-2016.

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