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Study on the species composition and status of free ranging butterflies (Lepidoptera: Rhopalocera) in Pt. G.B. Pant High Altitude Zoo, Nainital, Uttarakhand

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Abstract
Present paper deals with the species composition and status of butterflies in the campus of a high altitude zoo, situated in Nainital city of Uttarakhand, India. A total of 29 species of butterflies belonging to 25 genera and 6 families were recorded during the entire study. In terms of total number of species, Nymphalidae was the most dominant family with 9 species followed by Pieridae (7 species), Lycaenidae and Papilionidae (4 species each), Satyridae (3 species) and Danaidae (2 species), respectively. Status of butterflies significantly varied in the study area and on the basis of number of the sightings, 12 species were found fairly common followed by common (11 species) and uncommon (6 species), respectively. The findings of the present study indicate that the study area provides life supporting necessities such as host and nectar plants, ambient climatic conditions, and suitable habitat for the better growth and development of butterflies.

Keywords: Butterflies, family, genera, species, status, Nainital

1. Introduction
At present scenario, various components of biodiversity are depleting at an alarming rate therefore, conservation of biodiversity has become great challenge to naturalists, environmentalists and scientists throughout the world. Several techniques have been run to reduce the extinction of biodiversity, in which *in-situ* and *ex-situ* are major one [1]. *In-situ* conservation involves the conservation of species in its native and natural habitat. On the other hand, *ex-situ* conservation involves the transfer of target species away from its native and natural habitat to a safe place such as zoos and botanical gardens [2]. Zoos or zoological gardens or zoological parks in which animals are confined within enclosures or semi-natural and open areas, displayed to the public, and in which they may also breed. They are considered by universal thinkers and environmentalists as important means of conserving biodiversity [3, 4].
Insects are one of the crucial components of biodiversity and account for more than 60 percent of the total known species of animals on the planet earth. Butterflies are among the well known group of class Insecta and come under order Lepidoptera. There are about 18,000 species of butterflies in the world and 1,501 species are found in the Indian subcontinent [5]. Many species are strictly seasonal and being good indicators of climatic conditions as well as seasonal and ecological changes, they can serve in formulating strategies for conservation [6]. Due to their aesthetic and scientific values butterflies have attracted the attention of naturalists and scientists throughout the world. As a result, various aspects of butterflies have been studied in different regions of the world [7-17]. Present work aims to assess the species composition and status of butterflies in the campus of Nainital zoo in Uttarakhand, India.

2. Materials and Methods
2.1 Study area
The present work was carried out in the campus of Bharat Ratna Pt. Govind Ballabh Pant High Altitude Zoo, Nainital, Uttarakhand (Figure 1). Nainital zoo (29º22.890'- 29º22.939'N and 79º28.135'- 79º28.157'E) covers an area of about 4 hectares and lies between Shivalik and middle Himalayas' mountain range at an elevation of about 2100 m above mean sea level. It was established in 1984 in order to conserve the threatened species of wild animals endemic to Himalayan regions. It is covered by evergreen species of oak, cupressus and various associate

plant species. In addition, a large number of flowering plants are also found. The zoo has more than 30 species of wild animals including mammals and pheasants which are mainly of Himalayan origin. Due to its location in a natural and enchanting environment, it is a popular tourist attraction and thousands of tourist visit here every year.

2.2 Sampling and identification of butterflies

Sampling of butterflies was conducted from March, 2017 to June, 2017 on the basis of regular observations in the zoo campus. In order to sample the butterflies, net sweeping was adopted [18]. The net used for sweeping was made up of thick cotton cloth with a diameter of 30 cm at mouth and a beg length of 60 cm. In addition to sweeping, photography of butterflies was also done to avert the loss of biodiversity. The butterflies were identified with suitable literature and butterfly identification guides [5, 19-20].

2.3 Species composition and status of butterflies

In order to determine the species composition of butterflies, identified species were placed according to their families and an inventory was prepared. Status of butterflies was determined on the basis of number of the sightings in the study area and butterflies were placed in three categories namely fairly common (FC= more than 25 sightings), common (C=10-20 sightings) and uncommon (UC= less than 10 sightings), respectively.

Fig 1: Map showing the location of Pt. G.B. Pant High Altitude Zoo, Nainital

3. Results and discussion

A total of 29 species of butterflies belonging to 25 genera and 6 families were recorded during the entire study period (Table 1). Variation in total number of species, genera and status of different families of butterflies recorded from the study area are given in table 2 and figure 2. On the basis of total number of species, Nymphalidae was the most dominant family with 9 species followed by Pieridae (7 species), Lycaenidae and Papilionidae (4 species each), Satyridae (3 species) and Danaidae (2 species), respectively. Maximum numbers of genera were recorded for Nymphalidae (9) followed by Pieridae (6), Lycaenidae (4), Satyridae (3), Papilionidae (2) and Danaidae (1), respectively. In the present study, Nymphalidae was the most dominant family and a similar pattern has also been observed in various studies in other regions of the country [21-24]. The perusal of literature reveals that Nainital is rich in terms of Lepidopteran diversity. Prior to the present study, 76 species of butterflies and moths belonging to 15 families have been reported from different localities in this region [25]. Moreover, another study [14] has also documented 27 species of butterflies belonging to 8 families from different sites of the Nainital city.

On the basis of number of sightings in the study area, 12 species of butterflies were recorded as fairly common (FC) and accounted for 41.38% of the total species. Similarly, 11 species (37.93%) were common (C) while only 6 species were uncommon (UC) and constituted 20.68% of the total butterflies (figure 3). Maximum number of FC species belonged to family Pieridae (*Catopsilia pomona* (Fabricius), *Gonepteryx rhamni* (Linnaeus), *Pieris brassicae* (Linnaeus), *Pieris canidia* (Sparrman), *Colias fieldii* Menestries) followed by Lycaenidae (*Dodona durga* (Kollar), *Udara akasa* (Horsfield) and *Heliophorus sena* Kollar). On the other hand, Nymphalidae had the large number of uncommon species (*Argyreus hyperbius* (Linnaeus), *Euthalia sahadeva* (Moore), *Pseudergolis wedah* (Kollar) and *Cyrestis thyodamas* Boisduval).

Table 1: Species composition and status of butterflies recorded in and around the Nainital zoo.

S.No.	Order: Lepidoptera	Common Name	Status
Family: Nymphalidae			
1.	*Aglais cashmiriensis* (Kollar)	Indian Tortoiseshell	FC
2.	*Argyreus hyperbius* (Linnaeus)	Indian Fritillary	UC
3.	*Childrena childreni* (Gray)	Large Silverstripe	C
4.	*Cyrestis thyodamas* Boisduval	Common Map	UC
5.	*Euthalia sahadeva* (Moore)	Green Duke	UC
6.	*Kaniska canace* (Linnaeus)	Blue Admiral	C
7.	*Phalanta phalantha* (Drury)	Common Leopard	C
8.	*Pseudergolis wedah* (Kollar)	Tabby	UC
9.	*Vanessa cardui* (Linnaeus)	Painted Lady	FC
Family: Pieridae			
10.	*Aporia agathon* (Gray)	Great Blackvein	C
11.	*Catopsilia pomona* (Fabricius)	Common Emigrant	FC
12.	*Colias fieldii* Menestries	Dark Clouded Yellow	FC
13.	*Eurema hecabe* (Linnaeus)	Common Grass Yellow	C
14.	*Gonepteryx rhamni* (Linnaeus)	Common Brimstone	FC
15.	*Pieris brassicae* (Linnaeus)	Large Cabbage White	FC
16.	*Pieris canidia* (Sparrman)	Indian Cabbage White	FC
Family: Lycaenidae			
17.	*Dodona durga* (Kollar)	Common Punch	FC
18.	*Heliophorus sena* Kollar	Sorrel Sapphire	FC
19.	*Lycaena pavana* Kollar	White-Bordered Copper	C
20.	*Udara akasa* (Horsfield)	White Hedge Blue	FC
Family: Papilionidae			
21.	*Atrophaneura varuna* (White)	Common Batwing	C
22.	*Papilio polyctor* Boisduval	Common Peacock	UC
23.	*Papilio polytes* Linnaeus	Common Mormon	FC
24.	*Papilio protenor* Cramer	Spangle	UC
Family: Satyridae			
25.	*Aulocera swaha* (Kollar)	Common Satyr	FC
26.	*Callerebia ananda* (Moore)	Ringed Argus	C
27.	*Ypthima baldus* (Fabricius)	Common Fivering	C
Family: Danaidae			
28.	*Danaus chrysippus* (Linnaeus)	Plain Tiger	C
29.	*Danaus genutia* (Cramer)	Striped Tiger	C

(C= Common; FC= Fairly Common; UC= Uncommon)

Table 2: Variation in total number of genera, species and status of butterflies belonging to different families during the study.

S. No.	Family	Genera	Species	Status		
				C	FC	UC
1.	Nymphalidae	9	9	3	2	4
2.	Pieridae	6	7	2	5	-
3.	Lycaenidae	4	4	1	3	-
4.	Papilionidae	2	4	1	1	2
5.	Satyridae	3	3	2	1	-
6.	Danaidae	1	2	2	-	-
	Total	25	29	11	12	6

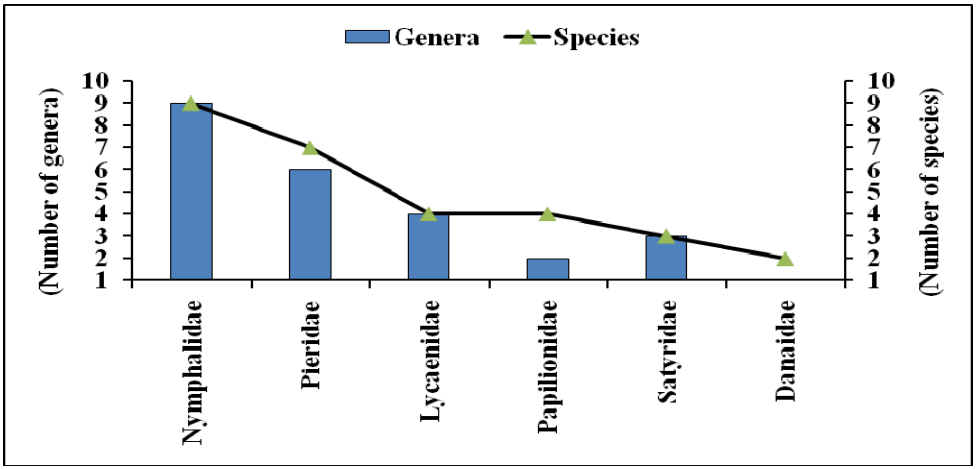

Fig 2: Number of genera and species of butterflies belonging to different families

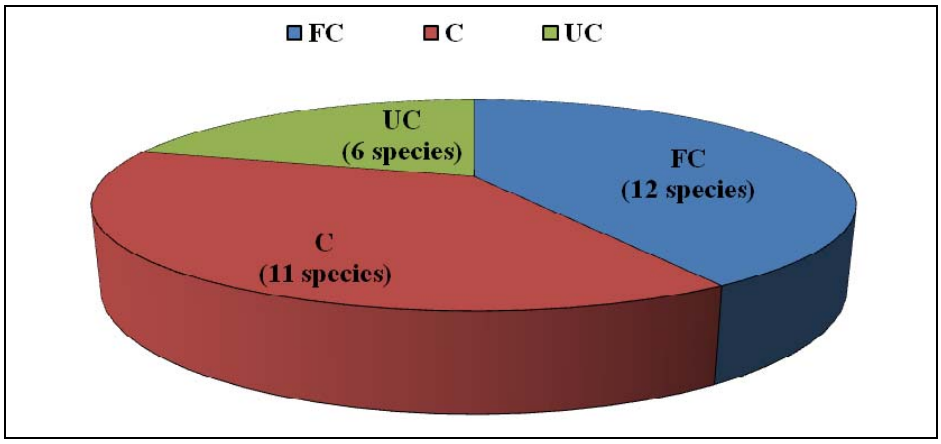

Fig 3: Status of different species of butterflies recorded from the study area

4. Conclusion

The presence of 29 species of butterflies in such a small area indicates that large number of host plants, favorable climatic conditions and suitable habitats are available in plenty in this area. However, as a result of increasing anthropogenic pressure around the area various life supporting necessities of such crucial members of the ecosystem has depleted from few years. Therefore, it is suggested that to conserve the biodiversity of such charming creatures, sustainable development is a must. Further, the study area may contain a large number of species of butterflies of conservation priorities therefore in order to explore them more studies should be done.

5. Acknowledgement

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