UTTAR PRADESH JOURNAL OF ZOOLOGY

41(15): 28-38, 2020
ISSN: 0256-971X (P)

DIVERSITY OF BUTTERFLIES (INSECTA: LEPIDOPTERA) IN AND AROUND SANDUR TALUK, BELLARY DISTRICT, KARNATAKA

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AUTHORS' CONTRIBUTIONS
This work was carried out in collaboration among all authors. Author SSH designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AS and Swathi managed the analyses of the study. Author Gururaja managed the literature searches. All authors read and approved the final manuscript.

Article Information

Editor(s):
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Reviewers:
(1) Reda Abdel-Galeil Amer, Agriculture Research Center, Egypt.
(2) Alixelhe Pacheco Damascena, Universidade Federal do Espírito Santo, Brazil.

Received: 06 August 2020
Accepted: 13 October 2020
Published: 28 October 2020

Original Research Article

ABSTRACT

A study of butterfly diversity was conducted during Sep 2019- Feb 2020 using Line transect count method to assess the species diversity in Sandur taluk, Bellary district, Karnataka. Habitat destruction in terms of mining activity can be a potential threat to this area and is expected to be the reason for reduction in the abundance of butterfly species in the study area. The present study was undertaken to document the species diversity of butterflies and explore the existing diversity of butterflies. A Total 56 species of butterflies belonging to 05 families, namely, Nymphalidae, Papilionidae, Pieridae, Lyncaenidae and Hesperiidae were recorded. This is the first study on butterfly diversity in this area. Our aim is to explore and document butterfly fauna, which will be a useful platform for conservation of butterflies and quantitative study of diversity.

Keywords: Habitat; biodiversity; mining; anthropogenic activities; conservation.

1. INTRODUCTION

The study of biological diversity shows the rich heritage of that particular area. In classification of invertebrate's arthropods still stands at the rank one and may remain so. Among insects, butterflies are the most studied group [1]. They are essential part of any natural ecosystem as pollinators and energy transformers from herbivore to the next tropic level [2].

More than half of earth's diversity comprises the insects. Butterflies play an important role in both ecological and economic benefits to human beings. They increase aesthetic value and actively involved in pollination thus help in seed setting of plants [3].

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Butterflies enhance earth's beauty due to their diverse colours on their wings [4]. Due to their beauty and ecological significance butterflies are the well-studied group throughout the world [5].

The habitat of butterflies is very specific and their occurrence is seasonal [6]. They are also considered as the good indicators of habitat quality including anthropogenic disturbances [7]. Butterflies are broadly considered as potent ecological indicators [8,9,10] and are sensitive to the temperature, humidity, and light levels and also to the habitat disturbance [11]. Butterflies are cold-blooded, their body temperature changes with the temperature of their surroundings. Butterflies can fly as long as the air is between 60^{o}-108^{o} F, although temperatures between 82^{o}-100^{o} F are best. When butterflies get too hot, they may head for shade or for cool areas like puddles. Some species will gather at shallow mud puddles or wet sandy areas, sipping the mineral-rich water. Generally more males than females puddle and it is believed that the salts and nutrients in the puddle are needed for successful mating. The relationship between plants and butterflies is highly complex and co-evolved [12], since the butterflies depend on plants for the food and completion of their life cycle, contrary to this many of the economically important plant species are pollinated by butterflies [13].

Butterflies are vital part of the ecosystem and they are the ideal population of organism for exploration of insect phenology because they are relatively conspicuous and are of more interest to humans than most other insects because of their size and colour structure which leads to observation and collection [14]. Among insects, butterflies are the most studied group [1]. They are essential part of any natural ecosystem as pollinators and energy transferors from herbivore to the next trophic level [15]. Many species of butterflies are strictly seasonal, preferring only particular habitats [6]. Because of their diversity, wide distribution, specificity to vegetation type, rapid response to perturbation, taxonomic tractability, significant abundance and ease of sampling, they are considered useful organisms to monitor environmental changes [16].

The diversity and distribution of a particular species is dependent not only on the geography of the area and ability of the species to move around within it, but also on the ecological demands of the species [17]. They are one of the most beautiful and striking species of insect on the earth and they are playing a very crucial role in the ecosystem as well as human health. They are commonly referred to as "insects of the sun" with their eye-catching colour and delicate charisma [18]. They have been admired for centuries for their physical beauty and behavioural display [19]. The presence of butterflies indicates the good condition of an ecosystem [20]. They have always enthralled common man because of their daintiness and beauty [19]. Out of about 25,000 species of butterflies recorded from all over the world, 1501 are from India [21]. Northern western ghat is a hot spot of biodiversity where total 191 species of butterflies belonging to 117 genera and 06 families are recorded [22].

The diversity of butterflies from Sandur taluk, Ballari district is not studied well and hence the present attempt was carried out. The aim of this study is to find out the current status of butterflies in Sandur taluk and to prepare a checklist of butterflies of this region for the purpose of conservation of butterfly species present in this area.

2. MATERIALS AND METHODS

2.1 Study Area

Bellary is the semi-arid tropical district situated in the north- eastern region in Karnataka state. Sandur is one of the 7 taluks of Bellary district. It is located between 14036' and 15031' N latitude and 750 45'and 760 35' E longitude with an area of 1258 sq km (Fig. 1). Sandur has been well known for its vast reserves of iron ore and manganese. Sandur boasts of "southern dry mixed deciduous forest" and its iron-rich soil is a boon for lush forest growth. Its greenery is like evergreen forests. The Narihalla reservoir is dotted by heavily forested hills and tiny green islands pop from between its sparkling waters. Sandur is rich in bio-diversity and has diverse medicinal plants, many of which have not been properly documented. The climate, physical and chemical properties of soils have a very important role in determining the floristic and structural features of the vegetation. Sandur lies about 817m above sea level and is cooler than surroundings due to its elevation. Sandur receives more than 1000 mm of rainfall. Sandur has the rich heritage of flora consisting of both flowering and non-flowering plants.

2.2 Data Collection and Identification

The study area was surveyed once in 15 days and the data was documented based on the observation of the individual species or by using photographs.Hand netting method was also employed during the survey from 8.30 AM to 10.30 AM and 3.00 PM to 5 PM. Line transect count method according to [23] was followed to record the butterfly diversity in the study area. Identification was done in the study area by direct observation of butterflies. Some of them which were difficult to identify were caught by using the hand nets without causing any damage to the

butterflies,and were closely observed for the identification marks. After the identification process the collected butterflies were released immediately into the same area of collection. Butterflies were identified by using various field guides [21,24,25,23,26].

3. RESULTS

The study revealed the presence of 56 species of butterflies, belonging to five families (Table 1). The family Nymphalidae is represented by 19 species; Papilionidae 09 species; Pieridae 17 species; Lyncaenidae 09 species; and Hesperiidae by 02 species. A graph representing the diversity of butterflies is shown in (Fig. 2). The checklists of all the species observed are given in (Table 2). Butterflies are sensitive to changes in the habitat and climate, which influence their distribution and abundance [25]. The conservation activities such as the monitoring and mapping of biodiversity played a key role in determining the status of the diversity [27]. The habitat fragmentation, and change in land use pattern are mainly responsible for loss of both butterflies and plants diversity. Along with the above, mining activity can also be treated as potential threat to biodiversity loss in this area. Among the 5 families, Nymphalidae was the most dominant family with high number of species and Hesperiidae was the least dominant family with only two species (Fig. 3).

Table 1. Number of families and species of butterfly recorded in study area

Sl. No	Family	No. of species
01	Nymphalidae	19
02	Papilionidae	09
03	Pieridae	17
04	Lyncaenidae	09
05	Hesperiidae	02
Total		**56**

Table 2. Checklist of butterflies recorded in the study area

Sl.No	Family	Common name	Scientific name
01	Nymphalidae	Great Eggfly	*Hypolimnas bolina*
		Plain Tiger	*Danaus chrysippus*
		Dark Evening Brown	*Melanitis phedima*
		Monarch butterfly	*Danaus plexippus*
		Common Crow	*Euploea core*
		Anomalous Nawab	*Charaxes agrarius*
		Lemon Pansy	*Junonia lemonias*
		Chocolate Pansy	*Unonia iphita*
		Common Castor	*Ariadne merione*
		Blue Tiger	*Tirumala limniace*
		Common Four-ring	*Ypthima huebneri*
		Tawny Coster	*Acraea terpsicore*
		Common Evening Brown	*Melanitis leda*
		Common Leopard	*Phalanta phalantha*
		Striped Tiger	*Danaus genutia*
		Peacock Pansy	*Junonia almana*
		Yellow Pansy	*Junonia hierta*
		Common Sailer	*Neptis hylas*
		Speckled wood	*Pararge aegeria*
02	Papilionidae	Malabar Banded Peacock	*Papilio buddha*
		Common Banded Peacock	*Papilio crino*
		Common Bluebottle	*Graphium sarpedon*
		Common Mormon	*Papilio polytes*
		Lime Swallowtail	*Papilio demoleus*
		Common Rose	*Pachliopta aristolochiae*
		Tailed Jay	*Graphium agamemnon*
		Crimson Rose	*Pachliopta hector*
		Blue Mormon	*Papilio polymnestor*

Sl.No	Family	Common name	Scientific name
03	Pieridae	Virginia white	*Pieris virginiensis*
		Little Orange tip	*Colotis etrida*
		Western Striped Albatross	*Appias libythea*
		Common Grass Yellow	*Eurema hecabe*
		Small Grass Yellow	*Eurema brigitta*
		Mottled Emigrant	*Catopsilia pyranthe*
		Asian Cabbage White	*Pieris canidia*
		Indian Wanderer	*Pareronia hippia*
		Indian Jezebel	*Delias eucharis*
		Yellow Orange tip	*Ixias pyrene*
		Crimson tip	*Colotis danae*
		Small Salmon Arab	*Colotis amata*
		Great Orange tip	*Hebomoia glaucippe*
		Pioneer	*Belenois aurota*
		White Orange tip	*Ixias marianne*
		Lemon Emigrant	*Catopsilia pomona*
		Large Salmon Arab	*Colotis fausta*
04	Lyncaenidae	Small Cupid	*Chilades parrhasius*
		Large Oakblue	*Arhopala amantes*
		Dark Cerulean	*Jamides bochus*
		Black-spotted Grass Jewel	*Freyeria putli*
		Common Silverline	*Spindasis vulcanus*
		Pea Blue	*Lampides boeticus*
		Common Pierrot	*Castalius rosimon*
		Dark Grass Blue	*Zizeeria karsandra*
		Common Cerulean	*Jamides celeno*
05	Hesperiidae	Banana Skipper.	*Erionota thrax*
		Bush Hopper	*Ampittia dioscorides*

4. DISCUSSION

Species richness was high in the study site. The abundance of butterfly population in the study area may be due to the availability of ample food, optimum climate and serene atmosphere [28]. High numbers of species were observed during September 2019, October 2019, November 2019, and December 2019. Butterflies prefer specific habitats [2] to avail themselves of available resources for survival in the forest ecosystem. They show diverse feeding habits, and the varied forest habitats offer suitable sites for breeding, foraging and resting during different stages in their life cycle [29]. Moreover, certain nectar producing tree species might have provided nectar for adult butterflies; and foliage from trees, shrubs and herbaceous vegetation could have provided the food for larval forms [30].

The biologically rich and active life supporting conditions at different forest ranges in Sandur taluk might have supported as much as 56 butterfly species. Moreover, it is obvious that nutritional requirements including need for water, food plants and their chemical constituents in relation to the larval feeding, growth rate and habitat preferences are not uniform among the butterfly species. Perhaps, all these variations might have influenced the distribution of butterfly species, This clearly indicated that certain butterfly species prefer specific habitats amidst the forest ecosystems; the temporal and spatial distribution of the butterfly species is directly correlated with the floral diversity and ecological conditions of the region [2]. Thus, butterflies are ubiquitous creatures, and exhibit unique evolutionary adaptations that enable them to associate with diversified ecosystems [31]. However, butterfly species habitat specificity requires thorough in-depth studies to better understand the butterfly biology, host plant ecology, and the food plants distribution and abundance in study area. Such information is essential to establish sound policy measures aimed at restoring existing flora among forest ecosystems in general, and protected areas in particular [6,22]. Further, seasonal migration of butterfly species and occurrence of few butterflies within a particular forest range help to reveal their unique life supporting requirements to complete their life cycle during their visit to such ecosystems. All these features indicate the importance of more additional studies to record periodically, and more systematically, the butterfly species' composition, species diversity, habitat quality and distribution pattern in Sandur taluk. Such studies could provide insight about the status of butterfly

species, and in turn to initiate further research for their conservation [32]. The presence of butterflies is very essential for pollinating different plant species within protected natural ecosystems.

Fig. 1. Location of study site

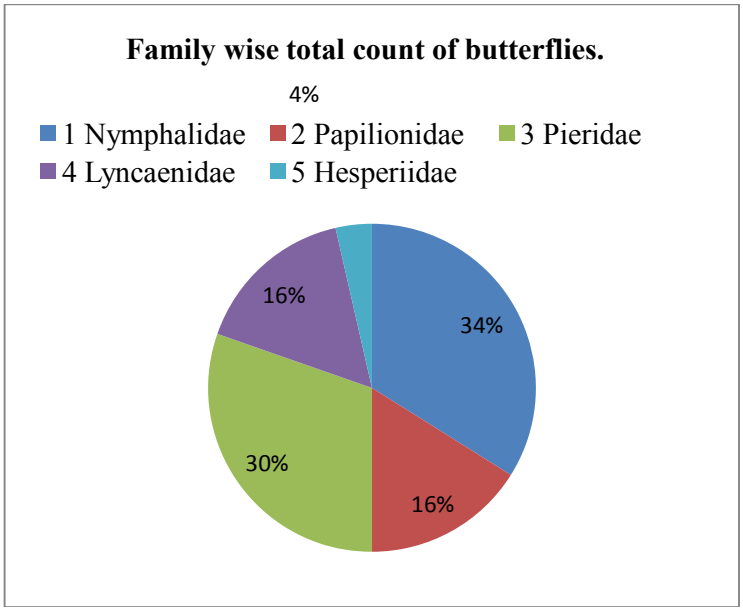
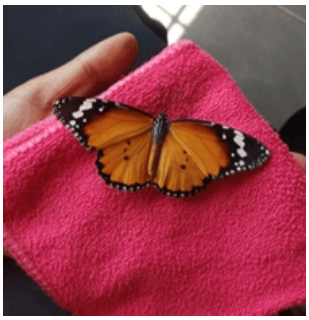


Fig. 2. A graph showing diversity of butterfly families

Family Nymphalidae

Hypolimnas bolina



Danaus chrysippus

Melanitis phedima

Danaus plexippus

Euploea core

Charaxes agrarius

Junonia lemonias

Unonia iphita

Ariadne merione

Tirumala limniace

Ypthima huebneri

Acraea terpsicore

Melanitis leda

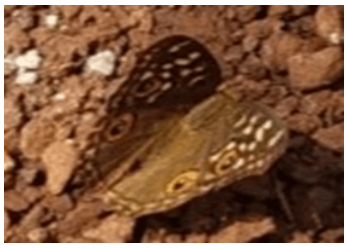
Phalanta phalantha

Danaus genutia

Junonia almana

Junonia hierta

Neptis hylas



Pararge aegeria

Family Papilionidae

Papilio buddha

Papilio crino

Graphium sarpedon

Papilio polytes

Papilio demoleus

Pachliopta aristolochiae

Graphium agamemnon

Pachliopta hector

Papilio polymnestor

Family Pieridae

Pieris virginiensis

Colotis etrida

Appias libythea

Eurema hecabe

Eurema brigitta

Catopsilia pyranthe

Pieris canidia

Pareronia hippia

Delias eucharis

Ixias pyrene

Colotis danae

Colotis amata

Hebomoia glaucippe

Belenois aurota

Ixias marianne

Catopsilia pomona

Colotis fausta

Family Lyncaenidae

Chilades parrhasius

Arhopala amantes

Jamides bochus

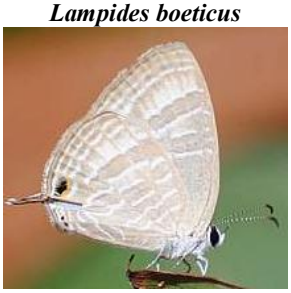
Freyeria putli

Spindasis vulcanus

Lampides boeticus

Castalius rosimon

Zizeeria karsandra



Jamides celeno

Family Hesperiidae

Erionota thrax

Ampittia dioscorides

Fig. 3. Different species of butterflies identified in study area

5. CONCLUSION

Present study shows the occurrence of vast number of butterfly species in Sandur taluk, Ballari district. Species distribution was not even in the study site. The butterfly fauna of Sandur was large with a varied number of species during the study time. It was observed that, the occurrence and distribution of butterflies were closely associated with the availability of food and rich biodiversity. The presence of all these species indicates that Sandur is rich and unique habitat that holds animal diversity that is typical of 'undisturbed tropical dry deciduous scrub forests'. Anthropogenic activities such as mining, construction of roads, movement of heavy vehicles, can result in biodiversity loss; habitat destruction could seriously affect the butterflies' distribution.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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