Original Article

Studies on temporal pattern of butterfly distribution in Sanjay Park, Ambikapur, Chattisgarh

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ABSTRACT

The present study was aimed to assess the diversity, distribution of butterflies on temporal scale along with to study the impact of temperature on butterfly diversity at different study sites of Sanjay park, Ambikapur, Chattisgarh. The present investigation was carried out during June 2015 to April 2016. The entire park were divided into five different study sites on the basis of habitat characteristics. Data were recorded during Monsoon, Winter, Summer seasons. During the entire study period 20 species of butterfly were recorded from five study sites at Sanjay Park. Butterfly diversity at Sanjay Park represented four families which includes Nymphalidae, Papiolionidae, Pieridae and Lycaenidae. Nymphalidae were found to be the most predominant over the other butterfly families. Practices such as monoplantation of flowering plants at different seasons, higher level of anthropogenic influence were found to be the significant factor to influence the butterfly diversity and distribution at Sanjay Park. Proper management practices needs to be implemented to conserve the butterfly diversity of Sanjay Park.

KEYWORDS: *Nymphallidae, diversity, seasonal variation, Temperature, Indiar.*

INTRODUCTION

Butterflies are part of the class of insects in the order Lepidoptera along with the moths. Adult butterflies have large, often brightly coloured wings, with conspicuous, fluttering flight. The group comprises the large supper-family Papilionoidea, along with two smaller groups, the skippers (Superfamily Hesperioidea) and the moth- butterflies (super family Hedyloidea) Butterfly fossils date to the Palaeocene, about 56 million year ago. Biologists around the globe are facing particularly great conservation challenges under the mounting threats of anthropogenic disturbances to biodiversity. Moreover, holistic inventory of diversity requires nearly impossible levels of time and effort (Lawton et al., 1998). Insects, representing majority of animal species (ranging anywhere from 5-30 million) are a perfect example of these challenges (Godfray et al., 1999). Consequently insects remain mostly undiscovered and are frequently omitted from conservation assessments (Leather et al., 2008). Butterflies represent an opportunity in this respect, in that many species can typically be sampled and identified in a short time and provide an indication of habitat or conservation value as well (Brown, 1997). Among the 19,238 described global butterfly species (Heppner, 1998) India hosts 1,501 species of butterflies (Gaonkar, 1996).

The India being a vast country with wide contrasts in the physical features, climate and the vegetation, possesses one of the richest and the most varied butterfly fauna in the world. These same factors cause some minor, but well-

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marked differences in the size, coloration and the other features among the butterflies of the same species distributed throughout the India. A butterfly from the north will differ slightly from the same species in the south. Often such geographical variation gives rise to the races or the subspecies. The prolonged isolation as on the oceanic islands in the Andaman- Nicobar Island, or in the inaccessible mountain terrain, like the Himalaya, prevents the interbreeding between the different population groups of the same species. This usually causes the races to evolve into a separate species. There are about 18,000 species of butterflies in the world. India has 1,501 species of which 321 are skippers, 107 swallowtails, 109 whites and Yellow, 521 Brush footed butterflies and 443 Blues (Kehimkar, 2008).Has recorded approximately 1439 species of butterflies from British India, Including Ceylon and Burma. India has one of the richest and most diverse butterfly fauna of the world. The diversity of the species depends on the factors like the climate and topography of that particular region. India is a large country with different types of physical features and contrasting climatic zones- from sun-baked deserts to the wettest places on the earth and from tropical hot desserts to cold alpine regions. The climate is an important factor in the change in butterfly diversity. In India the rainfall is one of the major climatic factors that govern the diversity and abundance of the butterfly fauna. India has two monsoon seasons, the summer monsoon better known as the southwest monsoon that is the major monsoon season of the country during that more than 70% of the annual rainfall is received and the winter monsoon season is known as the northeast monsoon. Chhattisgarh having 44% forest cover is endowed with higher level of biodiversity including butterfly diversity. The present study aims to examine the diversity and distribution of butterflies in different study sites of Sanjay Park along with assessment of impact of temperature on distribution pattern of butterfly diversity at different study sites of Sanjay Park, Ambikapur (C.G).

MATERIALS AND METHODS
Study area:
The present study is based on the field surveys conducted in Sanjay park, situated at Ambikapur, District head quarter of Surguja district. Sanjay Park is a zoo located in Ambikapur (Sarguja). The area lies between 23°8'39"N to 83°12'30"E.(Fig1)

Fig1: Sanjay Park, Ambikapur, Surguja

Sampling:
Data collections were done from July 2015 to April 2016. Generally, field works were conducted twice during daytime i.e. from morning 11 am to12:30 pm and from 01 pm to 02:30 pm during monsoon, winter, summer months. Specimens were identified referring Evans (1932), Talbot (1939 & 1947), Winter-

Blyth (1957), Kunte (2000) & Kehimkar (2008). Photographs taken during the field work helped in the identification of specimens by using Sony Cybershot digital camera.

Data obtained during present investigation were subjected to multivariate analysis through clustering of data. To establish interrelationship between the study variables correlation study were done with the observed data set.

RESULT

A total of 22 butterfly species belonging to families of Papilionidae, Pieriidae, Nymphalidae and Lycaenidae were recorded during the short period of present study. (Fig 2)There was significant level of variation in the temperature level at five studied sites of Sanjay park. Fig 7 represents the variation in temperature at five studied sites at Sanjay Park. From the result it appears that Site III recorded higher temperature during all the three seasons in comparison to other study sites. Among the five study sites highest temperature were recorded for site I and Site III and lowest were recorded for site-II.
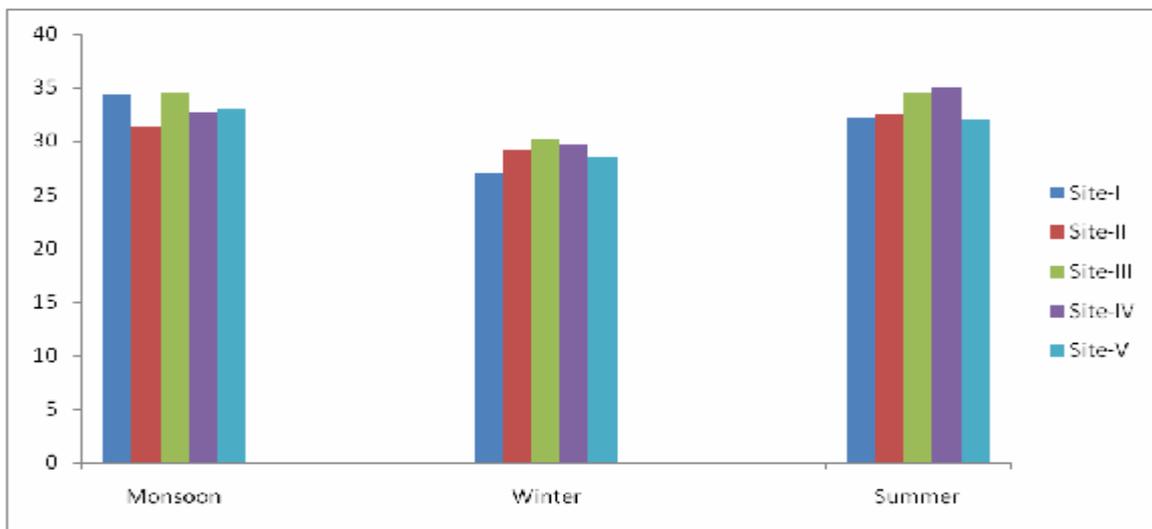

Fig2: Seasonal Variation of temperature at five different study sites at Sanjay Park

During the present investigation 20 butterflies belonging to 4 families were recorded from the five different study sites of Sanjay Park, Ambikapur, Chattisgarh. Among the studies butterflies some of the individuals are common, some are seasonal, and some showed their occasional appearance in the respective active study sites. Different species reflected different types of habitat preferences. Some of the species were recorded in all the study sites. (Table-1)

Table 1: Habitat Preferences and the observation status of the butterfly species at different study sites at Sanjay Park

S No.	Common Name	Scientific Name	Occurance Status	Habitat Preference
1	Indian Common Crow	*Euploea core* (Cramer)	C	AH
2	Plain tiger	*Danaus chrysippus*	O	AH
3	Common Grass Yellow	*Eurema hecabe* (linn)	VC	AH
4	Common Emigrant	*Catopsilia pomona*/fabricus	UC	ETH, WF
5	lemon pansy	*Junonia temonias*(linn)	S	PS, SJ
6	Common Leopard	*Phalanta phalantha*	S	SJ, FG

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7	Common Jay	*Graphicem doson* (csrfelder)	C	AH
8	Common wing	*Troides helena* (linn)	UC	WF
9	Twany coaster	*Acraea violae* (Fabricius)	UC	FG
10	Lime butterfly	*Papilio demoleus* (linn)	O	FG
11	Dotdash Seargent	*Athyma kanwa* Moore	S	SJ
12	Common mormon	*Papilio polytes* (linn)	UC	WF, FG
13	Grey Pansy	*Junonia catiltes* (linn)	C	PS
14	Peacock Pansy	*Junonia almana* (linn)	C	PS
15	Indian Angled Castor	*Ariadne ariadne* (linn)	S	ETH, SJ
16	Common pierrot	*Castalius rosimon* (Fabrius)	S	SJ, FG, WF
17	Common Sailer	*Neptis hylas* (linn)	C	AH
18	Common Wanderer	*Pareronia valeria* (Cramer)	O	AH
19	Common Tit	*Hypolycaena erylus* (hodert)	UC	ETH , PH
20	Common Jewel	*Freyeria trochyles* (Freyer)	UC	WF

AH- All Habitat ; PS-Pond Side ; FG-Flower Garden ; WF-Water Fountain; SJ- Scrub Jungle; ETH- Ecotourism Hut ; UC-uncommon C-Common ; O- Occasional ; S-Seasonal; VC- Very Common ;
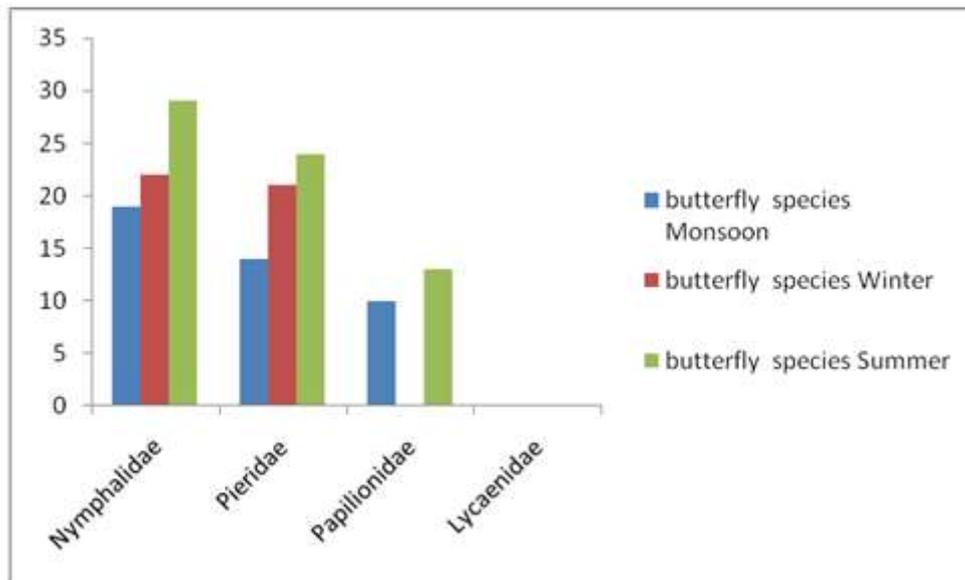

Fig 3: Distribution of butterfly families in Site I during all the seasons.

Data in fig 3 reflects significant level of variation in the distribution of four butterfly families at different study sites of Sanjay Park. Representatives of Family Lycaenidae were totally absent in site- I for all the seasons. Representatives of rest of the families were found to be higher in occurrence during summer months.
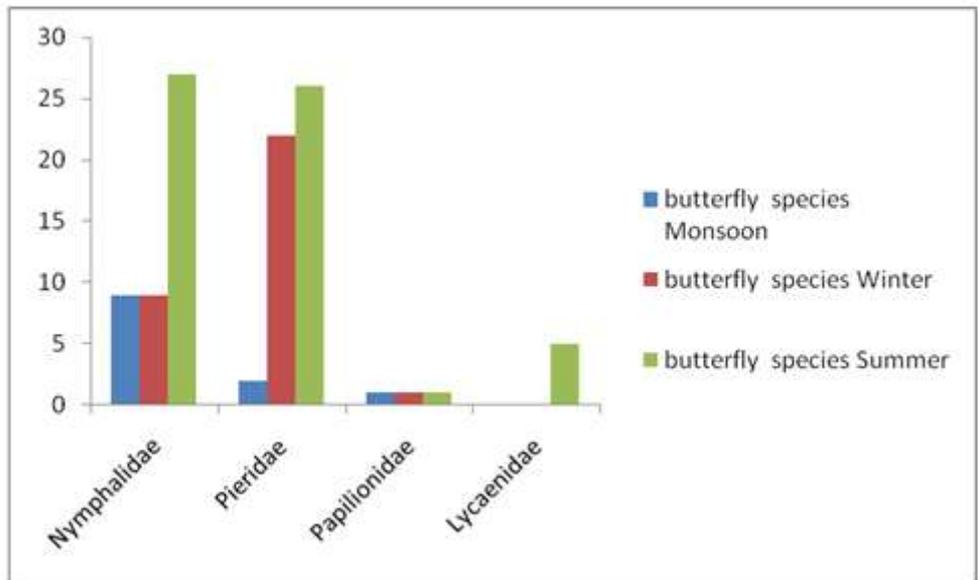
Fig 4: Distribution of butterfly families in Site II during all the seasons.

In site-II Family Papilionidae were least in occurrence in all the three seasons. Representatives of four families of butterflies were highest in occurrence during summer months in comparison to monsoon and winter seasons. Representatives of Family Lycaenidae appeared only during summer seasons. (fig 4)
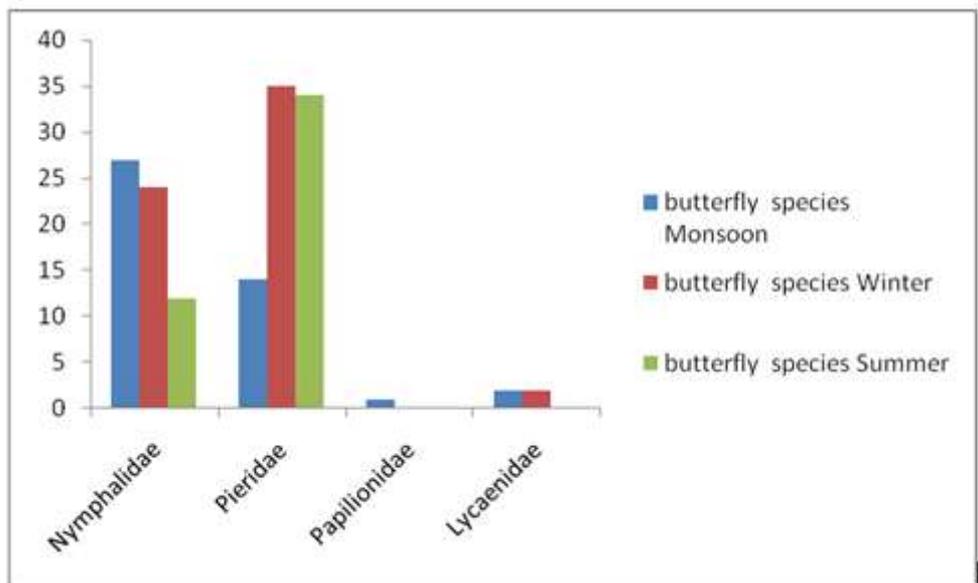

Fig 5: Distribution of butterfly families in Site III during all the seasons.

Duiring the present investigation in study site III it was found that representatives of Papilionidae appeared only during monsoon period. Species of Lycaenidae were absent during summer. Highest number of butterflies of Nymphalidae family were recorded during monsoon and butterflies of Pieridae were recorded in highest number during winter and summer.(fig 5)
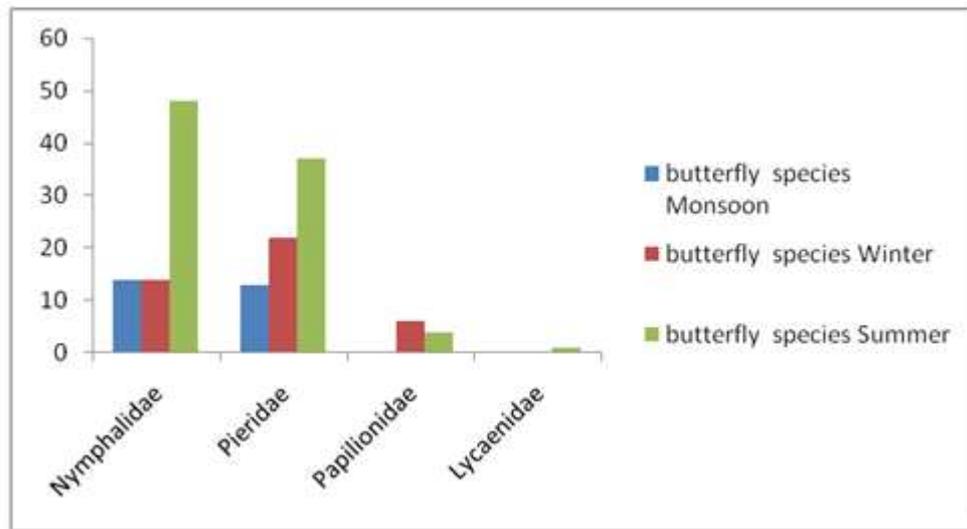
Fig 6: Distribution of butterfly families in Site IV during all the seasons.

Duiring the present investigation it was found that representatives of Lycaenidae appeared only during summer period in Study Site IV. Nymphalidae and Pieridae family provided maximum representation during summer season. Papilionidae and Lycaenidae representatives were absent during monsoon period. (fig 6)
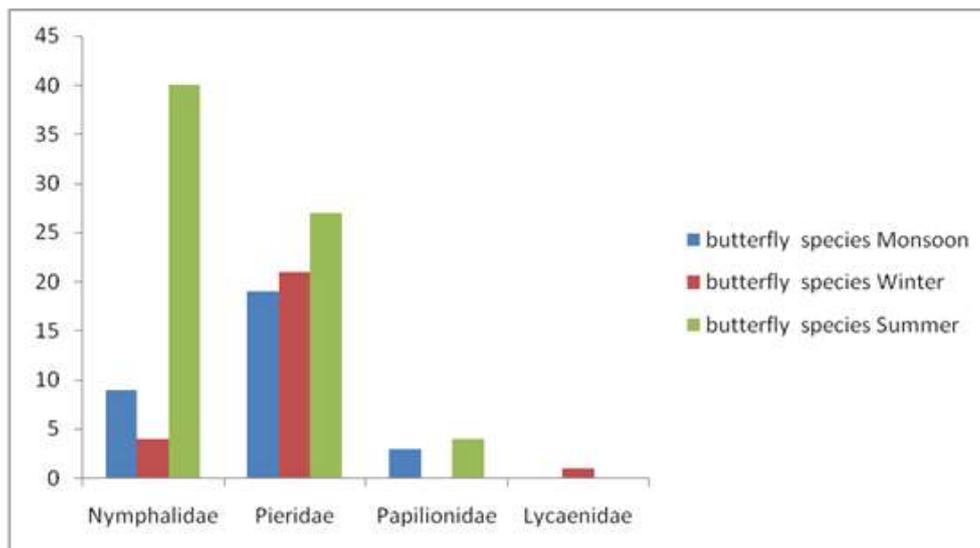

Fig7: Distribution of butterfly families in Site V during all the seasons.

In site-5 Family Papilionidae were absent in winter and representatives of Lycaenidae were absent in monsoon and summer. Representatives of Nymphalidae, Pieridae and Papilionidae reflected highest occurrence during summer months in comparison to monsoon and winter seasons. (Fig 7)
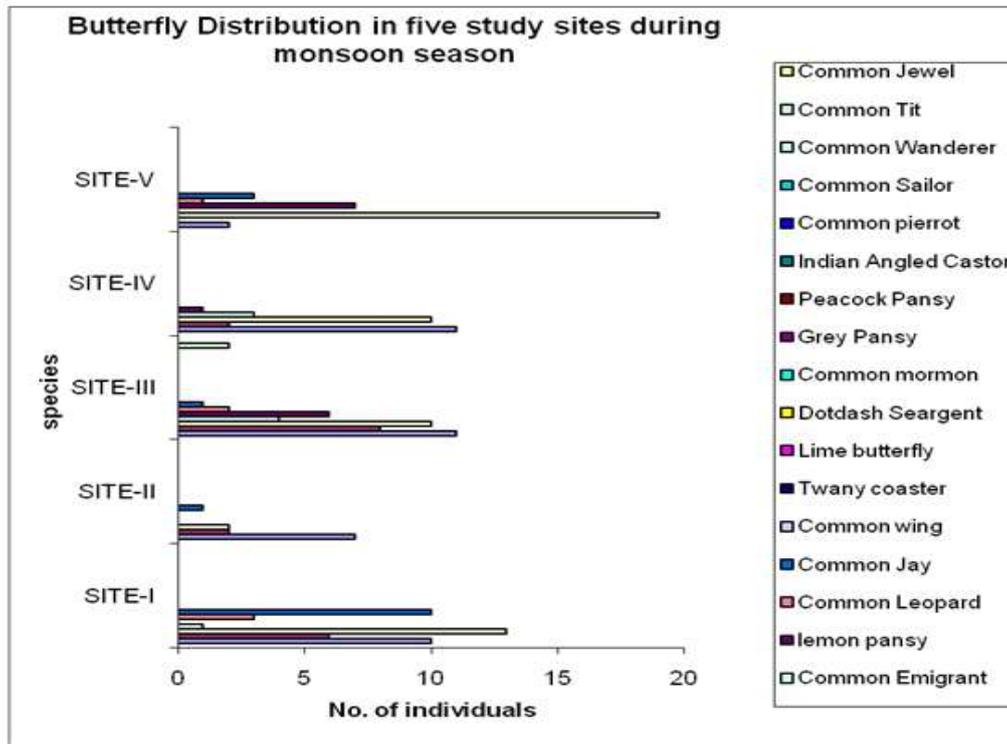
Fig 8: Distribution of butterfly species in five different study sites during monsoon

Data in fig 7 represents the distribution of butterfly species at five study sites of Sanjay park during monsoonal period. From the results it appears that the occurrence of common grass yellow appears to be highest during monsoon. Site-III represents the highest butterfly diversity (7 species) among the five studied sites. Site-II representing the lowest butterfly diversity among the five studied sites. Common wing, Tawny coaster, lime butterfly, dot dash sear gent, Common Mormon, Grey pansy, Peacock Pansy, Indian angled Castor, Common Pierrot, Common Sailor, Common wanderer and Common jewel were not present in all the five study sites during monsoonal period. (fig 8)
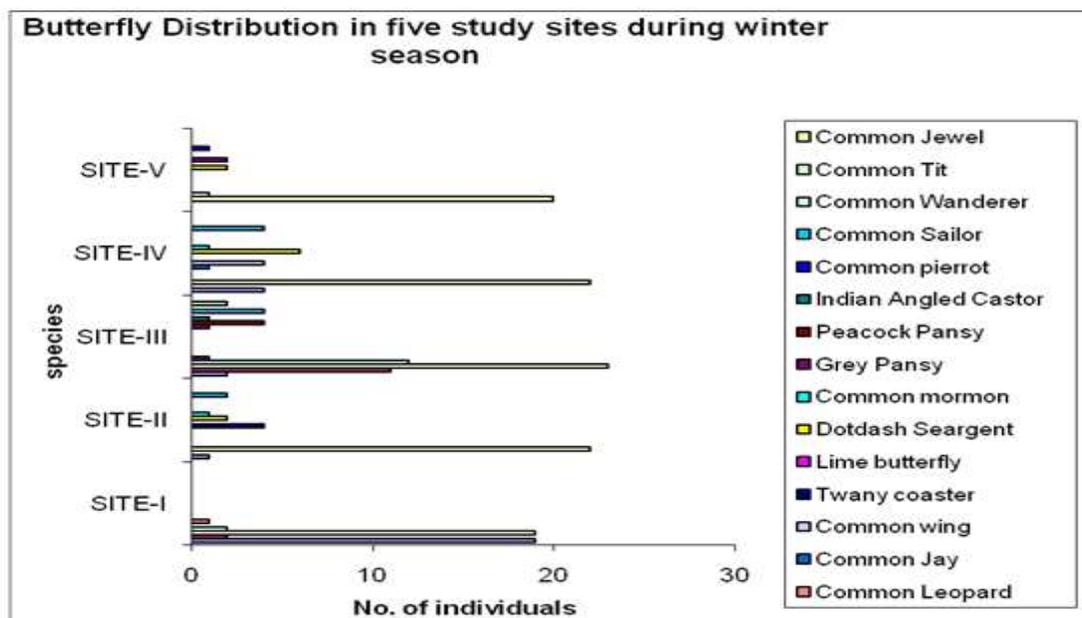
Fig 9: Distribution of butterfly species in five different study sites during Winter period

During winter the distribution of butterflies at five different sites reflected significant variation among themselves (Fig 9). From the results it appears that Common Grass yellow were highest in occurrence in all the study sites. Lime butterfly, Common Jewel were absent during winter season. Most of the butterflies were least in occurrence during winter season among the five different study sites. Among the 20 species of butterflies Indian common Crow, Plain Tiger, Common emigrant, Dot dash Sergeant and common sailor reflected significant presence among the studied sites during present investigation. During winter. It was observed that the number of individuals of Common Jay was higher during the early winter period but subsequently it decreased gradually. Common jay appeared in Site-I. The density of Lemon pansy also decreased gradually. In Site-III the number of individuals of Lemon pansy appeared higher in number. Common grass yellow was found to be cosmopolitan in distribution and lemon pansy occurred in Site-I and Site III. Tawny Coaster appeared in Site-III. Common Leopard was found to appear in Site IV during winter season. At the end of winter as well as at the starting of summer season the Number of Common Jay and Common Leopard increased considerably. Indian Common Crow, Plain Tiger density were reduced during the end of winter. Dot dash Sear gent appeared higher in number in Site-III and IV.
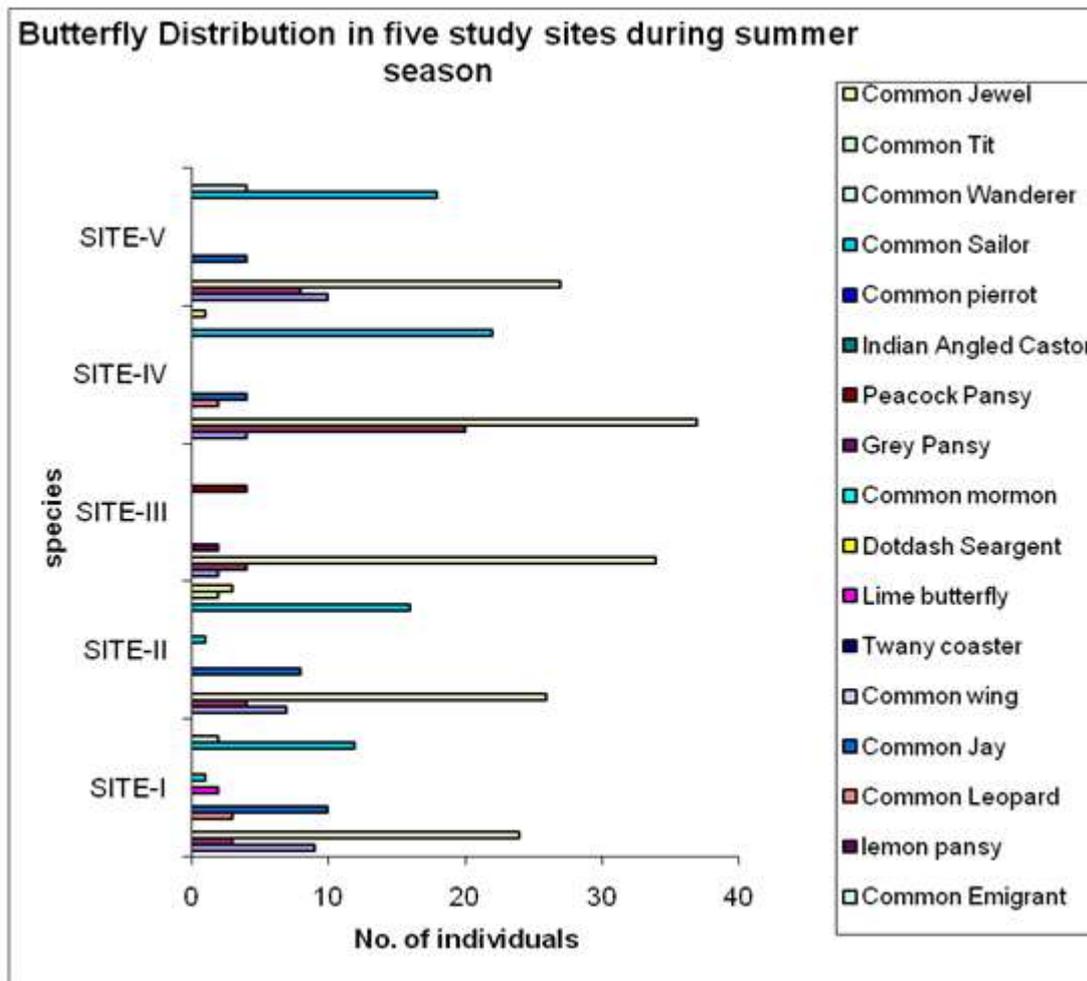

Fig 10: Distribution of butterfly species in five different study sites during Summer season

Fig 10 represents the distribution of butterfly species in all study sites during summer season.

From the results it appears that Common sailor is predominating in terms of their presence in

all the five study sites during summer season in comparison to monsoon and winter period. Common grass yellow appeared to be cosmopolitan in distribution in all the study sites. Indian Common crow appeared in the first study site only. Common leopard were found to occurred in site-IV .Common Sailor appeared in Site-I, II and IV. Common Mormon appeared

for the first time. Plain tiger was found to occur in the scrubby jungle areas. Common Wanderer appeared during the summer season. Common Tit appeared in II nd and III rd Site. Overall during the summer season Common Jay and Common Sailor reflected higher occurrence.
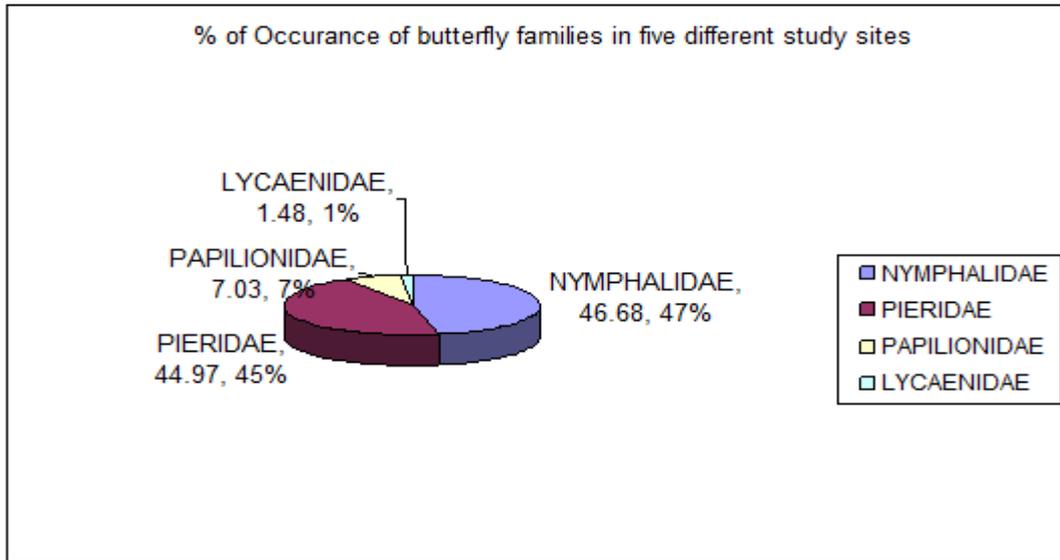

Fig 11: Distribution of butterfly families at five different study sites of Sanjay park.

Data presented in fig 11 reflects the overall distribution pattern of four butterfly families at different study sites of Sanjay Park. Family Nymphalidae (46.68%) reflecting higher prevalence over the other family. On the basis of % of occurrence the butterfly families can be arranged in the order of Nymphalidae>Pieridae>Papilionidae> Lycaenidae. Representatives of Lycaenidae were least in distribution.

Among the Family Pieridae the observed butterflies have strong migratory habit and Common Wanderer is protected under schedule II of Indian Wild Life (Protection) Act, 1972.

Table 2: Diversity indices of different study sites of Sanjay Park

	Site-I	Site-II	Site-III	Site-IV	Site-V
Dominance_D	0.2299	0.26	0.2786	0.2522	0.3012
Shannon_H	1.738	1.721	1.638	1.737	1.677
Simpson_1-D	0.7701	0.74	0.7214	0.7478	0.6988
Evenness_e^	0.5686	0.5588	0.5147	0.4732	0.4459
Menhinick	0.8111	0.9492	0.8392	0.9517	1.057
Margalef	1.791	1.911	1.816	2.17	2.263
Equitability_J	0.7548	0.7472	0.7116	0.6989	0.6749
Fisher_alpha	2.402	2.664	2.454	3.011	3.234
Berger-Parker	0.3684	0.4505	0.4718	0.434	0.5116

There is significant level of variation in the values of diversity indices among the five different sites of Sanjay Park. (Table 2) The dominance index value reflects species dominance for a specific habitat. The value of dominance index ranged between0.2522 to 0.3012. From the results it can be concluded that site V has higher species dominance in comparison to other study sites. Shannon and Simpson's index value represents species richness and diversity over a specific habitat. From the results it appears that Shannon and Simpson's index were highest for site I. Therefore the butterfly diversity would be higher in site I. Our findings were further supported by the dominance index value as

dominance index value was least in case of Site I. Lesser species dominance means higher species diversity. On the basis of diversity indices value the study sites can be arranged in the form Site I>Site-IV>Site-II>Site-V>Site-III. The Evenness index value ranged between 0.4459- 0.5686. Highest evenness index value were reported by study site I. Therefore the butterflies were evenly distributed in Study site I. Mechinick values Margalef values were found to be highest in site IV and site V respectively and Berger parker value was found to be higher in site V when compared to other sites.
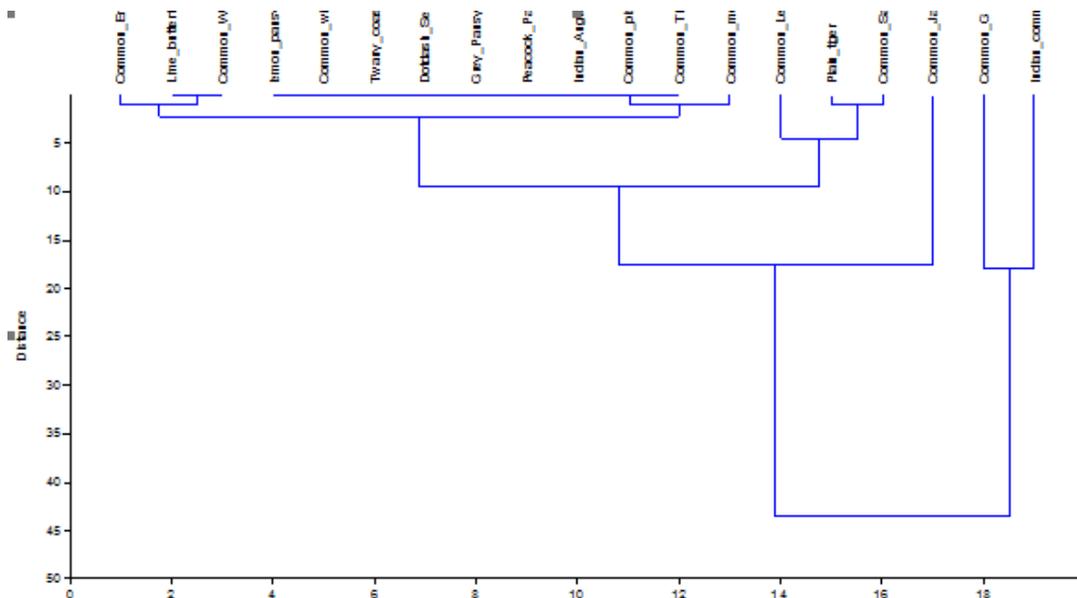

Fig 12: Distribution of butterfly species in all the study sites during monsoon.

Cluster analysis of the butterfly distribution in five study sites during monsoon period reveal few small clusters. Five clustering of butterflies were found during the monsoonal period. Cluster 1 comprises of Common Grass Yellow and Indian Common Crow, Cluster 2 comprises

of Common Sailor and Plain Tiger, Cluster 3 comprises of Common leopard Common Sailor and Plain Tiger, Cluster 4 comprises of Common Parrot and Common Mormon, Cluster 5 comprises of Common Wanderer and Common Emigrant.(fig12)
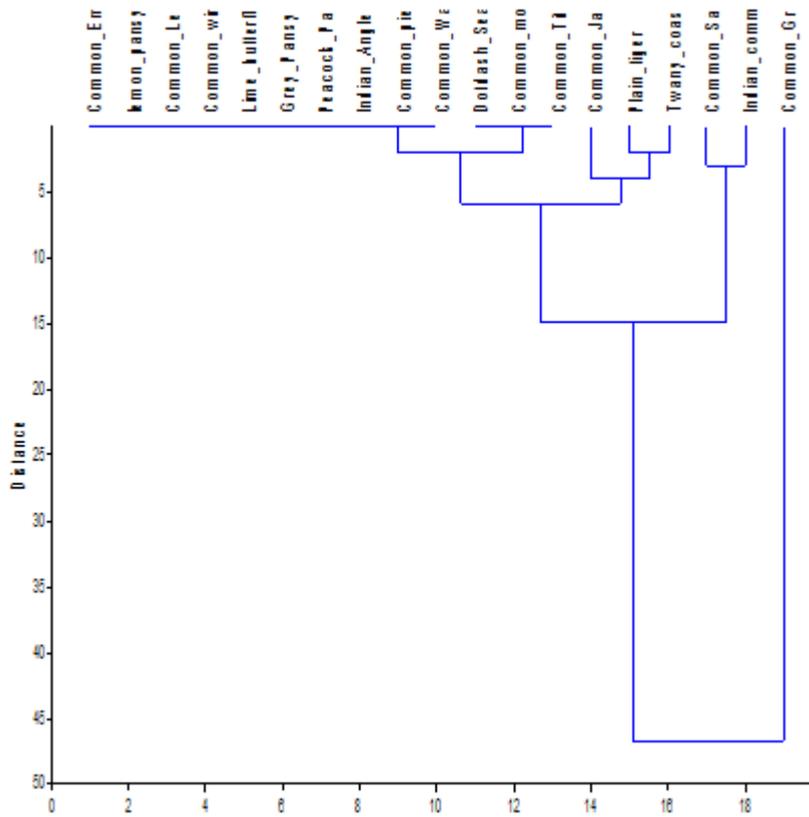
Fig 13: Distribution of butterfly species in all study sites   during winter.

During winter season of the present investigation five large clusters and two small clusters were found in terms of butterfly distribution at five studied sites at Sanjay Park. Among the large clusters, cluster 1 comprises of Common Emigrant, Lemon pansy, Common Leopard, Common wing, Lime Butterfly, Grey Pansy, Peacock pansy, Indian Angled castor, Common Pier rot and Common Wanderer, Cluster 2 comprises of Common pier rot, Common wing, Dot dash sear gent and Common Mormon. Cluster 2 further aggregates with Common Tit and Common Jay to form Cluster 3.Cluster 3   aggregates with Common sailor and Indian common crow to form Cluster 4. Cluster 4 further aggregates with Common grass yellow to form cluster 5. Among the small clusters Cluster 1 comprises of Common Sailor and Indian common Crow. Cluster 2 comprises of Plain tiger and Tawny Coster. (Fig 13)
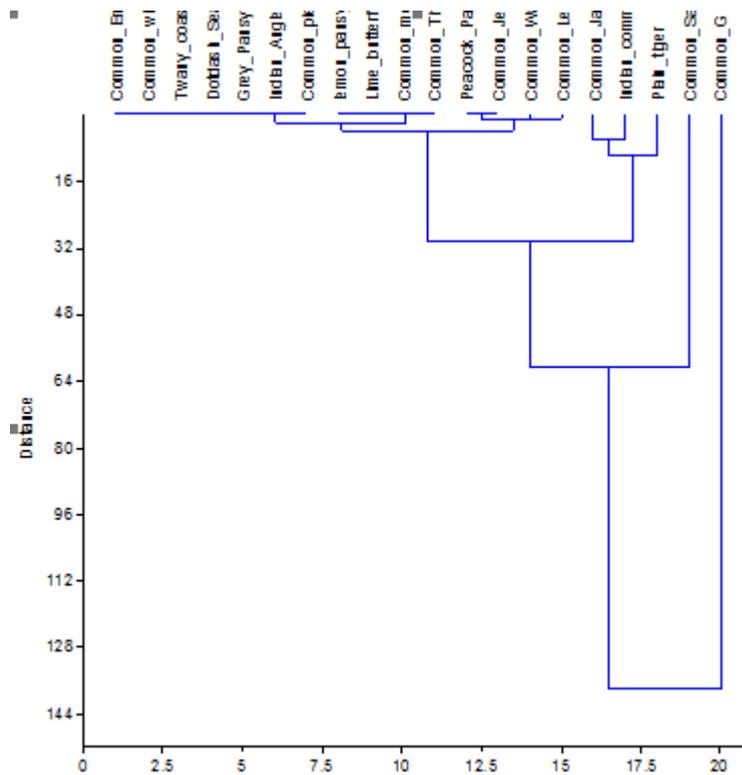
Fig 14: Distribution of butterfly species in all study sites   during summer.

Data presented in figure 14 represents distribution pattern of butterfly during summer months. From the results it appears that 3 large cluster and 4 small clusters were formed during summer season. Among the large clusters formed cluster 1 comprises of Common emigrant, Common wing, Tawny Coaster, Dot dash Seargent, Grey pansy , Indian angled castor and Common pier rot, Cluster 2 comprises of Common tit , Peacock pansy, Common Jewel , Common wanderer, Common Leopard , Common jay , Indian Common Crow and plain tiger, Cluster 3 Common tit , Peacock pansy, Common Jewel , Common wanderer, Common Leopard , Common jay , Indian Common Crow, Common sailor and Common Grass yellow.

Table 3- Correlation analysis between temperature and no of butterflies occurred at various seasons

	TEMP	MONSOON	WINTER	SUMMER
TEMP		0.48375	0.08001	0.040142
MONSOON	0.41497		0.2608	0.36058
WINTER	0.83276	0.62379		0.0050883
SUMMER	-0.89509	-0.52785	-0.97374	

Correlation study were done   between the number of butterflies of five study sites and recorded temperature at various seasons.(Table-3) From the results it was found that the temperature is showing positive correlation with the number of butterflies present during the winter seasons. Therefore it can be concluded that low temperature increases the density of butterfly. Number of butterflies is also significantly correlated with temperature during monsoon.
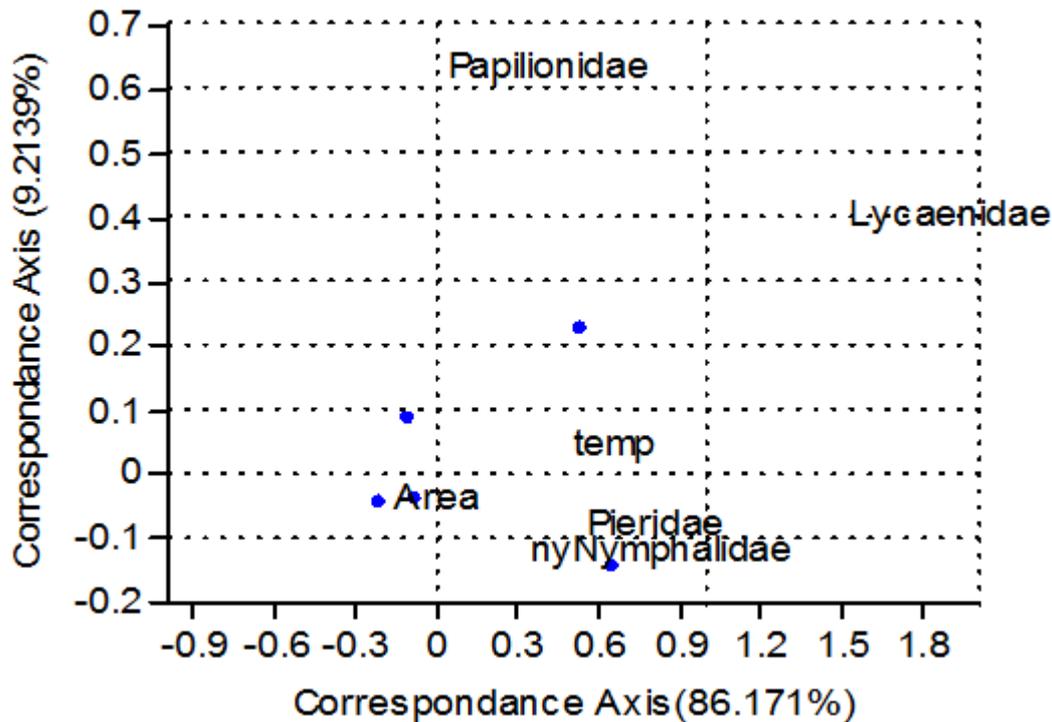
Fig 15: Area and Temp wise distribution of butterflies representing correspondence analysis of area and temperature wise distribution of families.

The correspondence analysis of Butterfly family distribution with respect to temperature and area revealed significant preferences for both the factors by different butterfly families. Both Nymphalidae and Pieridae showed preference for specific area and temperature as compared to Lycaenidae and Papilionidae. Lycaenidae and Papilionidae preferred more diverse temperature and area regime (fig 15).

DISCUSSION

From the result it appears that Nymphalidae family were predominant over other families of butterflies. Nymphalidae is the largest representative family of butterflies from India with 450 species .This may be attributed to their polyphagous habits, which probably helps to exist in a variety of habitats. Moreover, members of this species are active fliers and can forage a distant areas (Varshney, 1993). The higher prevalence of butterflies of Nymphalidae might also be attributed towards the dominance of their larval food plants in the region.

During our present investigation we found lesser representatives of butterfly species in different study sites of Sanjay park, as the concerned study sites are under the influence of anthropogenic activities. The study sites were in constant disturbance due to the cutting of grasses, weeding, plantation of flowering plants for landscaping which may be the reason for the overall reduction of the number of species (Tiple, 2012). Earlier works reported butterflies from Gorewada International Bio-Park, Nagpur, Maharastra and listed a total of 92 species spread over 5 families, of which Nymphalidae with more number of species followed with Lycaenidae, Pieridae and Papilionidae (seven). The family Pieridae includes butterflies that are small, white or yellow to orange shades. Kunte (2000) observed that the family Pieridae are generally seen in all types of habitats from semi desert to arid grass lands. The Nymphalids are large and brightly colored with tails at the hind wings.

They are generally seen in drier area and love to bask in the sun. The high percentage representation of Nymphalids may be due to the presence of flowers belonging to the families Euphorbiaceae, Compositae, Rubiaceae and Verbinaceae (Gunathilagaraj *et al* 1998) in the selected areas. The family Lycanidae includes moderate sized butterflies predominantly blue with series of spots on the wings and tail like delicate prolongations are seen on the hind wings the butterflies are selective in their choice of flowers and plants they visit. There is an intimate association between butterflies and plants (Uniyal and Mehra, 1996). The rate of visit of butterflies to a flower depends on color, odor and the shape of the flower. The family Papilionidae often visit citrus species of plants The Nymphalids and Pierids are sensitive to yellow, orange and red color.

The distributions of butterflies depend upon not only on the availability of food plants, but also on the climatic and topographic features of different regions observed that the distribution might also be associated with specialties in the floral composition of plants in a particular habitat. The preference of butterfly species at a particular habitat also depends upon other factors like abundance of predators, parasitoids and prevalence of diseases.

The preference of butterflies for particular habitats is associated with the availability of larval host plants and adult nectar plants. The rich diversity of butterflies, especially the Nymphalids and Lycaenids in Sanjay Park, Ambikapur, Chattisgarh indicates a varied assemblage of floral species. Butterfly diversity varies with season. They are abundant for only a few months and rare or absent during other months of the year. Wynter Blyth (1957) had identified two seasons as peaks, March-April and October for butterfly abundance in India. The abundances of diverse species were positively affected by approaching summer, high relative humidity and more rainfall. During the present study, the numbers of the butterflies were peaked during post-monsoon season (late August to October) which was similar to the findings of Tiple et al, (2007), Tiple,(2012), Tiple and Khurad (2009). The species abundance was less during monsoon. Apart from being one of the most prominent biodiversity indicators butterflies also act as our native gardener for their dependence on indigenous plants for completion of the life cycle. Therefore, an abundance (Kunte, 2000) of butterflies usually indicates a healthier ecosystem. Butterflies also serve as major pollinators of both wild and cultivated plants (Tiple, Desmukh and Dennis, 2006). With the pressing needs of the growing human population in India, natural greeneries are being clear-felled giving way to urbanization, pollution and overgrazing. Loss of prime habitat is the major threat to all wildlife including butterflies. In addition to these, a variety of threats from human recreational activities, trampling, run-off from roads, litter deposition and weeds are common factors which affect butterfly populations. Although we cannot completely nullify the ill effects of urbanization and development, we can at least try to reduce them by planting endemic trees and plants supporting the local wildlife. This will make sure that at least the common species will not go on to the verge of extinction.

The Wild Life (Protection) Act 1972 has enough provisions for conservation of butterflies. Under this Act, around 120 species and sub-species of butterflies and moths are in Schedule-I and nearly 292 species and sub-species are in Schedule-II. Not also legislation, but proper effective steps in maintaining the wild life habitat through continuous process of awareness generation among the local community, young generation is required.

CONCLUSION AND RECOMMENDATION

During the present investigation 20 species of butterfly were recorded from five study sites at Sanjay Park. Butterfly diversity at Sanjay Park represented four families which includes Nymphalidae, Papiolionidae, Pieridae and Lycaenidae. Nymphalidae were found to be the most predominant over the other butterfly families.

Practices such as monoplantation of flowering plants at different seasons higher level of anthropogenic influence were found to be the significant factor to influence the butterfly diversity and distribution at Sanjay Park. Proper management practices needs to be implemented to conserve the butterfly diversity of Sanjay Park.

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