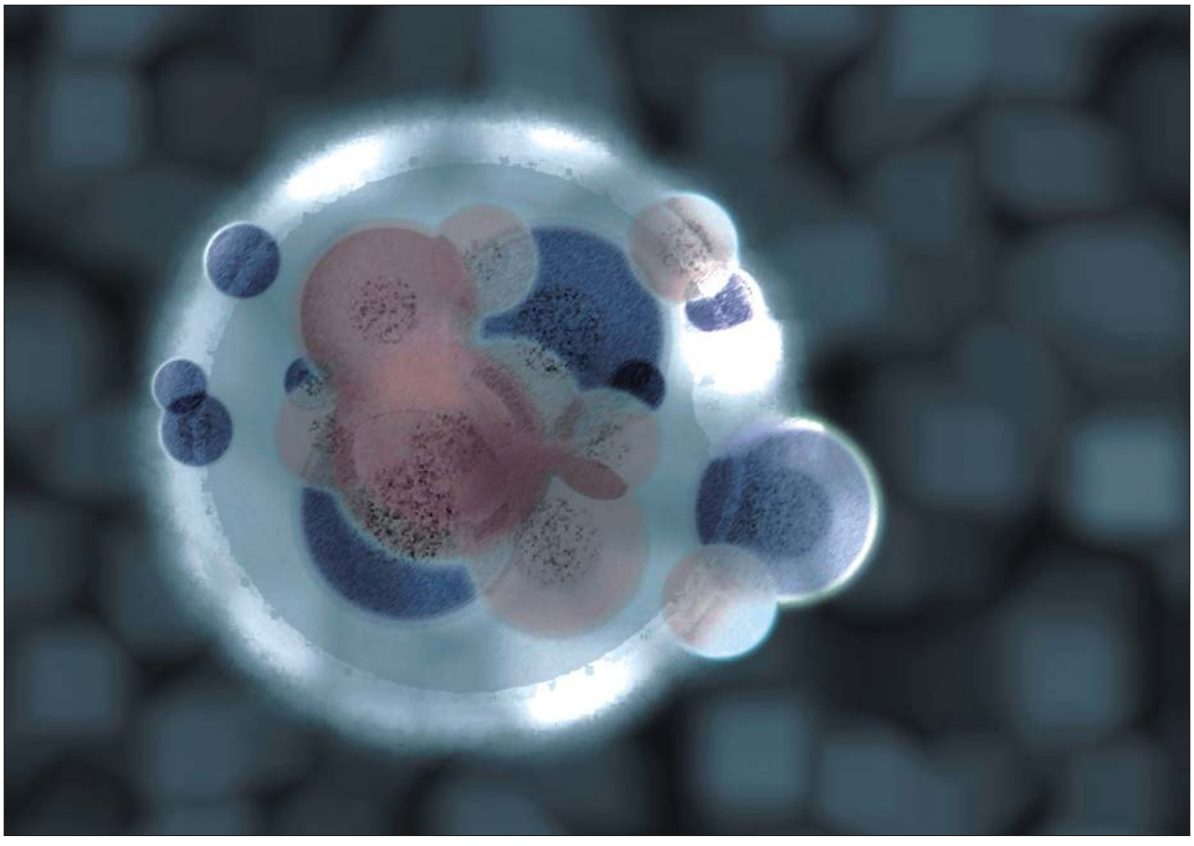

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Seasonal Variation in Diversity and Abundance of Butterfly at Sawanga Vithoba Lake Area District Amravati, Maharashtra India

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Abstract: Butterflies are the best taxonomically studied groups of insects and are also good indicators of environmental changes. Because of their diversity, wide distribution, specificity to vegetation type, rapid response to perturbation, taxonomic tractability, statistically significant abundance and ease of sampling, they have been considered useful organisms to monitor environmental changes. The present work is result of a survey on butterfly fauna of Sawanga-Vithoba Lake region. For the observations of the species transect of 1 km long and 5 m wide was followed. Butterflies were primarily identified directly in the field or, following photography. Study was carried out for one year. Total 28 species of butterfly at Sawanga Vithoba lake area under five different families were observed. Most of the species were common. Two rare species were observed in this region. Butterfly exhibits seasonal variation in distribution of species at four stations of Sawanga Vithoba lake. In monsoon total number of species was more than in winter and summer. Few species of butterfly such as *Papilio machaon* (Linnaeus), *Parnara guttata* (Brener and Grey). *Cepora nerissa* (Fabricius), *Pieris brassicae* (Linnaeus), *Junonia almana* (Linnaeus), *Junonia lemonias* (Linnaeus), *Phalanta phalantha* (Drury) and *Acraea terpsicore* were not observed in summer. Much similar species of butterfly are observed at four stations of Sawanga Vithoba Lake area. Species richness of few species such as *Catochrysops strabo*, *Eurema hecabe* (Linnaeus), *Pseudozizeeria maha* (Kollar) is higher in all the seasons. Family Nymphalidae is the most represented family at Sawanga Vithoba lake region district Amravati.

Key words: Seasonal variation, diversity, abundance, butterfly, Sawanga Vithoba

INTRODUCTION

There are around 1.4 million species on earth out of which around 53% are insects (Hassan, 1994). Approximately 17,200 species of butterfly have been reported world wide and of which around 1,501 species reside in India (Kunte, 2000). Around 351 and 334 species in Peninsular India and the Western Ghats (Tiple, 2011) and around 177 species in Madhya Pradesh and Vidarbha of central India are found (D'Abreu, 1931). Butterflies are recognized for their beauty and grace (Rafi *et al*., 2000). They are well studied due to their diurnal behaviour, marvelous shapes, bright colours and graceful flight (Javaid, 1978). They are the pollinators and indicator of environmental changes. They possess great aesthetic and commercial values (Ahsan and Javaid, 1975). Taxonomy of the butterflies are also well studied (Robbins and Opler, 1997). Butterflies are sensitive to habitat degradation and climate changes and thus good indicators of environmental changes (Kunte, 2000).

Butterflies are one of the important food chain components. They serve themselves as a food for the birds, spiders, reptiles and predatory insects. Butterflies and moths (order Lepidoptera) can be used as an indicators in the study of population and community ecology (Pollard, 1991).

Butterflies are diverse animals and are widely distributed. They are very specific to vegetation type and respond rapidly to perturbation. Their abundance, diversity, ease of sampling made them successful and useful organisms to check changes in environmental parameters. They exhibit seasonality (Kunte, 2000). Habitat destruction, fire, use of pesticides weedicides and illegal collection for trade reduced the diversity of butterfly fauna.

Diversity, richness and abundance of the butterfly fauna of Sawanga-Vithoba Lake region is presented in the current study. This study can be used as a baseline for the future studies of diversity patterns at Sawanga-Vithoba Lake region.

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MATERIALS AND METHODS

The findings presented here are based on a bi-weekly survey carried out from June 2011 to May 2012 at the Sawanga-Vithoba lake region. Sawanga-Vithoba lake is also known as Malkhed Prakalpa or Malkhed Talav. The observations were made from 08:00-11:00 am, which is a peak time for butterfly activities. Area around the lake was divided into four stations, East, West, North and South. Each station was surveyed in the three seasons multiple times. For the observations of the species transect of 1 km long and 5 m wide was followed. Butterflies were primarily identified directly in the field or, following photography. Study was carried out for one year. For identification of the species, book by Arun Pratap Singh was referred.

Statistical analysis

Species richness: Species richness was calculated by the equation:

$$D = \frac{S}{\sqrt{N}}$$

where, D is the species richness, S is the No. of individuals of a particular species and N is the total No. of the individuals.

Simpson's index (λ): It is a measure of dominance therefore (1-λ) measures species diversity:

$$\lambda = \Sigma n(n-1)/N(N-1)$$

where, n is the No. of individuals or amount of each species and N is the total No. of individuals for a site.

Shannon-Weiner index (H'): It measures both richness and abundance. It was calculated by the equation:

$$H' = -\Sigma[(n/N)]*\ln(n/N)]*$$

where, n is the No. of individuals or amount of each species and N is the total No. of individuals for a site and ln is natural log of the number.

Similarity index: Similarity index was calculated by following equation:

$$Sim = 2\Sigma nc/\Sigma n1+\Sigma n2$$

RESULTS

Butterfly diversity: Total twenty eight species of butterfly belonging to five different families were observed at Sawanga Vithoba lake area Most of the species were common. Two rare species were observed at this region. List of the species of butterfly at sawanga vithoba region is given in Table 1.

Documentation of butterfly species: At Sawanga Vithoba lake 10 species are very common, 14 species are common while 2 species are rare and 2 species are less common. Distribution of species of butterfly at four stations of Sawanga Vithoba lake was documented as in Table 1.

Family diversity of butterfly: It was observed that five families of butterfly reside at Sawanga Lake region. Ten species of family Nymphalidae, 9 species of family Pieridae, 4 species of family Hesperiidae, 3 species of family Lycaenidae and 2 species of family Papillionidae belonging to several genera are reported. Most of the butterfly species are common or very commonly found. But few rare species such as *Pelopidas conjuncta* which belongs to family Hesperiidae and *Papilio machaon* belonging to family Papillionidae are found. Diversity of families of butterfly at Sawanga Vithoba region is depicted in Fig. 1.

Seasonal variation in diversity of butterfly at Sawanga Vithoba lake area: Seasonal variation in distribution of butterfly species at four stations of Sawanga Vithoba Lake. In monsoon total number of species observed at the Sawanga Vithoba lake area was 28 with 351 individuals. In winter total number of species was 28 with 365 individuals while in summer total number of species was 19 with 181 individual. Few species of butterfly such as *Papilio machaon* (Linnaeus), *Parnara guttata* (Brener and Grey). *Cepora nerissa* (Fabricius), *Pieris brassicae* (Linnaeus), *Junonia almana* (Linnaeus), *Junonia lemonias* (Linnaeus), *Phalanta phalantha* (Drury) and *Acraea terpsicore* were not observed in summer.

Diversity indices for distribution of butterfly in monsoon: Diversity indices show that the distribution and diversity of butterfly at four stations of Sawanga Vithoba Lake area are in good range. Similarity index (J) in the range of 0.9 stating much similar species of butterfly at four stations of Sawanga Vithoba Lake area. Table 2 shows that all the four stations reside similar type of butterfly species. Various indices of butterfly diversity are shown in Table 2.

Diversity indices for distribution of butterfly in winter: Diversity indices show that the distribution and diversity of butterfly at four stations of Sawanga Vithoba Lake area are in good range. Similarity index (J) in the range of 0.9 stating much similar species of butterfly at four stations

Table 1: Documentation of butterfly species at Sawanga Vithoba lake region

Family and common name	Scientific name	Status
Nymphalidae		
Tawny Coster	*Acraea terpsicore* (Linnaeus)	VC
Plain Tiger	*Danaus chrysippus* (Linnaeus)	C
Blue Pansy	*Junonia orithya* (Linnaeus)	C
Peacock Pansy	*Junonia almana* (Linnaeus)	C
Lemon Pansy	*Junonia lemonias* (Linnaeus)	C
Common Leopard	*Phalanta phalantha* (Drury)	C
Glassy Tiger	*Parantica aglea* (Stoll)	C
Common Crow	*Euploea core* (Cramer)	VC
Blue Tiger	*Tirumala limniace* (Cramer)	LC
Great Eggfly	*Hypolimnas bolina* (Linnaeus)	C
Pieridae		
Large Cabbage White	*Pieris brassicae* (Linnaeus)	VC
Small Grass Yellow	*Eurema brigitta* (Cramer)	C
Common Emigrant	*Catopsilia pomona* (Fabricius)	VC
Mottled Emigrant	*Catopsilia pyranthe* (Linnaeus)	LC
Common Gull	*Cepora nerissa* (Fabricius)	VC
Common Jezebel	*Delias eucharis* (Drury)	VC
Pioneer	*Belenois aurota* (Fabricius)	VC
Three-Spot Grass Yellow	*Eurema blanda* (Boisduval)	C
Common Grass Yellow	*Eurema hecabe* (Linnaeus)	VC
Hesperiidae		
Conjoined Swift	*Pelopidas conjuncta* (Herrich-Schaffer)	R
Straight Swift	*Parnara guttata* (Brener and Grey)	C
Rice Swift	*Borbo cinnara* (Wallace)	C
Beavan's Swift	*Pseudoborbo bevani* (Moore)	C
Lycaenidae		
Forget-Me-Not	*Catochrysops strabo* (Fabricius)	C
Gram Blue	*Euchrysops cnejus* (Fabricius)	C
Pale Grass Blue	*Pseudozizeeria maha* (Kollar)	VC
Papillionidae		
Common Yellow Swallowtail	*Papilio machaon* (Linnaeus)	R
Common Mormon	*Papilio polytes* (Linnaeus)	VC

VC: Very common, C: Common, R: Rare, LC: Locally common

Table 2: Diversity indices for butterfly diversity and distribution at four stations of Sawanga Vithoba Lake area in rainy season

	Stations			
Index	East	West	North	South
Shannon H' Log Base 10	1.371	1.323	1.343	1.366
Shannon Hmax Log Base 10	1.447	1.431	1.431	1.431
Shannon J'	0.947	0.924	0.939	0.954
Simpsons Diversity (D)	0.039	0.046	0.043	0.039
Simpsons Diversity (1/D)	25.661	21.706	23.341	25.922

of Sawanga Vithoba Lake area. Table 3 shows that all the four stations reside similar type of butterfly species. Various indices of butterfly diversity are shown in Table 3.

Species *Junonia almana* (Linnaeus), *Junonia lemonias* (Linnaeus), *Phalanta phalanta* (Drury), *Parantica aglea* (Stoll), *Acraea terpsicore* (Fabricius) *Pieris brassicae Cepora nerissa* (Fabricius) *Parnara guttata* (Brener and Grey) *Papilio machaon* (Linnaeus) were not observed in summer. Most of the species were less in number. Few species such as *Catochrysops strabo* (Fabricius) (20 in number) *Euchrysops cnejus* (Fabricius) (21 in number) *Pseudozizeeria maha* (Kollar) (24 in number) were noticeable.

Diversity indices for butterfly in summer: Diversity indices show that the distribution and diversity of butterfly at four stations of Sawanga Vithoba Lake area is less as compared to winter and monsoon. Similarity index (J) in the range of 0.9 stating much similar species of butterfly at four stations of Sawanga Vithoba Lake area.

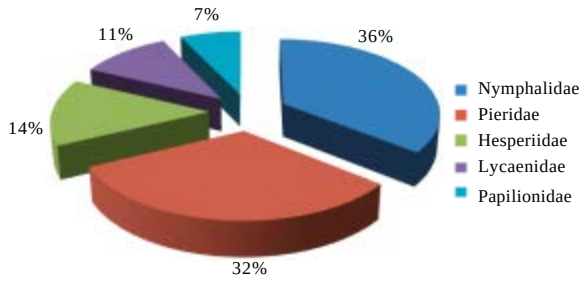

Fig. 1: Distribution of butterfly families at Sawanga Vithoba Lake area

Table 3: Diversity indices for butterfly diversity and distribution at four stations of Sawanga Vithoba Lake area in winter

	Stations			
Index	East	West	North	South
Shannon H' Log Base 10	1.368	1.337	1.394	1.319
Shannon Hmax Log Base 10	1.447	1.431	1.447	1.415
Shannon J'	0.945	0.934	0.963	0.932
Simpsons Diversity (D)	0.040	0.044	0.033	0.046
Simpsons Diversity (1/D)	25.193	22.504	30.385	21.902

Table 4: Diversity indices for butterfly diversity and distribution at four stations of Sawanga Vithoba Lake area in summer

	Stations			
Index	East	West	North	South
Shannon H' Log Base 10	1.181	1.190	1.172	1.105
Shannon Hmax Log Base 10	1.279	1.279	1.230	1.204
Shannon J'	0.924	0.931	0.952	0.917
Simpsons Diversity (D)	0.062	0.056	0.053	0.069
Simpsons Diversity (1/D)	16.139	17.754	18.813	14.478

Table 4 shows that all the four stations reside similar type of butterfly species. Various indices of butterfly diversity are shown in Table 4.

DISCUSSION

Butterfly species composition: A total of 28 species representing from 5 families were recorded from the multiple transect area (Table 5). Nymphalidae was the dominant family with 10 species, followed by Pieridae (9), Hesperiidae (4), Lycaenidae (3) and Papilionidae (2).

The species such as *Acraea terpsicore* (Linnaeus), *Danaus chrysippus* (Linnaeus), *Junonia orithya* (Linnaeus), *Euploea core* (Cramer), *Tirumala limniace* (Cramer), *Hypolimnas bolina* (Linnaeus), *Eurema brigitta* (Cramer), *Catopsilia pomona* (Fabricius), *Catopsilia pyranthe* (Linnaeus), *Delias eucharis* (Drury), *Belenois aurota* (Fabricius), *Eurema blanda* (Boisduval), *Pelopidas conjuncta* (Herrich-Schaffer), *Borbo cinnara* (Wallace), *Pseudoborbo bevani* (Moore), *Catochrysops strabo* (Fabricius), *Euchrysops cnejus* (Fabricius), *Pseudozizeeria maha* (Kollar), *Eurema hecabe* (Linnaeus), *Papilio polytes* (Linnaeus) were recorded throughout the year.

Habitat preference and species distribution: Butterflies are sensitive to the changes in the habitat and climate which influence their distribution and abundance (Wynter-Blyth, 1957). Analysis of the status showed that at Sawanga Vithoba lake 10 species, *Acraea terpsicore* (Linnaeus), *Euploea core* (Cramer), *Pieris brassicae* (Linnaeus), *Catopsilia pomona* (Fabricius), *Cepora nerissa* (Fabricius), *Delias eucharis* (Drury), *Belenois aurota* (Fabricius), *Pseudozizeeria maha* (Kollar), *Eurema hecabe* (Linnaeus) and *Papilio polytes* (Linnaeus) are very common, 14 species *Danaus chrysippus* (Linnaeus), *Junonia orithya* (Linnaeus), *Junonia almana* (Linnaeus), *Junonia lemonias* (Linnaeus), *Phalanta phalantha* (Drury), *Parantica aglea* (Stoll), *Hypolimnas bolina* (Linnaeus), *Eurema brigitta* (Cramer), *Eurema blanda* (Boisduval), *Parnara guttata* (Brener and Grey), *Borbo cinnara* (Wallace), *Pseudoborbo bevani* (Moore), *Catochrysops strabo* (Fabricius), *Euchrysops cnejus* (Fabricius) are common while 2 species *Papilio machaon* (Linnaeus) and *Pelopidas conjuncta* (Herrich-Schaffer) are rare and 2 species *Tirumala limniace* (Cramer), *Catopsilia pyranthe* (Linnaeus) are less common. Distribution of species of butterfly at four stations of Sawanga Vithoba lake was documented as in Table 1. Pattern of species distribution of butterfly at Sawanga Vithoba Lake area in monsoon, winter and summer is shown in Fig. 2-4, respectively.

Distributions of butterfly in different seasons at study area were assessed and result revealed that 100% were randomly distributed in monsoon, 93% were randomly distributed and 7% were aggregated in winter and 95% were randomly distributed and 5% were aggregated in summer. The aggregated distribution indicated the season preference where random distribution indicates the available resource use and suitability of season to survival (Table 6-8).

This species showing typically territorial behavior of males and many features of the steno topic K-selection strategy, can safely survive dry seasons in relatively humid groves of forests or clumps of the trees near stream area (Spitzer, 1982). In dry season, some species are often endangered in open area by birds feed and some other human factors.

Seasonality and status: In the present study, the number of butterfly encountered during monsoon were 351, which increased to 365 species in winter and it were only 181 during species in summer. However some species were recorded throughout the year.

Table 5: Seasonal variation in butterfly species richness at Sawanga Vithoba Lake area

	Species richness in season		
Family and scientific name	Rainy season	Winter	Summer
Nymphalidae			
Acraea terpsicore (Linnaeus)	0.37	0.20	0.00
Danaus chrysippus (Linnaeus)	1.01	0.157	0.66
Junonia orithya (Linnaeus)	0.48	0.47	0.44
Junonia almana (Linnaeus)	0.37	0.36	0.00
Junonia lemonias (Linnaeus)	0.32	0.36	0.00
Phalanta phalantha (Drury)	0.37	0.47	0.00
Parantica aglea (Stoll)	1.01	0.73	0.00
Euploea core (Cramer)	0.48	0.47	0.22
Tirumala limniace (Cramer)	0.58	0.52	0.22
Hypolimnas bolina (Linnaeus)	1.12	0.41	0.59
Pieridae			
Pieris brassicae (Linnaeus)	0.01	0.10	0.00
Eurema brigitta (Cramer)	1.06	0.47	1.11
Catopsilia pomona (Fabricius)	0.69	0.99	0.37
Catopsilia pyranthe (Linnaeus)	0.53	0.99	0.14
Cepora nerissa (Fabricius)	0.53	0.73	0.00
Delias eucharis (Drury)	0.42	0.62	0.22
Belenois anrota (Fabricius)	0.32	0.52	0.74
Eurema blanda (Boisduval)	1.17	0.57	0.59
Hesperiidae			
Pelopidas conjuncta (Herrich-Schaffer)	0.10	0.41	0.59
Parnara guttata (Brener and Grey)	0.32	0.31	0.00
Borbo cinnara (Wallace)	0.58	0.47	0.66
Pseudoborbo bevani (Moore)	0.32	0.52	0.44
Lycaenidae			
Catochrysops strabo (Fabricius)	1.38	1.51	1.48
Euchrysops cnejus (Fabricius)	0.69	0.83	1.56
Pseudozizeeria maha (Kollar)	1.70	1.30	1.78
Papillionidae			
Papilio machaon (Linnaeus)	0.48	0.26	0.00
Eurema hecabe (Linnaeus)	1.60	1.51	1.18
Papilio polytes (Linnaeus)	0.42	0.31	0.37

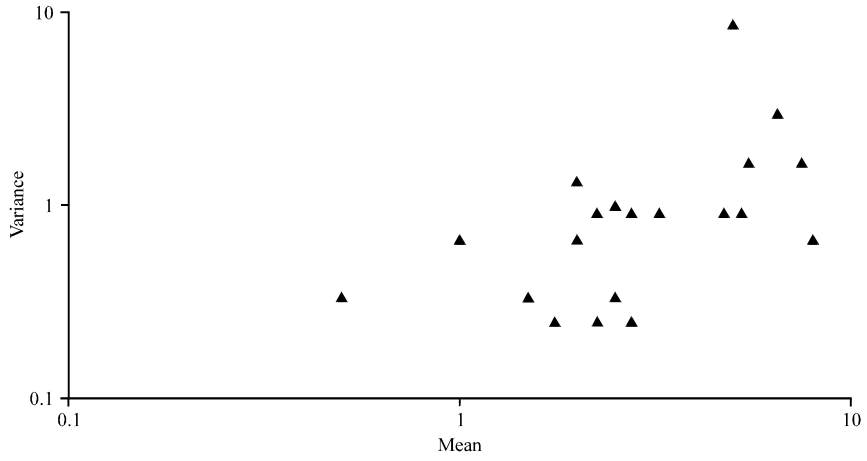

Fig. 2: Pattern of species distribution of butterfly at Sawanga Vithoba Lake area in monsoon

In monsoon 28 species of butterfly were identified while in winter and summer 27 and 19 species were identified respectively. Good number of vegetation of ground herbs and flowering plants makes the conditions ideal for butterfly feeding and roaming in this area. Butterfly is often observed in moist-deciduous, semi-evergreen and secondary evergreen forests mostly at the openings in the canopy where sunlight reach the ground vegetation.

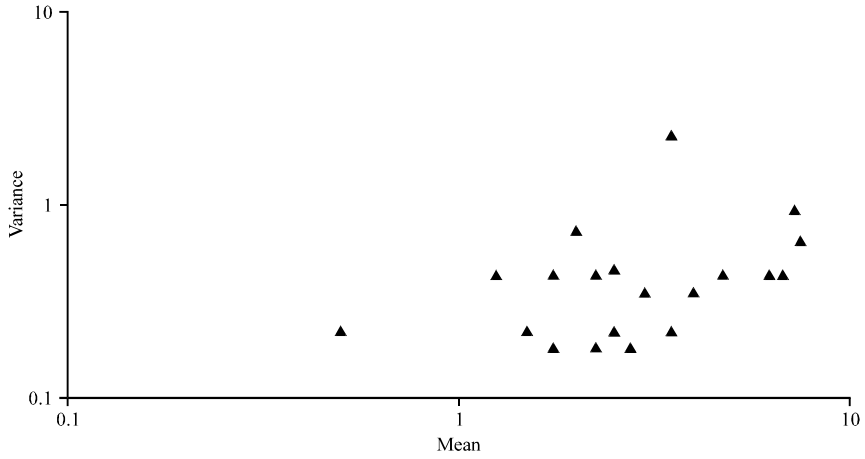

Fig. 3: Pattern of species distribution of butterfly at Sawanga Vithoba Lake area in winter

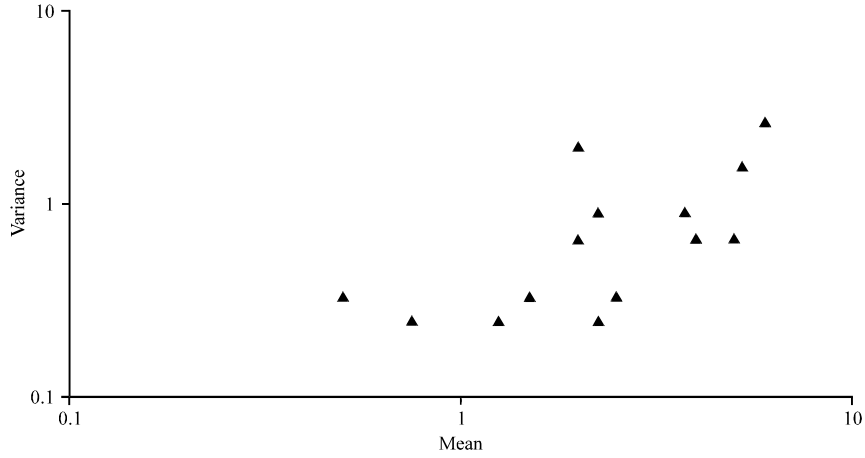

Fig. 4: Pattern of species distribution of butterfly at Sawanga Vithoba Lake area in summer

In monsoon lots of rain over there and much amount of humidity were present in that area with good vegetation of ground herbs and flower plants. This ideal condition of environment attracts the butterfly for feeding and roaming in this area. So in monsoon there was higher number of species found. Observation of individual species was higher so variance is higher and interprets very closely (Table 6).

In winter there was good green vegetation and favorable climate condition so species were more frequent compared to the summer but the density of individual species was very less compared to the monsoon (Table 7-8).

Butterflies: Are common for only a few months and rare or absent in other parts of the year (Kunte, 2000). Table 5 represents seasonal variation in species richness of different families observed during study.

Species diversity and abundance pattern: Shannon, Simpson and Hills diversity indices were calculated for three different seasons. The Shannon diversity index indicated that winter is relatively diverse (1.355) followed by monsoon (1.350) and summer (1.162) (Table 2-4). Species were also ranked according to their abundance.

Insects are extremely important components of the bioindicators of the world (Chakaravarthy *et al*., 1997; Jana *et al*., 2009). In India work on butterfly studies was reported in Century (Wood-Mason and De-Niceville, 1887; Gaonkar, 1996a). Many scientists have worked on butterfly in different parts of the India (Fergusson, 1891; Gaonkar, 1996b; Larsen, 1989; Mathew *et al*., 2000; Sudheendrakumar *et al*., 2000; Roy *et al*., 2010). Indian butterflies forms one fifth of the world's butterfly species (Kunte, 2000). About 1501 species of butterflies has been recorded from the India (Gaonkar, 1996a). Peninsular region of India resides about 350, Western Ghats hosts

Table 6: Species distribution of butterfly at Sawanga Vithoba Lake area in monsoon

Species	Variance	Mean	Chi-square	d.f	Probability	Aggregation
Acraea terpsicore (Linnaeus)	0.25	1.75	0.4286	3	0.9335119	Random
Danaus chrysippus (Linnaeus)	0.9167	4.75	0.5789	3	0.9012883	Random
Junonia orithya (Linnaeus)	0.25	2.25	0.3333	3	0.9525772	Random
Junonia almana (Linnaeus)	0.25	1.75	0.4286	3	0.9335119	Random
Junonia lemonias (Linnaeus)	0.3333	1.5	0.6667	3	0.881643	Random
Phalanta phalantha (Drury)	0.25	1.75	0.4286	3	0.9335119	Random
Parantica aglea (Stoll)	0.9167	4.75	0.5789	3	0.9012883	Random
Euploea core (Cramer)	0.25	2.25	0.3333	3	0.9525772	Random
Tirumala limniace (Cramer)	0.25	2.75	0.2727	3	0.9639589	Random
Hypolimnas bolina (Linnaeus)	0.9167	5.25	0.5238	3	0.9133492	Random
Pieris brassicae (Linnaeus)	0.6667	1	2	3	0.5762582	Random
Eurema brigitta (Cramer)	8.6667	5	5.2	3	0.1558781	Random
Catopsilia pomona (Fabricius)	0.9167	3.25	0.8462	3	0.840213	Random
Catopsilia pyranthe (Linnaeus)	1	2.5	1.2	3	0.756582	Random
Cepora nerissa (Fabricius)	0.3333	2.5	0.4	3	0.9393621	Random
Delias eucharis (Drury)	0.6667	2	1	3	0.8039588	Random
Belenois anrota (Fabricius)	0.3333	1.5	0.6667	3	0.881643	Random
Eurema blanda (Boisduval)	1.6667	5.5	0.9091	3	0.8254327	Random
Pelopidas conjuncta (Herrich-Schaffer)	0.3333	0.5	2	3	0.5762582	Random
Parnara guttata (Brener and Grey)	0.3333	1.5	0.6667	3	0.881643	Random
Borbo cinnara (Wallace)	0.3333	1.5	0.6667	3	0.881643	Random
Pseudoborbo bevani (Moore)	0.9167	2.75	1	3	0.8039588	Random
Catochrysops strabo (Fabricius)	3	6.5	1.3846	3	0.7132055	Random
Euchrysops cnejus (Fabricius)	0.9167	3.25	0.8462	3	0.840213	Random
Pseudozizeeria maha (Kollar)	0.6667	8	0.25	3	0.9680411	Random
Papilio machaon (Linnaeus)	0.9167	2.25	1.2222	3	0.7513317	Random
Eurema hecabe (Linnaeus)	1.6667	7.5	0.6667	3	0.881643	Random
Papilio polytes (Linnaeus)	1.3333	2	2	3	0.5762582	Random

Table 7: Species distribution of butterfly at Sawanga Vithoba Lake area in winter

Species	Variance	Mean	Chi-square	d.f	Probability	Aggregation
Acraea terpsicore (Linnaeus)	0	1	0	3	0	Aggregated
Danaus chrysippus (Linnaeus)	1.6667	7.5	0.6667	3	0.881643	Random
Junonia orithya (Linnaeus)	0.25	2.25	0.3333	3	0.9525772	Random
Junonia almana (Linnaeus)	0.25	1.75	0.4286	3	0.9335119	Random
Junonia lemonias (Linnaeus)	0.9167	1.75	1.5714	3	0.6701409	Random
Phalanta phalantha (Drury)	0.25	2.25	0.3333	3	0.9525772	Random
Parantica aglea (Stoll)	11	3.5	9.4286	3	0.0238569	Aggregated
Euploea core (Cramer)	0.9167	2.25	1.2222	3	0.7513317	Random
Tirumala limniace (Cramer)	1	2.5	1.2	3	0.756582	Random
Hypolimnas bolina (Linnaeus)	0.9167	6.75	0.4074	3	0.9378552	Random
Pieris brassicae (Linnaeus)	0.3333	0.5	2	3	0.5762582	Random
Eurema brigitta (Cramer)	0.25	2.25	0.3333	3	0.9525772	Random
Catopsilia pomona (Fabricius)	0.9167	4.75	0.5789	3	0.9012883	Random
Catopsilia pyranthe (Linnaeus)	0.9167	4.75	0.5789	3	0.9012883	Random
Cepora nerissa (Fabricius)	0.3333	3.5	0.2857	3	0.9615778	Random
Delias eucharis (Drury)	0.6667	3	0.6667	3	0.881643	Random
Belenois anrota (Fabricius)	0.3333	2.5	0.4	3	0.9393621	Random
Eurema blanda (Boisduval)	0.25	2.75	0.2727	3	0.9639589	Random
Pelopidas conjuncta (Herrich-Schaffer)	2	2	3	3	0.3927475	Random
Parnara guttata (Brener and Grey)	0.3333	1.5	0.6667	3	0.881643	Random
Borbo cinnara (Wallace)	0.25	2.25	0.3333	3	0.9525772	Random
Pseudoborbo bevani (Moore)	0.3333	2.5	0.4	3	0.9393621	Random
Catochrysops strabo (Fabricius)	2.9167	7.25	1.2069	3	0.754952	Random
Euchrysops cnejus (Fabricius)	0.6667	4	0.5	3	0.9184757	Random
Pseudozizeeria maha (Kollar)	0.9167	6.25	0.44	3	0.9311438	Random
Papilio machaon (Linnaeus)	0.9167	1.25	2.2	3	0.5353473	Random
Eurema hecabe (Linnaeus)	2.9167	7.25	1.2069	3	0.754952	Random
Papilio polytes (Linnaeus)	0.3333	1.5	0.6667	3	0.881643	Random

around 331 species and 313 species are reported in South India (Gaonkar, 1996b), of which 42 species are endemic to South India.

Availability of wide range of altitudinal gradients, microclimatic regimes, diverse habitats makes southern part of the peninsular India rich and diverse than the other parts. There are reports of migration of butterfly in India (Williams, 1938; Bharos, 2000; Palot *et al*., 2002). Butterflies are important plant pollinators and can pollinate about 50 economically important plant crops (Borges *et al*., 2003). Species diversity and composition of flora and fauna is greatly affected by the several manmade

Table 8: Probability of detection and abundance of species of butterfly at Sawanga Vithoba Lake area in summer

Species	Variance	Mean	Chi-square	d.f	Probability	Aggregation
Danaus chrysippus (Liunaeus)	0.9167	2.25	1.2222	3	0.7513317	Random
Junonia orithya (Linnaeus)	0.3333	1.5	0.6667	3	0.881643	Random
Euploea core (Cramer)	0.25	0.75	1	3	0.8039588	Random
Tirumala limniace (Cramer)	0.25	0.75	1	3	0.8039588	Random
Hypolimnas bolina (Liunaeus)	0.6667	2	1	3	0.8039588	Random
Eurema brigita (Cramer)	0.9167	3.75	0.7333	3	0.8664132	Random
Catopsilia pomona (Fabricius)	0.25	1.25	0.6	3	0.8966206	Random
Catopsilia pyranthe (Linnaeus)	0.3333	0.5	2	3	0.5762582	Random
Delias eucharis (Drury)	0.25	0.75	1	3	0.8039588	Random
Belenois anrota (Fabricius)	0.3333	2.5	0.4	3	0.9393621	Random
Eurema blanda (Boisduval)	0	2	0	3	0	Aggregated
Pelopidas conjuncta (Herrich-Schaffer)	2	2	3	3	0.3927475	Random
Borbo cinnara (Wallace)	0.25	2.25	0.3333	3	0.9525772	Random
Pseudoborbo bevani (Moore)	0.3333	1.5	0.6667	3	0.881643	Random
Catochrysops strabo (Fabricius)	0.6667	5	0.4	3	0.9393621	Random
Euchrysops cnejus (Fabricius)	1.5833	5.25	0.9048	3	0.8264521	Random
Pseudozizeeria maha (Kollar)	2.6667	6	1.3333	3	0.7251902	Random
Eurema hecabe (Liunaeus)	0.6667	4	0.5	3	0.9184757	Random
Papilio polytes (Linnaeus)	0.25	1.25	0.6	3	0.8966206	Random

factors in India. Rich and diverse insect fauna is found in the tropical region but the information on the insects in natural and man made habitats are very poor, especially for the Indian region.

CONCLUSION

Total twenty eight species of butterfly belonging to five families are observed at Sawanga Vithoba lake. Most of the species were common. Two rare species were observed.

Butterfly exhibits seasonal variation in distribution of butterfly species at four stations of Sawanga Vithoba lake. In monsoon total number of species was more than in winter and summer. Few species of butterfly such as *Papilio machaon* (Linnaeus), *Parnara guttata* (Brener and Grey). *Cepora nerissa* (Fabricius), *Pieris brassicae* (Linnaeus), *Junonia almana* (Linnaeus), *Junonia lemonias* (Linnaeus) *Phalanta phalanta* (Drury) and *Acraea terpsicore* were not observed in summer.

Similarity index states much similar species of butterfly at four stations of Sawanga Vithoba Lake area.

Species richness of few species such as *Catochrysops strabo* (RS-1.38, W-1.51, S-1.48), *Eurema hecabe* (Linnaeus) (RS-1.60, W-1.51, S-1.18), *Pseudozizeeria maha* (Kollar) (RS-1.70, W-1.30, S-1.78) is higher in all the seasons.

Family Nymphalidae is the most represented family at Sawanga Vithoba lake region district Amravati.

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