BUTTERFLY POPULATION DECLINE – IMPACT OF MICROCLIMATIC CHANGE

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Abstract - The present study focuses on population trend in Pieridae (Whites and yellows) butterflies at Bishop Heber College,Tiruchirappalli, India. The study was carried out during wet and cold season for two periods i.e. from [December 2009 to February 2010 (period1) and again in December 2015 to February 2016 (period2)] by following point count method. 6 species of pieridae (whites and yellows) butterflies were recorded during the study periods. The study revealed that there were significant decline in population of five species except Dark wanderer during the study. The collected data were analyzed and interpreted. The research signifies the impact of microclimatic change including excess rainfall, relative humidity and temperature rise and inappropriate management practices has led to decrease in butterfly population in period 2 when compared to period 1. Sustainable management practices are suggested.

Keywords - Pieridae butterflies, whites and yellows, population

I. INTRODUCTION

Butterflies are an ideal group for studying the effects of climate change because, their life-cycle, activity, distribution and abundance are influenced by temperature and are sensitive to micro climatic changes (Pollard 1988, Carlton et al. 2016).They are recognized as useful indicators, both for their rapid and sensitive responses to subtle habitat or climatic changes (UKBMS 2006). They are extremely sensitive to changes in temperature, humidity, and light levels, which are typically the results of habitat disturbance (Sparrow et al. 1994; Spitzer et al. 1997). They have strong associations with weather, rainfall and population fluctuations (Murphy and Weiss 1988, Roy et al., 2008). Thus the invertebrate population dynamics are influenced by environmental stochasticity (Larsson et al. 2000). As the constancy in environmental conditions is important to the perseverance of butterfly populations (Murphy and Weiss 1988), they are capable of providing a continuous assessment of changes in the environment over a wide range of stresses. Though butterflies are being monitored since mid 1970's in the UK (Pollard et al. 1975) in India studies are rather limited (Kishen Das, 2010). Ramesh et al. (2013), have monitored Population Dynamics and Migration of Butterflies in Coastal Plains of Kalpakkam, Southern India. The population trend and pattern of seasonal migration of Danauschrysippus at Tiruchirappalli had been studied by Daisy et al. (2016). Similar comparative studies had been made by Carlton et al. (2016). Butterflies are much easier to observe and take less time to survey than other indicators. Monitoring butterflies are relatively cost effective as minimal equipment and man-power is required to monitor them (Nowicki, 2013). Bishop Heber College, located at Tiruchirappalli, India is a significant spot for butterflies in terms of longitudinal (east-west) butterfly migration (Daisy et al. 2013). The present study would update with the understanding of the current trend of butterfly populations focusing on Pieridae (whites and yellows) family in wet and cold season of two different years 2009-2010 (period 1) and2015 – 2016 (period 2) and factors affecting it. It further enables to understand if the butterfly population had been affected by micro environmental changes and vice versa – if the environmental changes have affected butterfly population; the survey ensures to propose measures of conservation.

II. OBJECTIVES OF THE STUDY

1. To compare the population trend of butterflies of Pieridae (whites and yellows) family during wet and cold season in two years 2009–2010 and 2015 -2016.
2. To find the relationship between population and microclimatic factors including rainfall, temperature, Relative Humidity and wind speed.
3. To detect the factors effecting the population trend

III. METHODOLOGY

3.1 The Study Area

Bishop Heber College located at N10°48'51.5", E078°40'33.09 is in Tiruchirappalli in the tropics of Southern India. It is a small 25 acres campus beautified with about 55 species of trees and 116 species of other native and introduced plants which attract about 60 species of birds, 78 species of butterflies among other insects and arachnids. Most of the plants are ornamental and managed.

3.2 The Study Period

The study was carried out in two wet and cold seasons of 2009 and 2015. It included the months of

December 2009 to February 2010 (period 1) and December 2015 to February 2016 (period 2). From here onwards the study periods are referred as period 1 and period 2 respectively.

3.3 The Method

The present study was conducted by point count method (Pollard et al., 1975) counting the butterflies from 10.00hrs to 11.20 hrs. The locations were selected on random basis totaling to four sampling sites counting for 20 minutes at each site. Counting was done once a week wet and cold starting in December through February in 2009-10 (period 1) and 2015-16(period 2).

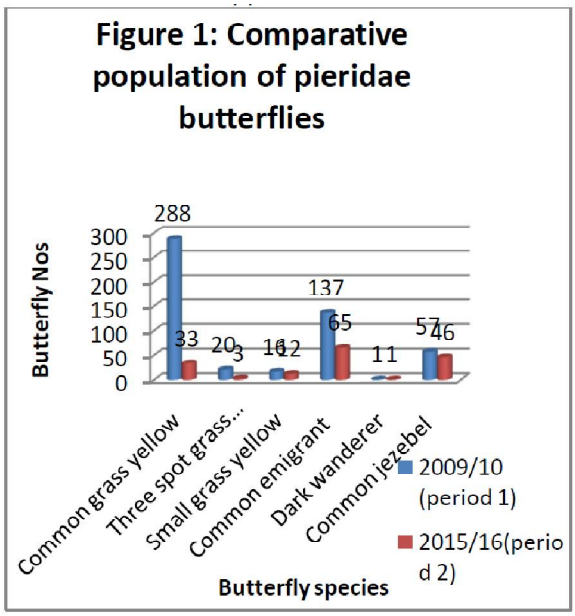
IV. RESULTS & ANALYSIS

Six species of pieriidae (whites and yellows) were recorded during the study periods. (Table 1) All the 6 species of the whites and yellows recorded in 2009-10 (period 1) have been recorded in 2015-16 (period 2). It can be inferred that the food plants and nectar plants and micro climate including temperature, weather, rainfall, relative humidity and wind speed are in favorable conditions or nearly favorable conditions. However, all the butterflies were significantly lesser in number in period 2 except dark wanderer which had no change (figure 1). This shows that there were significant changes in some of these factors. Listed below are the 6 species of pieridae (whites and yellows) recorded in the study area during period 1 and period 2.

Table 1
List of pieriidae butterflies in the two periods

#	Common name	Scientific name
1.	Common grass yellow	*Euremahecabe*
2.	Three spot grass yellow	*Euremablanda*
3.	Small grass yellow	*Euremabrigitta*
4.	Common emigrant	*Catopsilia Pomona*
5.	Dark wanderer	*Pareroniaceylanica*
6.	Common jezebel	*Delias eucharis*

The most common among the six species recorded was common grass yellow and common emigrant and the least common was Dark wanderer in both the study periods. The other species like three spot grass yellow, small grass yellow and common jezebel were moderately recorded. It is inferred that the trend of butterfly populations of different species of pieriidae are similar in the two study periods 1 and 2. The figure 1 above shows the population of pieridae butterflies in period 1 and period 2.



Further the total population of the whites and yellows (pieridae), showed a decreasing trend from 2009-2010 (584) to 2015-16 (140). Statistical analysis authenticates that the decrease is significant. This could be associated with the change in environmental conditions including weather, temperature and rainfall and microhabitat (Weiss et al. 1988; Sparrow et al. 1994; and Spitzer et al. 1997).

To find the impacting factors, the population of the pieriids was compared with the microclimatic factors including temperature, Relative Humidity, wind speed and rainfall. There is a highly significant inverse correlation between the population of the pieriids and temperature (Table 2). In the period 1, the average temperature ranged from 24.5 ^{O} C to 30 ^{O} C whereas in the period 2 it ranged from 24.0 ^{O} C to 34 ^{O} C. The maximum temperature in period 2 was approximately 4 ^{O} C higher than the period 1 (Table 3). This means there is raise in local temperature. It confirms that the increased temperature has played a vital role in decreasing the population. A similar result obtained by Carlton et al. (2016) confirms the role of increased temperature affecting the butterfly population. A similar study by However Roy et al. 2001 obtained positive associations between weather and population. This could be because the study was done in temperate region where the study had been done and butterflies benefitted more in warm weather. Since the present study was conducted in a tropical region, the higher temperature had negatively affected the population. Further analysis shows that temperature is not the only contributing factor for population change. One other reason for the decrease in abundance is the weather conditions. On rainy days they were typically less (first and second week). Further the Relative humidity was higher on first and second week. Hence we assume that the temperature and Relative humidity (also influenced by rain)

together play a role in the abundance of butterflies (Table 2 &3).

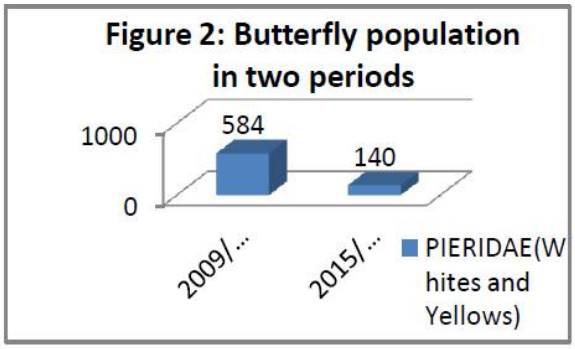
Table 2: Microclimatic conditions and butterfly populations during period 1				
Period 1				
Date	Temp ^{o}C	RH %	Weather	Nos
06.12.2009	29	56	Sunny	100
13.12.2009	28	80	Sunny	74
20.12.2009	30	70	Sunny	97
03.1.2010	26.4	71	Sunny	43
10.1.2010	24.5	76	Sunny	43
17.1.2010	29	64	Sunny	68
24.1.2010	29	68	Sunny	60
31.1.2010	30	60	Sunny	48
07.2.2010	28	62	Sunny	51

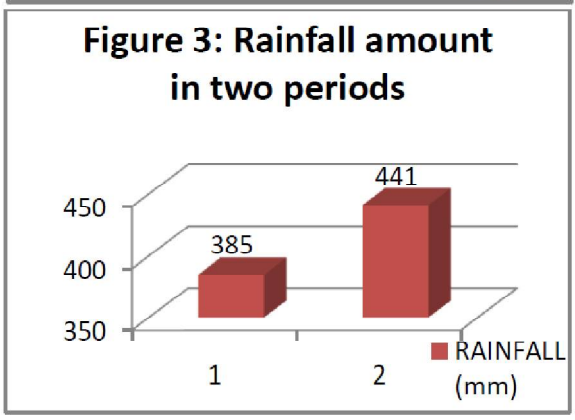
Table 3: Microclimatic conditions and butterfly populations during period 2				
Period 2				
Date	Temp ^{o}C	RH%	Weather	Nos
04.12.2015	24	81	rain &drizzle	-
17.12.2015	29.3	89.5	rain & sunny	-
23.12.2015	28	72	sunny	3
04.1.2016	32.5	60.2	cloudy	11
11.1.2016	32	69	sunny	18
18.1.2016	34	71	Sunny	26
25.1.2016	31	66	Sunny	27
1.2.2016	32	71	sunny	27
08.2.2016	34	71	Sunny	28

The Relative Humidity (RH) in the period 1 ranged from 56% to 80% and in the period 2 it ranged 60.2% to 89.5%. The minimum RH was 4% higher and Maximum RH is 9.5% higher in the period 2. It can be assumed that the RH raise has also influenced the butterfly population as similar to the temperature effect. However here is no consistency in the Relative humidity difference in the corresponding weeks.

Table 4: Wind speed during period 1&2			
Period 1(Wind speed)		Period 2(Wind speed)	
Date	kmph	Date	Kmph
06.12.2009	2.3	04.12.2015	1.1
13.12.2009	4.3	17.12.2015	1.1
20.12.2009	1.5	23.12.2015	1.1
03.1.2010	2.4	04.1.2016	2.0
10.1.2010	3.0	11.1.2016	2.2
17.1.2010	2.6	18.1.2016	2.5
24.1.2010	3.0	25.2.2016	1.5
07.2.2010	3.5	08.2.2016	1.2

The average wind speed during the period 1 ranged from 1.5 to 4.3 mph while in the period 2 it ranged from 1.1 to 2.5 mph (Table 4). Except for one week of the period 1, all the other weeks showed higher wind speed compared to the period 2. Ozden and Hodgson (2010) state that the wind speed has no effect on butterfly abundance. The reason could be that the wind speed may not be sufficient enough to change the population or direction of the flight as such to impact migration or local butterfly population.





The figures 2 and 3 depict that the butterfly population is inversely correlated with rainfall. The rainfall in the period 1 was normal (385). Hence the butterfly population is high. But in period 2 the rainfall was excess than normal (441). The excess rainfall also could have impacted the population. As mentioned earlier the plants are not naturally grown but managed by mowing, pruning and using more fertilizers and pesticides. As these activities affect the butterflies by way of host and nectar plants the population has much reduced.

CONCLUSION

The analysis of population of butterflies of family pieriidae over two periods 2009-10 and 2015-16 reveals that the populations have declined. The microclimatic change including excess rainfall, relative humidity and temperature rise and inappropriate gardening practices have resulted in the decline in population. Inappropriate gardening strategies added to the problem. The results caution us to take measures from further deterioration of the

environment. Habitat management is essential in maintaining butterfly populations (Warren, 1987). Eco friendly gardening techniques including usage of bio fertilizers and bio pesticides need to be implemented. Pruning of the plants may be done not all at a time but alternatively leaving temporal and spatial intervals. This would ensure the abundance of butterflies - the environmental indicators and for the sustenance of the biodiversity.

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