COMPARATIVE ANALYSIS OF BUTTERFLY POPULATIONS IN TWO PERIODS

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Abstract— The present study focuses on population trend in papilionidae (swallowtail) butterflies at Bishop Heber College. The study was carried out post monsoon from December 2009 to February 2010 (period1) and again in December 2015 to February 2016 (period2) following point count method. During both the study periods 6 species of swallowtail (Papilionidae) butterflies were recorded. The comparative study revealed that there were significant decline in population of all the six species of butterflies in 2015-16 period when compared to 2009-10. The collected data were analyzed using statistical package for social sciences (SPSS). It revealed that there is change in climatic factors like temperature, Relative Humidity, Rainfall & Wind speed between the two periods. There is significant correlation between butterfly population & Temperature, RH & wind speed. Inappropriate management practices of the campus would have also impacted the population. The research signifies the impact of environmental change and initiation of appropriate management practices.

Keywords— Papilionidae Butterflies, Population, Microclimate, Temperature, Relative Humidity, Wind Speed.

I. INTRODUCTION

Butterflies 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 are also affected by rainfall patterns and local microclimates (Murphy and Weiss 1988). Thus the invertebrate population dynamics are influenced by environmental stochasticity (Larsson et al. 2000). As the consistency in environmental conditions is important to the persistence 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. Monitoring butterfly abundance and diversity to detect changes in the environment has been initiated in the mid 1970's in the UK (Pollard et al. 1975). Nevertheless studies in India 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 *Danaus chrysippus* (plain tiger) at Tiruchirappalli had been done by Daisy et al. (2016)
Monitoring butterflies are cost effective. Minimal equipment and man-power is required to monitor butterflies (Nowicki, 2013). Researchers have found that butterflies are much easier to observe and take less time to survey than other indicators.
Bishop Heber College located at N10°48'51.5", E078°40'33.09 is a significant spot for butterflies in terms of longitudinal butterfly migration. Hence this study would enlighten with the knowledge of the current trend of butterfly populations in post monsoons of two different years 2008-2009 and 2015 – 2016 and factors affecting it. It further enables to understand if the butterfly population has been affected by environmental changes and vice versa – if the environmental changes have affected butterfly population; it thus facilitates to propose measures and reclaim the best possible sustainable environment.

II. OBJECTIVES OF THE STUDY

1. To compare the population trend of butterflies of Papilionaceae (swallow tails) family during post monsoon 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°40'33.09in Tiruchirappalli in the tropics of Southern India is a small campus of 25 acres beautified with about 55 species of trees and 116 species of other native and introduced plants which attract about 9 species of mammals, 62 species of birds, 15 species of reptiles, 7 species of amphibians and 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 post monsoon seasons of 2009 and 2015. It covered the months of December 2009 to February 2010 and December 2015 to February 2016. From here onwards it is 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 and counting for 20 minutes at each site. Counting was done once a week post monsoon starting in December through February in 2009-10 and 2015-16.

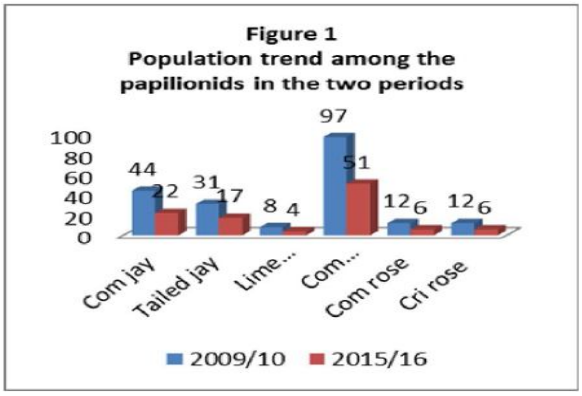
IV. RESULTS & ANALYSIS

Six species of swallow tails were recorded during the study periods. (Table 1) All the 6 species of the swallow tails recorded in 2009-10 (period 1) have been recorded in 2015-16. However all the butterflies are significantly lesser in number in 2015 – 16 (period 2). However their relative number among six species in the two years is similar. That is the trend of population among the different species is similar. The most common among the seven species is Common mormon and the least common is Lime butterfly in both the study periods. Common rose and crimson rose are less in number while common jay and tailed jay are moderate in number (Table 2).

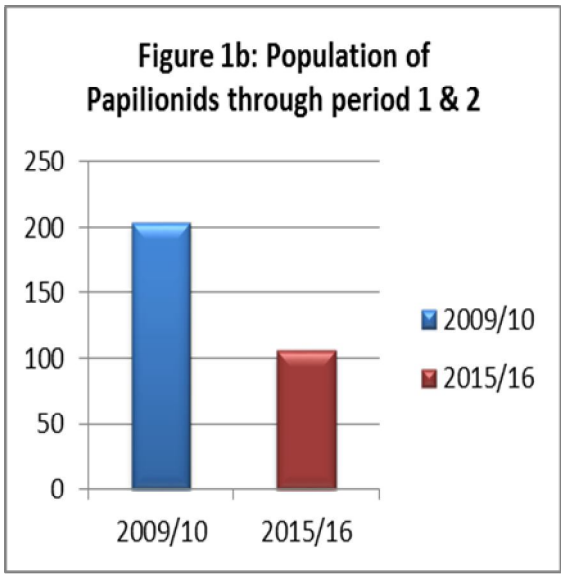
Listed below are the 6 species of papilionids (swallow tails) recorded in the study area during season 1 and season 2.

Table 1
List of papilionid butterflies in the two periods

#	Common name	Scientific name
1.	Common jay	*Graphium doson*
2.	Tailed jay	*Graphium agamemnon*
3.	Lime butterfly	*Papilio demoleus*
4.	Common Mormon	*Papilio polytes*
5.	Common rose	*Atrophaneura aristolochiae*
6.	Crimson rose	*Atrophaneura hector*



However the population of the papilionids, show a decreasing trend from 2009-2010 to 2015-16. Statistical analysis substantiates that the decrease is significant (Table: 2) .Further the total number of butterflies throughout the periods 2 has declined compared to period 1 (Figure 1b). This could be correlated with the change in environmental conditions including weather, temperature and rainfall and habitat as a whole (Weiss et al. 1988; Sparrow et al. 1994; and Spitzer et al. 1997).



To find the impacting factors, the population of the papilionids was compared with the microclimatic factors including temperature, Relative Humidity and rainfall. There is a highly significant inverse correlation between the population of the papilionids 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 is approximately 4 ^{O} C higher than the period 1 (Table 3). This implies there is raise in local temperature. It confirms that the increased temperature has played a vital role in decreasing the population. 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 are typically less (first and second week). Further the RH is higher on first and second week. Hence we assume that the temperature and RH (also influenced by rain) together play a role in the abundance of butterflies (Table 3a &3b).

Table 3a: Microclimatic conditions and butterfly populations during period 1				
Period 1				
Date	Temp ^{o} C	RH %	Weather	Nos
06.12.2009	29	56	sunny	18
13.12.2009	28	80	sunny	19
20.12.2009	30	70	sunny	18
26.12.2009	28	68	sunny	15
03.1.2010	26.4	71	sunny	24
10.1.2010	24.5	76	sunny	17
17.1.2010	29	64	sunny	17
24.1.2010	29	68	sunny	18
31.1.2010	30	60	sunny	16
07.2.2010	28	62	sunny	18

Table 3b: Microclimatic conditions and butterfly populations during period 2				
Period 2				
Date	Temp ^{o} C	RH%	Weather	Nos
06.12.2015	24	81	rain & drizzle	2
10.12.2015	29.3	89.5	rain & sunny	2
21.12.2015	28	72	sunny	4
23.12.2015	27.7	74	sunny	7
04.1.2016	32.5	60.2	cloudy	1
11.1.2016	32	69	sunny	12
18.1.2016	34	71	sunny	19
23.1.2016	31	66	sunny	16
29.1.2016	32	71	sunny	8
08.2.2016	34	71	sunny	22

The Relative Humidity (RH) in the period 1 from 56% to 80% ranged from and in the period 2 it ranged 60.2% to 89.5%. The minimum RH is 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 RH 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	06.12.2015	1.1
13.12.2009	4.3	10.12.2015	1.1
20.12.2009	1.5	21.12.2015	1.1
26.12.2009	0	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	23.1.2016	1.5
31.1.2010	3.5	29.1.2016	2.5
07.2.2010	3.5	08.2.2016	1.2

The average wind speed during the period 1 ranged from 0 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; as I have personally observed that very high wind speed ranging from 3-5mph has resulted in lesser number of butterflies.

Diversity Index

The Simpson index shows that the diversity is high in both the periods and the values are approximately equal (Table 5). Though the population has declined, the population maintains the same trend resulting in equal diversity. The index reveals that the microclimatic change has equally affected all the species of papilionid butterflies.

Table: 5: Diversity Indices of the papilionids in the two periods			
Period	Simpson's Index D	Simpson's Diversity Index 1-D	Inference
1	0.3007	0.699	high
2	0.0315	0.698	high

The other importance factor for the decline in population should be the management practices on the ornamental plants. It is learnt that the plants are pruned once in three months and pesticides are applied to ward off the pests. Insecticides such as acephate, chlorpyrifos, imidachloprid, dochlorvos and herbicides like roundup, 2,4-D and NPK fertilizers are regularly used. Pesticides are found to contributing towards the disappearance of butterflies (The guardian.com, 2015). They would have either directly affected the butterflies and their larvae or indirectly affect the food (onearth.com) and nectar plants. In either way, that would have resulted in the decline of butterfly population.

CONCLUSION

The analysis of population of butterflies of family papilionaceae over two periods 2009-10 and 2015-16 reveals that the populations have declined. The temperature rise and microclimatic change and inappropriate gardening practices have resulted in the decline in population. Inappropriate gardening strategies add 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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