Aspects of the pollination biology of *Lantana camara* (Verbenaceae)

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ABSTRACT

The research showed that butterflies are the main pollinators of *Lantana camara* in Amani Nature Reserve, Tanzania. The time of the day and relative humidity had a significant effect on the number of butterflies that visited the flowers. Afternoons had more visitors than mornings suggesting that the butterflies become active as the day warms up. Flower colour and nectar sucrose concentration had a positive influence on the number of visitors. A disturbed forest edge, adjacent to farmland, showed higher pollinator visiting frequencies than a gap in undisturbed forest.

INTRODUCTION

Lantana camara is a widespread species in East Africa, occurring mainly at forest edges. Its flowers are small, 5 lobed, in flat rounded heads about 5 cm across, in dense umbel- like aggregations that are brightly bicoloured (pink and yellow), tubular and sweet smelling. The flowers change colour from yellow to pink as they age and become non-functional thus increases the optical attractiveness of the inflorescence and at the same time distinguishes it from the young functional flowers that provide rewards for pollinators. The retained older pink flowers in an inflorescence, increase its size and maximize the platform for optimal landing by pollinators (Weiss, 1991). *Lantana camara* is primarily pollinated by butterflies (Schemske, 1976). The flowers are adapted to butterfly pollination (psychophilous flowers), and are open throughout the day. They have shorter tubes or spurs and provide a landing platform for the butterfly. The tubular flowers have long, conical papillae on petals and have a wet type of stigma. Butterflies not only have a relatively longer proboscis but also are active during the day, and they commonly alight on the flowers to take nectar. Bees and other insects are also attracted by nectar and pollinate *L. camara* flowers as they

spread the pollen from one plant to another. Pollination in *L. camara* consists of both self and cross-pollination.

Insect pollinators such as butterflies are affected by factors like temperature, relative humidity and time of the day. This study looked at the influence of temperature, relative humidity, nectar volume and sucrose concentration on the number of pollinators visiting *L. camara* in Amani Nature Reserve, Tanzania.

The objectives of the research were:

1 To determine the potential pollinators of *L. camara*

2 To determine whether there is any difference in *L. camara* pollination at different study sites.

3 To determine what time of the day the potential pollinators are most active

4 To determine whether temperature and relative humidity have any influence on *L. camara*

5 To determine whether there is any difference in nectar volume and sucrose concentration at different time of the day.

METHODS

Study plant

The study was conducted on *Lantana camara* (Verbenaceae), which is a low, erect or subscandent shrub with stout recurved prickles and a strong odour of blackcurrants. It grows to 1.2 to 2.4 meters or more in height. Its root system is very strong and it sends out a new flush of shoots even after repeated cuttings.

Study site and methodology

The study was conducted in Amani Nature Reserve in Tanzania. Two sites were chosen, one on Mbomole Hill (natural forest, 1050 meters above sea level) and the other on the edge of a disturbed forest (925 meters above sea level). Five plots of 1 m^2 were selected in each site. Four days were spent collecting data at intervals of 45 minutes from 08.00 to 17.00. Fifteen minutes were spent observing the visitors and

the numbers observed were recorded. The remaining 30 minutes were spent measuring temperature, relative humidity, nectar volume, and sucrose concentration and moving from one plot to another.

The number of both yellow and pink flowers at each plot were counted and recorded daily. Temperature and relative humidity were also measured and recorded daily between 08:00 and 17:00 using a digital thermometer and hygrometer, respectively. Nectar volume and sucrose concentration were measured using a 5 μl micropipette and refractometer, respectively, in ten randomly chosen yellow and pink flowers.

Data analysis

The data were analysed using Microsoft Excel and Statview. Linear regressions were performed to relate butterfly activity with temperature and relative humidity. To compare nectar volume and sucrose concentration at different times of the day, t-tests were performed. G-tests for goodness of fit were performed to test for differences in the number of butterflies at the two different sites that had an altitude difference of 125 meters.

RESULTS

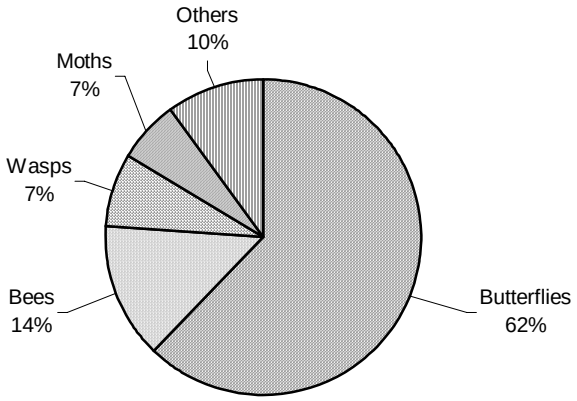

Figure 1: Pollinators of Lantana camara observed on 4 days

Butterflies were the most abundant pollinators of *L. camara* (Figure 1). Other pollinators were bees, wasps and moths.

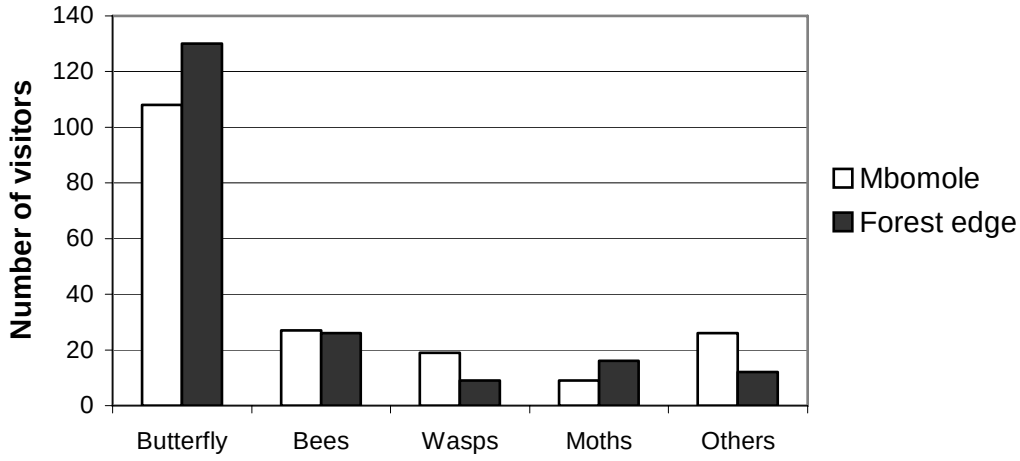

Figure 2: Insects observed in different study sites

Butterflies and moths showed higher numbers at the forest edge, whereas bees and wasps were more abundant at Mbomole Hill (Figure 2).

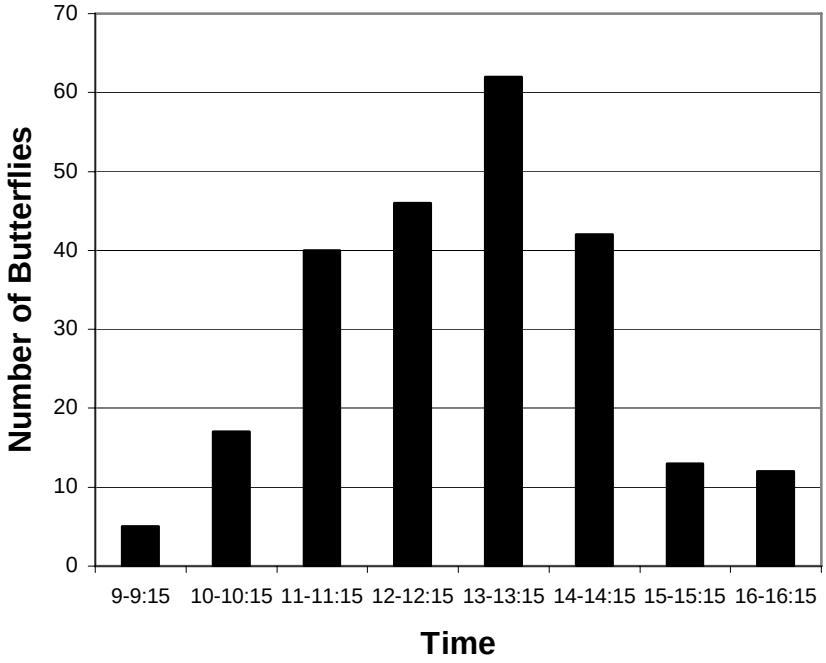

Figure 3: Number of butterflies observed at different time of the day

Butterflies were most active at 13:00-13:15 (fig. 3).

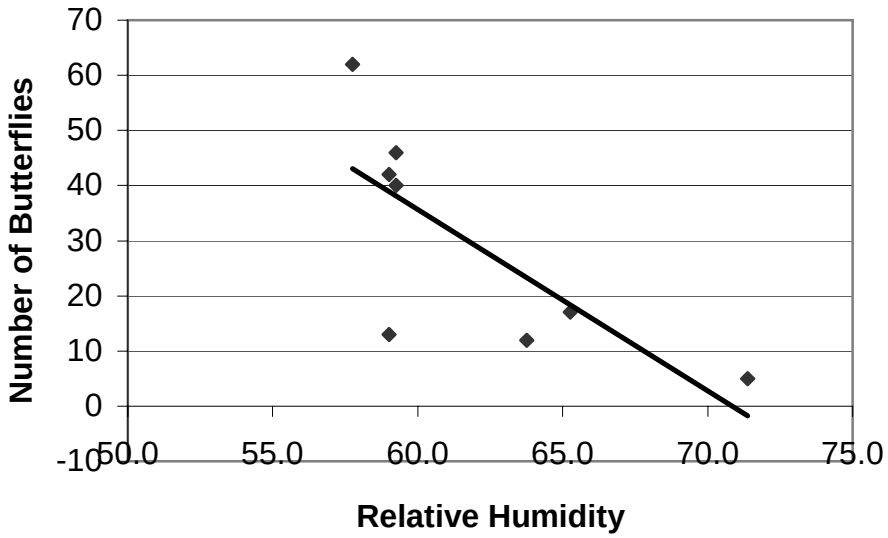

Figure 4(a) Number of butterflies related to the Relative Humidity

The number of butterflies decreases with increasing relative humidity ($R^2 = 0.5622$, p=0.019, fig 4a).

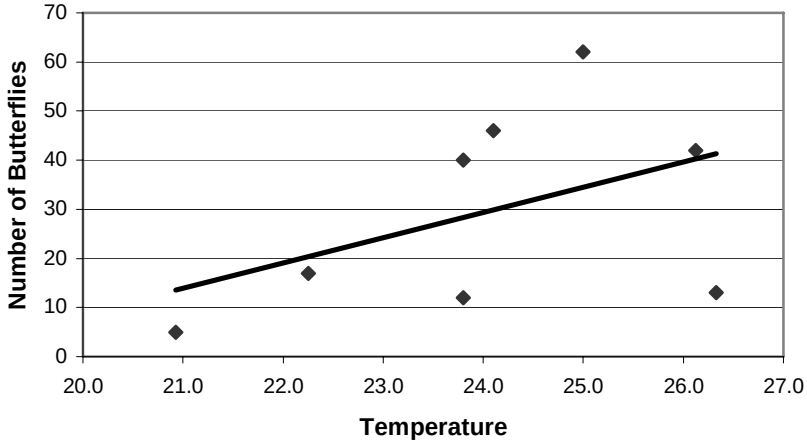

Figure 4(b): Temperature influence on *Lantana camara* pollination.

The number of butterflies increased with increasing temperature ($R^2 = 0.2122$, p=0.25, fig 4b).

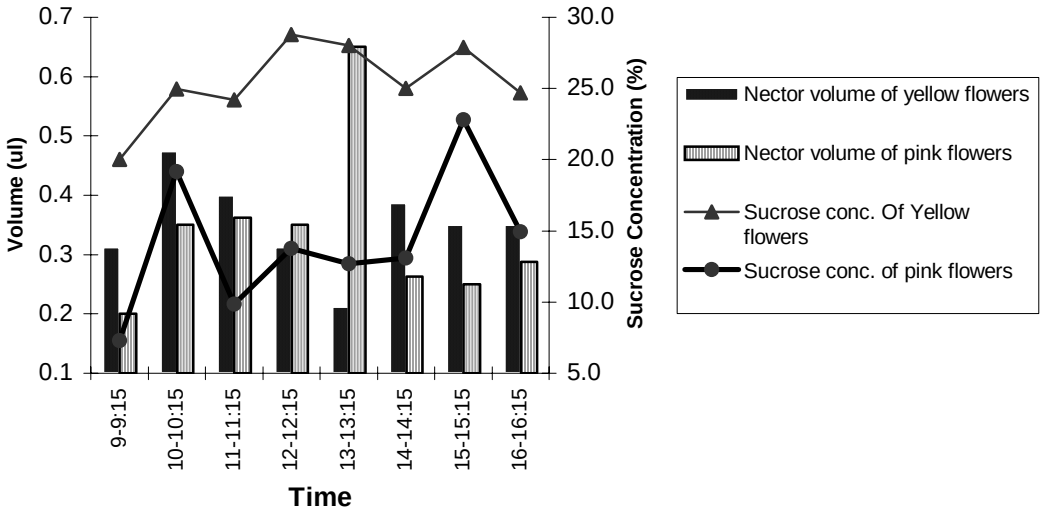

Figure 5: Nectar volume and Sucrose concentration at different time of the day.

Nectar volume in pink flowers was highest at 13:00-13:15 (figure 5), which coincided with the highest number of butterflies (figure 2). The nectar volume of yellow flowers was lowest at the same time.

The difference in sucrose concentration between yellow and pink flowers was significant (t= 5.61, p <0.05, df = 11 and 95% CI), whereas there was no difference in nectar volume (t = 0.20, p = 0.849, df = 10, 95% CI).

DISCUSSION

Butterflies are the most frequent pollinators of *L. camara*, as they constituted 62% of the total visitors. Bees, wasps, moths and other insect groups were also observed visiting *L. camara* flowers, but were less frequent pollinators. Similar findings were reported by Weiss (1995) who stated that the long corolla length of *L. camara* flowers eliminates all potential pollinators with a short proboscis but favors pollinators with a long proboscis.

The site at the forest edge where the altitude was 925 meters above sea level showed a significant higher number of pollinators compared to Mbomole Hill, which is 1050 meters above sea level (g= 12,93; p= 9.488). This is probably due to *L. camara* being more abundant on the disturbed forest edge, as the altitudinal difference is insufficient to be likely to cause this effect.

Temperature has a profound effect on pollination particularly in poikilothermic insects. Butterflies are mainly diurnal and are mostly active in bright sunshine with relatively low humidity. Butterflies are deriving most of their heat from the sun (Owen, 1971), and are inactive early in the morning, late in the evening, at night, and during cold and wet weather (Larsen, 1991). According to our observations few butterflies visited the flowers at 09:00-09:15 when temperature was below 21^{o}C. This confirms that butterflies are inactive at low temperatures, although the relationship between number of butterflies and temperature was not significant..
There was an increase in the number of butterflies as the time of day progressed, and a peak was noted at 13:00-13:15, which also coincided with the highest sucrose concentration in the yellow flowers. Pink flowers showed high nectar volume and lowest sucrose concentration at 13:00-13:15, due to the fact that butterflies prefer yellow flowers and thus consumption of nectar is lower.

There was a high butterfly visit frequency at low relative humidity ranging between 58 and 65%.

CONCLUSION

It is evident that butterflies are the most frequent pollinators in *L. camara* flowers. Other insects like bees, wasps and moths also visited the flowers.

The time of the day significantly influenced the visitation rate of the butterflies. As expected, the number of pollinators increased as the day progressed and temperature rose. This agreed with the findings of Heinrich and Raven (1972), which stipulated that the time of the day and consequently the temperature has significant effect on pollinators. The colour of flowers also had influence on the pollinators. Butterflies seemed to prefer yellow flowers of which a high number were observed being visited.

Temperature seemed to have no effect on butterfly activities in pollination since it did not show any significant effect. This may be due to the low amplitude in temperature differences during our study.

Relative humidity correlated with an increase in the number of butterflies.

The sucrose concentration, but not the nectar volume, highly influenced the number of pollinators in *L. camara* flowers.

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REFERENCES

Heinrich, B and Raven, P.H (1972). Energetic and Pollination ecology Science 176: 597-602.

Larsen, T.B (1991). The butterflies of Kenya and their natural history, Oxford Univesrsity Press, New york.

Owen, D.F (1971) Tropical butterflies: The ecology and behaviour of butterflies in the tropics with special reference to Africa species, Clarendon press, Oxford.

Schemske, D.W (1976). Pollination Specificity in *Lantana camara* and *Lantana trifolia* (Verbenaceae). *Biotropica* **8:** 260-264

Weiss M.R (1995) Floral Colour change: a widespread functional convergence. American Journal of Botany 82: 1671-1685.