THE EFFECTS OF HABITAT LIGHT INTENSITY ON LEPIDOPTERA COMMUNITIES

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Abstract. This study examined the effects of variable light intensity in different habitats on butterfly abundance, behavior, and community composition. Butterflies visited forest edge (< 25% shade) more than forest interior (> 75% shade). They spent a higher percentage of time flying in the interior habitats (97.0% of time budget), and a higher percentage of time resting in the edge habitats (38.7% of time budget). Butterflies in either habitat type preferentially chose sunny patches when resting. Sunny areas seem to provide butterfly populations with floral resources and opportunities for temperature regulation that are not available in the forest understory.

Key words: Habitat use, Lepidoptera, light conditions, poikilotherms

INTRODUCTION

Mid elevations of Pacific Costa Rica (900-1500 m), support 267 of the country's 543 butterfly species. This diversity is attributed to the mosaic of habitats created by mixing surface winds, mountainous terrain, and two bordering oceans (DeVries 1987). Our observations of butterfly movements at San Luis Biological Preserve suggested that light intensity was a critical determinant of butterfly habitat preferences. As poikilotherms, butterflies must rely on solar radiation for thermoregulation. In sunny areas butterflies can increase their body temperature by non-directional flying or sun-basking. Thus, we hypothesized that butterfly density would co-vary with changing light intensities from the forest interior to the forest edge. We predicted that more butterflies would visit forest edge habitat than a comparable area of forest interior. We also predicted that: (1) community composition would be similar in both forest interior and forest edge, (2) butterfly visit durations would be higher in edge habitats, and (3) butterfly activity budgets (flying and resting) would differ between habitats.

METHODS

Data were collected on 18-19 January 1996 at San Luis Biological Preserve, Costa Rica during the hours of 1000-1500, the period of peak butterfly activity. Observations were collected on 3 7 x 5 m plots each along the forest edge (< 25% shade) and forest interior (> 70% shade). For 30 minute observation periods all butterflies that flew into each transect were identified, and behavioral time budgets recorded. Behavior was divided into flying, foraging, and resting. Whenever butterflies perched, we noted their position relative to sun or shade. Percent shade in different habitat types was assessed by counting the shaded cm2 along a tape-measure transect in one of each forest edge and interior sites. Data for the two days were analyzed using Chi-square for community composition, resting preference, and total visits, and Student t-tests for time spent flying, resting, and overall time in transects. We tested whether butterflies chose to perch in sunny spots more often than by chance by calculating expected values based on the percent shade per plot, and analyzing with a Chi-square test.

RESULTS

Butterfly abundance and behavior differed significantly between forest edge and forest interior (Table 1). The total number of butterfly visits was greater in the edge transects ($X^2 = 29.15$, df = 1, P < .001). The same two species that were most abundant in the forest edge, *Pieriballia mandella* and *Erasia eutrophia*, were also most abundant in the forest interior (collectively 48% and 85% of the total butterflies present, respectively). However, the proportional contribution of those two species differed between habitats because there were fewer *Pieriballia mandella*, as well as fewer butterflies of other species, in the forest interior than in the forest edge ($X^2 = 25.71$, df = 2, P < 0.005). Butterflies tended to remain approximately twice as long in the edge transects as in the interior transects (t = 1.98, df = 145, P = 0.028). Butterflies spent a higher percentage of time flying in the forest interior (t = 3.00, df = 145, P = 0.003), and a higher percentage of time resting in the forest edge (t = 2.99, df = 145, P = 0.003).

Butterflies appeared to preferentially rest in patches of sunlight. In the forest edge, the number of butterflies resting in the sun was higher than expected based on the area of available sunlight (observed = 37/37 = 100%, expected = 79.7%; Chi-square = 10.2, df = 1, P < 0.005). In the forest interior, 2 of 4 resting butterflies chose patches of sunlight, although sun patches only made up 1.9% of habitat area.

Table 1. Number of butterfly visits, time spent and behavior in sun and shade habitats in a tropical cloud forest.

	Forest Edge	Forest Interior
Butterfly visits	114	33
Erasia eutrophia	31	25
Pieriballia mandella	24	3
Other	59	5
Visit duration (s)	14.2 ± 8.2	6.8 ± 0.3
Percentage of time:		
flying	57.5%	97.0%
resting	38.7%	3.0%

DISCUSSION

Butterfly preference for relatively sunny forest edge habitats was indicated by greater number of butterfly visits and longer time spent within the sun transects. Butterflies were common both in the forest interior and forest edge habitats, however, butterflies frequently flew straight through the forest interior transects, while tending to remain longer and exhibit a wider range of behavior in the edge habitats.

Butterflies could be attracted to the edge areas to forage and/or to thermoregulate. There were more flowers in the sun transects and butterflies appeared to spend more time foraging there, although foraging events occurred only infrequently during our transect observations. Butterflies were also attracted to the sun transects to increase their internal temperature. Butterflies exhibited a higher proportion of time resting in the sun and longer non-directional flying in the sun transects. These behaviors presumably aid the poikilothermic butterflies in maintaining the high thoracic temperatures that are necessary for flight. Butterflies could also be attracted to the edge habitats to search for larval host plants, or to locate mates.

Further research is needed to separate the reasons for preference in a more definitive manner. Thoracic temperature could be measured at intervals to quantify any increase in body temperature incurred during different activities in the edge habitat. Secondly, it would be important to examine a wider range of habitats to document all locations in which butterflies forage, mate and lay eggs.

LITERATURE CITED

DeVries, P. 1987. The Butterflies of Costa Rica. Princeton University Press: New York, USA.