OTS 91-3

Color pattern variation and flight distance in *Sceloporus malachiticus*

Category: Faculty Field Problem
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Site: Las Tablas

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Three species within the genus *Sceloporus* occur in Costa Rica. *Sceloporus malachiticus* is distinguished from the other two (*S. squamosus* and *S. variabilis*) by being larger and occurring at higher elevations (600 m and above). Robinson (1983) noted the conspicuous metachrosis of the species, in which individuals express one of three distinctive color patterns (dark brown, dark green, or bright green with a blue tail). He suggested that this variation might serve a thermoregulatory function. In this study, we investigated the association between ambient (and presumably lizard) temperatures and lizard coloration throughout the day. Our assumption was that darker lizards absorb heat faster, and thus would be the more common color morph during the lower temperatures of the early morning. We predicted that as ambient temperatures rose, more dark green and eventually bright green individuals would be seen.

We also recorded the distances at which the lizards fled in response to our approaches. In *Anolis lineatopus*, Rand (1967) observed that "shyness" decreased as lizard body temperatures increased. He suggested that warmer lizards allow predators to approach closer before fleeing because they are better able to escape faster, while cooler lizards flee sooner, presumably because they are slower moving and thus more vulnerable.

Methods

This study was conducted at Las Tablas, Costa Rica on July 8, 1991. We searched for lizards from 0700 to 1330 hours (with an hour break at 1200 for lunch). Three deforested pasture areas were searched; two of these areas were searched twice at different times to inspect for effects of the ambient temperature increases independent of site differences. Ambient temperatures were taken with a digital thermometer every 15 minutes. We searched all stumps and logs in the pastures for the presence of lizards. When we saw a lizard, we immediately recorded its color (dark brown, dark green, or bright green) and age class (juvenile or adult). Next, we approached the lizard very slowly until it fled from us, then measured with a meter tape the distance between the approacher and the lizard's location before it ran.

Results

Ambient temperatures increased from 17 C at 0700 to 22 C at 1330 (Fig. 1). From 0700 to 0845 no lizards were seen. At 0845, when temperatures had reached 19 C, we observed the first lizard. By 1330, a total of 79 adult and 14 juvenile lizards had been seen. The number of adult lizards of each color pattern that were recorded at different times during the day are summarized in Fig. 2. There was a significant difference in the proportion of lizards of each color pattern seen during different hours of the day ($G = 19.9$, $df = 6$, $p < 0.005$, Table 1a). However, in this analysis, the time of day effect was confounded with possible effects of differences among sites. Therefore, another analysis of color pattern differences was conducted for the one area that was searched twice at times when lizards were active (0930 and 1300). This analysis also showed a significant difference between the proportion of lizards of the different color patterns seen ($G = 12.16$, $df = 2$, $p < 0.01$, Table 1b).

A two-way ANOVA was performed to analyze the main effects and interactions of time of day and color pattern on lizard flight distance (log-transformed). Only adult flight distances were analyzed. Although no significant effects were found (Table 2), there was a trend for bright green adults to allow us to approach closer before fleeing, than individuals of darker coloration (mean flight distances: brown = 3.89 m, dark green = 3.14 m, bright green = 2.5 m).

Discussion

Ambient temperatures increased several degrees centigrade during the course of the morning. Although 830 stumps were inspected before 0845 (when temperatures remained below 20 C), no lizards were seen. Early morning temperatures are probably too cool for lizards to bask effectively. The significant heterogeneity in lizard color pattern observed during later hours in the day was consistant with Robinson's (1983) hypothesis that the metachrosis in this species serves a thermoregulatory function, with cooler lizards being darker than lizards at higher ambient temperatures (and presumably higher body temperatures).

No significant body color (i.e., presumed body temperature) or time of day effects were found on lizard flight distance, although a trend towards brighter lizards having shorter flight distances was seen (Table 2). A confounding factor not involving thermoregulatory functions may be related to the social system of these lizards. Individuals of S. malachiticus, especially dominant males, exhibit territorial defense, employing displays in which color pattern may play a role. In follow-up observations, VP observed 12 cases in which at least three individuals were seen using the same perch log or stump. In all cases, the trios consisted of two individuals of dark coloration and one bright green adult. Also, more darker juveniles were observed at high ambient temperatures than dark adults, which also could be related to factors associated with social status. Thus, dominant adult males presumably are larger, more brightly colored individuals that may allow predators to approach them more closely before running away. However, subordinant lizards seen at high ambient temperatures may remain dark due to their social status, instead of a low body temperature. If so, they also might be approached as closely as bright individuals. To test this possibility more detailed studies are needed, that consider how actual body temperature and social status of known individuals influence diel color pattern transitions.

Acknowledgements: We would like to dedicate this project to the memory of Douglas Robinson, herpetologist at the University of Costa Rica, who died just prior to the beginning of this course. His observations on Sceloporus malachiticus inspired this study.

Literature cited

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Table 1a. Number of adult Sceloporus malachiticus seen at different times of the day, by color pattern.

TIME	BROWN	DARK GREEN	BRIGHT GREEN
0845-1000	11	11	0
1000-1100	8	10	6
1100-1200	2	8	1
1300-1330	1	7	8

Table 1b. Number of adult Sceloporus malachiticus seen in the same area at two different times during the day, by color pattern.

TIME	BROWN	DARK GREEN	BRIGHT GREEN
9300-1000	6	3	0
1300-1330	1	7	8

Table 2. Two-way ANOVA of lizard color pattern and time of day on log-transformed lizard flight distance.

ANALYSIS OF VARIANCE

SOURCE	SS	DF	MEAN-SQUARE	F-RATIO	P
COLOR	0.167	2	0.083	0.150	0.861
TIME	0.945	2	0.472	0.851	0.438
COLOR*TIME	2.686	4	0.672	1.209	0.330
ERROR	14.993	27	0.555		

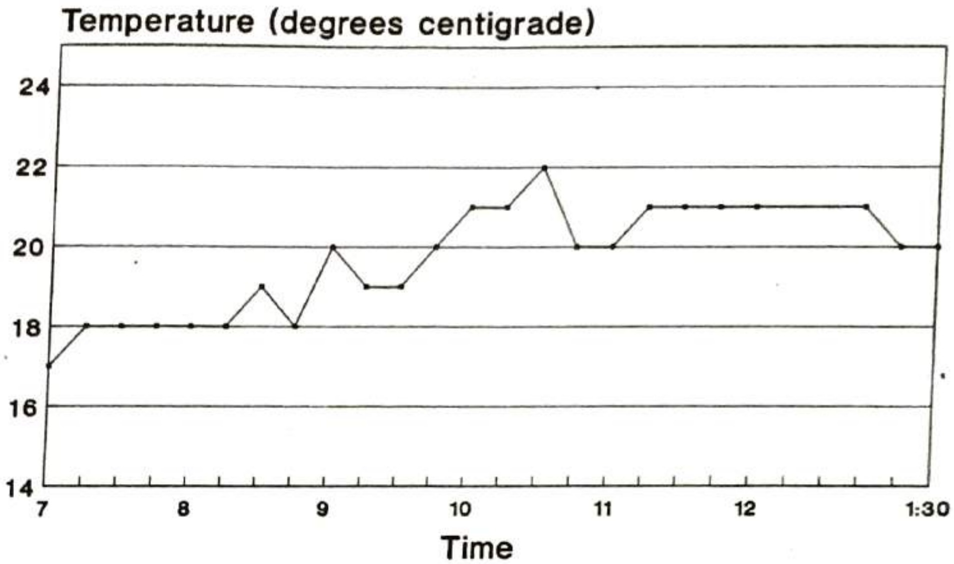

Fig # 1. Changes in ambient temperature during the day.

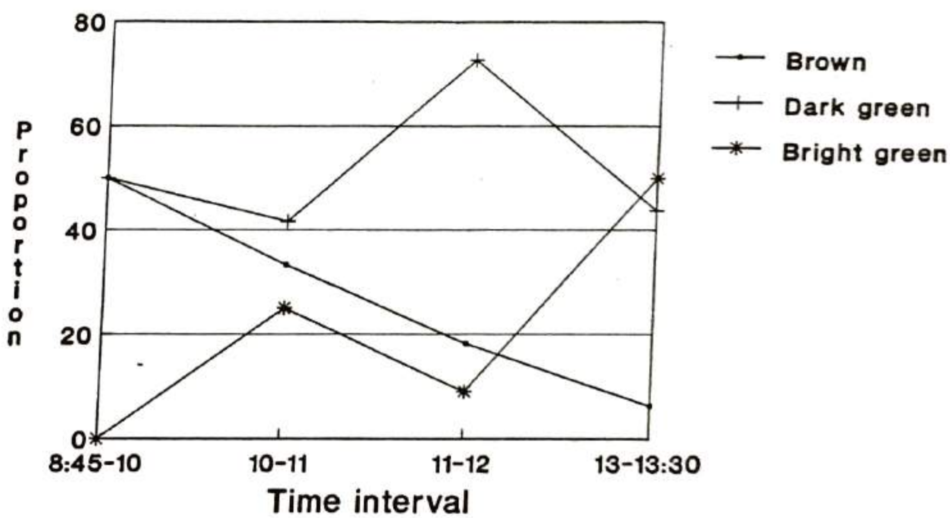

Fig # 2. Proportion of lizards of each color pattern seen at different times during the day.