NO SLEEP 'TILL BROODIN': FACTORS INFLUENCING THE DAILY ACTIVITY SCHEDULE OF A FEMALE VOLCANO HUMMINGBIRD WITH TWO YOUNG NESTLINGS

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Abstract: I looked at a day in the life of a female Volcano Hummingbird with two young nestlings in the Talamanca Mountains of Costa Rica. I hypothesized that her activity schedule would be most constrained by (1) her energy requirements, (2) the energy requirements of the nestlings, or (3) the thermoregulation requirements of the nestlings. For 3.5 hours on the afternoon of 29 January, and for 4 hours on the morning of 30 January, I observed the nest area and recorded the female's activities (630 events total) , ambient temperature, and nestling temperature. It appears that both the female's energy requirements and the nestlings' energy requirements were important determinants of the female's activity schedule, but that the nestlings' thermoregulation requirements did not play an important role. It is likely that the tiny nectar- and insect-feeding bird cannot afford to significantly reduce her own energy intake to feed her nestlings, and instead must increase overall foraging effort.

Key words: foraging, nutritional requirements, thermoregulation

INTRODUCTION

On the morning of 29 January 2004, I discovered a volcano hummingbird nest near the Cuerici Biological Station, in the Talamanca mountain range of Costa Rica. The cup-shaped nest was situated in the fork of a blackberry vine 1.5 m off the ground in an area of relatively open second-growth dominated by fuchsia, blackberry, and alder. The nest contained two nestlings (as is typical in the tropics) which I estimated to be only 2 - 3 days old. I looked at a day in the life of the mother, hypothesizing that her activity schedule would be most constrained by (1) her energy requirements, (2) the energy requirements of the nestlings, or (3) the thermoregulation requirements of the nestlings. Under H1, I predicted that she would forage most heavily in the early mornings (when her energy supplies are low), and in the late afternoons (to build up energy reserves for the night), to the neglect of nestling feedings; under H2, I predicted that nestling feedings would be relatively high in the early morning (when the nestlings' energy supplies are low), and in the late afternoons, but that foraging would not show corresponding peaks; and under H2, I predicted that she would brood more often in the early morning, when temperatures are lowest, to the neglect of both foraging and nestling feeding activity.

METHODS

For 3.5 h between 1330 and 1800 on 29 January and for 4 h between 0600 and 1030 on 30 January, I observed the nest area while sitting quietly in a green chair 5 m away. I continuously recorded the location and activity of the female, and took periodic measurements of the ambient temperature, and, when possible, the skin temperature of the nestlings. At the end of the observation period, I mapped all the locations where the female was observed (Appendix 1), and measured the dimensions of the nest.

RESULTS

I calculated rates of various activities during six time periods (early morning, mid-morning, late morning, early afternoon, mid-afternoon, and late afternoon), each of which corresponded to a continuous observation period of 1.05 to 1.77 h.

Both nectar and sally foraging rates were relatively high early and late in the day, and low in the middle of day. Nectar foraging was relatively high mid-morning, however, whereas mid-morning sally foraging rate dropped off steeply from the early morning rate (Fig. 1). Nestling feeding rate was relatively high early in the day and low in the middle of the day. No nestling feedings were observed in mid or late afternoon (Fig. 2). Buzz rate was very high in mid-afternoon and late afternoon and relatively low at all other times (Fig. 3). Brooding rate was relatively high in the early morning, intermediate mid-morning, and low late morning and late afternoon; no broodings were observed in the early afternoon or mid-afternoon (Fig. 4). Mean temperature was relatively low in the early morning (6.5° C), high in the mid-morning (17.5° C) and late morning (20.4° C), and intermediate in the early afternoon (14.0° C), mid-afternoon (13.8° C), and late afternoon (11.23° C).

Table 1. Number of times 11 different activities were observed in 7.5 h of observation of a female volcano hummingbird.

Activity	Number of times observed
Perch	249
Sally	97
Nectar foraging	94
Buzz	83
Out of sight	68
Feeding nestlings	13
Brooding	7
Chased	2
Chases	2
Chased/chases	2
Nest pass	1

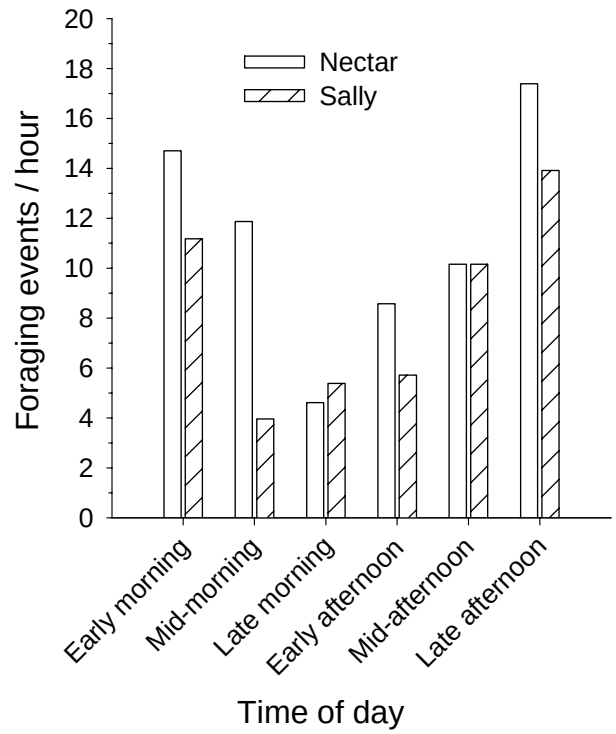


Figure 1. Number of nectar foraging events and sallies vs. time for a female volcano hummingbird with two young nestlings.

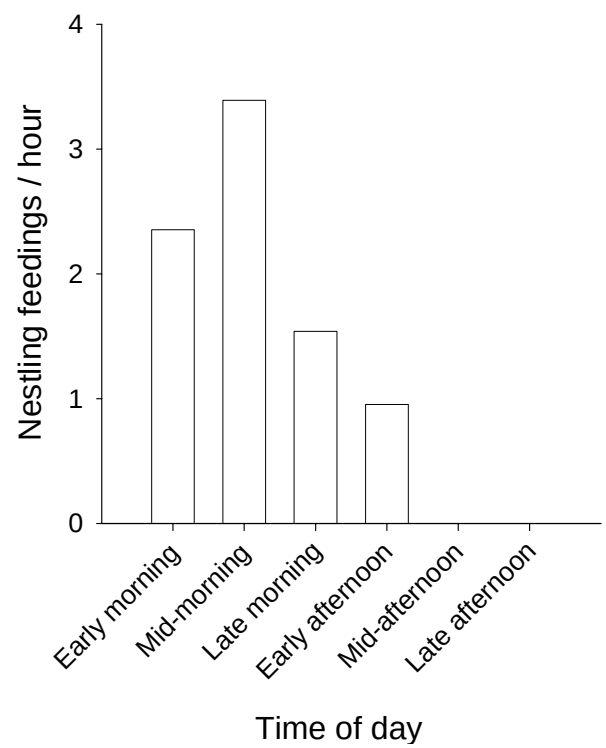


Figure 2. Number of nestling feeding events vs. time for a female volcano hummingbird with two young nestlings.

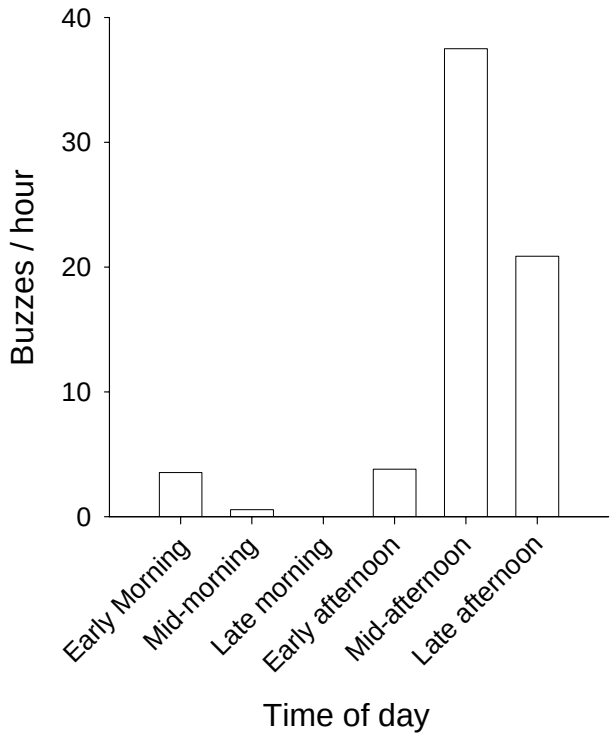


Figure 3. Number of buzzes (hovering flights < 1m from me with no apparent foraging behavior) vs. time for a female volcano hummingbird with two young nestlings.

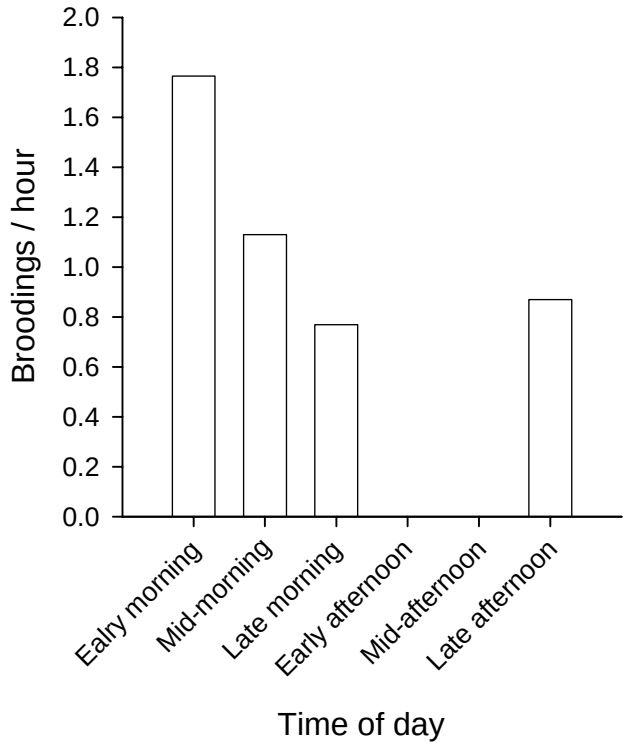


Figure 4. Number of brooding events vs. time for a female volcano hummingbird with two young nestlings.

I did not use nestling skin temperature measurements for any analyses because they appeared to vary greatly with location of the sensor on the nestlings.

The nest was 6.5 cm tall, with an external diameter of 6 cm, and an internal diameter of 4 cm.

Discussion

It appears that both the female's energy requirements and the nestlings' energy requirements were important determinants of the female's activity schedule, but that the nestlings' thermoregulation requirements did not play an important role. Foraging rate and nestling feeding rate were high early in the day, as predicted, when energy supplies would be expected to be low. Foraging rate was also high late in the day, possibly to build up energy supplies for the coming night, or, alternatively, as a response to high resource availability (assuming that nectar levels refilled after morning foraging, and that aerial insect abundance was higher late in the day). Nestling feeding rate would be expected to show a corresponding increase late in the day, especially since the smaller nestlings (with higher surface area : volume ratios) should need proportionately larger energy reserves than the female to make it through the night. However, this was not seen. The total absence of nestling feedings late in the day corresponded to very high buzz rates and low visitation of the nest in general, suggesting that the female may have been avoiding the nest because of my presence, so as not to reveal its location. Another afternoon of observation, after the female had apparently become habituated to my presence, would be needed to test this hypothesis. One difficulty of distinguishing between the relative importance of female nutritional requirements and nestling nutritional requirements is that the activity measures I used cannot so easily be sepa-

rated into those two categories; nestlings are fed both nectar and insects gathered during foraging activity (Stiles and Skutch 1989).

The locations and activities of the female during her 68 absences from my view are unclear. During some of them, she must have simply been perched nearby, but obscured by vegetation (it is easy to hide if you are 7 cm tall). Considering her aggressive defense of the area around the nest from conspecific individuals, it seems logical that she would only leave the area to seek better foraging opportunities. This was supported by her relatively high absence rate during early morning and late afternoon–the times of highest observed foraging activity (Fig. 5).

It is not surprising that both the female's energy requirements and the nestlings' energy requirements were important. All organisms must compromise between allocating resources to survival and reproduction. Many factors, including metabolic rate, can influence the nature of this compromise; it is likely that volcano hummingbirds have such high metabolic rates, due to their small size and active lifestyle, that a female cannot afford to significantly reduce her own energy intake to feed her nestlings. If so, total foraging effort, and possibly mortality, would be expected to increase during the brooding period. Future studies could look more closely at the nature of the compromise between survival and reproduction in volcano hummingbird females by comparing the activity schedules of females with and without nestlings, and looking for a decrease in overall foraging in females without nestlings.

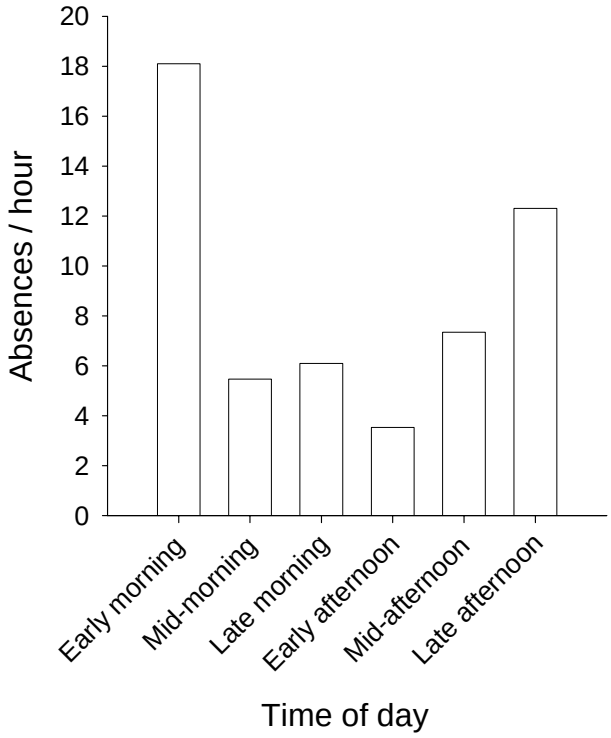
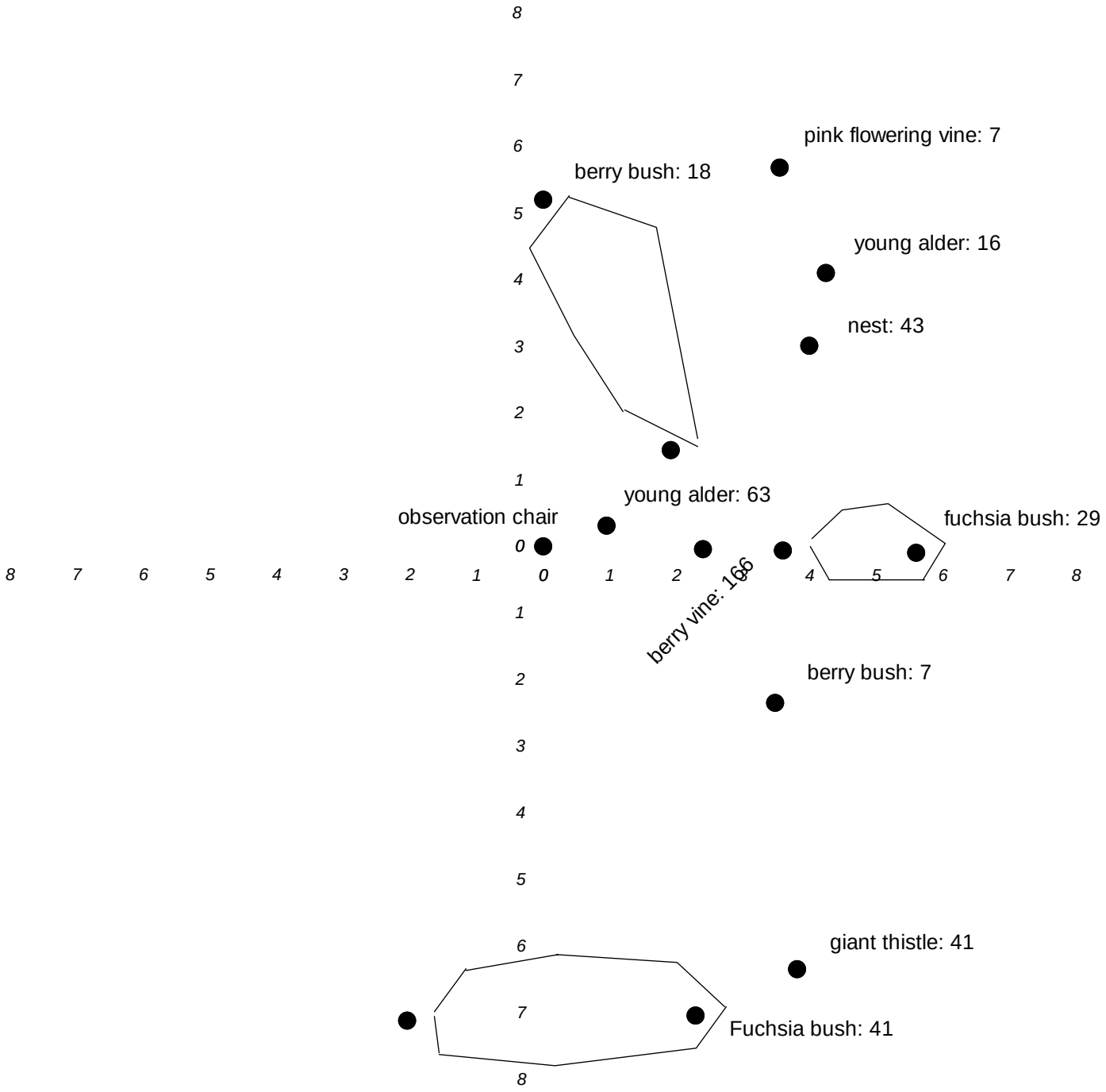


Figure 5. Number of absences from view vs. time for a female volcano hummingbird with two young nestlings.

Literature Cited

Stiles, G. F. and A. F. Skutch. 1989. A guide to the birds of Costa Rica. Cornell University Press: Ithaca, NY.

Appendix 1. Common perches and nectar sources (with number of times female was observed at each in 7.5 h of observation) of a female volcano hummingbird with two young nestlings. Distance axes are in meters.