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Behaviour of Bats During a Lunar Eclipse

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Summary. The hunting activity of tropical bats was observed during a lunar eclipse at night. During the eclipse, the activity was significantly higher than before and after when the bright full moon was visible. The decrease of hunting activity in bright light is interpreted as a direct adaptation to the light conditions, whereas endogenous factors seem not to be involved. The possible role of predators feeding on bats is discussed.

Introduction

It is well known that some nocturnal mammals, e.g. bats (Brown 1968; Fenton et al. 1977; Erkert 1974), kangaroo rats, *Dipodomys merriami* (Schwab 1966), and other rodents (Lockard and Owings 1974) restrict their activities in nights of bright moonlight to times when the moon is down. On some overcast, near full-moon nights, bannertails were more active than on cloudless nights (Lockard and Owings 1974). This may indicate that inhibition or modification of night activity is controlled by light intensity.

However, recently Morrison (1978) reported that the fruit-eating bats, *Artibeus jamaicensis*, returned to their roots, interrupting foraging activity from 0100 to 0700 hours, on full-moon nights even though the sky was overcast. In new-moon nights, they continued to forage outside throughout the night. Morrison characterized these changes in outside activity locked to the lunar cycle with the term 'lunar phobia'. He suggests that this specific behaviour is at least partly elicited by endogenous factors coupled to the lunar cycle. His observations on *Artibeus* and interpretations differ from other findings, not favoring an endogenous cause for 'lunar phobia'.

In our Unit of Animal Behaviour, currently a long-term survey of nightly foraging activities in different species of bats is under way. On the full-moon night of 13 March 1979, a lunar eclipse occurred from 0115 to 0430 hours. By sheer fortunate coincidence in the course of the above-mentioned study, at two different sites bat activities were studied throughout that night. The authors, observing at the two locations, had no prior or mutual information of a lunar eclipse occurring on that night. Thus the data presented here are not biased by any expectations of the observers. If 'lunar phobia' is controlled by endogenous factors, a lunar eclipse should not affect the outside activity of bats in a transitory manner.

Materials and Methods

The observations were made at the Madurai University campus (9°58′N, 78°10′E) and synchronously in a scrub jungle area about 7 km north-west of the Campus on 13 March 1979. To document activity of bats, 'bat passes', i.e. the number of bat flights seen by the observers, were counted by using Fenton's (1970) method. In the foraging grounds, bat passes were counted in 30-min intervals from 1850 to 0630 hours.

Attraction of bats to patchy aggregations of insects in the scrub jungle area was examined and observation sites were set up. To foster local concentration of insects, a Petromax lamp (300 cp) was placed 2 m above the ground. Within a few minutes of turning on the lamp, flying insects began converging near it, and there was usually a concentrated 'cone' of small flying insects (mainly Lepidoptera, Diptera, Coleoptera and Orthoptera).

At the University campus, the bats came to feed on insects attracted by the light of a street lamp. Bats hunted in open air, near the foliage and between the branches of nearby trees. Stereotyped flight circles and pathways around obstacles remained invariant in an observation interval of 29 weeks, indicating a stable foraging ground, most probably visited by the same individuals.

Bats active at the observation sites were *Pipistrellus* sp., *Hipposideros speoris* or *bicolor*, and *Rhinopoma* sp. Our observations reported here pertain to these species only.

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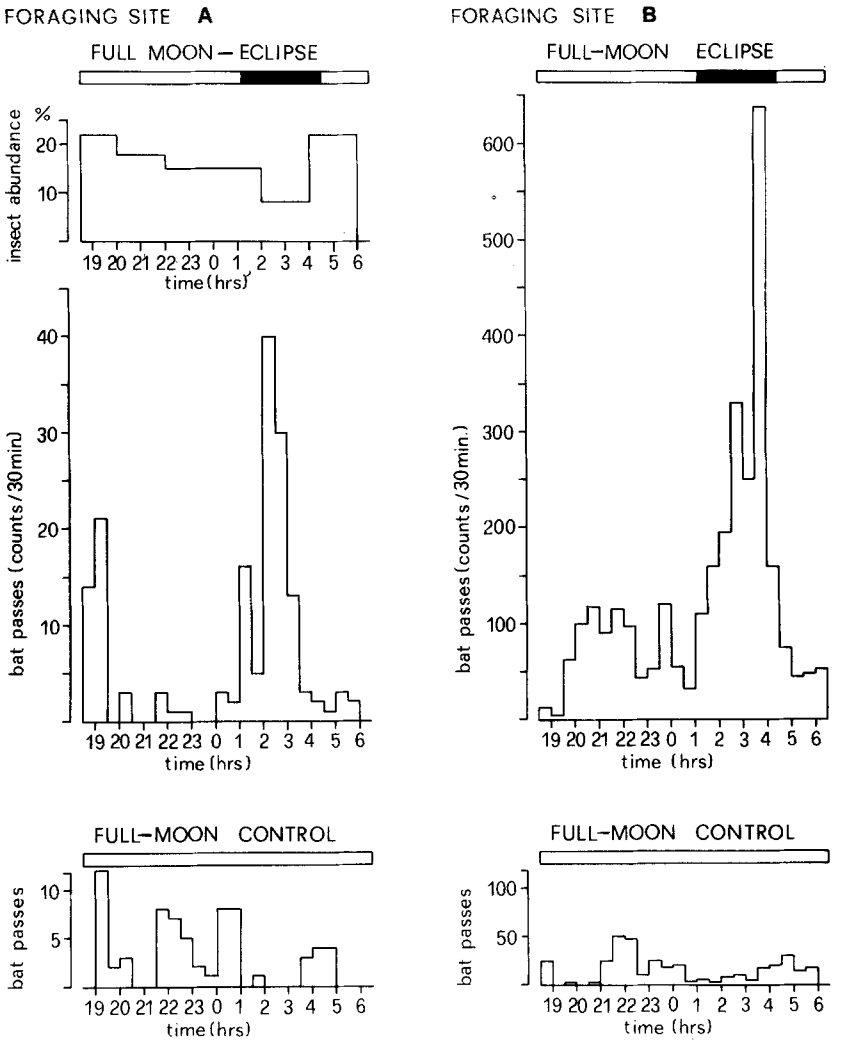

Fig. 1 A and B. Activity pattern of bats during a lunar eclipse on 13 March 1979, recorded synchronously at two foraging sites (**A** and **B**). The time and duration of the lunar eclipse during this full-moon night are indicated by the *black areas of the horizontal bars* at the top of the graphs. Insect abundance (%) is related to the total number of insects caught on this night. The *bottom* shows control measurements at the same spots on a full-moon night one month later

Results

The eclipse of the full moon began at 0115 hours and ended at 0430 hours. During the maximal eclipse at 0255 hours, about 75% of the moon was covered and invisible. Activity of the bats as measured by the bat passes showed marked differences in activity levels during eclipse and the bright moonlight preceding the eclipse and after (Fig. 1A and B). During the eclipse, activity of bats increased sharply and was significantly higher than that during the full-moon light.

Observations at the scrub jungle foraging site indicate that during bright moonlight there was relatively little activity of bats in the open, and most bats foraging seemed to have been consigned to the canopied pockets of the scrub. As also shown in Figure 1A, the relative absence of bats in bright moonlight does not correspond to a paucity of insects during that period. In fact, the number of insects caught at the lamp was larger during the moonlight than during eclipse.

At the foraging site on the campus (Fig. 1B), a total suppression of hunting activity, even under the canopy and within the foliage, was observed during the bright moonlight. On the full-moon night of 12 April 1979 at both foraging sites, suppression of activity persisted from moonrise to moonfall, that is, also during the period of 0115 to 0430 hours when bat activity sharply increased during eclipse on the full-moon night of 13 march 1979. From these data independently collected at two different foraging sites during routine weekly observations, we conclude that suppression of bat activity during moonlight is triggered by the overall brightness and not by endogenous factors coupled to the lunar cycle.

Discussion

The small experiment actually done for us, as it were, by nature and reported here, clearly shows that suppression of bat activity in moonlit nights is elicited by the overall brightness of the night sky and not by endogeneous factors locked to the lunar cycle. Otherwise, during the lunar eclipse on 13 March 1979, the bat activity should not have increased as sharply as it actually did (Fig. 1 A and B).

Our conclusion is in full agreement with many field observations and outdoor experiments in mice and bats, and also with the detailed laboratory experiments of Häusler and Erkert (1978). Only Morrison (1978) reports that *Artibeus jamaicensis*, a fruit-eating bat, is less active during overcast full moon nights. There is no reason to question his observations and, in fact, Erkert's observations (1974) show that different species of bats react differently to moonlight, even though all species he recorded reacted to brightness of the night and not to the lunar cycle. Most observations and experimental data presently at hand, including the ones we reported here, favor brightness-controlled activity suppression (Brown 1968; Fenton et al. 1977; Erkert 1974; Lockard and Owings 1974; Häusler and Erkert 1978). Our data are against an endogenously governed 'lunar phobia' (Morrison 1978). We therefore suggest that the term 'lunar phobia' be discarded as misleading.

Why do bats avoid bright nights? The most obvious explanation at hand is avoidance of predators. In our observation areas, bats were hunted by owls and night-hawks. However, owls usually stay close to the bats' cave, waiting for the bats emergence, and then strike on them, as do hawks. Pursuit of bats in open foraging grounds was rarely observed by us in about 120 night observations. From our observations, we cannot conclude that bats are under heavy predatory pressure during foraging activities. Emergence and return to the cave are the most dangerous periods for bats. However, we frequently hear owls calling in the foraging area and we can not exclude that chasing of foraging bats by owls goes on unnoticed by the observers. As shown in Figure 1 A, insect abundance was even greater during bright moonlight, so food scarcity may be ruled out as a cause for bright-sky avoidance. Until more evidence becomes available, the reason for avoidance of bright night skies by bats remains an open issue.

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