The Influence of the Natural Light-Dark Cycle on the Activity Rhythm of Pond Bats 
(Myotis dasycneme Boie, 1825) during Summer

A. M. Voûte, J. W. Sluiter, and M. P. Grimm

Department of Zoology, University of Utrecht, 
Section Ecology and Taxonomy, Utrecht

Received July 2, 1974

Summary. 1. The activity cycle in a colony of about 150 pond bats is studied throughout the summer season in Berlikum (Netherlands). The natural diurnal roosts of the bats are sited between rafters of a church loft where a nocturnal darkness reigns day and night. The onset of activity generally takes place in two phases: I—descending into and waiting in a narrow exit chamber from where daylight can be seen, II—flying out to the feeding grounds. The investigation includes electronic recording of passages of bats, and of light intensity during morning and evening twilight.

2. Phase I is regulated by an endogenous circadian timing system which is synchronised to the seasonal variation in daylength. The main entraining agent is daylight which the bats can only have observed, either when waiting in the exit chamber at dusk on the preceding day, or when flying home at dawn. The large time lapse occurring between the moments of arrival of first and last descender in the exit chamber (2 hrs), and between the return of the first and last homeflyer (1 hr) on a given day, is ascribed to lack of precision in timing of the right moment. This lack is thought to originate from two facts. First, the almost daily variation of cloudiness of the sky at the time of departure causes the rate of decrease of daylight to fluctuate irregularly. Second, at the times of departure and return most of the bats are confronted with very low light intensities only being poor entraining agents. In addition, there is some evidence that each individual has an oscillatory entrained activity cycle causing it to be among the first descenders (homeflyers, resp.) at one day, among the last descenders (homeflyers, resp.) at another day. Some relevant literature data on response-curves concerning other nocturnal mammals are discussed.

3. The seasonal phase relationship between the daylight cycle and the activity rhythm observed in pond bats accords with the Aschoff-Wever model, but only as far as the light-dark ratio is concerned. Twilight duration does not seem to be an important factor in this respect. The value of light intensity at the moment of departure of the first outflyer decreases as the season proceeds.

4. Phase II (the flying out) is regulated grosso modo by the absolute value of light intensity at the moment of departure. It is made plausible that the releasing stimulus for departure of the first outflyer, on clear evenings, is the surpassing of a threshold value of the rate of relative decrease of light intensity.

5. Literature data on activity cycles of other bat species are discussed.

1. Introduction

The factors regulating the timing of nocturnal activity in microchiropterid bats are of endogenous as well as exogenous origin. An endogenous circadian timing system is now wellknown to form the basis of 24-hr activity rhythms throughout the animal kingdom. Under natural circumstances, this rhythm is
synchronized to the earth's rotation. In higher vertebrates, the main entraining agent or "Zeitgeber" is the natural light-dark cycle (Aschoff, 1960, 1964, 1969). Endogenous rhythms in bats were first described by Griffin and Welsh (1938). Their synchronization by light-dark cycles was shown by Decoursey and Decoursey (1964).

A number of other variables may affect bat activity patterns. Reproductive and other physiological conditions can eventually play a role. Meteorological parameters such as precipitation, temperature and wind speed may influence times of onset and end as well as intensity of nocturnal hunting activity.

Yet light is presumably the most important variable involved in the regulation of activity times. In the course of the season, the natural light-dark cycle undergoes considerable variation in two parameters: daylength and twilight duration. The main objective of the present study has been to assess the start and the end of activity in a colony of vespertilionid bats throughout the summer season, and to evaluate the effect of several environmental parameters, especially light.

The investigation, extensively reported upon in a thesis by Voûte (1972), involved electronic recording of passages of bats through the exit holes of the colony, as well as of light intensity during morning and evening twilight.