

**FLIGHT ACTIVITY OF *NYCTALUS NOCTULA* BATS
(SCHREBER, 1774) (MAMMALIA: CHIROPTERA)
CLOSE TO THEIR WINTER COLONIES IN THE TOWN AREA
OF STARA ZAGORA, SOUTHERN BULGARIA**

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Abstract: The study was conducted in Stara Zagora town (Southern Bulgaria) during the autumn and winter between 30.10.2006 and 17.02.2007. The level of bat flight activity was assessed using a heterodyne bat detector. We found a strong positive correlation between the flight activity of the noctules and the temperature during the second hour after sunset ($r_{xy} = 0,61$) and week positive one during the first ($r_{xy} = 0,24$) and the third hour ($r_{xy} = 0,20$). In cold weather (0° to 10°C) bats were more active during the third hour and less active during the second. The reverse situation was observed in mild nights with temperatures over 10°C . The bats were more active flying close to their winter colonies during the second and the third hour.

KEY WORDS. *Nyctalus noctula*, flight, activity, hibernacula, town.

INTRODUCTION

The bats (*Chiroptera*) are one of the most diverse mammalian groups found in the urban areas all over the world. The usage of a great variety of roosts and habitats ensures a good adaptation to the dynamical environment of the towns (SIMON et al., 2004).

A lot of bat species were singly reported from towns in Bulgaria (BENDA et al., 2003). The most detailed study was carried out for the chiropterofauna of Burgas town (PANDURSKI, 2004).

The flight activity of bats in the Bulgarian town areas was not investigated so far, and in Europe there was a little information on this problem during their hibernation period (late autumn and winter). Accordingly our study was aimed on the flight activity of the most numerous species in Bulgaria, the noctule *Nyctalus noctula*

(Schreber, 1774) (BENDA et al., 2003; POPOV & SEDEFCHEV, 2003; PESHEV et al., 2004), during the hibernation period in a town area of southern part of the country.

MATERIAL AND METHODS

The study was conducted in the Stara Zagora town, situated between 42°25`N and 25°38`E (South-Eastern Bulgaria). The town borders with the small mountain of Sarnena Sredna Gora to the north and with the Upper Thracian Valley to the south. The mean annual rainfall in the region is 628 mm, the mean temperature is 12°C and the elevation 188 m a.s.l. The average annual wind speed is 1,4 m/s. The climate is temperate with a strong Mediterranean influence (NIKOLOV & MIHAILOV, 1963; KJUCHUKOVA, 1986; KOLEVA & PENEVA, 1990; STANKOV, 1991).

The investigation was carried out from one point all the time, placed on a terrace of a panel block of flats on the 7th floor. The winter colonies of the noctule bats were situated into the horizontal gaps of the panels, some of them close to the observing point. Such panel gaps are known to be strongly preferred by the noctule bats in the city environment having the most favorable microclimate conditions for the species (BIHARI, 2004). The habitat under the colonies was a grass terrain with few trees (mainly *Tilia* spp.) rounded by small streets with street lamps. This was a widely distributed habitat type in the region and a representative one for the town areas of Bulgaria occupied with blocks of flats.

Our study was carried out between 30.10.2006 and 17.02.2007. We used a heterodyne ultrasound bat detector Bat Box III, kindly consigned by NGO Green Balkans and Prof. Kate Jones (Zoological Society of London) and Prof. Colin Catto (Bat Conservation Trust, UK). The level of bat flight activity was assessed according to MCANEY & FAIRLEY (1988). The number of positive minutes in which bat ultrasound signals were detected, were recorded for 10 minutes sample intervals (BARTONIČKA, 2002; BARTONIČKA & ZUKAL, 2003) for three hours after sunset. Total 103 samples (1030 minutes) were done: 35 during the 3rd and 34 during the 1st and the 2nd hour. The temperature was measured and noted down at the end of each time interval. When the light allowed, some observations of the flying bats were made to support the detector indications, knowing that the noctules often emit calls from their winter roosts (KAŇUCH et al., 2005). The detector was tuned on 20 kHz, according the echolocation calls` peak frequency of the noctules, and they were also identified by their specific rhythm and pulse rate (BARATAUD, 2002). The bat detecting was not carried out when it was raining or in windy conditions. The minimal temperature during our study was 1,4 °C, and the maximum 16,4 °C.

We calculated the correlation coefficient r_{xy} between the temperature and the number of positive minutes in the 10 min samples for each hour using the program Microsoft Office Excel 2003. The number of the positive minutes per every 2°C interval from 0° to 18°C (considering the temperature interval of the study) was chosen to calculate the similarity between the three hours after sunset. To investigate the linkage between them, we used the clustering method of unweighted pair-group average using the program Statistica 5.1 for Windows.

RESULTS AND DISCUSSION

We found a strong positive correlation between the flight activity of the noctules and the temperature during the second hour after sunset ($r_{xy} = 0,61$) and week positive one during the first ($r_{xy} = 0,24$) and the third hour ($r_{xy} = 0,20$).

In cold weather (0° to 10°C) they were more active during the third hour and less active during the second. The reverse situation was observed in mild nights with temperatures over 10°C (Fig. 1). Such behavior differed from the bats' very early flying out of their roosts in the warm seasons (spring and summer) (PESHEV et al., 2004), some times in the mid day (around 13.30 h) observed in the study area.

The bats were more active flying close to their winter colonies during the second and the third hour. Accordingly the cluster analysis showed a close neighborhood between the last two hours of the study interval, and the first hour was not very similar and was separated from them.

It could be concluded that possibly not only the temperature was the reason for the emergence of the noctules for a flight and it was a complex of factors influencing it during the seasons in the area. Despite the temperature also could be an important factor, as it was estimated for example during the second hour after sunset in the wintering season.

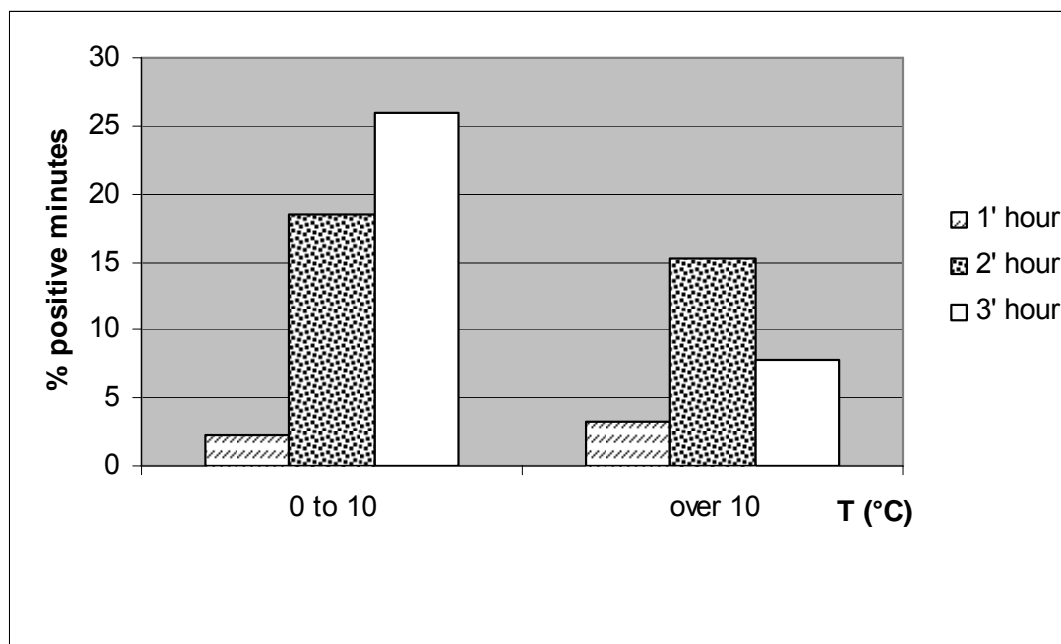


Fig. 1. The flight activity of the noctules *Nyctalus noctula* close to their winter colonies in Stara Zagora town in cold and mild night temperatures, represented as a percent of positive minutes from all minutes of the monitoring.

Фиг. 1. Летателна активност на ръждивите вечерници (*Nyctalus noctula*) в близост до техните зимни колонии в гр. Стара Загора при ниски и относително високи есенно-зимни температури, представена като процент положителни минути от общия брой минути на засичане с ултразвуков детектор.

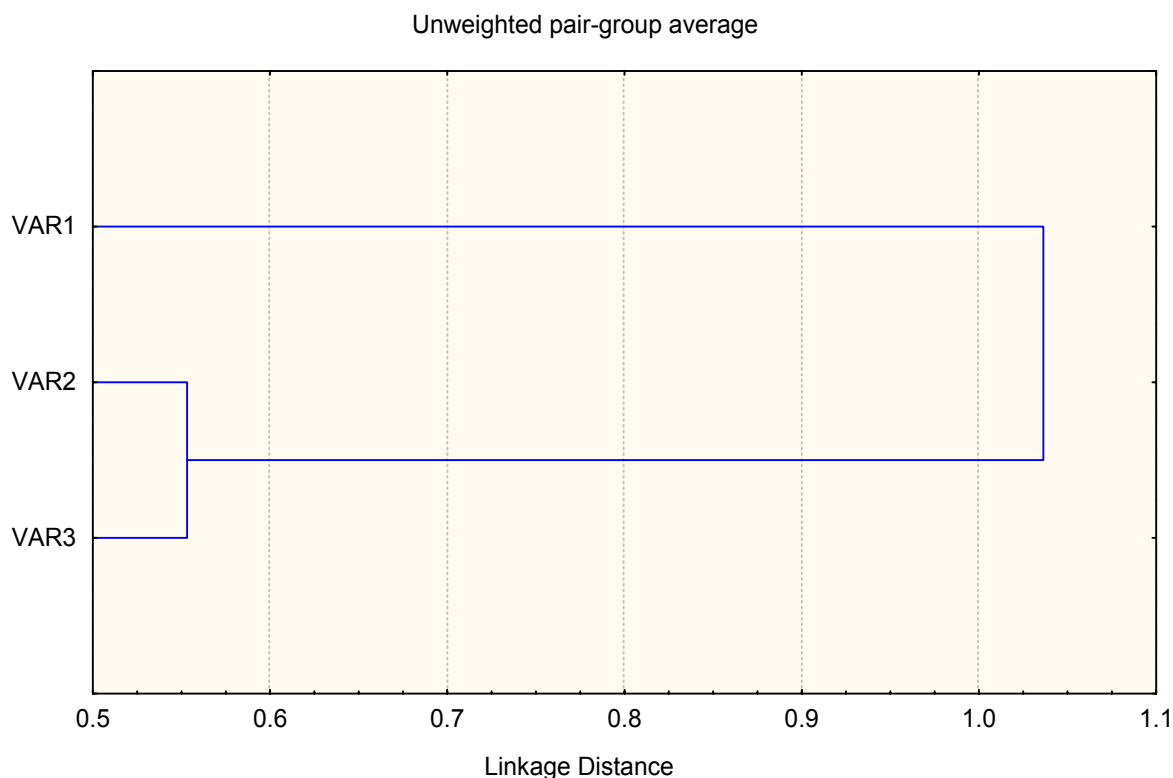


Fig. 2. The cluster analysis of the number of the positive minutes per every 2°C interval from 0° to 18°C (considering the temperature interval of the study) calculated for the three hours after sunset.

Фиг. 2. Клъстърен анализ на броя положителни минути за всеки 2°C – интервал от 0° до 18°C (според приетия температурен интервал при изследването), изчислен за трите часа след залез.

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**ЛЕТАТЕЛНА АКТИВНОСТ НА *NYCTALUS NOCTULA*
(SCHREBER, 1774) (МАММАЛИА: *CHIROPTERA*)
В БЛИЗОСТ ДО ЗИМНИТЕ МУ КОЛОНИИ
В ГРАД СТАРА ЗАГОРА, ЮЖНА БЪЛГАРИЯ**

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Установена е силна позитивна корелация между летателната активност на прилепите и температурата през втория час след залез ($r_{xy} = 0,61$) и слаба позитивна корелация през първия ($r_{xy} = 0,24$) и третия час след залез ($r_{xy} = 0,20$). Регистрирана е най-висока летателна активност на прилепите през втория и третия час след залез и много по-малка през първия. При ниски температури (0° to 10°C) ръждивите вечерници са по-активни и летят през третия час и по-малко активни са през втория. Обратната зависимост е установена за вечерите с по-високи температури над 10°C .

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