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REPRODUCTIVE BEHAVIOUR AND CONSERVATION STATUS OF NURSERY COLONIES OF *MYOTIS MYOTIS* (BORKHAUSEN, 1797) IN BULGARIA

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Abstract: The distribution of the most important nursery colonies of *Myotis myotis* on the territory of Bulgaria is presented. Data obtained in 1990 to 1995 are compared with literature reports; numbers of reproductive females in 22 summer roosts (caves and mines) are given. Fourteen of these roosts, inhabited by 100 to more than 1000 bats, are protected by law.

Birth period for *M. myotis* in Bulgaria is from 18-20 May to 25 June. The time of most births in the colonies lasted 3-4 days. Length of the stretched forearm and the weight was measured continously for the description of the postnatal growth rates. Maximum forearm length in the colonies (about 95% of the adult's values) was measured around the 70th day after birth.

Key words: *Myotis myotis*, nursery colonies, postnatal growth, conservation, Bulgaria

Introduction

Myotis myotis in Bulgaria is a typical cave-dwelling bat species and inhabits natural caves, shallow underground holes or abandoned mines. During winter months it may be found in many different roosts where the clusters normally are formed by both sexes and where the number varies from ten to thousands of individuals. Nursery colonies with maximum numbers (up to 6 000 to 8 000 individuals) are mainly formed by reproductive females and by young. According to **Beshkov** (1993) in summer roosts *M. myotis* often aggregates with *M. blythi* (Thomes, 1857), *M. capaccinii* (Bonaparte, 1837) and *Miniopterus schreibersi* (Kuhl, 1819). Twenty-two caves were inhabited by numerous nursery colonies. Fourteen of these caves are protected by law (Ministry of the Environment of the Republic of Bulgaria). On 7 June 1996 Devetashkata and Nanin kamak cave (North Bulgaria) were declared as "Nature reserves" with special emphasis on bat protection.

In this paper I will present figures of the most numerous nursery colonies of *Myotis myotis* in Bulgaria and the results of the studies on birth and the post-natal period in some of these colonies.

Material and methods

Reproduction (birth and weaning period) of *Myotis myotis* was investigated to some detail in Parnitice cave (North Bulgaria) where about 1500 reproductive females live in a mixed colony together with *M. blythi* (400 animals), *M. capaccinii* (700) and *Miniopterus schreibersi* (about 2000 females). The observations were made on 17-18

May 1990; 18-19 May 1991; 2-4 June 1991; 15-16 June 1991, 21-22 June 1991, 25-26 July 1991 and on 10-11 September 1991. Extra data were collected in Golashkata cave, an abandoned iron mine on 16-17 June 1991 (600 *M. myotis*, 300 *M. capaccinii* and 2000 *Miniopterus schreibersi*), 5 July 1991 and 25 July 1992 in Serapionavata cave (1500 *Myotis myotis* and 1000 *Miniopterus schreibersi*), 4 June 1994 in Devetashkata cave (2500 reproductive females of *Myotis myotis* and 2000 females of *Miniopterus schreibersi)* and 24 June and 2 August 1995 in Kolibata cave (200 females and young of *Myotis myotis/blythi*, about 150 *Miniopterus schreibersi* and 50 *Rhinolophus ferrumequinum*).

The method of **Beshkov** (1989) for the evaluation of the surface (in m²) which is occupied by bats was used to determine the number of animals in the colonies. **Beshkov** found that on average one m² contains 850 pregnant females of *M. myotis*. The numbers of *M. myotis* in nursery colonies collected during 1988-1989 (Beshkov 1989, 1993) were compared with the data of the last five years (1990-1995). The data of 1995 for Jarasa-ini and Orlova chukka caves were kindly supplied by **T. Ivanova**, National Museum of Natural History, Sofia.

Bats were captured with a Tuttle bat trap (**Tuttle** 1974) and mistnetted in front of the roost entrances. The lengths were measured with a precision of 0.01 mm, the weight to 0.2 g. The reproductive females were divided into three groups: pregnant (P), lactating (L) and post-lactating (PL).

In most cases *M. myotis* and *M. blythi* were found in mixed nursery colonies, where *M. myotis* was more abundant. For differentiation of both we used some morphological features (see tab.1), analysed by **Arlettaz** (1995) and **Strelkov** (1972).

feature (in mm)	*M. myotis* (n=131)		*M. blythi* (n=42)		t	P
	mean	SD	mean	SD		
length of forearm	58.00	1.85	56.40	1.70	15.62	>0.01
length of digit 3	102.00	3.80	99.00	2.90	5.88	>0.01
length of digit 5	81.00	3.60	83.00	2.70	3.57	>0.01
length of ear	23.10	1.73	21.50	2.04	5.27	>0.01
length of tail	51.14	4.20	50.80	4.70	5.63	>0.01

Tab.1: Measurements of *M. myotis* and *M. blythi* in the collected material

Results

Birth and growth of the young

The distribution of the nursery colonies of *M. myotis* in Bulgaria is presented in fig.1. The Great mouse-ear bat inhabits long, natural caves (100-3000 m long), shallow caves or abandoned mines. In the shelters the colonies are often situated in huge holes and under the roofs of the cave. Air temperature measured near the colony was between 9,2 and 22° C; humidity 75 to 94%. The variability of the microclimatic conditions between different roosts was larger than the monthly or yearly fluctuations in a given roost.

Birth started in the Parnicite cave in 1990 on 18 May and 1991 on 18-19 May. On this day females of *M. myotis* with new-born attached with the umbilical cord were caught.

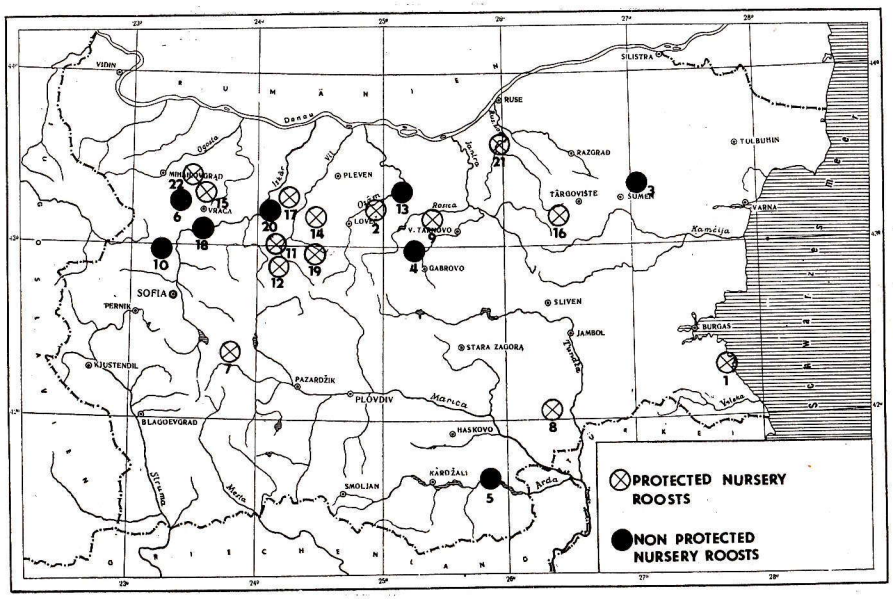

Fig.1: Distribution of nursery colonies of *M. myotis* in Bulgaria

Explanations:
1. Yuzhna podmolna peshtera - shallow sea cave
2. Devetashka peshtera - about 2000 m long cave
3. Madarska peshtera - shallow cave
4. Prilepnata peshtera - long natural cave
5. Jarasa-ini - shallow, about 20 m natural cave
6. Kalna matnitza - deep cave
7. Golashka peshtera - abandoned mine, 67 m
8. Dranci dupki - natural cave
9. Emenska peshtera - about 2000 m long cave
10. Kolibata - shallow natural cave
11. Lyastovitzata - long natural cave
12. Morovitza - long natural cave
13. Mandrata - 670 m long natural cave
14. Parnicite - about 2000 m long natural cave
15. Ponora - about 3000 m long natural cave
16. Prolazkata peshtera - natural cave
17. Sedlarkata - about 1000 m long natural cave
18. Serapionovata peshtera - natural cave - precipice
19. Toplya - natural cave
20. Haidushkata peshtera - natural cave
21. Orlova chukka - long natural cave
22. Boziyat most - shallow cave in a rocky complex

Each female had only one young. Forearm length of the new-born varied from 17 to 22 mm (≈ 34% of that of the female) and the weight from 4.0 to 4.8 g (≈ 15% of that of the female). During the first 2-3 weeks after birth the forearm length of the young increased most intensively (fig.2). Their birth weight doubled within 30-32 days (fig.3).

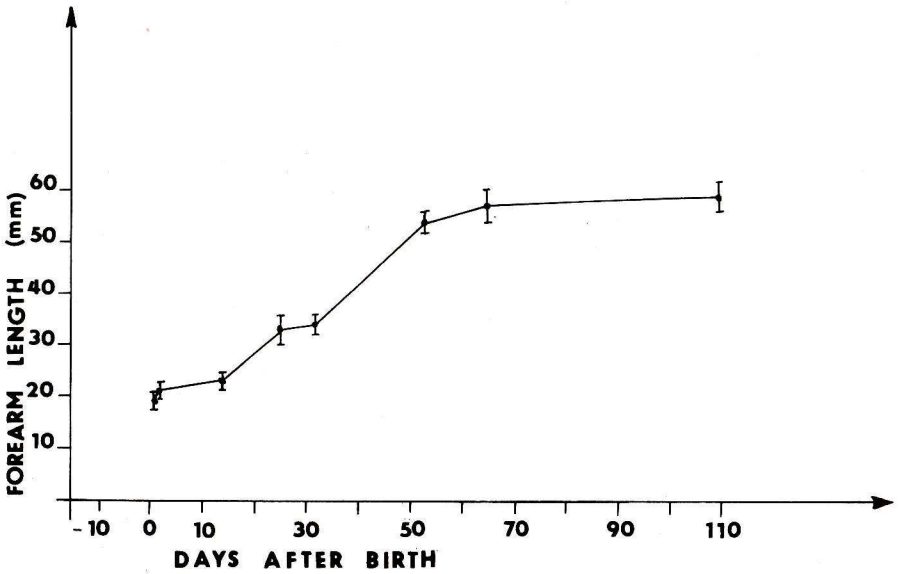

Fig.2: Post-natal increase of forearm length of *M. myotis*

With birth of the young the female lost about 8% of their average weight. One month after birth the weight of the lactating females decreased (fig.3) and increased again during the weaning period.

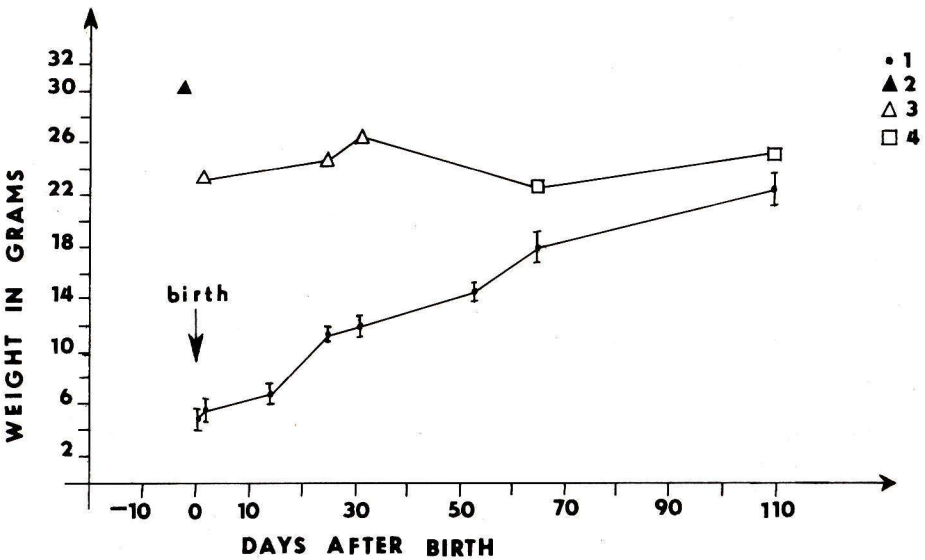

Fig.3: Changes of weight in *M. myotis* after birth, for young (1) and females (2 = pregnant, 3 = lactating, 4 = post-lactating)

At an age of one month the young were completely covered with grey fur. With an age of fifty days the young were still unable to fly outside the roosts. At an age of 65 days they started to leave. On 25 July 1991 I caught leaving young in front of the cave entrance with light-coloured, grey fur and visible epiphysial fissures. Their forearm had 93-95% of the size of adults and their weight was about 75% of that of adults. On 10 October (110 days after birth) the forearm length and the weight of the young were about 97 resp. 85% of that of adult females. In comparison with *Myotis capaccinii* and *Miniopterus schreibersi*, *Myotis myotis* in Parnicite cave was earlier in having young (17-20 May). *M. capaccinii* was not present in the cave till late May; lactating females of both species were observed for the first time in June.

Births of Greater mouse-eared bats were observed on 2-3 June 1990 in Haidushkata and on 30 May to 4 June 1994 in Devetashkata cave. In Serapionovata cave on 5 July 1992 youngs were not yet able to fly (forearm length 45 mm, weight 13 g) whereas on 31 July 1992 many of them performed short flies inside the roost (forearm length 55-56 mm, weight 17 g). On 2 August 1995 in the roost N10 (fig.1) females were mixed with immatures in dense clusters in the entrance hole; here the air temperature was 22° C.

Maternal behaviour

For many cave dwelling bat species the time to leave the cave is close to sunset. This behaviour of reproductive females was investigated from May to September (tab.2). During the second week of the lactating period females staid longer in the roosts. They were clustered close to the new-borns. They left 50-57 min after sunset. This behaviour is interpreted as "prolonged homeothermy" or "daily torpor", decreasing the energetic expenditures of pregnant and lactating females of *Myotis myotis* and other insectivorous bats (**Heindinger et al.** 1987; **Racey & Speakman** 1987).

Name of roost	Date	Hour of sunset	Min. after sunset
Parnicite	18 May 1990	20h 38'	2'
Parnicite	2 June 1991	20h 53'	3-5'
Haidushka	16 June 1990	21h 10'	25'
Parnicite	17 June 1991	21h 03'	50-57'
Parnicite	21 June 1991	21h 06'	11'
Parnicite	25 July 1991	20h 59'	12'
Parnicite	10 September 1991	19h 41'	51'

Tab.2: Time of leaving the roost of adult females

Maximum intensity of females returns were in the sixth hour after sunset, the foraging time of the females thus lasting about five hours.

During the first four weeks after birth the young were fully dependent on their mothers. During that time clusters with thousands of young bats were found close to the female colony. A curious behaviour of one female was observed about ten days after birth: she tried to cover and protect seven new-borns with her body and wings against the electric lights.

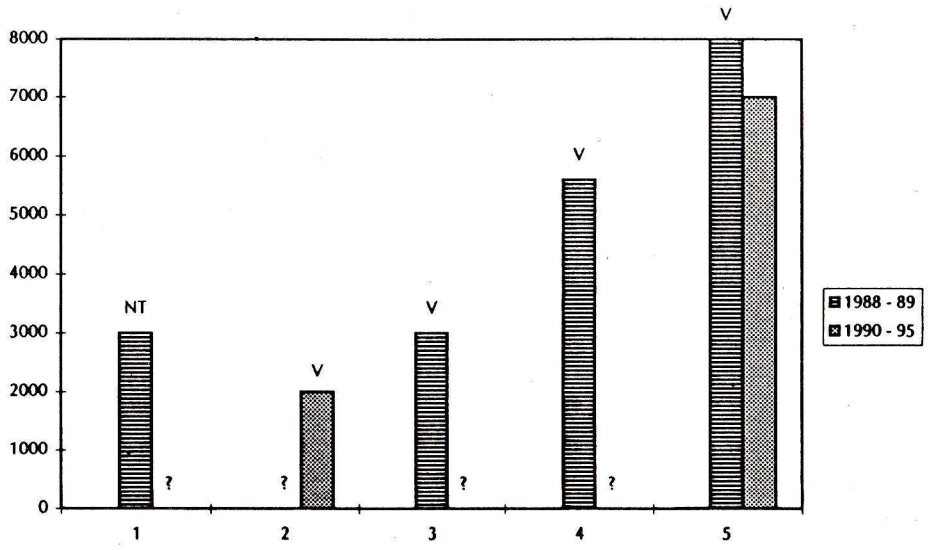

Fig.4: Number of individuals in the most numerous nursery colonies of *M. myotis* in Bulgaria (NT = not threatened; V = vulnerable)

Construction of the colonies

Shallow caves are inhabited by bats only in the summer months. Pregnant females of *M. myotis* migrate to these caves in May-June. Most of the well-known roosts are deep caves and hide bats all over the year. Although the Greater mouse-eared bats perform some seasonal movements between the roosts it is a permanent cave dweller in Bulgaria and in Europe (**Horaćek** 1983). Till August/September the colonies of this species consist of females and young. In September copulating pairs with unknown ages were found near the summer colonies (like Parnicite cave). According to **Weishaar** (1992) even one year old males show spermatogenesis in Central Europe. Mixed wintering colonies start to aggregate in late October in the most inner part of deep caves.

Conservation status

Fourteen bat colonies in Bulgaria are protected by law of the Ministry of the Environment as Natural Sights. Each protected roost is surrounded by a defined protected territory (0,5-12 ha). The aim is to preserve the natural character of the caves, the limestone side-scene and the adjacent fauna and flora. The protection status of the bats and their roosts prohibits:

- any kind of economic activities in the protected roosts and the surrounding areas,
- disturbing or killing bats, to use the entrances of the roosts for any sort of recreation
- tourism in the caves and any kind of activities during the reproductive period (from 30 May to 1 August).

Fig.4 shows the numbers of bats of *Myotis myotis* in the five most numerous roosts in Bulgaria. The colonies inhabiting roosts N1 and N8 (fig.1) are not threatened (NT) because of the low extend of direct human disturbances. The cave N6 needs legal

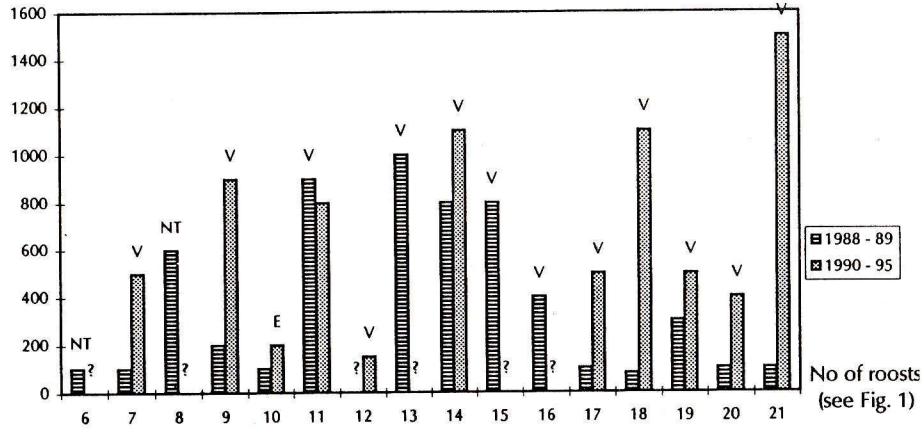

Fig.5: Changes in the numbers of individuals in some nursery colonies of *M. myotis* in Bulgaria (NT = not threatened; E = endangered; V = vulnerable)

protection. Although the numbers have increased in the last years (figs.4, 5) there exists disturbance by local people. That is the reason why most of the nursery colonies of *M. myotis* are considered to be vulnerable (V). The number of bats in Kolibata cave has increased in the last five years, but its numbers are still lower than the maximum of 800 individuals which was recorded in the 1970ies (**Beshkov** 1991). I consider this colony as endangered (E).

Discussion

Birth of *M. myotis* in different nurseries in Bulgaria was observed between 18-20 May and 10-15 June. The natural, long caves provide comparatively constant microclimatic conditions during the months of birth and weaning of the young.

In the period before they can fly of about six weeks the young *M. myotis* grow most intensively; their forearm's length reach more than 90% of the size of adults. The weight increases slower after the age of one month; in September young are still lighter than the adults. The results are very close to that of *M. myotis* in Central Europe (**Mazak** 1993, 1965; **Kratky** 1970). **Paz** (1986) reports larger sizes of new-borns from Spain: W = 6.2 g, LR = 25.1 mm.

According to several authors the limiting factors for growth of insectivorous bats are the climatic conditions (temperature, humidity) in the nurseries (**Bernard** 1994; **Kunz** 1987; **Tuttle** 1976). The caves in Bulgaria that include nurseries for *M. myotis* have air temperatures between 9.8 and 22° C. Normally the species prefers those shelters for birth of young with highest temperatures. In Bulgaria the nurseries are mostly located in the lowlands (= Prebalcan regions) in altitudes between 200 and 800 m. That satisfies the thermophily of the species during the reproductive period.

Protection of many bat roosts needs to be inforced in the near future. The appropriate conservation of the cave-dwelling bat species in Bulgaria requires protection and regular monitoring of nurseries and hibernating populations in numerous roosts.

Effective conservation activities should be developed in collaboration between the government and non-government organisations. The Regional Inspections of the Environment in Bulgaria together with the researchers are responsible to observe the situation of every protected colony and to prevent any negative influences.

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