

Dynamics of movements of bats inside some shelters

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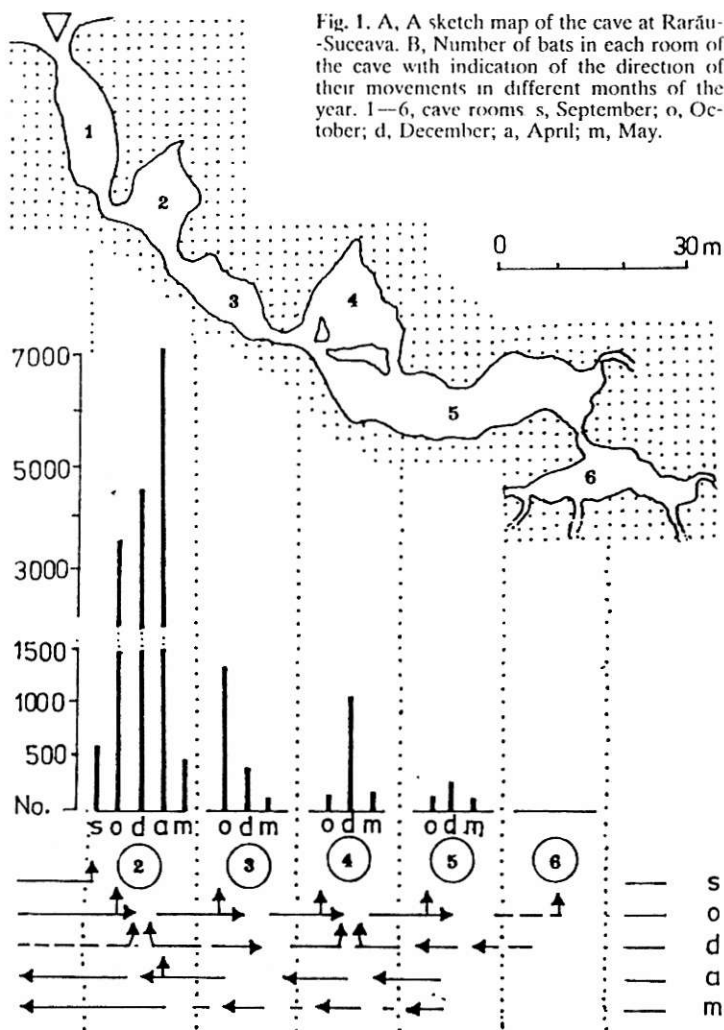
Abstract: Daily changes in roosting habits of a breeding colony of *Myotis myotis* and annual dynamics of a hibernating population are described with particular respect to their relations with the microclimatic condition of the shelters. An amount of spatial changes within a colony seems to depend upon a mode of temperature fluctuation inside the roost.

The bats of the fauna of Romania, and not only they, are heterothermic mammals. As these animals lack the capability of constructing shelters, they are obliged to utilize natural and artificial shelters which offer microclimatic conditions according to their metabolic needs. This is also one of the causes why bats have perform movements, including those between their winter and summer shelters, movements which have been studied by, and are well-known to a number of biologists (Allen 1952, Bels 1962, Brosset 1966, Hanák *et al.* 1962, Kowalski *et al.* 1961).

As microclimatic conditions inside the shelters sometimes vary considerably and at short time intervals, we have proposed to present in this paper the results of our research concerning the dynamics of bat movements inside some shelters. For this purpose, we have made observations on a natural shelter, the Rarău-Suceava cave, and on an artificial shelter, the roof of an old school at Dărmănești-Suceava.

Results and Discussion

The Rarău cave is situated in an altitude of 1500 m. It is relatively small, about 100 m in length, with a single entrance. The caves slopes down (Fig. 1A) and consists of six rooms. The relative air humidity in the cave varies between 90



and 100 percent in the course of the year, and the temperature between 8° C in summer and 1.5° C in winter. The cave serves as a winter shelter for up to 7,500 bats most of which, over 90 percent, belong to *Myotis oxygnathus*, besides

TABLE 1 — Number of bats and groups hibernating in the Rarău cave.

Date of observations	Number of bats in individual rooms						Total individuals	Total groups
	1	2	3	4	5	6		
14 VIII	0	300	0	0	0	0	300	1
12 IX	0	600	0	0	0	0	600	2
11 X	0	3 600	1 300	135	60	5	5 100	85
17 XI	0	4 530	500	1 050	367	3	6 450	52
27 XII	0	4 780	300	1 150	270	0	6 500	28
23 I	0	4 780	300	1 150	270	0	6 500	28
11 II	0	4 780	300	1 150	270	0	6 500	28
20 III	0	4 780	300	1 150	270	0	6 500	31
19 IV	0	7 100	65	180	55	0	7 500	31
21 V	50	430	2	28	0	0	460	61
18 VI	0	0	0	0	0	0	0	0
16 VII	0	0	0	0	0	0	0	0

Myotis myotis and occasional *Pipistrellus pipistrellus* and *Vespertilio murinus* (Valenciuc & Ion 1965).

In order to present an idea on the movements of bats inside the cave, we estimated and registered the number of existing individuals month by month in each room and in the whole cave. We also recorded the number of hibernating groups. These data are demonstrated in Tab. 1 and plotted in graphs in Figs. 1B and 2. Based on them, the following conclusions are drawn:

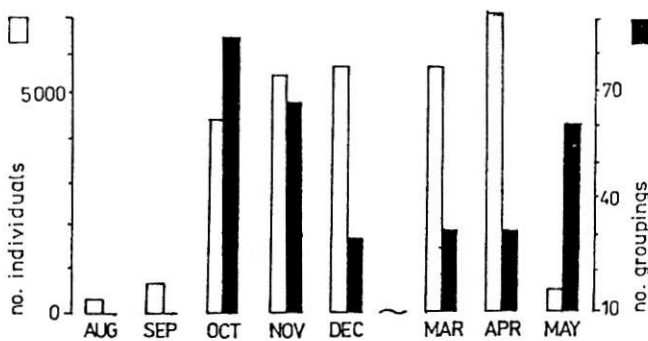


Fig. 2. Total number of bats and hibernating groups in the Rarău-Suceava Cave.

In autumn, in the period of hibernating colony formation, the bats shift gradually from the entrance towards the rooms deeper and deeper in the cave. In September they populate only room no. 2, but in October they occupy progressively and increasingly all the rooms of the cave. During hibernation, the

bats do not remain motionless. Owing to spontaneous awakening some of them leave the selected roost, passing from one room into another. In December, the numbers of bats in room 3 and 5 decrease in comparison with those of the previous months, but they increase in rooms 2 and 4 which are higher, the air being particularly still and almost one degree centigrade warmer.

During spring, the spontaneously awakened bats leave the rooms from the cave's depth and move in a direction contrary to that in autumn, crowding room no. 2. Room no. 1, being well lighted, is used only temporarily. As these awakenings do not coincide with the external climate conditions which would enable the bats to leave the shelter, they have to resume torpidity. Therefore, in spring, room no. 2 is much crowded than during the rest of year.

It follows from the observations mentioned above that the bats make shifts along the cave, passing from one room to another, in a sense or other, shifts which are made before the winter torpidity sets in the cold period, when the torpidity is interrupted spontaneously, or when the bats leave the winter shelter.

From analysis of the data demonstrated in the last two columns of Tab. 1 and from the graphs in Fig. 2, it follows that total number of bats, which gather in the cave, increases from the end of August till the end of December, while the number of hibernating groups decreases. For example, from 85 groups present in October it drops to 28 in December. As the weather outside the cave deteriorates and the air temperature in the cave drops gradually the hibernating groups increase in dimensions and decrease in number. This is due to the fusion of smaller groups and to the awakened individual bats joining the bigger groups, since collective hibernation is more advantageous. The greater number of groupings recorded in May is the result of the breaking up of bigger groupings because many of the bats leave the winter shelter, the females being the most hurried. Thus, the shifts are made not only from one room to another, but even within one and the same room: or from one grouping to another.

The summer shelter represented by the roof of an old school at Dărmănești-Suceava (Valenciuc 1971), is made up of wood and galvanized iron sheet. The volume defined by the plane of the roof is about 500 m³ and the boards bearing the sheet iron have chinks between them so that the sheet comes into contact directly with the air under the roof by a half of its surface. In such conditions the shelter microclimate presents ample variation from day and night and even from one hour to another. The variation in air temperature inside and outside the shelter is recorded in Tab. 2 and in Fig. 3.

The analysis of these results indicates that the shelter air temperature varies parallelly with the air temperature outside the shelter, but that it is 4 to 12° C higher.

During the warm season, this shelter contains a breeding colony of *Myotis myotis* consisting of about 1000 females. Simultaneously with the observation of the variation in air temperature we recorded the roosting position of the bats, which was always different in different parts of the day.

Fig. 3. Variation in air temperature inside (solid line) and outside (broken line) the Dărmănești-Suceava shelter.

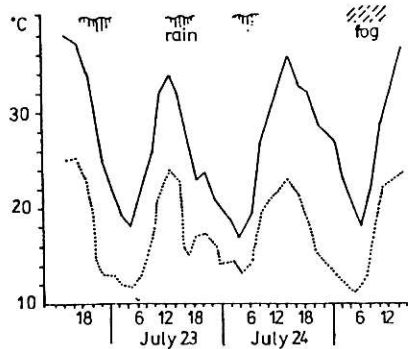


TABLE 2 — Variation in air temperature inside and outside the Dărmănești-Suceava shelter.

Hour	Date of observations							
	22 VII		23 VII		24 VII		25 VII	
	inside	outside	inside	outside	inside	outside	inside	outside
2	—	—	20	12	19	14	23	12
4	—	—	18	11.5	17	13	17	11
6	—	—	21	13	19	14	18	12
8	—	—	26	16	27	19	22	16
10	—	—	32	21	30	21	29	22
12	—	—	34	24	33	22	33	23
14	38	25	31	23	36	23	37	24
16	37.5	25	25	15	33	21	36	24
18	35	23	23	17	32	19	—	—
20	30	19	23.5	17	29	16	—	—
22	25	13	21	16	28	14	—	—
24	22	13	20	14	27	13	—	—

In the morning, about four o'clock, the bats are situated in the upper part of the roof (Fig. 4 and 6A), concentrating towards its eastern and western ends. After the sunrise, when the sheet iron or the eastern end of the roof begins to warm up strongly, the bats move towards the western end of the roof. About midday, the sheet iron on the southern part of the roof is heated strongly, the air temperature in the shelter rises up to 33° C, the bats move down along the chimneys (Fig. 5) to the base of the latter (Fig. 6D) as far away as possible from their night forays and the next day, if the weather is warm and quiet, without fog, clouds and rain, the bats will perform exactly the same movements in order to avoid overheating. If a sudden shower comes during a summer day the bats leave the walls of the chimney and hand on to the cool planes of the roof where they are found in the morning.

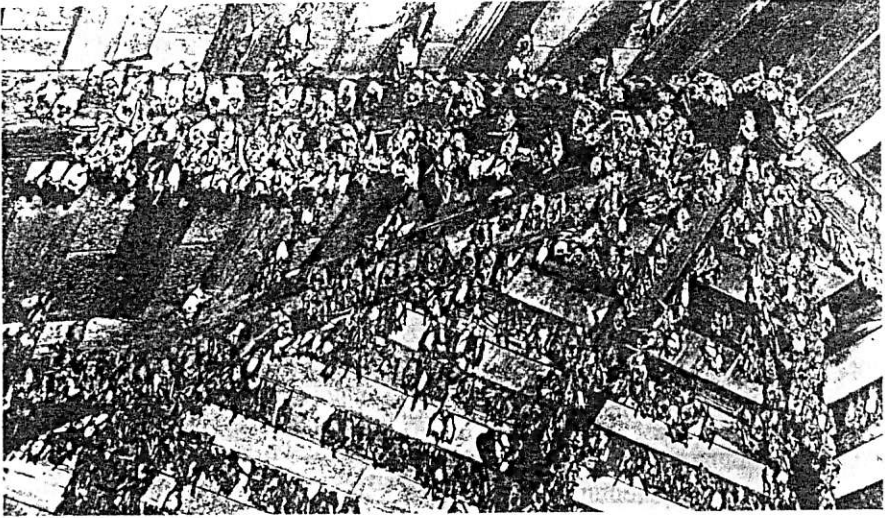


Fig. 4. Roosting place of the colony in the morning. upper

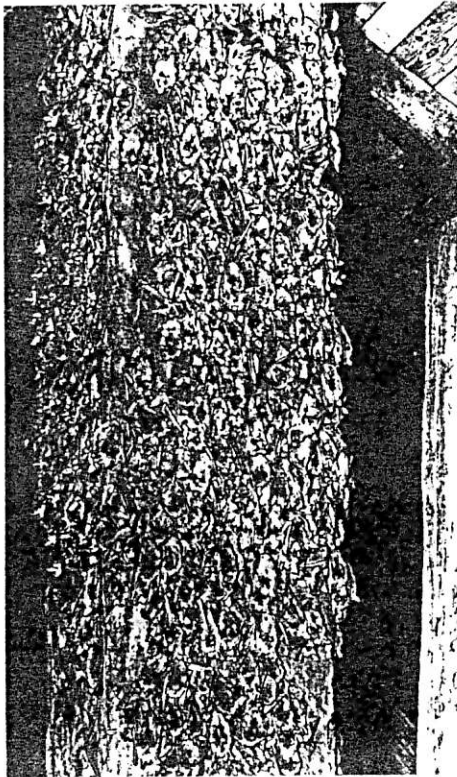


Fig. 5. Roosting place of the colony at mid-day left

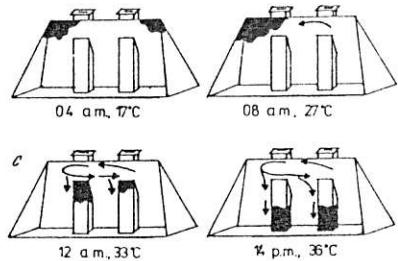


Fig. 6. Different roosting places of bats in the Dărmănești-Suceava shelter, changed in dependence upon air temperature.

In conclusion, bats as heterothermic mammals dependent upon roost supply in their surrounding, are always in search of some shelters whose microclimatic condition have to be in accord with their varying metabolic needs. As inherently the microclimate of the shelters is subject to some variation, the latter determines their movements inside the shelter in order to seek the best place for the diurnal rest or for hibernation. If the microclimatic changes are more discrete and take place over a longer period of time, then also the movements of bats are more discrete and do not stimulate but a part of the colony, as observed in the period of hibernation. But if the climatic changes are more ample and take place within a shorter period of time, then the shifts of bats are also evident, relatively rapid and comprise the whole colony, as observed in some summer shelters. If these changes pass beyond certain limits and become dangerous to the inhabitants of a shelter, then the bats have to leave it even under unfavourable weather conditions.

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