

## BAT SPECIES (MAMMALIA: CHIROPTERA) AND THEIR HABITAT PREFERENCES IN FĂGĂRAȘ MOUNTAINS (ROMANIA)

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**Abstract.** This is the first study on bats inventory performed in Făgăraș Mountains, the main valleys of the northern slope. We aimed to identify bat species and their preferences for different types of habitats. We identified a total of 22 species, which have not been mentioned so far in the literature in this area, belonging to three families: Vespertilionidae, Miniopteridae, Rhinolophidae and a number of 8 genera: *Rhinolophus*, *Eptesicus*, *Myotis*, *Nyctalus*, *Pipistrellus*, *Plecotus*, *Vespertilio*, *Miniopterus*. In the study area, we registered five crossing corridors, 14 feeding areas and two shelters.

**Keywords:** Fagăraș Mountains, the Carpathians, Romania, bat species composition.

### Rezumat. Speciile de lilieci (Mammalia: Chiroptera) și preferințele lor pentru habitate în Munții Făgăraș (România).

Acesta este primul studiu de inventariere a liliecilor care s-a desfășurat pe văile principale ale versantului nordic al Munților Făgăraș. Am urmărit identificarea speciilor de lilieci, precum și preferințele acestora pentru diferite tipuri de habitate. Au fost identificate un număr de 22 specii, care n-au mai fost citate până acum în literatura de specialitate în această zonă, aparținând la trei familii: Vespertilionidae, Miniopteridae, Rhinolophidae și un număr de 8 genuri: *Rhinolophus*, *Eptesicus*, *Myotis*, *Nyctalus*, *Pipistrellus*, *Plecotus*, *Vespertilio*, *Miniopterus*. În zona de studiu au fost înregistrate 5 coridoare de trecere, 14 zone de hrănire și 2 adăposturi.

**Cuvinte cheie:** Munții Făgăraș, Carpați, România, lilieci.

## INTRODUCTION

Făgăraș Mountains totalizing 198,495 ha, with altitudes between 351 m and 2544 m and an average altitude of 1400 m, are located between the Olt Valley to the west, the Bârsa, the Dâmbovița and the Groșetu valleys on the eastern side, Făgăraș Depression on the north and Jiblea, Arefu, Brădet and Campulung Depressions at the south part of the Southern Carpathians. This mountain massif is the largest alpine unit in Romania, being 70 km long and 40 km wide. Făgăraș Mountains Group has a network of dense waters, namely over 0.8 km/km<sup>2</sup>. The climate of Făgăraș Mountains is characterized by temperate and subpolar specific elements having a rough character. On the northern slope, winter lasts for 6 and 7 months. Extreme temperatures range between a minimum of -38°C and a maximum of up to 20°C, the annual average temperature reaching -2°C. In the highlands, rainfall amounts vary between 1200 and 1400 mm/year, while above the beech forests, between 800 and 1000 mm. Up to 1000 m altitude, there predominate beech forests while above this level, *Fagus sylvatica* is mixed with coniferous species, particularly with *Abies alba* and *Picea abies*. On the northern slope of Făgăraș Mountains, above 1200 m, beech and the others deciduous species start to disappear, being replaced by spruce forests (Fig. 1). The forest limit is up to 1600 m (BĂLĂCEANU et al., 1975).

17 bat species are mentioned in the published data of the study area, in the northwestern part of Făgăraș Mountains, specifically in the territorial units of Racovița and Avrig localities. Thus, in the west of the piedmont, in Racovița, there were recorded different species, the most common of them being *Eptesicus serotinus* and the least abundant – *Rhinolophus hipposideros* (MĂRGINEAN & STOICA, 2012). Near this areas, at the former military base Mârșa (Avrig district, Sibiu County), there were also mentioned 9 shelters of the species *R. hipposideros* and 1 migration route with the following species recorded: *Myotis alcathoe*, *M. bechsteinii*, *M. daubentonii*, *Miniopterus schreibersii*, *Eptesicus nilssonii*, *E. serotinus*, *Pipistrellus pipistrellus*, *P. pygmaeus*, *Barbastella barbastellus*, *Nyctalus noctula*, *Rhinolophus hipposideros* (MĂRGINEAN & MESAROȘ, 2012).

## MATERIAL AND METHODS

The field study took place on the northern slope of Făgăraș Mountains, within the territory of Sibiu and Brașov counties. A field campaign was carried during April-October 2011. The method consisted in fixed points transects, started 30 minutes after sunset. The points were chosen generally along the northern slope of Făgăraș Mountains and Piedmont, to be as representative as possible for the transect area. Depending on the selected transect we chose a number of 15 minutes recording points at equal distances (2-5 km), to be representative of for the transect length. During the entire field campaign, we performed a total of 536 recordings in 88 stationary points, resulting 391 determinations from 8 transects. Recordings were made with the Pettersson D240X bat detector and were stored on the Edirol R-09HR recorder. Sounds were analysed in the program BatSound 4; the sonograms settings varied depending on the structure and intensity of pulses. We also checked two underground shelters in Turnu Roșu and Sebeșu de Sus surroundings (Sibiu county).

## RESULTS AND DISCUSSIONS

From the following transects: Strâmbei Valley, Sebeşului de Sus Valley, Moasei Valley, Bârcaciu, Transfăgărăşan, Arpaşu de Sus (Sibiu County), Sâmbăta de Sus and Sebes Valley (Braşov County) we identified the following 22 species: *Nyctalus noctula* (Schreber, 1774), *Pipistrellus pipistrellus* (Schreber, 1774), *Eptesicus nilssonii* (Keyserling & Blasius, 1839), *Myotis daubentonii* (Kuhl, 1817), *Barbastella barbastellus* (Schreber, 1774), *E. serotinus* (Schreber, 1774), *M. bechsteinii* (Kuhl, 1817), *N. leisleri* (Kuhl, 1817), *P. pygmaeus* (Leach, 1825), *Vespertilio murinus* (Linnaeus, 1758), *M. brandtii* (Eversmann 1845), *M. mystacinus* (Kuhl, 1817), *M. nattereri* (Kuhl, 1817), *N. lasiopterus* (Schreber, 1780), *P. kuhlii* (Kuhl, 1817), *M. schreibersii* (Kuhl, 1817), *Rhinolophus hipposideros* (Bechstein, 1800), *M. myotis* (Borkhausen, 1797), *M. emarginatus* (Geoffroy, 1806), *P. nathusii* (Keyserling & Blasius, 1839), *Plecotus auritus* (Linnaeus, 1758), and *P. austriacus* (Fischer, 1829).

1. Strâmbei Valley (Sibiu County). The transect was conducted in July, near Turnu Roşu village, between 448 and 902 m altitude. Its length was of approximately 7 km with 9 recording points (Fig. 2). The broad habitat on this route consisted in deciduous species, following the river course. The analysis of the recordings revealed 8 species: *E. nilssonii*, *E. serotinus*, *M. myotis oxygnathus*, *N. noctula*, *P. pipistrellus*, *P. pygmaeus*, *V. murinus*, *M. schreibersii*. The highest activity was observed in the species *P. pipistrellus* and *N. noctula*, which are common species for Romania, with widespread forest habitats. We also noted the presence of *M. myotis oxygnathus* feeding near the water course.

2. Sebeşului de Sus Valley (Sibiu County). In early September, we started the transect from the exit part of Sebeşu de Sus village toward the mountain. This valley is situated in a parallel line with Moaşei Valley. We took 6 recording points at altitudes between 583 and 809 m (Fig. 3). The habitat consists in mixed forests, which partly follows the route of the river, with riparian vegetation. The identified species are: *B. barbastellus*, *E. serotinus*, *M. daubentonii*, *M. mystacinus*, *N. noctula*, *N. leisleri*, *P. pipistrellus*, *P. pygmaeus*, *V. murinus*, *M. schreibersii*. The most common species found in this transect were *P. pipistrellus* and *M. mystacinus* and most rare in this area were *E. serotinus*, *N. noctula*, *V. murinus* and *M. schreibersii*, the latter being a random presence because we do not know any underground shelters of this species in the study area.

3. Moasei Valley (Sibiu County). Located out of Sebeşu de Sus, towards the mountains, at altitudes between 502 and 788 m, in late April, the transect was 6 km long and we established 6 recording points (Fig. 4). Covered habitats were deciduous and mixed forests, partly with riparian vegetation on the river course. The 10 species identified are: *R. hipposideros*, *B. barbastellus*, *M. bechsteinii*, *M. brandtii*, *M. emarginatus*, *N. leisleri*, *P. kuhlii*, *P. pipistrellus*, *P. pygmaeus*, *V. murinus*. There is a major activity of the genus *Myotis* (*M. bechsteinii*, *M. brandtii*, *M. emarginatus*), their activity being directly correlated with the preferences of these species for forests located nearby water courses.

4. Bârcaciu (Sibiu County). In mid-July we made a transect with 10 recording points between 1560 m and 570 m. The habitats present along the route consist in coniferous, mixed and deciduous forests (Fig. 5). There were no water bodies on almost the entire length of the transect, having a negative influence on bat activity and species richness. Thus, we identified only 6 bat species: *E. nilssonii*, *M. bechsteinii*, *M. daubentonii*, *N. noctula*, *P. pipistrellus*, *P. auritus*. The common species *N. noctula* and *P. pipistrellus* were present. Genus *Myotis* appeared on the intersection of the route with the watercourse. Intense activity of bats was observed on the first 2 recording points, near the tourist lodge at an altitude of 1560 m. From the forest entrance to the intersection with the river, we did not detect any individual. From the river and continuing with the lighting poles near the buildings, bat species were recorded at each point.

5. Transfăgărăşan (Sibiu County), from Bălea Lake (2043 m) to Cârţişoara (533 m), in the first week of September. On the transect route, we took recordings on several types of habitat, in deciduous forests, mixed coniferous and wetlands (Fig. 6). The following species were recorded at that time: *B. barbastellus*, *E. nilssonii*, *E. serotinus*, *N. noctula*, *P. pipistrellus*, *V. murinus*, *M. daubentonii*, *N. lasiopterus* and *M. bechsteinii*. The common species of this transect were *E. nilssonii*, *N. noctula*, *P. pipistrellus* and *E. serotinus*. Surprisingly, *M. bechsteinii* was detected in a small number of individuals.

6. Arpaşu de Sus (Sibiu County). This transect was carried out in August, out of the village towards the mountain from 781 to 662 m altitude. We took 10 recording points. Predominant habitats were deciduous and mixed forests (Fig. 7). The recorded species were: *B. barbastellus*, *E. serotinus*, *M. bechsteinii*, *M. daubentonii*, *M. nattereri*, *N. noctula*, *P. kuhlii*, *P. pipistrellus*, *P. pygmaeus*, *V. murinus*, *M. schreibersii*. *M. daubentonii* were the main observed species at that time, followed by *B. barbastellus*, *P. pipistrellus*, *E. serotinus* and *P. kuhlii*.

7. Sâmbăta de Sus (Braşov County). The transect extended from the Sâmbăta de Sus complex, 947 m elevation upstream to Victoria city, 697 m altitude. In mid-August, there were made recordings in 10 points crossing deciduous and mixed forests (Fig. 8). The identified species were: *B. barbastellus*, *E. nilssonii*, *E. serotinus*, *M. bechsteinii*, *M. daubentonii*, *M. mystacinus*, *M. nattereri*, *N. leisleri*, *N. noctula*, *P. kuhlii*, *P. pipistrellus*, *V. murinus*; the most encountered species were *E. nilssonii*, *P. pipistrellus* and *M. daubentonii*.

8. Sebeş Valley (Braşov County). The route was performed in early October from Măliniş locality towards the mountains (Fig. 9). We took recordings in 5 points, between 420 and 970 m altitude. The species recorded were: *B. barbastellus*, *M. daubentonii*, *N. noctula*, *P. nathusii*, *P. pipistrellus*, *P. pygmaeus*, *P. austriacus*, *V. murinus*. Among these species, the most common ones were *P. pipistrellus* and *P. pygmaeus*.

Crossing corridors to feeding areas: Sebeşu de Sus Valley (1 corridor), Sebeş Valley - Braşov (1 corridor), Sâmbăta de Sus (2 corridors), Arpaşu de Sus (1 corridor), Moaşei Valley (1 corridor). Most of these crossing corridors

were observed at the beginning of bats activity at dusk and also during the night. Generally, these bat corridors followed the watercourses.

Feeding areas. In the studied area, we recorded most bat hunting especially in semi-open areas with light poles near water surfaces/watercourses. Specifically, feeding areas were identified following the transects: Transfagărășan (1 feeding area), Bârcaciu (3 feeding areas), Sebeș Valley - Brașov (1 feeding area), Sâmbăta de Sus (1 area), Arpașu de Sus (2 zones) Moașei Valley (2 zones).

In addition to feeding areas and crossing corridors, we registered hunting bats in flight to feeding habitats, the rest of bats being observed in crossing paths.

Table 1. The presence of bat species in different habitat types in the study area.

Species / habitat types	D+WB	D-WB	MF+WB	MF-WB	CF+WB	CF-WB
<i>R. hipposideros</i>	-	-	+	-	-	-
<i>B. barbastellus</i>	+	-	+	-	-	-
<i>E. nilssonii</i>	+	+	+	+	+	-
<i>E. serotinus</i>	+	+	+	-	+	+
<i>M. bechsteinii</i>	+	-	+	+	+	+
<i>M. brandtii</i>	+	-	+	-	-	+
<i>M. daubentonii</i>	+	-	+	-	-	-
<i>M. myotis/oxygnathus</i>	+	-	-	-	-	-
<i>M. mystacinus</i>	+	-	+	-	-	-
<i>M. nattereri</i>	+	-	+	-	-	-
<i>M. emarginatus</i>	+	-	+	-	-	-
<i>N. lasiopterus</i>	+	+	+	+	-	-
<i>N. leisleri</i>	+	+	+	+	-	-
<i>N. noctula</i>	+	+	+	+	+	+
<i>P. kuhlii</i>	+	+	+	+	+	-
<i>P. nathusii</i>	+	-	-	-	-	-
<i>P. pipistrellus</i>	+	+	+	+	+	+
<i>P. pygmaeus</i>	+	+	+	+	-	-
<i>P. auritus</i>	-	-	-	+	-	-
<i>P. austriacus</i>	+	+	-	-	-	-
<i>V. murinus</i>	+	+	+	+	+	+
<i>M. schreibersii</i>	+	+	+	+	-	-

Notation used was as it follows: D+WB: deciduous forest with water bodies, D-WB: deciduous forest without water bodies, MF+WB: mixed forests with water bodies, MF-WB: forests mixed without water bodies, CF+WB: coniferous forest with water bodies, CF-WB: coniferous forests without water bodies.

*B. barbastellus* was mainly recorded in deciduous forests, in 6 of the 8 transects, being identified even at the altitude of 2043 m hunting over Bâlea Lake. *E. serotinus* was countered in 5 of the 8 transects in all habitat types except mixed forests without body surfaces. *E. nilssonii* had significant activity in 4 of the 8 transects. It preferred mixed and coniferous forests and it was seen hunting near lakes and light poles from 390 to 2043 m altitude (STOICA & MĂRGINEAN, 2012). The genus *Myotis* is mainly associated with deciduous and mixed forests with habitats found in the vicinity of rivers, with the exception of *M. bechsteinii* encountered at altitudes from 660 to 1440 m in coniferous forests (pine) and mixed forests, near water bodies. Authors presume the existence of the species *M. oxygnathus* (TOMES, 1857) in the studied area, but its distinction based on ultrasounds parameters by the species *M. myotis* was not possible until the paper publication. *M. myotis* was detected only in deciduous forests with watercourses. Characteristic for habitats of riparian vegetation and watercourses, *M. daubentonii* recorded significant activity, being present in 6 of the 8 transects, preferring mixed and deciduous forests. In Făgăraș Mountains, we recorded this species between 692 and 913 m altitude. The presence of *M. brandtii* was rather weak, in only 2 of the 8 transects, being observed in deciduous and mixed forests, from 375 to 1105 m. These features cannot be 100% conclusive due to the difficulty of determining such indication of preferred habitat for this species (STOICA, 2012). *M. mystacinus* and *M. nattereri* was detected in 2 of the 8 transects. *M. mystacinus* registered a great activity on Sebeșu de Sus Valley transect. *N. lasiopterus* and *N. leisleri* were not detected in coniferous forests. *N. leisleri* was recorded over 710 m up to 1723 m altitude and *N. lasiopterus* between 685 and 1449 m altitude. Like *E. nilssonii*, *P. kuhlii* was recorded in all habitat types except coniferous forests without water bodies, around 700 m altitude. *P. pygmaeus* was observed feeding in Sebeș Valley, Brașov County. In the other 5 transects, it was detected in all habitat types except coniferous forests, between 584 and 898 m altitude. *P. auritus* and *P. austriacus* were recorded in 1 transect each. *P. auritus* was found in mixed forest without water surface and *P. austriacus* in deciduous forests. *M. schreibersii* was found in mixed forests and deciduous forests without water body. *R. hipposideros* was detected on Moașei Valley only, in a habitat of mixed forest, from 420 to 532 m altitude. The presence of this species was observed in the two shelters: 14 individuals in the abandoned mine Turnu Roșu and 2 individuals in a small cave of the Sebeșu de Sus village (Sibiu County).

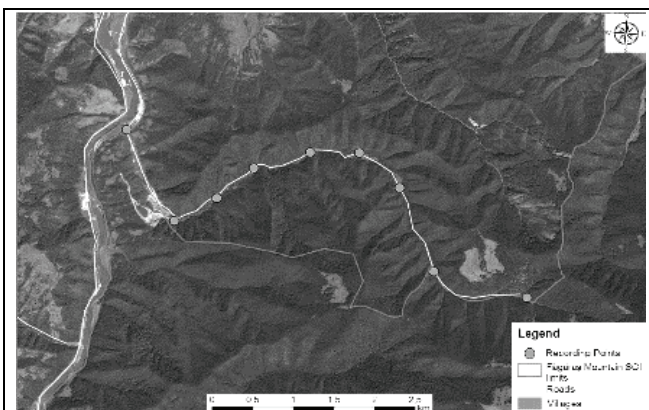


Figure 2. Strâmbei Valley Transect, Sibiu County. Map design: Stoica Vasile – Alexandru and Laurian Gheorghe – SPOT Image 2007 provided by the Ministry of Environment and Forests.

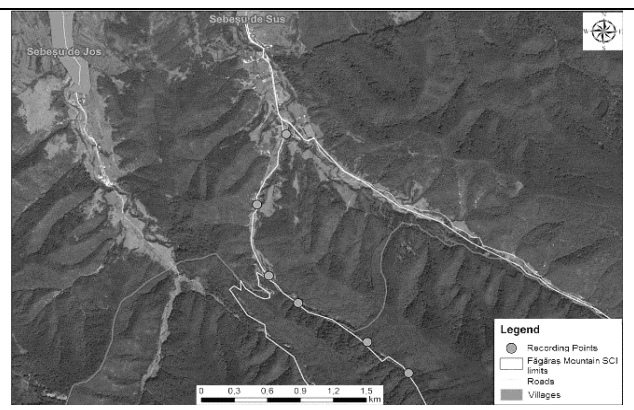


Figure 3. Sebeșu de Sus Valley Transect, Sibiu County. Map design: Stoica Vasile – Alexandru and Laurian Gheorghe – SPOT Image 2007 provided by the Ministry of Environment and Forests.



Figure 4. Moașei Valley Transect, Sibiu County. Map design: Stoica Vasile – Alexandru and Laurian Gheorghe – SPOT Image 2007 provided by the Ministry of Environment and Forests.

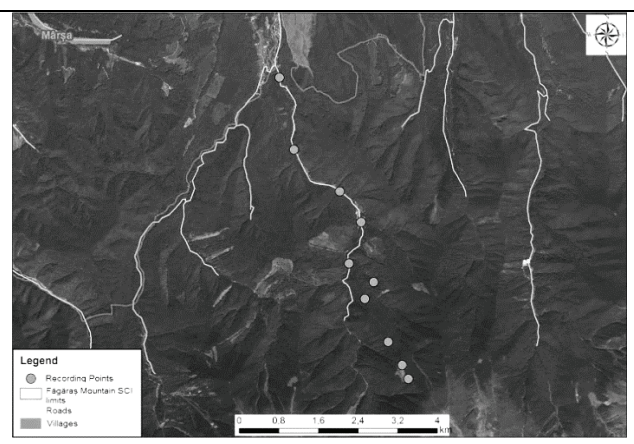


Figure 5. Bârcaciu Transect, Sibiu County. Map design: Stoica Vasile – Alexandru and Laurian Gheorghe – SPOT Image 2007 provided by the Ministry of Environment and Forests.

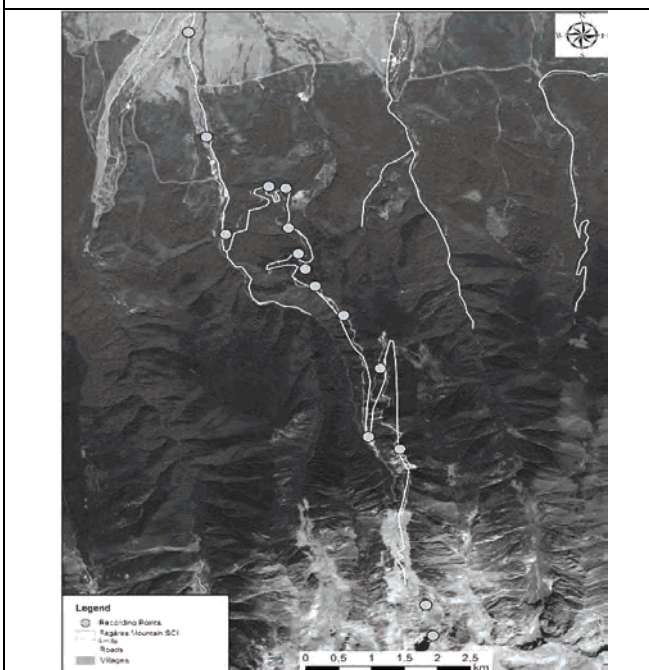


Figure 6. Transfăgărășan Sibiu Transect. Map design: Stoica Vasile – Alexandru and Laurian Gheorghe – SPOT Image 2007 provided by the Ministry of Environment and Forests.

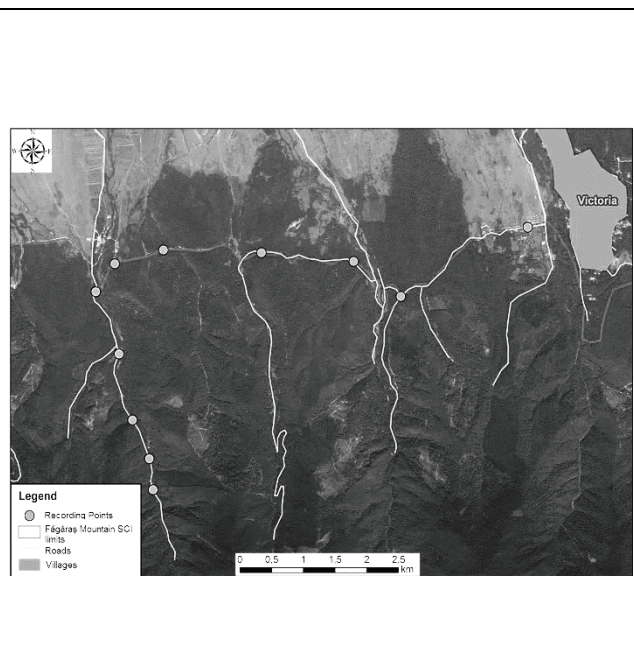


Figure 7. Arpașu de Sus Transect, Sibiu County. Map design: Stoica Vasile – Alexandru and Laurian Gheorghe – SPOT Image 2007 provided by the Ministry of Environment and Forests.

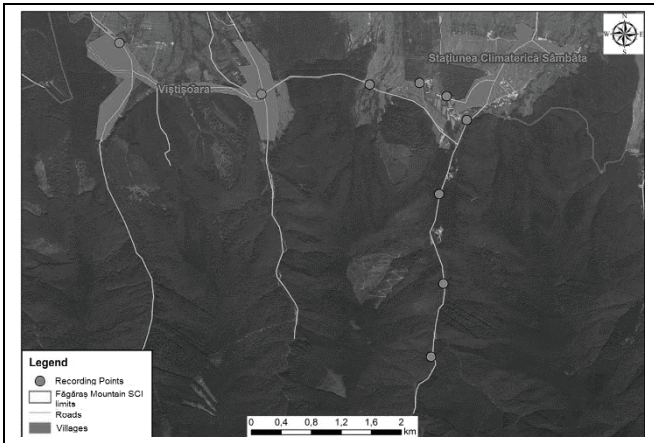


Figure 8. Sâmbăta de Sus Transect, Brașov County. Map design: Stoica Vasile – Alexandru and Laurian Gheorghe –SPOT Image 2007 provided by the Ministry of Environment and Forests.

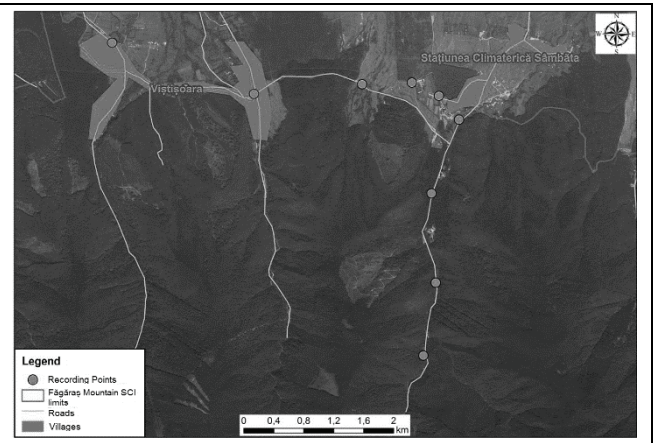


Figure 9. Sebeș Valley Transect, Brașov County. Map design: Stoica Vasile – Alexandru and Laurian Gheorghe –SPOT Image 2007 provided by the Ministry of Environment and Forests.

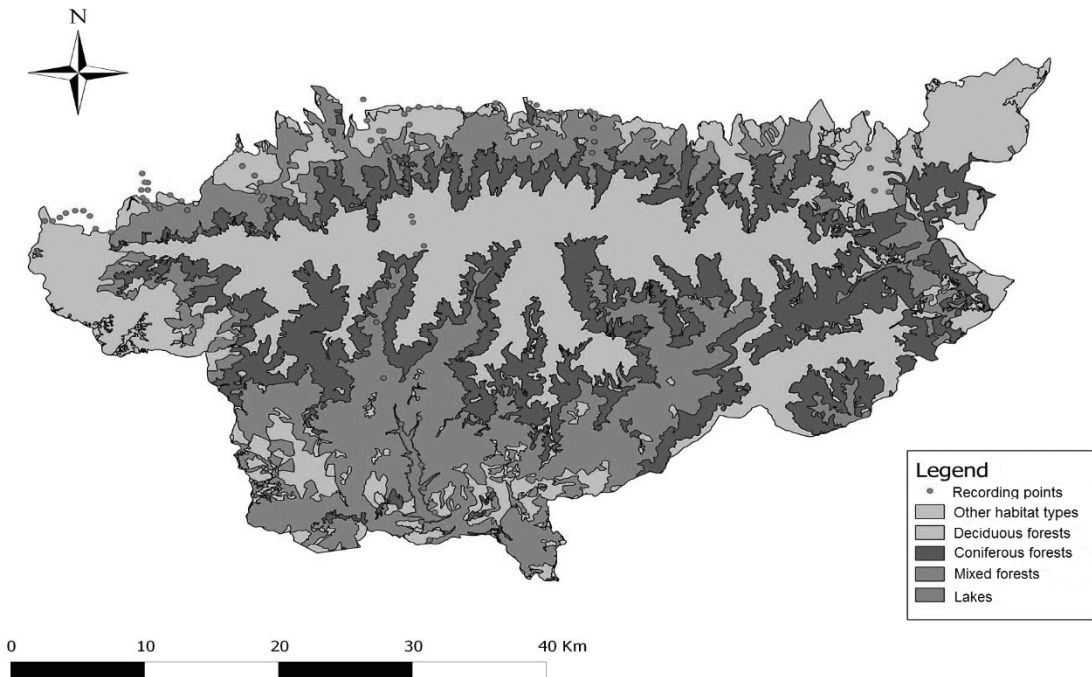


Figure 1. Habitat distribution map in Făgăraș Mountains. Map design: Stoica Vasile – Alexandru and Laurian Gheorghe –SPOT Image 2007 provided by the Ministry of Environment and Forests.

### CONCLUSIONS

Given all the examined transects throughout the study area, we found here 71% of the Romanian bat fauna. The common species were *V. murinus*, *P. pipistrellus* and *N. noctula*. These species were present in all habitat types at varied altitudes. The rarest encountered species at that time were *M. nattereri*, *P. nathusii*, *P. auritus* and *P. austriacus*.

Concerning the transects, the strongest similarity was noted between Sebeșului de Sus and Arpașu de Sus valleys. That transects traversed similar habitats with deciduous and mixed forests, with surface water and similar altitudes. Both of these transects, together with Sâmbăta de Sus present similarities regarding bat fauna composition with Transfăgărașan, because the latter presents most habitat types on varying altitudes. Bârcaciu shows a negative similarity to the rest of the transects. One explanation could be the absence of water bodies on most of its length.

**ACKNOWLEDGEMENTS**

Special thanks to Michel Barataud for his precious help in clarifying species difficult to determine on pulses. This study was partly performed within the project "Inventory of bat populations in sites of Community Importance (SCI) According to the Habitats Directive in Romania" project Issued by the Bat Working Group of Natuurpunt vzw. with support from the Agency for Nature and Forest, Belgium Flanders.

**REFERENCES**

- BĂLĂCEANU V., CICOTTI M., CRISTEA E., 1975. *Munții Făgărașului*. Edit. Sport-Turism. 5-25.
- MĂRGINEAN GEORGIANA & MESAROȘ ANA-MARIA. 2012. Shelter and habitat preference of bats in Mârșa area (Sibiu County, Romania). *Annual Zoological Congress of Grigore "Antipa Museum" - Book of abstracts*. (Eds. Murariu D. et al.). „Grigore Antipa” National Museum of Natural History. Bucharest. Romania. 184 pp.
- STOICA V. A. & MĂRGINEAN GEORGIANA. 2012. Study regarding the bat communities (Mammalia: Chiroptera) from Făgăraș Mountains (Romania). *Annual Zoological Congress of Grigore "Antipa Museum" - Book of abstracts* (Eds. Murariu D. et al.). „Grigore Antipa” National Museum of Natural History. Bucharest. Romania. 158 pp.
- STOICA V. A. 2012. Studiu asupra comunităților de chiroptere (Mammalia: Chiroptera) din Munții Făgărașului. *Dissertaton thesis*. Lucian Blaga University of Sibiu. Romania. 71 pp.
- VALENCIUC N. 2002. *Fauna României. Mammalia. Fascicula 3. Chiroptera*. Edit. Academiei Române București. **16**: 1-166.

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Received: March 23, 2014  
Accepted: May 26, 2014