

The bat fauna hibernating in the caves of the Polish Tatra Mountains, and its long-term changes

Research Article

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Abstract: We monitored bats hibernating in the Tatra Mountains during winters between 1997 and 2012. The Tatras are Central Europe's second-highest massif after the Alps. Our winter censuses identified 14 species of bats hibernating in caves of the Polish Tatras. The most characteristic features of these winter bat assemblages were the dominance of *Myotis mystacinus* and high numbers of *Eptesicus nilssonii*. During the monitoring period, we noted qualitative and quantitative changes in the hibernating bat fauna. Two thermophilous species not recorded earlier and absent during the entire Holocene appeared: *Rhinolophus hipposideros* and *Myotis emarginatus*. The abundance of *M. mystacinus*, *M. daubentonii*, *E. nilssonii* and *Plecotus auritus* increased. We found no such changes in the abundance of *M. myotis* or *M. nattereri*. The Tatra Mountains are a key region for the occurrence of bats of the *mystacinus* group (particularly *M. mystacinus sensu stricto*) in Europe, and for *E. nilssonii* an important region in Central Europe.

Keywords: Winter census • Long-term monitoring • Upward trends • Altitudinal range extension • Central Europe • *Myotis mystacinus* • *Eptesicus nilssonii*.

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1. Introduction

In the last few decades, great changes in the abundance and distribution patterns of many plant and animal species have been observed [1]. In bats, these changes are particularly noticeable because their ability to fly gives them mobility and ease of migration [2]. Among the many factors triggering such changes are fragmentation and degradation of natural habitats, deforestation, destruction of roost sites, global environmental changes, natural disasters (fires, cyclones, flooding), diseases (e.g., white nose syndrome), pesticide poisoning, chemical pollution, silting of waterways, disturbance by biologists and caving enthusiasts, and hunting [2-6]. Since bats (particularly insectivorous ones) occupy high trophic levels and are vulnerable to these stressors, they may be an ideal indicator of environmental changes [2]. Appropriate and effective research methods are needed to assess these changes. Because bats are a very diverse group of mammals, a variety of methods

are employed to evaluate changes in their abundance and distribution [7]. For temperate, cave-dwelling bats, long-term changes can be estimated by counting bats hibernating in winter. This method is simple, cost-effective, and facilitates comparisons among datasets.

Studies and programs based on winter censuses have been carried out in Europe and North America, a number of which have lasted several decades [8-25 and many others]. A great number of projects of this type – local, regional or supra-regional in scope – have been implemented in areas of low elevation. However, fewer projects are ongoing in high mountain areas, which are protected and are subject to fewer anthropogenic impacts.

The Tatra Mountains are Central Europe's highest massif and Europe's highest after the Alps. There is a long tradition of chiropterological studies in these mountains. The first mention of the bats of this region dates back to the late 19th century [26]. The first data on bats hibernating in the Tatras were reported by

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