THE HERPETOFAUNA OF THE MARAMUREŞ MOUNTAINS NATURAL PARK

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ABSTRACT

An inventory of the herpetofauna of the Maramureş Mountains Natural Park was conducted in 2007 over a period of three weeks. Amphibians and reptiles were found at 116 sites, where 13 species were inventoried, of which seven reptile and six amphibian species. Based on the distribution of herpetofauna in the nearby areas, in Ukraine and in the Maramureş County, we estimate that an additional six amphibian species are probably present in the natural park. Two species of amphibians were previously reported in the park but their presence was not confirmed during our inventory.
The altitudinal range covered during our inventory was 360-1900m, and higher species richness was observed at altitudes of 700-1000m as well as 1500-1600m. Species richness was positively correlated with traditional human activities. Based on the results of this inventory, five types of habitats have been identified for future monitoring activities.

Keywords*: amphibians, reptiles, herpetofauna, Maramureş Mountains Natural Park, inventory, monitoring.*

INTRODUCTION

Measuring biodiversity has become a priority target. In 2002, the 188 countries that are signatories to the Convention on Biological Diversity committed to achieve by 2010 a significant reduction of the current rate of biodiversity loss at global, regional and national level [1]. The first step of the measures directed to stop and reduce the present rate of biodiversity loss should be a better knowledge of species inventories and distribution, especially for species that are known to be worldwide declining worldwide. According to a recent global survey of 5.743 amphibian species, almost a third (1.856 species) were considered endangered and vulnerable [2-3]. An additional 1.300 species are probably also threatened, but scientists did not have sufficient data to asses their status [2]. Reptiles are considered to be undergoing a decline even more marked than the one affecting amphibians [4]. Population trends (including potential declines and their causes) can be detected only using long-term studies [5]. However, it was repeatedly shown that the habitat parameters describing habitat quality are often good predictors of the population status, and these data can be gathered using short-term surveys. Factors such as habitat loss and degradation, introduced invasive species, environmental pollution, disease and parasitism, unsustainable use, and global climate change are suspected to be associated with the decline of both amphibians and reptiles. An additional category comprises unexplained declines and cumulative effects of more than one factor could be the cause of decline [2, 3-6].

In the present paper, we report the results of a preliminary inventory of herpetofauna of the Maramureş Mountains Natural Park (MMNP), and identify the threats that could endanger amphibian and reptile populations. Based on the results of the inventory we selected several habitat types for future monitoring activities.

MATERIALS AND METHODS

Maramureş Mountains Natural Park (MMNP) is located in the northeast part of Maramureş County, Romania. It covers approximately 150.000 ha out of which 9.050 ha are nature reserves and 139.800 ha are protected landscape. The altitude varies between 300 and 1970 m a.s.l. The area receives an average 900 mm of rainfall annually and has an average annual temperature of 6^{o}C.

Two field trips were done, one in the north part of MMNP in June 2007, and the other in the eastern part of MMNP in August 2007. Most of the inventoried area is within the nature reserves, outside the populated areas. We used a combination of visual encounter, active search and dipnet sampling techniques to detect amphibians and visual encounter and active search for reptiles. The exact location and altitude of each inventory site was measured and recorded using a GPS device. We also recorded the characteristics of aquatic and terrestrial habitat (type, area, maxim depth, pH, conductivity, vegetation, presence of predators) and the human impact.

We built our distribution maps using *ArcGIS Desktop 9.2* (Environmental Systems Research Institute). A species accumulation curve was computed for amphibians and reptiles based on individual site data (i.e. sample based) using *EstimateS 7.5* [7]. Sample order was randomized 50 times and mean richness estimate was computed for each sample accumulation level. This removes the effect of sample order and generates a smoother curve. Due to incomplete sampling, estimators were derived to predict the true number of species based on the proportion of rare species in a sample [8]. We selected four estimators based on presence-absence data: incidence based coverage (ICE), Chao 2, Jackknife 2 (Jack 2), and Bootstrap estimators [7].

RESULTS AND DISCUSSION

Amphibians and reptiles were identified in 116 sites. A total of 225 species/site observations were conducted. The inventory of amphibians and reptiles includes 13 species, of which seven reptiles (*Lacerta vivipara, Lacerta agilis, Anguis fragilis, Natrix natrix, Elaphe longissima, Coronella austriaca* and *Vipera berus*), and six amphibians (*Salamandra salamandra, Triturus montandoni, Triturus alpestris, Bombina variegata, Bufo bufo* and *Rana temporaria*). The most abundant species were *Bombina variegata, Triturus montandoni*, *Rana temporaria* and *Lacerta vivipara*. Two species (*Bufo viridis* and *Rana dalmatina*) were previously reported in the park but their presence has not yet been confirmed.

Except for several alpine lakes and ponds with high amphibian species richness, we found only a low species richness (1-3 species) in most inventoried sites (Figure 1a, 1b).

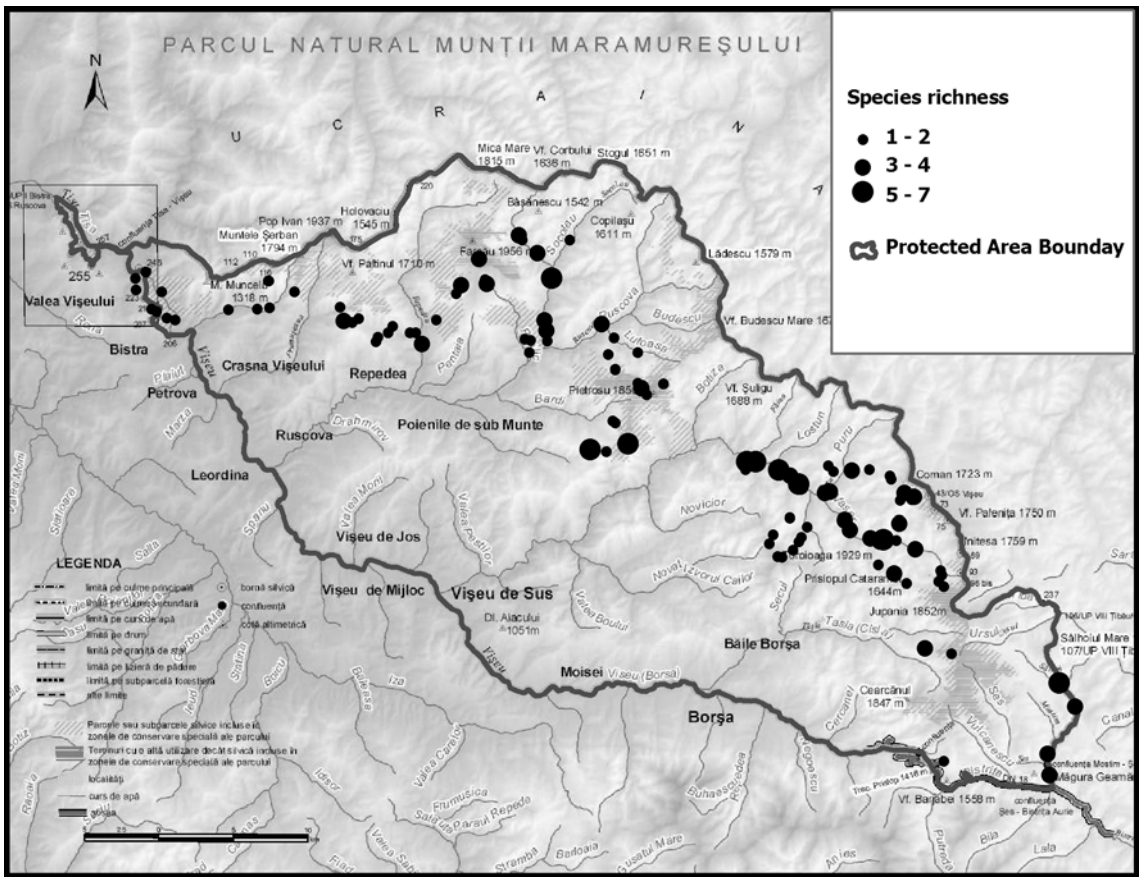

Fig. 1a. The relative species richness of amphibian and reptile species in MMNP.

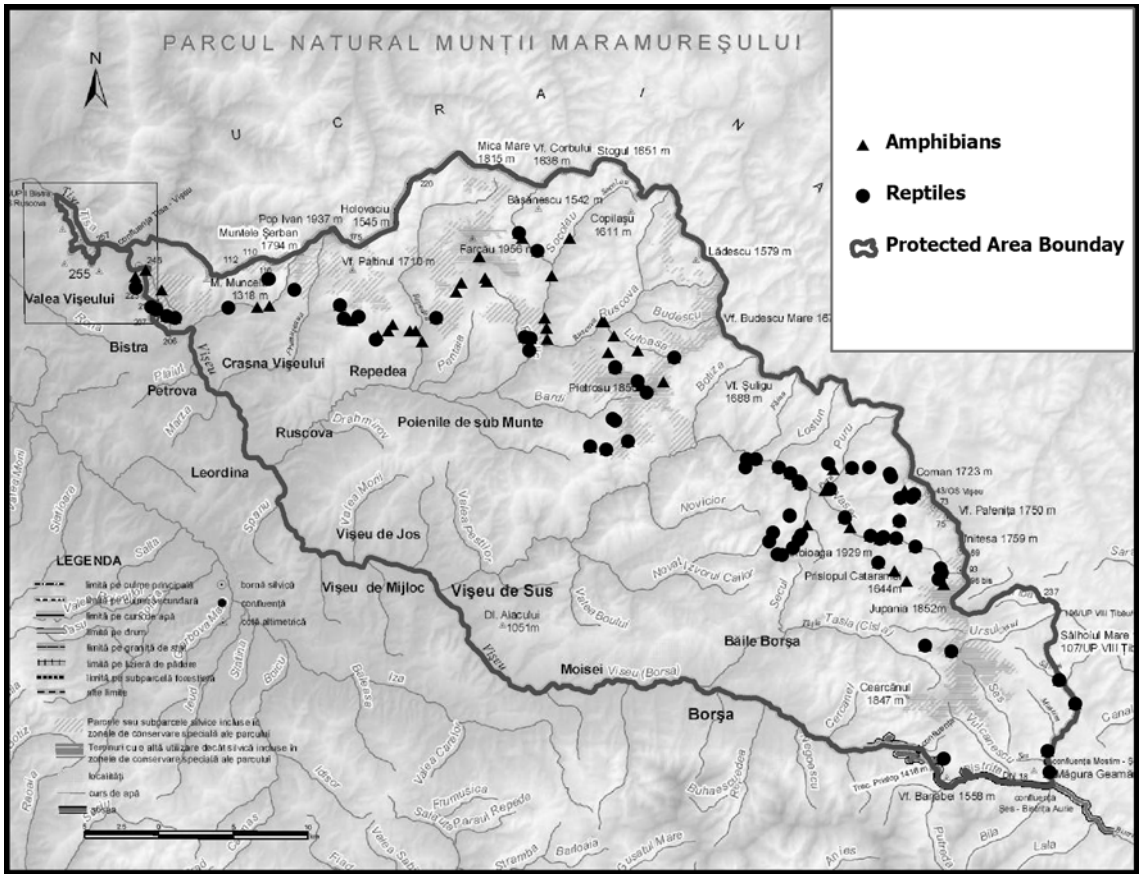

Fig. 1b. The spatial distribution of amphibian and reptile species in MMNP.

Along an altitudinal gradient inventoried (360-1900m), the altitudinal distribution was bimodal, with two peaks: one between 700 and 1000 m a.s.l. and the second between 1500 and 1600 m (Figure 2). Based on the altitudinal range, the most common species found in the park can be grouped in two categories: low altitude (first four species) and high altitude (last four species), but without a clear separation between their altitudinal ranges (Table 1).

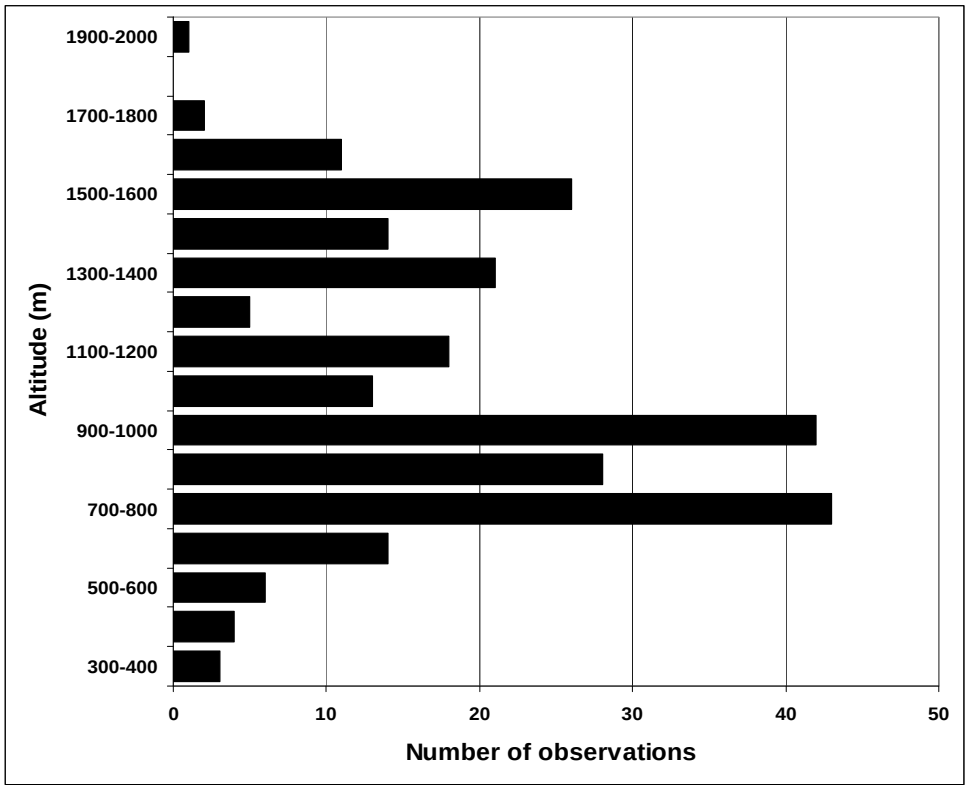

Fig. 2. The frequency of amphibian and reptile observations along an altitudinal gradient.

Table 1. Altitudinal range of the most frequent amphibian and reptile species. Where N represents the number of observations for each species.

Altitude (m)	*Anguis fragilis*	*Bombina variegata*	*Bufo bufo*	*Lacerta agilis*	*Lacerta vivipara*	*Rana temporaria*	*Triturus alpestris*	*Triturus montandoni*
Average	953.8	906.6	931.4	906.8	1212.7	1092.6	1306.0	1095.9
Median	980	837	866	815	1264.5	998.5	1513	941.5
Standard deviation	197.9	290.8	301.1	226.4	295.7	325.4	364.3	366.9
Range	549	1219	1090	744	1223	1280	897	1045
Minimum	655	366	547	578	700	400	778	630
Maximum	1204	1585	1637	1322	1923	1680	1675	1675
N	9	56	14	11	56	44	17	36

The species accumulation curve indicates a slow saturation without reaching a plateau. The estimators of species richness indicate a maximum of 13 or 14 species (Figure 3).

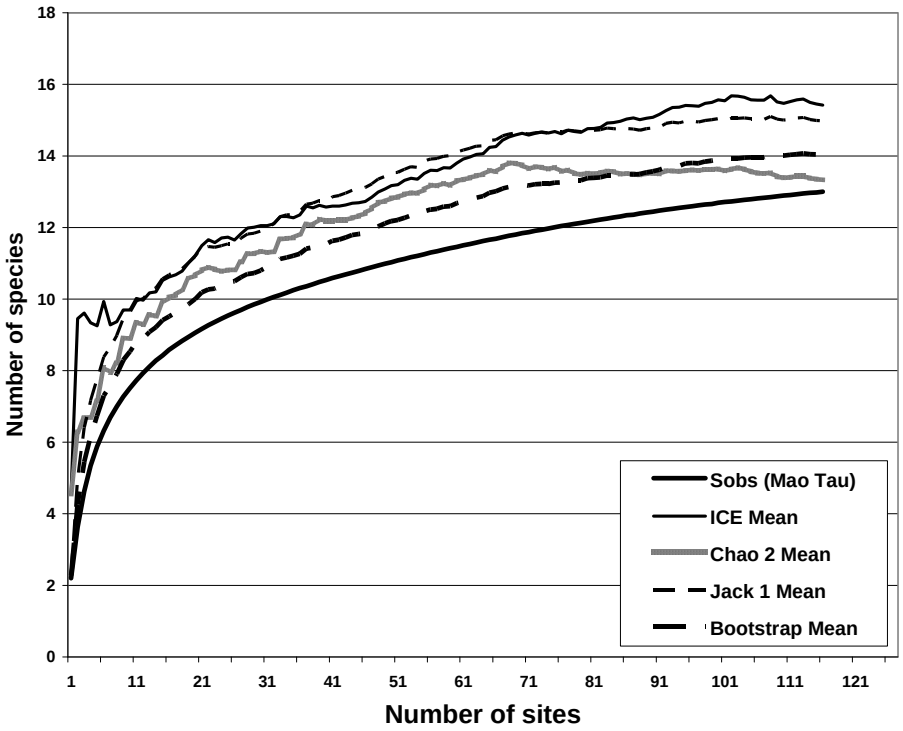

Fig. 3. Accumulation curve and sample-based species richness estimators (Sobs – observed species, ICE mean - incidence based coverage estimator, Chao 2 Mean, Jack 2 Mean and Bootstrap Mean).

Based on distribution records from nearby Ukraine [9-10] and Maramureş County [11-16] we estimate a presence of probably six additional amphibian species (*Triturus dobrogicus, Triturus vulgaris, Rana dalmatina, Hyla arborea, Rana esculenta, Rana ridibunda*).

Amphibian populations depend for reproduction on the aquatic habitats in the park, most often temporary or man-made, with the exception of alpine lakes, bogs and mires. The maintenance of these temporary habitats (which include ditches, car prints, holes, depressions, trenches etc.) is vital for the persistence of amphibian communities in an area where the availability of habitats is extremely limited.

The human impact is strong and diverse in the park, including but not limited to clear-cutting, grazing, erosion, pollution and mining. While the overall status and quality of the forests was bad, experiencing massive beetle invasions, windfalls, and inadequate forestry practices, the area around the villages has high habitat diversity. This is due to traditional human activities like animal keeping and breeding, low-scale agricultural activities, and logging that in turn maintain higher habitat and species diversity. Reptiles, especially snakes, were often found slaughtered, the victims being not only adders (*Vipera berus*) but also any other snake species, including the very common limbless lizard *Anguis fragilis*.

For future monitoring program within the park, we have identified five types of habitats that correspond to the minimal criteria set for the inclusion in a monitoring program: permanence, low or high human impact (but without involving its destruction), high species diversity and/or the presence of keystone species. The selected habitat types are: (i) aquatic habitats from the alpine area (lakes, bogs, mires); (ii) Vaser Valley, between Măcârlău and Suligu, strongly impacted by logging and tourism, with a high variety of habitats along the railway; (iii) the pastures and hay fields around the village of Poienile de sub Munte, an area with high habitat diversity severely impacted by human activities (sawdust pollution, logging, construction, erosion etc.); (iv) the wetlands along the Tisa River, near the confluence with Vişeu River to search for the presence of several potential amphibian species (*Triturus dobrogicus, T. vulgaris, Hyla arborea, Rana dalmatina, Bufo viridis, Rana esculenta, R. ridibunda*); and (v) highly degraded habitats by mining to monitor the success or failure of ecological restoration, identify resilient species with a potential for intensive use in reconstruction.

CONCLUSIONS

Our study offers a recently conducted inventory of the herpetofauna in the MMNP as background for a future monitoring program. Several aspects remain to be studied in the near future like the presence of additional amphibian species in the park and the factors responsible for the observed altitudinal gradient.

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