

Herpetofaunistic diversity in Lipova Hills, western Romania: Actual and past causes

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Abstract. In the southern side of the Lipova Hills we found 11 amphibian species, 9 reptile species and 2 types of hybrid between amphibian species. The herpetofauna of the region contains lowland, hill and mountain related species. Also, in the area are present southern species in the vicinity of the northern limit of their distribution range, and related species in the mountainous areas, found at lower altitudes than usually. The mixture of mountain and lowland species is a consequence of the current aspect of the region, with wide valleys located between hill ridges, valleys that allow the advancement of these lowland species in the hill areas. The second aspect is a consequence of the history of the region. Currently the herpetofauna of the Lipova Hills is greatly advantaged by the relatively large forest covered areas.

Key words: amphibians, reptiles, altitude, relief, distribution, continuity, forests.

Introduction

Recently, new data on the distribution of the Romanian herpetofauna were reunited in two monographic articles (Cogalniceanu et al. 2013a,b). However, despite the large volume of information, they don't cover the surface of the country evenly, nor all species properly, but tend to focus more on species with conservative value or easily detectable or on protected areas (Cogalniceanu et al. 2013a,b). Thus, on the herpetofauna distribution maps, areas with little data can be observed, like the Banat region, from southwestern Romania (Cogalniceanu et al. 2013a,b). Despite the new data (Bogdan et al. 2011, 2013, Iftime & Iftime 2013), in Banat, there are areas that are still poorly studied. This applies also to Lipova Hills, where detailed data is available only for the small northern sector (Covaciu-Marcov et al. 2005) or for a single species (Covaciu-Marcov et al. 2010), but the southern region, a much larger surface, is still a white spot (see in: Cogalniceanu et al. 2013a,b). The importance of the knowledge of the herpetofauna distribution has increased as a result of climate changes that may affect this group, making an extinction of some species in Romania expectable in the future (see in: Popescu et al. 2013). These effects are likely to be even more obvious in Banat, where the herpetofauna of the lowland areas is strongly affected anthropogenically (Bogdan et al. 2013). Thus, this material intends to contribute to the knowledge of distribution, zoogeographic importance and status of the herpetofauna in Lipova Hills of the Banat area.

Material and Methods

Field research was carried out during 2010, 2011 and 2012. The Lipova Hills are located in western Romania, south of the Mures River (Tufescu 1986). To the west, they are neighbored by units of the Western Plain, to the east they continue into Poiana Rusca Mountains, their eastern sector being represented by Bulza Hills (Posea & Badea 1984). The Lipova Hills have low altitudes, generally 200-300 m, higher in the eastern sector. The hills are more developed on the southern flank, where streams are longer, flowing into the Bega River (Mândruţ 2006). In total, we analyzed the herpetofauna in the vicinity of 49 localities in the southern part of Lipova Hills (Table 1), the northern sector, with a reduced area, being recently investigated (Covaciu-Marcov et al. 2005). As in other similar studies (e.g. Bogdan

et al. 2011, 2013), field research was conducted by direct methods, observing and determining encountered animals, including those killed by cars or directly by humans. In the case of amphibians, animals were caught with nets from their aquatic habitats. Only few specimens were captured and photographed, and were always released in their habitats.

Results

In Lipova Hills, we identified 11 species of amphibians (*Salamandra salamandra*, *Triturus cristatus*, *Lissotriton vulgaris*, *Bombina bombina*, *B. variegata*, *Hyla arborea*, *Bufo bufo*, *B. viridis*, *Pelophylax ridibundus*, *Rana dalmatina*, *R. temporaria*), 2 hybrid between amphibian species (between *B. bombina* and *B. variegata*, as well as *P. esculentus*) and 9 reptile species (*Emys orbicularis*, *Lacerta agilis*, *L. viridis*, *Darevskia praticola*, *Anguis fragilis*, *Natrix natrix*, *N. tessellata*, *Coronella austriaca*, *Vipera berus*). The most common amphibian species, *R. dalmatina*, was identified in 38 localities. It was followed by *P. ridibundus* (present in 33 localities) and *L. vulgaris* (found in 24 localities). Compared to amphibians, reptiles were poorly represented, the most common species being *N. natrix*, present in 25 localities and *L. agilis* in 16 localities. In contrast, *P. esculentus* and *D. praticola* were observed only in one locality each (Table 1).

In total, we identified 297 distribution locations for the 20 species and 2 hybrid forms in the 49 investigated localities from the Lipova Hills area (Table 1). The largest number of species identified in a single location was 14, more than half of the total found in the region. This situation was registered in Charlottenburg, in western Lipova Hills. We encountered 13 species in Costeiu de Sus, Nemesesti and Zorani, 12 species in Bulza, villages in the western Lipova Hills, in the Bulza Hills area. There were locations where we encountered a single species. The average number of species per locality was 6,061.

Discussions

In the Lipova Hills area there are more species of the herpetofauna, than in the plain sectors of western Banat (Bogdan et al. 2013), slightly less than in Poiana Rusca Mountains

Table 1. Distribution of amphibian and reptile species in the Lipova Hills (Ss=*Salamandra salamandra*, Tc=*Triturus cristatus*, Lv=*Lissotriton vulgaris*, Bb=*Bombina bombina*, Bv=*Bombina variegata*, BX=*Bombina bombina* X *Bombina variegata*, Ha=*Hyla arborea*, Buf=*Bufo bufo*, Buv=*Bufo viridis*, Pr=*Pelophylax ridibundus*, Pe=*Pelophylax kl. esculentus*, Rd=*Rana dalmatina*, Rt=*Rana temporaria*, Eo=*Emys orbicularis*, La=*Lacerta agilis*, Lv=*Lacerta viridis*, , Dp=*Darevskia praticola*, Af=*Anguis fragilis*, Nn=*Natrix natrix*, Nt=*Natrix tessellata*, Ca=*Coronella austriaca*, Vb=*Vipera berus*).

Locality	Ss	Tc	Lv	Bb	Bv	BX	Ha	Buf	Buv	Pr	Pe	Rd	Rt	Eo	La	Lv	Dp	Af	Nn	Nt	Ca	Vb
Altringen	-	-	-	-	-	-	X	-	-	X	-	X	-	-	X	-	-	-	X	-	-	-
Balint	-	-	X	X	-	-	-	-	-	X	-	X	-	-	-	-	-	-	X	-	-	-
Bara	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Bencecu de Jos	-	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Bethausen	-	-	X	X	-	-	X	-	X	X	-	X	-	-	-	-	-	-	X	-	-	-
Bichigi	X	-	-	-	X	-	X	-	-	-	-	X	-	-	X	-	-	-	X	-	-	-
Bodo	-	-	-	X	-	-	X	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Bogda	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Brestovat	-	X	X	X	-	X	X	X	-	X	-	X	-	-	X	X	-	-	X	-	-	-
Bunea Mare	X	-	X	-	X	-	-	X	-	-	-	X	-	-	X	-	-	-	-	-	-	-
Bulza	X	-	-	-	X	-	X	X	-	-	X	X	-	X	X	X	-	X	X	X	-	-
Buzad	-	X	X	-	X	-	X	X	-	X	-	X	-	X	X	-	-	X	X	-	-	-
Charlotenburg	-	X	X	X	X	X	X	X	X	X	-	X	-	X	X	-	-	X	X	-	-	-
Cladova	-	-	-	-	X	-	X	X	-	X	-	X	-	-	-	X	-	-	X	-	-	-
Comeat	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Costeiu de Sus	X	-	X	-	X	-	X	X	X	X	-	X	X	-	X	X	-	X	X	-	-	-
Cralovat	-	-	-	-	-	-	-	X	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Cutina	-	-	-	X	-	-	X	-	X	X	-	X	-	-	-	-	-	-	-	-	X	-
Dubesti	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Faget oras	-	-	-	-	-	-	X	X	-	-	-	X	-	-	-	-	-	-	X	-	-	-
Faget Dealu Inalt	X	-	-	-	X	-	-	X	-	-	-	X	-	-	-	-	X	-	X	-	-	-
Fibis	-	-	-	X	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Ghizela	-	X	X	X	-	-	X	-	X	X	-	X	-	-	-	-	-	-	X	-	-	-
Grosi	X	X	X	-	X	-	X	X	-	-	-	X	X	-	X	X	-	X	X	-	-	-
Herneacova	-	X	X	-	-	-	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Hisias	-	X	X	X	-	-	X	-	X	X	-	X	-	-	-	-	-	-	X	-	-	-
Hodos	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leucusesti	-	-	X	X	-	-	X	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Lucaret	-	-	-	-	-	-	X	-	-	X	-	-	-	-	X	-	-	-	X	-	-	-
Manastiur	-	-	-	X	-	-	X	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-
Marginea	-	-	-	-	-	-	X	X	-	X	-	X	-	-	X	X	-	-	X	X	-	-
Masloc	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Nemesesti	X	-	X	-	X	-	X	X	X	X	-	X	-	-	X	X	-	X	X	-	-	-
Ohaba Lunga	X	-	X	-	X	-	-	X	-	X	-	X	-	-	-	X	-	X	X	-	X	X
Ohaba Romana	X	-	X	-	X	-	-	X	-	X	-	X	-	-	-	X	-	X	-	-	-	X
Paniova	-	-	X	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Pischia	-	-	-	X	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Povargina	X	-	X	-	X	-	X	X	-	-	-	X	-	-	X	-	-	-	X	-	-	-
Rachita	-	-	-	-	-	-	X	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-
Remetea Lunca	-	-	X	-	-	-	X	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Remetea Mica	-	-	X	X	-	-	X	X	X	X	-	X	-	-	X	-	-	-	-	-	-	-
Salciua Noua	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-
Sintar	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-
Sintesti	X	-	X	-	X	-	X	X	X	-	-	X	-	-	-	X	-	X	X	X	-	-
Sanovita	-	-	X	X	-	-	-	-	X	X	-	-	-	-	-	-	-	-	X	-	X	-
Targoviste	-	-	X	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-
Temesesti	-	-	-	-	-	-	X	X	-	-	-	X	-	-	-	-	-	-	X	X	-	-
Tes	-	-	-	X	-	-	X	-	X	X	-	-	-	-	X	-	-	-	-	-	-	-
Zorani	X	-	X	-	X	-	X	X	X	-	-	X	-	-	X	X	-	X	X	X	-	-
Total localities	12	7	24	16	15	2	32	24	14	33	1	38	2	3	16	12	1	10	25	5	3	2

(Bogdan et al. 2011) and as many as in Tarcu Mountains (Iftime & Iftime 2013). If we add to the species identified now, the previously found *Ichthyosaura alpestris* (Covaciu-Marcov et al. 2010), the number of species is very close to

that of Poiana Rusca Mountains. *I. alpestris* is well represented in Bulza Hills, at altitudes above 200 m, being found in previously indicated locations (Covaciu-Marcov et al. 2010).

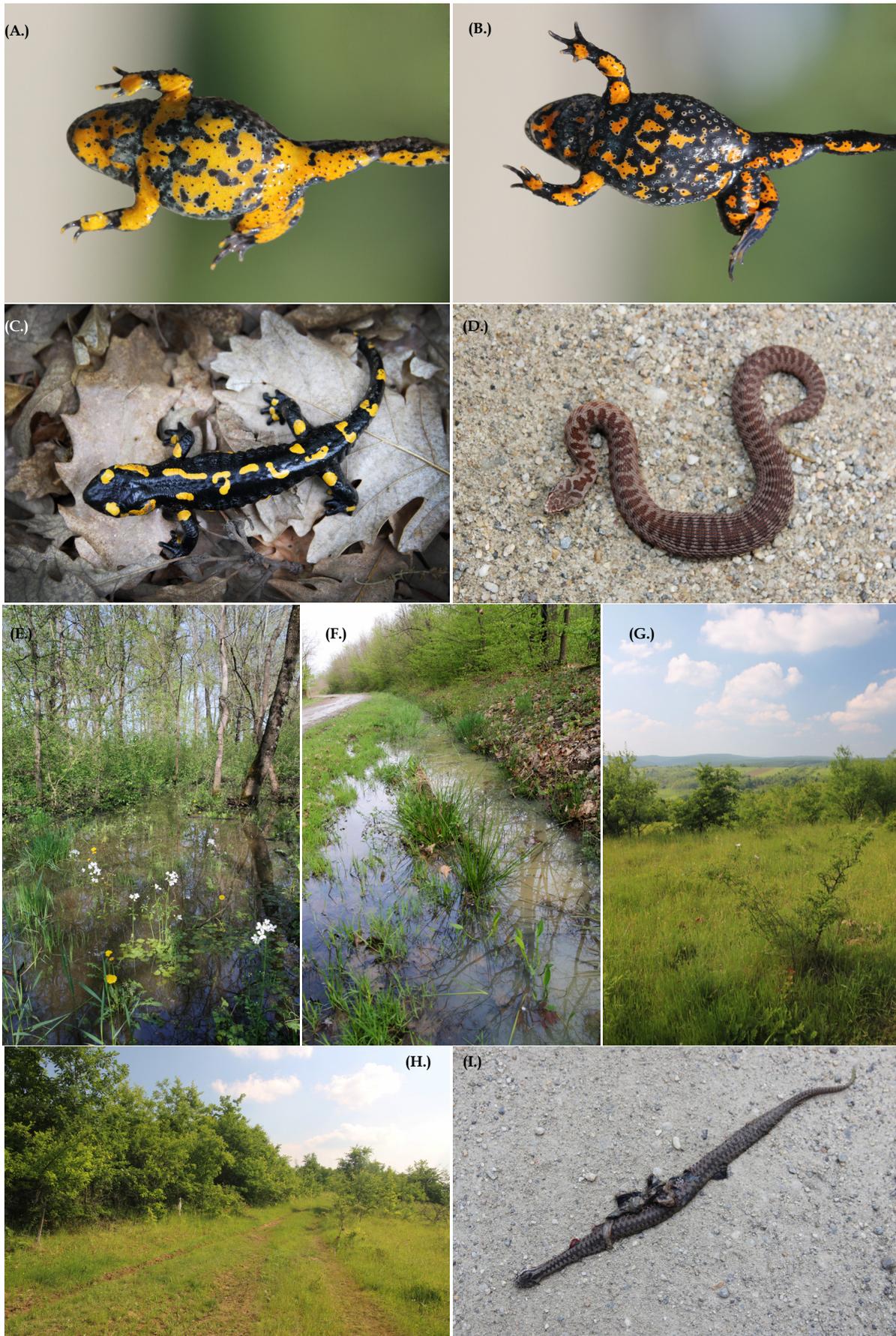


Figure 1. A.) *Bombina variegata* from Charlottenburg, B.) *Bombina bombina* from Charlottenburg, C.) *Salamandra salamandra* from Lipova Hills, D.) *Vipera berus* from Ohaba, E.) habitat near Charlottenburg locality, F.) habitat near Faget locality, G.-H.) habitat's near Ohaba locality, I.) road kill of *Vipera berus* near Ohaba locality.

The herpetofauna in Lipova Hills contains some of the species present in the plains from western Banat (Bogdan et al. 2013) as well as most of the species present in the mountains of the region (Bogdan et al. 2011, Iftime & Iftime 2013). There are some species missing in the region, like *Zootoca vivipara*. This mixture of lowland and mountain species is a consequence of the geography of the Lipova Hills. Thus, despite low altitudes, the hills are connected to the higher areas from the Poiana Rusca Mountains. In the same time, in the western and southern areas, the hills are directly linked with the lowland, being intersected by numerous large valleys, along which lowland species can ascend. This explains the presence of hybrids between *B. bombina* and *B. variegata*. Species found in higher areas are probably favored by the fact that in a large part of the Lipova Hills the average annual temperatures and especially rainfall, is similar to the surrounding areas of Poiana Rusca Mountains (Stoenescu et al. 1966).

Compared with neighboring plains, the herpetofauna in Lipova Hills is probably favored by the large areas covered by forests. Even if there are no big differences in the composition of the herpetofauna of the forests and pastures, there are species clearly favored by forests, like *S. salamandra* (e.g. Manenti et al. 2013). Thus, in Lipova Hills, *S. salamandra* is well represented, being found in 12 localities, although it wasn't previously reported in the region (Cogălniceanu et al. 2013a). Although forests are present in the western part of the hills, *S. salamandra* seems to populate only the eastern area, from Bulza Hills, being present even at lower altitudes than usually found in Romania (Cogălniceanu et al. 2000). Thus, in the area surrounding Bichigi, the species was identified even at 168 m altitude. As such, the Lipova Hills are added to the areas in western and southwestern Romania in which the species was found at low altitudes (e.g. Covaciu-Marcov et al. 2007, 2009, 2012a). Furthermore, this should be correlated with the presence of other species at low altitudes, like *I. alpestris* (Covaciu-Marcov et al. 2010).

Besides the lowland and highland species overlaying, there are warmer climate species, at the northern limit of their distribution range overlapping in the region, with colder climate species, usually categorized as mountainous for our country. The first category includes *D. praticola*, a species present only in southern Romania, that until recently had a northern limit for its distribution range in the Poiana Rusca Mountains (Sos et al. 2012). However, later *D. praticola* was documented north of Mures River, in the southern Apuseni Mountains (Gaceu & Josan 2013). Thus, the identification of the species in Lipova Hills, north of Faget town, indicates the connection between the populations of Poiana Rusca Mountains and those north of Mures, confirming the previous scenarios (Gaceu & Josan 2013).

The second category includes low altitude populations *V. berus*, a species previously considered mountainous in Romania (Fuhn & Vancea 1961), although it was later found in the northwestern part of the country, at the inferior limit of the hills or in the lowlands. (e.g. Covaciu-Marcov et al. 2008). In Lipova Hills the species is found only at 200 m, at the edge of the hills, and the populations were probably linked in the past with the ones previously observed in the north-eastern side of the unit (Covaciu-Marcov et al. 2005). In the region, *V. berus* inhabits skirts of oak forests, wet ar-

reas, areas of natural regrowth and road sides. In the woodland area between Ohaba Lunga and Ohaba Romana the populations seems pretty solid, as we also found individuals killed by cars on a dirt road. However, the species has not been previously seen in the neighboring area of western Poiana Rusca Mountains (Bogdan et al. 2011). This underlines the importance of the zoogeography of Lipova Hills and especially in the eastern areas, where along with *V. berus* there are *S. salamandra* and *I. alpestris* low altitude populations. Earlier, in the case of *I. alpestris*, the western area of Poiana Rusca Mountains was proposed as a refuge (Covaciu-Marcov et al. 2010). This confirms the data indicating that for the distribution of the herpetofauna, the past climate conditions are more important than the current ones (see in: Araújo et al. 2008).

Although the herpetofauna in Lipova Hills, made up of many species with apparently large populations in general, seems to be stable for now, it is still vulnerable. Lowland species probably withdrew here from the heavily affected plain areas (Bogdan et al. 2013). In the same time, mountain species have a reduced territory, benefiting of the connection with Poiana Rusca Mountains. Unfortunately, it seems that this connection will be affected by the construction of a highway that will go between Bulza Hill and Poiana Rusca Mountains and is planned to be finished in the next years (see in: Csutak 2013). This is exactly the area with an extremely high diversity of herpetofauna. Unless the highway will be constructed in a manner to allow the movement of amphibians under it, stopping their access to the road, the consequences will be extremely negative. In recent years in Romania some information appeared on the effect of road traffic on the herpetofauna (e.g. Hartel et al. 2009, Cicort-Lucaciu et al. 2012, Covaciu-Marcov et al. 2012b), the negative effect of the traffic on biodiversity being already known (e.g. Glista et al. 2008, Gryz & Krauze 2008, Elzanowski et al. 2009, Tellería et al. 2011, Kambourova-Ivanova et al. 2012, Wang et al. 2013). Unfortunately, in the Lipova Hills many species of the herpetofauna (*S. salamandra*, *B. viridis*, *L. agilis*, *A. fragilis*, *N. tessellata*, *N. natrix*, *V. berus*) fall victim of traffic, even on dirt roads. In the same time, there are deforestations in the region, exactly in the areas with diverse herpetofauna. Its effect is evident in some areas in the Lipova Hills, where forests were almost completely cleared, the herpetofauna being reduced to a few species.

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