

Postglacial Ages and the Herpetofauna of Romania

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The so-called glacial relicts in the Romanian herpetofauna - *Rana temporaria*, *Lacerta vivipara*, *Vipera berus* - are actually only cold-tolerant forms, able to survive in very cool habitats. Their ecological optimum is not in the subarctic or alpine tundra, but in cool beech woods. In the Romanian Carpathians, they are not abundant above the timberline. Their origin is not associated with the Periglacial. This "cold trio" is rather a relict of the Early Postglacial. According to Dely /1981/, *L. vivipara* was originally a preglacial plain dweller, which survived the ice-ages in the cold open plains /tundras/ of the non-glaciated areas of Quaternary Europe. I disagree: its origin is somewhere at the southern limits of the Eurasian coniferous woodland, perhaps in Siberia, at the end of the last Ice-Age. The geographical centre of *V. berus* is probably the Anatolian highland /Basoglu, 1947/. *R. temporaria* may have the same geographic origin, Asia Minor being the richest area of Eurasia for brown frogs. In the Early Postglacial /Spätglacial/ when the cold, wet climate favoured the northward advance of boreal coniferous forests and their animal communities, the "cold trio" was able to invade large postglacial woodlands of Europe and Siberia.

The glacial survivors /Glazialresistenten/ evolved in boreal habitats, probably at the end of the last Interglacial, and survived the last Ice-Age in some small forest refuges /Waldrefugien/ sheltered in mountain valleys of South-East Europe. To-day, such forms as *Triturus montandoni* and *T. alpestris*, occur only in restricted ranges in some European mountains. They did not spread far northward in the Postglacial, being closely associated with mountain habitats.

The cold-tolerant moor frog *Rana arvalis* is neither a glacial relict nor a glacial survivor. It belongs to the postglacial wave which came to the Carpathians in a cooler epoch from the Angara evolutionary centre /Stugren, 1966/. It occurs in Romania now only in a few sites with a cold local climate.

In the warm postglacial epoch, some 8000 B.C., deciduous trees replaced the taiga-type vegetation of the Spätglacial in Central Europe. Thermophilous trees /*Quercus*, *Corylus*/ advanced to higher levels in the Carpathians /Pop, 1945/. Warm grasslands expanded in South Russia and the Lower Danube area. During the postglacial optimum two waves of warm-tolerant amphibians and reptiles immigrated to Romania /Stugren & Kohl, 1980/: one from the Pontic steppes, the other from the Balkan Peninsula. Such pontic and East-mediterranean forms are not preglacial relicts, but only vestiges of a warmer postglacial epoch than the present one /Mertens, 1953/.

The yellow-bellied toad *Bombina variegata*, in Romania an immigrant from the Balkans, deserves special attention because of its high infra-specific variability. The species may have originated in South-East Europe by allopatric speciation /Mertens, 1928/ during the last Ice-Age. Three valid subspecies occur in South-East Europe /Mertnes & Wermuth, 1960/: *B. variegata scabra* in continental Greece, Albania, South Yugoslavia, and South Bulgaria; *B. variegata kolombatovici* in Dalmatia; *B. variegata variegata* in the northern parts of the Peninsula, as well as in the Carpathians, reaching westward to the Netherlands and France. In Italy, south of the plain of Po, *B. variegata pachypus* occurs. The high infra-specific diversity in the Balkans could be an outcome of the segregation of populations during the last Ice-Age in small, isolated forest islands, the gene-flow being thus interrupted. The evolutionary trend with the yellow-bellied toad shows a gradual reduction from the south to the north in the occurrence of specimens which have an almost entirely yellow ventral side. Specimens with large black spots on the belly become more frequent towards the north. In the Romanian Carpathians, specimens with a large yellow field on the ventral side are exceptions, the majority having a predominantly black abdomen. Therefore, I suppose, the southern subspecies *B. variegata scabra* is nearest to the unknown ancestral species. The northern subspecies *B. variegata variegata* originated probably in the northern parts of the Balkan Peninsula and spread during the climate optimum of the Postglacial toward Central and Western Europe.

The warm postglacial epoch restricted the ranges of cold-tolerant species. But the last act in the history of the Romanian herpetofauna coincides with Holocenic, historical times. The permanent contest between arid steppe and wet sub-Atlantic climate, between warm grasslands and cold beech-woods of the last 4000 - 6000 years /Köppen & Wegener, 1924/, generated an unstable environment and an unstable herpetofauna. In the Mediterranean area, the postglacial vegetation and climate were subjected to periodical oscillations of xeric and humid phases /Suc, 1984/. Palaeobotanic records /Pop, 1957/ suggest that in Romania there were periodic expansions and regressions of beech, some 2000 years B.C. Unfortunately, there are no subfossil records to tell the history of amphibians and reptiles. One could only suppose that in cool climate phases the cold-tolerant species extended their ranges, while in warm climate phases the warm-tolerant ones widened their areas. The actual pattern of the Romanian herpetofauna was eventually established some 3000 years ago, associated with the expansion of beechwoodlands. This view is supported by the fact that the distribution of cold-tolerant amphibians and reptiles is generally superimposed on the area of the Fagion dacicum-plant communities /an idea proposed by Soó, 1964/ in South-East Europe /Fig. 1/. In this epoch *R. temporaria* probably migrated down the mountain valleys. *V. berus* extended its range from the Carpathians in the large beech woodland of the hilly region between the Oriental Carpathians and the river Pruth. Relicts of its larger range are some isolated populations in South Romania, South Hungary, and North Bulgaria. *Salamandra salamandra* expanded its range following the beech. *L. vivipara* probably had a more extended range in the Carpathian Basin, vestiges of it being some isolated colonies in the Great Hungary Plain and in Eastern Slovakia. But, surprisingly enough, there are no such populations in the Sphagnum bogs and birch woods of Transsylvania. Perhaps the expansion of *L. vivipara* was blocked by the extension of human settlements with woods cleared for pasture and agriculture up the mountain valleys. This generated a more arid climate and favoured the invasion of *L. agilis* everywhere in the Carpathian valleys, up to the coniferous forest ecotone.

Thus, the Romanian herpetofauna seems to be mainly the product of postglacial evolution of climate and vegetation, being shaped definitively by the contest between beech-climate and steppe climate during Holocenic times.

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