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Updated distribution of hybrids between *Lissotriton vulgaris* and *Lissotriton montandoni* (Amphibia: Caudata: Salamandridae) in Romania

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Abstract. *Lissotriton montandoni* is an endemic newt species found only in the Carpathian Mountains and lives in sympatry with *Lissotriton vulgaris* in many aquatic habitats from the entire range of the former species in the Carpathian and Sudetes Mountains or in the hilly areas from the Subcarpathians. These two species usually generate hybrids where their parapatric ranges meet, especially along rivers that flow from the inside of the Carpathians, where valleys are used as ecological corridors by *L. vulgaris*. We surveyed several regions of the Eastern Carpathian Mountains between 2008 and 2011 and found 11 new populations of newts where hybrids between the two mentioned species were present. All new records of *L. montandoni* x *L. vulgaris* were described in the eastern part of the Eastern Carpathians, in Neamţ County, a region known also from previous literature to be a 'hot spot' for hybrids between these two species. The present paper also presents an updated review of the distribution of *Lissotriton* hybrids in Romania.

Keywords. Amphibians, Montandon's newt, Smooth newt, hybridization, Carpathians.

Lissotriton montandoni and *Lissotriton vulgaris* are two genetically related species with similar sexual behaviour (Belyaev, 1981; Pecio and Rafinski, 1985; Rafinski and Arntzen, 1987; Arntzen and Sparreboom, 1989) and they usually generate hybrids where the parapatric ranges of both species meet (Zavadil et al., 2003). *Lissotriton montandoni* is an endemic newt species found only in the Carpathian and Sudetes Mountains and lives in sympatry with *L. vulgaris* in many aquatic habitats from the entire range of *L. montandoni*, especially along small rivers in the mountains or in the hilly areas from the Subcarpathians (e.g. Fuhn, 1963; Şova, 1973; Szymura, 1974; Fuhn et al., 1976).

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Many authors have indicated the presence of hybrids in areas where the ranges of these species overlap: Ukraine (Hofmann, 1908; Kushniruk, 1963), Poland (Szeliga-Mierzeyewski and Ulasiewicz, 1931; Juszczyk and Swierad, 1984; Rafinski, 1985, 1988; Pecio and Rafinski, 1985; Rafinski and Pecio, 1989; Babik et al., 2003), the Czech Republic (Rehák, 1993; Šálek, 1993; Kotlík et al. 1997; Kotlík and Zavadil, 1999; Zavadil et al., 2003, 2004; Mikulicek and Zavadil, 2008). In Romania, hybrids between these two species were first reported by Fuhn (1963), Fuhn et al. (1976), Iftime (2004) (Transylvanian Alps) and by Gherghel et al. (2008) (Eastern Carpathian Mountains).

In this study, we present an updated distribution of hybrids between *L. montandoni* and *L. vulgaris* in Romania, based on the previous literature and several new, previously unpublished records.

Field surveys were conducted between the years 2008 and 2011 in the Eastern Carpathian Mountains, with emphasis on Neamț County, where several hybrid populations have been previously reported (Gherghel et al., 2008). We captured newts from various aquatic habitats using drag nets. Each newt individual was photographed using a Nikon L100 digital camera for future analysis of hybrid colouration and, subsequently, released in the original habitat. The morphological characteristics used for identifications of hybrids are those previously described by Kotlik and Zavadil (1999), Iftime (2004) and Mikulicek and Zavadil (2008) (Table 1).

Throughout our survey, we found hybrids between *L. vulgaris* and *L. montandoni* in 11 new locations (Table 2). All the sites with hybrids were located in the contact zone between the Carpathians and the Subcarpathians, areas where all breeding ponds were used by both parental species. Gherghel et al. (2008) found the hybrids at the contact of two biogeographic regions: continental (the Subcarpathians) and alpine (the Carpathian

Table 1. Comparison of morphological characters used for determination of animals.

Morphological feature	*Lissotriton vulgaris*	*Lissotriton montandoni*
dorsal crest	high and spotted	very low and without spots
crest denticulation	denticulated	not
dorsolateral folds	absent	present
lateral stripe on the lower tail margin	pale blue	cream coloured
spots on the belly	present	absent
spots on the throat	present	absent
colour of the cloaca	the same as the surrounding skin including spots	black
tail filament	absent	present
colour on the flanks	wide gold stripe between the orange ventral and brownish dorsal coloration	the orange ventral colour merges smoothly into dorsal coloration
webbing on the hind limbs	present	absent
colour of palms of the hind limbs	the same as the surrounding skin, often with spots	gray to black and without spots

Fig. 1. Habitat overview of breeding ponds of *Lissotriton* hybrids in the Eastern Carpathian Mountains; in the left photo (a) is a fresh snow-melt temporary pond, in the right photo (b) is a roadside ditched with water used by hybrids for reproduction.

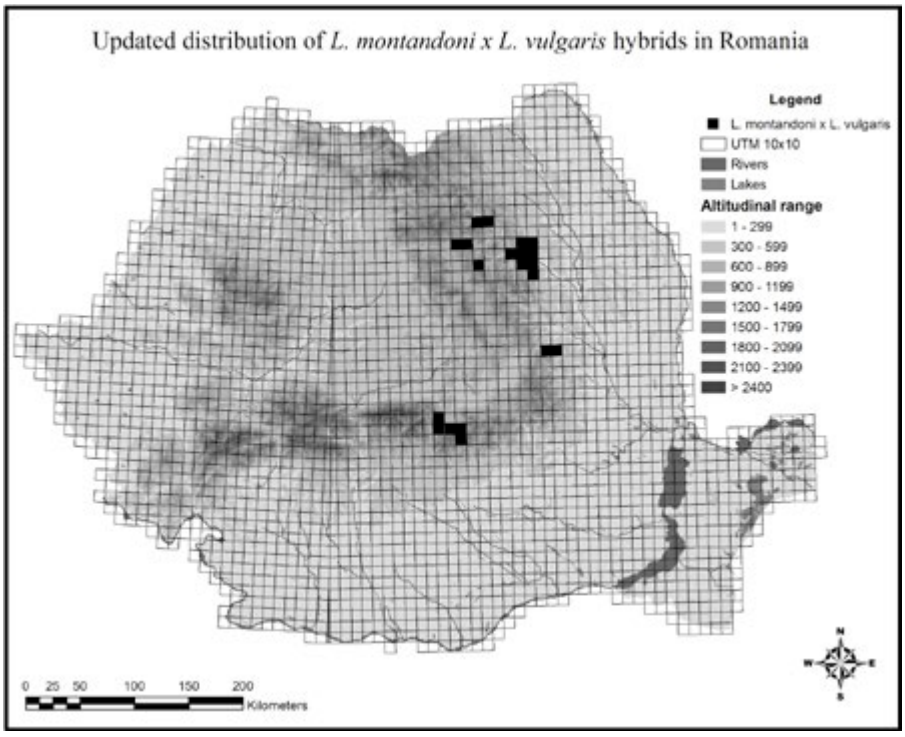

Fig. 2. Updated distribution of *L. montandoni x L. vulgaris* hybrids in Romania.

Fig. 3. Some individuals of *L. montandoni x L. vulgaris* founded in Negriteşti, Neamţ County.

Mountains). The characteristics of the breading ponds where we observed *L. vulgaris* x *L. montandoni* hybrids are similar to those found by Fuhn et al. (1976), Iftime (2004) and Gherghel et al. (2008) and can be described as temporary and permanent ponds formed by rainwater or snow-melt (Fig. 1a) or by overflowing mountain rivers. Other important habitats used by newts for reproduction are roadside puddles or roadside ditches (Fig. 1b). As observed by Iftime (2004), hybrids are generally present mostly in human disturbed areas, where the anthropogenic impact (like deforestation, heavy road traffic, near localities) is greater than inside forests.

Almost all records of *L. montandoni* x *L. vulgaris* in Romania were found in the eastern part of the Eastern Carpathians and in the extreme southern range of *L. montandoni*. Until now, no hybrids between these species have been recorded in northern and western slopes of the eastern part of Eastern Carpathians (Fig. 2, Fig. 3, Table 2).

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Table 2. Updated record review of *L. montandoni* x *L. vulgaris* hybrids in Romania with new records.

Locality	County	Toponym	Altitude (m)	Reference
Tarcău	NT		550 (deduced)	Fuhn, 1963
	BC	Crăcurele Lake, Nemira Mts.	850 (deduced)	Fuhn et al., 1976
	PH	Beria Valley, Ciucaş Mts.	780 (deduced)	Fuhn, 1963
Sinaia	PH		800 (deduced)	Fuhn, 1963
Gîrcina	NT	Cuiejdel Lake	650	Gherghel et al., 2008
Lacul Roşu	HR		1000	Gherghel et al., 2008
Nechit	NT		450	Gherghel et al., 2008
Sabasa	NT		600	Gherghel et al., 2008
Straja	NT		480	Gherghel et al., 2008
Tarcău	NT		430	Gherghel et al., 2008
Doamna	NT	Porcărie	320	Gherghel et al., 2008
		Lipoveni	430	Gherghel et al., 2008
Plaiu Foii	BV		1000	Iftime, 2004
Bârsa lui Bucur	BV		980	Iftime, 2004
Sinaia	PH		800	Iftime, 2004
Cheia	PH		900	Iftime, 2004
Tazlău	NT		630	our study
Dodeni	NT		570	our study
Bicaz	NT		600	our study
Capu Corbului	HR		600	our study
Secu	NT		670	our study
Agîrcia	NT		350	our study
Piatra Neamţ	NT	Văleni	300	our study
		Cernegura	450	our study
Pralea	BC		460	our study
Negriteşti	NT	Pârâul Iapa	360	our study
		Pârâul Calu	420	our study

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