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Review of recent taxonomic and nomenclatural changes in European Amphibia and Reptilia related to Romanian herpetofauna

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Abstract. The list of recent taxonomic and nomenclatural changes concerning Romanian amphibian and reptile species is presented in the light of new phylogenetic results. The status and distribution of some subspecies which inhabit Romania is discussed. The goals of contemporary conservation are revised. Also a list of used Romanian material in recent phylogeny studies is provided.

Keywords: Amphibia, Reptilia, taxonomy, Romania

Introduction

Recently, numerous amphibian and reptile genera were split in two or more genera, which were named differently and caused difficulties for biologists and non-biologists in the use of nomenclature (Smith & Chiszar 2006). Taxonomic views and the nomenclatural list of amphibians and reptiles are continuously changing, even in European species. This is, in part due to the use of new research techniques (e.g. artificial crossing, protein electrophoresis, cytogenetics, bioacoustic methods, DNA bar-coding, comparative analysis of nuclear DNA content, DNA flow cytometry, DNA sequencing, chromosome studies; see e.g. Borkin et al. 2004, Lee 2004), allowing the discovery of new "hidden" species. However, new taxa are sometimes even still revealed by better exploration of natural populations. In the light of the recent studies, this process does not seem to be stabilizing yet in (see e.g. Dubois 2004, 2005*a*,*b*, 2006*a*,*b*, Smith & Chiszar 2006, Dubois 2007, Hillis 2007).

At large as pointed out by Dubois (1998), these changes are based *i.* on the critical revision of well-known species groups using new techniques (e.g. Veith et al. 1998, Rafiński & Babik 2000, Kalyabina et al. 2001, Utiger et al. 2002, Nagy et al. 2004, Babik et al. 2004, 2005, Steinfartz et al. 2007) and new concepts (e.g. hybridogenesis, kleptons, see Dubois 1991), which include reevaluation of the status of some "subspecies", *ii.* but also on discovery of new taxa, which had completely escaped the attention of taxonomists because their morphological similarity with other taxa (cryptic species; e.g. Borkin et al. 2004, Fritz et al. 2006) and *iii.* on field discovery (or in collections) of a new species.

The goal of this review is to present new phylogenetic results concerning to the Romanian herpetofauna and adjacent areas (mainly Central and South-East Europe), which has resulted in taxonomic and nomenclatural changes in this fauna group. Studies in which Romanian genetic material is used are especially considered.

The review comprises data of possible cryptic species in the country, predicted from studies made on herpetofauna of adjacent countries, or even on Romanian genetic material. The concept of cryptic species is not a recently discovered concept. The advent of DNA taxonomy ("the molecularisation of taxonomy"; Lee 2004) caused a "renaissance" in interest for cryptic species (Fritz et al. 2006*a*). The problem of morphologically indistinguishable or very similar species was mentioned already by Ernst Mayr in 1942. Mayr used the term "sibling" species, derived from the German "Geschwisterarten", although later the term was gradually replaced by "cryptic species". The sibling concept is now used in term of sister group in the cladistic sense (Borkin et al. 2004). But the cryptic species concept has earlier correspondents as "dual species" or "biological species" from the second part of nineteen century (see Borkin et al. 2004). Usually the genetic differentiation and speciation is often preceded by morphological divergence. "The presence of even a subtle morphological difference between any two local populations seems to suggest the possibility of their independent taxonomic status" (Matsui et al. 1993; cited in Dubois 1998). But in the cryptic species the morphological differences are hardly or impossible to proved. According to Borkin et al. (2004) species may be treated as cryptic if they cannot be identified by morphological characters commonly used in systematics, or if the difference in these characters is purely statistical and the species identification can be reliable only at the level of samples, not at the level of single individual. In Mayr concept's the sibling species are capable to maintain their genetic integrity as result of intrinsic mechanisms, regardless whether the species represent paraphyletic or polyphyletic assemblages of populations. After Mayr, the human cognitive abilities of man are not or hardly able to recognize the morphologically almost similarly but genetically isolated entities of bisexual animals, which thus exist (Fritz et al. 2006).

Towards further taxonomic and so thus nomenclature changes related to the Romania herpetofauna is foretold as predicted by recent studies.

Review and discussion of new data on the phylogeny of Romanian European amphibians and reptilians

Salamandra salamandra (Linnaeus, 1758)

The Old World *Salamandra salamandra* complex represents a challenging morphologically, systematically, and biogeographically challenging group with at least 16 geographically delimited subspecies (García-París et al. 2003) or 6 distinct species (Steinfartz et al. 2000). The group is distributed around the Mediterranean Basin, reaching highest diversity in the Iberian Peninsula (García-París et al. 2003). The Fire Salamander from Romania was attributed to *S. s. salamandra* Linnaeus, 1758 (Fuhn 1960). According to Raffëelli (2007), the Romanian Carpathians is inhabited by *S. s. carpathica* Calinescu, 1931, which have contact with the nominal form in south-west of the country. The validity (and after, the distribution) of this subspecies must be revisited. A genetic differentiation (different haplotypes and allel combination) was found between East and West European subpopulations of the group (Veith et al. 1998, Steinfartz et al. 2000). This differentiation can be explained with the former existence of two distinct refuges, one western refugium (maybe in the Iberian Peninsula) and one eastern refugium (maybe in the Balkans), where the species was constrained during the last Ice Age. Thus, the contemporary distribution area was recolonized by two source populations, which today overlap in Central Europe (Steinfartz et al. 2000). The Romanian populations geographically are part of the eastern lineage, but the cited investigations lack genetic material from our country.

Triturus cristatus superspecies

Recently the Northern Crested Newt or Warty Newt, *Triturus cristatus* (Laurenti, 1768) and the Danube Crested Newt *Triturus dobrogicus* Kiritzescu, 1903 were elevated from subspecies status of *T. cristatus* to species rank as proposed and confirmed by many studies (Kalezić & Hedgecock 1980, Bucci-Innocenti et al. 1983, Wallis & Arntzen 1989, MacGregor et al. 1990, Litvinchuk et al. 1994, 1997, Zajc & Arntzen 1999, Litvinchuk et al. 2003, Steinfartz et al. 2007). The Danube Crested Newt has been described from the environs of Sulina, Tulcea and the Danube River Delta in the northern part of Dobrogea in Romania as a variety of the Crested Newt (Kiritzescu 1903, Litvinchuk & Borkin 2000).

The two species remain in the genus *Triturus*, sensu stricto, which is composed by the *Triturus cristatus* and *T. marmoratus* superspecies groups (Rafiński & Arntzen 1987, Arntzen & Sparreboom 1989, MacGregor et al. 1990, García-París et al. 2004, Frost et al. 2006, Weisrock et al. 2006, Steinfartz et al. 2007). Hybridization between the two forms in the intergradation area was reported (Fuhn & Freytag 1961, Mikulícek 2003, Litvinchuk et al. 1997, Mikulícek et al. 2004). The hybrid zone seems to be narrow (Wallis & Arntzen 1989, Litvinchuk et al. 1997) and limited gene flow between the species is probably caused by their marked ecological differentiation (Mikulícek et al. 2004).

The two species can be differentiated morphologically, irrespective the *T. dobrogicus* possesses an elongated body, shorter limbs and more rib-bearing vertebrae than the *T. cristatus*. These differences may be related to more aquatic lifestyle and a more piscine locomotion in *T. dobrogicus*, with the sister species, *T. cristatus*, which is a more terrestrial form (Arntzen & Wallis 1999, Crnobjnja-Isailović et al. 1997).

The distributions of the species and their intergradation area in Romania need more investigation. Older dates from literature related to the *T. cristatus* may refer to both species (Cogălniceanu 1991). Recent studies found that the Danube Crested Newt is distributed in the lowlands of the Danube, the Tisza and the Sava disjuncted in a western, Pannonian part and an eastern, Dobrogean part – the connection of this part along the Danube through the Iron Gate is not proved (Arntzen et al. 1997).

The *T. cristatus* seems to be a monotypic (Steinfartz et al. 2007). Whithin *T. dobrogicus*, Litvinchuk & Borkin (2000) distinguished two subspecies: *T. d. dobrogicus* (Kiritzescu, 1903), which is considered endemic to the Danube Delta, the *T. d. macrosoma* (Boulenger, 1908) (not *macrosomus*, see Crochet & Dubois 2004), which inhabits the Pannonian and Vienna basins reaching westernmost Romania (Arntzen et al. 1997), and is likely to occur in an isolated area along the Lower Danube. If specimens signed as belonging to Danube River Basin in Litvinchuk et al. (2005) are not from Romania or Bulgaria, the taxonomic status and phylogeny of populations between the two core area (Pannonian and Dobrogean) has no genetic prove (Litvinchuk & Borkin 2000; Figure 1.). According to Vörös et al. (2007), the phylogenetic analysis of the mitochondrial *nad2* gene in specimens from Pannonian lowland, revealed two main clades, indicating two different postglacial colonization routes, associated with the Danube and Tisza rivers, respectively. Interestingly, the *Triton cristatus danubialis* form (now *Triturus dobrogicus macrosoma*) has been described from the environs of Braşov (cited like Kronstadt) too, later the forms from this area was regarded like a transitional lineage from *T. c. danubialis* to the typical subspecies (Litvinchuk & Borkin 2000). This "misidentification" could be questioned in future.

Recently Arntzen et al. (2007) supposed the presence of *T. karelinii* in southern part of Dobrudja, but without wroting anything about a vocher (or even a seen) specimen from this area.

Ichthyosaura alpestris (Laurenti, 1768)

Bolkay (1928) recommended a subgenus (*Mesotriton*) for Alpine Newt based on osteological records (i.e. skull morphology), although in despite of his recommendation for long time after the species belonged to the *Triturus* genera. Its taxonomical position was not clearly resolved even half decade later (Arntzen & Sparreboom 1989, MacGregor et al. 1990, Arntzen, 1995, Zajc & Arntzen 1999). The numerous genetic studies listed by MacGregor et al. (1990) proved that the intermediate-sized Alpine Newt has an intermediate place between two major groups (subgenus *Triturus* or *Neotriton* – *cristatus* species group or large-bodied newts – and subgenus *Paleotriton* – *vulgaris* species group or small-bodied newts). Recently, Weisrock et al. (2006) considered the Alpine Newt to represent a different clade by itself, but Steinfartz et al. (2007) found the Alpine Newt is in closely related to the "Modern Asian Newts" group (*Pachytriton* and *Cynops*). The latter team recommended the inclusion of the species in a monotypic genus named *Mesotriton*, similarly to Bolkay (1928), MacGregor et al. (1990), García-París et al. (2004) and early adopted by Frost et al. (2006). However, Schmidtler (2007) showed the use of the genus name *Ichthyosaura* to be rightfull. Although the recent split of *Triturus* genus in some authors opinion is still warranted (e.g. Vences 2007).

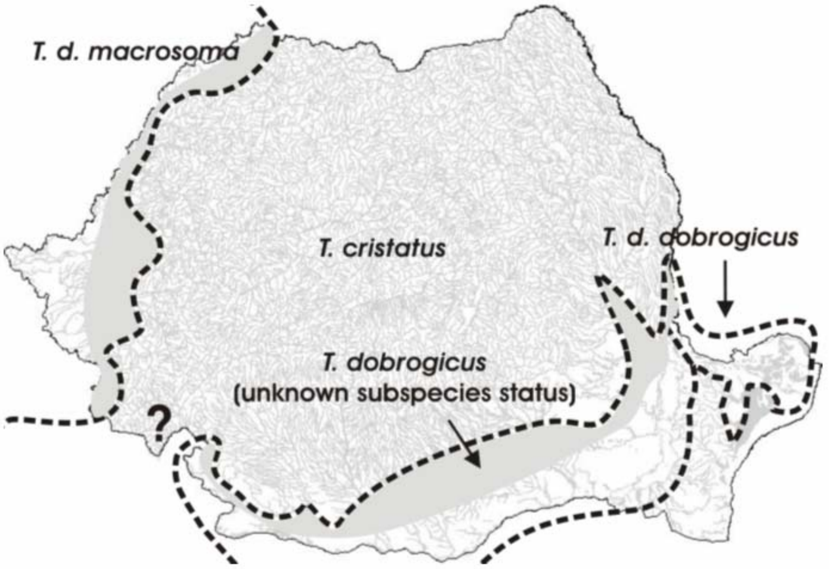

Figure 1. Approximate range limits of subspecies of *T. dobrogicus* and the contact zone with *T. cristatus* after Fuhn (1960), Wallis & Artnzen (1989), Cogălniceanu (1991), Litvinchuk et al. (1994, 1999), Cogălniceanu et al. (2000) and Litvinchuk & Borkin (2000).

The number of recognized subspecies is disputed (e.g. Sotiropoulos et al. 2001). In Romania, the nominotypical *I. a. alpestris* Laurenti, 1768 is said to occur (Fuhn 1960). In spite of large molecular differentiation (Kalezić & Hedgecock 1980, Rafiński & Arntzen 1987), the species is characterised with low morphological differentiation (Alcobendas et al. 2003). Arano & Arntzen (1987) found that the southernmost, Spanish populations are genetically clearly separate from those of the north and centre of the species distribution range. Based on sequences analyses, two well differentiated clades (one from the Balkans and one from Spain to Hungary) were subsequently distinguished and the polyphyletic status of nominotypical subspecies was established (Alcobendas et al. 2003). Although on a smaller geographical scale, the amount of nuclear DNA in four geographically isolated, but nearby populations of *I. a. alpestris* from Ukrainian Carpathians, Maloe Opol’e Eminence, Romanian Bihor Mountains and Montenegro was quite similar (Litvinchiuk et al. 2005). Then again, in Poland, despite geographic proximity (Carpathian, Sudetes and Holy Cross Mountains), three unique genetic units with incipient evolutionary trajectories were distinguished at the northeastern border of the Alpine Newt’s range by Pabijan & Babik (2006). Pabijan & Babik (2006) found that the Romanian samples suggest a substantial genetic divergence from Polish populations. More recent and comprehensive study (Sotiropoulos et al. 2007) found that traditional systematics do not cover the existing genetic diversity in the species. Some widely recognized “subspecies” represents the same genetical group, while other “subspecies” comprise genetically well differentiated groups. The species shows a complex phylogenetical and biogeographical history. The form is grouped in two early and well differentiated major clade and the existence of cryptic speciation in the species is suggested. The western lineage divided in two clades occurs in Romanian Eastern Carpathians with one clade, which is distributed in central Europe and Iberia, while the eastern lineages also divided in two lineages is represented by the central-northern Balkan clade in southern and western Carpathians. The intergradation zone of the two Romanian forms need further investigations.

Lissotriton vulgaris (Linnaeus, 1758)

Formerly the Smooth Newt was placed in genus the *Triturus* and the subgenus *Paleotriton* (Bolkay 1928). More recent studies confirmed the separate status of the *vulgaris* species group or small-bodied newts (together with *L. montandoni* and *L. helveticus*) in regard to the other Old World newts (Rafiński & Arntzen 1987, Arntzen & Sparreboom 1989, MacGregor et al. 1990, Zajc & Arntzen 1999, Weisrock et al. 2006). Thus García-París et al. (2004) proposed a new genus for the *vulgaris* species group named *Lissotriton*, accepted later by Frost et al. (2006) and Steinfartz et al. (2007) too.

The Smooth Newt contains seven or eight subspecies (Raxworthy 1990, Krizmanic 1997, Babik et al. 2005). In Romania, two subspecies occur: the nominotypical *L. v. vulgaris* Linnaeus, 1758 and an endemic subspecies, the Rumanian Smooth Newt (*L. v. ampelensis* Fuhn, 1951). The nominotypical subspecies, subdivided into 6 clades, is paraphyletic with respect to *T. v. ampelensis* (Babik et al. 2005). As pointed out Babik et al. (2005), resulting from samples from 14 Romanian localities for *L. v. vulgaris* and 9 for *L. v. ampelensis*, Romania houses three major *L. vulgaris* clades. One of the clades is divided into two subclades and occupies a small area around the Iron Gate and in southwestern Romania, which started from western Romania to adjacent territories. The second clade is found in the south of the Eastern Carpathians and in Romanian *L. montandoni*. Due to the haplotype diversity in southern Romania, the presence of same haplotypes in *L. montandoni* and the same postulated refugium for the *T. cristatus* (Wallis & Arntzen 1989) supposed that this lineage had its glacial refugia there. The third clade was found almost exclusively in Transylvania, in an area which is occupied mostly by *L. v. ampelensis*. This subspecies probably survived several glacial cycles *in situ* (in the area of Apuseni Mountains) and this evolutionary history confers to its distinctiveness status (Cogălniceanu & Venczel 1992, Michalak & Rafiński 1999, Rafiński et al. 2001).

Regarding the relationship between the two subspecies, a population intermediate in allozyme frequencies between the two subspecies was reported from Romania (Rafiński et al. 2001). Rafiński et al. (2001) on material sampled from 7 localities found that the mean genetic distance is estimated to be 0,114, but Litvinchuk et al. (2003) found that although values of genome size were significantly different, the Nei genetic distances of *L. v. ampelensis* (Dej, Romania) from *L. v. vulgaris* were quite low (0,03). The Ukrainian Transcarphatians *L. vulgaris* morphometrically were intermediate between *L. v. vulgaris* and *L. v. ampelensis*, that may reflect former gene exchange existed between these subspecies (Skorinov et al. 2007). Based on this result, the endemicity of the *L. v. ampelensis* to Romania should be questioned.

The distribution of *L. v. ampelensis* and the intergradation area in the country need more data (Cogălniceanu 1991, Cogălniceanu et al. 2000, Sos, unpublished data; Figure 2.).

Lissotriton montandoni Boulenger, 1880

The species was described from an exemplar from Pârâul Bârnarului (Valea Bistriței) near Broşteni (Romanian) captured by Montandon (Şova 1970). As mentioned above, the *L. montandoni* belongs to the recently recognized *Lissotriton* genus (García-París et al. 2004, Frost et al. 2006, Steinfartz et al. 2007).

In the genus, *L. montandoni* is most closely related to the *L. vulgaris* (Cogălniceanu & Venczel

1992) and the two species hybridise in nature (Cogălniceanu et al. 2000, Babik et al. 2003, Litvinchuk et al. 2003*a*, Babik & Rafiński 2004). Interestingly, the *L. montandoni* is part of the same monophyletic mtDNA lineage as *L. v. vulgaris*, as its original mitochondrial genome was replaced by the mitochondrial genome of the *L. vulgaris* through introgression (Babik et al. 2005, Fritz et al. 2006*b*). Hybridization can be a limiting factor for Montandon's Newt, reducting its range (Cogălniceanu 1997). To have a clear image of extent of intergradation areas in the country we need more data (Cogălniceanu et al. 2000).

L. montandoni represents the basal form of the group (Cogălniceanu 1994) and it is restricted to the margin of distribution of *L. vulgaris*. Endemic to the eastern and western Carpathians and the easternmost part of the Sudetes (Babik et al. 2005), it occupies the areas where *L. vulgaris* reaches the limits of its ecological optimum and is less abundant and competitively strong (Cogălniceanu & Venczel 1992). It is suggested that *L. vulgaris* group evolved as a consequence of increasing sexual dimorphism (Cogălniceanu 1994, Rafiński et al. 2001). Between the two species, a considerable amount of sexual selection was found (Michalak et al. 1997, Michalak & Rafiński 1999).

At the intraspecific level, Litvinchuk et al. (2005) did not find any differences in genome size, allozymes and morphology between two Ukrainian isolated populations and samples from the Romanian Carpathians (Nemira Mountains).

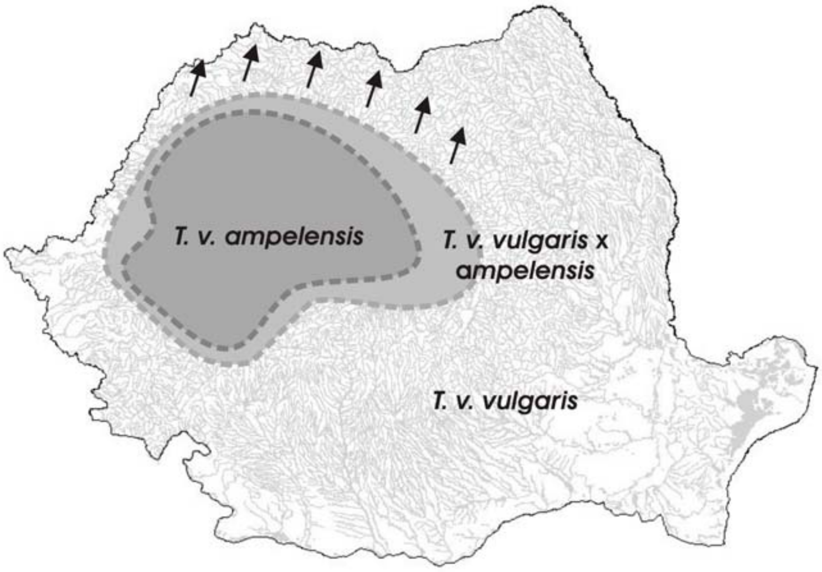

Figure 2. Approximate range limits of *L. v. ampelensis* and the intergradation zone after Fuhn (1960), Cogălniceanu (1991), Cogălniceanu et al. (2000) and Rafiński et al. (2001). The arrows shows a possible more wider intergradation zone between the two subspecies to north according to Skorinov et al. (2007).

Bombina bombina (Linnaeus, 1761)

In Romania, the nominotypical *B. b. bombina* Linnaeus, 1761 is said to occur (Fuhn 1960). Although within the Fire-bellied Toad two genetically closely related clades were found: a northern group, which inhabits lowlands north of the Carpathian Mountains, and a southern group, distributed along the Danube lowlands from the Black Sea up to Moravia (Hofman et al. 2007). Szymura et al. (2000) found that the species entered the Pannonian plain from the southeast through the narrow Iron Gate along the Danube River, and restricted *B. v. variegata* to enclaves on the isolated mountain tops scattered in the plain (Szymura et al. 2000). This idea is also supported by Hofman et al. (2007). They found that the species had its refugium in the lowlands near to Black Sea, or even in the now inundated shelf in the northwestern part of the Black Sea, from where it expanded along the Danube through the Iron Gate into the Hungarian Plains and with another branch expanding to the northeast.

Bombina variegata (Linnaeus, 1758)

The core region of the geographic range of the Yellow-bellied Toad in terms of evolutionary interest has benn shown to be the central Balkans and adjacent areas (e.g., the Carpathian massif; Vukov et al. 2006). The nominal form, *B. v. variegata*, which inhabits the Romanian territories too, was divided into the Carpathian and western (or Alpian) groups (Szymura 1998). According to Hofman et al. (2007), the Carpathian *B. variegata* consists of two clades: the eastern, limited to the easternmost part of the Carpathian arch, and the western, which occupies nearly all of the Carpathians, but the Carpathian bend. The presence of *B. variegata* has benn established in the Carpathian bend too (Cogălniceanu 1991, Cogălniceanu et al. 2000, Ghira et al. 2002), thus the origin of these populations is probably related to the western lineages (Figure 3.). It is supposed that, the two Carpathian *B. v. variegata* groups survived in two separate refugia: one in the southeast bend of the Carpathians and the other in the southern Carpathians (Hofman et al. 2007).

The two *Bombina* species, clearly distinguished by morphology, anatomy, ecology and behaviour, hybridise in central Europe (Vörös et al. 2006, Hofman et al. 2007). Romania is situated in the area were the geographic ranges of the two species meet in a complex pattern at the transition zone between lowlands and mountains (Cogălniceanu et al. 2000, Vines et al. 2003). The species show different habitat preferences but can come in touch in a limited area, in environmentally complex, mosaic zones or zones of smooth clinal zones (Szymura et al. 2000,

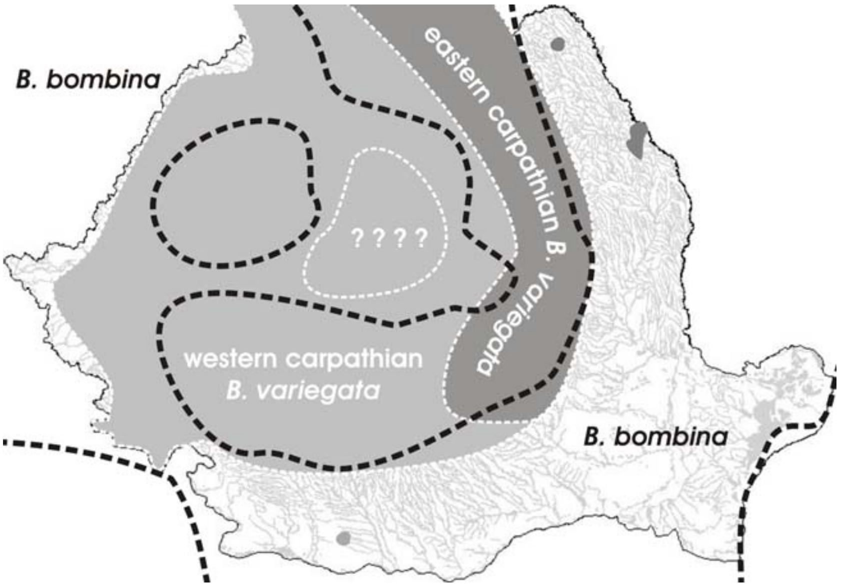

Figure 3. Approximate range limits of *Bombina bombina* and *B. v. variegata* (including the two Carpathian clades) and its expected intergradation zone after Fuhn (1960), Cogălniceanu (1991), Cogălniceanu et al. (2000), Ghira et al. (2002), Covaciu–Marcov et al. (2003*a*), Hofman et al. (2007) and Ghiurcă & Gherghel (2007).

Yanchukov et al. 2003, 2006, Hofman et al. 2007). Sometimes the hybrid zone is separated from the pure parent species (Vines et al. 2003). The contact zone between the two species and the genetic structures of the hybrid zones is not well known in Romania (but see studies cited in Covaciu-Marcov et al. 2005, Vines et al. 2003; also see Figure 3.).

Pelobates fuscus (Laurenti, 1768)

In the traditional taxonomic view, the nominal subspecies, *P. f. fuscus* (Laurenti, 1768) occurs in Romania (Fuhn 1960, Cogălniceanu et al. 2000). The subspecies was split into two allopatric groups (a western type and an eastern type) which meet at the border of the Ukraine and European Russia (Borkin et al. 2001*a*, 2003, 2005, Lada et al. 2005). The groups shows external morphological (including colours and patterns) differences, but diagnostic characters, which could allow to make reliable identification of each specimen, were not found, thus this seems to be a case of cryptic speciation in this case (Lada et al. 2005). The western group will keep its former name (Crochet & Dubois 2004, Crottini et al. 2007).

Eggert et al. (2006) found that even the western lineage is differentiated into north-western and south-eastern populations (from the refugial areas) and suggested them to be considered as different evolutionary units. The Danube system is considered as the centre of diversity for the western lineage and the Pontic and Lower Danube River area as glacial refugia, from were the Lower Danube lineage colonized the Upper Danube plain (Crottini et al. 2007). Thus, Romania, covers an important core area for the western lineage of the species, deserving concrete conservational implications.

Pelobates syriacus Boettger, 1889

In the traditional taxonomic view, in Romania, the species is represented by the *P. s. balcanicus* Karaman, 1928 subspecies (Fuhn 1960, Cogălniceanu et al. 2000). The taxonomy of this species or species complex is not resolved (Crochet & Dubois 2004, Borkin et al. 2005). Ugurtas et al. (2002) found statistically significant morphological differences in the *balcanicus* group. They suggest the restriction of the *P. s. balcanicus* name to populations within Macedonia, Bulgaria, Romania, Greece and Turkish Thrace. Veith et al. (2006) propose the recognition of its species rank. Ugurtas et al. (2002) found that the Serbian populations are a distinct group and can be defined as a new taxon. Thus the Romanian populations, while no Romanian material was sampled, most likely belong to the same taxonomic unit. The presence of the "Serbian" group in south-west Romania is highly possible.

Bufo bufo (Linnaeus, 1758)

The nominal form, *B. b. bufo* (Linnaeus, 1758) is said to live in Romania (Fuhn 1960, Cogălniceanu et al. 2000). The species has a large geographical distribution and intraspecific variations in need of revision (Crochet & Dubois 2004).

Epidalea viridis (Laurenti, 1768)

In traditional taxonomic view, Romania is in the range of the nominal form, *E. v. viridis* Laurenti, 1768 (Fuhn 1960, Cogălniceanu et al. 2000). The *E. viridis* complex comprises diploid, triploid and tetraploid species too, the nominal form is a diploid form and belonging to the eastern group (Stöck et al. 2006, Litvinchuk et al. 2007). The taxonomy status of different forms are not yet established (e.g. Vences 2007), although some proposals were down. Frost et al. (1996) proposed the new *Pseudoepidalea* genus for the species, proposals which later was refuted, but still changed to *Epidalea* (for more see in Speybroek & Crochet 2007).

Hyla arborea (Linnaeus, 1758)

The nominal form, *H. a. arborea* (Linnaeus, 1758) inhabits Romania (Fuhn 1960, Cogălniceanu et al. 2000). At least two lineages resulting from two independent invasions to Eurasia have been established (Borkin 1999), thus taxonomic changes can be expected (Edenhamn et al. 2000). Recently Gvoždik et al. (2007) found that the intraspecific taxonomy of *H. arborea*, traditionally based on morphometrical differences, is incongruent with the molecular phylogeographic pattern.

Rana temporaria (Linnaeus, 1758)

The Common Frog, which inhabits Romania in traditional taxonomic view with the nominal form, *R. t. temporaria* Linnaeus, 1758 (Fuhn 1960, Cogălniceanu et al. 2000), shows very complex geographical variation, with large morphological differentiation even at small geographical scale (Veith et al. 2002, Palo et al. 2003). Pidancier et al. (2003) found that the investigated Romanian populations belong to the "eastern" clade, which had its glacial refugium in the Balkans.

Rana arvalis Nilsson, 1842

The populations from Romanian Carpathian Basin were assigned to *R. a. wolterstorffi* Fejérváry 1919, distinguished by relatively longer legs, larger body size and 'slender habit' comparative to the nominal form, while the populations from the Romanian Carpathian corner were called *R. a. arvalis* Nilsson, 1842 nominal form (Fuhn 1960, Babik & Rafiński 2000). Although Babik & Rafiński (2000) found no significant differences between samples from Romanian Carpathians and those inhabiting western territories, its status is not yet clarified (Veith et al 2003, Babik et al. 2004). It is supposed that the different hind limb lengths are result of phenotypic plasticity. Growth and differentiation are temperature-sensitive and at low temperatures, differentiation is more strongly limited than growth rate. Thus, in a colder environment, like the northern part of its distribution and in the Carpathian corner, frogs develop slower (accordingly shorter legs) and metamorphosise at a larger size (Babik & Rafiński 2000).

The isolated status of the population from Reci, cited in recent studies (Babik & Rafiński 2000, Rafiński & Babik 2000) could be questioned on the basis even on older distribution data (Fuhn 1960, Cogălniceanu et al. 2000, Sos 2007, Sas et al. 2008). The distribution of the species at a large geographical scale shows a continuity between the population from the Pannonian Basin and the Carpathian populations, which contact was shown in an allozyme study (Rafiński & Babik 2000). Specimens from Reci are morphologically intermediate between northern and other southern populations, which is probably due to the differences in environmental conditions (Rafiński & Babik 2000).

The northern and southern populations of the species (occurring both within Romanian), are, however, genetically clearly distinct and therefore treating them as a separate conservation units is recommended (Rafiński & Babik 2000). Based on genome size, allozyme and mtDNA studies, Litvinchuk et al. (in press) suggested that the *R. a. wolterstorffi* seems to be a subspecies at an initial stage of formation.The glacial refugia of the species are suggested in the unglaciated areas of the southeastern part of European Russia or even further east in Western Siberia and/or northern Kazakhstan (Babik et al. 2004).

Rana dalmatina Fitzinger *in* Bonaparte, 1838

The species description data changed (e.g. Frost et al. 2006). No obvious geographical trends were found in the species (Arnold & Owenden 2002); it is considered monotypic lineage (Veith et al. 2003) altough intra-specific variability was described (Felicilello et al. 2006).

The *Pelophylax esculentus* complex

Fei et al. (1991) proposed the new *Pelophylax* genus for this group, which was later generally accepted (e.g. Frost et al. 2006). Thus, the gender of species names of Marsh and Edible Frog was changed from *ridibunda* and *esculenta* to *ridibundus* and *esculentus* respectively.

The real phylogenetical status of *P. ridibundus* recently was discovered: the name of this species was applied to a bunch of cryptic species with allo- and parapatric species closely similar in terms of morphology (e.g. Plötner et al. 2001, Borkin et al. 2004). More than nine different species was described. These data mostly concern the western part of the range. A recent study suggest that the traditionally described *P. ridibundus* Pallas, 1771 will remain restricted just to the eastern populations from its supposed distribution area (Plötner 2005).

Further taxonomic changes in the complex can be expected as Tegelström & Sjögren-Gulve (2004) found a differentiated northern clade in *P. lessonae*. Morphological differences between *P. lessonae* and *P.* kl. *esculentus* from the Danube delta and from those inhabiting Central Europe were found by Günther et al. (1991), although the study use a limited number of specimens.

P. kl. *esculentus* Linnaeus, 1758 is a hemiclone originated from "primary" hybridization between *P. r. ridibundus* Pallas, 1771 and *P. lessonae* Camerano, 1882, as a result of hybridogenesis. This is a mode of reproduction in which one parental genome is not transmitted to the progeny, while the remaining is transmitted clonally (Schmidt 1993). This kind of hybrid is named a klepton, which is abbreviated in the "species" name (Dubois 1998). Parental species or even hybridogens can constitute "pure" populations (Daf et al. 2006, Sas et al. 2009).

Excluding the well known distribution of the complex in North-Western and South-Western part of Romania (Covaciu-Marcov et al. 2007, Covaciu-Marcov et al. 2008*a)*, we are far from having a real image of distribution of the complex in Romania (Cogălniceanu et al. 2000). The *P. lessonae* parental species seems to have the most limited distribution in the country (Fuhn 1960, Cogălniceanu & Tesio 1993, Cogălniceanu et al. 2000). In case of this species, along the other threatened factors, the existence of the *P. r. ridibundus* (sometimes introduced) and thus the inducted hybridization process can result into local disappearance of the species, when through hybridogenesis just in pure *P. lessonae* mating combination arise *P. lessoane* (Spolsky & Uzzel 1986, Vorburger & Reyer 2003; see also Table 1.). Thus, *P. r. ridibundus* will increase in the population at the expense of *P. lessonae*. Since their sexual host becomes less common, *P.* kl. *esculentus* will also decline, finally resulting in a pure *P. ridibundus* population (Vorburger & Reyer 2003). Hence the pure *P. lessonae* populations (e.g. Reci, Covasna County, Cogălniceanu & Tesio 1993) need special conservation status and considerations.

Table 1. The possible reproduction lineage in the *Pelophylax esculentus* complex (modified after Spolsky & Uzzel 1986, Schmidt 1993 and Vorburger & Reyer 2003).

		MALE		
		P. lessonae (LL)	*P.* kl. *esculentus* (RL)	*P. ridibundus* (RR)
FEMALE	*P. lessonae* (LL)	*P. lessonae* (LL)	*P.* kl. *esculentus* (RL)[1]	*P.* kl. *esculenta* (RL)[1]
	P. kl. *esculentus* (RL)	*P.* kl. *esculentus* (RL)	*P. ridibundus* (RR) *P.* kl. *esculentus* (RL)[2]	*P. ridibundus* (RR)[1]
	P. ridibundus (RR)	*P.* kl. *esculentus* (RL)	*P. ridibundus* (RR)	*P. ridibundus* (RR)

[1] These hybrids are rare due to the size preferences of males in mating. The male water frogs show a marked preference for larger females. This could be identified when an overlap in size exists between the individuals belonging to the different parental species or the hybrid form involved in mating. Since the smallest sexually mature males of *P. ridibundus* are almost invariably longer than the largest female *P. lessonae*, the male *P. ridibundus* and female *P. lessonae* combination in nature is highly improbable. However accidental fertilisation is possible due to the reproduction type of the water frogs and due to the chorus behaviour.

[2] The hybrids are almost all females.

Testudo hermanni Gmelin, 1789

The *'hermanni'* group represents a different lineage in the *Testudo* group and is not a member of the group (Parham et al. 2005). According to Lapparent de Broin et al. (2006*a,b*), based on a study on external and osteological characters, a subgenus within the *Testudo* or *Agrionemys* clade or a separate genus status is claimed (the last is preferred). For the new genus, the new name *Eurotestudo* is proposed (Lapparent de Broin et al. 2006*a,b,c*). At present the genus status of the species is still under discussion, thus the former name is used (e.g. Speybroek & Crochet 2008).

The *T. h. boettgeri* Gmelin, 1789 taxon inhabits the Romanian part of its distribution (Fuhn & Vancea 1961, Rozylowicz 2008). Some studies (e.g. Gmira 1995 cited in Lapparent de Broin et al. 2006*c*) based on osteological diagnosis suggest the elevation of the subspecies *T. h. hermanni* and *T. h. boettgeri* to species status. The two subspecies represent independent evolutionary lineages (van der Kuyl et al. 2002), and the *T. h. boettgeri* group is a genetically well defined unit (Fritz et al. 2005). Some authors do, however, object to splitting the group in two species due their lower level of divergence (Crochet & Dubois 2004, Fritz et al. 2006*b*).

The diversity of haplotypes showed that the *T. h. boettgeri* had several glacial refuges in the Balkan Peninsula (van der Kuyl et al. 2002, Fritz et al. 2006*b*) and an incipient taxonomic differentiation within this group is indicated, probably caused by limited gene flow through geographical barriers. In the south-western part of Romania (Banat) 1 haplotype was found (Fritz et al. 2006*b*). In view of recently rediscovered South Dobrudjan populations (Iftime 2002, Sos et al. 2008) and the haplotypes diversity of nearby Bulgarian populations (Fritz et al. 2006*b*), the presence of more haplotypes in the area is possible.

Testudo graeca Linnaeus, 1758

According to Fuhn & Vancea (1961), the *T. g. ibera* Pallas, 1814 inhabits the Dobrudja area (south-east part of Romania). The systematics of the *Testudo graeca* group are complex (e.g. Buskirk et al. 2001, van der Kuyl et al. 2005, Fritz et al. 2007*a*), although Fritz et al. (1996) found only two distinct lineages based on morphology. Some authors suggest the elevation of the subspecies to species rank (e.g. Bour 2004, van der Kuyl et al. 2005), while others found no evidence for different species ranks (e.g. Perälä 2002) or considered the level of differences between insufficient to allow elevation to species rank (Crochet & Dubois 2004). Recently Fritz et al. (2007*a*), found that the complex is not so complex regarding genetical differences; the group constitutes a monophyletic complex and the validity of certain subspecies are questioned on based on incongruence between morphology-based taxonomy and genetic differentiation. They propose the reduction of number of subspecies. They also assign populations from Romania belongs to the same former subspecies, which is delimited by them to the populations from Southeast Europe, western Asia Minor, Russian and Georgian Black Sea coast, and suggest the junior synonyms to be *Testudo ibera racovitzai* Călinescu, 1931 with type locality Tutrakan, Bulgaria.

Emys orbicularis (Linnaeus, 1758)

The nominal form, *E. o. orbicularis* Linnaeus, 1758, is said to occur in Romania (Fuhn & Vancea 1961). Based partly on Romanian material, two lineages are shown to reside in the country, which are distributed in Eastern Europe and Asia Minor for one and in central Europe and the central Balkans for the other (Lenk et al. 1998, 1999, Fritz et al. 2007*b*). For the first lineage, the localised distribution is suggested to rlate to the fact that the Black Sea region represented the glacial refugium, while for the second the south-eastern Balkan Peninsula is suggested as refugium, from where it spread to the Danube catchment (Fritz et al. 2007*b*). In the Balkan Peninsula, the Dinarid and Pindos Mountains acts as a barrier between the lineages, but in the Lower Danube area a contact zone exists between the two lineages (Lenk et al. 1990, Fritz et al. 2007*b*). In the northern part of the country, the Carpathians separate the two lineages (Lenk et al. 1990, Fritz et al. 2007*b*), although contacts could be possible through some river valleys (e.g. Olt, Jiu, Argeş) acting as corridors (Fritz 2001). Further study is needed to be able to draw the exact distribution of lineages in Romania.

Eremias (*Ommateremias*) *arguta* (Pallas, 1773)

In Romania the subspecies *E. a. deserti* (Gmelin 1789) occurs (Fuhn & Vancea 1961). Recent genetical study (Orlova et al. 2007) confirmed the validity of this subspecies.

Lacerta viridis (Laurenti 1768)

The former *L. viridis* was separated into two species based on hybridizations experiments and molecular studies (see articles cited in Böhme et al. 2005, Joger et al. 2007). Thus the Romanian form belongs to the eastern green lizard group, while the western group was assigned as *L. bilineata*. In the *L. viridis* clade, four distinct lineages were found; of which one clade refers to the *L. v. viridis* Laurenti 1768 nominal form and another to the subspecies *L. v. meridionalis* Cyren, 1933 confirming their subspecies status (Böhme et al. 2005). Böhme et al. (2005) considered that *L. v. meridionalis* haplotypes to be restricted to the southern Balkans, while the form was also found in northern Dobrudja (southeastern part of Romania) and in southern Romania (Fuhn & Vancea 1961, Schlüter 2005*b*, Ghira, I., pers. com.). Intergradation forms between the two subspecies are found where the two subspecies occur sympatricly (Fuhn & Vancea 1961, Schlüter 2005*b*, Sos, unpublished data).

Lacerta trilineata Bedriaga, 1886

In Romania, the species occurs as *L. t. dobrogica* Fuhn & Mertens 1959 (Fuhn & Mertens 1959, Fuhn & Vancea 1961). No study concerning the phylogeny involving this form seems to be.

Lacerta agilis Linnaeus, 1758

The center of origin and dispersion of *L. agilis* is suggested to be in the Caucasian and Transcaucasian regions (Bischoff 1988, Kalyabina et al. 2001). The Romanian Sand Lizard populations belong to the Western (Balkan) group of the species (Kalyabina et al. 2001, Joger et al. 2007).

The initial *L. a. agilis* Linnaeus 1758 form was divided into two subspecies based on color pattern and scalation: the western nominal form and *L. a. argus* (Laurenti, 1768), which inhabits the Eastern part of Central Europe (Bischoff 1988). However, Bischoff (1984) and Rahmel (1988) found no definitive diagnostic characters which allow the clear identification of subspecies. The distribution of *L. a. argus* was delimited in the areas were the *erythronota* (or syn. *rubra*) namely red-backed variants exists (Rahmel 1988), thus the Romanian Sand Lizard from the Carpathian region and basin could belong to this subspecies. Contrarly, the red-backed variants can be observed in *L. a. chersonensis* too (e.g. Fuhn 1967). Recent work (Kalyabina et al. 2001) provided no genetic confirmation for the difference between *L. a. agilis* and *L. a. argus* (i.e. specimens from the border zone of the proposed forms), thus use of the name of the former subspecies is more advisable until further investigation.

Nevertheless Kalyabina et al. (2001) confirms the genetically distinction between *L. a. agilis* and the *L. a. chersonensis* Andrzejowski, 1832, the second subspecies, which inhabits regions in Europe from the Carpathian Mountains eastward, including Romania outside of the Carpathian Belt (Fuhn & Vancea 1961, Bischoff 1988). The intergradation zone between the two subspecies is expected to be situated at the outside base of the Eastern and South Carpathians Mountains.

The *L. a. euxinica* subspecies, which represented a brown type of *L. a. chersonensis*, proposed by Fuhn & Vancea (1964), were put into synonymy with the

L. a. chersonensis form (Bischoff 1984, Kalyabina et al. 2001). Whether this morph is the result of phenotypic plasticity, due to special environmental conditions (restricted to the coastal zone of the Black Sea) or it deserves a distinct taxonomic status, needs further study.

Zootoca vivipara (Jacquin, 1787)

Formerly place within the genus *Lacerta* the Common Lizard was placed in the monospecific genus *Zootoca* (see e.g. Mayer & Bischoff 1996).

In view of current studies the nominotipical subspecies (*Z. v. vivipara* Jacquin, 1830) corresponds to the western viviparous lineages, while the populations of Romania belong to the eastern viviparous group, which inhabit Eastern Europe and Asia (Odierna et al. 1998, Heulin et al. 1999, Surget-Groba et al. 2006). The eastern viviparous lineage corresponds with the formerly described *Z. v. sachalinensis* Pereleshin & Terentjev, 1963 (Mayer & Böhme 2000, Crochet & Dubois 2004). The contact zone with the western viviparous group can be expected in the northern Balkan area. The phylogenetic status of populations from the lowlands of the northwestern and northeastern part of Romania (Ghira et al. 2002, Covaciu-Marcov et al. 2003*a*, Covaciu-Marcov et al. 2008*b*) can be questioned.

Podarcis muralis (Laurenti, 1768)

The forms from the Carpathian bend were assigned to the typical form *P. m. muralis* Laurenti 1768, while the populations from outside the Carpathian region differentiated in belly color (similar to the balkanian subspecies inhabiting an area from the north of Italy to northwest Croatia), is suggested to belong to a different form (*P. muralis* aff. *maculiventris* Werner, 1891; Fuhn & Vancea 1961). Schlüter (2005*a*) considered *P. m. albanicus* Bolkay 1919 to occur in Dobrudja (based on one locality). The morphological differences and genetical status of these forms need revision.

Podarcis tauricus (Pallas, 1814)

The masculine gender of the genus name *Podarcis* necessitates the gender name of the species name of this species to be changed from *taurica* to *tauricus* (e.g. Böhme & Köhler 2004, Crochet & Dubois 2004).

From the three subspecies recognized on the basis of coloration, pattern and relative leg length (e.g. Chondropoulos et al. 1993), only nominal form occurs in Romania (*P. t. tauricus* Pallas, 1814; Fuhn & Vancea 1961). Populations of the Balkan Wall Lizard were recently discovered in north-western part of Romania (Covaciu-Marcov et al. 2003*b*).

Darevskia praticola (Eversmann, 1834)

Based on morphological and genetic data (see studies cited in Crochet & Dubois) the Caucasian mountain lizards were placed in the new genus *Darevskia* Arribas, 1997.

The Romanian populations belong to the eastern group of the species (*D. p. pontica* Lantz & Cyren, 1919; Fuhn & Vancea 1961). The inclusion of the Romanian forms in the *D. p. hungarica* Sobolewsky 1930 subspecies (Stugren 1961), and the validity of this subspecies were rejected (Fuhn & Vancea 1961, Stugren 1984), as the morphometric characters, on which the differentiation of the subspecies was based, showed both gradual and discontinuous variation in the range of different population, demonstrating that the main diagnostic characteristic has limited use for the southern European populations (see in Ljubisavljevic et al. 2006). The two subspecies (nominal and *D. p. pontica*) were recommended to be elevated to species rank, although with no genetic data was provided yet (see studies cited in Ljubisavljevic et al. (2006).

Ablepharus kitaibelii Bibron & Bory, 1833

Of the four recognized subspecies, the *A. k. stepaneki* Fuhn, 1970 form occurs in Romania (Fuhn & Vancea 1961, Fuhn 1969). The data of Ljubisvljevic et al.

(2002) on Serbian populations and the data on distribution of the species in Romania (Fuhn & Vancea 1961, Iftime 1997) show the continuity of the distribution of the subspecies between the two countries, although the Danube represents a barrier between the two areas. Ljubisvljevic et al. (2002) found that intergradation between the mentioned subspecies and the *A. k. kitaibelii* (Bibron & Bory, 1833) occurs near the Serbian-Romanian border. Due to these findings and due to the distribution of the same subspecies in Serbia and Romania, we can speculate about the existence of an the intergradation zone in the south-western part of Romania too.

Anguis fragilis (Linnaeus, 1758)

Romania is situated in the range of the distribution of *A. f. colchicus* Nordmann 1840 subspecies (Fuhn & Vancea 1961). The form is considered to be the primitive form (e.g. Dely 1974), which had is glacial refuge in the south Europe (Wermuth 1950).

Populations with mixed characters between the mentioned subspecies and the nominal one, *A. f. fragilis* Linnaeus, 1758 were found in the Bihor Mountains by Stugren et al. (1962). They suggested that this population belongs to a glacial relict, which entered in contact with the younger *A. f. fragilis* branch, while the south-eastern *A. f. colchicus* branch occupied the major part of Romania.

Musters & in den Bosch (1982) remarked that the intergradation zone between the two subspecies shows a complex pattern, mainly in the Balkan Peninsula. The taxonomic status of the two subspecies and the intergradation zone between them must be revised.

Eryx jaculus (Linnaeus, 1758)

The very rare Sand Boa (see Krecsák & Iftime 2003) occurs in Romania as *E. j. turcicus* Olivier, 1801 form (Vancea & Fuhn 1961). No recent study concerning the phylogeny of the species seems to be available.

Dolichophis caspius (Gmelin, 1789)

The initially recommended new genus for the form was *Hierophis* (Schätti & Utiger 2001), but the genus name *Dolichophis* is now recognised (Nagy et al. 2004). This former subspecies of *Coluber jugularis* (Fuhn & Vancea 1961) has recently been recognized as a monotypic species (e.g. Nagy et al. 2004).

Elaphe sauromates (Pallas, 1814)

Based on a large genetic divergence from the related *E. quatorlineata* and distinct morphological differences, this taxon was raised to species rank (Lenk et al. 2001, Utiger et al. 2002). We are far from having a good image of the distribution of this critically endangered snake in Romania (Török 2006). Recently, the presence of the species was established also outside of the Dobrudja area (Ţibu & Strugariu 2007).

Zamenis longissimus (Laurenti, 1768)

The masculine gender of the genus name necessitates the gender name of the species name to be changed from *longissima* to *longissimus* (e.g. see in Böhme & Köhler 2004, Crochet & Dubois 2004). Recently, the species, usually recognised as being monotypic, was assigned to the *Zamenis* genus (Utiger et al. 2002). In traditional taxonomic view the nominal form, *Z. l. longissimus* (Laurenti, 1768) occurs in Romania. Although a further taxonomic differentiation within the species could be expected (e.g. Lenk & Joger 1994), as Joger et al. (2007) found that the species is grouped in two haplotype groups: a western and an eastern one. The south-western Romanian Aesculap Snake possible belong to the Danubian haplotype, one of the three western haplotypes groups. Although the study lacks Romanian genetical material, the philogenetic status of rest of Romanian populations is uncertain, even the presence of eastern haplotypes group in the country is highly probable.

Natrix natrix (Linnaeus, 1758)

Over time the number of accepted Grass Snake subspecies changed considerably (see Thorpe 1980). In present, the accepted subspecies number varies from author to author (e.g. Guicking et al. 2006, Kreiner 2007). According to Thorpe (1980) - based on morphological study, in Europe just four subspecies occur, despite of large racial differences in the species. The eastern subspecies, the nominal form *N. n. natrix* Linnaeus, 1758, inhabits the Romanian territories (Fuhn & Vancea 1961). The western subspecies, related to the *N. n. helvetica* and the eastern one are considered to be a not completely differentiated semispecies or incipient species, resulted from postglacial expansion which intergradate in a narrow contact zone (Thorpe 1980). According to other authors, in Romania two subspecies occur or intergradate (e.g. Fuhn & Vancea 1962, Kreiner 2007). After Kreiner (2007), in the southern part of Romania, under the Carpathian Belt, an intergradation zone exists between the nominal form and *N. n. persa* Pallas, 1814, while in the Dobrudjan part, a pure *N. n. persa* can be encountered. Even Thorpe (1979, 1980) found four different racial types which inhabit respectively northeastern, the southwestern, the southern and respectively the remaining part of Romania. The subspecific subdevision of the species needs further investigations.

Natrix tessellata (Laurenti, 1768)

If the validity of the *N. t. heinrothi* (Hecht 1930) from the Ukrainian Black Sea island of Ostrov Zmeinyi is refuted (e.g. Gruschwitz et al. 1999), the species could be considered monotypic. However, a recent study (Guicking et al. 2002) showed that traditional systematics do not cover the existing genetic diversity in the species. The study found 6 distinct clades, with genetic distances between them lying within the range of distances between closely related species and subspecies in other reptiles. The Romanian populations belongs to the European clade (Guicking et al. 2002). Based on the phylogeographic analysis of cytochrome b sequence data revealed 10 distinct haplotype groups, two of which occur in Greece and only one in the rest of Europe (Joger et al. 2007). The genetic diversity among European populations is low and with little geographic structuring.

Coronella austriaca Laurenti, 1768

The nominal form *C. a. austriaca* Laurenti, 1768 is cited from Romania (e.g. Fuhn & Vancea 1961), but further investigation of intraspecific variation is needed in all of its range (e.g. Malkmus 1995).

The *Vipera* genus

Zerova (1992) placed the *V. berus* and *V. ursinii* complexes in the "shield-headed" vipers or *Pelias* subgenus, while the *V. ammodytes* complexes was placed in a group af the small scale-headed vipers consisting the *Vipera* 1 subgroup. Garrigues et al. (2005) found that the *Pelias* group consists of two subgroups, thus the *V. berus* and *V. ursinii* complex are separated in two different clades, while the *V. ammodytes* complex represent a separate monophyletic clade.

Vipera (Acridophaga) ursinii (Bonaparte, 1835)

The recently rediscovered Danubian Meadow or Steppe Viper (*V. u. rakosiensis* Méhely, 1893) from Transylvania (Ghira 2007) and the Moldavian Meadow or Steppe Viper (*V. u. moldavica* Nilson, Andren & Joger, 1993; Nilson et al. 1993) from Moldavia belongs to the *Acridophaga* complex (i.e. subgenus; Nilson & Andrén 2001, Krecsák et al. 2003).

The populations from Moldavia were considered an intermediate form between *V. u. rakosiensis* and *V. u. renardi* (e.g. Fuhn & Vancea 1961), while the populations from the Danube Delta were considered as *V. u. ursinii* and/or *V. u. renardi* (in present *V. renardi*, e.g. Nilson & Andrén 2001), or as intermediate forms (see studies cited in Krecsák et al. 2003). Recently, the two groups were included in the *V. u. moldavica* taxon (Nilson et al. 1993, Nilson & Andrén 2001). They found that the vipers from the Danube Delta are morphologically similar to those from Romanian Moldova, except concerning the number of midbody dorsal scale rows. In other author' opinions, the taxonomic status of the populations from Danube Delta is still unresolved (e.g. Krecsák et al. 2003). Korsós et al. (1997) and Krecsák et al. (2003) consider that the populations from the Danube Delta represent a different taxon on the basis of morphological characters, although a recent study (Halpern et al. 2007, Ghira, I., pers. com.) confirms the same genetical status of Moldavian's and Danube Delta's populations. The extinct population from Rarău Mountains is identified as an intermediate form between *V. u. rakosiensis* und *V. u. moldavica* (Nilson & Andrén 2001).

Vipera berus (Linnaeus, 1758)

The *V. b. berus* Linnaeus, 1758 populations from Romania belong to the Carpathian subclade of the northern clade of the species, which originated from a refugial area in Eastern Europe, near the Carpathian Mountains, possible situated in the northern part of the Romanian Carpathian Mountains (Carlsson 2003, Ursenbacher et al. 2006).

The presence of *V. b. bosniensis* (Boettger 1880) or *V. bosniensis* (e.g. Kalyabina-Hauf et al. 2004) in Romania is based mostly on anecdotal information, and requires further confirmation (e.g. Krecsák 2001). Judging from recent studies (Ursenbacher et al. 2006), its occurrence in Romanian is highly improbable.

Vipera ammodytes (Linnaeus, 1758)

Two subspecies were described from Romania: *V. a. ammodytes* Linnaeus, 1758 in the southwestern part of country and *V. a. montandoni* Boulenger, 1904 in the Dobrudjan part of the country (e.g. Fuhn & Vancea 1961). The validity of *V. a. montandoni* was questioned recently based of on morphological characters (Christov & Beshkov 1999, Tomović & Džukić 2003). Garrigues et al. (2005) found that *V. a. montandoni* is phylogenetically closely related to *V. a. meridionalis*, thus these authors proposed to regarded the former as a synonym of *V. a. meridionalis*. However, Tomović (2006) reconfirm the validity of *V. a.* montandoni, based on morphometric analysis of five mersitic and qualitative characters on 922 specimens.

Conclusions

Summarising the results of recent phylogenetical studies related to the Romanian herpetofauna, can list the next changes:

i.) division of species in different genetical lineages (*S. salamandra*, *I. alpestris*, *L. vulgaris*, *L. montandoni*, *B. bombina*, *B. variegata*, *H. arborea*, *R. temporaria*, *R. arvalis*, *E. orbicularis*, *L. viridis*, *L. agilis*, *Z. vivipara*, *N. tessellata* and *V. berus*);

ii.) discovery of "cryptic" species (*I. alpestris*(?), *P. fuscus*);

iii.) description of new taxa (*T. d. macrosoma* and *V. u. moldavica*);

iv.) elevation of subspecies to species status (*T. cristatus*, *T. dobrogicus*, *D. caspius* and *E. sauromates*);

v.) genetic confirmation of validity of some subspecies (*L. v. ampelensis*, *T. h. boettgeri*, *E. a. deserti*, *L. v. viridis*, *L. v. meridionalis*, *L. a. chersonensis*, *V. u. rakosiensis*, *V. a. moldovica*, *V. a. ammodytes*, *V. a. montandoni*);

vi.) rejection of subspecies status of different subspecies (*R. a. wolterstorffi* and *L. a. euxinica*);

vii.) rediscovery of a taxon considered extinct from Romania (*V. u. rakosiensis*);

viii.) taxonomic and nomenclatural changes (e.g. *Ichthyosaura*, *Lissotriton*, *Epidalea*, *Pelophylax*);

ix.) expected existence of new taxa (i.e. subspecies) in Romania (*P. syriacus*, *A. kitaibelii* or *V. berus*);

x.) description of main refugia in different areas than believed in the past (e.g. *B. variegata, P. fuscus* or *E. orbicularis*).

In other common widespread genera (e.g. *Bombina*, *Pelobates*, *Bufo*, *Hyla,* and *Rana*), subgroups live under different ecological conditions. Hence, future genetic taxonomy studies may reveal further species-level diversity amongst existing taxa, thus the discovery of twin species (Džukić & Kalezić 2001, Borkin *egres* 2001*a*, Litvinchuk et al. 2007). Taxa which are almost indistinguishable in morphology but obviously reproductively isolated can be identified by non-morphological characteristics, such as differences in ecology, behaviour, cytogenetics or biochemistry. In population genetic terms, species are delimited by the level of reproductive, i.e., genetic isolation rather than the degree of morphological and other differences (Borkin egres 2001*a*, Fritz et al. 2006*a*). Possible morphological taxonomical differentiation does, however, of course still exist as proposed by Fritz et al. (2006*a*). For swift correction of taxonomic classifications based on external morphological features the use of "first-class qualitative morphological differences between taxa than relying on statistical differences produced by an – in the worst case – biased sampling or even wrong application of powerful statistical methods" must be advocated.

Further taxonomy changes in the Romanian herpetofauna can be expected (e.g. Dubois 1998), mainly to the not exactly determined and flexible use of the genetic "species" concept used in most genetical studies. "In practice, specialists in "molecular" systematics often use typological (phenetic) methods and base their conclusions on some criteria (distances) that are generally accepted among their colleagues but may be different in various amphibian groups" (Veith 1996 cited in Borkin et al. 2004). Actually, no general "species criterion" exists (e.g. see Borkin et al. 2004, Borkin & Litvinchuk 2007). Different genetical methods can have different results concerning a certain status of certain subgroups.

From a conservation perspective, the recognition of genetically differentiated subgroups in species, even if they are not elevated to a subspecies status, is critical. The different Evolutionary Significant Units represent genetically differentiated entities, even if they do not have a taxonomic rank (e.g. Canestrelli et al. 2006). Subgroups, which inhabit the former glacial refugia areas have in all species a higher genetical heterogeneity than the expanded branches from recently colonized areas, which generally exhibit low effective population sizes due to the population bottleneck of colonisation (Eggert et al. 2006, Crottini et al. 2007, Hofman et al. 2007, Joger et al. 2007). Contemporary conservation activities should be developed on the basis of long-term conservation policies, devoted to genetic diversity management and they should prioritise protection and sustainability of genetically different populations (e.g. Arntzen 1995, Eggert et al. 2006). The recognition of genetically differentiated subgroups as conservational units will substantially limit the effects of taxonomic changes on conservational legislative and activities.

In conclusion, informed choices, resulting from phylogenetic studies, can markedly increase intraspecific genetic diversity, sometimes safeguarding it without increasing expenditure (e.g. Arntzen 1995). Furthermore, at a smaller scale, as Pabijan & Babik (2006) pointed out, "the understanding of the genetic structure of populations and gene flow among them is critical for the maintenance of ecologically and evolutionary viable species or populations".

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Appendix 1. Recent changes in nomenclature related to Romanian amphibian and reptile species and subspecies and their established or expected phylogenetical status.

Species	Subspecies	Former name	English name	Romanian name
Salamandra salamandra (Linnaeus, 1758)	*S. s. salamandra* Linnaeus, 1758 [East-European clade (Veith et al. 1998)]		Fire Salamander	Salamandra
Triturus cristatus (Laurenti, 1768)		*T. c. cristatus*	Northern Crested Newt/Warty Newt	Tritonul cu creastă
Triturus dobrogicus Kiritzescu, 1903	*Triturus d. dobrogicus* (Kiritzescu, 1903)	*T. cristatus dobrogicus*	Danube Crested Newt	Tritonul cu creastă dobrogean
	Triturus d. macrosoma (Boulenger, 1908)	*T. cristatus. dobrogicus*		"Tritonul cu creastă dunărean"
Ichthyosaura alpestris (Laurenti, 1768)	*I. a. alpestris* Laurenti, 1768 [possible two cryptic species: one in Romanian Eastern Carpathians and second in Southern and Western Carpathians (Sotiropoulos et al. 2007)]	*Triturus*	Alpine Newt	Tritonul de munte
Lissotriton vulgaris (Linnaeus, 1758)	*L. v. vulgaris* Linnaeus, 1758 [2 major clade (Babik et al. 2005)]	*Triturus*	Smooth Newt	Tritonul comun
	L. v. ampelensis Fuhn 1951	*Triturus*	Romanian Smooth Newt	"Tritonul românesc"
Lissotriton montandoni Boulenger, 1880		*Triturus*	Montandon's Newt	Tritonul carpatic
Bombina bombina (Linnaeus, 1761) [southern clade (Hofman et al. 2007)]			Fire-bellied Toad	Buhaiul de baltă (izvoraşul) cu burta roşie
Bombina variegata (Linnaeus, 1758)	*B. v. variegata* (Linnaeus, 1758) [western and eastern Carpathian clade (Hofman et al. 2007)]		Yellow-bellied Toad	Buhaiul de baltă (izvoraşul) cu burta galbenă
Pelobates fuscus (Laurenti, 1768)	*Pelobates f. fuscus* (Laurenti, 1768) [south eastern lineage of western group (Eggert et al. 2007)]		Common Spadefoot	Broasca de pământ brună
Pelobates syriacus Boettger, 1889	*P. s. balcanicus* Karaman, 1928		Eastern Spadefoot	Broasca de pământ siriacă
Bufo bufo (Linnaeus, 1758)	*B. b. bufo* (Linnaeus, 1758)		Common Toad	Broasca râioasă brună
Epidalea viridis (Laurenti, 1768)	*E. v. viridis* (Laurenti, 1768) [eastern lineage of diploid form (Litvinchuk et al. 2007)]		Green Toad	Broasca râioasă verde
Hyla arborea (Linnaeus, 1758)	*H. a. arborea* (Linnaeus, 1758)		Common Tree Frog	Brotăcelul

Appendix 1. (Continued)

Species	**Subspecies**	**Former name**	**English name**	**Romanian name**
Rana temporaria (Linnaeus, 1758)	*R. t. temporaria* Linnaeus, 1758 ["eastern" or Balkan clade (Pidancier et al. 2003)]		Common Frog	Broasca roşie de munte
Rana arvalis Nilsson, 1842 [southern lineage (Babik et al. 2004)]	*R. a. arvalis* Nilsson, 1842 [the status of population from Reci assigned to this form is retracted (Babik et al. 2004)]			
	R. a. wolterstorffi Fejérváry, 1919 [its taxonomic status is not clarified (Babik et al. 2004)]		Moor Frog	Broasca de mlaştină
Rana dalmatina Fitzinger *in* Bonaparte, 1838		Bonaparte, 1840	Agile Frog	Broasca roşie de pădure
Pelophylax ridibundus Pallas, 1771	*P. r. ridibundus* Pallas, 1771	*Rana*	Marsh Frog	Broasca mare de lac
Pelophylax lessonae Camerano, 1882		*Rana*	Pool Frog	"Broasca lui Lessona"
Pelophylax kl. *esculentus* Linnaeus, 1758		*Rana*	Edible Frog Roesel's Green Frog	Broasca mică de lac
Testudo hermanni Gmelin, 1789	*T. h. boettgeri* Gmelin, 1789 [syn. *Eurotestudo hermanni boettgeri* Mojsisovics, 1889 or *Eurotestudo boettgeri* Mojsisovics, 1889; see text] [eastern lineage (Fritz et al. 2006]		Hermann's Tortoise	Ţestoasa bănăţeană Ţestoasa lui Hermanni
Testudo graeca Linnaeus, 1758	*T. g. ibera* Pallas, 1814		Spur-thighed Tortoise	"Ţestoasa de uscat dobrogeană"
Emys orbicularis (Linnaeus, 1758)	*E. o. orbicularis* Linnaeus, 1758 [2 eastern lineages (Fritz et al. 2007]		European Pond Terrapin	Ţestoasa de apă
Eremias (*Ommateremias*) *arguta* (Pallas, 1773)	*E.*(*O.*) *a. deserti* Gmelin 1789		Steppe Runner	Şopârla de nisip
Lacerta viridis (Laurenti 1768)	*L. v. viridis* Laurenti 1768 [1 lineages (Böhme et al. 2005)]		(Eastern) Green Lizard	Guşter
	L. v. meridionalis Cyren 1933 [1 lineages (Böhme et al. 2005)]			
Lacerta trilineata Bedriaga, 1886	*L. t. dobrogica* Fuhn & Mertens 1959		Balkan Green Lizard	Guşterul vărgat

Appendix 1. (Continued)

Species	Subspecies	Former name	English name	Romanian name
Lacerta agilis Linnaeus, 1758	*L. a. agilis* Linnaeus 1758 [?*L. a. argus* (Laurenti, 1768)]		Sand Lizard	Şopârla de câmp
	L. a. chersonensis Andrzejowski, 1832			
Zootoca vivipara (Jacquin, 1787)	*Z. vivipara* (Jacquin, 1787) [eastern viviparous group (Surget-Groba et al. 2006) ≈ *Z. v. sachalinensis* Pereleshin & Terentjev, 1963]	*Lacerta*	Common Lizard Viviparous Lizard	Şopârla de munte
Podarcis muralis (Laurenti, 1768)	*P. m. muralis* Laurenti 1768		Common Wall Lizard	Şopârla de ziduri
	(?) *P. muralis* aff. *maculiventris* Werner, 1891			
	(?) *P. m. albanicus* Bolkay 1919			
Podarcis tauricus (Pallas, 1814)	*P. t. tauricus* Pallas, 1814	*taurica*	Balkan Wall Lizard	Şopârla de iarbă
Darevskia praticola (Eversmann, 1834)	*D. p. pontica* Lantz & Cyren, 1919	*Lacerta*	Meadow Lizard	Şopârla de pădure
Ablepharus kitaibelii Bibron & Bory, 1833	*A. k. stepaneki* Fuhn, 1970		Snake-eyed Skink	Şopârliţa de frunzar
Anguis fragilis (Linnaeus, 1758)	*A. f. colchicus* Nordmann 1840		Slow Worm	Năpârcă
	(?) *A. f. fragilis* Linnaeus, 1758			
Eryx jaculus (Linnaeus, 1758)	*E. j. turcicus* Olivier, 1801		(Western) Sand Boa	Şarpele de nisip
Dolichophis caspius (Gmelin, 1789)		*Coluber jugularis caspius* *Hierophis caspius*	Caspian Whip Snake	Şarpele rău
Elaphe sauromates Pallas, 1814		*Elaphe quatorlineata sauromates*	Eastern (Four-lined) Rat Snake, Blotched Snake	Balaur
Zamenis longissimus (Laurenti, 1768)	*Z. l. longissimus* (Laurenti, 1768) [1. danubian haplotype 2. eastern haplotype (?) (Joger et al. 2007)]	*Elaphe longissima longissima*	Aesculapian Snake	Şarpele lui Esculap
Natrix natrix (Linnaeus, 1758)	*N. n. natrix* Linnaeus, 1758		Grass Snake	Şarpele de casă
	(?) *N. n. persa* Pallas, 1814		Stripped Grass Snake	Şarpele de casă "persană"

Appendix 1. (Continued)

Species	**Subspecies**	**Former name**	**English name**	**Romanian name**
Natrix tessellata (Laurenti, 1768) [European clade (Guicking et al. 2002)]	(?) *N. t. tessellata* (Laurenti, 1768)		Dice Snake, Tessellated Water Snake	Şarpele de apă
Coronella austriaca Laurenti, 1768	*C. a. austriaca* Laurenti, 1768			
Vipera ursinii (Bonaparte, 1835)	*V. u. rakosiensis* Méhely, 1893		Danube Steppe (Meadow) Viper	Vipera de fâneaţă "dunăreană"
	V. u. moldavica Nilson, Andren & Joger, 1993	*V. u. ursinii* *V. u. renardi* *V. u. ursinii & V. u. renardi* *V. u. rakosiensis* & *V. u. renardi*	Moldavian Steppe (Meadow) Viper	Vipera de fâneaţă "moldoveană"
Vipera berus (Linnaeus, 1758)	*V. b. berus* Linnaeus, 1758 [Carpathian subclade of the Northern clade (Ursenbacher et al. 2006)]		Adder, Common European Viper	Vipera
Vipera ammodytes (Linnaeus, 1758)	*V. a. ammodytes* Linnaeus, 1758		European Nose-horned (Sand) Viper	Vipera cu corn
	V. a. montandoni Boulenger, 1904		Dobrudja Nose-horned Viper	Vipera cu corn "dobrogeană"

Appendix 2. Romanian material used in cited phylogenetic studies.

Species /subspecies	Locality	Source
T. cristatus	Bogdana, Bumbeşti-Jiu, Câmpeni, Crăciuneşti, Crasna, Drighiu, Găloieşti, Halmaşd, Hurezani, Huta-Certeze, Jitia, Marghita, Picâturile, Sebiş, Sinaia, Tăşnad, Târgovişte, Turt, Videle, Vipereşti, Vârfuri	Arntzen & Wallis 1999
	Şebiş, Vârfuri, Câmpeni, Sinaia, Târgovişte,	Wallis & Arntzen 1989
	Dej, Câmpeni, Reghin	Litvinchuk et al. 1999
	Sinaia	Zajc & Arntzen 1999
	Sinaia	Steinfartz et al. 2007
T. dobrogicus	Andrid, Băbeşti, Gherteniş, Pişcolt, Şebiş, Vârfuri, Amărăşti de Jos, Ariciu, Hogioaia, Obrejiţa, Prahova Forest (N of Bucharest), Tărtăl, Ziminicea	Arntzen & Wallis 1999
	Şebiş, Vârfuri, Ziminicea	Wallis & Arntzen 1989
	Danube Delta	Mikulícek & Piálek 2003
	Zimnicea	Steinfartz et al. 2007
T. cristatus x *T. dobrogicus*	Videle	Wallis & Arntzen 1989
I. a. alpestris	Bihor Mountains (Câmpeni)	Litvinchuk et al. 2005
	Retezat Mountains, Baiu Mountains	Pabijan & Babik 2006
	Tăul Secat, Zănoaga Lake (Retezat Mountains), Vidraru Lake (Făgăraş Mountains), Prahova Valley	
	Sihăstria Monastery, Văratec	
L. v. vulgaris	Reci, Băneasa	Rafiński et al. 2001
	Craidorolţ, Couăş, Acâş, Andrid, Săcăşeni, Supuru de Sus, Sălard, Crăcurele, Rupea, Reci, Moraviţă, Greoni, Scroviştea, Băneasa	Babik et al. 2005
	Romanian Bihor Mountains (Nemira Mountains)	Litvinchuk et al. 2005
L. v. ampelensis	Dej	Litvinchuk et al. 2003b
	Cărpiniş, Izvorul Ampoiului, Zlatna, Deva	Rafiński et al. 2001
	Cluj, Briheni, Cărpiniş, Izvorul Ampoiului, Zlatna, Săcărâmbu, Deva, Calan-Băi, Câmpu lui Neag	Babik et al. 2005
	Dej, Reghin and Câmpeni (Romanian Bihor Mountains)	Litvinchuk et al. 2005
L. v. vulgaris x	Câmpu lui Neag	Rafiński et al. 2001
L. v. ampelensis	Bihor Mountains (Câmpeni)	Litvinchuk et al. 2005
L. montandoni	Izvoarele, Sadova, Predeal, Baiu,	Babik et al. 2005
	Nemira Mountains	Litvinchuk et al. 2005
	Sinaia	Steinfartz et al. 2007
B. bombina	Bucureşti	Szymura et al. 2000
P. f. fuscus	Bucureşti, Brăila	Eggert et al. 2006
	Bucureşti, Brăila	Crottini et al. 2007
B. v. viridis	Sinaia	Litvinchuk et al. 2007
R. t. temporaria	Romania	Pidancier et al. 2003

Appendix 2. (Continued)

Species /subspecies	**Locality**	**Source**
R. arvalis	Reci	Babik & Rafiński 2000, Rafiński & Babik 2000, Babik et al. 2004
T. h. boettgeri	Romania	Kuyl et al. 2002
	Banat	Fritz et al. 2006
T. g. ibera	Histria	Fritz et al. 2007*a*
E. o. orbicularis	estuary of Danube	Lenk et al. 1998
Z. v. vivipara	Apuseni, Poiana Florilor, Marghita, Şureanu, Vlădeasa, Eremitu, Retezat, Rodnei	Surget-Groba et al. 2006
Z. l. longissima	Bâcia	Lenk & Joger 1994
N. t. tessellata	Tulcea	Guicking et al. 2002
V. u. moldavica	Valea lui David, Călăraşi/Dorohoi, Româneşti/Ursoaia, Carpathians/Rarău Mountains, Danube Delta/Braţul Sfântu Gheorghe, C. A. Rosetti, Grindul Perişor	Nilson & Andrén 2001
V. b. berus	Apuseni Mt., Oradea, Chirui, Cârţa	Ursenbacher et al. 2006