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, 2005a,b, 2006a,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. 2006a). 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 Rafféelli (2007), the Romanian Carpathians is inhabited by S. s. carpatica 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 Kiritsescu, 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 (Kiritsescu 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 (Rafirski & Arntzen 1987, Arntzen & Sparreboom 1989, MacGregor et al. 1990, Garcia-Paris 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, Mikulicek 2003, Litvinchuk et al. 1997, Mikulicek 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 (Mikulicek 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* (Kiritsescu, 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 Brașov (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 voucher (or even a seen) specimen from this area.

**Ichthyosaura alpestris** (Laurenti, 1768)

Bolkay (1928) recommended a subgenus (*Meso Triton*) 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).

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 & Hedgcock 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 (Litvinchuk 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

**Figure 1.** Approximate range limits of subspecies of *T. dobrogicus* and the contact zone with *T. cristatus* after Fuhn (1960), Wallis & Arntzen (1989), Cogălniceanu (1991), Litvinchuk et al. (1994, 1999), Cogălniceanu et al. (2000) and Litvinchuk & Borkin (2000).
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* (Déj, Romania) from *L. v. vulgaris* were quite low (0,03). The Ukrainian Transcarpathians *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 endemicty 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 Păraul Bănarului (Valea Bistriței) near Broșteni (Romanian) captured by Montandon (Șova 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

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1992) and the two species hybridise in nature (Cogălniceanu et al. 2000, Babik et al. 2003, Litvinchuk et al. 2003a, 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. 2006b). Hybridization can be a limiting factor for Montandon’s Newt, reducing 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 been 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 been 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. (2003a), 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. 2003, 2005, Lada et al. 2005). The groups show 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) although 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-Marcoev et al. 2008a), 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).

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<tr>
<td>M</td>
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<td>P. ridibundus (RR)</td>
<td>P. kl. esculentus (RL)</td>
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<tr>
<td>A</td>
<td>P. kl. esculentus (RL)</td>
<td>P. kl. esculentus (RL)</td>
<td>P. ridibundus (RR)</td>
<td>P. kl. esculentus (RL)</td>
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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. (2006a,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. 2006a,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. 2006c) 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). 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. 2006b) 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. 2006b). 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. 2006b), 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. 2007a), 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. (2007a), 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* Calinescu, 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. 2007b). For the first lineage, the localised distribution is suggested to relate 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. 2007b). 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. 2007b). In the northern part of the country, the Carpathians separate the two lineages (Lenk et al. 1990, Fritz et al. 2007b), although contacts could be possible through some river valleys (e.g. Olt, Jiu, Arges) acting as corridors (Fritz 2001). Further study is needed to be able to draw the exact distribution of lineages in Romania.

Eremias (Ommaterremias) 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 2005b, Ghira, I., pers. com.). Intergradation forms between the two subspecies are found where the two subspecies occur sympatricly (Fuhn & Vancea 1961, Schlüter 2005b, 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 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. Contrarily, 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 nominotypical 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, Covaci-Marcov et al. 2003a, Covaci-Marcov et al. 2008b) 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 (2005a) 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 (Covaci-Marcov et al. 2003b).

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 Ljubisavljević 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 Ljubisavljević 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 Ljubisavljević 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. Ljubisvić 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 of 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’s 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 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 regard 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 2001a, 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 2001a, Fritz et al. 2006a). Possible morphological taxonomical differentiation does, however, of course still exist as proposed by Fritz et al. (2006a). 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 genetic 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”.

Acknowledgements. D. Cogălniceanu, I. Ghira, S. N. Litvinchuk, J. Speybroeck and M. Vences’ comments highly improved the article contents and/or language. The persons listed below kindly provided some of the reference paper: D. Bird, D. Cogălniceanu, U. Fritz, I. Ghira, S. N. Litvinchuk, K. Ljubisavljevic, Mara Gy., Ishchenko V., M. Pabijan, Sas L., A. Strugariu, Vágási Cs. and A. Zinenko. My sincere thanks go to all. I am indebted also to my friends, Daróczi Sz. and Zeitz R. for their help on field trips.
References


T. vittatus, with a reinterpretation of the species groups within Triturus (Caudata, Salamandridae). Copeia 662-672.


Review of recent taxonomic and nomenclatural changes in European Amphibia and Reptilia


(Laurenti, 1768) as suggested by protein electrophoresis and DNA fingerprinting. Amphibia-Reptilia 15: 363-373.


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

<table>
<thead>
<tr>
<th>Species Subspecies</th>
<th>Former name</th>
<th>English name</th>
<th>Romanian name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Salamandra salamandra</em> (Linnaeus, 1758)</td>
<td>S. s. salamandra Linnaeus, 1758</td>
<td>Fire Salamander</td>
<td>Salamandra</td>
</tr>
<tr>
<td>[East-European clade (Veith et al. 1998)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Triturus cristatus</em> (Laurenti, 1768)</td>
<td>T. c. cristatus</td>
<td>Northern Crested Newt/Warty Newt</td>
<td>Tritonul cu creștă</td>
</tr>
<tr>
<td><em>Triturus dobrogicus</em> Kiritzescu, 1903</td>
<td>Triturus d. dobrogicus (Kiritzescu, 1903)</td>
<td>Danube Crested Newt</td>
<td>Tritonul cu creștă dobrogean</td>
</tr>
<tr>
<td><em>Ichthyosaura alpestris</em> (Laurenti, 1768)</td>
<td>I. a. alpestris Laurenti, 1768</td>
<td>Alpine Newt</td>
<td>Tritonul de munte</td>
</tr>
<tr>
<td>[possible two cryptic species: one in Romanian Eastern Carpathians and second in Southern and Western Carpathians (Sotiropoulos et al. 2007)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Lissotriton vulgaris</em> (Linnaeus, 1758)</td>
<td>L. v. vulgaris Linnaeus, 1758 [2 major clade (Babik et al. 2005)]</td>
<td>Smooth Newt</td>
<td>Tritonul comun</td>
</tr>
<tr>
<td><em>L. v. amplexensis</em> Fuhn 1951</td>
<td>Triturus Romanian Smooth Newt</td>
<td>“Tritonul românesc”</td>
<td></td>
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<tr>
<td><em>Lissotriton montandoni</em> Boulenger, 1880</td>
<td>Triturus Montandon’s Newt</td>
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<td>Tritonul carpatic</td>
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<tr>
<td><em>Bombina bombina</em> (Linnaeus, 1761) [southern clade (Hofman et al. 2007)]</td>
<td>Bombina variegata (Linnaeus, 1758) [western and eastern Carpathian clade (Hofman et al. 2007)]</td>
<td>Fire-bellied Toad</td>
<td>Buhaiul de baltă (izvorașul) cu burta roșie</td>
</tr>
<tr>
<td><em>Pelobates fuscus</em> (Laurenti, 1768)</td>
<td>Pelobates f. fuscus (Laurenti, 1768) [south eastern lineage of western group (Eggert et al. 2007)]</td>
<td>Common Spadefoot</td>
<td>Broasca de pământ brună</td>
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<tr>
<td><em>Pelobates syriacus</em> Boettger, 1889</td>
<td>P. s. balcanicus Karaman, 1928</td>
<td>Eastern Spadefoot</td>
<td>Broasca de pământ siriacă</td>
</tr>
<tr>
<td><em>Bufo bufo</em> (Linnaeus, 1758)</td>
<td>B. b. bufo (Linnaeus, 1758)</td>
<td>Common Toad</td>
<td>Broasca răioasă brună</td>
</tr>
<tr>
<td><em>Epidalea viridis</em> (Laurenti, 1768)</td>
<td>E. v. viridis (Laurenti, 1768) [eastern lineage of diploid form (Litvinchuk et al. 2007)]</td>
<td>Green Toad</td>
<td>Broasca răioasă verde</td>
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<tr>
<td><em>Hyla arborea</em> (Linnaeus, 1758)</td>
<td>H. a. arborea (Linnaeus, 1758)</td>
<td>Common Tree Frog</td>
<td>Brotâcelul</td>
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### Appendix 1. (Continued)

<table>
<thead>
<tr>
<th>Species</th>
<th>Subspecies</th>
<th>Former name</th>
<th>English name</th>
<th>Romanian name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Rana temporaria</em> (Linnaeus, 1758)</td>
<td><em>R. t. temporaria</em> Linnaeus, 1758</td>
<td>Common Frog</td>
<td>Broasca roșie de munte</td>
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</tr>
<tr>
<td></td>
<td>[&quot;eastern&quot; or Balkan clade (Pidancier et al. 2003)]</td>
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</tr>
<tr>
<td><em>Rana arvalis</em> Nilsson, 1842 [southern lineage (Babik et al. 2004)]</td>
<td><em>R. a. arvalis</em> Nilsson, 1842 [the status of population from Reci assigned to this form is retracted (Babik et al. 2004)]</td>
<td>Moor Frog</td>
<td>Broasca de mlaștină</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[its taxonomic status is not clarified (Babik et al. 2004)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Rana dalmatina</em> Fitzinger in Bonaparte, 1838</td>
<td>Bonaparte, 1840</td>
<td>Agile Frog</td>
<td>Broasca roșie de pădure</td>
<td></td>
</tr>
<tr>
<td><em>Pelophylax ridibundus</em> Pallas, 1771</td>
<td><em>P. r. ridibundus</em> Pallas, 1771</td>
<td>Rana</td>
<td>Marsh Frog</td>
<td>Broasca mare de lac</td>
</tr>
<tr>
<td><em>Pelophylax lessonae</em> Camerano, 1882</td>
<td>Rana</td>
<td>Pool Frog</td>
<td>“Broasca lui Lessona”</td>
<td></td>
</tr>
<tr>
<td><em>Pelophylax kl. esculentus</em> Linnaeus, 1758</td>
<td>Rana</td>
<td>Edible Frog</td>
<td>Broasca mică de lac</td>
<td></td>
</tr>
<tr>
<td><em>Testudo hermanni</em> Gmelin, 1789</td>
<td><em>T. h. boettgeri</em> Gmelin, 1789 [syn. Eurotestudo hermanni boettgeri Mojsisovics, 1889 or Eurotestudo boettgeri Mojsisovics, 1889; see text] [eastern lineage (Fritz et al. 2006)]</td>
<td>Hermann’s Tortoise</td>
<td>Țestoasa bănațeană</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Țestoasa lui Hermanni</td>
<td></td>
</tr>
<tr>
<td><em>Testudo graeca</em> Linnaeus, 1758</td>
<td><em>T. g. ibera</em> Pallas, 1814</td>
<td>Spur-thighed Tortoise</td>
<td>“Țestoasa de uscat dobrogeană”</td>
<td></td>
</tr>
<tr>
<td><em>Emys orbicularis</em> (Linnaeus, 1758)</td>
<td><em>E. o. orbicularis</em> Linnaeus, 1758 [2 eastern lineages (Fritz et al. 2007)]</td>
<td>European Pond Terrapin</td>
<td>Țestoasa de apă</td>
<td></td>
</tr>
<tr>
<td><em>Eremias (Omnateremias) arguta</em> (Pallas, 1773)</td>
<td><em>E.(O.) a. deserti</em> Gmelin 1789</td>
<td>Steppe Runner</td>
<td>Șopârla de nisip</td>
<td></td>
</tr>
<tr>
<td><em>Lacerta viridis</em> (Laurenti 1768)</td>
<td><em>L. v. viridis</em> Laurenti 1768 [1 lineages (Böhme et al. 2005)]</td>
<td>(Eastern) Green Lizard</td>
<td>Gușter</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><em>Lacerta triulicata</em> Bedriaga, 1886</td>
<td><em>L. t. dobrogica</em> Fuhn &amp; Mertens 1959</td>
<td>Balkan Green Lizard</td>
<td>Gușterul vârgat</td>
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</table>
### Appendix 1. (Continued)

<table>
<thead>
<tr>
<th>Species</th>
<th>Subspecies</th>
<th>Former name</th>
<th>English name</th>
<th>Romanian name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Lacerta agilis</em> Linnaeus, 1758</td>
<td><em>L. a. agilis</em> Linnaeus 1758 [? <em>L. a. argus</em> (Laurenti, 1768)]</td>
<td>Sand Lizard</td>
<td>Şopârla de câmp</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>L. a. chersonensis</em> Andrzejowski, 1832</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><em>Zootoca vivipara</em> (Jacquin, 1787)</td>
<td><em>Z. vivipara</em> (Jacquin, 1787) [eastern viviparous group (Surget-Groba et al. 2006) ~ <em>Z. v. sachalinensis</em> Pereleshin &amp; Terentjev, 1963]</td>
<td>Common Lizard</td>
<td>Şopârla de munte</td>
<td></td>
</tr>
<tr>
<td><em>Podarcis muralis</em> (Laurenti, 1768)</td>
<td><em>P. m. muralis</em> Laurenti 1768</td>
<td>Common Wall Lizard</td>
<td>Şopârla de ziduri</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(? <em>P. m. aff. maculiventris</em> Werner, 1891)</td>
<td>Common Wall Lizard</td>
<td>Şopârla de iarbă</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(? <em>P. m. albanicus</em> Bolkay 1919)</td>
<td>Common Wall Lizard</td>
<td>Şopârla de ziduri</td>
<td></td>
</tr>
<tr>
<td><em>Podarcis tauricus</em> (Pallas, 1814)</td>
<td><em>P. t. tauricus</em> Pallas, 1814</td>
<td><em>taurica</em> Balkan Wall Lizard</td>
<td>Şopârla de iarbă</td>
<td></td>
</tr>
<tr>
<td><em>Darevskia pratolica</em> (Eversmann, 1834)</td>
<td><em>D. p. pontica</em> Lantz &amp; Cyren, 1919</td>
<td><em>Lacerta</em> Meadow Lizard</td>
<td>Şopârla de pădure</td>
<td></td>
</tr>
<tr>
<td><em>Ablepharus kitaibelii</em> Bibron &amp; Bory, 1833</td>
<td><em>A. k. stepaneki</em> Fuhn, 1970</td>
<td><em>Snake-eyed Skink</em></td>
<td>Şopârla de frunzar</td>
<td></td>
</tr>
<tr>
<td><em>Anguis fragilis</em> (Linnaeus, 1758)</td>
<td><em>A. f. colchicus</em> Nordmann 1840</td>
<td><em>Slow Worm</em></td>
<td>Năpârcă</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(? <em>A. f. fragilis</em> Linnaeus, 1758)</td>
<td><em>Slow Worm</em></td>
<td>Năpârcă</td>
<td></td>
</tr>
<tr>
<td><em>Eryx jaculus</em> (Linnaeus, 1758)</td>
<td><em>E. j. tauricus</em> Olivier, 1801</td>
<td>(Western) Sand Boa</td>
<td>Şarpele de nisip</td>
<td></td>
</tr>
<tr>
<td><em>Dolichophis caspius</em> (Gmelin, 1789)</td>
<td><em>Coluber jugularis</em> caspius Hierophis caspius</td>
<td>Caspian Whip Snake</td>
<td>Şarpele râu</td>
<td></td>
</tr>
</tbody>
</table>
| *Elaphe sauromates* Pallas, 1814 | *Elaph quatorlineata* sauromates | Eastern (Four-lined) Rat Snake, Blotched Snake | Balaurs |}

*Herpetol. Rom, 2, 2008*
### Appendix 1. (Continued)

<table>
<thead>
<tr>
<th>Species</th>
<th>Subspecies</th>
<th>Former name</th>
<th>English name</th>
<th>Romanian name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Natrix tessellata</em> (Laurenti, 1768)</td>
<td>(?) <em>N. t. tessellata</em> (Laurenti, 1768)</td>
<td>diced snake, tessellated water snake</td>
<td>Dice Snake, Tessellated Water Snake</td>
<td>şarpele de apă</td>
</tr>
<tr>
<td><em>Coronella austriaca</em> Laurenti, 1768</td>
<td>C. a. austriaca Laurenti, 1768</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><em>Vipera ursinii</em> (Bonaparte, 1835)</td>
<td><em>V. u. rakosiensis</em> Méhely, 1893</td>
<td></td>
<td>danube steppe (meadow) viper</td>
<td>Vipera de fâneață “dunăreană”</td>
</tr>
<tr>
<td></td>
<td><em>V. u. moldavica</em> Nilson, Andren &amp; Joger, 1993</td>
<td>v. u. ursinii</td>
<td>Moldavian Steppe (Meadow) Viper</td>
<td>Vipera de fâneață “moldoveană”</td>
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<td></td>
<td><em>V. u. renardi</em></td>
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<td></td>
<td></td>
<td><em>V. u. ursinii</em> &amp; <em>V. u. renardi</em></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td><em>V. u. rakosiensis</em> &amp; <em>V. u. renardi</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Vipera berus</em> (Linnaeus, 1758)</td>
<td><em>V. b. berus</em> Linnaeus, 1758</td>
<td></td>
<td>adder, common European Viper</td>
<td>Vipera</td>
</tr>
<tr>
<td></td>
<td>[carpathian subclade of the Northern clade (Ursenbacher et al. 2006)]</td>
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<td><em>Vipera ammodytes</em> (Linnaeus, 1758)</td>
<td><em>V. a. ammodytes</em> Linnaeus, 1758</td>
<td></td>
<td>European Nose-horned (Sand) Viper</td>
<td>Vipera cu corn</td>
</tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>V. a. montandoni</em> Boulenger, 1904</td>
<td></td>
<td>dobrudja Nose-horned Viper</td>
<td>Vipera cu corn “dobrogeană”</td>
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</table>
Appendix 2. Romanian material used in cited phylogenetic studies.

<table>
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<tr>
<th>Species /subspecies</th>
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<tr>
<td><em>T. cristatus</em></td>
<td>Bogdana, Bumbești-Jiu, Cămpani, Crăciunesti, Crasna, Drighiu, Gâlăoiești, Hâlnașd, Hurezani, Huta-Certeze, Jiția, Marghita, Picăturile, Sebiș, Sinaia, Țașnad, Târgoviște, Turț, Videle, Viperești, Vârful</td>
<td>Arntzen &amp; Wallis 1999</td>
</tr>
<tr>
<td></td>
<td>Şebiș, Vârfuri, Cămpani, Sinaia, Târgoviște,</td>
<td>Wallis &amp; Arntzen 1989</td>
</tr>
<tr>
<td></td>
<td>Dej, Cămpeni, Reghin</td>
<td>Litvinchuk et al. 1999</td>
</tr>
<tr>
<td></td>
<td>Sinaia</td>
<td>Zajc &amp; Arntzen 1999</td>
</tr>
<tr>
<td></td>
<td>Sinaia</td>
<td>Steinfartz et al. 2007</td>
</tr>
<tr>
<td><em>T. dobrogicus</em></td>
<td>Andrid, Băbenaști, Gherteniș, Pișcolți, Sebiș, Vârfuri, Amârăști de Jos, Ariciu, Hogioaia, Obrejița, Prahova Forest (N of Bucharest), Târtălă, Zimnicea</td>
<td>Arntzen &amp; Wallis 1999</td>
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<td></td>
<td>Şebiș, Vârfuri, Zimnicea</td>
<td>Wallis &amp; Arntzen 1989</td>
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<td></td>
<td>Danube Delta</td>
<td>Mikulícek &amp; Pálek 2003</td>
</tr>
<tr>
<td></td>
<td>Zimnicea</td>
<td>Steinfartz et al. 2007</td>
</tr>
<tr>
<td><em>T. cristatus</em> x T. dobrogicus</td>
<td>Videle</td>
<td>Wallis &amp; Arntzen 1989</td>
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<td><em>I. a. alpestris</em></td>
<td>Bihor Mountains (Cămpeni)</td>
<td>Litvinchuk et al. 2005</td>
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<td>Retezat Mountains, Băiului Mountains</td>
<td>Pabijan &amp; Babik 2006</td>
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<td></td>
<td>Tâul Secat, Zănoaga Lake (Retezat Mountains), Vidraru Lake (Făgăraș Mountains), Prahova Valley</td>
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<td>Sibhăstria Monastery, Văratec</td>
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<td><em>L. v. vulgaris</em></td>
<td>Reci, Băneasa</td>
<td>Rafiński et al. 2001</td>
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<td>Craidoiți, Couăș, Acăș, Andrid, Săcășeni, Supuru de Sus, Sălard, Crăcurele, Rupea, Reci, Moravijă, Greoni, Scroviște, Băneasa</td>
<td>Babik et al. 2005</td>
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<td></td>
<td>Romanian Bihor Mountains (Nemira Mountains)</td>
<td>Litvinchuk et al. 2005</td>
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<td>Litvinchuk et al. 2003b</td>
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<td>Rafiński et al. 2001</td>
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<td>Cluj, Biheniș, Cârpieniș, Izvorul Ampoiului, Zlatna, Sâcărâmbu, Deva, Calan-Băi, Câmpul lui Neag</td>
<td>Babik et al. 2005</td>
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<td>Dej, Reghin and Cămpeni (Romanian Bihor Mountains)</td>
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<td>Rafiński et al. 2001</td>
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<td>Litvinchuk et al. 2005</td>
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<td>Babik et al. 2005</td>
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<td>Steinfartz et al. 2007</td>
</tr>
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<td><em>B. bombina</em></td>
<td>București</td>
<td>Szymura et al. 2000</td>
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<td><em>P. f. fuscus</em></td>
<td>București, Brăila</td>
<td>Eggert et al. 2006</td>
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<td>București, Brăila</td>
<td>Crottini et al. 2007</td>
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<td>Litvinchuk et al. 2007</td>
</tr>
<tr>
<td><em>R. t. temporaria</em></td>
<td>Romania</td>
<td>Pidancier et al. 2003</td>
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Appendix 2. (Continued)

<table>
<thead>
<tr>
<th>Species /subspecies</th>
<th>Locality</th>
<th>Source</th>
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<tr>
<td>R. arvalis</td>
<td>Reci</td>
<td>Babik &amp; Rafiński 2000, Rafiński &amp; Babik 2000, Babik et al. 2004</td>
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<td>T. h. boettgeri</td>
<td>Romania</td>
<td>Kuyl et al. 2002</td>
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<td>Banat</td>
<td>Fritz et al. 2006</td>
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<td>T. g. iberi</td>
<td>Histria</td>
<td>Fritz et al. 2007a</td>
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<td>E. a. orbicularis</td>
<td>estuary of Danube</td>
<td>Lenk et al. 1998</td>
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<td>Z. v. vivipara</td>
<td>Apuseni, Poiana Florilor, Marghita, Șureanu, Vlădeasa, Eremițu, Rețezat, Rodnei</td>
<td>Surget-Groba et al. 2006</td>
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<td>Z. l. longissima</td>
<td>Băcia</td>
<td>Lenk &amp; Joger 1994</td>
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<td>N. t. tessellata</td>
<td>Tulcea</td>
<td>Guicking et al. 2002</td>
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<td>V. b. iberus</td>
<td>Apuseni Mt., Oradea, Chirui, Cărța</td>
<td>Ursenbacher et al. 2006</td>
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