

A tentative species list of the European herpetofauna (Amphibia and Reptilia) — an update

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Abstract

Research on the taxonomy of European amphibians and reptiles has increased noticeably over the last few decades, indicating the need for recognition of new species and the cancellation of others. This paper provides a critical review of recent changes and draws up a tentative species list.

Key words: amphibians, reptiles, taxonomy, nomenclature, review, Europe

Introduction

The steady accumulation of European herpetological literature during the 18th and 19th century permitted the early compilation of species lists, which initially comprised mostly nations and often did not combine reptiles and amphibians (e.g. Bonaparte 1840; Bocage 1863; Böttger 1869; de Betta 1874; Camerano 1884). Schreiber (1875) was the first to assemble a list of both reptiles and amphibians of Europe (including western Russia) which recorded 97 species. The rise of intensified herpetological research in Europe during the 20th century, eventually combined with systematic studies based on phylogenetic relations, created the need for multiple revisions of the European herpetofauna list. While Mertens and Müller (1928) and Mertens and Wermuth (1960) may have well served as the initial contemporary baseline, revisions were given by Arnold *et al.* (1978), Engelmann *et al.* (1993), Dubois (1998) and Arnold and Ovenden (2002). Recent taxonomical updates were given by e.g. Danflous *et al.* (2004) and Crochet and Dubois (2004). A tentative updated overview of European amphibian and reptile taxonomy was provided by Speybroeck and Crochet (2007). In the meantime, research activities have continued intensively, feeding the need for this new update. Our emphasis is on species and higher level changes, dealing with subspecific taxonomy only in a limited number of cases of special interest.

We keep to the same —subjectively— delimited geographical area as Speybroeck and Crochet (2007): geographic Europe without former Soviet republics. As a consequence, species occurring only on Asiatic or African islands politically belonging to European countries are omitted. These islands include among others the Greek isles east of the mid-Aegean trench. For instance, Karpathos is considered Europe, while Lesbos, Chios, Samos, Rhodes, Symi, among others (with numerous Anatolian fauna elements like *Anatololacerta* spp., *Trachylepis aurata*, *Blanus strauchi*) are considered to be Asian islands. The Canary Islands, Azores, Selvagens, Madeira, Alborán and Lampedusa, Pantelleria and nearby islets are geographically considered as parts of the African continent.

Issues that were discussed by Speybroeck and Crochet (2007) and which are not reassessed or elaborated any further below, remain as such, pending further research. Authorship and year for family, genus and

species nomina —as given in the species list— have been cross-checked with multiple papers, books and online resources. We will not go into detail on the related issues, while generally the same uncertainties as those previously listed by Speybroeck and Crochet (2007) remain.

We have tried to strictly follow the rules of the International Code of Zoological Nomenclature (the Code hereafter, International Commission on Zoological Nomenclature 1999) for nomenclature at the species, genus and family level.

Nomina of taxa above the species rank are currently not regulated by the Code (see Dubois 2005). This results in many uncertainties and ample debate concerning the correct nomina to be used for higher-ranked taxa. As no “official” way exists to settle these uncertainties and to attribute authorship to higher-rank nomina, we have simply provided the commonly used nomen (or alternative nomina in case of conflicting views) for taxa above the family rank.

The general nature and intent of our paper can be adequately illustrated by our agreement —in part— with two predominantly contrasting viewpoints, raised in the discussion following the publication of *The Amphibian Tree of Life* (Frost *et al.* 2006). We largely agree with [Pauly *et al.*'s \(2009\)](#) basic assumption that all accepted taxa should be “well-established and strongly supported clades that are inferred under multiple analyses and from various data sources” and that “the scientific name of the species (genus-species combination) should only be changed when there is strong evidence that the changes are necessary to reflect evolutionary history”. On the other hand, we do not believe in strenuous conservatism either, agreeing with Frost *et al.* (2009) that taxon partitioning is often an unavoidable consequence of systematics research: non-monophyly must be avoided for taxa above the species rank.

For species level systematics, we generally adhere to the biological species concept, as we believe that speciation is really the gradual evolution of intrinsic reproductive barriers that allow species to persist as distinct evolutionary lineages, independently of geographic isolation. Our conception of species is thus similar to the “genotypic cluster definition” of [Mallet \(1995\)](#): “speciation is the formation of a genotypic cluster that can overlap without fusing with its sibling”. Successful hybridisation is not per se an argument against species rank, as long as the barriers to interspecific gene flow are strong enough so that hybridisation does not mix the hybridising genomes (see [Mallet 2005, 2008](#)). Hence, to identify species, we prefer to put more emphasis on reproductive isolation between sympatric or parapatric taxa, rather than on other proposed properties of species such as diagnosability or monophyly. In other words, we do not believe that all evolutionary units should be treated at species rank.

As already widely recognised, one of the main problems with the biological species concept is that it is difficult to test for reproductive isolation between allopatric populations. In that case, we use information on level of divergence (genetic, acoustic, and morphological) as a possible indication to infer the level of isolation of entities, if they were to meet naturally. We are perfectly aware that this is somewhat subjective. With reproductive isolation evolving in no predictable way or at no regular rate, no simple relationships between the level of divergence for any character and the level of reproductive isolation exist (e.g. Gourbière and Mallet 2010). However, in the absence of other sources of information, it is reasonable to assume that taxa which are as divergent (genetically, acoustically, or morphologically) as valid biological species within the same genus or family are better treated as valid species. Allopatric taxa whose divergence is comparable with divergence among subspecies are best treated as conspecific. This “consistency” approach is in fact widely used in systematics, albeit often implicit (see e.g. Sites and Marshall 2004 for more elaborate discussion on these issues and [Alström *et al.* 2008](#) for an application in birds).

Facing the lack of a widely accepted genus concept, we have applied the same approach to the genus level. As a distinct genus, we tend to recognise monophyletic clades that are genetically as divergent as other widely accepted genera in the same group. This is usually the approach employed by authors of scientific papers. In most cases, our conclusions follow published decisions.

We wish to stress that this paper is merely a proposal for synthesis of recent changes based on published information. However, we hope that our proposed list might be considered valuable and that our conclusions might receive ample adoption or at least stimulate further debate.

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Caudata or Urodela

Different opinions exist on whether Caudata (e.g. Frost *et al.* 2006) or Urodela (e.g. Dubois 2004) should be used to refer to the the order of salamanders and newts.

A recent paper on the Salamandridae family taxonomy (Dubois and Raffaëlli 2009) proposed a number of systematic changes, many of which above and below the species level. Concerning species of European newts and salamanders, the proposed changes include treating six taxa as new species: *Lissotriton graecus*, *L. meridionalis*, *L. maltzani*, *Salamandra aurorae*, *S. almanzoris* and *S. longirostris*.

Dubois and Raffaëlli (2009) elevated *L. v. graecus* and *L. v. meridionalis* to species level, based on the results of Babik *et al.* (2005). They interpret these results as suggesting that if *L. montandoni* (Carpathian Newt) is recognised as a distinct species, *Lissotriton vulgaris* (Smooth Newt) as traditionally understood is paraphyletic. In fact, this seems to be a misinterpretation of Babik *et al.*'s (2005) results - the latter authors convincingly argue that the paraphyly of the mitochondrial haplotypes of *vulgaris* is caused by repeated introgression of *vulgaris* mitochondrial lineages into *montandoni*, resulting in the replacement of the original *montandoni* mtDNA by *vulgaris* mtDNA. Conclusively, *L. vulgaris* mtDNA is paraphyletic in relation to *L. montandoni* mtDNA, but this is probably not true for the species themselves.

Indeed, even while both *graecus* and *meridionalis* (in addition to several other Anatolian and Caucasian subspecies) are distinct in molecular (mtDNA: Babik *et al.* 2005, nuclear DNA: Kalezić 1983; Kalezić and Tucić 1984) and morphological (Schmidtler and Franzen 2004) features (however, mainly based on male secondary sexual characters - Raxworthy 1990, but see Pellarini and Lapini 2000), Babik *et al.* (2005) revealed high levels of mtDNA introgression in contact zones between several subspecies/lineages, including both *graecus* and *meridionalis*, and a general lack of concordance between subspecies limits, defined on the basis of mtDNA and morphological data. Although *L. v. meridionalis* is represented by a single clade in peninsular Italy (albeit represented by only two samples), Istrian and Slovenian populations which have been attributed to this taxon based on morphology and allozymes (Schmidtler and Franzen 2004), seem to belong to *L. v. vulgaris* according to mtDNA data (Babik *et al.* 2005). Concerning *L. v. graecus*, the current northern parts of its distributional range seems to be introgressed by populations related to *L. v. vulgaris*, while Corfu represents a relictual lineage and sampling is lacking from central parts of southern Greece. Thus, despite a high level of mtDNA divergence and evidence of ancient diversification events between some subspecies in *L. vulgaris* (Babik *et al.* 2005), the available data do not allow drawing definite conclusions on these taxa. We therefore refrain from accepting *graecus* and *meridionalis* as full species until additional data on contact zones and wider geographical sampling of these taxa are presented.

The Algarve clade of Bosca's Newt (*Lissotriton boscai*) found by Martínez-Solano *et al.* (2006) might deserve species rank, the name *maltzani* apparently being available for it (Montori *et al.* 2005), as already mentioned by Speybroeck and Crochet (2007). However, more sampling in (possible) transition zones and the study of nuclear genes and morphology seems required, prior to any new arrangement. The distinct clade found by Herrero (1991) also deserves further attention. Quoting Martínez-Solano *et al.* (2006): "(...) new data from independent sources are needed to clarify the taxonomic status of these two divergent lineages, and morphological and molecular studies including data on variation in nuclear markers will be particularly helpful in this respect. Variation in populations within *L. boscai* has been already studied from morphological and genetic perspectives, but previous studies have failed to include representatives of all the clades identified in our study (...)". As no additional evidence seems to have been presented in the mean time, we agree with this. As such, we consider Dubois and Raffaëlli's (2009) proposal to accept *Lissotriton maltzani* to be premature.

Elevating *Salamandra atra aurorae* to species rank, as the same authors do, seems quite clearly unwarranted, as —with little or no doubt— their acceptance renders the Alpine Salamander (*S. atra*) paraphyletic. Indeed, papers stating *aurorae* to be a sister group to all other *atra* populations (Steinfartz *et al.* 2000; Bonato and Steinfartz, 2005) have been contradicted by those including samples from northern Dinaric populations from Slovenia and Croatia (Ribéron *et al.* 2001, 2004). Dubois and Raffaëlli (2009) also accepted the subspecies *S. a. prenzensis*, restricting it to Bosnia and Herzegovina, Serbia, Montenegro and Albania,

“because it is isolated from the other populations in the non-Dinaric Alps and shows morphological differences from them, being smaller and slightly different in coloration”. Klewen (1988) and Guex and Grossenbacher (2003), however, consider these differences to fall within the intraspecific variation of *S. atra* and do not accept *prenjensis* as a separate taxon.

Dubois and Raffaëlli (2009) also consider *Salamandra salamandra almanzoris* to deserve species rank, rather than its conventional treatment as a subspecies of the Fire Salamander (*S. salamandra*). However, García-París *et al.* (2003) and Iraola and García-París (2004) suggest that *almanzoris* belongs to a main clade with *S. s. morenica* and *S. s. crespoides*, making it impossible to treat the former as a species without consequences for the status of the other taxa. Martínez-Solano *et al.* (2005) showed that *almanzoris* is more widespread than traditionally considered, being distributed over most of the mountains of the Spanish Sistema Central. They found that the genetic divergence in allozymes between *almanzoris* and *bejarae* is typical for intraspecific levels in amphibians and that allozymes, morphology and mtDNA provide contrasting results on the delimitation of those taxa, evidencing introgression in contact zones. Thus, we do not follow the proposal to elevate this taxon to species rank, which is clearly not the most divergent among the Iberian *Salamandra* lineages.

The more difficult case of *Salamandra (salamandra) longirostris* seems primarily to depend on where to draw the line based on mtDNA sequence divergence between allopatric taxa. Steinfartz *et al.* (2000) note 6.3% mtDNA divergence (control region sequences) between this taxon, *S. s. morenica* and *S. s. crespoides* versus all other subspecies of *S. salamandra*, but group *longirostris* together with *morenica* and *crespoides*. Corresponding divergence times were tentatively estimated at approximately 2–4 mya. Using a different mitochondrial gene (cytochrome b), García-París *et al.* (1998) found a basal position of *longirostris* in relation to all other Iberian lineages (including *morenica* and *crespoides*) and a 5.1%–5.7% sequence divergence between *longirostris* and the main clade. According to these authors, *S. (s.) longirostris* became isolated from other *Salamandra* taxa either by the Betic Strait in the Miocene, or during the Pliocene formation of the Guadalquivir river valley. Under this second (favoured) hypothesis, *longirostris* would have split 2.5–5.3 mya. In yet another study, Escoriza *et al.* (2006) place *longirostris* close to *S. inframaculata orientalis*, but admit that this sister taxon relationship may very well be an artefact. Additionally, we note that Dubois and Raffaëlli (2009) claim a close relationship between *longirostris* and *S. algira*, whereas this is in clear contrast to the findings of other authors (e.g. Steinfartz *et al.* 2000; Donaire Barroso and Bogaerts 2003). Donaire Barroso *et al.* (2009) provided some additional data on the distinctiveness of the *longirostris* colour pattern. Although *longirostris* may well deserve full species rank, conflicting phylogenetic trees prompt us to maintain it as a subspecies until conclusive evidence is provided.

Following Schmidtler (2004), Speybroeck and Crochet (2007) and the online database “Amphibian Species of the World 5.3” have accepted that *Triturus Rafinesque 1815* is a nomen nudum and thus nomenclaturally unavailable. However, this was clearly a mistake: as demonstrated by Dubois and Raffaëlli (2009), *Triturus Rafinesque 1815* was a neonym (nomen novum) for *Triton Laurenti 1768* and thus an available nomen. This means that authorship for this taxon remains 1815 and not 1820.

We note that the rejection of the works of de la Cèpède (International Commission on Zoological Nomenclature 2005) lead to attribution of some names to Bonnaterre, 1789. This was already adopted by Speybroeck and Crochet (2007) for e.g. the Southern Spectacled Salamander (*Salamandrina terdigitata*). As pointed out by Dubois and Raffaëlli (2009), this also holds true for *Salamandra salamandra terrestris*. Referral to the latter taxon by means of junior synonyms like *europaea* Bedriaga, 1883 seems therefore unwarranted.

Finally, we are reluctant to accept Dubois and Raffaëlli’s (2009) new subspecific arrangement of the Alpine Newt (*Ichthyosaura alpestris*), because we believe that mtDNA data alone are not sufficient for revising intraspecific systematics, and any proposal for changes seems currently premature. The same applies to Sotiropoulos *et al.* (2007): we are not (yet) convinced that the subspecies *inexpectata* should be abandoned. As a side comment, both Sotiropoulos *et al.* (2007 - mtDNA) and Canestrelli *et al.* (2006a - allozymes and mtDNA) uncovered a level of genetic divergence between peninsular Italian and continental European *Ichthyosaura* which is more typical of interspecific divergence than intraspecific variation in Caudata. Lack of

clear concordance between mtDNA clades and morphology, and absence of supporting evidence for the most basal lineages in [Sotiropoulos et al. \(2007\)](#) prevent us from adopting any systematic changes here, but we anticipate future splits when additional data will become available.

Two species in the genus *Salamandrina* -the Southern Spectacled Salamander *S. terdigitata* and the Northern Spectacled Salamander *S. perspicillata*- have been recognised in recent years, based on both mtDNA and nuclear markers ([Mattocchia et al. 2005](#); [Canestrelli et al. 2006b](#)), apparently separated by the Volturno river. However, only a restricted number of samples was used and morphological data was lacking. [Romano et al. \(2009\)](#) presented evidence of morphological divergence between the species, based on body size and dorsal colouration differences. New localities and additional samples revealed a contact zone south of the Volturno River in northern Campania, where both species occur syntopically in several locations, but they remain distinct in terms of (at least) mtDNA.

[Arntzen et al. \(2007\)](#) found a high level of allozyme differentiation between *Triturus carnifex carnifex* (Italian Crested Newt) and *T. c. macedonicus* (Macedonian Crested Newt) (Nei's genetic distance = 0.19, similar to the divergence between *T. marmoratus* and *T. pygmaeus*) suggesting a long (> 5 million years) separate evolution. As a consequence, they elevated the latter to species rank as *Triturus macedonicus*. Even more recently, [Espregueira Themudo et al. \(2009\)](#) elevated the European Southern Crested Newt to species rank as *Triturus arntzeni* (Arntzen's Crested Newt). Forthcoming papers will have to delimit the geographical range of *arntzeni* and *karelinii*, as different sources of information give contrasting results ([Olgun et al. in prep.](#); [Wielstra et al. in prep.](#)). As a consequence, it is unclear at present whether *karelinii* s.s. occurs in the area considered in our paper.

[Carretero et al. \(2009\)](#) issued an updated 'lista patrón' of the Spanish herpetofauna, as first released by [Montori et al. \(2005\)](#). In conflict with the rules of the International Code of Zoological Nomenclature, they reject *Ichthyosaura* (containing the species *alpestris*) on grounds of confusion with the prehistorical taxon *Ichthyosaurus*. As stated in the introduction, we firmly believe that the Code should be followed consistently, thus we advocate the use of this name over e.g. *Mesotriton*.

[Frost \(2009\)](#) attributes the name *Ichthyosaura* to [Latreille in Sonnini de Manoncourt and Latreille, 1801](#). [Dubois \(2008\)](#) advocated attribution of nomina to the author name(s) as cited in the original publication. In this case, the book is authored by C.S. Sonnini and P.A. Latreille. As pointed out by [Dubois and Raffaelli \(2009\)](#), the relevant part of this 4-volume work contains no specification on whether it was written by either author or both. In this part, singular ('je' = I) and plural ('nous' = we) are mixed up, while the part dealing with *Proteus tritonius* is written in plural. As *Ichthyosaura* was based on the latter taxon, we attribute this name to [Sonnini and Latreille, 1801](#), as does [Schmidtler \(2009\)](#). The latter also pointed out that the name is of female gender, therefore requiring accordingly inflected subspecies names (e.g. *apuana*, *inexpectata*, *serdara*, ...), regardless of their validity.

As discussed in [Speybroeck and Crochet \(2007\)](#) and in contrast to a number of recent papers (e.g. [Carranza et al. 2008a](#); [van der Meijden et al. 2009](#)), we extend the use of the genus name *Speleomantes* for the European cave salamanders. [Nascetti et al. \(1996\)](#) found a huge genetic distance between the Californian *Hydromantes shastae* and the Sardinian *Speleomantes genei* (Gené's Cave Salamander; $D_{\text{Nei}} 3.38$) and *S. imperialis* (Scented Cave Salamander; $D_{\text{Nei}} 3.92$), and all available studies resolve the European species as a monophyletic clade. [Wake et al. \(2005\)](#) proposed the genus name *Atylodes* for *Speleomantes genei*, which can be used at genus or subgenus level ([Crochet 2007](#)). [Vieites et al. \(2007\)](#) proposed to use *Atylodes*, *Speleomantes* and *Hydromantes* at the genus level. However, [van der Meijden et al. \(2009\)](#) could not find a strongly supported (basal) position for *genei*. Consequently, using *Atylodes* as a valid taxon may render *Speleomantes* paraphyletic. We thus refrain from using this name at any level.

[Carranza et al. \(2008\)](#) elevated the Sette Fratelli Cave Salamander from southeastern Sardinia to species rank as *Speleomantes sarrabusensis*. The still unnamed "subspecies B" of *Speleomantes genei* was shown to be more widespread ([van der Meijden et al. 2009](#)) than previously assumed ([Lanza et al. 2005](#)). [Van der Meijden et al. \(2009\)](#) confirmed that the genetic distance between the A and B *genei* taxa is of a magnitude that could warrant treatment of both taxa as separate species. Furthermore, their easternmost sample of *Speleomantes imperialis* (Lago Omodeo area) appeared quite distinct from their other *imperialis* samples.

Taxonomic consequences, however, remain premature, pending more range-wide sampling, including samples of the central parts of the species' range. On the other hand, the results of van der [Meijden et al. \(2009\)](#) confirmed that the current systematics of the *italicus* - *ambrosii* group (Italian and Ambrosi's Cave Salamander) is probably inadequate: in their phylogenetic tree, specimens of *S. ambrosii ambrosii* are more closely related to specimens of *S. italicus* than to specimens of *S. ambrosii bianchii*. Based on extensive introgression in contact zones ([Lanza et al. 2005](#)), it might be better to treat *ambrosii* as a subspecies of *italicus*. However, we refrain from proposing any formal change for the time being.

Anura

[Hofman et al. \(2007\)](#) and [Zheng et al. \(2009\)](#) investigated the phylogeography of fire-bellied toad species (*Bombina*). Their mtDNA data showed *Bombina pachypus* (Italian Yellow-bellied Toad) to be nested within *B. variegata* (Yellow-bellied Toad) lineages, with Carpathian populations occupying the most basal position within the phylogeny of *variegata* s.l. Pending more detailed studies of genetic variation and level of introgression in contact zones in this complex, we prefer to consider this Italian taxon at subspecies rank as *Bombina variegata pachypus*, rather than treating it as a full species.

[Gonçalves et al. \(2009\)](#) established high levels of genetic divergence within the Iberian Midwife Toad (*Alytes cisternasii*), but considered these to be within the range of typical intraspecific variation in amphibians.

[Carretero et al. \(2009\)](#) disagreed with [Zangari et al.'s \(2006\)](#) decision to treat the Eastern Iberian Painted Frog as a subspecies, *Discoglossus galganoi jeanneae*. They found additional support for the species rank of these two taxa in [Velo-Antón et al. \(2008\)](#) and stated that, given the lack of more detailed studies allowing assessment of gene flow between both taxa in secondary contact areas, there is no reason to treat them as conspecific. This is in conflict with our fundamental appraisal that splitting a species can only be valid if the split is substantiated by scientific evidence, rather than considering taxa as species because of lack of reason to treat them as conspecific. As long as this is not the case, we promote conspecificity to be the rule. In fact, [Velo-Antón et al.'s \(2008\)](#) results are in agreement with [Zangari et al.'s \(2006\)](#) work. The fact that both studies found the same low level of nuclear differentiation with independent markers certainly calls for a reassessment of the validity of the specific status of *jeanneae* and reinforces our reluctance to treat it as a valid species.

The comprehensive work of [Frost et al. \(2006\)](#) on amphibian systematics has provoked contrasting responses, including (among quite some others) a rather strong critique by [Wiens \(2007\)](#), which saw a subsequent rebuttal by [Frost et al. \(2008\)](#). Indirectly, [Pauly et al. \(2009\)](#) also criticised [Frost et al. \(2006\)](#), and also received a response ([Frost et al. 2009](#)). Overall, [Speybroeck and Crochet's \(2007\)](#) treatment of the proposed changes seems to have been largely in correspondence to what other authors have concluded. An exception deserves, however, our renewed attention. While [Speybroeck and Crochet \(2007\)](#) proposed to attribute the European 'true toad' species to 2 genera (*Bufo* and *Epidalea*), general consent in this case seems to be towards conserving *Bufo* as the genus for all, at least for the time being ([Vences 2007](#); [Bour et al. 2008](#); [Lescure 2008](#)). These authors argue that cases of natural hybridisation (e.g. a very recent record of hybridisation *Bufo bufo* x *viridis* by [Duda 2008](#)) should encourage rejection of a genus level split, as proposed by [Dubois \(1988\)](#) and applied to the case of *Bufo* for the first time by [Dubois and Dinesh \(2007\)](#). Concerning European species, [Van Bocxlaer et al. \(2009\)](#) provide some support for the generic arrangement proposed by [Frost et al. \(2006\)](#), which might very well make attribution of Green Toad (*Bufo viridis* (s.l. - see below)) to the genus *Pseudepidalea* and the Natterjack (*Bufo calamita*) to *Epidalea* a valid arrangement. Yet, with different relationships turning up from different studies (cf. also [Pramuk et al. 2008](#)) and many taxa still in need of investigation, it seems cautious not to draw any taxonomical conclusions just yet. Pending additional research, we therefore place all European species back in the single genus *Bufo*. Additionally, we note that according to [Dubois and Bour \(in press\)](#), the use of the name *Pseudepidalea* should be abandoned for that of the junior synonym *Bufotes* [Rafinesque, 1815](#), while the name *Epidalea* [Cope, 1864](#) remains available.

We have previously been reluctant to accept Stöck *et al.*'s (2006) *Bufo viridis* (Green Toad) splits (Speybroeck and Crochet 2007). Stöck *et al.* (2008a) described yet another new species from Sicily, *Bufo siculus* (Sicilian Green Toad). Despite Carretero *et al.*'s (2009) adoption of these new species, we still believe that mtDNA lineages alone cannot be used to substantiate new species, and that the level of divergence of the taxa, which are also supported by other characters (e.g. *siculus* which is also supported by nuclear and morphological data, albeit without comparing the taxon morphologically with its closest African relatives), is not high enough to be in itself evidence of specific status. To a certain degree at least, this seems to be corroborated by Van Bocxlaer *et al.* (2009): divergence between the Green Toad splits *viridis* and 'cf. *variabilis*' appears to be smaller than between the Common Toad (sub)species *bufo* and *spinosus*. We also treat the latter two taxa as conspecific. While we do not claim that the green toads of the Western Palearctic definitely belong to a single species, we maintain that the available information cannot (yet) support any species level split.

As noted by Razzetti (2008), the correct name for the green toads of peninsular Italy, Corsica, Sardinia and northeastern Sicily is still controversial. Balletto *et al.* (2007), based on specimens from Venice, used *Bufo lineatus* Ninni, 1879 (type locality: surroundings of Venice - Frost, 2009) as the valid nomen for the clade of peninsular Italy, while Stöck *et al.* (2006, 2008a) considered *Bufo lineatus* as a junior synonym of *Bufo viridis*, because they found specimens from Padua and Trieste that belong to the nominotypical lineage.

Stöck *et al.* (2008b) studied the phylogeography of the genus *Hyla* (tree frogs) around the Mediterranean. They identified three deeply divergent mitochondrial lineages in populations currently classified as *Hyla arborea*, each of them being supported by variation in one nuclear intron. In their mitochondrial tree (but not in their nuclear tree), treating *H. sarda* and *H. intermedia* as valid species could render *H. arborea* paraphyletic, because the three mitochondrial lineages identified within *arborea* are not necessarily each other's closest relatives. Since the specific status of *intermedia* is well supported by reproductive isolation in contact zones (Verardi *et al.* 2009), and since *sarda* displays distinct and well-known morphological and acoustic characters (Schneider 1974; Lanza 1983; Rosso *et al.* 2001, 2004; Castellano *et al.* 2002), we maintain them as valid species. As a consequence, the mitochondrial data provide strong evidence for recognising the Iberian taxon *molleri* and the eastern taxon *orientalis* (currently only known in Europe from the Black Sea Coast of Romania and European Turkey) as valid species as well. Nevertheless, the distributional limits of these two taxa remain unknown. There is no evidence of reproductive isolation in the continuous range of tree frogs in the Balkans, no known obvious morphological characters to separate them, and no obvious acoustic difference between *molleri* and *arborea*, nor *orientalis* and *arborea* (Schneider 1974, 2002). Accepting these two new European species would thus rest entirely on mtDNA data from a very small number of specimens (seven *orientalis* and only two *molleri*). Therefore, while a species level split is likely to be required, we prefer to wait for additional data, as specified, before recognising *molleri* and/or *orientalis* as valid species.

Detailed study by Gvoždík *et al.* (2008) uncovered a complex pattern of geographical variation in morphology among populations of *Hyla arborea* and *Hyla savignyi*. The similarity among populations is not necessarily greater within species than between species. On the contrary, populations of different species inhabiting neighbouring regions are often more similar than populations of the same species inhabiting distant regions. Groups of populations defined by morphology do not correspond to the mitochondrial lineages defined by Stöck *et al.* (2008) either. In fact, Gvoždík *et al.* (2008) suggest that morphological variation of *Hyla* is more linked to climate variation than to evolutionary history.

Stöck *et al.*'s (2008b) unnamed clade of *Hyla cf. intermedia* from Switzerland corresponds with the northern clade of Canestrelli *et al.* (2007a). Allozyme divergence between this northern clade and the south-central clade of *H. intermedia* s.l. is typical of intraspecific level of divergence: Nei's distance value of 0.07 according to Canestrelli *et al.* (2007b), to be compared with Nei's distance of 0.55 between *arborea* and *intermedia* (Verardi *et al.* 2009). Thus, in our opinion, the various clades within *Hyla intermedia* s.l. might well prove to constitute valid subspecies, but are unlikely to represent distinct species. In any case, we strongly advocate detailed analyses of contact zones prior to any formal proposal.

A detailed phylogeographic analysis of the Pool Frog in Italy (Canestrelli and Nascetti 2008) supported

the subspecific status of *Pelophylax lessonae bergeri* suggested by Crochet and Dubois (2004) and followed by Speybroeck and Crochet (2007). The same study confirmed that Sicilian pool frogs should also be recognised as a distinct subspecies (see also [Santucci et al. 1996](#)).

[Lymberakis et al. \(2007\)](#) investigated Eastern Mediterranean water frog phylogeny by means of mitochondrial DNA. Their results reinforce the idea that *Pelophylax kurtmuelleri* (Greek Marsh Frog) should be treated as conspecific with central European populations of the *P. ridibundus* complex (Marsh Frog), as previously established with allozyme data (Beerli 1994). The precise status of these populations should be investigated in a range-wide analysis of the *P. ridibundus* complex. As long as mating call differences are the only support for specific treatment ([Schneider et al. 1993](#)), we suggest to no longer recognise *kurtmuelleri* as a valid species.

Alleged contact zones between *ridibundus* and *kurtmuelleri* in Thrace ([Schneider et al. 1993](#)) seem to be in fact contact zones with *Pelophylax bedriagae* (Bedriaga's Water Frog) rather than *ridibundus*, as Beerli (1994) identified Thracian water frogs unambiguously as *Pelophylax bedriagae*. This seems to have been confirmed by [Lymberakis et al.'s \(2007\)](#) results, which included a sample from Thrace (Dadia) attributed to *P. bedriagae* and closely related to Lesbos and Chios populations. However, their results also attributed a sample from a very nearby location, as well as other Thracian samples, to *Pelophylax ridibundus*. All these results suggest that *bedriagae* and "European *ridibundus*" form a contact zone in Thrace, where these two taxa are reproductively isolated ([Schneider et al. 1993](#)). This indicates that the two subclades B5 and B6 of [Lymberakis et al. \(2007\)](#) are valid biological species and thus supports the widely accepted species status of *P. bedriagae* and *P. ridibundus* (sensu lato). However, [Lymberakis et al. \(2007\)](#) did not include samples from the type locality of *ridibundus* (northern Caspian Sea area), so it remains to be determined if European populations of Marsh Frogs are conspecific with sensu stricto *P. ridibundus* or not. If not, the names *Pelophylax ranaeformis* (Laurenti, 1768) and *Pelophylax fortis* (Boulenger, 1884) might apply to the European Marsh Frog (Dubois & Ohler 1995a,b). The former name relates (at least) to the populations of the Greek island Limnos (Dubois & Ohler 1995b).

[Lymberakis et al. \(2007\)](#) found *Pelophylax cerigensis* (Karpathos Water Frog) to be nested within their subclade B5, corresponding to *P. bedriagae*. We note that these authors also attributed Rhodes populations to *P. cerigensis*, whereas the original description only considered this to be a possibility ([Beerli et al. 1994](#)). Indeed, based on biochemical data, [Plötner \(2005\)](#) placed Rhodes and Karpathos water frogs together, different from both *bedriagae* and *ridibundus*, and attributed populations from "Karpathos and probably Rhodes" to *cerigensis*. However, to our knowledge, no subsequent papers have provided definite evidence ascertaining the specific status of Rhodes water frogs. The results of [Lymberakis et al. \(2007\)](#) invalidate a *P. cerigensis* limited to Karpathos and Rhodes. Apart from the authors' suggestion that *P. cerigensis* could be treated as a junior synonym for *P. bedriagae*, alternative arrangements seem compatible with the available evidence: to restrict the name *P. bedriagae* to (at least some of) the more eastern populations (Syria and some surrounding areas, also Cyprus), whereas populations from Turkey, the eastern Aegean islands, including Karpathos and Rhodes could be attributed to *P. caralitanus* ([Arıkan 1988](#)), for which *cerigensis* ([Beerli, Hotz, Tunner, Heppich and Uzzell 1994](#)) would be a junior synonym. A second alternative could include splitting of the latter group, with the Karpathos populations being attributed to *P. cerigensis* and treating the Turkish, eastern Aegean and Rhodes populations as a different species. Under either of these alternative hypotheses, several other species would need to be recognised for Anatolian and Middle Eastern water frog populations. Our second alternative might result in retaining the validity of *P. cerigensis* (for Karpathos populations only). However, for the time being, we believe material from geographically intermediate populations is required to warrant these alternative arrangements, and therefore preliminarily consider *P. cerigensis* to represent a part of *P. bedriagae* rather than a separate species. The most recent available results about the contact zones between the western and central Anatolian lineages of water frogs ([Akın et al. 2010](#)) support the view that at least part of the genetic diversity within the *bedriagae* complex represents intraspecific variation. We thus suggest to recognise, for the time being, a single species of Middle East water frog, whose name should be either *bedriagae* or *ranaeformis*, depending on the identity of the water frogs of Limnos. The nomen *cerigensis* thus currently becomes a synonym of *bedriagae* at the species rank.

Testudines or Chelonii

Different opinions exist on whether Testudines (e.g. [Fritz and Havas 2007](#); [Rhodin *et al.* 2008](#)) or Chelonii (e.g. [Bour and Dubois 1985](#)) should be used to refer to the the order of turtles, tortoises and terrapins.

[Spinks and Shaffer \(2009\)](#) performed a phylogenetic study of the genus *Emys* based on multiple genes, both mtDNA and nuclear. There is generally no reciprocal monophyly between *Emys orbicularis* (European Pond Terrapin) and *E. trinacris* (Sicilian Pond Terrapin) in their trees based on nuclear genes, providing additional substantiation for rejection of the latter taxon at species level ([Speybroeck and Crochet 2007](#)).

[Fritz *et al.* \(2009\)](#) investigated the mitochondrial phylogeography of the Spur-thighed Tortoise (*Testudo graeca*) from the western parts of the Mediterranean, and recognised *T. g. nabeulensis* as a valid subspecies for the Tunisian populations, with Sardinian and Sicilian animals belonging to this taxon. In this arrangement, Majorcan and Spanish populations remain treated as *T. g. graeca*.

Sauria

[Gamble *et al.* \(2008a\)](#) investigated Gekkota taxonomy, attributing the genus *Tarentola* to a new trans-atlantic family Phyllodactylidae. In this view, *Euleptes* is placed within the Sphaerodactylidae ([Gamble *et al.* 2008b](#)), and *Hemidactylus* and *Mediodactylus* remain within the Gekkonidae ([Bauer *et al.* 2008](#); [Gamble *et al.* 2008a](#)). [Perera and Harris \(2008\)](#) found three clades of the Moorish Gecko (*Tarentola mauritanica*) in Iberia: one that is widespread throughout Europe and found in eastern and southern Spain, one from central parts of the Iberian Peninsula, and one closely related to populations of northern and central Morocco, restricted to a few southern Iberian localities. This study, together with [Harris *et al.* \(2009\)](#) and other previous results ([Harris *et al.* 2004](#)), confirms that populations currently classified as *T. mauritanica* constitute a species complex, with several valid species scattered within a paraphyletic *T. mauritanica*. A taxonomical revision, which might add a new *Tarentola* species to the European fauna, *T. (m.) fascicularis*, remains highly desirable.

[Červenka *et al.* \(2008\)](#) advocated the use of the genus name *Mediodactylus* for Kotschy's Gecko (*M. kotschyi*): *Mediodactylus* appears to be a well supported, monophyletic clade and its inclusion in *Cyrtopodion* would clearly threaten the monophyly of the latter. We follow this here and recognise *Mediodactylus* at genus rank.

Overlooked by [Speybroeck and Crochet \(2007\)](#), the genetic substructuring of *Mediodactylus kotschyi* shows a high degree of divergence, indicating that the numerous taxa described in this “species” probably constitute in fact a species complex ([Kasapidis *et al.* 2005](#)). For instance, the most basal lineage in this complex (the Cretan clade) is estimated to have diverged 10 mya, which is considerably longer than with typical within-species divergences. Additional range-wide sampling at a finer scale (especially in southwestern Turkey) and results from additional data sets (morphological and nuclear data) are clearly warranted.

Investigating the relationships within the subfamily Lacertinae, [Pavlicev and Mayer \(2009\)](#) used combined nuclear and mtDNA data sequences to reveal whether the bush-like phylogenetic trees found by previous authors were due to methodological artefacts, rather than the reflection of rapid diversification. The latter seems to be the case. A surprising result is the strongly supported placement of *Dinarolacerta* within the *Algyroides* clade, even while the authors cautiously note the evidence to be still insufficient to conclude that *Algyroides* is paraphyletic.

While Iberian populations of the Fringe-toed Lizard (*Acanthodactylus erythrurus*) do not -based on mtDNA data- form a monophyletic group, suggesting multiple independent colonisation events from northern Africa, the monophyly of the nominal subspecies has not been rejected ([Fonseca *et al.* 2009](#)).

[Paulo *et al.* \(2008\)](#) confirmed the basal position of *Timon lepidus nevadensis* in relation to other Ocellated Lizard (*Timon lepidus*) populations, without discussing the possible species rank of the former. Again, analyses of morphological and/or genetic variation in contact zones are highly desirable.

[Salvi *et al.* \(2009a\)](#) investigated allozyme differentiation of Bedriaga's Rock Lizard (*Archaeolacerta bedriagae*), showing lower differentiation than in [Guillaume and Lanza \(1982\)](#). As acknowledged by

Guillaume (1987), however, the latter results were miscalculated. [Arnold et al. \(2007\)](#) pointed out that mtDNA variation suggested the existence of more than one Tyrrhenian rock lizard species. In contrast, [Salvi et al. \(2009a, b\)](#) convincingly advocate that their allozyme data support the recognition of a single *Archaeolacerta* species, as the intraspecific divergence of *A. bedriagae* is well within the limits of divergence known from other lacertid lizards. On the other hand, their data suggest that the current intraspecific taxonomy is in need of revision through synonymisation of several Sardinian subspecies. Based on the available allozyme data, South Sardinian populations from the Sette Fratelli Mountains, seemed to represent an undescribed subspecies (Guillaume 1987; [Salvi et al. 2009a](#)), but this is contradicted by the mitochondrial data of [Salvi et al.](#) (in press). The latter established a clearly divergent lineage from northern Corsica, while populations from the remainder of the species' range seemed to group together (albeit displaying clear within-lineage differentiation). Taxonomic implications were not (yet) put forward.

[Arribas \(2009\)](#) described the oviparous Cantabrian and Pyrenean populations of the Viviparous Lizard as a distinct subspecies, *Zootoca vivipara louislantzi*.

[Geniez et al. \(2007\)](#) redefined the nominotypical Iberian Wall Lizard (*Podarcis hispanicus* s.s.). [Renoult et al. \(2009\)](#) provided new information on the distribution of *P. liolepis* (= morphotype 3). Formal description of remaining morphotypes 1 and 2, as well as investigation of further clades, remain to be published (cf. e.g. [Pinho et al. 2008](#)). A review of the status of the research on Iberian *Podarcis* was provided by [Carretero \(2008\)](#).

[Lymberakis et al. \(2008\)](#) investigated the phylogeny of the superspecies *Podarcis erhardii* (Erhard's Wall Lizard). With *Podarcis peloponnesiacus* (Peloponnesian Wall Lizard) clearly nested inside the traditional "*P. erhardii*" clades, two options were available: (1) synonymise *peloponnesiacus* with *erhardii* or (2) split *erhardii*. In view of, among others, the genetic divergence, we support the authors' choice for the latter option. Thus, two new lizard species deserve acceptance: the Cretan Wall Lizard, *Podarcis cretensis*, from western Crete and islets surrounding Crete, and the large-bodied Pori Wall Lizard, *Podarcis lewendis*, from two islets off Antikythira (Pori and Lagouvardos). Further splitting of *erhardii* into (at least) a mainland and a Cycladic species seems desirable, but requires further study.

[Montori et al. \(2009\)](#) stated that the origin of the Menorcan populations of *Scelarcis perspicillata* (Moroccan Rock Lizard), while presumed to be Algeria, remains unclear, despite [Perera et al.'s \(2007\)](#) results, which suggested a close relationship with Taza (Morocco) populations from the subspecies *chabanaudi*. The latter might represent a full species, thus possibly necessitating a name change for the European populations.

[Carranza et al. \(2008\)](#) revealed a surprisingly high level of mtDNA diversity within the Ocellated Skink (*Chalcides ocellatus*), suggesting it might constitute a species complex. Indeed, one of the clades in this complex has already been put forward as a separate species (Baha el Din 2006 - *C. humilis*). However, morphological variation in the Ocellated Skink is still poorly understood and the currently identified morphological subspecies do not agree with the mtDNA clades. For example, the Tunisian clade does not include all populations traditionally attributed to the subspecies *Chalcides ocellatus tiligugu*. In Europe, this clade has been identified on Sardinia, and could also be present on Sicily and Malta, even though [Carranza et al. \(2008\)](#) did not include specimens from the two latter islands. [Kornilios et al. \(2010\)](#) investigated the phylogeography of the species with mtDNA, confirming its complex past history and high level of current genetic diversity but without providing new data on systematics. We refrain from proposing any systematic changes until additional sources of evidence have been gathered.

The distinctness of the Italian Three-toed Skink subspecies *Chalcides chalcides vittatus* from Tunisia, which is also present on Sardinia, as found by [Giovanotti et al. \(2007\)](#), was confirmed by [Carranza et al. \(2008\)](#).

The presence of both *C. c. vittatus* and *C. o. tiligugu* on Sardinia seems to be due to human introduction from northern Tunisia ([Carranza et al. 2008](#)), while Sicilian haplotypes of *C. chalcides* are distinct from Tunisian haplotypes, suggesting a long-term separation ([Giovanotti et al. 2007](#)).

[Gvoždík et al. \(2010\)](#) investigated the genetic structure of the Slow Worm (*Anguis fragilis*) and treated two taxa as species new to the European herpetofauna: *A. colchica* and *A. graeca*. For the former, three subspecies are proposed, with *A. c. incerta* being present in the area discussed in our paper. While the range of

their *Anguis fragilis* s.s. is clearly undersampled (especially Italy and the Iberian Peninsula) and the mitochondrial and nuclear phylogenies are not entirely congruent, the available molecular and morphological data seem to warrant the proposed split. More range-wide sampling and additional morphological study remain desirable.

Amphisbaenia

Overlooked by Speybroeck and Crochet (2007), worm lizards of the genus *Blanus* gave their name to a new family, Blanidae. This change results from research results including a fascinating transatlantic rafting hypothesis (Kearney 2003; Kearney and Stuart 2004; Vidal *et al.* 2008a), and has also been adopted by the online TIGR Reptile Database (Uetz and Hallermann 2009).

Recent studies investigating the phylogeography and morphology of the Iberian Worm Lizard (*Blanus cinereus*) (Vasconcelos "Vaconcelos" *et al.* 2006; Albert *et al.* 2007; Albert and Fernández 2009) established two clearly divergent clades occurring on the Iberian Peninsula. Albert and Fernández (2009) described the clade from the southwestern parts of the Iberian Peninsula as a new species, *Blanus mariae* (Maria's Worm Lizard). We tentatively accept this new species, because of its highly divergent mtDNA (divergence similar to that between the North African *B. mettetali* and *B. tingitanus*) and allegedly concordant patterns of nuclear DNA variation. Nevertheless, we note that detailed nuclear data are not available in Albert *et al.* (2007), nor Albert and Fernández (2009), making it impossible to really evaluate the degree of concordance between nuclear and mtDNA data. Morphological results in Albert and Fernández (2009) indicate average differences between specimens of both clades, but do not allow to determine whether morphological differences are retained near contact zones or not. Thus, in this instance, we repeat our plea for detailed analysis of contact zones. Finally, we wish to point out some regrettable mistakes in the nomenclatural part of Albert and Fernández (2009). For instance, their lectotype designation is invalid, due to the lack of explicitly stated taxonomic purpose (see Art. 74.7.3 of the Code), they have not properly established whether the original type series consists of one holotype or several syntypes, and they have not examined the status of other, older nomina in the synonymy of Iberian *Blanus* (see Gans 2005).

Serpentes

A number of studies indicated the paraphyly of the family Colubridae, as traditionally understood, in relation to the Elapidae and the Atractaspididae (Vidal and Hedges 2002; Nagy *et al.* 2003). As adopted by Kelly *et al.* (2008, 2009), this resulted into relocating *Malpolon* (Montpellier snakes) to the family Psammophiidae. In addition, the clade containing the water snakes (*Natrix*) is now generally treated as the family Natricidae (see also Vidal *et al.* 2007, Zaher *et al.* 2009). While Carretero *et al.* (2009) treated this as premature, we do accept these changes, as they are well-supported by several independent studies.

The sand boas also have been shown to be quite distinct from true boas (Noonan and Chippindale 2006), and have been placed in the family Erycidae (Vidal and Hedges 2002).

Nuclear and mitochondrial DNA data was analysed for specimens throughout the distribution range of the Western Whip Snake (*Hierophis viridiflavus*) by Rato *et al.* (2009), providing a wider geographical coverage than Nagy *et al.* (2002). Geographical distribution of colour patterns observed within the species did not entirely coincide with two established mtDNA lineages. Levels of divergence were interpreted as being intraspecific for colubrid snakes. Both lineages were found in northwestern Italy (albeit not syntopically), where the 'typical' colour pattern was almost exclusively found. It seems appropriate to refer to populations of the eastern clade as subspecies *carbonarius*, noting that colour pattern cannot be fully relied upon for distinction between this and the nominal form.

Santos *et al.*'s (2008) mtDNA data confirmed the distinctness of the Smooth Snake subspecies *Coronella austriaca acutirostris*, but not that of *C. a. fitzingeri*.

Guicking *et al.* (2008) advocated the division of *Natrix maura* (Viperine Snake) into 3 or 4 phylogenetic taxa (including a Tunesian clade present on Sardinia), but refrained from choosing whether subspecies or species rank might be the most appropriate choice, pending more data e.g. from southern Spain. They did not (yet) deal with the related nomenclatural issues. As noted by Speybroeck and Crochet (2007), Guicking *et al.* (2006) considered lineages of this species and *Natrix tessellata* to fall within the boundaries of intraspecific divergence. Concerning the latter species, a subsequent paper additionally highlighted its high intraspecific variation (Guicking *et al.* 2009). Three major clades were identified for Europe: Greece, Crete and the remainder of Europe, with the former being the most basal of the three and the two latter being positioned as sister clades in the *tessellata* phylogeny. The authors refrained from any decision on splitting this species into different taxonomical units, pending further genetic and phenotypic data.

Zinenko *et al.* (2010) reported on morphological variation of vipers of the *Vipera berus* (Adder) complex in Eastern Romania, the Republic of Moldova and West and Central Ukraine, using multivariate analyses. They identified populations with typical *nikolskii* morphology, colourless venom and habitat divergence in respect to *V. b. berus* in the northeastern Romanian forest-steppe zone, indicating that this taxon would occur in the area considered in our paper. Intermediate morphology of the vipers in the eastern Romanian lowlands suggested morphological introgression in the contact zone between *V. b. berus* and *V. b. nikolskii*, while the presence of *V. b. berus* mtDNA cytochrome b haplotypes in the western range of *V. b. nikolskii* demonstrated considerable mitochondrial introgression (Kalyabina-Hauf *et al.* 2004; Joger *et al.* 2007). Thus, available data clearly do not support a full species status for this taxon. Additional range wide sampling of *V. b. nikolskii* is necessary to establish whether genetically “pure” populations occur within the geographical extent of our paper.

The validity of the Asp Viper subspecies *Vipera aspis atra* was recently questioned: neither morphological data (Golay *et al.* 2008) nor molecular evidence (Ursenbacher *et al.* 2006) supported its distinctiveness. However, neither of these studies investigated colour pattern, and Golay *et al.* (2008) included in “*atra*” many populations which do not show the *atra* colour pattern. While *atra* probably does not constitute a distinctive evolutionary unit in the *aspis* complex (in contrast to e.g. Zuffi 2002), we think it could still constitute a valid morphological subspecies.

Barbanera *et al.* (2009) investigated the variation in phenotype, mtDNA and nuclear DNA (microsatellites) in *Vipera aspis* in Italy. They showed that microsatellites, mtDNA and phenotype indicate concordant groups of populations. More precisely, mtDNA and phenotype agreed on the range limit between *aspis* and *francisciredi*, with microsatellites providing a somewhat ambiguous signal (no distinct cluster with Bayesian clustering, but very limited gene flow), probably as a result of the low number of *aspis* specimens. The boundary between *francisciredi* and *hugyi* was concordant for the three markers, and gene flow seemed to be similarly low, even if several specimens from the center of the Italian Peninsula showed signs of nuclear introgression. In addition, mtDNA data exhibited traces of an ancient introgression event (ancient mitochondrial capture of *francisciredi* haplotypes by northern populations of *hugyi*). In conclusion, *aspis*, *francisciredi* and *hugyi* are three well-supported evolutionary units in the Asp Viper complex, genetic data show signs of ancient introgression between *francisciredi* and *hugyi*, but the nature of their interaction in contact zones remains to be studied, to establish if gene flow is currently restricted or not.

Morphological as well as molecular data confirmed that the Nose-horned Viper subspecies *Vipera ammodytes ruffoi* and *V. a. gregorwallneri* are to be placed in synonymy with the nominal subspecies (Tomović 2006; Ursenbacher *et al.* 2008).

Species list

Changes in comparison with the list by Speybroeck and Crochet (2007) have been underlined.

We note that, subsequent to the rediscovery of the works of Garsault (1764), a number of names has to be attributed to this author, instead of to Laurenti, 1768 (Dubois and Bour in press). In the case of the genus names *Bufo*, *Salamandra* and *Vipera*, this involves adding brackets to the authorship of species names described after 1764.

Two water frog taxa have “kl.” inserted into their name, in between the genus and the species name. These are not truly biological species, but hemiclones, with “kl.” referring to the Greek word “klepton”, meaning thief. For more background reading in this issue see e.g. Dubois and Günther (1982).

During the reviewing process, it became clear that a lot of controversy exists regarding authorship and year of description for many taxa. For some cases that we were unable to solve, we therefore provide both alternative options, as a reminder to the reader of these problems in the nomenclature of European reptiles and amphibians. The authorship and year for reptile family names as presented here should be regarded as preliminary, while those of the amphibians have been thoroughly investigated ([Dubois 1984, 1985](#)).

Class Amphibia (amphibians)

Order Caudata or Urodela (salamanders and newts)

Family Salamandridae Goldfuss, 1820 (true salamanders and newts)

Calotriton Gray, 1858

arnoldi Carranza and Amat, 2005 — Montseny Brook Newt

asper (Dugès, 1852) — Pyrenean Brook Newt

Chioglossa Bocage, 1864

lusitanica Bocage, 1864 — Golden-striped Salamander

Euproctus Gené, 1839

montanus (Savi, 1838) — Corsican Brook Newt

platycephalus (Gravenhorst, 1829) — Sardinian Brook Newt

Ichthyosaura [Sonnini and Latreille](#), 1801

alpestris (Laurenti, 1768) — Alpine Newt

Lissotriton Bell, 1839

boscai (Lataste in Blanchard, 1879) — Bosca's Newt

helveticus (Razoumowsky, 1789) — Palmate Newt

italicus (Peracca, 1898) — Italian Newt

montandoni (Boulenger, 1880) — Montandon's Newt

vulgaris (Linnaeus, 1758) — Smooth Newt

Lyciasalamandra Veith and Steinfartz, 2004

helterseni (Pieper, 1963) — Karpathos Salamander

Pleurodeles Michahelles, 1830

waltl Michahelles, 1830 — Sharp-ribbed Newt

Salamandra Garsault, 1764

atra (Laurenti, 1768) — Alpine Salamander

corsica (Savi, 1838) — Corsican Fire Salamander

lanzai (Nascetti, Andreone, Capula and Bullini, 1988) — Lanza's (Alpine) Salamander

salamandra (Linnaeus, 1758) — Fire Salamander

Salamandrina Fitzinger, 1826

perspicillata (Savi, 1821) — Northern Spectacled Salamander

terdigitata (Bonnaterre, 1789) — Southern Spectacled Salamander

Triturus Rafinesque, 1815

arntzeni [Litvinchuk, Borkin, Džukić and Kalezić](#), 1999 — [Arntzen's Crested Newt](#)

carnifex (Laurenti, 1768) — Italian Crested Newt

cristatus (Laurenti, 1768) — (Great or Northern) Crested Newt

dobrogicus (Kiritzescu, 1903) — Danube Crested Newt

? *karelinii* (Strauch, 1870) — Southern Crested Newt — presence in Europe depends on location of boundary with *arntzeni*

macedonicus (Karaman, 1922) — [Macedonian Crested Newt](#)

marmoratus (Latreille, 1800) — Marbled Newt

pygmaeus (Wolterstorff, 1905) — Southern Marbled Newt

Family Plethodontidae Gray, 1850 (lungless salamanders)

Speleomantes Dubois, 1984

ambrosii (Lanza, 1955) — Ambrosi's Cave Salamander

flavus (Stefani, 1969) — Monte Albo Cave Salamander

genei (Temminck and Schlegel, 1838) — Gené's Cave Salamander

imperialis (Stefani, 1969) — Scented Cave Salamander

italicus (Dunn, 1923) — Italian Cave Salamander

sarrabusensis Lanza, Leo, Forti, Cimmaruta, Caputo and Nascetti 2001 — Sette Fratelli Cave Salamander

strinatii (Aellen, 1958) — Strinati's Cave Salamander

supramontis (Lanza, Nascetti and Bullini, 1986) — Sopramonte Cave Salamander

Family Proteidae Gray, 1825 (olms)

Proteus Laurenti, 1768

anguinus Laurenti, 1768 — Olm

Order Anura (frogs and toads)

Family Alytidae Fitzinger, 1843 (painted frogs and midwife toads)

Alytes Wagler, 1829

cisternasii Boscá, 1879 — Iberian Midwife Toad

dickhilleni Arntzen and García-París, 1995 — Southern Midwife Toad

muletensis (Sanchíz and Adrover, 1977) — Majorca Midwife Toad

obstetricans (Laurenti, 1768) — Common Midwife Toad

Discoglossus Otth, 1837

galganoi Capula, Nascetti, Lanza, Bullini and Crespo, 1985 — Iberian Painted Frog

montalentii Lanza, Nascetti, Capula and Bullini, 1984 — Corsican Painted Frog

pictus Otth, 1837 — Painted Frog

sardus Tschudi in: Otth, 1837 — Tyrrhenian Painted Frog

Family Bombinatoridae Gray, 1825 (fire-bellied toads)

Bombina Oken, 1816

bombina (Linnaeus, 1761) — Fire-bellied Toad

variegata (Linnaeus, 1758) — Yellow-bellied Toad

Family Pelobatidae Bonaparte, 1850 (spadefoot toads)

Pelobates Wagler, 1830

cultripes (Cuvier, 1829) — Western Spadefoot

fuscus (Laurenti, 1768) — Common Spadefoot

syriacus Boettger, 1889 — Eastern Spadefoot

Family Pelodytidae Bonaparte, 1850 (parsley frogs)

Pelodytes Bonaparte, 1838

ibericus Sánchez-Herráiz, Barbadillo, Machordom and Sanchiz, 2000 — Iberian Parsley Frog

punctatus (Daudin, 1802) — Parsley Frog

Family Bufonidae Gray, 1825 (true toads)

Bufo Laurenti, 1768

bufo (Linnaeus, 1758) — Common Toad

calamita (Laurenti, 1768) — Natterjack

viridis (Laurenti, 1768) — Green Toad

Family Hylidae Rafinesque, 1815 (tree frogs)

Hyla Laurenti, 1768

arborea (Linnaeus, 1758) — Common Tree Frog

intermedia Boulenger, 1882 — Italian Tree Frog

meridionalis Boettger, 1874 — Stripeless Tree Frog

sarda (de Betta, 1857) — Tyrrhenian Tree Frog

Family Ranidae Rafinesque-Schmaltz, 1814 (true frogs)

Pelophylax Fitzinger, 1843

bedriagae (Camerano, 1882) — Bedriaga's Water Frog

cretensis (Beerli, Hotz, Tunner, Heppich and Uzzell, 1994) — Cretan Water Frog

epeiroticus (Schneider, Sofianidou and Kyriakopoulou-Sklavounou, 1984) — Epirus Water Frog

kl. *esculentus* (Linnaeus, 1758) — Edible Frog

kl. *grafi* (Crochet, Dubois, Ohler and Tunner, 1995) — Graf's Hybrid Frog

lessonae (Camerano, 1882) — Pool Frog

perezi (Seoane, 1885) — Iberian Water Frog

ridibundus (Pallas, 1771) — Marsh Frog

shqipericus (Hotz, Uzzell, Günther, Tunner and Heppich, 1987) — Albanian Pool Frog

Rana Linnaeus, 1758

arvalis Nilsson, 1842 — Moor Frog

dalmatina Fitzinger in Bonaparte, 1838 — Agile Frog

graeca Boulenger, 1891 — Greek Stream Frog

iberica Boulenger, 1879 — Iberian Stream Frog

italica Dubois, 1987 — Italian Stream Frog

latastei Boulenger, 1879 — Italian Agile Frog

pyrenaica Serra—Cobo, 1993 — Pyrenean Stream Frog

temporaria Linnaeus, 1758 — Grass Frog

Class Reptilia (reptiles)

Order Testudines or Chelonii (turtles, tortoises and terrapins)

Family Cheloniidae Opper, 1811 (sea turtles)

Caretta Rafinesque-Schmaltz, 1814

caretta (Linnaeus, 1758) — Loggerhead ((Sea) Turtle)

Family Dermochelyidae Fitzinger, 1843 (1825) (leatherbacks)

Dermochelys de Blainville, 1816

coriacea (Vandelli, 1761) — Leatherback

Family Testudinidae Batsch, 1788 (tortoises)

Testudo Linnaeus, 1758

graeca Linnaeus, 1758 — Spur-thighed Tortoise

hermanni Gmelin, 1789 — Hermann's Tortoise

marginata Schoepff, 1792 — Marginated Tortoise

Family Geoemydidae Theobald, 1868 (Old World terrapins)

Mauremys Gray, 1869

leprosa (Schweigger, 1812) — Spanish Terrapin

rivulata (Valenciennes, 1833) — Balkan Terrapin

Family Emydidae Rafinesque, 1815 (New World terrapins)

Emys Duméril, 1805

orbicularis (Linnaeus, 1758) — European Pond Terrapin

Order Squamata

Suborder Sauria (lizards)

Family Agamidae Spix, 1825 or Fitzinger, 1826 (agamans)

Laudakia Gray, 1845

stellio (Linnaeus, 1758) — Starred Agama

Family Chamaeleonidae Gray, 1825 or Rafinesque, 1815 (Chamaeleontidae) (chameleons)

Chamaeleo Laurenti, 1768

africanus Laurenti, 1768 — African Chameleon

chamaeleon (Linnaeus, 1758) — Mediterranean Chameleon

Family Sphaerodactylidae Underwood, 1954 (leaf-toed geckos)

Euleptes Fitzinger, 1843

europaea (Gené, 1839) — European Leaf-toed Gecko

Family Gekkonidae Oppel, 1811 or Gray, 1825 (true geckos)

Hemidactylus Oken, 1817

turcicus (Linnaeus, 1758) — Turkish Gecko

Mediodactylus Szczerbak and Golubev, 1977

kotschyi (Steindachner, 1870) — Kotschy's Gecko

Family Phyllodactylidae Gamble, Bauer, Greenbaum and Jackman, 2008 (leaf-toed geckos)

Tarentola Gray, 1825

mauritanica (Linnaeus, 1758) — Moorish Gecko

Family Lacertidae Batsch, 1788 (true lizards)

Acanthodactylus Wiegmann, 1834

erythrurus (Schinz, 1833) — Spiny-footed Lizard

Algyroides Bibron and Bory de Saint-Vincent, 1833

fitzingeri (Wiegmann, 1834) — Tyrrhenian Algyroides

marchi Valverde, 1958 — Spanish Algyroides

moreoticus Bibron and Bory de Saint-Vincent, 1833 — Greek Algyroides

nigropunctatus (Duméril and Bibron, 1839) — Dalmatian Algyroides

Archaeolacerta Mertens, 1921

bedriagae (Camerano, 1885) — Tyrrhenian Rock Lizard

Dalmatolacerta Arnold, Arribas and Carranza, 2007

oxycephala Duméril and Bibron, 1839 — Sharp-snouted Rock Lizard

Darevskia Arribas, 1997

pratricula (Eversmann, 1834) — Meadow Lizard

Dinarolacerta Arnold, Arribas and Carranza, 2007

montenegrina Ljubisavljević, Arribas, Džukić and Carranza, 2007 — Prokletije Rock Lizard

mosorensis Kolombatović, 1886 — Mosor Rock Lizard

Eremias Fitzinger in Wiegmann, 1834

arguta (Pallas, 1773) — Steppe Runner

Hellenolacerta Arnold, Arribas and Carranza, 2007

graeca Bedriaga, 1886 — Greek Rock Lizard

Iberolacerta Arribas, 1997

aranica (Arribas, 1993) — Aran Rock Lizard

aurelioi (Arribas, 1994) — Aurelio's Rock Lizard

bonnali (Lantz, 1927) — Pyrenean Rock Lizard

cyreni (Müller and Hellmich, 1937) — Cyren's Rock Lizard

galani Arribas, Carranza and Odierna, 2006 — Galan's Rock Lizard

horvathi (Méhely, 1904) — Horvath's Rock Lizard

martinezricai (Arribas, 1996) — Martinez-Rica's or Peña de Francia Rock Lizard

monticola (Boulenger, 1905) — (West-)Iberian Rock Lizard

Lacerta Linnaeus, 1758

agilis Linnaeus, 1758 — Sand Lizard

bilineata Daudin, 1802 — Western Green Lizard

schreiberi Bedriaga, 1878 — Schreiber's Green Lizard

trilineata Bedriaga, 1886 — Balkan Green Lizard

viridis (Laurenti, 1768) — Eastern Green Lizard

Ophisops Ménétries, 1832

elegans Ménétries, 1832 — Snake-eyed Lacertid

Parvilacerta Arnold, Arribas and Carranza, 2007

? *parva* (Boulenger, 1887) — Dwarf Lizard — single record from Turkish Thrace (Venchi and Bologna 1996), actual presence within considered area requires confirmation

Podarcis Wagler, 1830

bocagei (Seoane, 1884) — Bocage's Wall Lizard

carbonelli Pérez-Mellado, 1981 — Carbonell's Wall Lizard

cretensis (Wettstein, 1952) — Cretan Wall Lizard

erhardii (Bedriaga, 1876) — Erhard's Wall Lizard

filfolensis (Bedriaga, 1876) — Maltese Wall Lizard

gaigeae (Werner, 1930) — Skyros Wall Lizard

hispanicus (Steindachner, 1870) including s.s. morphotype, morphotype 1, and morphotype 2 — Iberian Wall Lizard

levendis Lymberakis, Poulakakis, Kaliontzopoulou, Valakos and Mylonas, 2008 — Pori Wall Lizard

lilfordi (Günther, 1874) — Lilford's Wall Lizard

liolepis (Boulenger, 1905) — Catalanian Wall Lizard

melisellensis (Braun, 1877) — Dalmatian Wall Lizard

milensis (Bedriaga, 1882) — Milos Wall Lizard

muralis (Laurenti, 1768) — Common Wall Lizard

peloponnesiacus (Bibron and Bory de Saint-Vincent, 1833) — Peloponnese Wall Lizard

pityusensis (Boscá, 1883) — Ibiza Wall Lizard

raffonei (Mertens, 1952) — Aeolian Wall Lizard

siculus (Rafinesque-Schmaltz, 1810) — Italian Wall Lizard

tauricus (Pallas, 1814) — Balkan Wall Lizard

tiliguerta (Gmelin, 1789) — Tyrrhenian Wall Lizard

vaucheri (Boulenger, 1905) — Vaucher's Wall Lizard

waglerianus Gistel, 1868 — Sicilian Wall Lizard

Psammodromus Fitzinger, 1826

algerus (Linnaeus, 1758) — Large Psammodromus

hispanicus Fitzinger, 1826 — Spanish Psammodromus

Scelarcis Fitzinger, 1843

perspicillata (Duméril and Bibron, 1839) — Moroccan Rock Lizard

Timon Tschudi, 1836

lepidus (Daudin, 1802) — Ocellated Lizard

Zootoca Wagler, 1830

vivipara (Jacquin, 1787) or (Lichtenstein, 1823) — Viviparous Lizard

Family Scincidae Oppel, 1811 or Gray, 1825 (skinks)

Ablepharus Fitzinger in Eversmann, 1823

kitaibelii Bibron and Bory de Saint-Vincent, 1833 — Snake-eyed Skink

Chalcides Laurenti, 1768

bedriagai (Boscá, 1880) — Bedriaga's Skink

chalcides (Linnaeus, 1758) — Italian Three-toed Skink

ocellatus (Forskål, 1775) — Ocellated Skink

striatus (Cuvier, 1829) — Iberian Three-toed Skink

Ophiomorus Duméril and Bibron, 1839

punctatissimus (Bibron and Bory de Saint-Vincent, 1833) — Limbless Skink

Family Anguillidae Gray, 1825 (slow worms)

Anguis Linnaeus, 1758

cephallonica Werner, 1894 — Peloponnese Slow Worm

colchica (Nordmann, 1840) — Eastern Slow Worm

fragilis Linnaeus, 1758 — Slow Worm

graeca Bedriaga, 1881 — Greek Slow Worm

Pseudopus Merrem, 1820

apodus (Pallas, 1775) — Glass Lizard

Suborder Amphisbaenia (worm lizards)

Family Blanidae Kearney, 2003 (Mediterranean worm lizards)

Blanus Wagler, 1830

cinereus (Vandelli, 1797) — Iberian Worm Lizard

mariae Albert and Fernández (2009) — Maria's Worm Lizard

Suborder Serpentes (snakes)

Family Typhlopidae Merrem, 1820 or Jan, 1863 (worm snakes)

Typhlops Schneider in Oppel, 1811

vermicularis Merrem, 1820 — Worm Snake

Family Erycidae Bonaparte, 1840 (sand boas)

Eryx Daudin, 1803

jaculus (Linnaeus, 1758) — Sand Boa

Family Psammophiidae Boie, 1827 (African sand snakes and Montpellier snakes)

Malpolon Fitzinger, 1826

insignitus (Geoffroy Saint-Hilaire, 1827) — Eastern Montpellier Snake

monspessulanus (Hermann, 1804) — Western Montpellier Snake

Family Natricidae Bonaparte, 1840 (Eurasian water snakes)

Natrix Laurenti, 1768

maura (Linnaeus, 1758) — Viperine Snake

natrix (Linnaeus, 1758) — Grass Snake

tessellata (Laurenti, 1768) — Dice Snake

Family Colubridae Oppel, 1811 (colubrids)

Coronella Laurenti, 1768

austriaca Laurenti, 1768 — Smooth Snake

girondica (Daudin, 1803) — Southern Smooth Snake

Dolichophis Gistel, 1868

caspicus (Gmelin, 1789) — Caspian Whip Snake

Eirenis Jan, 1863

? *modestus* (Martin, 1838) — (Masked) Dwarf Snake — actual presence within the considered area requires confirmation

Elaphe Fitzinger, 1833

quatuorlineata (Bonnaterre, 1790) — (Western) Four-lined Snake

sauromates (Pallas, 1814) — Blotched Snake or Eastern Four-lined Snake

Hemorrhois Boie, 1826

algirus (Jan, 1863) — Algerian Whip Snake

hippocrepis (Linnaeus, 1758) — Horseshoe Whip Snake

? *nummifer* (Reuss, 1834) — Coin-marked Snake — actual presence within considered area requires confirmation

Hierophis Fitzinger in Bonaparte, 1834

gemonensis (Laurenti, 1768) — Balkan Whip Snake

viridiflavus (Lacépède, 1789) — Western Whip Snake

Macroprotodon Guichenot, 1850

brevis (Günther, 1862) — Western or Iberian False Smooth Snake

cucullatus (Geoffroy Saint-Hilaire, 1809) — Eastern or African False Smooth Snake

Platyceps Blyth, 1860

collaris (Müller, 1878) — Reddish Whip Snake

najadum (Eichwald, 1831) — Dahl's Whip Snake

Rhinechis Michahelles in Wagler, 1833

scalaris (Schinz, 1822) — Ladder Snake

Telescopus Wagler, 1830

fallax (Fleischmann, 1831) — Cat Snake

Zamenis Wagler, 1830

lineatus (Camerano, 1891) — Italian Aesculapian Snake

longissimus (Laurenti, 1768) — Aesculapian Snake

situla (Linnaeus, 1758) — Leopard Snake

Family Viperidae Opperl, 1811 (true vipers)

Macrovipera Reuss, 1927

schweizeri (Werner, 1935) — Milos Viper

Montivipera Nilson, Tuniyev, Andrén, Orlov, Joger and Herrmann, 1999

xanthina (Gray, 1849) — Ottoman Viper

Vipera Garsault, 1764

ammodytes (Linnaeus, 1758) — Nose-horned Viper

aspis (Linnaeus, 1758) — Asp Viper

berus (Linnaeus, 1758) — Adder

latastei (Boscá, 1878) — Lataste's Viper

seoanei (Lataste, 1879) — Seoane's Viper

ursinii (Bonaparte, 1835) — Meadow Viper

Some exogenous species which have become well-established during the last century

Class Amphibia (amphibians)

Order Anura (frogs and toads)

Family Pipidae Gray, 1825 (clawed toads and pipa toads)

Xenopus Wagler, 1827

laevis (Daudin, 1802) — (African) Clawed Toad

Family Ranidae Rafinesque-Schmaltz, 1814 (true frogs)

Lithobates Fitzinger, 1843

catesbeianus (Shaw, 1802) — (American) Bull Frog

Class Reptilia (reptiles)

Order Testudines or Chelonii (turtles, tortoises and terrapins)

Family Emydidae Rafinesque, 1815 (New World terrapins)

Trachemys Agassiz, 1857

scripta (Thunberg in Schoepff, 1792) — Red-eared Slider or Terrapin (ssp. *elegans* Wied-Neuwied, 1838)

other exogenous terrapin species have frequently been recorded

Order Squamata

Suborder Sauria MacCartney, 1802 (lizards)

Family Lacertidae Opperl, 1811 (true lizards)

Teira Gray, 1838

dugesii (Milne-Edwards, 1829) — Madeiran Wall Lizard — introduced to Lisbon harbour

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