

Nomenclatural availability of the names applied to “varieties” of the green toad (*Bufo viridis* subgroup) in the Italian territory, with emphasis on the variety *lineata* of Ninni (Anura: Bufonidae)

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Abstract. Recent molecular investigations on Eurasian green toads led to the recognition of distinct lineages and to the establishment of new taxa within the former *Bufo viridis*; as a consequence, significant range-wide nomenclatural changes have been proposed, although some uncertainties remained on the available names applicable within the Italian territory. In order to contribute to clarify the matter, we evaluated, under the provisions of the International Code of Zoological Nomenclature, the nomenclatural availability of all the names that have been applied to infrasubspecific entities of the *Bufo viridis* subgroup within the Italian territory. We also provided a historical overview of the usage of all these names, as well as detailed information on the original material upon which the variety *lineata* of A.P. Ninni was established. Our analysis supports the view that only the names *crucigera* Eichwald, 1831 and *balearica* Boettger, 1880 are available, the former being however junior synonym of *B. viridis* Laurenti, 1768, whereas the names *acutirostris* and *obtusirostris* of Lessona, *lineata* of Ninni, *concolor* and *maculata* of Camerano, and *nardoii* of Paolucci, Fuhn and Bruno are all not available.

Keywords. *Bufo viridis* subgroup, green toads, Italy, nomenclature, taxonomy, availability, infrasubspecific names, variety.

INTRODUCTION

On-going molecular investigations on Eurasian green toads (*Bufo viridis* Laurenti, 1768 subgroup; sensu Stöck et al., 2001, 2006) are greatly contributing to reveal phylogenetic diversity and phylogeographic structure within this anuran group (Balletto et al., 2000, 2007; Stöck et al., 2005, 2006, 2008b; Batista et al., 2006). The consequent recognition of

distinct lineages within *B. viridis* has led to the establishment of new taxa and therefore to the introduction of new names or the resurrection of old, neglected synonyms (Stöck et al., 2005, 2006, 2008a, b; Balletto et al., 2007). As a result, significant range-wide nomenclatural changes appeared recently in the taxonomy of this widespread species-group.

In the mean time, a further source of nomenclatural “destabilization” was introduced, at genus level, by the comprehensive amphibian phylogeny of Frost et al. (2006), who transferred the *Bufo viridis* subgroup to the newly established genus *Pseudepidalea* Frost, Grant, Faivovich, Bain, Haas, Haddad, de Sá, Channing, Wilkinson, Donnellan, Raxworthy, Campbell, Blotto, Moler, Drewes, Nussbaum, Lynch, Green and Wheeler, 2006. Claimed flaws in the analysis (e.g.: Wiens, 2007), however, may allow the adoption of only part of their nomenclatural revision, suggesting instead the possible placement of the green toads within the genus *Epidalea* Cope, 1864 (Speybroeck and Crochet, 2007). These new generic combinations, although promptly adopted by some authors, have been regarded by others at least as premature, if not truly unjustified (Lanza et al., 2007a; Vences, 2007; Stöck et al., 2008b), whereas some advocated their usage at subgenus rank (Smith and Chiszar, 2006 [*vide* Frost, 2009]; Duda, 2008).

Within this framework, recent investigations on green toad populations from the Italian region led to the recognition of at least four lineages deserving the status of distinct species, although different research groups achieved partially different results, thus proposing different nomenclatural changes. Particularly, both Stöck et al. (2006, 2008b) and Balletto et al. (2000, 2007) distinguished independently a previously unrecognized taxon (mainly widespread in the Italian peninsula, the Po Plain, Corsica and Sardinia) from *Bufo viridis* Laurenti, 1768 (*sensu stricto*) (inhabiting most of Europe and reaching Italy in the North-east only). Due to partial differences in their samples and analyses, however, two alternative names were proposed for the same species, namely *Bufo balearicus* by Stöck et al. (2006, 2008b), from *Bufo viridis balearicus* originally introduced by Boettger (1880) as a variety, and *Bufo lineatus* by Balletto et al. (2007), from the variety name *lineata* established by Ninni (1879).

Razzetti (2008) discussed in detail several apparent homonyms and synonyms of these names, including the previous usage of the binomen *Bufo lineatus* by Daudin (1802) and Donoso-Barros (1972), applied to taxa unrelated to the *B. viridis* subgroup. Razzetti (2008) concluded that either *lineatus* or *balearicus* should be properly applied to the species inhabiting most of the Italian region, the correct choice being dependent upon the definitive identification of the taxon living in Venice and the surrounding plain (Venetia region, NE Italy), from where the *lineata* variety was originally described. Notwithstanding taxonomic uncertainties, both names have been hitherto considered “available” in the sense established by the International Code of Zoological Nomenclature (International Commission of Zoological Nomenclature, 1999), hereafter ICZN, even though the matter – at best of our knowledge – has not been explicitly addressed or discussed.

More generally, out of the many names coined in the past for varieties and other apparently infrasubspecific entities of green toads from the Italian region, only few of them have been explicitly evaluated for their nomenclatural availability, namely *concolor* and *maculata* of Camerano (1883) (Stöck et al., 2008b) and *nardoi* of Paolucci et al. (1999) (Razzetti, 2008).

The aim of the present paper, therefore, is to contribute an evaluation of the nomenclatural availability of the names applied to putative infrasubspecific entities of the *Bufo viridis* subgroup within the Italian region, with emphasis on the name *lineata*. Instrumen-

tal to this evaluation, we provide a historical overview of the usage of all these names, as well as detailed information on the original material upon which the variety *lineata* was established. To provide the reader with the appropriate background for a thorough evaluation of the nomenclatural availability of each name, we believe useful to include, as footnotes, the most significant excerpts of all relevant publications in their original language, together with an English version (our translations). Any taxonomic issue is out of our scope. Nevertheless, we hope that the present nomenclatural analysis will be useful in supporting the taxonomic changes required by recent systematic advances, contributed by phylogeographic investigations in progress, within the *B. viridis* subgroup.

DISCUSSION

“Varieties” of the green toad in the Italian territory: a historical overview

Several previous authors working on green toads in Italy acknowledged great variability in morphology and colouration but failed to detect any consistent geographical pattern for such variation that could be suggestive of distinct phyletic lineages, a concept that was stressed explicitly by Camerano (1882, 1883). Nevertheless, over the past 150 years, several varieties and other apparently infrasubspecific entities were identified, and often named, within the Italian region.

The first variety identified in Italy was *Bufo viridis* var. *calamita* Laur., reported by Jan (1857) from Lombardy and by Nardo (1860) from the “Province Venete” (Venetian Provinces, roughly corresponding to present-day Venetia and Friuli, NE Italy), in both cases as bare list entries without comments. The name *calamita* was first introduced by Laurenti (1768) at species rank and indeed *Bufo calamita* Laurenti, 1768 is presently recognised as a distinct species, inhabiting western and central Europe. However, around the middle of the 19th century, following Dumeril and Bibron (1841), *calamita* was regarded as a mere striped phenotype of *Bufo viridis* by several authors (see also: De Betta, 1857; Nardo, 1874; Camerano, 1883). Misdirected by the work of Jan (1857), Nardo (1860) and others, De Betta (1874) included the species *B. calamita* within the fauna of Venetia, though possibly limited to the Alps.

A few years later, Lessona (1877) described in great detail the morphology and colour of the anurans of Piedmont, recognizing many “forme” (forms) and “varietà” (varieties), among which several forms and varieties of green toads (as *Bufo viridis*) were reported based on jaw morphology, wart arrangement and colour pattern. However, these three character sets were considered independently and different forms or varieties were identified with respect to one set at a time. Particularly, based on jaw morphology, Lessona (1877) distinguished and named two forms of *B. viridis*, “forma *acutirostris*” and “forma *obtusirostris*” respectively¹, apparently following var. *acutirostris* and var. *obtusirostris* coined by Fatio (1872) for *Rana temporaria* Linnaeus, 1758. It is worth noting

¹ “Anche qui possiamo stabilire negli individui adulti una forma *acutirostris* ed una forma *obtusirostris*.” [= Here also, we can distinguish, among adults, an *acutirostris* form and an *obtusirostris* form.] (Lessona, 1877, p. 1087).

that these same two terms were applied, across the paper (Lessona, 1877), to alternative phenotypes of several species, often using a trinomial arrangement (e.g.: *Rana esculenta acutirostris* and *Rana esculenta obtusirostris*, *Rana temporaria acutirostris* and *Rana temporaria obtusirostris*, *Bufo vulgaris acutirostris* and *Bufo vulgaris obtusirostris*), although the explicit trinomial form was never used with *B. viridis*. In addition, morphologically distinguished phenotypes were always referred to as “forme”, whereas those based on colouration or wart arrangement were called “varietà”, a linguistic distinction which is consistent throughout the whole paper. The distinction *acutirostris* vs. *obtusirostris* does not seem to relate consistently to the same factor of variation across species, in some being related either to sex or to growth stage, in others to geographical provenance, but sometimes simply indicating a general dimorphism. The latter seems the case with respect to the green toad, since none of the two forms was indicated as limited to a single sex, to a particular growth stage or to any locality or area.

In the same publication, Lessona (1877) described also two sets of “varietà” of the green toad, one based on wart size, shape, number and arrangement, and the other on colour pattern. The first set included four varieties, which were not named but simply labelled with the letters “a” through “d”². Two of these varieties were reported as associated to sex and/or age, whereas none of the four was reported as exclusive of particular localities or areas, neither occurring alone in any place.

With respect to colour and spot arrangement, Lessona (1877) described instead seven varieties, again unnamed and simply listed in alphabetical order from “a” to “g”³, clear-

² “Possiamo per rapporto alle verruche stabilire le varietà seguenti: || a) Pelle liscia; qualche verruca nella regione lombare; parti inferiori granulose; non rara. || b) Verruche numerose, ma non molto cospicue, alcune disposte in modo da formare due linee che partendo un po' sotto alle ghiandole auricolari si dirigono in basso e si continuano sui fianchi (Tavola V fig. 36). | Questa varietà non è molto comune in Piemonte; ne ho trovato individui nei contorni di Saluzzo, di Torino, di Vigevano. || c) Il dorso ed i fianchi cosparsi di verruche di grandezza fra loro pressoché eguali munite di una piccola spina nera nel mezzo. Comune, specialmente nei maschi. || d) Verruche numerose e cospicue; granulazioni della parte inferiore molto sviluppate; le zampe anteriori e le posteriori pure coperte di grosse e numerose verruche; non rara nei maschi vecchi.” [= With respect to warts, we can distinguish the following varieties: || a) Smooth skin; some warts in the lumbar region; granulation on the ventral side; not rare. || b) Many warts, but not very conspicuous; some of them arranged in two lines that, starting slightly below parotoid glands, point ventrally and continue along the flanks (Table V fig. 36). | This variety is not very common in Piedmont; I found specimens around Saluzzo, Turin, and Vigevano. || c) Back and flanks covered with scattered warts of almost equal size provided with a small black spine in the middle. Common, especially among males. || d) Many conspicuous warts; well developed granulation on the ventral side; forelegs as well as hind legs covered with many large warts; not rare among old males.] (Lessona, 1877, p. 1089).

³ “Possiamo negli adulti, avuto riguardo ai colori ed alla disposizione delle macchie, stabilire le varietà seguenti: || a) Tinta fondamentale grigia, più o meno intensa a seconda delle stagioni; macchie verdi non molto numerose e cospicue, numerosi i punticini rossi sparsi su tutto il corpo. | Questa varietà non è rara specialmente fra i maschi dei contorni di Saluzzo, Cuneo, Vigevano, Mondovì. || b) Le macchie sopra la regione della nuca incontrantisi in modo da formare grossolanamente una croce di sant'Andrea; colore fondamentale tendente al rosso. | Questa varietà è molto affine a quella che l'Eichwald descrisse col nome di *Bufo crucigera*; non molto comune in Piemonte: ne trovai alcuni individui nei contorni di Vigevano e Torino. || c) Color fondamentale giallognolo più o meno intenso, più o meno puro secondo le stagioni, macchie di color verde grandi e numerose disposte regolarmente: verruche più o meno numerose; comunissima in tutto il Piemonte sia fra i maschi sia fra le femmine. || d) Color fondamentale bruno grigio uniforme; nessuna macchia sul dorso, sui fianchi, sulle zampe anteriori e sulle coscie; poche o poco distinte sulle gambe posteriori; non rara fra i maschi specialmente dei contorni di Torino (Rivoli, Venaria reale). || e) Color fondamentale come nella varietà precedente; macchie piccole e numerosissime; non rara in tutto il Piemonte. || f) Color fondamentale grigio o giallognolo; macchie numerose; presenza di una linea dorsale chiara, meno ampia e meno regolare che non quella del *Bufo calamita*.

ly unrelated to the previous wart-based ones. These varieties were defined explicitly for adult specimens only, some of them were reported as associated with sex or particularly frequent in some places, whereas multiple varieties were reported from single localities. Lessona (1877) made his observations from either living or preserved individuals, some of which were illustrated by L. Camerano in the plates accompanying the article; unfortunately, throughout the paper, Lessona did not say a word about the fate of the specimens he had meticulously described.

In 1879, A.P. Ninni published a paper on the green toads (as *Bufo viridis*) of Venetia, in which, acknowledging the existence of Lessona's dorsally striped variety, he suggested that the claimed presence of *Bufo calamita* among Venetian amphibians had been due to a mistake of Nardo (1860), who misidentified local specimens of this variety of green toad as "*B. viridis* var. *calamita*" (Ninni, 1879). In a footnote to the paper, Ninni (1879) named this striped variety of green toad "*lineata*".

Ninni's (1879) article comprises three well distinct sections. Two of them are announced yet in the title: 1) "On the supposed existence of *Bufo calamita* Laur. in Venetia (...)" and 2) "(...) on a distinctive habit of the green toad"; whereas the third one is the final "Note" dealing with the donation of his collection to the Museum of Venice, but also introducing for the first time the name "*lineata*"⁴. In the first part, Ninni's (1879) aim is to report, explicitly and exclusively, on the putative presence of *B. calamita* in Venetia, claimed by Nardo (1860) and later acknowledged by De Betta (1874) and others, and to rectify such a misunderstanding. Here, the author, after summarizing the controversy, introduced the variety "*f*" of Lessona (1877), quoting literally the diagnosis and comments (i.e.: in Piedmont, espe-

Non rara in Piemonte specialmente fra i maschi. || g) Color fondamentale grigio, o giallognolo; macchie cospicue e disposte in modo da formare due linee non interrotte sul dorso; verruche disperse in due linee regolari sui fianchi. | Questa varietà non è molto comune in Piemonte; fino ad ora non ne ho trovato che qualche individuo nei contorni di Torino, di Vigevano e di Saluzzo." [= In adults, with respect to the colour and arrangement of spots, we can establish the following varieties: || a) Grey background, more or less intense according to the season; few, conspicuous green spots; many small red dots scattered on the whole body. | This variety is not rare, especially among males in the surroundings of Saluzzo, Cuneo, Vigevano, Mondovì. || b) Spots on the nuchal region meeting each other so as to shape roughly a St. Andrew cross; reddish background. | This variety is very close to that described by Eichwald as *Bufo crucigera*; not very common in Piedmont; I found some specimens in the vicinity of Vigevano and Turin. || c) Yellowish background, more or less deep, more or less pure according to seasons; numerous, large green spots, evenly arranged: more or less numerous warts; very common in the whole Piedmont among both males and females. || d) Evenly grey-brown background; no spots on the back, the sides, the forelimbs and the thighs; few or undefined spots on the hind limbs; not rare among males, especially in the surroundings of Turin (Rivoli, Venaria reale). || e) Background like in the previous variety; small, very numerous spots; not rare in the whole Piedmont. || f) Grey or yellowish background; numerous spots; presence of a light dorsal line, less wide and less regular than that of *Bufo calamita*. Not rare in Piedmont especially among males. || g) Grey background, or yellowish; conspicuous spots arranged so as to shape two unbroken lines on the back; warts scattered along two regular rows along the flanks. | This variety is not very common in Piedmont; so far, I found only some individual in the surroundings of Turin, Vigevano and Saluzzo.] (Lessona, 1877, p. 1089-1090).

⁴"Nota. Gli esemplari di *Bufo viridis* della varietà ch'io chiamerò *lineata*, nonché i girini dei quali feci menzione più sopra, si trovano nella collezione zoologica del civico Museo di Venezia. Nel Museo anzidetto io depositai una raccolta completa di tutti i Rettili ed Anfibi del Veneto comprese le specie più rare, tra le quali l'unico e rarissimo esemplare di *Chelonia mydas* preso vicino a Venezia." [= Note. The specimens of *Bufo viridis* of the variety that I will name *lineata*, as well as the tadpoles mentioned above, are in the zoological collection of the civic Museum of Venice. In the above mentioned Museum I deposited a complete collection of all Reptiles and Amphibians of Venetia including the rarest species, among which is the single and very rare specimen of *Chelonia mydas* caught near Venice.] (Ninni, 1879, p. 973).

cially among males) of the latter author⁵. In the following lines, Ninni stated explicitly that the same (Lessona's) variety was rather common also in Venetia, especially among young individuals, as he could find it in the city of Venice, as well as in the provinces of Padua and Treviso. Nowhere, in this section, Ninni made any comment, explicit or implicit, on the taxonomic status of this variety, and no statement by the author can be interpreted as possibly disagreeing with Lessona's original view, other than including Venetia into the variety distribution range. It is also reported here the collecting of several young, 30 mm-long specimens bearing the line described by Lessona, while catching green toad tadpoles. In the second part of the paper, Ninni (1879) dealt only with the ecology and habits of green toads, reporting about the dens dug by these amphibians in the sand dunes of the Lido di Venezia island, on their food and on some usage in the Venetian traditional medicine. Nowhere, in this "ecological" section, the author mentions the variety he had just discussed, but reference is made only to "*Bufo viridis*" in general. The third part, a tail-end note, simply reports the donation to the Museum of Venice, together with a full collection of amphibians and reptiles from Venetia, of "the specimens of *Bufo viridis* of the variety that I will name *lineata* [the 30 mm-long specimens mentioned in the first section], as well as the tadpoles that I mentioned above [also in the first part]" (Ninni, 1879). According to Ninni's own words then, the tadpoles, although collected together with striped young toads, are not included as *lineata*, a name that the author appears to reserve exclusively to those individuals visibly bearing the character at hand (i.e.: the dorsal stripe), obviously absent on tadpoles. Therefore, in our view, the content of Ninni (1879) is suggesting unambiguously, although not explicitly, the value of mere individual phenotype of the var. *lineata*.

Nevertheless, a look to Ninni's usage of the term "varietà" in other contexts, as well as to his attitude toward the application of taxonomic ranks (which included the use of species, subspecies and variety as well distinct entities), may be helpful for better understanding his taxonomic philosophy. Actually, whenever Ninni had been dealing with biological entities that did not appear to him as clearly separated from the "tipo" (the "type"

⁵ "Il prof. Lessona descrisse una varietà del *Bufo viridis*, che avrebbe i seguenti caratteri: Color fondamentale grigio o giallognolo, macchie numerose, presenza di una linea dorsale chiara, meno ampia e meno regolare che non quella del *Bufo calamita*. Non rara in Piemonte specialmente nei maschi (²). | Questa varietà che, a primo aspetto, potrebbe essere scambiata col *Bufo calamita* (³), e che non fu notata dai naturalisti veneti, è abbastanza comune tra noi specialmente nei giovani individui. Io la trovai nella stessa città di Venezia, ed anche nello scorso giugno pescando, per oggetto di studio, girini di rospo smeraldino, molti dei quali avevano già compiuta la loro metamorfosi (¹), raccolti parecchi esemplari giovani (lungh. corp. mm. 30 circa) con la riga descritta dei prof. Lessona, ed altri pure di simili potei vederne in epoche diverse nelle provincia di Padova e di Treviso. | Non vi ha dubbio per me, che gli esemplari dati dal Nardo come *Bufo calamita* (= var. *calamita*) appartengono invece alla varietà da me indicata, per cui resta, io credo, spiegata la illegittima comparsa del *Bufo calamita* negli elenchi degli Anuri del Veneto." [= Prof. Lessona described a variety of *Bufo viridis*, which bore the following characters: Grey or yellowish background, numerous spots, presence of a light dorsal line less wide and less regular than that of *Bufo calamita*. Not rare in Piedmont especially in males (²). | This variety that, at first glance, could be mistaken for *Bufo calamita* (³), and which has not been noticed by Venetian naturalists, is quite common around us especially in young individuals. I found it in the same city of Venice, and even last June, while fishing tadpoles of green toad, for scientific purposes, most of which had already completed their metamorphosis (¹), I collected many young specimens (body length ca. 30 mm) with the line described by Prof. Lessona, and I could see other similar ones as well, at different times, in the provinces of Padua and Treviso. | It is doubtless to me that the specimens identified by Nardo as *Bufo calamita* (= var. *calamita*) belong instead to the variety indicated by myself; therefore, I think, it is so explained the incorrect appearance of *Bufo calamita* within the lists of Anurans of Venetia.] (Ninni, 1879, p. 970-971).

form), he always referred to them as “forme” (forms) and/or “varietà” (varieties). This is the case, for instance, with *Tinca italica* and *T. chrysitis*, which he claimed as simple varieties of *Tinca tinca* (Linnaeus, 1758) (as *Tinca vulgaris*) due to the existence of uninterrupted series of intermediate forms (Ninni, 1863); with a newly established variety of *Natrix natrix* (Linnaeus, 1758) (as *Tropidonotus natrix*), which he named *concolor* but that he reported as connected to the “tipo” by an uninterrupted series of intermediate phenotypes and also did not differ from it in pholidosis or body shape (Ninni, 1880); with some varieties of *Rattus rattus* (Linnaeus, 1758) (as *Mus rattus*), including the newly named variety *intermedius* (Ninni, 1882). He also used the term “varietà” while reporting single peculiar zoological specimens, as a single light-coloured specimen of marten (Ninni, 1864) and a single large specimen of the bat *Nyctalus lasiopterus* (Schreber, 1780) (as *Vesperugo noctula*) (Ninni, 1883). In addition, criticism was always raised by Ninni towards those authors who attempted to establish species or subspecies in absence of well supported evidences, as demonstrated by his argument with E. De Betta. In fact, in the course of a lively academic debate on Italian brown frogs (*Rana* spp.), De Betta (1885) proposed subspecific rank for *Rana agilis* Thomas, 1855 (= *R. dalmatina* Fitzinger in Bonaparte, 1838) and *Rana latastei* Boulenger, 1879, due to the supposed existence of many intermediate forms between them and *Rana temporaria* Linnaeus, 1758. To this argument Ninni (1885) replied rejecting the subspecific rank for these two taxa, based on an explicit conceptual difference between subspecies and local or individual mutations. Moreover, the following year, he published two other papers on amphibians: a short paper on “*Triton cristatus*, Laur. s.sp. *Karelinii*” (= present-day *Triturus carnifex* (Laurenti, 1768), non *Triturus karelinii* (Strauch, 1870)) (Ninni, 1886b), where the taxon was clearly indicated as subspecies, and a paper on Venetian anurans (Ninni, 1886a), where *lineata* was still regarded as a variety and was listed together with two other varieties of *Bufo viridis* described by Camerano (1883).

Following Ninni’s argument about Nardo’s misidentification, De Betta (1883, 1885) acknowledged the existence of a striped form of green toad (as *B. viridis*), definitively rejecting the presence of *B. calamita* in Venetia.

Meanwhile, Camerano (1882) published a paper on the variability of *Rana esculenta* Linnaeus, 1758 and *Bufo viridis*, where several varieties of the former species were described, including one named “*Lessonae*”, now *Pelophylax lessonae* (Camerano, 1882). In the paper section on *Bufo viridis*, Camerano (1882) stated explicitly that, after examining specimens from different Italian regions (including Piedmont, Lombardy, Venetia, Tuscany, Sicily, Sardinia) and other areas in south-eastern Europe and the Middle East, he could not single out any defined subspecies⁶. Consistently with his opinion on the lack of any taxonomically meaningful pattern of variation in green toads, while discussing colour pattern, he described four “sub-variétés” (sub-varieties), labelled “A” through “D”⁷. These

⁶ “Le *Bufo viridis* est, ainsi que la *Rana esculenta*, très variable dans sa forme; mais s’après l’examen des exemplaires de plusieurs localités que j’ai pu observer en Piémont, Lombardie, Vénétie, Toscane, Sicile, Sardaigne (en Italie), Grèce, Syrie, Tiflis, Erivan, je n’ai pu conclure à quelques séparations de sous-espèce un peu marquées.” [= *Bufo viridis* is, as much as *Rana esculenta*, very variable in shape, however, after the examination of specimens from several localities, that I could observe in Piedmont, Lombardy, Tuscany, Sicily, Sardinia (within Italy), Greece, Syria, Georgia, Armenia, I could not come to the distinction of any subspecies pronounced enough] (Camerano, 1882, p. 690).

⁷ “La coloration dans cette espèce est très variable. Je ne parle ici que de variétés qui proviennent des localités en dehors du Piémont, car le professeur Lessonna [sic], dans l’ouvrage que j’ai cité, a déjà traité des

sub-varieties were referred only to Sardinia (A and B) and the Middle East (A through D), whereas for Piedmont the author explicitly addressed the reader to Lessona (1877), without further discussing the rest of Italy. No one of the four sub-varieties was reported as bearing a dorsal-lined pattern.

The same author, in his influential monograph of Italian anuran amphibians (Camerano, 1883)⁸, published a revised, more detailed treatment of the variability of green toads (as *B. viridis*), integrating the contributions of previous authors with his own observations. There, he finally described and named four “varietà”, all based on colour pattern only⁹.

variétés du Piémont. | *Sous-variété A.* - Parties supérieures claires (animaux dans l'alcool) avec des taches plus ou moins nombreuses d'une couleur verdâtre sombre, arrondies, isolées; parties inférieures avec quelques taches brunes (Perse, Sardaigne). | *Sous-variété B.* - Parties supérieures claires, taches olivâtres, sombres, évidentes et confluentes entre elles. Un nombre plus ou moins grand de tubercules sur le dos; sur les flancs et sur les extrémités (Sardaigne, Syrie). | *Sous-variété C.* - Parties supérieures d'une couleur brune, olivâtre obscur, taches très peu évidentes; parties inférieures avec des petites taches brunes (Perse). | *Sous-variété D.* - Parties supérieures brunes uniformément, taches tout à fait invisibles; parties inférieures sans taches (Perse, Erivan).” [= The colouration in this species is very variable. I do not report here about any variety but those coming from outside Piedmont, because professor Lessona, in the work I formerly quoted, treated already the varieties of Piedmont. | *Sub-variety A* – Light upper sides (animals in alcohol) with more or less numerous spots of greenish colour, rounded and isolate; ventral side with some brown dot (Persia, Syria). | *Sub-variety B* – Light upper sides, olive spots, dark, evident and merging into each other. A more or less large number of warts on the back, the sides and the limbs (Sardinia, Syria). | *Sub-variety C* – Upper sides of a dark brown-olive colour, spots poorly discernible; underside with small brown spots (Persia) | *Sub-variety D* – Upper sides even brown, spots completely invisible; lower parts without spots (Persia, Armenia)] (Camerano, 1882, p. 692).

⁸ Camerano's “Monografia degli anfibi anuri italiani”, first read at the Academy of Sciences of Turin in 1882, is often quoted as published either in 1883 (e.g., De Betta, 1885; Ninni, 1886a; Boulenger, 1898; Sindaco et al., 2006) or in 1884 (e.g., Gavetti and Andreone, 1993; Andreone and Sindaco, 1999; Bonato et al., 2007; Razzetti, 2008; Stöck et al., 2008a,b). This is because the work was published as both a stand-alone monograph in 1883 (page numbering: 1-100) and a journal article in 1884 (in the “Memorie della Reale Accademia delle Scienze di Torino”, Ser. II, Vol. XXXV: 187-287). Camerano himself quotes this work as published in 1883 in several following papers (Camerano, 1884, 1885, 1891), stating explicitly “uscita nel 1883” [= published in 1883] in one of them (Camerano, 1884, p. 3 [= 1885, p. 405]: another paper published twice in subsequent years). In fact, the “Memorie” were published usually at the end of each academic year (encompassing part of two calendar years), as a collection of the essays read at the Academy during that academic year (occasionally including essays from previous ones), which, however, had been already printed individually at the time of the reading (E. Borgi, pers. comm.). So, since “1883” appears the proper year of publication of the first available print of Camerano's anuran monograph, we recommend using this print when dealing with issues relevant for nomenclature and taxonomy.

⁹ “La colorazione del *Bufo viridis* è molto variabile, e non ho trovato nessuna varietà locale ben caratterizzabile. [...] Rispetto alla colorazione io credo si possano stabilire le seguenti varietà principali: || Var. *maculata*. – Parti superiori con macchie più o meno cospicue, più o meno numerose a contorni netti e di forma più o meno allungata o rotondeggiante; le macchie sono disposte irregolarmente. Questa varietà è assai frequente in tutte le località italiane; talvolta alcune delle macchie del dorso si uniscono per qualche tratto e pare tendano a formare come delle fasce longitudinali (qualche individuo di Modica-Sicilia). || Var. *crucigera*. | Sin. *Bufo crucigera*. Eichw. Zool. spec. Ross. et Polon., p. 167, 3 γ. | Il colore fondamentale tende al rosso, le macchie della nuca si incontrano in modo da formare grossolanamente una croce di S. Andrea. | Questa varietà è rara in Italia, io non l'ho osservata che in Piemonte (1). || Var. *lineata*. | Sin. *Bufo viridis* var. *lineata*. A. Ninni. Sulla supposta esistenza del *Bufo calamita* nel Veneto, ecc., Atti Inst. Venet., Ser. V, vol. V. | *Bufo viridis* var. *calamita* (2). Nardo, Prospetti sistemat. degli Anim. Prov. Ven., Atti R. Inst. Venet., sor. III, vol. V. p. 605. | *Bufo viridis* var. *F. Lessona*. Anfibi del Piemonte, Atti Acc. Lincei, ser. III, vol. I. | Macchie delle parti superiori più o meno numerose, rotondeggianti e talvolta più o meno confluenti: una linea dorsale mediana longitudinale più o meno ampia e più o meno regolare va dall'apice del muso all'ano; talvolta questa linea è interrotta da qualche macchia rotondeggiante. | Questa varietà che ha fatto credere a vari autori l'esistenza del vero *Bufo calamita* in varie località italiane, si trova frequente in Piemonte, nel Veneto, in Lombardia. Gli esemplari più belli io li ho avuti da Catania. || Var. *concolor*. | Sin. *Bufo viridis* var. *d.* Lessona, op. cit. | Color fondamentale bruno grigio uniforme; nessuna macchia

Of these four varieties, only one was first established and named in this paper (Camerano, 1883), the “var. *maculata*”, which was generically reported as very common everywhere in Italy, the single locality of Modica (Sicily) being cited only as the origin of some specimens bearing a peculiar colour pattern. According to Tortonese (1942), specimens from different Italian localities (Marcellise (Venetia), Florence, Modica (Sicily), Sardinia and Corsica) in the collections of the “Reale Museo Zoologico” of Turin were all attributed by Camerano to the variety *maculata*, although Elter (1982) and Gavetti and Andreone (1993) mentioned only three or four specimens labelled as “*maculata*” (all from Sardinia). Recently, however, the locality of Modica has been regarded as the single locality from where the variety *maculata* had been described (Balletto et al., 2007; Frost, 2009), which appears unjustified.

Following the resemblance first noticed by Lessona (1877), a second variety was identified by Camerano (1883) with the “var. *crucigera*” of Eichwald (1831), which the author observed only in Piedmont and considered rare within Italy. *Bufo variabilis* var. *crucigera* was described by Eichwald (1831) upon specimens from Astrakhan (southern European Russia) (see also: Kuzmin, 1999; Stöck et al., 2001); later on, Eichwald himself cited it in a binomen within a simple list of taxa (Eichwald, 1834, p. 31: “*bufo cruciger*, m.”; with the genus name oddly written in lower case), but in a further publication he reported it again unambiguously as a variety (Eichwald, 1840, p. 127: “Observavi Astrachani *varietatem crucigeram*” in the main text, and “var. *Bufo cruciger*” in an associated footnote). Although several subsequent authors cited this variety in binominal form, as either “*Bufo crucigera*” or “*Bufo cruciger*” (e.g.: Schreiber, 1875, 1912; Lessona, 1877; Camerano, 1883; Bedriaga, 1890; Nikolskii, 1918 [1963]), none seemed to foster in any way, explicitly or implicitly, species rank for this variety, *crucigera* being always reported explicitly as variety in the text, and as junior synonym of *Bufo viridis* (as such or as *Bufo variabilis*) in the synonymy lists. Thus, occasional binominal arrangement for *crucigera* seems due to misreading or misinterpretation of Eichwald’s (1831, 1834, 1840) works (see above) and not to any authors’ choice to properly treat this name at species rank. More recently, Kuzmin (1999) listed it also among the synonyms of *Bufo viridis viridis* Laurenti, 1768, as “*Bufo cruciger* Eichwald, 1831” (page 251) and “*Bufo variabilis crucigera* Eichwald, 1831” (p. 255), a conclusion acknowledged by Stöck et al. (2001).

sul dorso, sui fianchi, sulle zampe anteriori e sulle coscie, poche e poco distinte sulle gambe posteriori. Non ho osservato questa varietà, fino ad ora, che in Piemonte.” [= The colouration of *Bufo viridis* is very variable, and I did not find any well distinguishable local variety. [...] With respect to coloration, I think the following main varieties might be established: || Var. *maculata*. – Upper sides with spots more or less conspicuous, more or less numerous with distinct borders and more or less elongate or roundish in shape; spots are arranged irregularly. This variety is very common in all Italian localities; at times, some dorsal spots become partially coalescent, so that they appear forming longitudinal bands (some specimens from Modica-Sicilia). || Var. *crucigera*. | Sin. *Bufo crucigera*. Eichw. Zool. spec. Ross. et Polon., p. 167, 3 γ. | The background is reddish, the nuchal spots meet so as to shape roughly a St. Andrew’s cross. | This variety is rare in Italy, I could not observe it but in Piedmont (1). || Var. *lineata*. | Sin. *Bufo viridis* var. *lineata*. A. Ninni. Sulla supposta esistenza del *Bufo calamita* nel Veneto, etc., Atti Inst. Venet., Ser. V, vol. V. | *Bufo viridis* var. *calamita* (2). Nardo, Prospetti sistemat. degli Anim. Prov. Ven., Atti R. Inst. Venet., sor. III, vol. V. p. 605. | *Bufo viridis* var. *F*. Lessona. Anfibi del Piemonte, Atti Acc. Lincei, ser. III, vol. I. | Spots of the dorsal parts more or less numerous, roundish and sometimes more or less coalescent: a mid-dorsal longitudinal line, more or less wide and more or less regular, runs from the tip of the snout to the anus; sometimes this line is broken off by some roundish spot. | This variety, which led some authors to believe the existence of the true *Bufo calamita* in various Italian localities, it is frequently found in Piedmont, in Venetia, in Lombardy. I had the finest specimens from Catania. || Var. *concolor*. | Sin. *Bufo viridis* var. *d*. Lessona, op. cit. | Background uniformly grey-brown; no spots on the back, flanks, forelimbs and thighs, few and little marked [spots] on the hind limbs. So far, I could not find this variety but in Piedmont.] (Camerano, 1883, p. 49-50).

The third variety recognized by Camerano (1883) was the “var. *lineata*” of Ninni (1879), which he reported as common in Piedmont, Venetia and Lombardy, but evidently considered present also in other regions, as he explicitly stated to have received his finest specimens from Catania (Sicily).

Lastly, Camerano (1883) newly introduced the name “var. *concolor*” for the variety “*d*” of Lessona (1877) (doubtlessly the colour-based variety “*d*”, not the wart-based one), which he reported from Piedmont only. Likely due to the authorship of the description, Bedriaga (1890) erroneously credited to Lessona the name *concolor*. Later on, Nikolskii (1918 [1963]) cited this variety in a trinomen, “Camerano’s *Bufo viridis concolor*”, probably misquoting Camerano (1883) and only to remark that it “is nothing but a specimen of the usual *B. viridis* without spots” (see below).

According to Camerano (1883, p. 18), all specimens listed in the paper, numbering more than 1200 individuals and including 59 green toads, were deposited in the Italian vertebrates collection of the “R. Museo Zoologico” of Turin. Apparently, before the Second World War, most of those green toads were still recognizable within the collection of Italian amphibians and reptiles of the museum, as reported in a catalogue by Tortonese (1942). Unfortunately, the bombing of the museum in 1942, as well as some periods of missing cares, produced several damages to the fluid collections and many specimens were destroyed or had to be discarded (Tortonese, 1957). Today in fact, Italian specimens of “*Bufo viridis*” from the original collection of Camerano do not seem to exist anymore in the present-day Regional Museum of Natural Sciences in Turin, or either they cannot be confidently located, to the possible exception of some samples from Sardinia (Elter, 1982; Gavetti and Andreone, 1993; Balletto et al., 2007; Stöck et al., 2008b; F. Andreone, pers. comm.).

Acknowledging the conclusions of Camerano (1883), a subsequent check-list of Venetian anurans compiled by Ninni (1886a) mentioned three “varietà” of green toad (as *B. viridis*), namely *maculata* [sic], *lineata* and *concolor* (thus extending to Venetia the range of the latter variety). For the description of all anuran varieties reported in this paper, including *lineata*, the author explicitly referred the reader to the works of Lessona and Camerano (Ninni, 1886a).

During the 20th century, attention was paid only rarely to these varieties. Most surprisingly, in a paper on the morphological variability of *Bufo viridis* and other Mediterranean toads, amazingly rich of morphometric data, Camerano (1904) himself did not mention at all the four varieties he had described two decades earlier.

In the second edition of his *Herpetologia Europaea*, however, Schreiber (1912) reported a short diagnosis for the “*typus*” of *Bufo viridis*, followed by four varieties, unnamed and listed in alphabetical order (“a” through “d”), each distinguished upon colour pattern or morphological traits¹⁰. Particularly, varieties “a”, “b” and “c” were clearly derived from three of the varieties reported by Camerano (1883), namely *crucigera*, *lineata* and *concolor*

¹⁰ Typus: *Supra sordide grisescens vel albidus, maculis viridibus lemniscatis variegatus* || var. a) *Maculis obscuris in cervicibus decussatim confluentibus.* | *Bufo crucigera*. Eichw. Zool. spec. Ross. et Polon. pag. 167, 3, γ (1831). || var. b) *Dorso linea vertebrali flavescente.* | *Bufo viridis* var. *lineata* Ninni Sulla susp. esist. d. *Bufo calam.* n. Veneto. Atti Inst. Venet. Ser. V vol. V. – *Bufo viridis* var. *calamita* Nardo Prospetti sistem. d. Anim. Prov. Ven. Atti Inst. Ven. ser. III, vol. V, pag. 605. – *Bufo viridis* var. F. Lessona Anf. d. Piem. Atti Acc. Lin. ser. III, vol. I. || var. c) *Supra griseo-fuscescens, concolor.* *Bufo viridis* var. d. Lessona l. c. – *Bufo viridis* var. *concolor* Camerano Anf. an. ital. pag. 50 (1883). || var. d) *Membrana natatoria plantarum distinctissima, fere integra.* *Bufo variabilis* var. *balearica*. Boettg. Zoolog. Anzeig. Nr. 72 (1880). (Schreiber, 1912; p. 218).

(*maculata*, possibly identified with the “*typus*”, was not mentioned); varieties “b” and “c” were reported as exclusive of northern Italy, whereas “a” was referred to the whole south-eastern Europe (Schreiber, 1912; p. 220). The fourth variety (“d”) was identified with the “var. *balearica*” of Boettger (1880). The same are also listed in the systematic synopsis at the end of the volume as “v. *cruciger* Eichw.”, “v. *lineatus* Ninni”, “v. *concolor* Cam.” and “v. *balearicus* Boettg.” (Schreiber, 1912; p. 915), but are again recalled through alphabetical letters only in the next year’s supplement (Schreiber, 1913; p. 12).

The varieties of Camerano (1883) were mentioned also by Vandoni (1914), who erroneously credited all four to the first author, still as mere chromatic varieties and without making reference to their geographical distribution¹¹. Instead, a green toad specimen was reported by Paolucci (1915) as “*Bufo maculata*” in the catalogue of his herpetological collection (n. 7), now in the “Museo Paolucci” of Offagna (Ancona). However, the original jar label of this specimen reports “*Bufo viridis* var. *maculata* | Trasimeno” (V. Caputo, pers. comm.), suggesting, together with other mistakes (e.g.: many species names are wrongly credited to Linnaeus), that the name was reported erroneously in the paper by the author or the printer (Paolucci, 1915).

Nikolskii (1918 [1963]), in his “comparative notes” on green toads¹², stated explicitly that “there are no varieties of the green toad” and, among others, regarded “Camerano’s *Bufo viridis concolor*” as mere unspotted individuals of the proper *B. viridis*. The same author, however, seems somehow to acknowledge taxonomic status to “*Bufo viridis balearicus* Boettg.”, as based upon precise anatomical features. Oddly, in the “notes”, the varieties just mentioned are reported as trinomia, whereas a third one (*crucigera*) is cited as “*Bufo crucigera*”. The synonymy list of the same paper, however, reports the latter as “*Bufo viridis* var. *crucigera*” and does not mention at all the other two varieties (Nikolskii, 1918 [1963]; p. 73).

Later on, Mertens and Wermuth (1960) listed “1831 *Bufo variabilis* var. *crucigera* Eichwald” (*terra typica*: streets of the city of Astrakhan), “1879 *Bufo viridis* var. *lineata*

¹¹ “Esse possono essere distinte e isolate (var. *maculata* Camer.), qualche volta confluenti, talora disposte in modo da formare sulla regione nuco-scapolare una croce (var. *crucigera* Camer.) Delle punteggiature rosse sono sparse sui fianchi e sulle cosce; tanto queste che le macchie verdi possono mancare od essere appena accennate (var. *concolor* Camer.). [...] In certi individui si può notare una sottile striscia gialla decorrente lungo la colonna vertebrale (var. *lineata* Camer.). Questo carattere ha fatto credere a molti che gli individui italiani appartenessero alla specie *calamita* Laur: questa in realtà è assai affine alla forma presente, ma in Italia non è ancora stata rinvenuta.” [= They [the spots] may be distinct and isolated (var. *maculata* Camer.), sometimes coalescent, sometimes arranged so as to shape a cross on the nuchal-scapular region (var. *crucigera* Camer.). Some red dots are scattered on the flanks and the thighs; these dots as well as the green spots can be absent or barely distinguishable (var. *concolor* Camer.). [...] In some specimens a yellow narrow stripe can be seen running along the vertebral column (var. *lineata* Camer.). This character induced many authors to believe that the Italian specimens bearing it were belonging to the species *calamita* Laur: actually, this [latter species] is very similar to the present form, but it has not been found yet in Italy.] (Vandoni, 1914, p. 73).

¹² COMPARATIVE NOTES. Despite its wide distribution, there are no varieties of the green toad. It is true that some zoologists have tried to establish the existence of such varieties, but the only differences found in the specimens taken were in the colour. However, the colour of this toad varies to such a degree that one can hardly find even two specimens of the same colour. Pallas, with good reason, called it *Bufo variabilis*. Under the name *Bufo crucigera* Eichwald describes specimens in which the spots of the back are shaped like a St. Andrew’s cross. Merrem* described specimens, with rose coloured spots on the back, which he termed *Bufo roseus*. Camerano’s** *Bufo viridis concolor* is nothing but a specimen of the usual *B. viridis* without spots, while only *B. viridis balearicus* Boettg.*** is clearly characterised in that the toes of the forelegs are clearly webbed. (Nikolskii, 1918 [1963], p. 77).

Ninni” (*terra typica*: Venetia) and “1883 *Bufo viridis* var. *concolor* Camerano” (*terra typica*: Piedmont) only as synonyms of *Bufo viridis viridis*; like Schreiber (1912), they did not mention the var. *maculata*.

More recently, Paolucci et al. (1999) quoted the varieties *maculata* and *concolor* for Abruzzo (central Italy) from “Altobello [1930]”, an unpublished catalogue of G. Altobello’s amphibian collection (Bruno and Guacci, 1993; C. Guacci, pers. comm.). Then, inexplicably, after reporting literally Camerano’s descriptions for the two above-mentioned varieties, the authors claimed Camerano (1883) to have left a “nomenclatural gap” by not providing a name for the variety he had referred to both Nardo’s “var. *calamita*” and Lessona’s “var. *F*”¹³. While not mentioning at all the name *lineata* of Ninni (1879), clearly acknowledged by Camerano (1883) for the dorsally striped variety, these authors, or more likely S. Bruno alone (see also: Razzetti and Sindaco, 2006; Razzetti, 2008), suggested instead the new name “var. *nardo*”, dedicated to G.D. Nardo. The status of this latter variety has been discussed by Razzetti (2008), who recognized its unavailability. However, he erroneously related “*nardo*” to *Bufo siculus* Stöck, Sicilia, Belfiore, Buckley, Lo Brutto, Lo Valvo and Arculeo, 2008, whereas the name was clearly proposed as a substitute for the Italy-wide distributed variety *lineata*.

Lastly, Stöck et al. (2006) identified significant molecular divergence between a taxon inhabiting the Italian peninsula south of the Po basin, a small part of Sicily, Corsica and

¹³ “A questo punto è forse doverosa la seguente precisazione per colmare un vuoto nomenclatoriale lasciato, inspiegabilmente, dallo zoologo piemontese [L. Camerano, cit., 233-234, nota (2) di 233]: | “*Bufo viridis* var. *calamita* (2). Nardo, Prospetti sistemat. degli Anim. Prov. Ven., Atti R. Inst. Venet., ser. III, vol. V, p. 605. | “*Bufo viridis* var. *F* Lessona, *Anfibii del Piemonte*, Atti Acc. Lincei, ser. III, vol. I. | “Macchie delle parti superiori più o meno numerose, rotondeggianti e talvolta più o meno confluenti: una linea dorsale mediana longitudinale più o meno ampia e più o meno regolare va dall’apice del muso all’ano; talvolta questa linea è interrotta da qualche macchia rotondeggiante. | “Questa varietà ha fatto credere a vari autori l’esistenza del vero *Bufo calamita* in varie località italiane, si trova frequente in Piemonte, nel Veneto, in Lombardia. Gli esemplari più belli io li ho avuti da Catania”. | Inoltre, sempre nella nota (2), L. Camerano precisa: “È molto probabile, come dice il NINNI nell’opera sopra menzionata [“Sulla supposta esistenza del *Bufo calamita* nel Veneto, ecc., Atti Inst. Venet, Ser. V, vol. V], che il NARDO, abbia considerato come appartenente alla var. *calamita* (così allora si considerava il *Bufo calamita* propriamente detto) gli esemplari del Veneto aventi una linea dorsale longitudinale chiara. Non possiamo, per ragioni di chiarezza, conservare alla varietà in questione del *Bufo viridis* il nome del Nardo”. | Di conseguenza: dal momento che L. Camerano ha chiamato *concolor* la var. *d* del Lessona (*1877) perché, dopo le sue giuste riserve in nota (2), non ha dato una denominazione, nomenclatoriamente attendibile, anche alla var. *F* del Lessona? A nostro avviso, fermo restando i presenti quali parametri della questione, riteniamo che il suo appellativo storiograficamente più appropriato possa essere quella di *Bufo viridis* varietà *nardo*.” [= At this point, perhaps, the following clarification is needed to fill a nomenclatural gap left, inexplicably, by the Piedmontese zoologist [L. Camerano, cit., 233-234, note (2) of 233]: | “*Bufo viridis* var. *calamita* (2). Nardo, Prospetti sistemat. degli Anim. Prov. Ven., Atti R. Inst. Venet., ser. III, vol. V, p. 605. | “*Bufo viridis* var. *F* Lessona, *Anfibii del Piemonte*, Atti Acc. Lincei, ser. III, vol. I. | “Spots of the dorsal parts more or less numerous, roundish and sometimes more or less coalescent: a mid-dorsal longitudinal line, more or less wide and more or less regular, runs from the tip of the snout to the anus; sometimes this line is broken off by some roundish spot. | “This variety led some authors to believe the existence of the true *Bufo calamita* in various Italian localities, it is found frequently in Piedmont, in Venetia, in Lombardy. I had the finest specimens from Catania.” | Moreover, still in the note (2), L. Camerano clarify: “It is very likely, as Ninni says in the above mentioned publication [“Sulla supposta esistenza del *Bufo calamita* nel Veneto, ecc., Atti Inst. Venet, Ser. V, vol. V”], that Nardo has regarded the Venetian specimens bearing a light longitudinal dorsal line as belonging to the var. *calamita* (so it was considered, at that time, the proper *Bufo calamita*). For the sake of clarity, we cannot keep the name of Nardo for the variety of *Bufo viridis* in question”. | Therefore: since L. Camerano called *concolor* the variety *d* of Lessona (*1877), why, after expressing his proper reservation in the note (2), did he not give a nomenclaturally reliable name to Lessona’s variety *F* as well? In our view, we think that the name historiographically most appropriate could be that of *Bufo viridis* variety *nardo*.] (Paolucci et al., 1999, p. 30).

Sardinia, as well as the Balearic Islands, and other green toads (as *Bufo viridis viridis*), which were recognized only in north-east Italy (Padua and Trieste) and further north and east in Europe. The clustering of NE-Italian specimens (not including samples from Venice, however) with *Bufo viridis* led Stöck et al. (2006, 2008b) to discard the name *lineata* of Ninni (1879) for the Italian green toad, which they considered junior synonym of *Bufo viridis viridis* Laurenti, 1768. Instead, since their samples from the rest of Italy (to the exception of most of Sicily) clustered with those from the Balearic Islands, they proposed for the Italian species the name *Bufo balearicus* Boettger, 1880, from *Bufo viridis balearicus*, the subspecies currently recognized in the Balearic Islands (Pons and Palmer, 1996; García-París et al., 2004; Pleguezuelos et al., 2004). This latter taxon, originally described by Boettger (1880) as “*Bufo variabilis* Pall. var. *balearica*” upon specimens from Mallorca and Minorca, and for which a lectotype was selected by Mertens (1967), was raised to subspecies rank by Hemmer et al. (1981) on the basis of serological and bioacoustical results. However, since the latter authors did not provide a detailed taxonomic analysis and the validity of the variety had been questioned by Vidal-Celma (1965) and Vidal (1966) on morphological ground, several subsequent authors regarded this subspecies as doubtful (e.g.: Roth, in Gasc et al., 2004; Lanza et al., 2006; Bologna and Giacoma, in Sindaco et al., 2006; Balletto et al., 2007). It is worth noting, however, that the sample of “*Bufo viridis viridis*” that Vidal (1966) compared to his Balearic specimens included also individuals from Sardinia and Venice. In addition to Stöck et al. (2006, 2008b), strong phylogenetic affinities of the ssp. *balearicus* with the green toads of Corsica and Sardinia were also reported by Hemmer et al. (1981), who also proposed a Bronze-age human introduction of green toads into the Balearic islands from the Tyrrhenian islands, and Batista et al. (2006).

About the same time, the name *lineata* was resurrected and elevated to species rank by Balletto et al. (2007), as “*Bufo lineatus* Ninni, 1879”. This name was adopted by the authors following the claimed results of molecular analyses, so far unpublished, that revealed the occurrence in most of Italy, including Sardinia and Corsica, of a taxon different from *Bufo viridis* Laurenti, 1768, inhabiting most of Europe and that they restricted, within Italy, to Friuli-Venezia Giulia only (Balletto et al., 2000, 2007). Although Balletto et al. (2007) did not specified whether or not the molecular evidences they quoted (“Cervella et al., unpublished” and “Lattes et al., unpublished”: p. 297, 300) included in fact specimens from Venice or its surroundings, samples from the nearby island of Pellestrina were used at least for some analyses (E. Balletto, pers. comm.; also suggested by previous papers: Castellano and Giacoma, 1998; Balletto et al., 2000). On a pure nomenclatural ground, Balletto et al. (2007) apparently took for granted that the name *lineata* was available since its original introduction by Ninni (1879), possibly due to its recurrent presence in the synonymy lists of many papers (e.g.: Mertens and Wermuth, 1960), as did likely Lanza et al. (2007b) as well (but see also Lanza et al., 2009: p. 394). In fact, they labelled the species name as “*Bufo lineatus* Ninni, 1879 *status novus*” (Balletto et al., 2007, p. 299), did not provide any comment on its nomenclatural status and identified the main locality cited by Ninni (1879) as the type locality of the taxon, although in generic terms¹⁴. Despite the explicit indication of a type locality and the possible indication of a deposi-

¹⁴ “*Locus typicus*: “vicino a Venezia” (in Museo Civico di Storia Naturale di Venezia).” [= Type locality: “near Venice” (in the Civic Museum of Natural History of Venice)] (Balletto et al., 2007, p. 299).

tory for the type material, however, Balletto et al. (2007) did not make explicit reference to a holotype or syntypes, neither in general to Ninni's original specimens (that they did not check), so that their species account stands just as a taxonomical change of status and cannot be considered a valid description of a new taxon, according to the ICZN.

Nomenclatural availability of names

calamita – Originally coined by Laurenti (1768, pp. 27 and 119) as “*Bufo calamita*”. A clearly available name under the provisions of the ICZN, however coined for a species belonging to a fully different lineage and that entered the present context due to misidentification.

crucigera – Originally coined by Eichwald (1831, p. 167) as “Var. γ . *crucigera*” of *Bufo variabilis* (formerly regarded as junior synonym of *B. viridis*, but see Stöck et al., 2006, 2008a). Available under the provisions of the ICZN, as it was introduced following a binomen as a “variety”, the author did not expressly give it otherwise infrasubspecific rank, neither the content of the work unambiguously reveal infrasubspecific status (ICZN: 45.6.4), and it was introduced accompanied by a description (ICZN: 12.1). Type material: not stated. Type locality: the city of Astrakhan, Russia (Eichwald, 1831, 1840; Mertens and Wermuth, 1960; Kuzmin, 1999; Frost, 2009).

acutirostris – Originally coined by Lessona (1877, pp. 1087) as “forma *acutirostris*” of *Bufo viridis*. Not available under the provisions of the ICZN, as it was introduced for an entity whose infrasubspecific status is unambiguously revealed by the content of the work (ICZN: 45.5, 45.6.1, 45.6.4) and – at the best of our knowledge – it was neither adopted as the valid name of a species-group taxon or treated as a senior homonym before 1985 (ICZN: 45.6.4.1). Evidence for infrasubspecific status from the content of the original publication (Lessona, 1877): i) *acutirostris* is not indicated as restricted to localities or areas; ii) *acutirostris* is distinguished based on a single character only, whereas different varieties are distinguished in the same species following two other fully independent classifications based on different, unrelated characters; iii) the same name *acutirostris* is used in many other species to distinguish a form based on the same character; iv) among the other species in which a homonymous form is distinguished, that form is sometimes associated to sex or growth stage, in no case clearly suggesting a possible subspecific status.

obtusirostris – Originally coined by Lessona (1877, pp. 1087) as “forma *obtusirostris*” of *Bufo viridis*. Not available under the provisions of the ICZN, as it was introduced for an entity whose infrasubspecific status is unambiguously revealed by the content of the work (ICZN: 45.5, 45.6.1, 45.6.4) and – at the best of our knowledge – it was neither adopted as the valid name of a species-group taxon or treated as a senior homonym before 1985 (ICZN: 45.6.4.1). Evidence for infrasubspecific status from the content of the original publication (Lessona, 1877): the same listed for *acutirostris* (see above).

lineata – Originally coined by Ninni (1879, p. 973) as “varietà [...] *lineata*” of *Bufo viridis*. Not available under the provisions of the ICZN, as it was introduced for an entity whose infrasubspecific status is unambiguously revealed by the content of the work (ICZN: 45.5, 45.6.1, 45.6.4) and – at the best of our knowledge – it was neither adopted as the valid name of a species-group taxon or treated as a senior homonym before 1985 (ICZN: 45.6.4.1). Evidence for infrasubspecific status from the content of the original publication

(Ninni, 1879): i) *lineata* was explicitly coined for one of the alternative chromatic phenotypes previously described by Lessona (1877), who did not name them and treated them as merely infrasubspecific entities without any reasonable doubt; ii) no consideration of taxonomic relevance is made by Ninni other than providing a name for *lineata* and extending its range to Venetia; iii) *lineata* is not reported as restricted to localities or areas, neither to be present as the exclusive variety in some localities or areas; iv) *lineata* is reported with different frequency among different subsets of the population related to sex and growth stage, tadpoles being especially not reported as *lineata*. The elevation to species rank by Balletto et al. (2007) did not confer availability to the name (ICZN: 45.5.1, 16.1, Recommendation 16A) neither it has to be taken as the introduction of an available new name, as it was not accompanied by the explicit fixation of a holotype or syntypes (ICZN: 16.4.1, 72.3).

balearica – Originally coined by Boettger (1880, p. 642) as “var. *balearica*” of *Bufo variabilis* (formerly regarded as junior synonym of *B. viridis*, but see Stöck et al., 2006, 2008a). Available under the provisions of the ICZN, as it has been introduced following a binomen as a “variety”, the author did not expressly give it otherwise infrasubspecific rank (other than as above), neither the content of the work unambiguously reveal infrasubspecific status (ICZN: 45.6.4), and it has been established accompanied by a description (ICZN: 12.1). Moreover, should *balearica* be demonstrated as originally established for an infrasubspecific entity, it is nevertheless to be considered subspecific from its original publication as it has been adopted as a valid subspecies before 1985 (ICZN: 45.6.4.1). The availability of *balearica* was already recognized by Stöck et al. (2006, 2008b) and Razzetti (2008). Type material: lectotype: SMF 3722 (formerly: 1297, 1a), paralectotype: SMF 3726 (Mertens, 1967; L. Acker, pers. comm.), in the Senckenberg Forschungsinstitut und Naturmuseum (Frankfurt, Germany). Type locality: Majorca and Minorca, Balearic Islands (Boettger, 1880), restricted to Palma (Majorca, Balearic Islands, Spain) by lectotype designation (Mertens, 1967).



Fig. 1. Specimens of the green toad upon which Ninni (1879) established the variety *lineata*, from the collections of the Museum of Natural History of Venice (Italy): (A) MSNVE-848, with label “*B. viridis* | v. *lineata* Nin. | Venezia VII 1879”; (B) MSNVE-952, with label “*Bufo viridis* | var. *lineata*. Venezia.” (photo: N. Novarini).

maculata – Originally coined by Camerano (1883, p. 49) as “Var. *maculata*” of *Bufo viridis*. Not available under the provisions of the ICZN, as it was introduced for an entity whose infrasubspecific status is unambiguously revealed by the content of the work (ICZN: 45.5, 45.6.1, 45.6.4) and – at the best of our knowledge – it was neither adopted as the valid name of a species-group taxon or treated as a senior homonym before 1985 (ICZN: 45.6.4.1). Evidence for infrasubspecific status from the content of the original publication (Camerano, 1883): i) the “varietà” is considered an infrasubspecific rank by the author, as clarified by the taxonomic treatment of other species, for which he distinguished between “sottospecie” (subspecies) and “varietà” (variety), sometimes clearly citing a variety hierarchically under a subspecies; ii) *maculata* is not reported as restricted to localities or areas, neither to be present as the exclusive variety in any locality or area. Moreover, should *maculata* be deemed specific or subspecific from its original publication, it would become a primary junior homonym of *Bufo maculatus* (Hallowell 1854), being permanently invalid (ICZN: 57.2). The unavailability of the name has been already recognized by Stöck et al. (2008b, Add. file 2) and registered by Razzetti (2008).

concolor – Originally coined by Camerano (1883, p. 50) as “Var. *concolor*” of *Bufo viridis*. Not available under the provisions of the ICZN, as it was introduced for an entity whose infrasubspecific status is unambiguously revealed by the content of the work (ICZN: 45.5, 45.6.1, 45.6.4) and – at the best of our knowledge – it was neither adopted as the valid name of a species-group taxon or treated as a senior homonym before 1985 (ICZN: 45.6.4.1). Evidence for infrasubspecific status from the content of the original publication (Camerano, 1883): i) the “varietà” is considered an infrasubspecific rank by the author, as clarified by the taxonomic treatment of other species, for which he distinguished between “sottospecie” (subspecies) and “varietà” (variety), sometimes explicitly citing a variety hierarchically under a subspecies; ii) *concolor* is explicitly considered identical to one of the alternative chromatic phenotypes previously described by Lessona (1877), who did not name them and treated them as merely infrasubspecific entities without any reasonable doubt. The unavailability of the name *concolor* has been already recognized by Stöck et al. (2008b, Add. file 2).

nardoi – Originally introduced in Paolucci et al. (1999, p. 30) as “varietà *nardoi*” of *Bufo viridis*. Not available under the provisions of the ICZN, as it was introduced after 1960 for an infrasubspecific entity (ICZN: 45.5, 45.6.3). The unavailability of the name has been already recognized and discussed by Razzetti (2008).

The original specimens of Bufo viridis var. lineata

Ninni (1879) stated that he had found green toad specimens bearing a dorsal line inside the city of Venice and, while collecting tadpoles in June 1879, apparently in the same place, he obtained some young metamorphosed individuals bearing the same pattern, about 3 cm long. Upon these specimens he established the variety *lineata*. He also stated to have observed specimens of this variety in the provinces of Padua and Treviso as well, but did not mention any collecting from these localities. All the collected specimens belonging to this variety were donated by Ninni himself to the civic Museum of Venice, as part of a larger herpetological collection including the above-mentioned tadpoles and a specimen of *Chelonia mydas* caught near Venice.

The herpetological collection of A. P. Ninni still exists in the present Museum of Natural History of Venice (MSNVE), which inherited the zoological collections of the former “Museo Civico e Raccolta Correr”. Ninni’s collection, which was donated to that museum in several subsequent lots, was ordered and catalogued first by the contemporary natural-

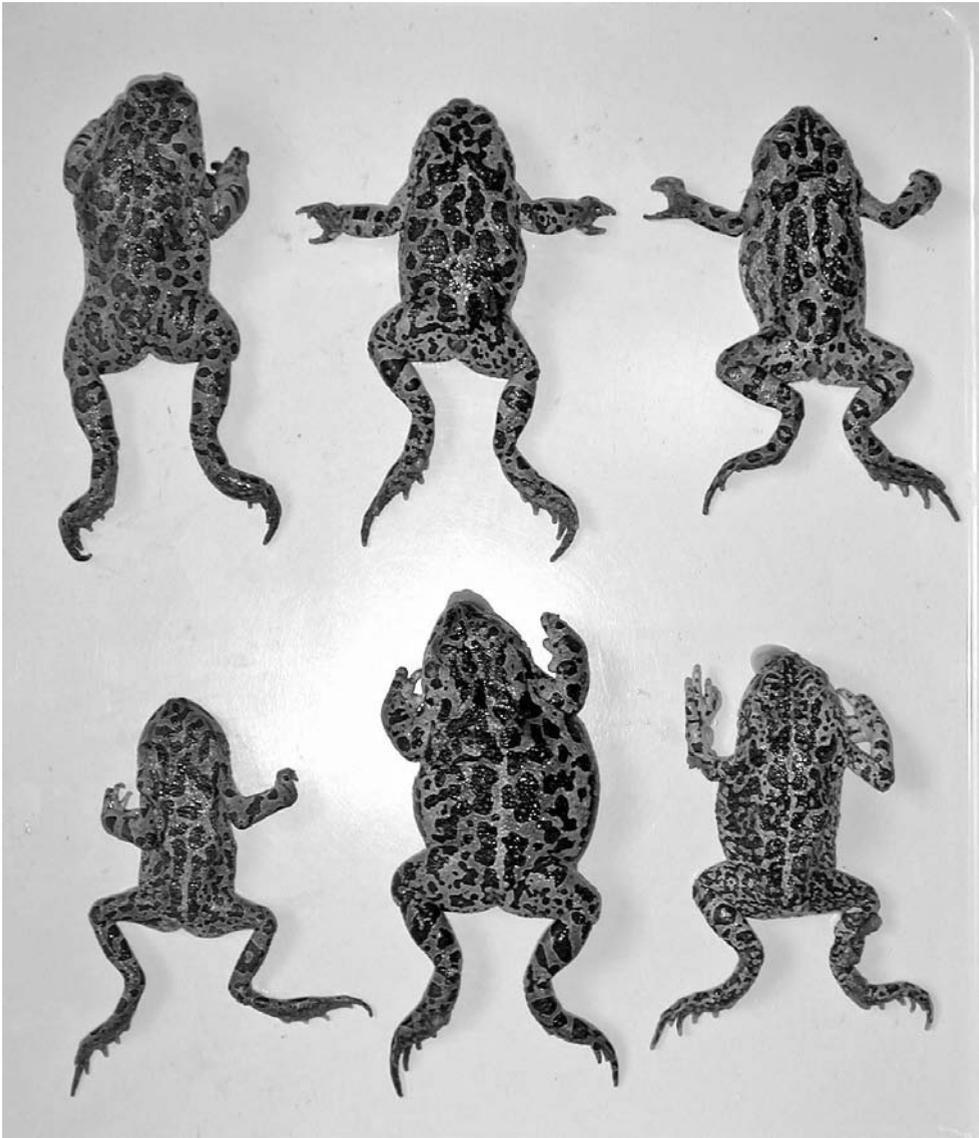


Fig. 2. Green toads (MSNVE-19319) from one of the extant populations inhabiting the city of Venice, in the outdoor spaces of “The Venice Biennale” (specimens found dead near breeding site, April 2008) (photo: N. Novarini).

ist Giuseppe Scarpa of Treviso, at the end of the 19th century, then by A. P. Ninni's son Emilio Ninni, who reorganized his father's collections after the foundation of the MSNVE in 1923, and possibly again by other museum technicians and curators at later times (Levi-Morenos, 1897; Scarpa, 1897; Anon., 1930; Novarini, in press).

In the present-day fluid collection of the museum, all what remains of the original material upon which Ninni described the variety *lineata* can be confidently recognized in five specimens. These are all metamorphosed juveniles (total length = 26.9-30.3 mm), and are preserved in two small jars identified as MSNVE-848 and MSNVE-952 respectively. MSNVE-848 contains 3 specimens and is labelled "*B. viridis* | v. *lineata* Nin. | Venezia VII 1879" (Fig. 1a), whereas MSNVE-952 contains 2 specimens and is labelled "*Bufo viridis* | var. *lineata*. Venezia" (Fig. 1b). All five specimens are sufficiently well preserved to be



Fig. 3. Specimen of green toad found in the small urban wood "Bosco dell'Osellino" in Mestre, about 6 km NW of Venice, in spring 2008 (photo: N. Novarini). Arrows point to a well visible, very thin dorsal line.

unambiguously recognizable as green toads of the *Bufo viridis* subgroup, although they are largely discoloured and their dorsal pattern is barely distinguishable.

Even though the two jars are not identified by any of the labels usually attached to Ninni's specimens (i.e.: bearing "Raccolta A.P. Ninni", in print) and their labels have different origin, both jars can be assigned confidently to Ninni's herpetological collection, as the original material upon which the variety *lineata* was established, on the basis of the following evidences: i) after a comparison of the label handwritings with documents signed by A.P. Ninni held in the Museum library, the label of MSNVE-848 (the most informative one, bearing also the date of collection) can be confidently attributed to A.P. Ninni, whereas the other label may have been compiled later by his son E. Ninni; ii) both labels report explicitly the variety name "*lineata*", whereas no other specimens currently present in the collections of the Museum, at either adult, young or larval stage, bear the same name; iii) both labels report "Venezia" as collection locality, which is consistent with Ninni (1879); iv) the body length of all specimens is congruent with that reported by Ninni (1879) for the specimens he collected; v) no other specimens compatible with the information given by Ninni (1879) are present in the Museum of Venice.

A minor discrepancy can be noticed, however, between the date of collection written on one of the jar labels (the other bearing no date), July 1879, and that reported by Ninni (1879) in the paper, June 1879. Both having been written by the collector himself, we cannot rule out that the apparent difference may be due to a *lapsus calami* in the label or to a typographical error in the paper.

In a following paper, Ninni (1886a) reported also the collection of tadpoles of *B. viridis* (unspecified variety), at different developmental stages, from the Lido di Venezia island on June 28th 1879. This might imply that the specimens mentioned in Ninni (1879) may have been actually collected in the neighbouring island of Lido, instead of Venice, although it is far more probable that the author had been collecting in both islands (just a few kilometres apart) during that June. A few jars containing tadpoles of *B. viridis*, apparently from the 19th century, are actually present in the Museum of Venice but, bearing no data at all, they cannot be reliably identified as those collected by Ninni in June 1879, neither they can be confidently assigned to Ninni's collection in general.

It is also worth noting that no samples referred to *B. viridis* var. *lineata* are present in other collections to which A.P. Ninni is known, or suspected, to have contributed samples (Novarini, in press), including the collection of G. Scarpa in the "Museo G. Scarpa" of Treviso (pers. obs.; also G. Zanata, pers. comm.), despite the close friendship and documented exchanges of specimens between the two naturalists (Scarpa, 1882; Carraro, 1933), the collection of E. De Betta in the "Museo civico di Storia Naturale" in Verona (Mauci, 1971; R. Salmaso, pers. comm.) and that of L. Camerano in the "Museo Regionale di Scienze Naturali" in Turin (Tortonese, 1942; Elter, 1982; Gavetti and Andreone, 1993; F. Andreone, pers. comm.), both frequently engaged in sample exchanges with Ninni as well, neither among the collections of the natural history museums of Vienna (H. Grillitsch, pers. comm.), Pavia (E. Razzetti, pers. comm.), Genoa (Doria et al., 2002), Domodossola (largely contributed by Camerano; Andreone et al., 2005) and Padua (B. Centis, unpubl.).

Recently, the geographical provenance of the specimens upon which Ninni established the variety *lineata* has been sometimes reported as "vicino a Venezia" (near Venice) (Balletto et al., 2007; Frost, 2009). The use of quotation marks seems to imply a literal cita-

tion, possibly from Ninni (1879) where, however, the author expressly indicated the city of Venice, not its vicinity, as the collecting place, which is also confirmed by the jars labels of the putative voucher specimens. Actually, the exact wording “vicino a Venezia” does appear in the relevant footnote of Ninni (1879), however, it is not referred to specimens of green toads but to the mentioned individual of *Chelonia mydas*.

At present, within the present-day historical centre of Venice, at least two populations of green toads still survive, but at the end of the 19th century the city was less urbanized and the species may have been more widespread. The two extant populations are located one in the gardens of “The Venice Biennale” and the other in the nearby island of Giudecca (Novarini, 2005); Venice itself being a system of islands, both populations appear fairly isolated. Several other populations are present in adjacent islands, still within the present borders of the Venice municipality, e.g.: Sant’Erasmus, Murano, Mazzorbetto, Lido di Venezia and Pellestrina, as well as in the neighbouring mainland of Mestre and Marghera (Novarini, 2005, 2006).

Mid-dorsally striped specimens can still be found in many of these populations, together with non-striped individuals. In general, when present, the stripe appears more often the result of the arrangement of the green spots, which tend to merge lengthwise into two paramedian bands leaving a light vertebral area in between (Fig. 2), rather than a true stripe. Nevertheless, some individuals actually show a poorly defined mid-dorsal stripe, sometimes just a very thin line (Fig. 3), slightly lighter than the background, apparently unrelated to green spots arrangement and that appears more evident especially during the aquatic phase (pers. obs.).

CONCLUSIONS

Among the names so far applied to varieties, or other infrasubspecific entities, of green toads of the *Bufo viridis* subgroup inhabiting the Italian territory, our evaluation of relevant published works revealed that only *crucigera*, coined by Eichwald (1831), and *balearica* coined by Boettger (1880), are available names under the provisions of the ICZN. However, *crucigera* Eichwald, 1831, which was established for specimens from the northwestern coast of the Caspian Sea (type locality: the city of Astrakhan) and was later applied by Camerano (1883), at clearly infrasubspecific rank, to indicate an apparent chromatic phenotype of some Italian populations, is now recognized as junior subjective synonym of *Bufo viridis* Laurenti, 1768 (Kuzmin 1999, Stöck et al. 2001, Frost, 2009). Instead, *balearica* Boettger, 1880, which was already in use for the Balearic subspecies of *B. viridis* (type locality: Palma, Majorca), has been recently identified as the valid name for the newly detected species *B. balearicus* (Stöck et al., 2006, 2008a, b).

Conversely, the names *acutirostris* and *obtusirostris* introduced by Lessona (1877), *lineata* introduced by Ninni (1879), *concolor* and *maculata* introduced by Camerano (1883) and *nardoi* introduced by Paolucci et al. (1999) are all not available within the meaning of the ICZN. Therefore, irrespective of any taxonomic opinion, the recently proposed adoption of the name *lineata* of Ninni (1879) for a newly recognized species appears inappropriate on a pure nomenclatural ground.

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