



On the validity of the recently described northern green anaconda *Eunectes akayima* (Squamata, Serpentes)

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Abstract

Recently, a taxonomic work was published concerning the existence of a new cryptic species of green anaconda. The authors justified the recognition of a phylogenetic lineage as a new species, which they named *Eunectes akayima*, based on genetic and geographical distribution differences. Regardless of whether the evidence provided to justify the recognition of this new species is sufficient, the article in question violates fundamental aspects of the *International Code of Zoological Nomenclature*, such as the principle of priority and the rules for the designation of lectotypes. Furthermore, the authors make unjustified assumptions regarding the type locality of *Eunectes murinus*, compromising the integrity of their nomenclatural actions. Here, we present a critique of this work grounded in the application of the rules of zoological nomenclature, leading to the synonymizing of the recently described species.

Key words

International Code of Zoological Nomenclature, nomenclature, synonymy, lectotype, taxonomy, *Eunectes*, anacondas, South America.

1. Introduction

In a recent publication by Rivas *et al.* (2024), the authors explored the phylogenetic relationships within the boid genus *Eunectes*, commonly known as anacondas. As part of their results, the green anaconda *Eunectes murinus* Linnaeus, 1758 was split into two different species, maintaining the Linnaean name for a clade denoted as southern and establishing *Eunectes akayima* Rivas *et al.*, 2024, for the clade denoted as northern. Setting aside other considerations about the species description and

naming, we want to comment on the validity of the new species name based on the application of the *International Code of Zoological Nomenclature* (Anonymous 1999; hereafter the *Code*) and the uncertainty about the type locality of *E. murinus*.

Our primary concern with the actions of Rivas *et al.* (2024) pertains to the determination of the type locality of *Eunectes murinus* and the challenge of describing a new species when there is uncertainty in determining to which of two lineages the existing nomen, *E. murinus sensu stricto*, applies. In this case, as was common for many specimens described by Linnaeus, its type locality was mentioned only as “America”. Rivas *et al.* (2024) were aware of this situation and dedicated a section of their discussion to this issue. However, despite the authors’ explicit statement that *E. murinus* and their newly described species, *E. akayima* cannot be differentiated on the basis of external morphology, and their recognition of the uncertainty as to which of the two lineages should be associated with the former name, they assigned it to their southern clade “because of its larger distribution and for historical reasons” (Rivas *et al.* 2024: 17).

2. Critique of Rivas *et al.* (2024)

Regarding the first point, Rivas *et al.* (2024) expect that *Eunectes akayima* will occupy a relatively smaller range in the westernmost part of the distribution of *E. murinus sensu lato*, and that by default, *E. murinus sensu stricto* must be found in the remaining area. However, the limits of the distribution of both species are unclear because, as stated by the authors, they cannot be distinguished without genotypification, and most of the Amazon lacks genetic sampling (see Fig. 5 in Rivas *et al.* 2024). For instance, it is not known how far east *E. akayima* reaches in the central Amazon. Additionally, as we will further discuss, it is impossible to confirm the provenance of the *E. murinus* type series, and thus to determine its extent of distribution using other data, such as museum specimens, literature or citizen science records. We would like to clarify that we are not arguing that morphological diagnosability must be a requirement for availability when describing species. Indeed, we consider that the statement by Rivas *et al.* (2024: 12): “The high level of genetic divergence and geographic separation justifies the recognition of the northern population as a distinct species” is sufficient to satisfy the criteria of availability of the Article 13.1.1 of the *Code* as a definition in words of the characters purported to differentiate the taxon, even though we disagree with their geographic argument. It is important to bear in mind that the *Code*’s definition of character includes: “Any attribute of organisms used for recognizing, differentiating, or classifying taxa” (Anonymous 1999: 101). Here we are taking a broad definition of what constitutes a diagnosis, including distribution or evolutionary history as attributes themselves. See Bauer *et al.* (2011) for a discussion on the contrary considerations in the use of these kind of traits. We recognize that the *Code* is not explicitly limited to morphology, and that divergent lineages considered species are not necessarily phenetically diagnosable (Queiroz 2007).

On the other hand, the historical justifications in Rivas *et al.* (2024) are related to the assumption that much of the material described by Linnaeus came from Suriname. In this regard, we partially agree with the authors because their hypothesis is well-documented in the literature (Duellman 1971; Husson 1978; Hoogmoed 1982; Lavilla *et al.* 2010). However, unlike the material that was systematically collected for Linnaeus by his “South American emissaries” such as Pehr Löfling and Daniel Rolander, whose steps can be traced back to specific regions, including Suriname, the only known surviving type of *E. murinus* was originally part of King Adolf Fredrik’s private collection. This was derived from various sources, including merchants of naturalia, who provided rarities from the natural world, often without any provenance, to sell in Europe (Fernholm & Wheeler 1983). Taking this into consideration, the uncertainty associated with the provenance of the *E. murinus*

type series is high, making it challenging, if not impossible, to track. Moreover, even under the assumption of Suriname as its origin, Rivas *et al.* (2024) stated that both French Guiana and Suriname are probably part of a contact zone between *E. murinus* and *E. akayima*, which bring us back to the initial issue, that there is no certainty as to whether the specimen(s) examined by Linnaeus belong to the northern or southern clade.



FIGURE 1. Type series (syntypes) of *Boa murina* according to the information provided by Linnaeus (1758) in his original description. **A:** Specimen NRM 9. Note that despite being poorly positioned, it appears to be well-preserved. **B:** Plate 29 from Seba (1735) referenced by Linnaeus. **C:** Plate 23 from Seba (1735) referenced directly by Gronovius (1756) and indirectly by Linnaeus when referencing Gronovius. **D:** Plate 606 from Scheuchzer (1735), referenced directly by Gronovius (1756) and indirectly by Linnaeus when referencing Gronovius. Red arrows indicate the particular illustrations portraying the specimens that are *E. murinus* syntypes. Figure 1A was obtained from the public website of the Museum Adolphi Friderici, and digitally upscaled AI-assisted, while Fig. B–D from Seba (1735) and Gronovius (1756).

Rivas *et al.* (2024: 17) also argued that naming the new species as the one with the smallest range “will contribute to the stability of the nomenclature code, as it will result in less geographical change”. In this sense, we disagree because their decision has the opposite effect in terms of taxonomic stability, particularly across the large part of the Amazonian region not encompassed within their current genetic sampling. In other words, such populations could not be identified in the absence of a phylogenetic framework, being condemned to be labeled using qualifiers like *sp.* (*species*), *cf.* (*confer*) or *aff.* (*affinis*). Although we regard using a diagnosis based on phylogenetic position a valid but highly controversial practice (ignoring the main issue here, of which name should accompany which clade), its cost and technical requirements make it inaccessible for many people, including most researchers within the distribution of green anacondas.

A second observation we wish to make has to do with the lectotype of *Eunectes murinus* as treated by Rivas *et al.* (2024). These authors referred to a lectotype specimen collected in 2011 from Pará, Brazil and housed in the Museu Paraense Emílio Goeldi (MPEG) as MPEG 27428. It is unclear from the main text why or by whom this specimen was designated as the lectotype, although Table S3 — “Paratypes [*sic*] designated in this study” in Rivas *et al.* (2024) implies that this designation was made by them. Conveniently for them, this specimen is included in their phylogeny, also supporting the designation of the southern clade as the *E. murinus sensu stricto*. However, according to Article 74 of the *Code*, the designation of a lectotype can only be made using syntypes, which are by definition, all the specimens mentioned by the original author as type material when there is no explicit designation of a holotype. As Rivas *et al.* (2024) summarized, the syntypes of *E. murinus* comprise a specimen housed in the Swedish Museum of Natural History (NRM), identified as NRM 9 (Figure 1A), and at least three other specimens referenced directly or indirectly by Linnaeus (Figure 1B–D) from Seba (1735) and Gronovius (1756). According to the *Code*’s Article 72.5.6, those specimens may be considered as part of the syntype series. The problem, as discussed by Rivas *et al.* (2024), is that two of these three specimens are only known from Seba’s illustrations, lacking a reference to the physical material on which they were based, and the third one, despite having been in the collection of Johann Heinrich Linck (now part of the Museum Naturalienkabinett Waldenburg), is now lost (Bauer & Wahlgren 2013). In any case, except for the NRM specimen, the location of the remaining syntypes is unknown and they are presumably lost. Based on the above, it is clear that MPEG 27428 is not part of the original type series of *E. murinus*, therefore, making it unavailable for lectotype designation (Article 74.2).

In addition, regarding the origin of the type material of *Eunectes murinus*, the NRM’s database includes an observation that clarifies that it was originally part of a cabinet of curiosities belonging to King Adolf Fredrik, as confirmed by Andersson (1899), and after being examined by Linnaeus, it was transferred to the Royal Swedish Academy of Sciences (KVA) in 1801 and subsequently, to its current location. Based on this and considering other historical sources that link the King Adolf Fredrik collection with Linnaeus (Linnaeus 1764), it is likely that NRM 9 is the same specimen referred to on page 215 of *Systema Naturae* (Linnaeus 1758). Despite the fact that the text of Rivas *et al.* (2024) suggests that the authors considered the NRM specimen as a type both based on its historical link and the match of its lepidosis to Linnaeus’ referred specimen, in a subsequent communication Rivas expressed doubt, arguing: “NRM 9 **might** be a syntype but the voucher of the specimen does not support that. There is no record of its provenance beyond the fact that it is labeled *Boa murina* but it could have been another specimen in the collection [...]” (Rivas pers. comm. through ResearchGate on February 18, 2024). We assume that his doubt arises from the fact that there is not an explicit reference to an NRM voucher in Linnaeus’s work. However, it is important to note that NRM is a collection code assigned by the Swedish Museum of Natural History, which was not founded until 1819, and before that, it was labelled KVA-MUSADFR2, a code associated with the Royal Swedish Academy of Sciences, which held the specimen prior to that. It is likely that the specimen examined by

Linnaeus was not clearly labeled, as King Adolf Fredrik's collection was not systematically organized prior to Linnaeus (1754, 1764). Regarding the other nine *Eunectes* specimens currently in the NRM, all of them can be eliminated from consideration because museum records indicate all (including those with no data) were collected and/or determined after Linnaeus and came from sources other than King Adolf Fredrik's collection. Based on this information and following Article 72.4.1.1 of the *Code*, we believe that there is enough evidence to consider the NRM 9 as a syntype that constitutes part of the type series.

Furthermore, within the synonymy list of *Eunectes murinus* there are: *Boa scytale* Linnaeus, 1758; *Boa glauca* Boddaert, 1783; *Boa gigas* Latreille in Sonnini & Latreille, 1801; *Boa anacondo* Daudin, 1803; *Boa aquatica* Wied-Neuwied, 1823; and *Eunectes barbouri* Dunn & Conant, 1936. *Boa gigas* is an available name that could be attributable to the same taxonomic entity Rivas *et al.* (2024) described as *E. akayima*, as the authors themselves suggested based on the work of Dunn & Conant (1936). Other senior synonyms are not considered because they cannot be allocated to the same entity allegedly to be *E. akayima*. Specifically, Rivas *et al.* (2024: 18) stated: "Previous work had identified other candidate species and subspecies of the anaconda in the Orinoco basin with somewhat similar distribution to *E. akayima*". However, Rivas *et al.* (2024) considered all previous synonyms as "invalid" because morphological differences among species were previously considered ambiguous (Dirksen & Böhme 1998; Tarkhnishvili *et al.* 2022), opting instead to establish a new name. It is important to note that according to the *Code*, validity and availability are two different concepts, and that these are confounded by Rivas *et al.* (2024). In this regard, an invalid name (such as a junior synonym) remains available (Article 10.6). For the case of *Boa gigas*, the name is not in a category of excluded nomina (Article 1.3); it meets the criteria of publication (Article 8); and it meets the criteria of availability (Articles 10, 11, 12). Further, for a nomen published before 1931, diagnosability is not a required condition by the *Code* (Article 12.1), thus there is no case to be made for the unavailability (i.e., invalidity *sensu* Rivas *et al.* 2024) of *B. gigas*, as suggested by Rivas *et al.* (2024).

In addition, Rivas *et al.* (2024) considered the name "*akayima*" (as a monomial) to be a senior synonym of the former ones, based on their personal perception that this name should take priority. They argue that it has been used by indigenous people even before 1758, the date from which the *Code* takes its starting point. This may be true, but it does not give license to apply the *Code* only when it is convenient to do so, or to ignore it entirely. Here there is also an evident failure in the editorial processes, since the journal in which this new species was published (MDPI *Diversity*) explicitly states in its author guidelines that new taxa must comply with the *Code*.

As authors from countries (Colombia and Mexico) that have experienced colonization processes, we believe that it is necessary to shift towards a more inclusive science, but this should come from structural changes in the system, rather than decisions that, far from being "an unorthodox position" (Rivas *et al.*, 2024: 18), are arbitrary.

3. Conclusions

If the nomen *Eunectes murinus* could be unambiguously allocated to the southern clade *sensu* Rivas *et al.* (2024), according to the Principle of Priority (Article 23), the valid name for the northern clade should be the oldest available name applied to it, in this case *E. gigas* (Latreille in Sonnini & Latreille, 1801), and *E. akayima* would become a junior subjective synonym of *E. gigas* following Article 61.3.1. Nevertheless, as we have commented, it is not possible to corroborate which of the clades in Rivas *et al.* (2024) should bear the name *E. murinus*. Thus, although the evidence supports the existence of two evolutionary lineages of green anacondas, the authors' actions in designating

an ineligible specimen as a lectotype and describing a new species when there are available putative senior synonyms are negligent, non-Code-compliant, and as random as the flip of a coin. Therefore, in order to maintain nomenclatural stability until further evidence is available to resolve the nomina applicable to these two lineages, we propose that *E. akayima*, if available, be considered as a junior subjective synonym of *E. murinus*.

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