



EDITORIAL NOTE

Scientific errors in paleontology - the case of *Bakiribu*: pterosaur or fish?

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When Unwin and colleagues sent us the manuscript questioning a newly described pterosaur as being a fish (Unwin et al. 2026), I was somewhat surprised. Not so much by the content of their study, but why they have chosen the Annals of the Brazilian Academy of Sciences (AABC) to publish what, despite new and relevant information, can be considered a rebuttal of a previous paper. Unwin and colleagues doubted the results published by Pêgas et al. (2025), who introduced a new flying reptile, *Bakiribu waridza* (a nice name, by the way, valuing the indigenous habitants from Brazil that has started for pterosaurs with Campos & Kellner 1985) from the Romualdo Formation, one of the more remarkable paleontological deposits worldwide (e.g., Maisey 1991, Kellner & Saraiva 2019), where pterosaurs are an important faunal component (e.g., Pinheiro et al. 2025). They had already made their objection public in a preprint (Unwin et al. 2025) and, naturally, were looking for a journal to formally publish their results. To the best of my judgment, the right place to submit their piece would have been the original journal where the article of Pêgas and colleagues was published, as I explicitly mentioned to Dr. Unwin, the correspondent author. Nevertheless, there is scientific merit in their study, and I pointed out to Dr. Unwin that the only way for the AABC to publish their manuscript would be by submitting it through the regular evaluation system of our periodical (a normal procedure to which nobody would object) and, if approved, give Pêgas and colleagues the opportunity to respond formally in an article that would be published in connection with theirs.

After the manuscript came back from the review process with positive evaluations (the reviewers were researchers working with pterosaurs and fishes), the lead authors of Pêgas et al. (2025) were invited to respond. Although they initially agreed, when I contacted them about their missed deadline, pointing out that the AABC would publish Unwin and colleagues' results with or without their response and would settle the matter (at least for the AABC), they did not ask for an extension (which, if reasonable, would be considered) and declined our offer. As informed, they are working on some analyses that, according to them, will conclusively "prove" the specimen to be a pterosaur (A.M. Ghilardi, pers. comm. 2026, R. Pêgas, pers. comm. 2026).

To give a general overview of the importance of this controversy, nobody questions that pterosaurs, amazing creatures that once dominated the skies of the world, can be considered rare and that there are several gaps in our knowledge regarding these flying animals. New discoveries made over the years have attracted paleontologists to come together and discuss several issues regarding them. To recapitulate a little bit of recent history, the first of such meetings ('First Pterosaur Workshop'), gathering "pterosaurologists", was held on October 16th, 1995, during the 55th Annual Meeting of the Society of Vertebrate Paleontology (SVP), in a rather informal way. As a result of this successful venue,

the first symposium on pterosaurs (Symposium Advances in the study of Pterosaurs) was organized the following year (1996), during the the 56th Annual Meeting of the SVP at the American Museum of Natural History, New York (Kellner 2025). The last of such meetings (The Crato Ptero – 9th Symposium on Pterosaurs) was held in Brazil (Sayão et al. 2025) and the next one (The 10th International Pterosaur Conference – Hami Ptero 2026) will be held in Hami, China, later this year. Yes, lots of activity regarding these volant creatures.

The discovery of *Bakiribu* as a highly specialized filter-feeding pterosaur, similar to *Pterodaustro* from Argentina (e.g., Chiappe et al. 2000) in the Romualdo Formation would be quite exceptional and definitively contribute to a better understanding of the evolutionary history of these fascinating creatures. A paper that might be submitted to Nature or Science. Since the depositional environment of the Romualdo Formation is considered a lagoon, I personally would rather expect that, if highly specialized filter-feeding flying reptiles were to be found in the Araripe Basin, the Crato Formation, deposited in shallow lakes that sometimes could become hypersaline, would be a better candidate.

Errors and questions about interpretations are not new to paleontology, the field that studies all evidence of life in deep time. Being a paleontologist myself, it is sometimes challenging (and even frustrating) to make decisions based on rather incomplete material and too often some of our ideas hinge on very slim evidence. Unwin and colleagues have themselves been in this situation, when they mistook a pterosaur rib and a humerus for a radius and ulna (Martill & Unwin 1989), that sparked questions about their results (e.g., Kellner 1994, 1996). Curiously, the material also came from the Romualdo Formation, the same deposit as *Bakiribu* which is being discussed here.

Mistaking a fish with a pterosaur is, indeed, an awkward situation but it has happened before (see Unwin et al. 2026). It is, perhaps, not as bad as if, theoretically, someone extracted a tooth from a crocodylomorph dentary and called it a mammal. Errors have been observed in the paleontological literature before. Among the most recent ones is “*Archaeoraptor*”, regarded as a missing link between birds and non-avian dinosaurs, but later discovered to be a hoax, with several individuals “glued” together (e.g., Zhou et al. 2002). Another notorious case was the supposed hummingbird-sized reptile found in amber deposits from Myanmar thought to be a bird but later identified to be a lizard, causing the article to be retracted (Xing et al. 2020, Bolet et al. 2021) - perhaps also a good way for authors to correct errors made in good faith. There are also many misinterpretations of fossils coming from the Cambrian, the basal period from the Paleozoic Era (e.g., Butterfield 2003). Some are not even organic remains, but artifacts of different origins (e.g., Toniolo et al. 2023). Yes, paleontologists do not have an easy life...

When it became clear that Pêgas and colleagues would not respond to Unwin et al. (2026), I asked to examine the material for the present editorial. To make a long story short, although initially there was an indication that I would get permission to see the holotype (a category of specimens that, due to their importance, should be readily made available to scientists), after making it clear that I disagreed with their interpretation, several difficulties arose, and it became evident that I would not be able to examine the holotype of *Bakiribu waridza* within the timeframe necessary to complete this editorial. Perhaps I will have an opportunity to see this material when it is returned, providing the loan is not extended.

Coming back to the more scientific aspect of the “pterofish” issue, Unwin et al. (2025, 2026) present compelling evidence to their claim. Without going into much detail about the work of

Pêgas et al. (2025), they mentioned the presence of a pterosaurian metatarsal and pedal phalanx but did not give them much attention. Examining the published images, the identification of the bones indicated as reptilian (my main objective in examining the holotype of *Bakiribu*), could not be verified. Perhaps in a future paper, Pêgas and colleagues could present photos of the articulation ends of these bones which, if they are indeed reptilian, would be quite different from fish elements. Although not conclusive, this would strengthen their case.

Among the most problematic points in the article by Pêgas et al. (2025) are the paleohistological sections of the teeth, from which not much can be learned. They mentioned the presence of dentine, but nothing in the published figures indicates the existence of this dental tissue. Based on their figures, the alleged dentine of *Bakiribu* is quite different from that reported in *Pterodaustro* (Cerdeira & Codorniú 2023) to which the Brazilian species is regarded to be closely related. In fact, if the reconstruction of figures 5B and 5E published by Pêgas et al. (2025) are to be believed, there are no dentine tubules. To make matters more complex, there seem to be additional round structures close to the supposedly pulp cavity, quite unusual for a tooth. The teeth of *Bakiribu* also differ from those of other pterosaurs regarded as filter feeders (Zhou et al. 2025), although these species are less specialized for this feeding mode.

The sole conclusion I can infer from the available information is that *Bakiribu waridza* is not a reptile, much less a pterosaur, but a fish, as stated by Unwin et al. (2025, 2026). Until more information becomes available, rather being regarded as a *nomen dubium* (Unwin et al. 2026), *Bakiribu waridza* might be considered as Actinopterygii indet or a *species inquirenda*. If, in the future, the gill arch apparatus present in this specimen can be attributed to one of the several fish species from the Romualdo Formation (or from any other deposit) - which seems to be a rather difficult task - perhaps this name might fall into synonymy.

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