Peer Community In Paleontology

New baenid turtle material from the Campanian of Wyoming

Jérémy Anquetin based on peer reviews by *Heather F. Smith* and *Brent Adrian*

Ka Yan Wu, Jared Heuck, Frank J. Varriale, and Andrew A. Farke (2023) A baenid turtle shell from the Mesaverde Formation (Campanian, Late Cretaceous) of Park County, Wyoming, USA. PaleorXiv, ver. 5, peer-reviewed and recommended by Peer Community in Paleontology. https://doi.org/10.31233/osf.io/uk3ac

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The *Baenidae* form a diverse extinct clade of exclusively North American paracryptodiran turtles known from the Early Cretaceous to the Eocene (Hay, 1908; Gaffney, 1972; Joyce and Lyson, 2015). Their fossil record was recently extended down to the Berriasian-Valanginian (Joyce et al. 2020), but the group probably originates in the Late Jurassic because it is usually retrieved as the sister group of *Pleurosternidae* in phylogenetic analyses. However, baenids only became abundant during the Late Cretaceous, when they are restricted in distribution to the western United States, Alberta and Saskatchewan (Joyce and Lyson, 2015).

During the Campanian, baenids are abundant in the northern (Alberta, Montana) and southern (Texas, New Mexico, Utah) parts of their range, but in the middle part of this range they are mostly represented by poorly diagnosable shell fragments. In their new contribution, Wu et al. (2023) describe a new articulated baenid specimen from the Campanian Mesaverde Formation of Wyoming. Despite its poor preservation, they are able to confidently assign this partial shell to *Neurankylus* sp., hence definitively confirming the presence of baenids and *Neurankylus* in this formation. Incidentally, this new specimen was found in a non-fluvial depositional environment, which would also confirm the interpretation of *Neurankylus* as a pond turtle (Hutchinson and Archibald, 1986; Sullivan et al., 1988; Wu et al., 2023; see also comments from the second reviewer).

The study of Wu et al. (2023) also includes a detailed account of the state of the fossil when it was discovered and the subsequent extraction and preparation procedures followed by the team. This may seem excessive or out of place to some, but I agree with the authors that such information, when available, should be more commonly integrated into scientific articles describing new fossil specimens. Preparation and restoration can have a significant impact on the perceived morphology. This must be taken into account when working with fossil specimens. The chemicals or products used to treat, prepare, or consolidate the specimens are also

important information for long-term curation. Therefore, it is important that such information is recorded and made available for researchers, curators, and preparators.

References:

Gaffney, E. S. (1972). The systematics of the North American family Baenidae (Reptilia, Cryptodira). Bulletin of the American Museum of Natural History, 147(5), 241–320.

Hay, O. P. (1908). The Fossil Turtles of North America. Carnegie Institution of Washington, Washington, D.C. https://doi.org/10.5962/bhl.title.12500

Hutchison, J. H., and Archibald, J. D. (1986). Diversity of turtles across the Cretaceous/Tertiary boundary in Northeastern Montana. Palaeogeography, Palaeoclimatology, Palaeoecology, 55(1), 1–22. https://doi.org/10.1016/0031-0182(86)90133-1

Joyce, W. G., and Lyson, T. R. (2015). A review of the fossil record of turtles of the clade *Baenidae*. Bulletin of the Peabody Museum of Natural History, 56(2), 147–183. https://doi.org/10.3374/014.058.0105

Joyce, W. G., Rollot, Y., and Cifelli, R. L. (2020). A new species of baenid turtle from the Early Cretaceous Lakota Formation of South Dakota. Fossil Record, 23(1), 1–13. https://doi.org/10.5194/fr-23-1-2020

Sullivan, R. M., Lucas, S. G., Hunt, A. P., and Fritts, T. H. (1988). Color pattern on the selmacryptodiran turtle *Neurankylus* from the Early Paleocene (Puercan) of the San Juan Basin, New Mexico. Contributions in Science, 401, 1–9. https://doi.org/10.5962/p.241286

Wu, K. Y., Heuck, J., Varriale, F. J., and Farke, A. (2023). A baenid turtle shell from the Mesaverde Formation (Campanian, Late Cretaceous) of Park County, Wyoming, USA. PaleorXiv, uk3ac, ver. 5, peer-reviewed and recommended by Peer Community In Paleontology. https://doi.org/10.31233/osf.io/uk3ac

Reviews

Evaluation round #1

DOI or URL of the preprint: https://doi.org/10.31233/osf.io/uk3ac
Version of the preprint: 2

Authors' reply, 02 June 2023

We thank the reviewers and editor for the very helpful comments on the earlier version of our manuscript. Revisions are indicated in the updated manuscript files, response to reviewers, and tracked changes document.

Download author's reply
Download tracked changes file

Decision by Jérémy Anquetin, posted 09 February 2023, validated 10 February 2023

Moderate revision

The two reviewers agree that your work is interesting and contributes to the understanding of the baenid fossil record. Both of them provided a detailed review of your manuscript and made a number of pertinent suggestions, notably concerning the identification of the specimen, the shape of the femoral-anal sulcus, and the phylogenetic analysis. I am looking forward to reading a revised version of this paper. Please submit a rebuttal letter refering to the different points raised by the reviewers and a tracked-changes file along with your revision.

Reviewed by Heather F. Smith, 03 February 2023

Thank you for inviting me to review this interesting paper on an intriguing Campanian baenid specimen from the Mesaverde Formation. The specimen has a curious combination of features; however, its fragmentary nature and incomplete preservation render definitive taxonomic assessment difficult. The paper contributes to the understanding of the baenid fossil record and is worthy of publication. I have a few suggestions for the authors as they proceed, which are divided into more substantive comments and minor (mostly typographical) suggestions.

Major comments:

General:

I think the authors are correct not to erect a new taxon based on this specimen. However, I would encourage them to be a bit more definitive regarding taxonomic attributions. Despite lack of resolution in the phylogenetic tree, I downloaded the data matrix and I see that RAM 28750 is identical to Neurankylus eximius and N. torrejonensis for all characters for which it can be coded. Since there are no coded character differences, I think it would be reasonable to tentatively assign RAM 28750 to "Cf. Neurankylus" or "Neurankylus sp.". Additionally, adult shell size is also a diagnostic character among baenids with few taxa reaching a carapace length of 450 mm. RAM 28750 is the right size to belong to Neurankylus.

The only apparently contrasting trait to a diagnosis of Neurankylus appears to be the omega-shaped femoral-anal sulcus. I completely agree that this morphology is unexpected for Neurankylus and more typical of baenodds; however, given that all other lines of morphological evidence suggest affinities with Neurankylus, I'd be inclined to consider the possibility that you could be seeing some individual variation. The sulcus is also incomplete, given that the right side of the plastron is missing, so while it's reasonable to reconstruct the sulcus shape in RAM 28750 as likely omega-shaped, it's also not entirely certain.

Phylogenetic methods:

The Rollot et al 2022 data matrix used here is generally solid; however, it has also been modified since the original Joyce, Lyson, et al iterations and is now formatted more for assessing relationships among basal baenids and among other paracryptodires (note the large number of non-baenid taxa included). It's not as well-suited for evaluating the details of relationships among derived baenids. Earlier versions of the matrix, most notably Lyson et al., 2016, include a larger number of baenid taxa, including additional species of Neurankylus, N. baueri and N. lithographicus. I just revisited the Lyson et al. (2016) character list, and I think RAM 28750 for could be coded for more than 7 characters in this dataset, so the resolution may be improved. I'd encourage the authors to code RAM 28750 for the Lyson et al. (2016) characters, re-run the phylogenetic analysis, and see if the topology changes.

If/when you run a new phylogenetic analysis, you might also try adjusting a few settings. For example, 100,000 replications is a lot! It's not surprising that you ended up with 75k trees and a strict consensus with minimal resolution. According to my reading, both Rollot et al. (2022) and Lyson et al. (2016) used 1000 replications. That's probably plenty. You might also consider assessing the majority-rule consensus tree rather than the strict consensus to see if there are any patterns that are being overlooked in the more conservative strict version. Rollot et al. also ran the analysis again using implied weighting of K=12, which you could try. (In TNT, it's under Settings-> Implied Weighting-> Basic Settings-> Click "Using Implied Weights" and change the "weight with default function" to K = 12).

I'd love to see a phylogenetic tree included as a figure in the Results, even if the resolution is suboptimal.

Descriptions and Interpretations:

Lines 161-164: The anterior plastral lobe is also trapezoidal in Neurankylus torrejonensis. This morphology is characteristic of Neurankylus.

Lines 168-169: The posterior plastral lobe is reportedly larger than the anterior plastral lobe in N. eximius and N. lithographicus, but not N. baueri.

Lines 180-181: The phrase "narrowing just anterior to the midpoint" here is a bit unclear. Do you mean the anteroposterior midpoint of the carapace? Please clarify.

Lines 191-194: N. torrejonensis has posterior scalloping, but some other Neurankylus species do not. Given the other morphological affinities to Neurankylus, I think this would be worth mentioning.

Can you tell how well developed the axillary and inguinal buttresses are? Do they contact the costals broadly? This is the case in many baenids and seems likely here, so it would be worth mentioning if you can tell.

Many baenid taxa are shell-only. Thus, the absence of a skull typically does not dictate the decision as to whether to name a new taxon. For example, I don't believe a skull is known for Neurankylus baueri. Thus, I'd suggest deleting the phrase "in addition to the lack of a skull" from line 209.

Figure 2 caption: Anterior and posterior "pleural" lobes, should be "plastral" lobes. Pleural scutes are on the carapace.

Minor typographic suggestions:

Line 21: Suggest deleting the phrase "of the Cretaceous". Readers of the paper will generally know that the Campanian falls within the Cretaceous.

Line 30: Suggest changing "anal-femoral" to "femoral-anal"

Line 57: Are dates known? If so, I'd suggest listing them here.

Line 65: Suggest changing "collecting" to "collection".

Line 79: Add a comma after "basin".

Line 83: Should "near shore" by "nearshore"? I've more often seen it written as one word, although perhaps it's a matter of personal preference.

Line 109: Since other measurements are listed in Arabic numerals, I'd suggest changing "one to three cm" to "1-3 cm" for consistency.

Lines 104-122: The prep section is substantially longer and more detailed than most fossil turtle papers I've read. While I appreciate the forthcoming nature of the information, I'd encourage the authors to consider condensing it a bit as the level of detail detracts slightly from the more significant parts of the paper, the morphological descriptions and implications.

Line 120: Suggest changing "place" to "location" or "position".

Line 126: Suggest changing "run" to "conducted' or "performed".

Line 128: While I understand what you mean, the consecutive numbers and commas in the phrase "random seed of 1, 100,000 replications..." could look confusing to the reader. Perhaps swap the order to "100,000 replications, random seed of 1..." or write out the word "one" for clarity.

Line 163: "lithographica" should be "lithographicus"

Line 187: "Denizenemys" should be "Denazinemys".

Line 200: "Lakotaemys" should be "Lakotemys"

Lines 207-208: "anterior plastral lobe of the plastron" is a bit redundant. Suggest just "anterior plastral lobe."

References mentioned:

Lyson, T.R. Joyce, W.G., Lucas, S.G., and Sullivan, R.M. 2016. A new baenid turtle from the early Paleocene (Torrejonian) of New Mexico and a species-level phylogenetic analysis of Baenidae. Journal of Paleontology 90, 305–316. https://doi.org/10.1017/jpa.2016.47

The authors are welcome to contact me directly with any questions. Nice work!

Sincerely,

Heather Smith

Reviewed by Brent Adrian, 06 February 2023

Download the review