

Original article

Samrukia nessovi, from the Late Cretaceous of Kazakhstan: A large pterosaur, not a giant bird

Samrukia nessovi, du Crétacé supérieur du Kazakhstan est un grand ptérosaure et non un oiseau géant

Eric Buffetaut

Centre national de la recherche scientifique, UMR 8538, laboratoire de géologie de l'école normale supérieure,
24, rue Lhomond, 75231 Paris cedex 05, France

Available online 10 November 2011

Abstract

Samrukia nessovi was described as a giant bird on the basis of a pair of mandibular rami from the Late Cretaceous of Kazakhstan. Anatomical comparison shows that the specimen bears no distinctive avian characters, and that its purported autapomorphies, as well as all its other characters, are in fact well-known pterosaurian features. The published phylogenetic analysis placing *Samrukia* within Aves is flawed because it did not include pterosaurs. *Samrukia nessovi* is clearly a large pterosaur, not a giant bird.

© 2011 Elsevier Masson SAS. All rights reserved.

Keywords: *Samrukia*; Aves; Pterosauria; Kazakhstan; Late Cretaceous

Résumé

Samrukia nessovi a été décrit comme un oiseau géant sur la base d'une paire de branches mandibulaires du Crétacé supérieur du Kazakhstan. Une comparaison anatomique montre que ce spécimen ne présente aucun caractère distinctif avien, et que ses supposées autapomorphies, ainsi que tous ses autres caractères, sont en fait des traits ptérosauriens bien connus. L'analyse phylogénétique publiée, qui place *Samrukia* parmi les oiseaux, est biaisée car elle n'inclut pas de ptérosaures. *Samrukia nessovi* est clairement un grand ptérosaure, et non un oiseau géant.

© 2011 Elsevier Masson SAS. Tous droits réservés.

Mots clés : *Samrukia* ; Aves ; Pterosauria ; Kazakhstan ; Crétacé supérieur

E-mail address: eric.buffetaut@sfr.fr

1. Introduction

Naish et al. (2011) described as *Samrukia nessovi* a pair of mandibular rami from the Late Cretaceous of Kazakhstan which they refer to a giant bird, their claim being supported by a cladistic analysis. However, detailed anatomical comparisons, based on the description and illustrations provided by Naish et al. (2011), clearly show that the specimen is not avian but belongs to a large pterosaur. The purpose of the present paper is to examine first the purported avian characters of *S. nessovi* and then its supposed autapomorphies and other characters from the perspective of comparative anatomy rather than of phylogenetic analysis. This clearly reveals that the specimen from Kazakhstan belongs to a pterosaur.

2. Purported avian characters of *Samrukia nessovi*

Naish et al. (2011) do not provide much osteological evidence to support their claim that *S. nessovi* is a bird. The only clearly listed avian character is “extensive fusion of mandibular bones”, which is considered as “characteristic of Aves” (Naish et al., 2011, p. 1). However, as noted by Bennett, 2001, p. 94, in the mature skeleton of the pterosaur *Pteranodon*, “elements of the skull and mandible fuse completely”. According to Wellnhofer (1991a), this is a general feature of pterosaurs. Therefore, this fusion cannot be considered as exclusively characteristic of birds, since it also occurs in pterosaurs.

In addition, to judge from their Fig. 1, Naish et al. (2011) seem to consider “articular pneumaticity” as an avian character. This apparently alludes to the presence of a pneumatic foramen on the articular bone, posterior to the medial cotyle. As shown below, such a pneumatic foramen, in precisely that position, is known in many pterosaurs and therefore cannot be considered as a distinctive avian character.

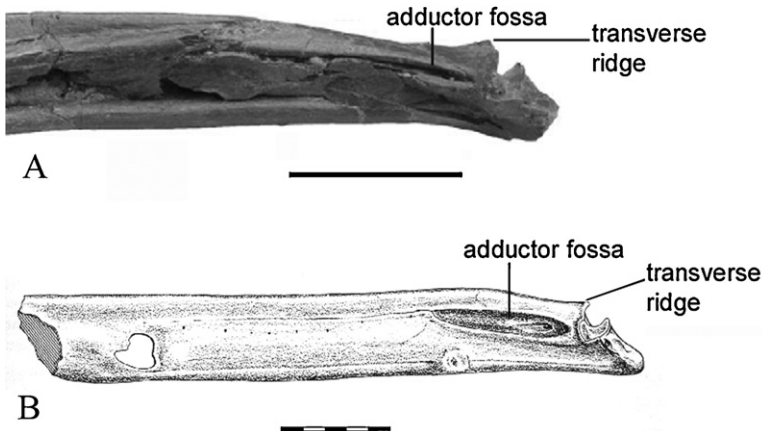


Fig. 1. Purported distinctive characters of the lower jaw of *Samrukia nessovi* which are in fact pterosaur characters: medial views of the posterior part of the lower jaw in *S. nessovi* (A, modified after Naish et al., 2011) and *Santanadactylus araripensis* (B, modified after Wellnhofer, 1985). The adductor fossa is the so-called “mediodorsal sulcus” of Naish et al. Scales bars: 50 mm.

Caractères supposés distinctifs de la mandibule de Samrukia nessovi qui sont en fait des caractères de ptérosaures : vues médiales de la partie postérieure de la mâchoire inférieure de S. nessovi (A, modifié d'après Naish et al., 2011) et Santanadactylus araripensis (B, modifié d'après Wellnhofer, 1985). La fosse adductrice est le « sulcus médiadorsal » de Naish et al. Barres d'échelle : 50 mm.

3. Purported autapomorphies of *Samrukia nessovi*

Among the autapomorphies listed in the diagnosis of *S. nessovi* by Naish et al. (2011), large size can be dismissed, since it is obviously known in a great number of living and extinct birds (including ratites, gastornithids, phorusrhacids, etc.) and can hardly be considered as an autapomorphy.

A potentially more significant character considered as an autapomorphy by Naish et al., (2011, p. 1) is the “presence of a deep mediodorsal sulcus in the post-dentary region”. The authors further note that “no similar structure has been reported within Theropoda”, which is correct. However, such a sulcus, in exactly the same anatomical position (Fig. 1), has been described, as the adductor fossa (for the insertion of jaw muscles), in various pterosaur specimens in which the posterior portion of the lower jaw rami is sufficiently well preserved for this character to be observed. The adductor fossa is an elongate, deep depression on the medial face of the mandibular ramus (Fig. 1), which, according to Wellnhofer’s interpretation of *Santanadactylus araripensis* (Wellnhofer, 1985), is bounded ventrally by the prearticular, dorsally by the surangular and coronoid, and reaches the posterior end of the splenial cranially. As noted by Veldmeijer (2003) in his description of *Coloborhynchus*, the prearticular forms a ridge along the ventral side of the adductor fossa (see also Wellnhofer, 1985). This corresponds to the lamina described in this position in *S. nessovi* by Naish et al. (2011). The adductor fossa has been reported in various Cretaceous pterosaurs belonging to different families, such as *Quetzalcoatlus* (Kellner and Langston, 1996), *Pteranodon* (Bennett, 1993; Wellnhofer, 1980), a pterodactyloid from the Gosau Formation of Austria (Wellnhofer, 1980), a possible ornithocheirid from the Cambridge Greensand (Wellnhofer, 1980), *Santanadactylus* (Wellnhofer, 1985), *Coloborhynchus* (Veldmeijer, 2003) and *Anhanguera* (Veldmeijer et al., 2005). It is known in Jurassic pterosaurs such as the pterodactyloid *Germanodactylus* (Plieninger, 1901) and the rhamphorhynchid *Sericipterus* (Andres et al., 2010). In *Eudimorphodon ranzii*, a basal pterosaur from the Late Triassic of Italy, a depression in the medial face of the mandibular ramus, ending just anterior to the articular region, was described by Wild (1978) as the “Fenestra mandibularis”. It seems to be homologous with the adductor fossa of other pterosaurs. The adductor fossa thus seems to be extremely widespread among Pterosauria, and is probably present in all members of the group.

A third possible autapomorphy is “the presence of a prominent and raised anterior margin of the mandibular cotyla”. This feature, again, is the usual condition in pterosaurs (Fig. 1), where the anterior margin of the cotyles usually forms a sharp transverse ridge, as described by Seeley (1870) as early as 1870 in pterosaurs from the Cambridge Greensand. This condition was already present in the basal pterosaur *Eudimorphodon ranzii*, from the Late Triassic of Italy, as noted by Wild (1978), and it has been described or illustrated in a large number of pterosaurs belonging to various families (e.g. Averianov, 2010; Bennett, 2001; Eaton, 1910; Veldmeijer et al., 2005; Wellnhofer, 1980, 1985; Wild, 1990). Again, this raised anterior margin of the mandibular cotyla appears to be a very common character of pterosaurs.

It thus appears that out of the three autapomorphies listed by Naish et al. (2011) for *S. nessovi*, one (large size) is irrelevant, and the other two (medial sulcus and raised anterior margin of cotyla) are in fact pterosaurian characters.

4. Other characters of *Samrukia nessovi*

Beyond the above-mentioned purported autapomorphies, which in fact are pterosaur characters, other features listed by Naish et al. (2011) also support pterosaurian affinities for *Samrukia*. In

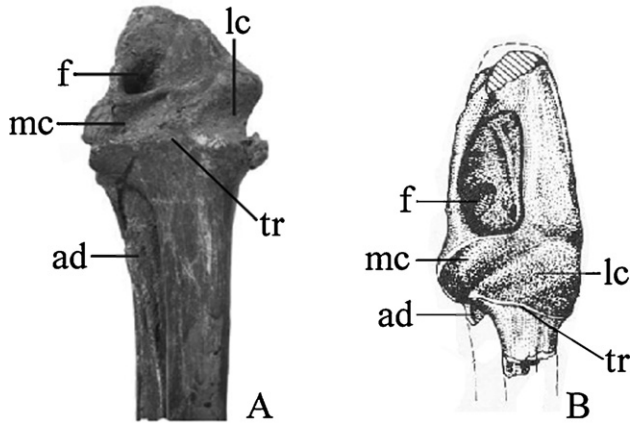


Fig. 2. The left articular region of the lower jaw in *Samrukia nessovi* (A, modified after Naish et al., 2011) and a pterodactyloid pterosaur from the Campanian of Austria (B, modified after Wellnhofer, 1980); ad: adductor fossa; f: pneumatic foramen; lc: lateral cotyle; mc: medial cotyle; tr: transverse ridge. Not to scale. Views are at slightly different angles.

La région articulaire gauche de la mandibule chez *Samrukia nessovi* (A, modifié d'après Naish et al., 2011) et un ptérodactyloïde du Crétacé supérieur d'Autriche (B, modifié d'après Wellnhofer, 1980); ad: fosse adductrice; f: foramen pneumatique; lc: cotyle latéral; mc: cotyle médial; tr: crête transversale. Échelles différentes. Les vues sont sous des angles légèrement différents.

particular, the complex morphology of the articular region, with two oblique cotyles separated by an anteromedially-posterolaterally oriented ridge (Fig. 2) is typically found in various groups of pterosaurs. Seeley described this condition in Cambridge Greensand pterosaurs as early as 1870. This peculiar type of jaw joint was described in detail in *Pteranodon*, a pterodactyloid from the Gosau Formation, and a probable ornithocheirid from the Cambridge Greensand by Wellnhofer (1980), who also reported it in *Santanadactylus* (Wellnhofer, 1985) and *Anhanguera* (Wellnhofer, 1991b). Other descriptions of this type of articular region in pterosaurs can be found in e.g. Averianov (2010), Bennett (2001), Eaton (1910), Kellner and Langston (1996), Veldmeijer et al. (2005). As remarked by Wellnhofer (1980), some birds, such as *Pelecanus*, exhibit a somewhat similar construction of the articular region, but the condition in *Samrukia* is exactly that seen in pterosaurs and differs in several ways from that of pelicans. In the latter, there is no sharp transverse ridge anterior to the cotyles, and no clear oblique ridge separating the cotyles (see Wellnhofer, 1980). Wellnhofer (1985) noted that the above-described type of mandibular articulation is usual in pterosaurs. However, some forms, such as *Bakonydraco*, do not seem to exhibit it (Buffetaut et al., 2011). Nevertheless, it remains that the lower jaw articulation of *S. nessovi* is identical with that seen in various Cretaceous pterosaurs belonging to different families (Pteranodontidae, Azhdarchidae, Ornithocheiridae. . .).

Naish et al. (2011) noted the presence of a large, oval pneumatic foramen posterior to the medial cotyle (Fig. 2), and remarked that a similar foramen is present in *Ichthyornis* and Neornithes. However, it should be noted that such a foramen has been described, in exactly that position, in many pterosaurs (e.g. Bennett, 2001; Kellner and Langston, 1996; Veldmeijer, 2003; Veldmeijer et al., 2005; Wellnhofer, 1985, 1991b). In at least some Late Cretaceous forms it is enlarged and located at the bottom of a large pit (Wellnhofer, 1980), as in *S. nessovi*. In this regard, too, the jaw from Kazakhstan does not differ from that of pterosaurs.

Other similarities between *Samrukia* and pterosaurs include small and caudoventrally sloping retroarticular processes and a ridge-like dorsal margin of the jaw rami anterior to the adductor fossa. The general outline of the ramus in lateral or medial view, with a convex dorsal margin and a slightly concave ventral margin, as seen in *Samrukia*, is very frequently observed in pterosaurs, including azhdarchids such as *Quetzalcoatlus* (Kellner and Langston, 1996).

5. Conclusions

The phylogenetic analysis performed by Naish et al. (2011) resulted in a cladogram where *S. nessovi* is placed in a polytomy among ornithuromorph birds (Naish et al., 2011, Fig. 1). This at first sight may suggest that the phylogenetic position of *Samrukia* among Aves is well supported (although it should be noted that out of 1025 characters used in the analysis, only 16 could be coded for *Samrukia*). However, this result is flawed, because the analysis, having been arbitrarily restricted to birds and non-avian theropods, did not include any pterosaur. It therefore could not possibly recover *S. nessovi* as a pterosaur. In the present paper, a detailed anatomical comparison has been preferred to a phylogenetic analysis and has revealed complete identity between the preserved parts of *S. nessovi* and the corresponding region in pterosaurs.

As mentioned above, none of the few characters listed by Naish et al. (2011) as typically avian can be considered as bird apomorphies. The purported autapomorphies of *S. nessovi* are not known in Theropoda, as pointed out by Naish et al. (2011), but they are well known in pterosaurs. Other characters listed by Naish et al. are common pterosaurian features. In view of this, there are basically two options: either *S. nessovi* is a bird which shows no distinguishing avian characters and is completely convergent with pterosaurs in all its morphological features, or it is a pterosaur. The second option obviously appears more likely than the first: all morphological evidence indicates that *S. nessovi* belongs to the Pterosauria. A more precise assignment is not easy on the basis of the available evidence, although the outline of the jaw rami may suggest azhdarchid affinities, which would not be surprising in view of the frequent occurrence of azhdarchids in the Late Cretaceous of Central Asia (Averianov, 2010). The size of this animal does not appear to be exceptional by the standards of some Late Cretaceous pterosaurs; the width of the articular region is apparently slightly less than in the so-called “small” species of *Quetzalcoatlus* (see Kellner and Langston, 1996), which may have had a wingspan of about 5 m. Whether the type material of *S. nessovi* is sufficient to warrant the erection of a new pterosaur taxon is debatable, so that *S. nessovi* may turn out to be a *nomen dubium*. However, more detailed comparisons of the specimen from Kazakhstan with other pterosaurs will be needed to settle this matter. Since *S. nessovi* clearly is a pterosaur, the only certain giant Mesozoic bird remains the flightless *Gargantuavis philoinos*, from the Late Cretaceous of France (Buffetaut and Le Loeuff, 1998, 2010).

As noted by art historian Carola Hicks in a completely different context, “. . . people find what they want to find and see what they choose to see” (Hicks, 2007, p. 289). Whatever the merits of phylogenetic analysis, the misidentification of *S. nessovi* as a bird seems to be an additional illustration of that fact.

Acknowledgments

This work was supported by a grant from the INTERRVIE Programme of the Institut National des Sciences de l’Univers, Centre National de la Recherche Scientifique.

References

- Andres, B., Clark, J.M., Xu, X., 2010. A new rhamphorhynchid pterosaur from the Upper Jurassic of Xinjiang, and the phylogenetic relationships of basal pterosaurs. *Journal of Vertebrate Paleontology* 30, 163–187.
- Averianov, A., 2010. The osteology of *Azhdarcho lancicollis* Nessov, 1984 (Pterosauria, Azhdarchidae) from the Late Cretaceous of Uzbekistan. *Proceedings of the Zoological Institute RAS* 314, 264–317.
- Bennett, S.C., 1993. The ontogeny of *Pteranodon* and other pterosaurs. *Paleobiology* 19, 92–106.
- Bennett, S.C., 2001. The osteology and functional morphology of the Late Cretaceous pterosaur *Pteranodon*. Part I. General description and osteology. *Palaeontographica A* 260, 1–112.
- Buffetaut, E., Le Loeuff, J., 1998. A new giant ground bird from the Upper Cretaceous of Southern France. *Journal of the Geological Society London* 155, 1–4.
- Buffetaut, E., Le Loeuff, J., 2010. *Gargantuavis philoinos*: giant bird or giant pterosaur? *Annales de Paléontologie* 96, 135–141.
- Buffetaut, E., Ösi, A., Prondvai, E., 2011. The pterosaurian remains from the Grünbach Formation (Campanian Gosau Group) of Austria: a reappraisal of “*Ornithocheirus buenzeli*”. *Geological Magazine* 148, 334–339.
- Eaton, G.F., 1910. Osteology of *Pteranodon*. *Memoirs of the Connecticut Academy of Arts and Sciences* 2, 1–38.
- Hicks, C., 2007. *The Bayeux Tapestry. The Life Story of a Masterpiece*. Vintage, London.
- Kellner, A.W.A., Langston, W., 1996. Cranial remains of *Quetzalcoatlus* (Pterosauria, Azhdarchidae) from Late Cretaceous sediments of Big Bend National Park, Texas. *Journal of Vertebrate Paleontology* 16, 222–231.
- Naish, D., Dyke, G., Cau, A., Escuillié, P., Godefroit, P., 2011. A gigantic bird from the Upper Cretaceous of Central Asia. *Biology Letters*, 1–4, doi:10.1098/rsbl.2011.0683.
- Plieninger, F., 1901. Beiträge zur Kenntniss der Flugsaurier. *Palaeontographica* 48, 65–90.
- Seeley, H.G., 1870. *The Ornithosauria: an elementary study of the bones of pterodactyls*. Deighton, Bell and Co., Cambridge, 134 pp.
- Veldmeijer, A.J., 2003. Description of *Coloborhynchus spielbergi* sp. nov. (Pterodactyloidea) from the Albian (Lower Cretaceous) of Brazil. *Scripta Geologica* 125, 35–139.
- Veldmeijer, A.J., Signore, M., Meijer, H.J.M., 2005. Description of two pterosaur (Pterodactyloidea) mandibles from the lower Cretaceous Santana Formation, Brazil. *Deinsea* 11, 67–86.
- Wellnhofer, P., 1980. Flugsaurierreste aus der Gosau-Kreide von Muthmannsdorf (Niederösterreich) ein Beitrag zur Kiefermechanik der Pterosaurier. *Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie* 20, 95–112.
- Wellnhofer, P., 1985. Neue Pterosaurier aus der Santana-Formation (Apt) der Chapada do Araripe, Brasilien. *Palaeontographica A* 187, 105–182.
- Wellnhofer, P., 1991a. *The Illustrated Encyclopedia of Pterosaurs*. Salamander Books, London, 192 pp.
- Wellnhofer, P., 1991b. Weitere Pterosaurierfunde aus der Santana-Formation (Apt) der Chapada do Araripe, Brasilien. *Palaeontographica A* 215, 43–101.
- Wild, R., 1978. Die Flugsaurier (Reptilia, Pterosauria) aus der Oberen Trias von Cene bei Bergamo, Italien. *Bolletino della Società Paleontologica Italiana* 17, 176–256.
- Wild, R., 1990. Ein Flugsaurierrest (Reptilia, Pterosauria) aus der Unterkreide (Hauterive) von Hannover (Niedersachsen). *Neues Jahrbuch für Geologie und Paläontologie. Abhandlungen* 181, 241–254.