

HISTORIA NATURAL

Tercera Serie | Volumen 4 (2) | 2014/5-12

FIRST RECORD OF THE GENUS *Angolabatis* (RAJIFORMES, HYPSOBATIDAE) FROM THE LATE CRETACEOUS OF PATAGONIA, ARGENTINA

Primer registro del género Angolabatis (Rajiformes, Hypsobatidae) del Cretácico Tardío de Patagonia, Argentina

Sergio Bogan¹ and Federico L. Agnolin^{1,2}

¹Fundación de Historia Natural “Félix de Azara”, Departamento de Ciencias Naturales y Antropológicas, Universidad Maimónides, Hidalgo 775 piso 7 (C1405BDB) Ciudad Autónoma de Buenos Aires, Argentina. sergiobogan@yahoo.com.ar

²Laboratorio de Anatomía Comparada y Evolución de los Vertebrados, Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Av. Ángel Gallardo 470 (C1405BDB) Ciudad Autónoma de Buenos Aires, Argentina. fedeagnolin@yahoo.com.ar



Abstract. Isolated teeth representing an indeterminate species of the batoid hypsobatid genus *Angolabatis* are described. The specimens come from the Late Cretaceous (Campanian-Maastrichtian) deposits of the Allen Formation at northern Patagonia, Río Negro province, Argentina. It constitutes the first record of the family in South America, and the first record of *Angolabatis* outside Africa, being an important addition to Mesozoic ichthyofaunas of the continent.

Keywords. *Angolabatis*, Hypsobatidae, Allen Formation, Patagonia, Argentina.

Resumen. En la presente contribución se describen dientes aislados referibles a una especie indeterminada del género de batoideo Hypsobatidae *Angolabatis*. Los especímenes provienen de depósitos del Cretácico Tardío (Campaniano-Maastrichtiano) de la Formación Allen, en la provincia de Río Negro, Patagonia Norte, Argentina. Este material constituye el primer registro de la familia en Sudamérica y el primero para el género *Angolabatis* fuera de África, siendo una importante adición a las ictiofaunas mesozoicas del continente.

Palabras clave. *Angolabatis*, Hypsobatidae, Formación Allen, Patagonia, Argentina.

INTRODUCTION

The family Hypsobatidae was described by Cappetta (1992) with the aim to include several poorly known genera from the Cretaceous of Europe, North America, and Africa (Cappetta, 1992; Antunes and Cappetta, 2002). Although it was referred to the Rhinobatoidei by Cappetta (1992; see also Antunes and Cappetta, 2002), the phylogenetic affinities of the hypsobatids are still uncertain (Underwood, 2006). This poorly known clade is only represented by isolated teeth coming from the Campanian-Maastrichtian time span (Cappetta, 1992; Underwood, 2006). The Hypsobatid record is mainly restricted to the Northern Hemisphere, especially North America and Europe, whereas in the Southern Hemisphere is only known by some records at the North and Central Africa (Cappetta, 1987; Antunes and Cappetta, 2002). The rays com-

posing this peculiar family exhibit slightly heterodonty and robust teeth with smooth occlusal surfaces (Cappetta, 1992) conforming a mosaic of crushing teeth (Cappetta, 1987). The Hypsobatidae were erected in order to include the extinct genera *Hypsobatis*, *Youssoubatis*, *Pseudohypolophus*, and *Protoplatyrhina* (Cappetta, 1992); later, Antunes and Cappetta (2002) included the new genus *Angolaia*. However, this name was preoccupied by a living insect, and thus Antunes and Cappetta (2006) replaced it by the name *Angolabatis*. This genus is only known by the species *A. benguelaensis* (Antunes and Cappetta, 2002). It is represented by isolated teeth coming from its type locality, Quimbala, at the Benguela Basin, Angola, Africa (Antunes and Cappetta, 2002). The available material was recovered from Late Cretaceous, Late Campanian-Maastrichtian marine beds of the "Margas con *Inoceramus*" (Antunes and

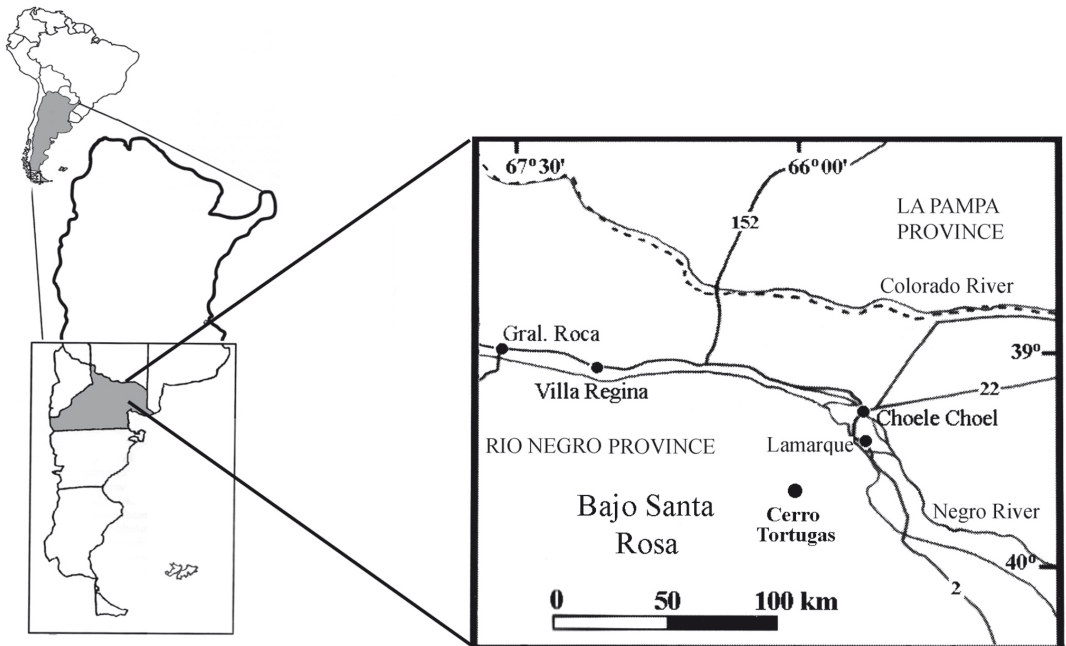


Figure 1 - Map showing the fossiliferous locality where the specimens of *Angolabatis* sp. were found.

Cappetta, 2002). In Argentina, the Mesozoic batoid record is still patchy and biased. From Jurassic beds, an indeterminate batoid was recovered from the Vaca Muerta Formation (Tithonian) of Neuquén province, Patagonia (Cione, 1999). From the Late Cretaceous, several authors reported indeterminate batoid remains from several localities from the Allen, Los Alamitos and Loncoche Formations (Cione, 1987; Arratia and Cione, 1996; González Riga, 1999; Martinelli and Forasiepi, 2004). From Maastrichtian beds of Northwestern Argentina Salta Province, the batoid *Pucapristis branisi* has been reported from the Yacoraite Formation (Schaeffer, 1963; Powell, 1979). More recently, Bogan and Gallina (2011) recognized the presence of the species *Hypolophodon sylvestris* for the Late Maastrichtian Jagüel Formation, at Río Negro province, Patagonia (see also Bogan and Agnolin, 2010), which was later considered as a new species by Cione *et al.* (2013) on the basis of new and abundant specimens.

The aim of the present paper is to describe and discuss the presence of the batoid genus *Angolabatis* coming from the Late Cretaceous beds of the Allen Formation, in a fossiliferous locality placed in Northeastern Patagonia, Río Negro province, Argentina (Figure 1).

SYSTEMATIC PALEONTOLOGY

Chondrichthyes Huxley, 1880

Elasmobranchii Bonaparte, 1838

Rajiformes Compagno, 1973

Hypsobatidae Cappetta, 1992

Angolabatis Antunes and Cappetta, 2006

Angolabatis sp.

Referred material. MML-PV 1230 (Museo Municipal de Lamarque, Colección Paleontología de Vertebrados, Lamarque, Río

Negro, Argentina), anterior tooth. Measurements: maximum length, 72 1,65 mm; maximum crown width, 1,8 mm (Figure 2). MML-PV 1231, lateral tooth. Measurements: maximum length, 75 1,7 mm; maximum crown width, 2,2 mm (Figure 2).

LOCALITY AND HORIZON

The specimens here reported were collected in Cerro Tortuga fossiliferous locality at Santa Rosa Basin (see Novas *et al.*, 2009), Río Negro province, Patagonia, Argentina. This locality is placed at 39°26'50.S, 67°19'20.W (Figure 1). It is characterized by the presence of extensive outcrops belonging to the Campanian-Maastrichtian (Late Cretaceous) Allen Formation (Leanza *et al.*, 2004). The deposits of the Allen Formation comprise siltstones and sandstones showing evidence of a lacustrine and fluvial environment (Casadio, 1994). Cerro Tortuga yielded a large amount of fossil invertebrates and vertebrates, including freshwater molluscs mammals, birds, dinosaurs, frogs, turtles, lizards, snakes and a wide variety of fresh-water fishes, as for example, isolated batoid vertebrae (Brito, 1997; Coria, 2001; Clarke and Chiappe, 2001; Hugo and Leanza, 2001; Hope, 2002; Martinelli and Forasiepi, 2004; Apesteugia and Rougier, 2007; Novas *et al.*, 2009; Rougier *et al.*, 2009; Bogan *et al.*, 2010, 2011).

The teeth here reported were recovered in tabular and finely stratified siltstones and fine sandstone beds approximately 40 m below the top of the Allen Formation, where other authors recovered abundant faunistic remains (Rougier *et al.*, 2009). The newly reported individuals were obtained by means of sieving. Together with the specimens here described were found several undetermined rhinobatoid teeth,

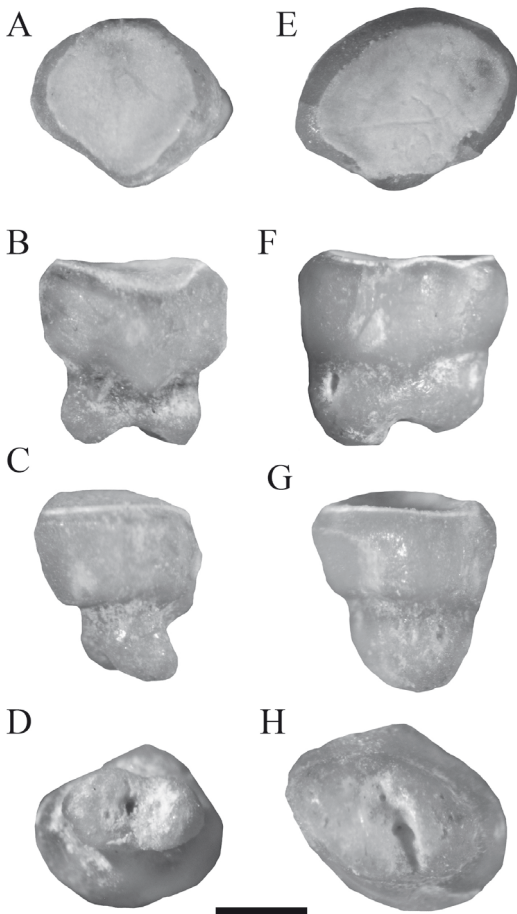


Figure 2 - *Angolabatis* sp. A-D, anterior tooth (MML-PV 1230) in A, occlusal; B, lingual; C, left lateral; and D, basal views. E-H, lateral tooth (MML-PV 1231) in E, occlusal; F, lingual; G, left lateral; and H, basal views. Scale bar, 1 mm.

aspidorhynchid scales, and small-sized siluriform spines, material that is still under study by present authors.

DESCRIPTION

The teeth are small (less than 2.5 mm.), with high and smooth crowns which are

rounded in contour. The crown is slightly taller than the roots. In occlusal view the lateral extremities of the crown are rounded, and the labial margin exhibits a gently convex outline. The lingual margin in occlusal view is subtriangular in contour. The occlusal surface is slightly concave. The central uvula is massive and of wide base, but is slightly elongate. There are no lateral uvulae.

The root is proportionally small, narrower than the crown. It is not lingually displaced. It is bilobate and shows a deep and wide central sulcus with a large central foramen. The marginal foramina are present, and the lingual edge of the root lobes is indented at its level. At the limit between the crown and the root there are several irregularly disposed nutrient foramina.

There is slight heterodonty among the tooth row a condition reminiscent to the species *A. benguelaensis* (Antunes and Cappetta, 2002). The anterior tooth is narrower than the lateral tooth, and shows a concave lateral margin of the root, near the crown-root boundary. The lateral tooth shows a transversely wider occlusal surface and the central sulcus of the root is obliquely oriented.

DISCUSSION

The specimens here described may be included within Hypsobatidae on the basis of the following unique combination of characters (Cappetta, 1992): slightly heterodont teeth with robust crushing surfaces, holaulacorhize bilobate roots, absent transverse carina on its occlusal surface, and smooth enameloid on its occlusal surface. As indicated by Antunes and Cappetta (2002) this simple crushing tooth morphology is present only in the Cretaceous gen-

era *Pseudohypolophus*, *Angolabatis*, *Protoplatyrhina*, *Youssoubatis*, and *Hypsobatis* (see Cappetta, 1987, 1992). The described material is here included within *Angolabatis* by having a unique combination of derived features, including small size (less than 3 mm), crown slightly dorsoventrally taller than the root, the lateral extremities of the occlusal surface are not acute, absence of lingual cingulum, lingual surface with a well defined and short median uvula, transversely narrow root with its basal face showing a well defined central sulcus (Antunes and Cappetta, 2002). The above mentioned combination of characters allows including MML PV-1230 and MML PV-1231 within the genus *Angolabatis*.

From other Hypsobatidae, the specimens differs from *Pseudohypolophus* by having smaller teeth, the roots more transversely compressed at its base, and the crown with a well developed median uvula (Antunes and Cappetta, 2002). Moreover, the specimens differ from *Hypsobatis* by having lower crowns, lacking the basal lingual cingulum, and an occlusal transverse crest (Cappetta, 1992; Antunes and Cappetta, 2002). It is also clearly distinguished from *Youssoubatis* because the latter has acute lateral angles (Cappetta, 1992). In addition, it differs from the distantly related genus *Protoplatyrhina* by having a taller crown, with clearly differentiated occlusal surface (Antunes and Cappetta, 2002). In addition, the root in *Angolabatis* is much more transversely compressed at its base (Antunes and Cappetta, 2002), a feature clearly present in MML PV-1230 and MML PV-1231.

The specimens MML PV-1230 and MML PV-1231 are distinguished from *A. benguelaensis*, the only previously known species of the genus, by the following features: 1) occlusal surface in dorsal view with rounded lateral extremities and convex posterior

margin (vs. truncate lateral extremities and acute anterior and posterior margins in *A. benguelaensis*), 2) concave occlusal surface (vs. flat in *A. benguelaensis*), 3) anterior tooth with lateral margins of root concave near the crown root contact (vs. straight to convex in *A. benguelaensis*), and 4) central sulcus of tooth roots transversely wider than in *A. benguelaensis*. In spite of such remarkable differences, the scanty material from Patagonia is not enough to name a new species, and thus, are here regarded as an indeterminate species *Angolabatis*.

The type species of the genus *Angolabatis*, *A. benguelaensis* was reported associated with a large assemblage of marine fishes, suggesting a marine genesis of the deposits (e.g. *Echinorhinus*, *Chlamydoselachus*, *Notidanodon*, *Brachyrhizodus*; Antunes and Cappetta, 2002). On the hand, *Angolabatis* sp. here reported was recovered in a continental basin, associated with several freshwater fishes (e.g. *Belonostomus lamarquensis*, Amiidae, Dipnoi; Bogan *et al.*, 2010, 2011; Agnolin, 2010; Cione and Gouiric, 2012). This suggests that the genus *Angolabatis* probably possessed some degree of adaptive plasticity allowing the settlement of different environments as do many extant batoid species.

CONCLUSIONS

Present paper reports for the first time the Hypsobatidae family for the Mesozoic of South America. This record is based on an indeterminate species of the genus *Angolabatis* that up to the date was considered as monotypic, and restricted to its geographical distribution to the African continent (Antunes and Cappetta, 2002). *Angolabatis benguelaensis*, the genotype species, was reported in sediments from the latest Cre-

taceous (Campanian-Maastrichtian). Similarly, the records of *Angolabatis* sp. here described come from Campanian-Maastrichtian sedimentary units. The coetaneous presence of *Angolabatis* in both western Africa and South America indicates that this taxon was probably widely distributed among Southern Hemisphere. Moreover, *Angolabatis* sp. constitutes the southernmost record for the genus and the family.

ACKNOWLEDGEMENTS

We specially thank our friend Daniel Cabaza, director of the MML for his help during the revision of the collections under his care. We also thank Liliana López from MML for logistic support. Flavia Zorzi helped with the general confection of the manuscript. We thank the Fundación de Historia Natural "Félix de Azara" and Universidad Maimónides for their help and general support. Finally we thank Jürgen Pollerspöck and Miguel Antunes for their help with some bibliographical sources.

BIBLIOGRAPHY

- Agnolin, F. 2010. A new species of the genus *Atlantoceratodus* (Dipnoiformes: Ceratontoidei) from the uppermost Cretaceous of Patagonia and a brief overview of fossil dipnoans from the Cretaceous and Paleogene of South America. *Brazilian Geographical Journal, Geosciences and Humanities Research Medium*, 1: 162-210.
- Antunes M.T. and Cappetta, H. 2002. Selaciens du Cretace (Albien-Maastrichtien) de Angola. *Palaeontographica Abteilung A*, 264: 85-146.
- Antunes, M.T. and Cappetta, H. 2006. *Angolabatis* nom. nov., a replacement name for the Cretaceous genus *Angolaia* Antunes and Cappetta, 2002 (Chondrichthyes: Rajiformes), a preoccupied name. *Palaeovertebrata*, 34: 27-28.
- Apestequia, S. and Rougier, G.W. 2007. A late Campanian sphenodontid maxilla from northern Patagonia. *American Museum Novitates*, 3581: 1-11.
- Arratia, G. and Cione, A. 1996. The Record of Fossil Fishes of Southern South America. *Müncher Geowissenschaftliche Abhandlungen, Reihe A. Geologie und Paläontologie*, 30: 9-72.
- Bogan, S. and Agnolin, F.L. 2010. Primera ictiofauna marina del Cretácico Superior (Formación Jagüel; Maastrichtiano) de la provincia de Río Negro, Argentina. *Papéis Avulsos de Zoología*, 50: 175-188.
- Bogan, S. and Gallina, P.A. 2011. Consideraciones sobre el registro de *Hypolophodon* (Chondrichthyes, Myliobatiformes) en el techo de la formación Jagüel (Maastrichtense), provincia de Río negro, Argentina. *Studia geologica Salmanticensis*, 47: 57-67.
- Bogan, S., Taverne, L. and Agnolin, F.L. 2010. First fossil record of an amiid fish (Halecomorphi, Amiidae) from the Latest Cretaceous of Patagonia, Argentina, and comments on the status of *Pappichthys patagonica* Ameghino, 1906 (Teleostei, Osteoglossidae). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre*, 80: 163-170.
- Brito, P.M. 1997. Révision des Aspidorhynchidae (Pisces, Actinopterygii) du Mésozoïque: ostéologie, relations phylogénétiques, données environnementales et biogéographiques. *Geodiversitas*, 19: 681-772.
- Cappetta, H. 1987. Chondrichthyes II: Mesozoic and Cenozoic Elasmobranchii. In: Schultze, H. P. (Ed.), *Handbook of Paleichthyology, Volume 3B*. Gustav Fischer Verlag, Stuttgart, 193 pp.
- Cappetta, H. 1992. Nouveaux Rhinobatoidei (Neoselachii, Rajiformes) a denture specialisee du Maastrichtien du Maroc. Remarques sur l'evolution dentaire des Rajiformes et des Myliobatiformes. *Neues Jahrbuch Fur Geologie und Palaontologie, Abhandlungen*, 187: 31-52.
- Casadio, S.A. 1994. *Estratigrafía y paleontología del intervalo Maastrichtiano-Daniano en el Occidente de la Provincia de La Pampa, Argentina*. Ph.D. thesis, Córdoba, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Córdoba, 420 pp.
- Cione, A.L. 1987. The Late Cretaceous fauna of Los Alamitos, Patagonia, Argentina. The fishes. *Revista del Museo Argentino de Ciencias Naturales*, 3: 111-120.
- Cione, A.L. 1999. First report of a Jurassic ray out-

- side of Europe. In: Arratia, G. and Schultze, H. P. (Eds.), *Mesozoic Fishes 2 - Systematics and Fossil Record*. Verlag Dr. Friedrich Pfeil, München, 21-28.
- Cione, A.L. and Gouiric, S. 2012. *Metaceratodus kaopen* comb. nov. and *M. wichmanni* comb. nov., two Late Cretaceous South American species of an Austral lungfish genus (Dipnoi). *Alcheringa*, 36: 203-216.
- Cione, A.L., Tejedor, M. and Goin, F.J. 2013. A new species of the rare batomorph genus *Hypolophodon* (?latest Cretaceous to earliest Paleocene, Argentina). *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen*, 267: 1-8.
- Clarke, J.A., and Chiappe, L.M. 2001. A new carinate bird from the Late Cretaceous of Patagonia (Argentina). *American Museum Novitates*, 3323: 1-23.
- Coria, R.A. 2001. New theropod from the Late Cretaceous of Patagonia. *Mesozoic Vertebrate Life*, 1: 3-9.
- González Riga, B.J. 1999. Hallazgo de vertebrados fósiles en la Formación Loncoche, Cretácico Superior de la provincia de Mendoza, Argentina. *Ameghiniana*, 36: 401-410.
- Hope, S. 2002. The Mesozoic radiation of Neornithes. In: Chiappe, L.M. and Witmer, L.M. (Eds.), *Mesozoic birds: above the heads of dinosaurs*. Berkeley University Press, Berkeley, 168-218.
- Hugo, C.A. and Leanza, H.A. 2001. Hoja Geológica 3966-III, Villa Regina, provincia Río Negro. *Instituto de Geología y Recursos Naturales, SEGEMAR, Boletín*, 309: 1-53.
- Leanza, H., Apesteeguía, S., Novas, F.E., and De La Fuente, M.S. 2004. Cretaceous terrestrial beds from the Neuquén Basin (Argentina) and their tetrapod assemblages. *Cretaceous Research*, 25: 61-87.
- Martinelli, A.G. and Forasiepi, A. M. 2004. Late Cretaceous vertebrates from Bajo de Santa Rosa (Allen Formation), Río Negro province, Argentina, with the description of a new saurpoid dinosaur (Titanosauridae). *Revista del Museo Argentino de Ciencias Naturales*, 222: 257-305.
- Novas, F.E., Pol, D., Canale, J.I., Porfiri, J.D. and Calvo, J.O. 2009. A bizarre Cretaceous theropod dinosaur from Patagonia and the evolution of Gondwanan dromaeosaurids. *Proceedings of the Royal Society of London B*, 276: 1101-1107.
- Powell, J.E. 1979. Sobre una asociación de dinosaurios y otras evidencias del Cretácico superior de la región de La Candelaria, prov. de Salta, Argentina. *Ameghiniana*, 16: 191-204.
- Rougier, G.W., Chornogubsky, L., Casadio, S., Arango, N.P., and Giallombardo, A. 2009. Mammals from the Allen Formation, Late Cretaceous, Argentina. *Cretaceous Research*, 30: 223-238.
- Schaeffer, B. 1963. Cretaceous fishes from Bolivia, with comments on Pristid evolution. *American Museum Novitates*, 2159: 1-20.
- Underwood, C. J. 2006. Diversification of the Neoselachii (Chondrichthyes) during the Jurassic and Cretaceous. *Paleobiology*, 32: 215-235.

Recibido: 18/07/2014 - Aceptado: 15/10/2014