

Megascyliorhinus trelewensis (Neoselachii) in the ?Middle-Upper Miocene of Paraná, Central eastern Argentina

Alberto Luis CIONE¹, Jorge MENNUCCI¹, Leandro PÉREZ², and María Julia BARLA³

Abstract: *Megascyliorhinus trelewensis* (NEOSELACHII) IN THE ?MIDDLE-UPPER MIOCENE OF PARANÁ, CENTRAL EASTERN ARGENTINA.-The third and youngest record of the species *Megascyliorhinus trelewensis* is described from the uppermost beds of the Paraná Formation outcropping in the Provincia de Entre Ríos, Argentina. *Megascyliorhinus trelewensis* is an endemic marine South American species of a rare and extinct genus. The species of *Megascyliorhinus* were widely distributed and appears to have been mainly restricted to warm temperate waters.

Key words: Elasmobranchii, South America, Argentina, Entre Ríos, Miocene.

Resumen: *Megascyliorhinus trelewensis* (NEOSELACHII) EN EL MIOCENO MEDIO?-SUPERIOR DE PARANÁ, ARGENTINA ORIENTAL. El tercer y más joven registro de la especie *Megascyliorhinus trelewensis* se describe a partir de dientes hallados en las capas superiores de la Formación Paraná aflorantes en la Provincia de Entre Ríos, Argentina. *Megascyliorhinus trelewensis* es una especie endémica de Sudamérica de un género raro y extinto. Las especies de *Megascyliorhinus* se distribuyen ampliamente y parece haber estado restringidas a aguas templado cálidas.

Palabras clave: Elasmobranchii, Sudamérica, Argentina, Entre Ríos, Mioceno.

Introduction

The extinct genus *Megascyliorhinus* was created by Cappetta and Ward (1977) for including the Miocene species *Rhincodon miocenicus* Antunes y Jonet, 1970 from Portugal and Morocco and the Eocene species *M. cooperi* from England. Posteriorly, the genus was recorded in other continents (see below).

A new species, *M. trelewensis*, was described from early Miocene beds in Patagonia (Cione, 1986). Recently, one tooth of this species was found in sediments of the same age from central Chile (Suárez et al., 2006). In this note, we report the occurrence of *M. trelewensis* in the ?middle-late Miocene Paraná Formation of Argentina.

Geology

The continental and marine beds in the Paraná riverside cliffs in Entre Ríos, Argentina have been scientifically known since 1827 when Alcide D'Orbigny visited the area (D'Orbigny, 1842; Figs. 1, 2). The relationships between the marine and continental units cropping out in the cliffs were studied by many researchers. Most authors identi-

1. División Paleozoología Vertebrados, Museo de La Plata, 1900 La Plata, Argentina
e-mail: acione@museo.fcnym.unlp.edu.ar

2. División Paleozoología Invertebrados, Museo de La Plata, 1900 La Plata, Argentina

3. Facultad de Ciencias Naturales y Museo, 122 y 60, 1900 La Plata, Argentina

fied only one marine unit recognizable (Paraná Formation) at the base of the cliffs and in subsoil (Ameghino, 1906; Scartascini, 1954; Aceñolaza, 1976; Herbst and Zabert, 1987). The Paraná Formation is overlain by a thick fluvial (Ituzaingó Formation) and a terrestrial sequence. In subsoil, the Paraná Formation includes deposits of fluvial origin. Aceñolaza (1976) suggested that the marine beds located at higher levels in the riverside cliffs are relicts of an ancient topography that had been interpreted as different marine incursions, especially by Frenguelli (1920). The Paraná Formation is mainly composed by green mudstones, sands, limestones, and several oyster banks (Aceñolaza, 1976, 2000). The Paraná Formation was deposited during the large marine encroachment that covered the Chacopampean region during the middle Miocene and part of the late Miocene ("Mid Transgressive Onlap Sequence;" see Uliana and Biddle, 1988; del Río, 1990, 1991; Cione et al., 2000, 2005). Mammals occurring in the base of the overlying Ituzaingó Formation are Huayquerian in age in the South American chronology (Cione, 2000; Cione and Tonni, 2005). The Huayquerian ranges from about 9 Ma to about 6 Ma (Tortonian, late Miocene; sea Flynn and Swisher, 1995; Cione et al., 2000, 2005; Cione and Tonni, 2005; Woodburne et al., 2006).

Section at La Juanita

The material was collected from marine rocks belonging to the uppermost part of the Paraná Formation exposed in a locality called La Juanita (GPS: 31°52'46"S 60°38'59"W; Figure 1) (Pérez et al., 2001). This locality is close to the Aldea Brasilera village in the Departamento de Diamante, Provincia de Entre Ríos. The section exposed measures seven meters (Figure 2). The lowermost bed includes alternating whitish to yellowish sands and green siltstones, both strongly bioturbated by *Ophiomorpha nodosa*.

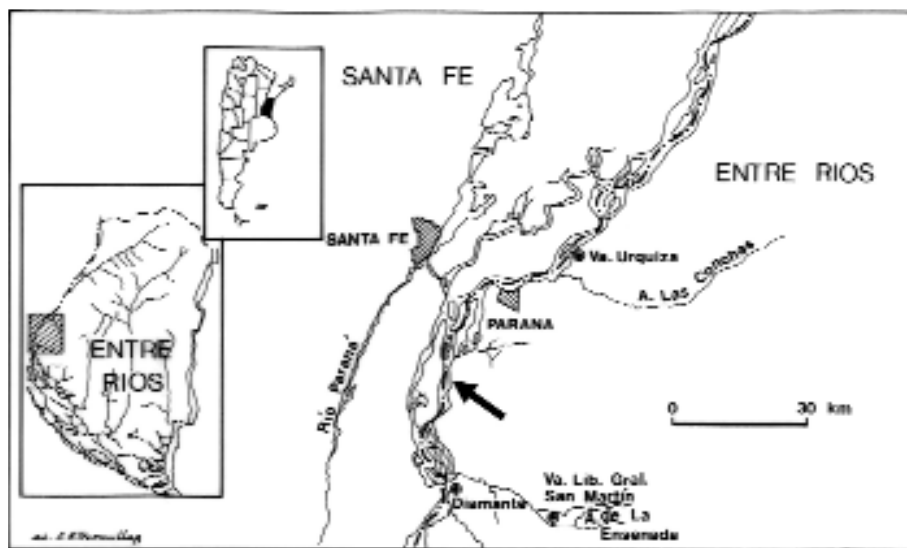


Figure 1: Location map. La Juanita, Arroyo Ensenada. The arrow point to the locality

The rhythmic stratification is interrupted by an erosional bed of lenticular geometry, with a lateral extension of at least 150 meters along the cliff. It shows a normal gradation from beds with sabulitic matrix at the bottom to sandy matrix at the top, forming a coquina with bioclasts of different grain sizes. Towards the middle of the section there is a strong carbonate cementation between the bioclasts and the siliceous ones. The maximum thickness of this bed is about 50 cm. A rich vertebrate and invertebrate fauna is present in the lens. The base of the section is covered by debris fallen from the cliff and the top by vegetation.

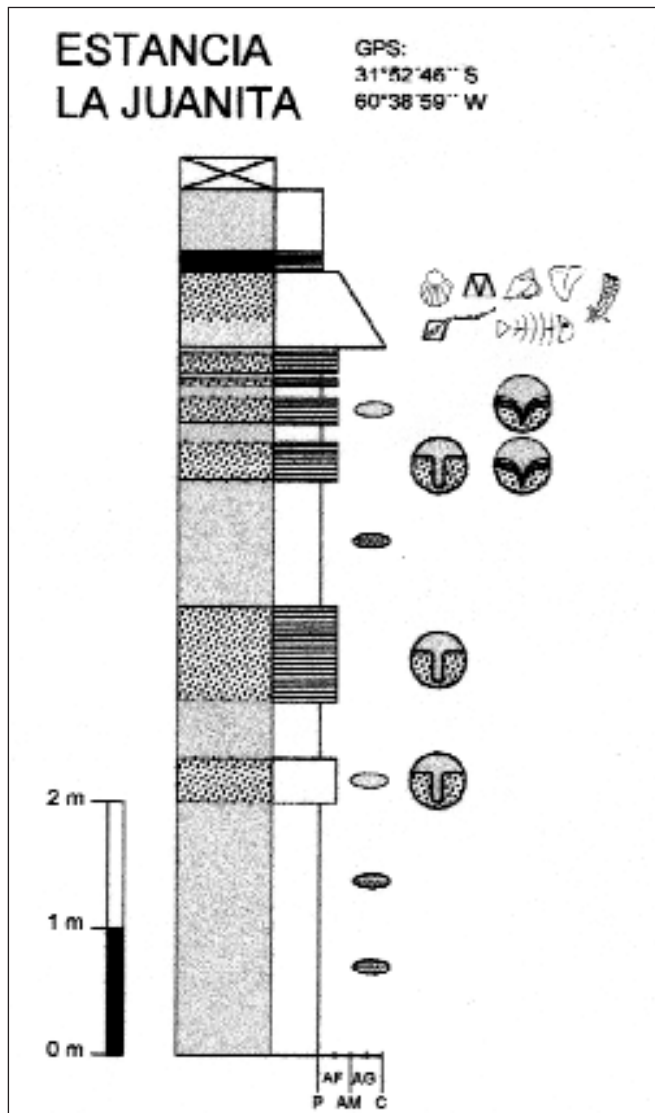


Figure 2: Stratigraphic section at La Juanita

Systematics

Elasmobranchii

Neoselachii

Carcharhiniformes

Carcharhinidae

Genus *Megascyliorhinus* Cappetta and Ward, 1977*Megascyliorhinus trelewensis* Cione, 1986

Figure 3

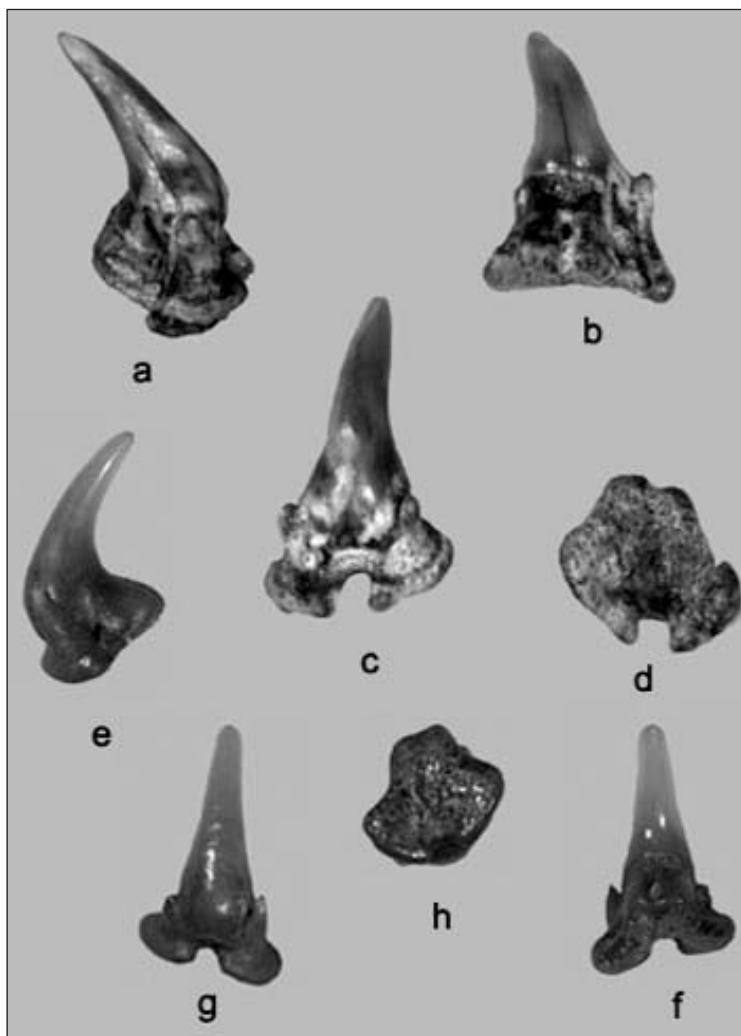


Figure 3: *Megascyliorhinus trelewensis*. Anterior teeth. a-d. MLP 86-II-27-44 (Gaiman Formation, early Miocene from the lower río Chubut valley, Chubut, Argentina). e-h. CICYTTP-PV-P-1-126 (Paraná Formation, middle-early late Miocene from the La Juanita, Entre Ríos, Argentina). a, e: lateral view. b, f: lingual view. c, g: labial view. d, h: basal view. The bar is one mm.

Material

CICYTTP-PV-P-1-126, CICYTTP-PV-P-1-127, CICYTTP-PV-P-1-127, CICYTTP-PV-P-1-128, four anterior teeth. Paraná Formation fossiliferous bed at La Juanita, Aldea Brasileira, Entre Ríos, Argentina. The material is deposited in the Centro de Investigaciones Científicas y Técnicas y Transferencia, Dr. Materi y España 3105 Diamante, Entre Ríos, Argentina. Another tooth was found by ALC in the Florentino Ameghino Collection of the Museo Argentino de Ciencias Naturales “Bernardino Rivadavia,” Angel Gallardo 470, Buenos Aires, Argentina. It was labeled “*Squatina*” by Florentino Ameghino.

Diagnosis

Megascyliorhinus of large size; crown curving lingually; labial face very strongly and deeply striated; lingual face with delicate, sinuous, anastomosing striations; lateral cutting edge sometimes reaching the base of the crown; lobes of the root diverging strongly; base of the root not flat, but with lobes inclined toward anterior central line in the lingual region. Basal root groove never reaching lingual face or absent. Lateral denticles differently developed. Lateroposterior teeth stocky (Cione, 1986).

Description

Teeth present crown strongly curved lingually. The labial and lingual faces are convex and there are almost parallel striations on the lower third of the both lingual and labial faces. The cutting edges are not well preserved, and they extend a short distance below the crown apex. Striations on the lingual face extend one-third from crown base, they are fine, less deep, rather sinuous and more numerous and closer than those of the labial face. On the labial face there are strong and shorter striations. The root-crown junction is constricted. A sulcus, interrupted on the labial face separates the divergent root lobes, which are of different size. The lingual region has a protuberance with a mid vertical groove. The lingual protuberance bears two lateral foramina, mesolingual and distolingual, and a central foramen on the vertical groove. The teeth have two straight and well developed lateral denticles, round in cross section, with a striated crown surface. The baso-apical section of the crown shows an orthodontine-type structure.

Comments

Antunes y Jonet (1970) formerly attributed the species *R. miocenicus* to the whale shark genus *Rhiniodon* (using the junior synonym *Rinobodon*; Orectolobiformes, Rhiniodontidae). Later, Cappetta and Ward (1977) created the genus *Megascyliorhinus* for the species *M. miocenicus* and *M. cooperi* and assigned it to the family Carcharhinidae of the order Carcharhiniformes. Some other authors consider it referable to Family Parascyllidae of Order Orectolobiformes (e.g. Fitzgerald, 2004). We here refer the genus to Order Carcharhiniformes according to external characters and histology (see also Adnet, 2000).

Stratigraphic and geographic distribution of *Megascyliorhinus*

The extinct genus *Megascyliorhinus* has been found, always with relatively rare specimens, from the Eocene (Ypresian) of England (Cappetta and Ward, 1977), the Oligocene of Czech Republic ((Brzobohaty and Kalabis, 1970; Cappetta and Ward, 1977) and Belgium (Baut and Génault, 1999), the Miocene (Helvettian and probably Serravallian) of France (Cappetta and Ward, 1977), United States (Purdy et al, 2001; Bourdon, 2007) and Japan (Hiroyuki and Karasawa, 1991), late Miocene-early Pliocene of Australia (Fitzgerald, 2004), the Pliocene of Tunisia (Cappetta and Ward, 1977), the Tertiary of Chatham Rise (Pfeil, 1984), the Oligocene to Pleistocene of New Zealand (Keyes, 1984). The South American record is restricted to the species *M. trelewensis* in the Lower Miocene of Patagonia and Chile so far. The occurrence of the South American endemic species *M. trelewensis* in Paraná is the first record of the genus in younger beds and the northernmost in the continent. No Pliocene record is known in South America (e.g. in Peru, where there is an abundant elasmobranch record). The extremely abundant Eocene record of Antarctica does not include *Megascyliorhinus* (Cione, 1978; Arratia and Cione, 1996). Besides, the Paraná Formation ichthyofauna does not appear to be tropical (Cione et al., 2000, 2005). Consequently, according to the present knowledge, the genus had a bipolar distribution and appears to have been restricted to warm temperate waters.

Paleoecology

Megascyliorhinus species are marine taxa. However, the faunal assemblage found at La Juanita includes organisms from diverse environments. Paleoecological analysis of the bioclastic bed received special attention, as it includes both marine and freshwater organisms, but also includes terrestrial tetrapods.

Among the marine fossils found there are large numbers of shell belonging to molluscs that inhabited nearshore environments. This is the case of pectinids, arcoids, mytiloids and veneroids. There are also marine fish such as sharks and ray, together with marine turtles and cetaceans. Also abundant are brackish water molluscs such as macrtrids oysters and *Erodona*, among others. Among the fishes, there are some amphibiotic or continental taxa such as drums, and doradid and ariid catfishes. Less abundantly, some terrestrial vertebrates occur. They are represented by few bird bones, xenarthran plates, and rodent teeth. These fossils may have been added to the sediment during the storm event that probably originated the shelled deposit.

This fossil assemblage clearly shows an environmental averaging, which produced the mixed array of taxa recorded at this locality. However, it is clear that the assemblages from different environments were coetaneous, because the remains show little evidence of transport as it is shown by the fine ornamentation details preserved in the mollusc shells and the intact edges of the smaller valves.

Acknowledgments

We would like to thank to Carlos Steger, for loaning part of the material, and the Agencia Nacional de Promoción Científica y Tecnológica, Consejo Nacional de Investigaciones Científicas y Técnicas, Comisión de Investigaciones Científicas de la Provincia de Buenos Aires, Universidad Nacional de La Plata, and Internacional Association of Sedimentology for permanent financial support.

Bibliography

- Aceñolaza, F.G. 1976. Consideraciones bioestratigráficas sobre el Terciario marino de Paraná y alrededores. *Acta Geológica Lilloana* 13:91-107.
- Aceñolaza, F. G. 2000. La Formación Paraná (Mioceno medio): estratigrafía, distribución regional y unidades equivalentes. *Serie Correlación Geológica* 14:9-28.
- Adnet, S. 2000. *Les Elasmobranches fossiles du Paleogene des Landes (Sud-Ouest, France) Implications dans la connaissance des communautés d'elasmobranches d'eaux profondes. Evolution des Squaliformes et paleoecologie.* Unpublished PhD dissertation. Université de Montpellier II, France. Pp. 412.
- Ameghino, F. 1906. Les formations sédimentaires du Crétacé et du Tertiaire de Patagonie, avec un parallèle entre leurs faunes mammalogiques et celles de l'ancien continent. *Anales del Museo Nacional de Historia Natural* 15: 1-568.
- Antunes, M.T. and A. C. Balbino. 2004. Os Carcharhiniformes (Chondrichthyes, Neoselachii) da Bacia de Alvalade (Portugal). *Revista Española de Paleontología* 19:73-92.
- Antunes, M.T. and S. Jonet. 1970. Requins de l'Helvétien supérieur et du Tortonien de Lisbonne. *Revista da Faculdade de Ciências de Lisboa* 16:119-280.
- Arratia, G. and A.L. Cione. 1996. The fossil fish record of Southern South America. In: G. Arratia (ed.) The fossil vertebrate record of Southern South America. *München Geowissenschaft Abhandlungen* 30: 9-72.
- Baut, J. P. and B. Génault. 1999. Les Elasmobranches des Sables de Kerniel (Rupélien), à Gellik, Nord Est de la Belgique. *Memoires of the Geological Survey of Belgium* 45:1-61.
- Bourdon, J. 2007. Lee Creek aka Aurora. A Neogene fauna from North Carolina. http://www.elasmo.com/frameMe.html?file=leecreek/sp_shrk1.html&menu=bin/menu_leecreek-alt.html
- Brzobohaty, R. and V. Kalabis. 1970. Die Fischzähne aus Pouzdrany (Pouzdrany-Schichten, Oligozän). *Casopis Moravského Musea*:41-50.
- Cappetta, H. and D. Ward. 1977. A new Eocene shark from the London Clay of Essex. *Palaeontology* 20:196-202.
- Cione A.L. 1978 Aportes paleoictiológicos al conocimiento de la evolución de las paleotemperaturas en el área austral del América del Sur durante el Cenozoico. Aspectos zoogeográficos y ecológicos conexos. *Ameghiniana* 15:183-208.
- Cione, A. L. 1986. A new *Megascyliorhinus* (Chondrichthyes, Galeomorphii) from the middle Tertiary of Patagonia. *Journal of Vertebrate Paleontology* 6:105-112.
- Cione, A. L., M. Azpelicueta, M. Bond, A. Carlini, J. Casciotta, M. A. Cozzuol, M. d. I. Fuente, Z. Gasparini, F. Goin, J. Noriega, G. J. Scillato-Yané, L. Soibelzon, E. Tonni, D. Verzi, and M. G. Vucetich. 2000. Miocene vertebrates from Entre Ríos province, Argentina. *Serie Correlación Geológica* 14:191-238.
- Cione, A.L., J.R. Casciotta, M.M. Azpelicueta, M.J. Barla and M.A. Cozzuol. 2005. Peces marinos y continentales del Mioceno del área mesopotámica argentina, procedencia estratigráfica y relaciones biogeográficas. *Miscelánea INSUGEO* 12: 49-64.
- Cione, A. L. and E. P. Tonni. 2005. Bioestratigrafía basada en mamíferos del Cenozoico superior de la región pampeana. In: R. d. Barrio, R. Etcheverry, M. F. Caballé, and E. Llambías (eds.) *Geología y Recursos Minerales de la Provincia de Buenos Aires. Relatorio del XVI Congreso Geológico Argentino* 11: 193-200. La Plata.
- Fitzgerald, E. M. 2004. A review of the Tertiary fossil Cetacea (Mammalia) localities in Australia. *Memoirs of Museum of Victoria* 61: 183-208.
- Flynn, J. J. and C. C. Swisher. 1995. Cenozoic South American Land-mammal ages: correlation to global geochronologies. In: W. A. Berggren, D. V. Kent, and J. Handerbol (eds.) *Geochronology, Time scales, and Correlation: Framework for a Historical Geology.* SEPM Special Publication: 317-333.
- Frenguelli, G. 1920. Contribución al conocimiento de la geología de Entre Ríos. *Boletín Academia Nacional de Ciencias de Córdoba* 24:55-256.
- Herbst, R. and L. L. Zabert. 1987. Microfauna de la Formación Paraná (Mioceno superior) de la cuenca Chaco-Paranense (Argentina). *Facena* 7:165-206.
- Hiroyuki, N. and H. Karasawa. 1991. Notes on *Megascyliorhinus miocaenicus* (Antunes and Donet, 1970)

- (Orectolobiformes: Elasmobranchii) from the Miocene Bihoku Group, Southwest Japan. *Bulletin of the Mizunami Fossil Museum* 18: 107-110.
- Keyes, I. W. 1984. New records of fossil elasmobranch genera *Megascyliorhinus*, *Centrophorus*, and *Dalatias* (Order Selachii) in New Zealand. *New Zealand Journal of Geology and Geophysics* 27:203-216.
- Orbigny, A d'. 1842. *Voyage dans l'Amerique meridionale*. P.Bertrand, Paris, 188 pp.
- Pérez, L., A. L. Cione, M. Griffin, and M. Muravchik. 2001. Estancia La Juanita, una nueva localidad con invertebrados y vertebrados de la Formación Paraná (Mioceno de la provincia de Entre Ríos, Argentina). *Ameghiniana. Resúmenes* 38:40R.
- Pfeil, F. Neoselachian teeth collected from phosphorite-bearing Greensand on Chatham Rise East of New Zealand. 1984. *Geological Jahrbuch* 65:107-115.
- Purdy, R., V. P. Schneider, S. Applegate, J. H. McLellan, R. L. Meyer, and B. H. Slaughter. 2001. The Neogene sharks, rays and bony fishes from Lee Creek Mine, Aurora, North Carolina. *Smithsonian Contributions to Paleobiology* 90:71-201.
- Río, C. del. 1990. Composición, origen y significado paleoclimático de la malacofauna "Entrerriense" (Mioceno medio) de la Argentina. *Anales de la Academia Nacional de Ciencias Exactas, Físicas y Naturales*. 42:207-226.
- Río, C. del. 1991. Revisión sistemática de los bivalvos de la Formación Paraná (Mioceno medio), provincia de Entre Ríos, Argentina. *Monografías de la Academia Nacional de Ciencias Exactas, Físicas y Naturales* 7:11-90.
- Scartascini, G. 1954. El límite Plio-Pleistoceno de la Provincia de Entre Ríos. *Revista del Museo Municipal de Ciencias Naturales de Mar del Plata* 1:55-77.
- Suárez, M., A. Encinas and D. Ward. 2006. An Early Miocene elasmobranch fauna from the Navidad Formation, Central Chile, South America. *Cainozoic Research* 4:3-18.
- Uliana, M.A. and K.T. Biddle. 1988. Mesozoic-Cenozoic paleogeographic and godynamic evolution of southern South America. *Revista Brasileira de Geociências* 18:172-190.
- Woodburne, M. O., A. L. Cione, and E. P. Tonni. 2006. Central American Provincialism and the Great American Biotic Interchange. In: Carranza-Castañeda, O. & E.H. Lindsay (eds.) *Advances in late Tertiary vertebrate paleontology in Mexico and the Great American Biotic Interchange. Publicación Especial del Instituto de Geología y Centro de Geociencias de la Universidad Nacional Autónoma de México* 4:73-101.

Recibido 20 de noviembre de 2007

Aceptado 15 de diciembre de 2007