AN ARIID CATFISH (OSTEICHTHYES: SILURIFORMES) FROM MARINE MIDDLE MIOCENE BEDS OF PATAGONIA. RECENT ARIID BIOGEOGRAPHY IN SOUTHERN SOUTH AMERICA

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ABSTRACT

The first record is given of a marine catfish from the Cenozoic of southern South America. The material comes from the Middle Miocene marine Puerto Madryn Formation at the Valdés Península, in east-central Patagonia. The southernmost geographic range of the family Ariidae in the West Atlantic coastal area is the San Matías Gulf (northern Patagonia). Ariids are only occasionally reported from southern Patagonia. The ariids represent the southernmost living record of the order Siluriformes.

Keywords: Siluriformes, Ariidae, Miocene, Patagonia, Biogeography.

RESUMEN

Se da a conocer el primer registro de un pez gato marino para el Cenozoico de la parte austral de América del Sur. El material procede de la Formación Puerto Madryn (Mioceno Medio) en Península Valdés, Patagonia centro-oriental. El límite meridional de la distribución habitual de la familia Ariidae en el Atlántico Occidental es el norte del Golfo de San Matías (norte de Patagonia). El registro en áreas más australes es ocasional. Los áriidos son los peces gato que alcanzan en la actualidad la distribución más austral dentro del orden Siluriformes.

Palabras clave: Siluriformes, Ariidae, Mioceno, Patagonia, Biogeografía.

INTRODUCTION

The family Ariidae is a mostly marine group of catfishes common in warm and warm-temperate regions. A few species stray into temperate areas that are warmer in summer (Burgess, 1989). Ariid remains have also been reported from marine Cenozoic units throughout the world (e.g. Casier, 1946).

In this note, a spine assignable to the Family Ariidae coming from Miocene beds at Península Valdés (Patagonia; Figure 1) is reported and the geographical distribution of ariid catfishes in Patagonia is commented.

Abbreviations: AMNH, American Museum of Natural History of New York, USA. MLP, Departamento Científico Zoología Vertebrados, Facultad de Ciencias Naturales y Museo, Argentina. MCPUCRS, Museo de Ciências, Pontificia Universidade, Rio Grande do Sul, Brasil. MZUSP, Museu de Zoologia, Universidade de São Paulo, Brasil.

RECENT MATERIAL FOR COMPARISON

Netuma barba, three specimens, one of them cleared and stained. Valeria del Mar, Buenos Aires province; MLP, uncat. Three dried skulls, Río Negro mouth; MLP, uncat. One specimen, sea coast, Rio Grande, Rio Grande do Sul, Brazil; MLP, uncat.

Netuma planifrons, One specimen, sea coast, Rio Grande, Rio Grande do Sul, Brazil; MLP, uncat.

Arius spixii, one specimen, Brazil, MZUSP, uncat.

Arius felis, one dry skeleton. AMNH 57713, without locality.

Bagre bagre, one specimen. Northern Brazil, MCPCURS 5638.

Bagre marinus, one specimen; Joao Pessoa, Paraiba, Brazil, MCPUCRS 14399. One dry skeleton; AMNH 56170, without locality.

Genidens genidens, one specimen. Rio Guaiba na Ilha de Junco, Rio Grande do Sul, Brazil. MCPUCRS 14703. One

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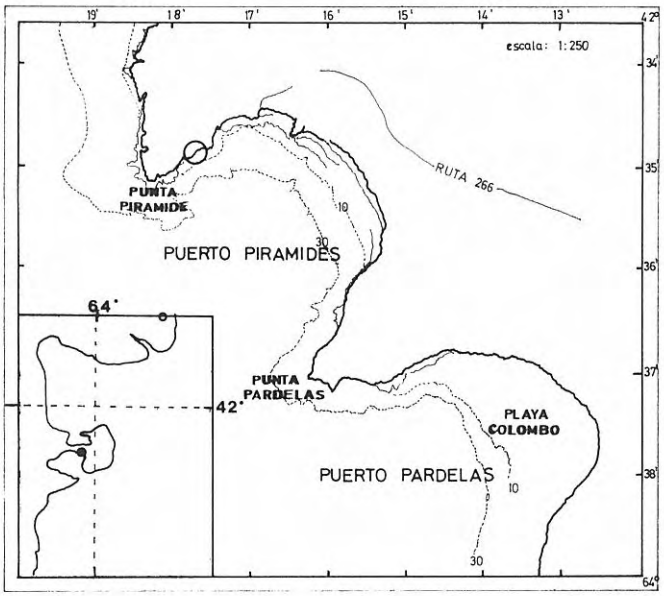

Figure 1. Location map.

specimen, sea coast, Rio Grande, Rio Grande do Sul, Brazil, MLP, uncat.

SYSTEMATIC PALEONTOLOGY

CLASS OSTEICHTHYES Howes, 1894
SUBCLASS ACTINOPTERYGII Klein, 1895
SUBDIVISION TELEOSTEI
(*sensu* Patterson & Rosen, 1977)
SUPERORDER OSTARIOPHYSI
(*sensu* Fink & Fink, 1981)
ORDER SILURIFORMES (*sensu* Chardon, 1968)
SUBORDER SILUROIDEI (*sensu* Grande, 1987)
Family **Ariidae** Günther, 1864

Ariidae indet.

Fig. 2a,b

Material

A complete dorsal spine. Personal collection of Guillermo Caille (Number N14), Trelew, Chubut, Argentina.

Occurrence

The material was collected by Guillermo Caille in the summer of 1989 in the marine cliffs to the Northwest of Puerto Pirámides, 1.5 km in direction to the Punta Pirámide sealions reserve, Península Valdés, Chubut province, Argentina (Figures 1, 3). The spine comes from a level of light brown sandstones located at 50 m over the lowest sea level (Figure 3) in the Puerto Madryn Formation, Middle Miocene (Feruglio, 1949; Haller, 1978; Río, 1988, 1990, 1991).

The Puerto Madryn Formation crops out in the Península Valdés area and is correlative with the Paraná Formation of central-eastern Argentina (Feruglio, 1949; Río, 1988, 1990, 1991). Those units correspond to the late part of the extensive marine encroachment that lasted from the Late Oligocene until the Middle Miocene ("Mid Tertiary Transgressive Onlap Sequence" of Williams & Hubbard,

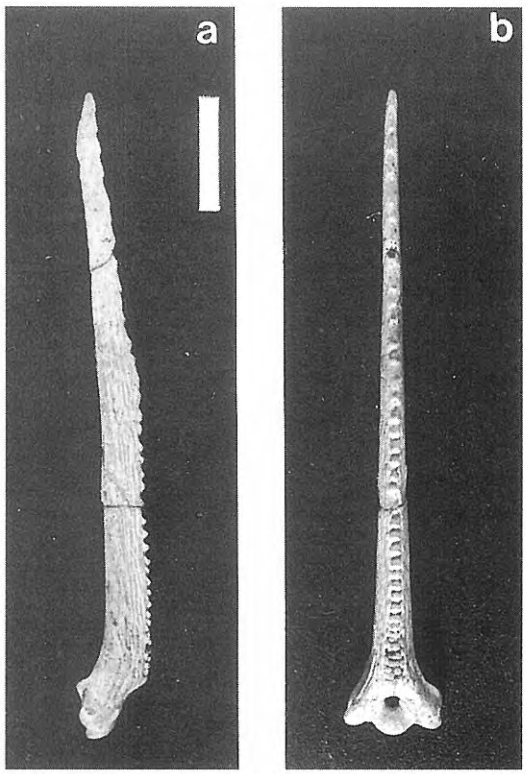

Figure 2. Ariidae indet. Dorsal spine. Guillermo Caille Personal collection (Number N14). A, lateral view. B, anterior view. Scale bar, 10 mm.

1984) paralleling the early Neogene trend of global eustatic rise (Haq *et al.*, 1987; Uliana & Biddle, 1988; Río, 1991). The marine influence reached Bolivia (Marshall *et al.*, 1993) and Paraguay (Sosa, 1979). The large areal extent of the Miocene marine deposits reveals that the mean freeboard of the plate interior was low (Uliana & Biddle, 1988). However, the marine deposits of Middle Miocene age are restricted to northeastern Patagonia. This limited range in Patagonia strongly contrast with the rocks of Late Chattian-Early Miocene age (the Leonian Stage) that cover a large part of Patagonia (Figure 4; Cione, 1978, 1986, 1988). For a different view see Legarreta & Uliana (1994). The Puerto Madryn Formation overlies the leonian Gaiman Formation in the Península Valdés and lower Chubut river area unconformably according to Feruglio (1949), and separated by an omission surface according to Scasso & Río (1987).

The Puerto Madryn Formation is presently assigned to the Middle Miocene (Río, 1988, 1990, 1991). A tuff in the top of Puerto Madryn Formation at Bahía Cracker, to the south of Península Valdés, yielded three 40K-40Ar dates (9.11 ± 0.1, 9.55 ± 0.3, 9.56 ± 0.3 Ma, Zinsmeister *et al.*, 1979). These dates are close to the boundary between Serravallian and Tortonian. In western Argentina, the Chiquimil Formation (of Chasicoan age according to Marshall *et al.*, 1983) overlies the San José Formation which is correlated with the Anta Formation (Figure 4; Vergani & Starck, 1989; Gavriloff, 1990; Cione *et al.*, 1995). The typical Chasicoan overlies the Paraná Formation in eastern Argentina and is considered Tortonian in age (Cione, 1988). The Paraná Formation, at Paraná riverside, is covered by the continental Ituzaingó Formation which, at least in the lowest

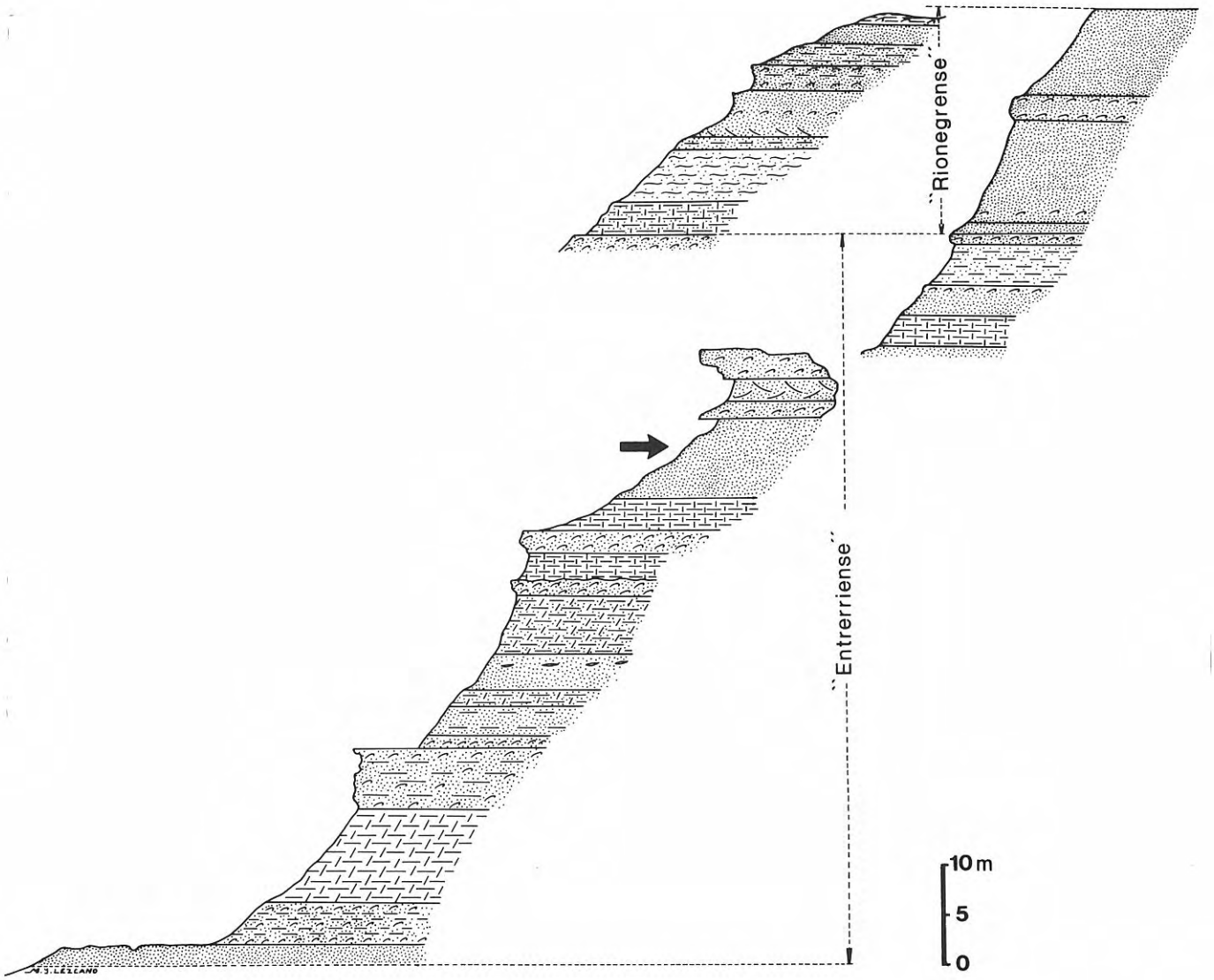

Figure 3. Section of Puerto Madryn Formation at the Punta Pirámide Sealions Reserve (modified from Feruglio, 1949 who cited it as "Lobería de Puerto Pirámides"). Feruglio (1949) used informal names for the lower and upper terms of the Puerto Madryn Formation ("Entrerriense" and "Rionegrense"). The arrow indicates the bed from where the spine was obtained.

part, is Huayquerian (Tortonian) in age. Chasicoan and Huayquerian are succesive stages (Kraglievich, 1934). The Anta Formation is approximately correlated with the Middle Miocene Friasian-Colloncuran-Mayoan stages of the southern South American chronostratigraphic standard (Figure 4; Pascual *et al.*, 1965; Vucetich *et al.*, 1993).

Description

Many catfishes have a dorsal locking mechanism in which the largest element is the second dorsal ray modified as a pungent spine. Muscles, ligaments and articular surfaces relate the spine with the modified first ray and the first and second proximal radials.

The material is a second dorsal spine of an ariid, with 65 mm total length. The ornamentation of both lateral spine surfaces consists of marked longitudinal striae, although they have been worn out from the distal third of the spine, as well as the serrae of the anterior distal third and posterior margins (Figure 2A). Anteriorly, the spine has a roughed surface; in the basal third, the ornamentation consists of several tubercles regularly placed in lines and sometimes joined forming a transverse rib (Figure 2B).

All articular surfaces of the spine base are preserved and the foramen of the spine base, pierced by the lock, is complete.

Remarks

Siluriform spines show frequent ontogenetic morphological variability. However, some features are useful at different categorial levels. A strongly ossified spine, absence of odontodes, absence of strong anterior serrae, relatively weak posterior serrae, and the ornamentation of the anterior surface, when taken in combination, separates the material from spines of freshwater fossil and recent South American catfish families. We assign the spine to the marine family

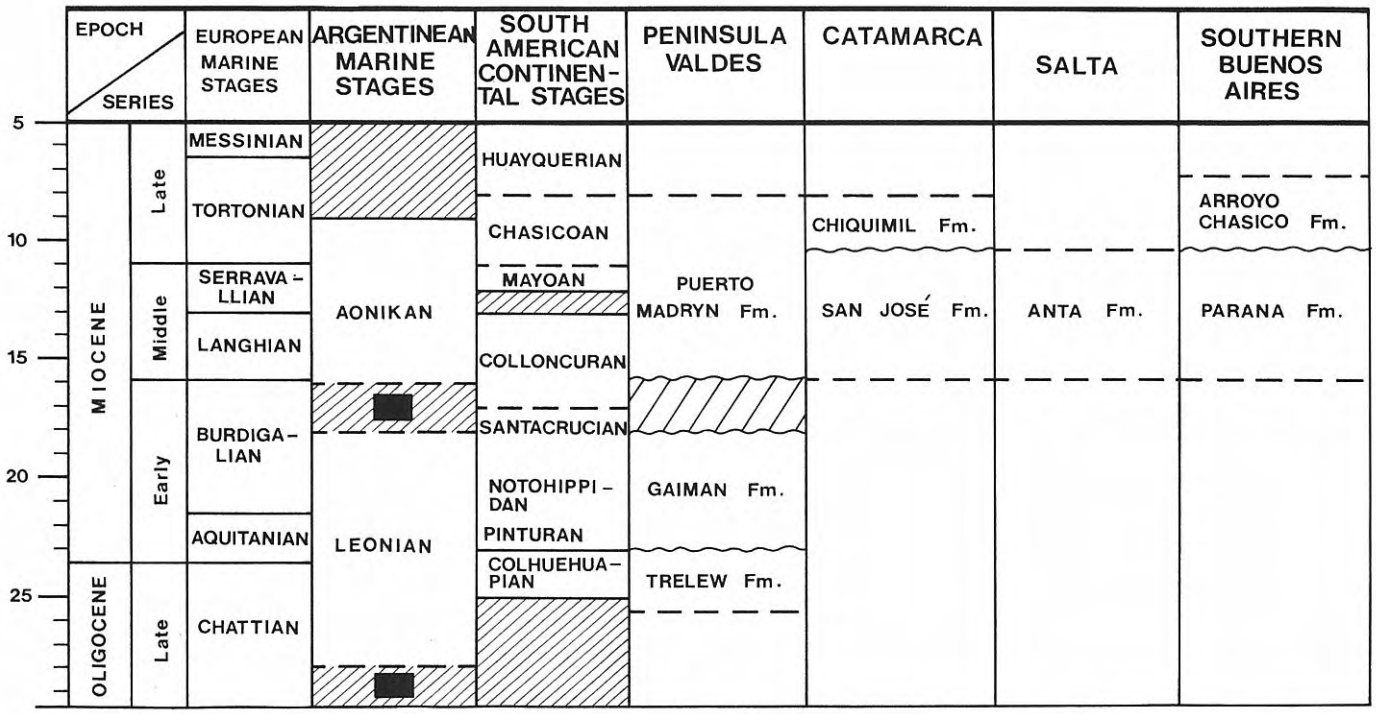

Figure 4. Correlation chart of some late Oligocene and Miocene marine and continental South American formations. The European marine stages are according to Harland *et al.* (1990), the Argentinean marine stages according to Río (1988), and the South American continental stages according to Cione (1988), Cione *et al.*, 1995; Cione and Cozzuol (Ms).

Ariidae based on the peculiar ornamentation of the anterior part described above.

There are about 40 nominal ariid species in the Western Atlantic. In the Atlantic coast of South America the genera *Bagre* (Oken, 1817), *Genidens* (Castelman, 1855), *Netuma* (Bleeker, 1858), *Arius* (Cuvier & Valenciennes, 1840), *Sciaedeichthys* (Bleeker, 1858), *Hexanematichthys* (Bleeker, 1858), and *Notarius* (Gill, 1863) occur (Figueiredo & Menezes, 1978).

Bagre has a clearly distinct filamentous dorsal fin spine appearing as long ribbons (Taylor & Menezes, 1977; Burgess, 1989). The dorsal spines of *Sciaedeichthys* are ornamented by numerous tubercles (Bertin, 1958). The dorsal spines of *Arius spixii* (Agassiz, 1829), *Netuma barba* (Lacépède, 1803), *N. planifrons* (Higuchi, Reis & Araujo, 1982), and *Genidens genidens* (Valenciennes, 1839) are similar and agree with the morphology and ornamentation of the fossil material. We have not seen examples of the other taxa and prefer to identify the specimen to familial level.

The fossil spine is markedly more slender than similar size spines of *Netuma barba,* the only ariid species presently known in Argentina.

Fossil siluriform remains (mainly spines) have also been reported from the Campanian and Maastrichtian (late Cretaceous) of South America (Patagonia: Cione & Lafitte, 1980; Cione, 1987; Northwestern Argentina: Cione & Pereira, 1985; Cione *et al.*, 1985; Arratia & Cione, in press; Bolivia: Gayet, 1992; Brazil: Gayet & Marques Brito, 1989). South America is the sole continent where Cretaceous catfishes occur (Cione & Lafitte, 1980). Quite the contrary, Tertiary catfishes, frequently ariids, have been reported from many areas in the world (e.g. Cione, 1978; Cione *et al.*, 1985; Rubilar, 1992). The supposed ariid species *"Arius" argentinus* Dolgopol de Sáez, 1941 from the La Huitrera Formation of northwestern Chubut, Argentina is indistinguishable from *Bachmania chubutensis* Dolgopol de Sáez, 1941 from the same locality, and it is not an ariid (Pereira, 1988; Cione & Azpelicueta, personal observation). Gayet (1992) described catfish remains assigned to Ariidae from the upper Cretaceous of Bolivia. The spine ornamentation is very different from that of the Puerto Pirámides spine. Ariids have also been reported but not described in Miocene beds at Paraná, Argentina (Cione, 1986) and Sacaco, Perú (Muizon & DeVries, 1985).

BIOGEOGRAPHY

The species of the family Ariidae are world-wide distributed in warm and warm-temperate waters today; they inhabit marine and brackish environments and some of them enter or even are restricted to freshwaters (Figueiredo & Menezes, 1978). In the Western Atlantic, they range from the United States to Argentinean coasts inhabiting the littoral, estuaries and mouth of rivers; ariids are present in shallow areas with sandy and muddy bottoms (Burgess, 1989).

The atlas of distribution of freshwater fishes by Berra (1981) states that the family Ariidae in the South American coasts reaches south the latitude of Rio de Janeiro in the Atlantic and the boundary of Ecuador and Peru in the Pacific. However, the range of the family is

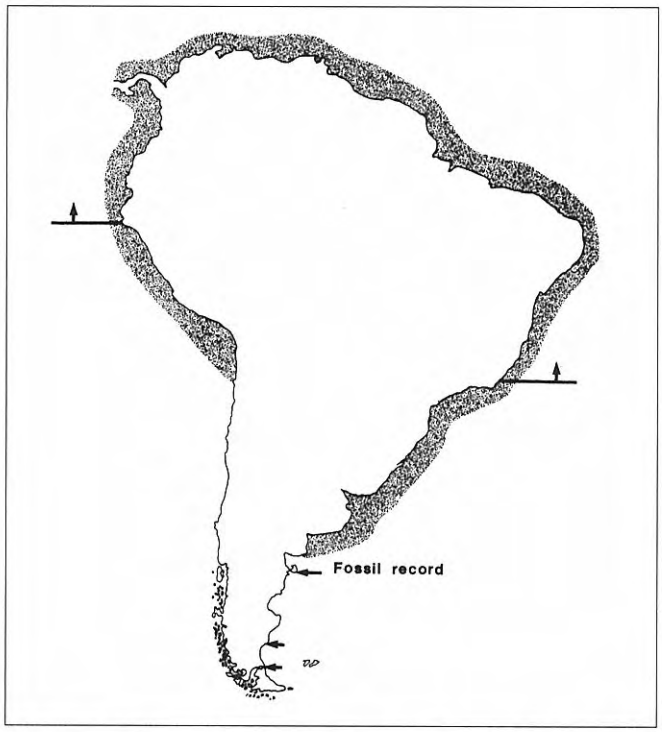

Figure 5. Geographical distribution of Ariidae (stippled area). Horizontal bars with arrows indicate the southern limits of ariid distribution according Berra (1981). The arrows indicate occasional records (Río Santa Cruz: Perugia, 1891; Bahía Santa Cruz: Berg, 1895; eastern mouth of the Estrecho de Magallanes: Sielfeld, 1979).

much larger (Figure 5). Ariids range in the Atlantic coast to the Estrecho de Magallanes (Sielfeld, 1979) and in the Pacific to Antofagasta (23° 40'S 70° 23'W; Chile; Sielfeld, 1979; see also Chirichigno, 1974; Bahamonde & Pequeño, 1975).

Ariid diversity empoverishes from the tropics to the south: 8 species in central-north Brazil, 3 species in Rio Grande do Sul, and one species in Argentina.

Two marine biogeographic provinces have been recognized in the Argentinean coast: Argentinean and Magallanean provinces (López, 1964). The boundary between both provinces in the coast is located at the latitude of Península Valdés. The sole ariid present in Argentina, *Netuma barba,* is an usual inhabitant of the Argentinean Province (of warm-temperate waters; López, 1964). *Genidens genidens* had been reported from the coast of Argentina and Uruguay (Ringuelet *et al.,* 1967; Figueredo & Menezes, 1978). However, Nani (1964) considered that this species was misidentified (see also Menni *et al.,* 1984). *Netuma barba* is relatively common in Buenos Aires province coasts in summer (personal observations of María de las Mercedes Azpelicueta at San Bernardo, Valeria del Mar, and Río Negro mouth, and catching records from Mar del Plata, Necochea and San Blas; López & Bellisio, 1965).

The occurrence of *N. barba* seems to be occasional in the colder waters of the Magallanean province: Río Santa Cruz; 50° 03'S 68° 35'W (Perugia, 1891), Bahía Santa Cruz; idem (Berg, 1895) and eastern mouth of the Estrecho de Magallanes, aprox. 52° 30'S 68° 30'S (Sielfeld, 1979).

Notably, the record of *N. barba* in the Estrecho de Magallanes is the southermost record of a living siluriform. During the early Cenozoic thermospheric period, catfishes ranged to higher latitude in the Antarctic continent (Middle Eocene, Seymour Island, 64° 14'S, 56° 43'W; Grande & Eastman, 1986). Other fishes that usually inhabit warmer areas incidentally are caught in the coastal waters of the Magallanean province (*e.g.* the swordfish *Xiphias gladius,* López, 1963 and the moonfish *Mola mola,* Alonso de Arámburu, 1957). These coastal waters present a higher temperature than those located more off-shore at the same latitude and are called "aguas residuales de plataforma" (shelf residual waters).

The fossil ariid record of Península Valdés is in agreement with: 1) the invertebrate fauna which indicates Caribbean affinities (Río, 1988, 1990, 1991); 2) the shark evidence, with warm temperate taxa (*Isurus* sp., *Galeocerdo aduncus, Carcharocles megalodon, Carcharias* sp., *Squatina* sp.; Cione, 1978, 1988; Cione & Expósito, 1980); *Carcharocles megalodon* is an extinct warm-temperate species and the recent species of *Isurus, Galeocerdo,* and *Carcharias* do not live today at the latitude of the Península Valdés in the Argentinean coast (Siccardi *et al.,* 1981; Cione, 1988); 3) the relatively high global temperatures in the Lower-Middle Miocene (Savin *et al.,* 1975; Savin & Douglas, 1985).

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