Zootaxa 3245: 30–53 (2012)
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

Taxonomic revision of Brazilian Mactridae Lamarck, 1809 (Bivalvia: Cardiida)

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Abstract

The worldwide distributed family Mactridae Lamarck, 1809, is well represented in the western Atlantic Ocean. An exhaustive literature research revealed 54 nominal species from the Brazilian coast. The study was done using morphological characters of shell and in some cases mantle cavity organs. All type material was examined and illustrated. Eleven valid living species are confirmed from the Brazilian littoral and their synonymies and geographic distributions are updated. Redescriptions are provided for *Mactrellona alata* (Spengler, 1802); *Mactrotoma fragilis* (Gmelin, 1791); *Mulinia cleryana* (d´Orbigny, 1846) and *Anatina anatina* (Spengler, 1802). The revision of *Trinitasia iheringi* (Dall, 1897) new combination, reveals the presence of a Tertiary genus among the Recent fauna of South America.

Key words: *Mactrellona*, *Mactrotoma*, Taxonomy, *Mulinia*, Southwestern Atlantic

Introduction

The family Mactridae was registered since the Early Cretaceous in North America (Skelton & Benton, 1993). Bieler *et al.* (2010) recognize five subfamilies: Mactrinae Lamarck, 1809; Lutrariinae Gray, 1853; Kymatoxinae Stenzel & Krause, 1957 [=Pteropsellinae Keen, 1969]; Zenatinae Dall, 1895 [=Resasniinae Marwick, 1931] and Tanysiphoninae Scarlato & Starobogatov in Nevesskaja *et al.* 1971. However, the suprageneric arrangement is still under study. Nevesskaja (2009) considered Tanysiphonidae as a separated family and Beu (2006) considered Zenatinae as a synonym of Lutrariinae. Recently, the subfamily Darininae was proposed to include the genera *Darina* and *Darcinia* from South America (Signorelli in Carter *et al*. 2011). The morphological character that defines mactrids is the V-shaped tooth in the left valve, which is formed by the fusion of two cardinal teeth (Keen in Cox *et al.* 1969). The anterior and posterior lateral teeth have, in general, only one cusp. Several authors have studied anatomical characters such as ctenidia morphology, labial palp fusion, siphons, stomach, and shell microstructure to quantify the morphological variation within the group (Atkins 1937; Yonge 1948; Purchon 1960; Stasek 1963).

During the 19th and early 20th centuries, several authors contributed to the knowledge of the mactrids over the world introducing new species (e.g. Spengler 1802; Lamarck 1815–1822; Gray 1825, 1837, 1853, 1854; Conrad 1831, 1837; Reeve 1854; Deshayes 1854, 1855a, 1855b; Dall 1894a, 1894b, 1894c, 1895, 1897, 1915; Smith 1915; Doello-Jurado 1949, among others). Lamy (1913, 1914, 1917–1918, 1925) studied the species described by Lamarck (1815–1822) and all other South American forms deposited at the Museúm national d'Histoire naturelle in Paris. Species catalogues provided by Rios (1966, 1969, 1975, 1994, 2009), Abbott & Dance (1986), Díaz Merlano & Puyana Hegedus (1994) and Mikkelsen & Bieler (2007) mention about twelve living mactrids from the southern coast of the United States, Caribbean Sea and along the Brazilian coast. However, an exhaustive literature search reveals 54 nominal species for the Brazilian and Argentine zoogeographical provinces. For our ongoing revision of the Magellan and Argentine Mactridae (Signorelli & Scarabino 2010; Signorelli & Pastorino 2011, 2012) it therefore became necessary to carry out a taxonomic revision of Brazilian species. As a result, this article determines the valid names for the mactrid species living along the southern Brazilian coast updating their synonymy and biogeographic distribution.

 Accepted by N. Malchus: 25 Jan. 2012; published: 23 Mar. 2012

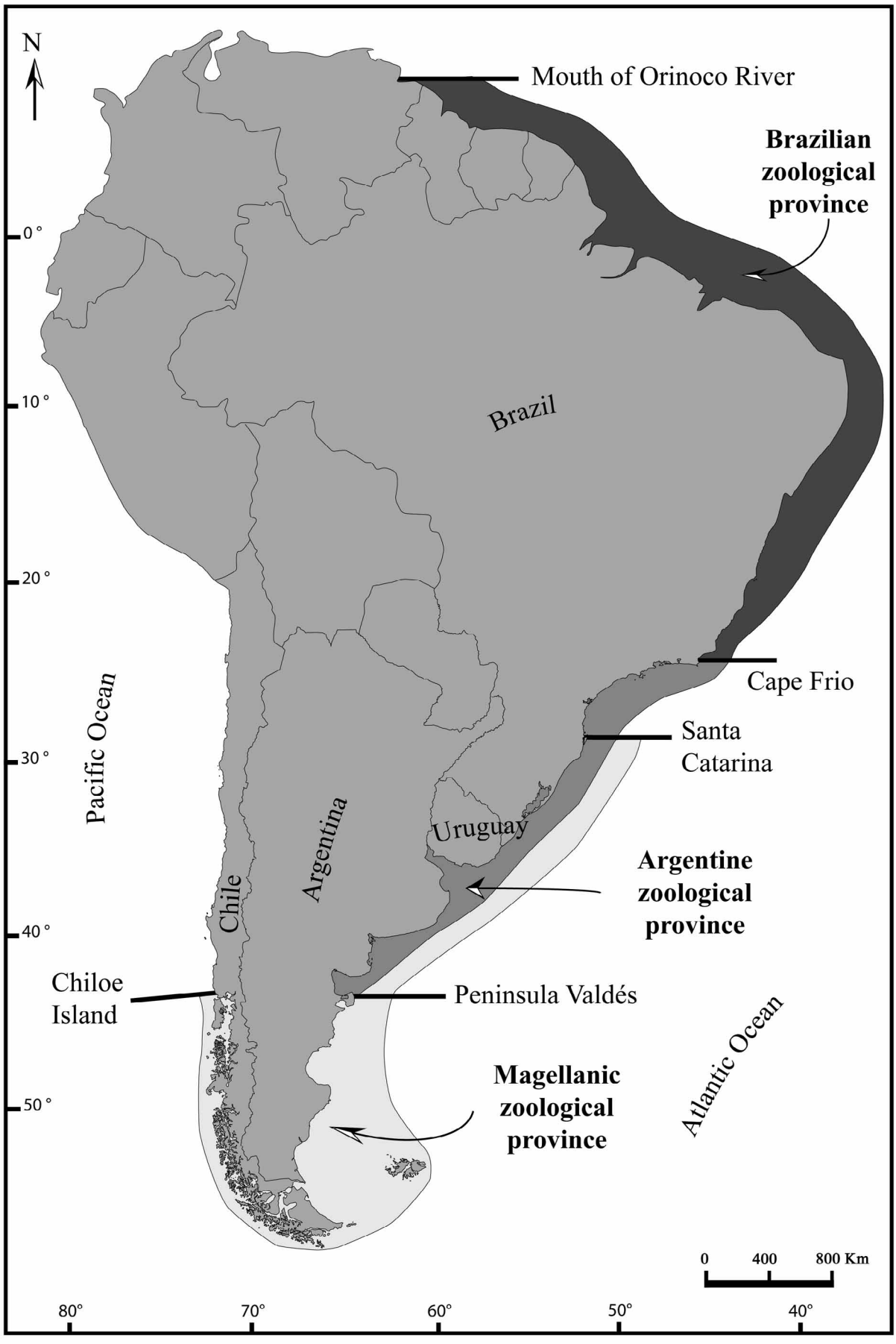

FIGURE 1. Map of the study area showing the limits of the western Atlantic zoological provinces.

The limits of the Atlantic South American provinces were formally defined by Woodward (1856) and later recognized by Boschi (1979, 2000), Balech & Ehrlich (2008), among others. According to current usage the Brazilian province comprises the area from to the mouth of the Orinoco River, Venezuela, to Cape Frio, Brazil, and the Argentine zoological province from Cape Frio to the Peninsula Valdés, northern Patagonia, (Fig. 1). These provinces were recognized and confirmed after the study of different macro-organism (e.g., Boschi, 1979, 2000).

Material and methods

All type material, as well as additional specimens studied, are deposited in the following institutions: American Museum of Natural History (AMNH), New York; Academy of Natural Sciences of Philadelphia (ANSP); California Academy of Sciences (CAS-IZ); Cleveland Museum of Natural History (CMNH); Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" (MACN-In), Buenos Aires; Museo de la Plata (MLP); Museúm national d'Histoire naturelle (MNHN), Paris; Museo Nacional de Historia Natural (MNHNM), Montevideo; Museu Nacional Rio de Janeiro (MNRJ); Museo Oceanográfico "Prof. E. C. Rios" (MORG), Rio Grande do Sul; Museu de Zoologia da Universidade de São Paulo (MZUSP); The Natural History Museum (NHMUK), London; Naturhistorisches Museum (NMBE), Bern; Paleontological Research Institution, Ithaca (PRI); National Museum of Natural History, Smithsonian Institution (USNM), Washington DC, United States; Museum für Naturkunde (ZMB), Berlin, and Zoologisk Museum (ZMUC), Copenhagen.

Specimens with soft parts were requested from malacological collections and dissected under a stereoscopical microscope. Digital images were taken with a Nikon D100 with a 60 mm Nikkor micro lens. The hinge was described with the method developed by Bernard & Munier Chalmas (according to Cox in Moore, 1969) where Arabic numerals are used to designate cardinal teeth and Roman numerals for lateral teeth. This method assigns odd numerals to all teeth in a right valve and even numerals to all teeth in a left valve. The microstructure of the valves in radial section, and critical point dried siphons, ctenidia and labial palps were analyzed with a scanning electron microscope (SEM) Phillips XL30 at the MACN. An exhaustive search for synonymies was carried out after the study of the type material of all nominal species.

Right valves (RV) and left valves (LV) are indicated in the figure legends. The larval shells could not be illustrated in this article either because of processing restrictions or because the early shell was eroded.

Systematics

Order Cardiida Férussac, 1822 in 1821–1822

Superfamily Mactroidea Lamarck, 1809

Family Mactridae Lamarck, 1809

Subfamily Mactrinae Lamarck, 1809

Genus *Trinitasia* Maury, 1928

Type species. *Thyasira sanctiandreae* Maury, 1925 [original designation]

Diagnosis. Shell trigonal to subcircular, lunule well defined; pallial sinus deep, V-shaped; lateral teeth short, close to cardinals, anterior ones almost fused with anterior cardinal tooth, accessory lamella strong; anterior end round and high.

Distribution. Atlantic coasts of Central and South America. Registered in the Miocene of Trinidad y Tobago, Venezuela and Colombia.

***Trinitasia iheringi* (Dall, 1897) new combination**
Figures 2A–D, 3A–H

Mactrella iheringi Dall, 1897: 123; 1902: 510, pl. 32, fig. 8; 1915: 62.
Mulinia kempfi Cauquoin, 1969b: 1175, fig. 1.
Mactra iheringi (Dall, 1897)—Rios, 1970: 196, pl. 57; 1975: 236, pl. 75, fig. 1130; 1985: 243, pl. 86, fig. 1211; 1994: 265, pl. 90, fig. 1293; 2009: 536, fig. 1487.
Mactrellona iheringi (Dall, 1897)—Altena, 1971: 54, pl. 5, fig. 1–3.
Mactra inceri Petuch, 1998: 39, figs. 7, 8, 11.

Diagnosis. Shell length up to 65 mm, anterodorsal margin concave; pallial sinus deep and V-shaped; left hinge with the V-shaped cardinal tooth almost fused with the anterior lateral tooth, dorsal edge prolonged.

Description. Shell trigonal to subcircular, inequilateral, strong, umbones prosogyrate, inflated; dorsal margin concave in front of umbones (Fig. 2A–B), anterior end rounded; escutcheon not defined, ventral margin convex; external surface smooth, maximum length measured 57 mm (MACN-In 1817). Internally white, left hinge with two short lateral teeth (AII & PII), with one cusp, cardinal tooth V-shaped composed of two simple divergent cardinals (2a & 2b) flanked by accessory lamella (4b) (Fig. 2I); right hinge with two anterior lateral teeth (AI & AIII) elongated and similar in size and shape, two posterior lateral teeth (PI & PIII), the ventral one larger and elongated; with two cardinal teeth (3a & 3b) unfused and fragile; a trigonal chondrophore ventrally developed complete the hinge plate (Fig. 2H); pallial sinus V-shaped and deep to about half shell length. Ultrastructure of the shell with an outer crossed lamellar layer of elongated crystallites arranged into lamellae; crystallites in adjacent lamellae differ in alignment by approximately 90–98°. Inner shell layer variably complex crossed lamellar (Figs. 2J–K).

Mantle cavity organs. Siphons entirely fused and covered by the periostracum (Fig. 3A), internal papillae observed along the length axis (Figs. 3B–C); body laterally compressed with a rounded and large foot (Fig. 3H); ctenidia composed of two elongated and lenticular demibranchs, inner demibranch larger (Fig. 3D) with a food groove over the ventral margin (Fig. 3E), not observed in the outer one; labial palps trigonal, moderately elongated but large in relation to ctenidia size (Fig. 3F–G).

Type material. [*Mactrella iheringi*] USNM 107632, holotype, one LV; [*Mulinia kempfi*] MNHN unnumbered, two syntypes; [*Mactra inceri*] CMNH 47338, holotype, length 35.5 m, width 41 mm; CMNH 47346–50, four paratypes.

Type locality. São Paulo state, Brazil, collected by H. von Ihering.

Other material examined. Nicaragua Bragman's Bluff, Puerto Cabezas (CMNH 47.338, holotype, length 35.5 m, width 41 mm; CMNH 47346–50, four paratypes). Brazil—Aracaju, (MNRJ 724, 1406); Alagoas (FURG 11134); Bahía (FURG 11450, 27544); Caravelas (MZUSP 13039); Alcobaça (MNRJ 8536); Espírito Santo (MZUSP 82659; FURG 15977); Amapá (FURG 14838; 14128); Rio de Janeiro (MZUSP 45110); Peruíbe (FURG 37478); Cananeia (MZUSP 22388); Guarujá (MZUSP 15856); Iguapé (MZUSP 22386); Ilha Cardoso (MZUSP 44977); Peruíbe (FURG 17258; MZUSP 15124, 15132, 15145, 22384, 22385, 34290, 44975, 44978, 44995, 45193, 80825); Ilha Grande (MZUSP 77488, 84042); São Vicente (MZUSP 80967); Santos (USNM 465565, 152631; MZUSP 303, 44976); São Paulo (MNRJ 2709; USNM 681901, 775649; FURG 31562; MZUSP 659, 22382, 22383, 22387, 22389, 22390, 46481, 77487); Ubatuba (MZUSP 22372, 22373, 22374, 22375, 22376, 22377, 22378, 22379, 22380, 22381, 44969, 46789); Guaratuba (MZUSP 15072, 22367); Paraná (MZUSP 22368, 22369); Paranaguá (FURG 5180); Praia do Saí, Paraná (MZUSP 22370); Santa Catarina (FURG 42979, 47887, 34350, 47655; MZUSP 4627).

Distribution. From Puerto Cabezas, Nicaragua to Santa Catarina state, Brazil.

Remarks. The types of *M. kempfi* (Figs. 2C–D) and *M. inceri*, illustrated by Petuch (1998), coincide with *Trinitasia iheringi*. *Mulinia kempfi* was synonymized by Rios (1985, p. 243). The analysis of types confirmed this synonymy. When Petuch (1998) described *M. inceri*, he pointed out shell differences between his species and *T. iheringi*. They were a less elongated shell, slightly anterior to the midline umbo position, depressed lunule producing a noticeable concavity along the anterior-dorsal area and pallial sinus deeper in Petuch's species. However, those differences must be considered intraspecific and both names considered as synonyms. *Trinitasia iheringi* was included in different genera in the literature (Dall 1897; Altena, 1971; among others); however, the shell characters suggest the new combination proposed here. It does not belong in *Mactra* as its type species has a more elongated shell with a hinge characterized by lateral teeth equal in size and shape and a shallower pallial sinus. The absence

of concentric external ornamentation, the stronger lateral teeth, the V-shaped pallial sinus and the poorly defined escutcheon suggest that *T. iheringi* does not belong to the genus *Mactrella.* In addition, the absence of a well developed keel and differences in hinge morphology separate it from *Mactrellona*.

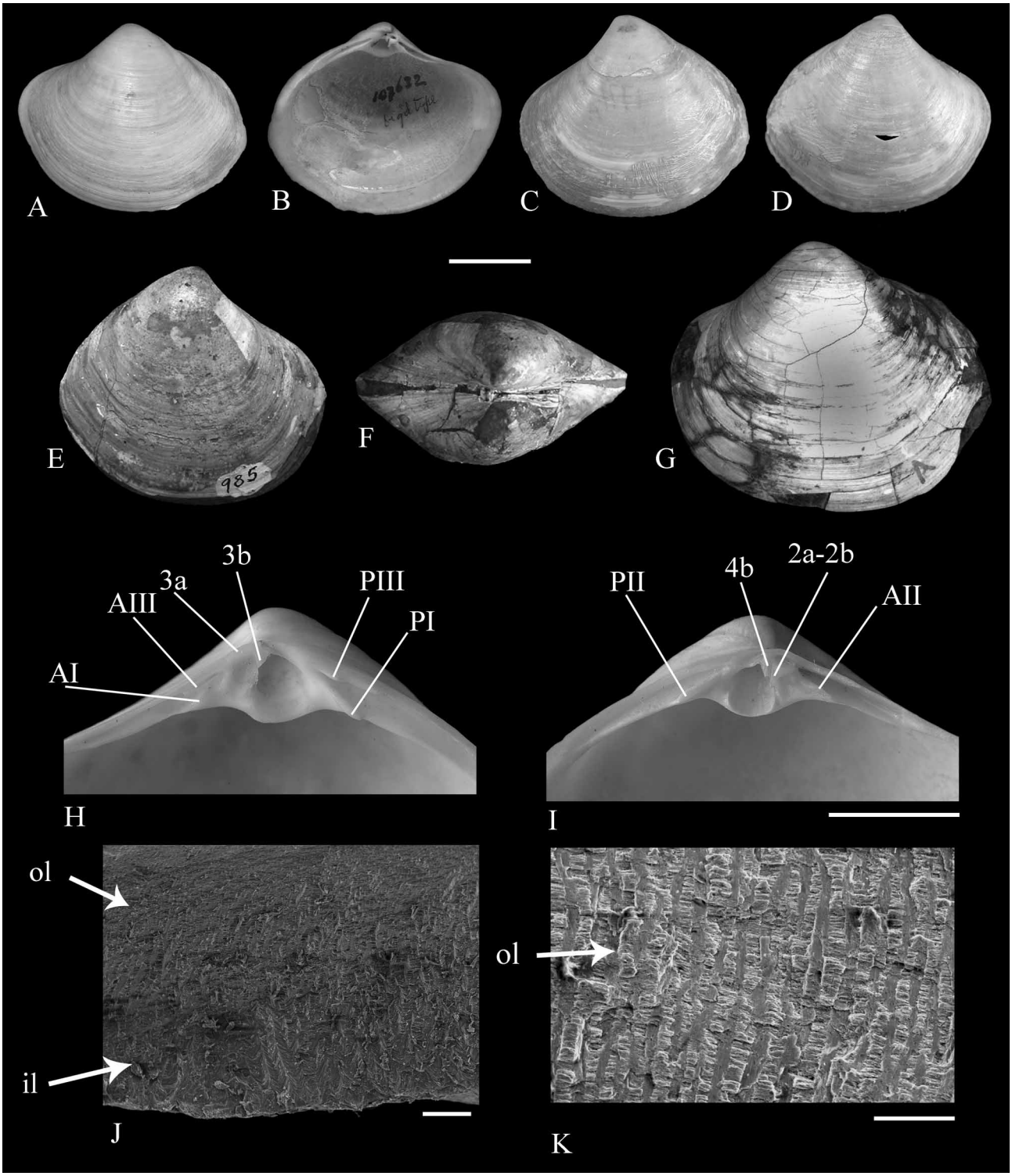

FIGURE 2. *Trinitasia iheringi* (Dall, 1897). A–B. holotype (USNM 107632), LV; C–D: *Mulinia kempfi* Cauquoin, 1969b, two syntypes (MNHN unnumbered); E–F: *Thyasira sanctiandreae* Maury, 1925, PRI 985, holotype (courtesy of the Paleontological Research Institution); G: *Dermatomya? harrisi* Weisbord, 1929, PRI 22913 (courtesy of the Paleontological Research Institution); scale bar = 1 cm; H–I: hinge description according to the nomenclature developed by Bernard & Munier Chalmas, scale bar = 1 cm; J–K: ultrastructure of the shell, I: general aspect of radial section of a LV from close to hinge to ventral margin, ol: outer layer, il: inner layer; K: detail of the outer layer with the cross lamellar structure, scale bar J = 200 µm, K = 100 µm.

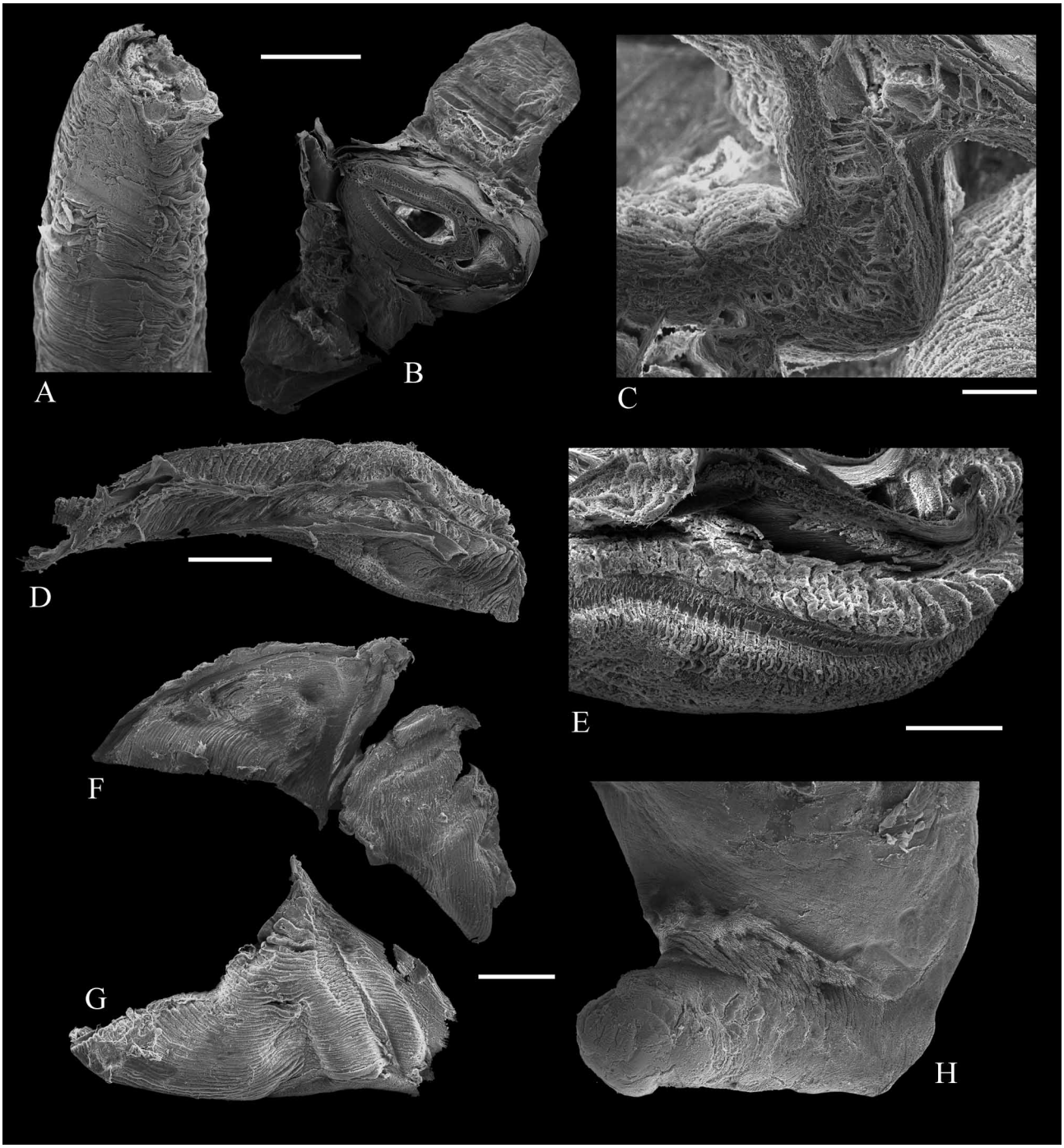

FIGURE 3. *Trinitasia iheringi* (Dall, 1897). A–C: Scanning electron micrograph (SEM) of siphons, A, general aspect, B, transversal section, scale bar = 1000 µm, C, detail of papillae, scale bar = 200 µm; D–E: SEM picture of ctenidia, D, external view of inner demibranch, scale bar = 1000 µm E, detail of food groove, scale bar = 500 µm; F–G: SEM picture of labial palps, scale bar = 1000 µm; H: foot, scale bar = 1000 µm.

The genus *Trinitasia*, introduced by Maury (1928) from the Miocene of Trinidad, was described to include the species *Thyasira sanctiandreae* Maury, 1925 (Fig. 2E–F). This genus was placed in Lucinidae by Chavan in Moore (1969: N505). Later, Woodring (1982) placed it in Mactridae after the examination of additional material. He also examined additional material from two species considered synonyms of *Trinitasia sanctiandreae*. The first one was described by Weisbord (1929) as *Dermatomya harrisi* from Tubará formation of Colombia (Fig. 2G). The second was introduced a few months later by Anderson (1929) as *Mactra* (*Mulinia?*) *atlanticola* from the same locality. The shell characters observed on the three related fossil taxa coincide with those of the types of Dall. The new combination thus provides the first evidence of the Tertiary genus in the living fauna from Brazil.

Genus *Mactrellona* Marks, 1951

Type species. *Mactra alata* Spengler, 1802 [original designation].

Diagnosis. Shell large with a posterior area defined by keel, hinge plate inclined anteriorly, with short lateral teeth.

Distribution. Atlantic coast of America, from United States to Brazil, Pacific coast of North America to Peru.

Mactrellona alata (Spengler, 1802)

Figures 4A–G, 5A–D

Mactra alata Spengler, 1802: 99—Reeve, 1854: pl. 8, fig. 29; Carpenter, 1855, in Carpenter, 1855–57: 50; Krebs, 1864: 105; Mörch, 1870: 122; Gundlach, 1883b: 482; Olsson, 1935: 105; Rios, 1970: 195.

Mactra laevigata Schumacher, 1817: 167.

Mactra carinata Lamarck, 1818, in 1815–1822: 473; Bory de Saint Vincent, 1827 [in Bruguière *et al.* (1791–1827)]: 151; Deshayes & Milne-Edwards, 1835: 98; Chenu, 1843 in 1842–54: pl. 2, figs. 2–2b; 1859–62: 55, fig. 227–228; Conrad, 1868: 34; Weinkauff, 1884: 5, pl. 1, fig. 2; Dall, 1894b: 26; Lamy, 1914: 128.

Mactra concentrica Valenciennes in Bory de Saint Vincent, 1827 [in Bruguière *et al.* (1791–1827)]: 151.

Mactra (Mactrella) alata Adams & Adams, 1856 in 1853–1858: 377—Carpenter, 1864: 668; Conrad, 1868: 34; Dall, 1894b: 26; 1901: 142; 1915: 62; Lamy, 1917: 264; Cauquoin, 1969a: 1026.

Mactrella carinata Chenu, 1862: 55, figs. 227–228.

Mactra (Mactrella) subalata Mörch, 1861: 180.

Mactrella subalata, Dall, 1894c: 42.

Mactrellona alata (Spengler, 1802)—Olsson, 1961: 327, pl. 56, fig. 4; Rios, 1975: 236, pl. 75, fig. 1132; 1985: 243, pl. 86, fig. 1214; 1994: 266, pl. 91, fig. 1296; 2009: 537, fig. 1490.

Diagnosis. Shell up to 120 mm in length; short lateral teeth close to the cardinals, very conspicuous keel at the posterior end.

Description. Shell trigonal, inflated, inequilateral; external surface smooth; greyish, thin periostracum, anterior end rounded, ventral margin convex; umbones prominent, prosogyrous; posterior area typically defined by a keel-like ridge (Fig. 4A–B); internally white, left hinge with the diagnostic V-shaped cardinal tooth (2a–b) and short anterior and posterior lateral teeth (AII & PII) (Fig. 5B); right hinge with two anterior and two posterior lateral teeth (AI, AIII, PI & PIII), dorsal one smaller, cardinal teeth unfused in this valve (3a & 3b) (Fig. 5A); chondrophore well developed, flanked dorsally by a shell ridge which separates the external ligament from the resilium; valves slightly gaping at the posterior end. Microstructure consisting of an outer crossed-lamellar and an inner complex crossed-lamellar structure (Figs. 5C–D).

Type material. [*M. alata*] ZMUC unnumbered, holotype, a complete specimen, one smaller paratype; [*Mactra carinata*] MNHN unnumbered, two syntypes; [*M. (Mactrella) subalata*] ZMUC N° 235, holotype, one RV from Realejo, Nicaragua.

Type locality. "South America".

Other material examined. Mexico—Acapulco (AMNH 309307, 131830). Central America—Nicaragua (USNM 181844; 462394, 462390, 253129); Panama, Chiriqui lagoon (USNM 169859); Darien gulf (ANSP 52691; USNM 618727); Pedro Gonzalez Island (AMNH 158848); Guatemala (MZUSP 13040); Honduras (USNM 215588, 364571); Costa Rica (USNM 54353); Jamaica (USNM 24941, 619068); Puerto Rico, Humacao beach (USNM 523626, 464242); Haiti (USNM 439246, 440241, 442572); Dominican Republic (AMNH 44641, 44103 10–40 m); Santo Domingo (ANSP 173266; USNM 462395); Tortola, Virgin Islands (ANSP 51414). Colombia—West Columbia (MACN-In 11428); Santa Marta (AMNH 34737); Cartagena (ANSP 51404; USNM 364329). Venezuela—Margarita Island (AMNH 158817; ANSP 51410); Macuto beach (ANSP 175308); Brazil—Fortaleza (MZUSP 16260); Rio Grande do Norte (ANSP 300282, 300230; MZUSP 40123); Natal (FURG 15243); Ilha de Itamaracá (FURG 6453); Pernambuco (MZUSP 41377, 41388); Recife (MZUSP 14819); Praia de Pirambu (MACN-In 5047); Maceio (MZUSP 22405, 62826; FURG 34344, 831); Jaraguá (FURG 7542); Bahía (MZUSP 81424, ANSP 263465, USNM 337297); Caravela (MZUSP 26276); Praia de Santa Mónica, Guarapari (AMNH 248027); Espírito Santo (MZUSP 70679; AMNH 248028; FURG 14485, 11814; ANSP 343904); Itaparica (FURG 11001); Peruíbe (FURG 31418; MZUSP 22415); São Paulo (FURG 7301; USNM 681990; MZUSP 301, 661,

14969, 15143, 15155; 15404, 15815, 22407, 22408, 22410, 22412, 22413, 22416, 22417, 22418, 43380; 43488, 44965, 44966, 44970, 44972, 44974, 44979, 56640, 62787, 62791, 62793; 62794, 62795, 79931, 80161; MACN-In 1819); Ubatuba (MZUSP 22409, 22411, 22414; MACN-In 1818); Paraná (MZUSP 22420, 22419; AMNH 199215); Camboriú (FURG 16075); Porto Belo (FURG 18124); Santa Catarina state (MZUSP 300, 15063; AMNH 278721; FURG 5175).

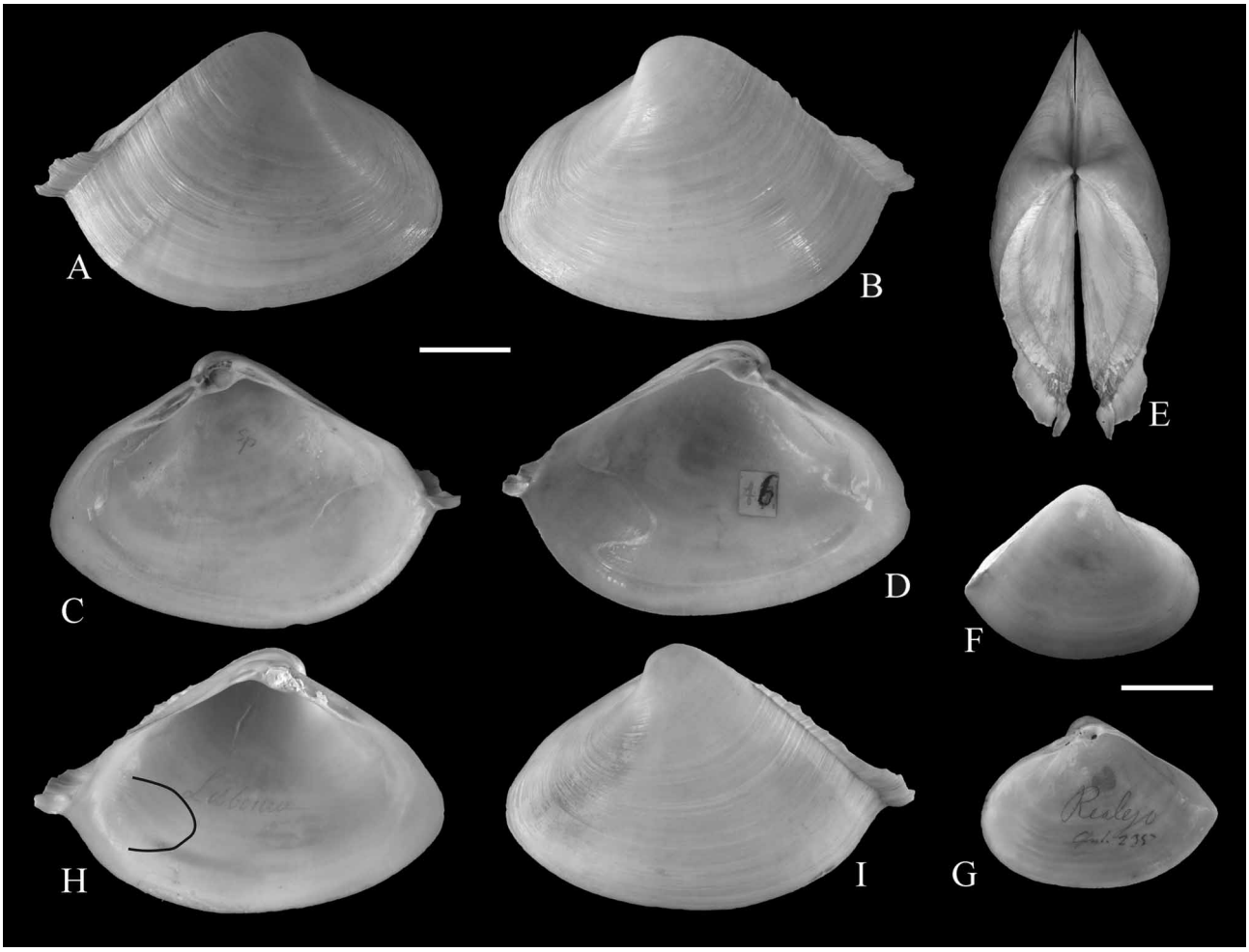

FIGURE 4. *Mactrellona alata* (Spengler, 1802). A–E: holotype (ZMUC unnumbered), A: RV, B: LV; F–G: *Mactra (Mactrella) subalata* Mörch, 1861, holotype (ZMUC N° 235); H–I: *Mactra carinata* Lamarck, 1818, syntype (MNHN unnumbered), scale bar = 1 cm.

Distribution. From Gulf of México to Santa Catarina, Brazil, and from Nicaragua to Ecuador in the Pacific Ocean.

Remarks. The genus *Mactrellona*, introduced by Marks (1951), groups three species: *M. alata* (Spengler, 1802), *M. exoleta* (Gray, 1837) and *M. clisia* (Dall, 1915). The three species were originally included in the genus *Mactrella* Gray (Chenu, 1862; Conrad, 1868; Dall, 1915; Lamy, 1917; among others). They erroneously considered *M. alata* Spengler as the type species of *Mactrella*,. However, when Gray (1853) introduced *Mactrella*, he assigned *Mactra striatula* Linnaeus, 1767, as type species. The error could be due to the diagnosis of *Mactrella* given by Gray, which fits more adequately to *M. alata* than to M. *striatula*. This problem was treated by Marks (1951) who accepted the designation of *M. striatula* as genotype of *Mactrella*.

Mactrellona alata is a valid species, very common in the Gulf of Mexico and Brazilian coast. The presence of this species in the Pacific Ocean was reported by Olsson (1961). Later, Rios (1985) reported shell differences between Atlantic and Pacific specimens. However, the specimens examined by us do not suggest the presence of two distinguishable species. The synonymous species checked here are *Mactra subalata* Mörch, 1861 (Figs. 4F–G), described from Realejo, Nicaragua, and *Mactra carinata* Lamarck, 1818 (Figs. 4H–I). *Mactra concentrica* Valenciennes in Bory de Saint Vincent, 1827 [in Bruguière *et al.*(1791–1827)] and *Mactra laevigata* Schumacher,

1817, are two nominal species that were based on the plates previously published by Bruguière (1797, pl. 251, fig. 2a–b, pl. 252, fig. 2b) [in Bruguière *et al.* (1791–1827)]. The original illustrations of Bruguière coincide with the shell morphology of the type material of *M. alata*. In conclusion, both species are added to the synonymy of Spengler´s species.

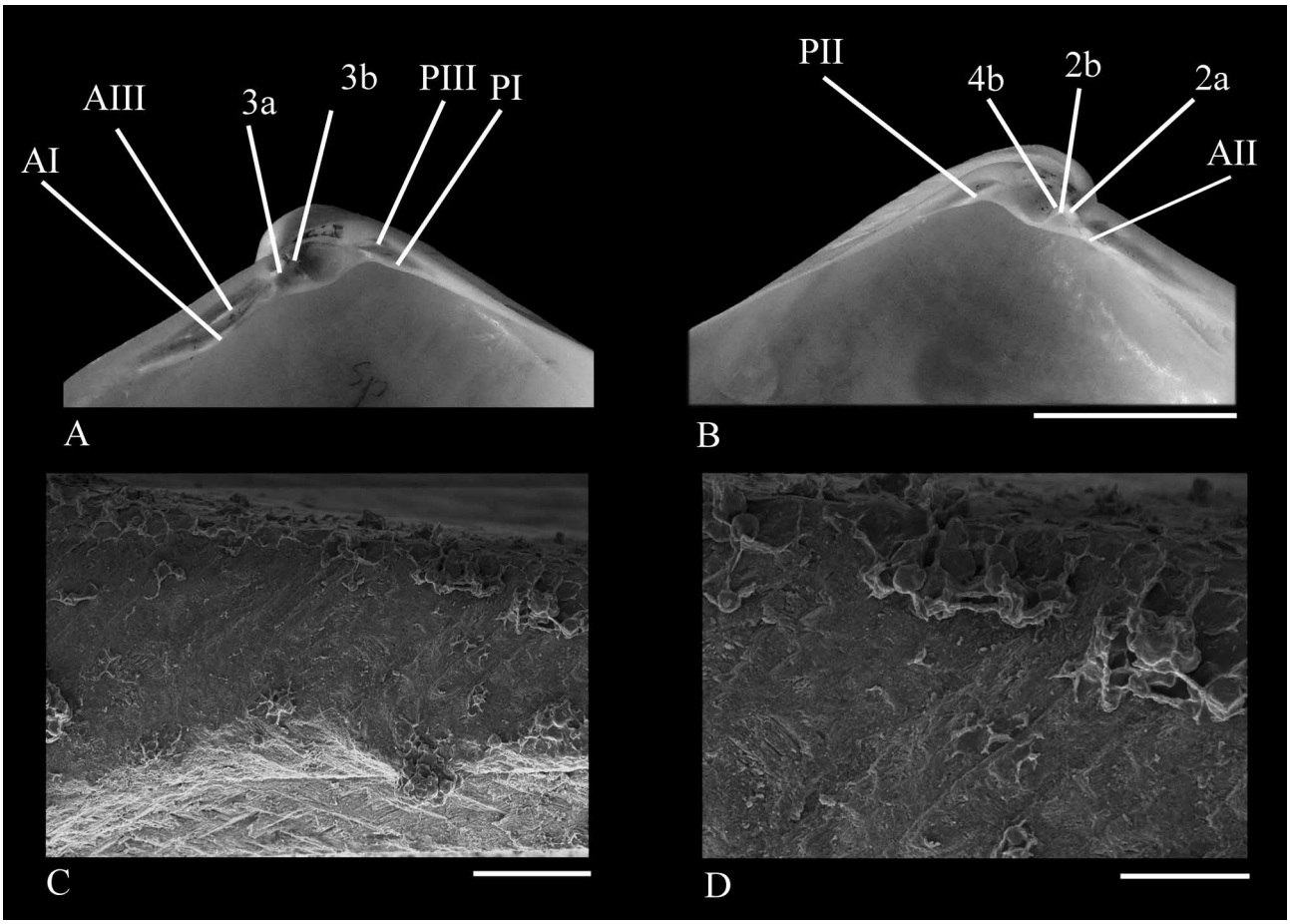

FIGURE 5. *Mactrellona alata* (Spengler, 1802), A–B: hinge description according to the nomenclature developed by Bernard & Munier Chalmas, A: RV, B: LV, scale bar = 1 cm; C–D: SEM picture of ultrastructure of the shell, C general aspect, ol: outer layer, il: inner layer, scale bar = 100 µm; D: detail of the outer layer with the cross lamellar structure, scale bar = 50 µm.

Genus *Mactrotoma* Dall, 1894

Type species. *Mactra fragilis* Gmelin, 1791, [Dall, 1894b, original designation].

Diagnosis. Shell trigonal to subcircular, posterior area covered by a thick periostracum and defined by a line.

Distribution. Atlantic coast of America, from United States to Brazil, Pacific coast of North America to Peru, South east Asia.

Mactrotoma fragilis (Gmelin, 1791)

Figures 6A–K, 7A–E

Mactra fragilis Chemnitz, 1782: 236, pl. 24, fig. 235 (rejected by ICZN, 1944, Opinion 184); Gmelin, 1791: 3261; Spengler 1802: 124; Wood, 1818: 30; Turton, 1822: 74, pl. 4, fig. 10; Conrad, 1831: 61, pl. 14, fig. 3; De Kay, 1843: 230; d'Orbigny, 1846 in 1834–1847: 508; 1853: 222; Forbes & Hanley, 1853: 368; Reeve, 1854: pl. 11, fig.47; Wood & Hanley, 1856: 39, fig. 32; Carpenter, 1855, in Carpenter, 1855–57: 51; Martinez y Saez, 1869: 12; Mörch, 1870: 124; Weinkauff, 1884: 17, pl. 5, fig. 2; Dall, 1895: 211; 1894: 26; Lamy, 1917: 246; Maury, 1920: 131; Perry, 1940: 82, pl. 17, fig. 113; Abbott, 1954: 488, fig. 5587; Cauquoin, 1967: 223; Rios, 1970: 195; 1975: 236, pl. 75, fig. 1129; 1985: 243, pl. 86, fig. 1210; 1994: 265, pl. 90, fig. 1292, 2009: 535, fig. 1486; Altena, 1971: 52.

Lutraria candida Lamarck, 1818 in 1815–1822: 470; Deshayes & Milne-Edwards, 1835: 92; Hanley, 1842 in 1842–1856: 27; Lamy, 1913: 346.

Mactra braziliana Lamarck, 1818 in 1815–1822: 478—Deshayes & Milne-Edwards, 1835: 106; Beau, 1853: 414; Hanley, 1842 in 1842–1856: 31, pl. 10, fig. 60; Conrad, 1868, 45; Gundlach, 1883b: 482; Dall, 1894b: 26; Lamy, 1914: 243.

Mactra oblonga Say, 1822: 310—Conrad, 1868, 45; Dall, 1894b: 26.

Mactra oblongata [error pro oblonga] Ravenel, 1834: 2.

Spisula fragilis Gray, 1837: 373; Conrad, 1868: 45.

Mactra bilineata Reeve, 1854: pl. 15, fig. 72—Deshayes, 1855a: 67; Weinkauff, 1884: 84, pl. 28, figs. 6–6a; Tomlin, 1924: 136.

Standella bilineata H. Adams & A. Adams, 1856 in 1853–1858: 382—Dall, 1894b: 26.

Standella fragilis H. Adams & A. Adams, 1856 in 1853–1858: 382; Conrad, 1868: 45.

Spisula (*Standella*) *bilineata*(Reeve, 1854)—Conrad, 1868: 44.

Mactra anserina Guppy, 1875: 49, pl. 7, fig.1—Dall, 1894b: 26.

Diagnosis. Shell trigonal to oval, pallial sinus rounded and deep of about half shell length, maximum length measured 85 mm (ANSP 338354); left hinge with anterior lateral teeth with two cusps, right hinge with anterior ventral lateral teeth with two cusps.

Description. Shell trigonal to oval, inequilateral, external surface smooth without ornamentation (Fig. 6D), posterodorsal area defined by a line from umbones to posterior end and covered by a brownish periostracum; anterior end rounded, lunule not defined; ventral margin convex; internally white, right hinge with two anterior and two posterior lateral teeth, the ventral anterior with two cusps, the posterior similar in size and with one cusp; two cardinal teeth (3a & 3b) unfused (Fig. 7A); left hinge with V-shaped cardinal tooth composed of two single cardinals (2a & 2b), one anterior and one posterior lateral tooth (AII & PII), the anterior with two cusps (Fig. 7B). Ultrastructure of the shell with two layers as in other species here studied (Figs. 7C–E).

Type material. [*Mactra fragilis*] types not found at ZMUC, ZMB and Zoological Institute of Russian Academy of Science of St. Petersburg (Martynov 2002), probably lost; [*Lutraria candida*] MNHN unnumbered, two syntypes; [*Mactra braziliana*] MNHN unnumbered, one syntype; [*Mactra oblonga*] ANSP 51418, one syntype; [*Mactra bilineata*] NHMUK unnumbered, two syntypes; [*Mactra anserina*] types not found at NHMUK, Guppy main collection deposited at Victoria Institute, Trinidad , destroyed by fire in 1920 (Sherborn 1940).

Type locality. Nicobar Islands, India, erroneously recorded.

Other material examined. United States of America—Myrtle Beach, North Carolina (USNM 471502, 487435); South Carolina (USNM 27020; ANSP 51417, 51419, 51418, 178514; AMNH 292619, 270166); Beaufort, South Carolina (MNRJ 1289; USNM 27015, 462356, 426251, 126104; USNM 54361); Florida (FURG 3106; USNM 54351, 124262, 604795; ANSP 43998, 175870, 132403, 186630, 51420, 76091, 174710, 158565, 189774, 174685, 180440, 387126, 88241, 76656, 354086, 264033; AMNH 210012, 311038, 139098, 131872, 121162, 125638, 100385, 248021, 172235, 248026; MZUSP 36139, 46840, 62656, 62663); Cape Canaveral (ANSP 371472); Peanut Island (AMNH 293566); Prickly Bay, Florida (ANSP 296550); Lake Worth, Florida (USNM 253194, 127259, 127259, 599286); Miami, Florida (AMNH 140442, 36058); Biscayne Bay, Florida (AMNH 120144); Caesars Creek bank (USNM 462364); Honda Bay, Florida (AMNH 309253); Sanibel (ANSP 175433, 170554; AMNH 309260, 120142, 103342, 100035, 97438, 99887); Lemon Bay (USNM 732875, 741380); Sarasota Beach, Florida (USNM 533964); Sarasota Bay, Florida (AMNH 120143); Bird Key, Tortugas (USNM 426252, 27016, 462357); Manatee River (USNM 61076, 604755); Bradenton Beach, Florida (AMNH 199586); St. Petersburg. Florida (AMNH 248820; 172236); Egmont Key, Florida (USNM 117656); Tampa Bay (USNM 27014, 462361); Cedar Key (USNM 36039, 134863, 93660); Dog Island, Apalachicola (USNM 185476); West Florida (ANSP 193681); Saint Augustine, Florida (USNM 61158); St. Andrews Bay, Florida (AMNH 266831; 266832); Texas (USNM 125653; ANSP 161372, 180061, 176590, 348776, 401045; AMNH 293567; MZUSP 13033); North of Mississippi (ANSP 209694); Palisades (USNM 442511); Old Providence (ANSP 154635); Dickinson Bay, Texas (ANSP 394662); Matagorda Bay, Texas (USNM 106996, 134410, 465242, 107376); Rockport, Texas (USNM 134411); Corpus Christi, Texas (USNM 123487). Central America—Gulf of Mexico (ANSP 338354); San Carlos Bay, Mexico (AMNH 131189); Yucatán (USNM 27017); Hopkins, Belize (ANSP 282762, 282921); Belize (USNM 777780, 771015, 771028; AMNH 183702; ANSP 285014, 282293, 284251, 284252); Honduras (NHMUK 1963.33.1–4, 4 valves, 1 illustrated by Reeve (1854)); Venado, Panama (AMNH 248509); Panama channel (USNM 743472; 783033, 821599); Randolph, Panama (USNM 759164, 759346); Panama bay (AMNH 159536); Bahamas (AMNH 168779; USNM 707309, USNM 846338; ANSP 375172; 375171); La Habana bay (ANSP 52698); Cabañas Harbour, Cuba (USNM 462366); Cárdenas Bay, Cuba (USNM 462365); Cuba (AMNH 113659); Santa Rosa, Cuba (USNM 462360); Cienfuegos, Cuba (USNM 462363; Jamaica (USNM 440799,

442762, 423771, 102894, 27018, 441315, 375542; AMNH 34065, 34901); Haiti (USNM 383300, 440449, 440227); Dominican Republic (AMNH 94720); Santa Bárbara de Samana (MNRJ 1290); Santo Domingo (ANSP 173309, 182441); Talleboa, Puerto Rico (AMNH 174); Virgin Islands (AMNH 185921, 185851); Saint Thomas (USNM 530415, 604811, 250119, 321646); Tortola (ANSP 51415); Seaforth Bay, Antigua (AMNH 311152); Saint George, Grenada (ANSP 344048, 332097; AMNH 185257); Icacos, Trinidad (ANSP 157776). Colombia—Cartagena (USNM 517823, 364328); Puerto Colombia (USNM 543429). Venezuela—Margarita Island, (USNM 786537; MZUSP 57369, 58709, 61627); La Guaira (ANSP 264261). Brazil—Pernambuco (MZUSP 14805); Marau (MZUSP 22391); Salvador (MZUSP 28480, 44241, 44980, 44982, 45005, 59291, 59292, 59301, 77465, 77466, 81200); Bahía (MZUSP 15644, 26828, 70207; FURG 22285, 23467, 41374, 10814, 47433, 9945; ANSP 263476); Espírito Santo (MZUSP 73065); Búzios (MZUSP 48473, 57127); Niterói (MNRJ 4387); Muriqui (MNRJ 1479); Mangaratiba (MNRJ 5354); Rio de Janeiro (MNRJ 2708, 6610, USNM 17500, 120193, AMNH 34064, 34063; MACN-In 5022; MZUSP 22392, 77464, 83188, 40122); Ilha Grande (MZUSP 22316); Peruíbe (MZUSP 80834); São Sebastião (MZUSP 22398, 22401, 22402, 44203, 44244, 44997, 56205; FURG 17158); Santos (MZUSP 13042); São Paulo (MZUSP 22400, 59311, 81934); Ubatuba (MZUSP 14944, 22394, 26477); Bertioga (MZUSP 50484, 62147); Cananeia (MZUSP 83348, 83386); Ilha Bela (MZUSP 22399, 41683, 41712, 41785, 44971, 44996, 77463, 77467, 77468, 77469, 77470, 77579, 79935, 83468); Porto Belo (FURG 11784); Bombinhas (MZUSP 34588); Santa Catarina (FURG 40237, 1576, 47781; MZUSP 13041).

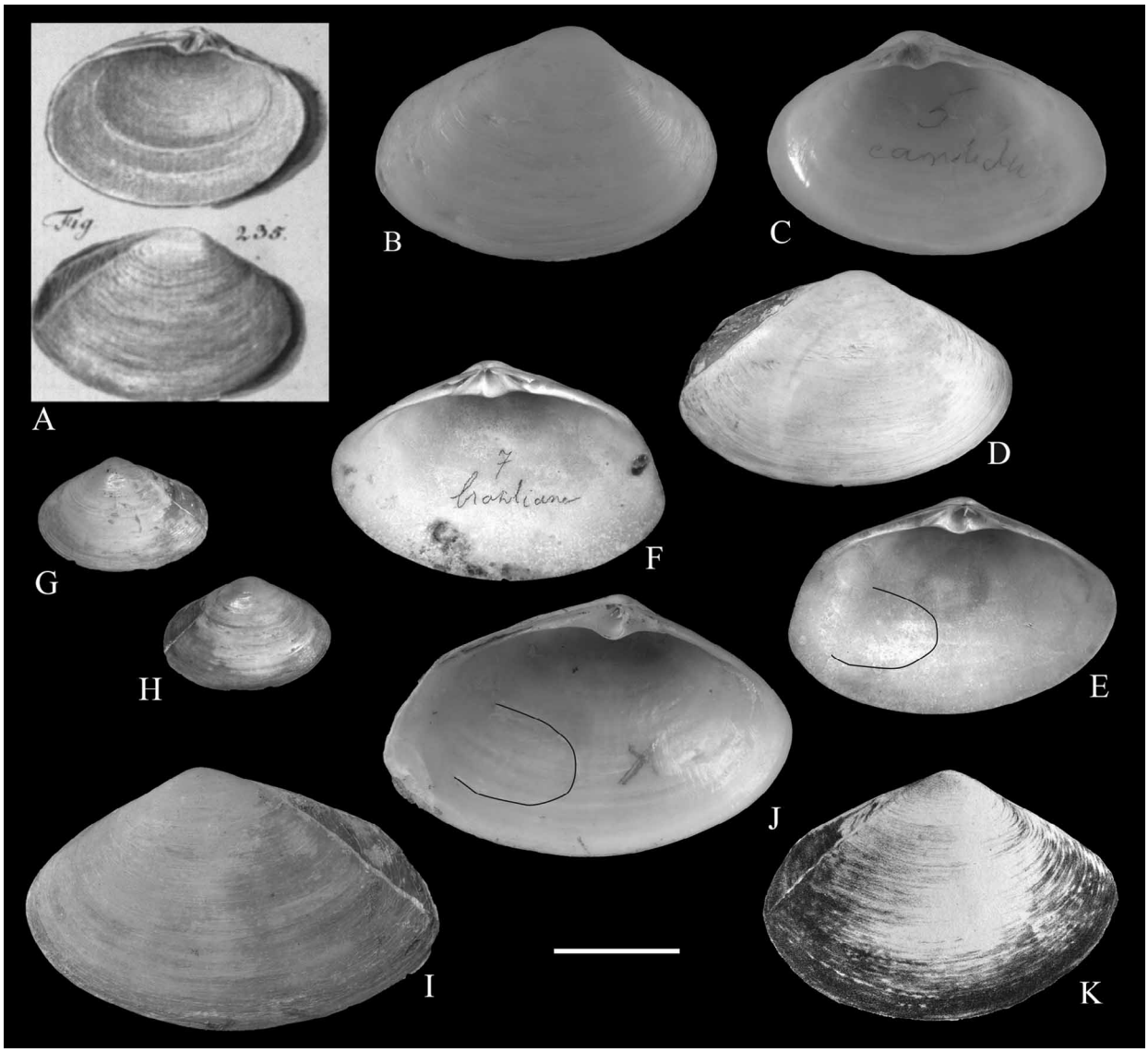

FIGURE 6. *Mactrotoma fragilis* (Gmelin, 1791). A: original illustration of Chemnitz; B–C: *Lutraria candida* Lamarck, 1818, syntype (MNHN unnumbered), RV; D–F: *Mactra braziliana*, Lamarck, 1818, syntype (MNHN unnumbered), D: RV, E: LV; G–H: *Mactra oblonga* Say, 1822 syntype (ANSP 51418) LV and RV respectively; I–J: *Mactra bilineata* Deshayes in Reeve, 1854, Syntype, NHMUK unnumbered; K: *Mactra anserina*, original illustration of Guppy, 1875, scale bar = 1 cm.

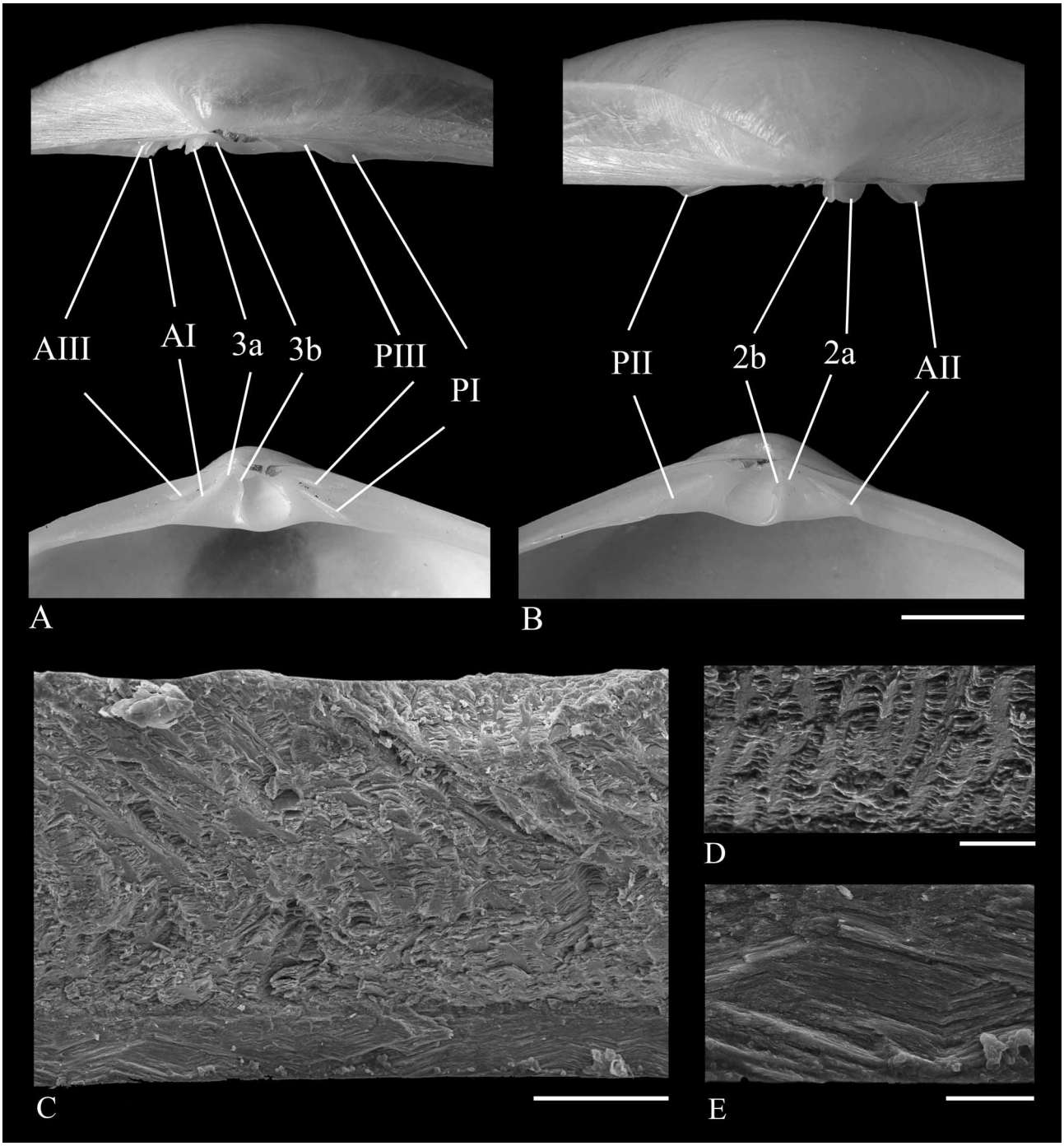

FIGURE 7. *Mactrotoma fragilis* (Gmelin, 1791), A–B: hinge description by using the nomenclature developed by Bernard and Munier Chalmas, scale bar = 1 cm, A: RV, B: LV; C–E: Ultrastructure of the shell, C: general aspect of radial section of a LV from close to hinge to ventral margin scale bar = 100 µm, D: detail of the outer layer with cross lamella structure, scale bar = 50 µm, E: detail of inner layer with the cross lamellar complex, scale bar = 20 µm.

Distribution. From North Carolina, USA, to Santa Catarina, Brazil.

Remarks. *Mactra fragilis* was introduced by Chemnitz (1782). However, this work was rejected due to nomenclatorial causes (Direction 1 ICZN 1954, Opinion 184, 1944). *Mactra fragilis* (Gmelin, 1791), a common species living in the western Atlantic has been cited with other names, i.e.: *Lutraria candida* Lamarck, 1818 (Figs. 6B–C); *Mactra braziliana* Lamarck, 1818 (Figs. 6D–F); *Mactra oblonga* Say, 1822 (Figs. 6G–H); *Mactra bilineata* Reeve, 1854 (Figs. 6I–J) and *Mactra anserina* Guppy, 1875 (Fig. 6K) which are considered synonyms according to the similarities observed in the type material. *Mactra oblonga* was erroneously cited by Ravenel (1834) as *M. oblongata* (*nomen nudum*).

Mactra dealbata Pulteney, 1799, later named as *M. tellinoides* Pulteney, 1813, is a valid species that was erroneously considered a synonym of *M. fragilis* by Wood and Hanley (1856), Dall (1894b), Lamy (1917), among others. This species was mentioned living along the coast of Dorset, England. *Mactra ambigua* Weinkauff, 1884, cited by Dall (1894b) as synonym of *M. fragilis*, is in fact a synonym of *M. compressa* Spengler, 1802, living along the northern Atlantic coast of Africa. This conclusion was drawn after the revision of Spengler´s mactrid types deposited at ZMUC. Finally, *Mactra ovalina* Lamarck, 1818, cited as synonym of *M. fragilis* by Carpenter (1855, in Carpenter, 1855–57), Dall (1894b), and others, is a valid species living in Arabia (Bosch *et al.*1995).

Genus *Mulinia* Gray, 1837

Type species. *Mulinia typica* Gray, 1837 (=*Mactra edulis* King, 1832) [original designation].

Diagnosis. Shell thick, trigonal to subcircular, ligament exclusively internal.

Distribution. Atlantic coast of Central and South America, Pacific coast of South America and East coast of Southern Africa (Indian Ocean).

Mulinia cleryana (d´Orbigny, 1846)

Figure 8A–G

Mactra cleryana d'Orbigny, 1846 in 1834–1847: 510.
Mactra guadelupensis Récluz, 1852: 249, pl. 10, figs. 4–4´; Beau, 1853: 414; Ijzerman, 1931: 36.
Mulinea portoricensis Shuttleworth, 1856: 174; Adams & Adams, 1856 in 1853–1858: 380; Conrad, 1868: 31.
Mactra carinulata Deshayes in Reeve, 1854, pl. 10, fig. 38.
Mulinia portoricensis (Shuttleworth, 1856)—Adams & Adams, 1856 in 1853–1858: 380.
Mactra guadeloupensis, (Récluz, 1852)—Krebs, 1864: 105; Weinkauff, 1884: 33, pl. 11, figs. 1–3.
Mactra donacaeformis Krebs, 1864: 105 (non Gray, 1837, *Mulinia donaciformis* Gray, 1837, p. 376).
Mactra gaudelupensis (Récluz, 1852)—Conrad 1868: 32
Trigonella guadelupensis (Récluz, 1852)—Conrad, 1868: 37.
Gnathodon guadelupensis (Récluz, 1852)—Sowerby in Reeve, 1873: pl. 1, fig. 2.
Gnathodon cantrainei Récluz ms., Sowerby in Reeve, 1873: pl.1, fig. 2—Gundlach, 1883a: 58; Dall, 1894b: 27.
Mactra portoricensis (Shuttleworth, 1856)—Weinkauff, 1884: 30, pl. 11, fig. 1–3; Schepman, 1887: 164; d'Audretsch, 1953: 239.
Mulinia guadelupensis, Dall, 1894a: 104; 1894b: 27; Lamy, 1918: 341.
Mulinia branneri Dall, 1901: 145.
Mulinia portoricensis, Warmke & Abbott, 1961: 204, fig. 43d.
Mulinia cleryana, Weisbord, 1964: 382, pl. 55, fig. 3–6; Altena, 1968: 159; 1969: 178; 1971: 51, pl. 4, fig. 13–15; Rios, 1970: 196; 1975: 236, pl. 75, fig. 1133; 1985: 244, pl. 86, fig. 1215; 1994: 266, pl. 91, fig. 1297; 2009: 537, fig. 1491; Abbott, 1974: 491.

Diagnosis. Shell trigonal, anterior and posterior end well defined and closer to the ventral edge than to the dorsal edge; posterior carina delimited by a ridge, average size up to 30 mm in length.

Description. Shell trigonal, inflated, inequilateral, umbones placed about half shell length, inflated and prosogyrate; posterodorsal area defined by a conspicuous keel-like carina (Figs. 8A–E); anterodorsal area wide but not defined by a lunule; anterior and posterior ends low and well defined; ventral margin sinuous; external surface smooth without concentric ridges, maximum shell length measured 36 mm; right hinge with two anterior and two posterior lateral teeth (AI, AIII, PI & PIII) strong and short, being the ventral more elongated, two divergent and unfused cardinal (3a & 3b) teeth, the 3b vertically oriented (Fig. 8F); left hinge with the usual V-shaped cardinal tooth (2a–b), flanked by an accessory lamella (4b), one anterior and one posterior lateral tooth (AII & PII) complete the hinge; anterior adductor muscle scars semielliptical, posterior oval; pallial sinus low and V-shaped (Fig. 8G). Shell ultrastructure with two layers as the other species studied.

Type material. [*Mactra cleryana*] NHMUK 1854.12.4.670, three syntypes; [*Mactra guadelupensis*] MNHN unnumbered, two syntypes; [*Mulinea portoricensis*] NMBE 501777, one syntype; [*Gnathodon cantrainei*] types not found at NHMUK; [*Mulinia branneri*] USNM 107829, holotype, one complete specimen, CAS-IZ 64436.00, paratype, one RV.

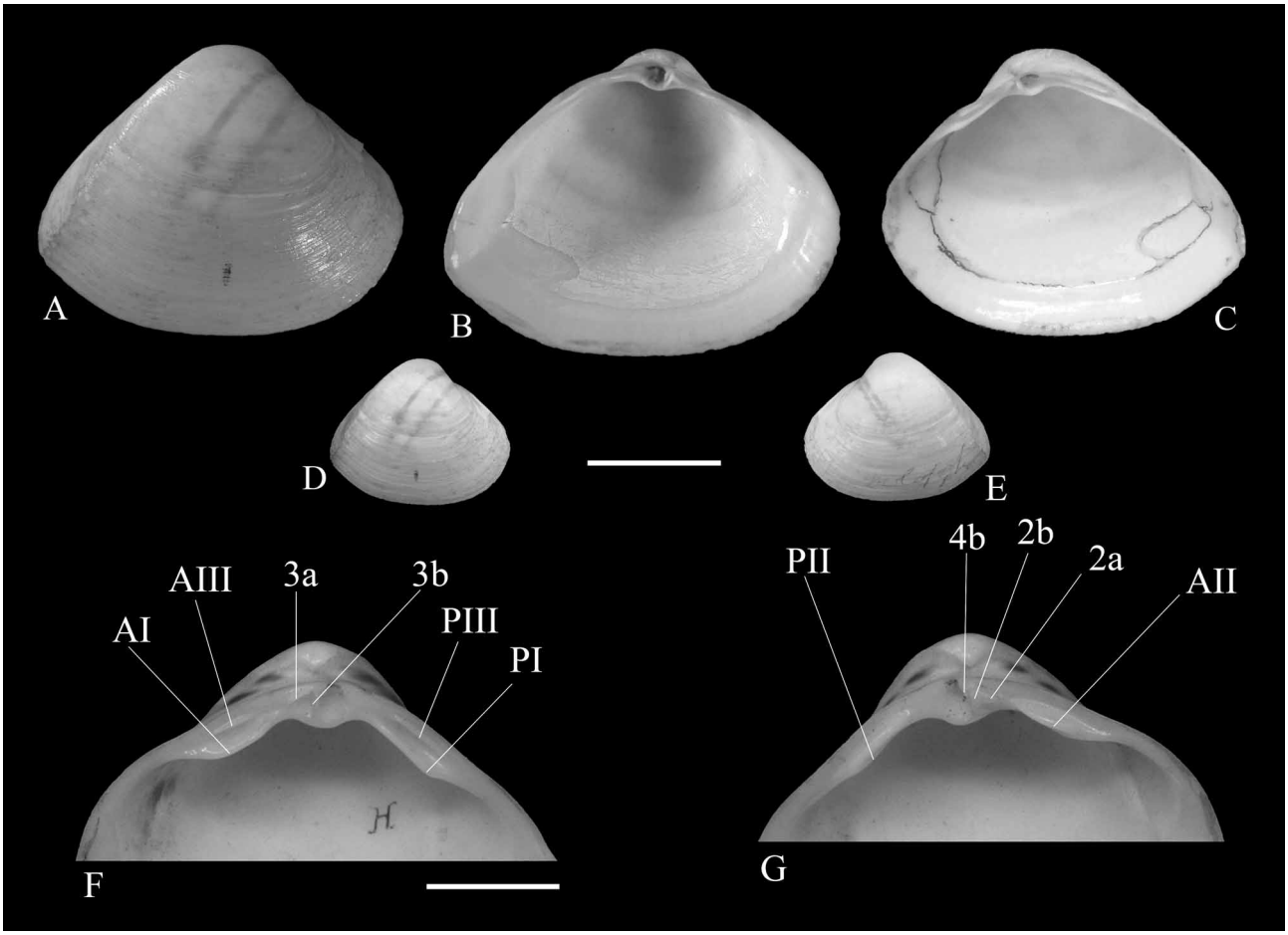

FIGURE 8. *Mulinia cleryana* (d´Orbigny, 1846). A–E: syntypes (NHMUK 1854.12.4.670), scale bar = 1 cm; F–G: hinge description by using the nomenclature developed by Bernard and Munier Chalmas, F: right, G: LV, scale bar = 1 cm.

Type locality. Rio de Janeiro, Brazil.

Other material examined. United States of America—Texas (ANSP 217231). Central America—Sonora, Mexico (AMNH 131270); Punta Gorda, Belize (ANSP 282500); Haiti (USNM 439219, 440574, 440218, 440208, 439225, 439273, 440063, 383161, 439372, 367371, 383301, 439206); Santo Domingo (FURG 37443; USNM 367281, 367254, 379850; ANSP 173315); Puerto Rico (MNRJ 1297, 1298; 13049; USNM 523629, 464238, 128324; AMNH 34073); Guadeloupe Islands (AMNH 34106, 34131); Trinidad (USNM 365250; ANSP 263921). Venezuela—Venezuela (USNM 381915). Guyana—British Guyana (USNM 432392, 889595). Brazil—Salinópolis (MZUSP 22264); São Luís do Maranhão (FURG 13751; MZUSP 14669); Aquiraz, Ceará (MZUSP 81810); Ceará (MZUSP 13050); Fortaleza (FURG 34384, 34427; MZUSP 22265, 81787); Morro Branco, Ceará (MZUSP 22266); Areia Branca (MZUSP 40119); Natal (ANSP 300239); Rio Grande do Norte (ANSP 300283); Pernambuco (MZUSP 45285, 45308, 45399); Cabedelo, Paraiba (MZUSP 41386, 413339); Paripueira (MZUSP 22267; FURG 37481); Alagoas (FURG 1952); Maceió (FURG 34396); Aracajú (MNRJ 72); Alcobaça (AMNH 91580); Caravelas (MZUSP 22268); Bahia (USNM 337300; FURG 29303); Rio Caravelas (FURG 29267); Espírito Santo (MZUSP 32544,66340); Regência (MZUSP 82670); Vitória (MZUSP 22269); Rio de Janeiro (MZUSP 22270); Angra dos Reis (MZUSP 63184, 63260); Ilha Grande (MZUSP 22271, 22272); Recreio des Bandeirantes (USNM 487373); Bertioga (MNHNM 7345); Iguapé (MZUSP 79652); Ilha Comprida (MZUSP 22292); Peruíbe (AMNH 120412); Praia Grande (MZUSP 62790, 83971, 60010, 60001, 60017; FURG 21063); São Sebastião (MZUSP 301, 312); Santos (MLP 9385; ANSP 195118, 195133, MNHNM 7338; USNM 359301; MZUSP 15169, 22288, 22289, 22290; MACN-In 5091; 42635); São Paulo (MZUSP 13051, 14971, 15137, 22291, 22293, 32936, 43019, 43892, 44986, 44990, 45027, 45029, 45143, 45177, 59079, 60019, 60022, 60028, 60038, 60057, 60066, 62325, 79140, 80330, 80741, 80980; FURG 18885, 267, 31563, 34412, MNHNM 7341); Ubatuba (MACN-In 1824); Paraná (MZUSP 15080, 22295, 15078, 15083); Camboriú (MZUSP 15071); Itapema (MZUSP 22297); Itajaí (MZUSP

34621); Santa Catarina (MNRJ 1015; MZUSP 13047, 13055, 22296); Rio Grande do Sul (FURG 22336, 813, 23692).

Distribution. Gulf of Mexico to Rio Grande do Sul, Brazil.

Remarks. *Mulinia cleryana*, dedicated to M. Cléry, is a valid species. The synonym list includes *Mactra guadelupensis* Récluz, 1852 (Figs. 9A–D), *Mulinea portoricensis* Shuttleworth, 1856 (Figs. 9E–F), *Mactra carinulata* Deshayes in Reeve, 1854, *Gnathodon cantrainei* Sowerby in Reeve, 1873 and *Mulinia branneri* Dall, 1901 (Figs. 9G–K). The type materials of all these nominal species were examined and their status confirmed. Conrad (1868) mentioned *Mactra grandis* Deshayes & Milne-Edwards, 1835 (not Gmelin, 1791) and *Mactra lamarckii* Philippi, 1846 as synonyms of *M. cleryana*. However, the examined original illustrations of both species differ clearly from the type of d'Orbigny's species. There exists no type material of *Mactra grandis* and *Mactra lamarckii*. The first one is an illustration published by Lamarck in Bruguière *et al.* in the "Encyclopédie Méthodique" (1797, pl. 253, Fig. 1a–b); and cited later by Deshayes & Milne-Edwards (1835) making erroneously reference to *Mactra grandis* Gmelin, 1791. Later, Philippi (1846) introduced a new name for the illustration given by Lamarck. The two nominal taxa should not be considered synonymous with *M. cleryana*.

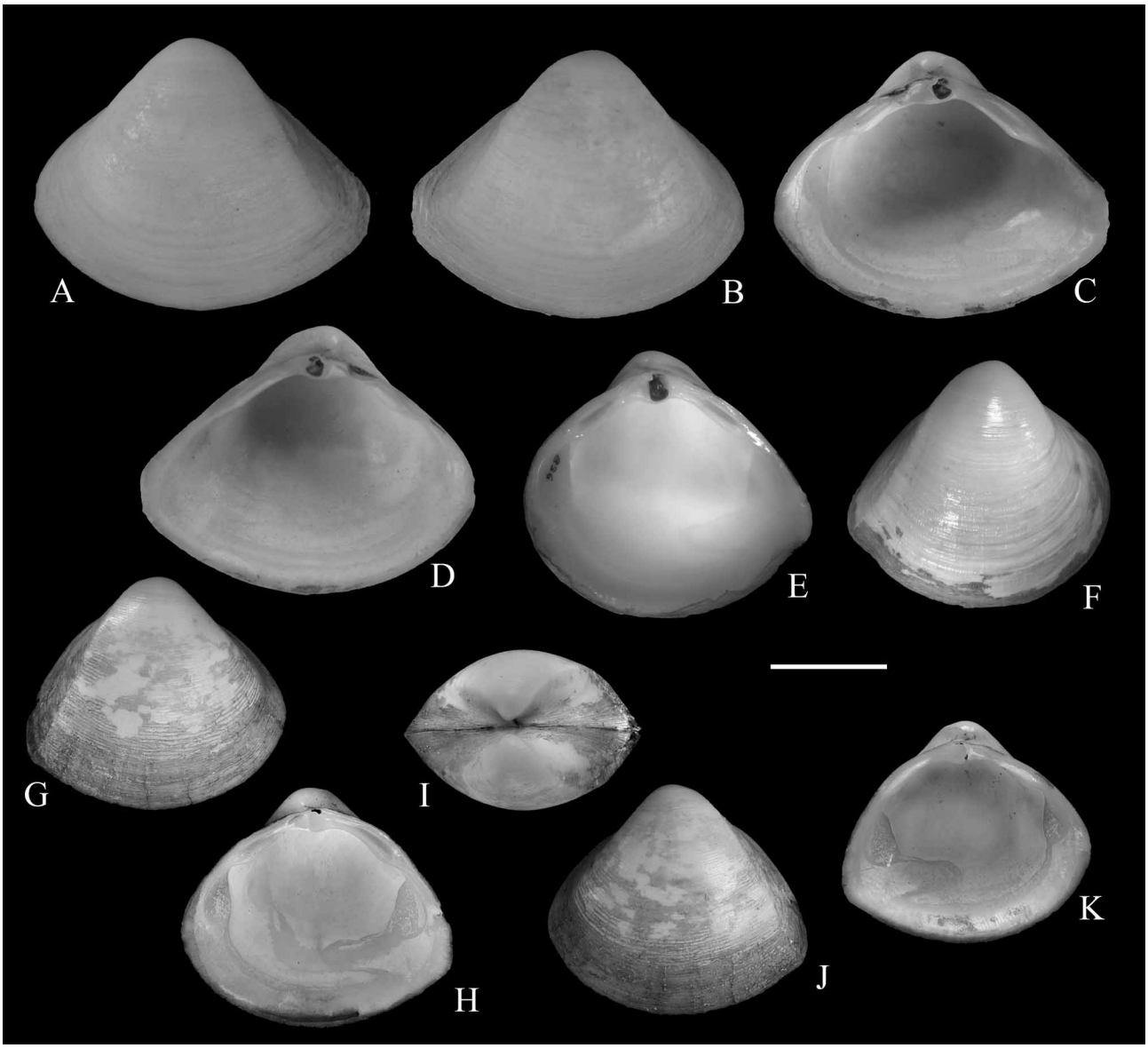

FIGURE 9. *Mulinia cleryana* (d´Orbigny, 1846). A–D: *Mactra guadelupensis* Récluz, 1852, syntypes (MNHN unnumbered), A: LV, B: RV; E–F: *Mulinea portoricensis*, Shuttleworth, 1856, syntype (NMBE 501777), RV; G–K: *Mulinia branneri* Dall, 1901 holotype (USNM 107829), G: RV, scale bar = 1 cm.

Although the examination of type material confirms the synonymy list, preliminary results from geometric morphometric studies suggest a shell variation along the specimens examined. This variation, currently in process of study suggest the presence of a Caribbean and a Brazilian morphotype. Finally the shell characters observed in *Mulinia cleryana* separate this species from the superficially similar *Mactra isabelleana* d´Orbigny, 1846. The main differences are the absence of an external ligament, smaller shell length and the posterior keel-like carina in the Brazilian species.

Subfamily Kymatoxinae Stenzel & Krause, 1957

Genus *Anatina* Schumacher, 1817: 126. [=*Labiosa* Möller, 1832 (ex Schmidt MS) (unnecessary n.n. pro *Anatina* Schumacher, 1817, not preocupied by Anatines (vernacular) Lamarck in Bosc, 1816); *Cypricia* Gray, 1847; *Leucoparia* Mayer, 1867, (nom. pro *Cypricia*)]

Type species. *Anatina pellucida* Schumacher, 1817 (= *Mactra anatina* Spengler, 1802), [monotypy].

Diagnosis. Shell fragile, posterodorsal area with a siphonal gap and defined by a line from umbones to posterior end; hinge with conspicuous cardinal teeth and rudimentary laterals.

Distribution. Atlantic and Pacific coast of the American continent.

Anatina anatina (Spengler, 1802)

Figure 10A–F

Mactra anatina Spengler, 1802: 120; Mörch, 1870: 124.
Anatina pellucida Schumacher, 1817: 126, pl. 8, fig. 1
Lutraria papyracea Lamarck, 1818 (not Gmelin, 1791); G. B. Sowerby I, 1821–1834: pl. 38, fig. 2; Deshayes & Milne-Edwards, 1835: 93; Reeve, 1841: 60, pl. 41, fig. 2; Chenu, 1844 in 1842–1854: pl. 1, fig. 3. Sowerby II, 1852: 317, fig. 77; Hanley, 1842 in 1842–1856: 27; Dall, 1894c: 41.
Lutraria lineata Say, 1822: 310—Conrad, 1831: 47, pl. 10, fig. 2; De Kay, 1843: 232
Mactra recurva Wood, 1828: pl. 1, fig 2.
Lutraria recurva Gray, 1837: 375.
Mactra nuttallii Reeve, 1854: fig. 125 (not Conrad, 1837); Dall, 1894b: 27.
Labiosa anatina, Adams & Adams, 1856 in 1853–1858: 386; Conrad, 1868: 42; 1894: 41; Rios, 1970: 197.
Labiosa papyracea, Chenu, 1862: 61, fig. 250.
Labiosa lineata, Conrad, 1868:42; Dall, 1894b: 27; Wilkins, 1957: 165, pl. 24, fig. 10.
Labiosa pellucida, Dall, 1894c: 41
Anatina lineata, Perry, 1940: 83, pl. 18, fig. 116.
Anatina anatina, Rios, 1975: 237, pl.75, fig. 1135; 1985: 244, pl. 86, fig. 1216; 1994: 266, pl. 91, fig. 1299; 2009: 538, fig. 1493.

Diagnosis. Shell subcircular, pellucid, external surface with concentric ridges, more grouped at umbonal area; umbones opisthogyrate; pallial sinus deep and high, maximum length 65 mm.

Description. Shell subcircular, fragile, pellucid, inequilateral, large, up to 65 mm in length, umbones opisthogyrate and moderately inflated; anterodorsal margin straight, posterior very short; anterior end rounded, posterior area delimited by a line from the umbones to middle posterior end; siphonal gap formed by shell folds; external surface with concentric ridges more conspicuous along the umbonal area (Figs.10A–D); internally white with a deep and high pallial sinus of about half of shell length; right hinge with two unfused cardinal teeth (3a & 3b), one anterior lateral tooth (AI) aligned with the 3a; one posterior lateral tooth (PI) short (Fig. 10E); left hinge with V-shaped cardinal tooth (2a & 2b), 2b more elongated, one anterior and one posterior lateral teeth (AII & PII) complete the hinge (Fig. 10F).

Type material. [*Mactra anatina*] ZMUC, unnumbered, two syntypes; [*Anatina pellucida*] ZMUC unnumbered, one syntype, RV; [*Lutraria lineata*] ANSP 51313, four syntypes collected at Beaufort, North Carolina; [*Mactra recurva*] NHMUK 2010-0621, holotype.

Type locality. "South America"

Other material examined. Unites States of America—Georges Bank, Massachusetts (AMNH 185938, "Atlantis expedition"); Fort Macon, North Carolina (USNM 40762, 2494); Beaufort (USNM 27580, 24586;

MACN-In 19252, 4 specimens); South Carolina (MZUSP 664; USNM 54352); Charleston (USNM 27579, 10380); Florida (USNM 46864); Biscayne Bay (AMNH 165884); Captiva Island (AMNH 99991); Marco Island (AMNH 248025); Peanut Island (AMNH 294015); Sarasota Beach (USNM 60785); Sanibel (AMNH 249003, 1 specimen; 269914, 1 specimen with periostracum; 294016, mud and sandy bottom; 99880, 120439, 203205); St. Augustine, Florida (USNM unnumbered); St. Petersburg. Florida (AMNH 172239); Georgia (AMNH 34749); Sea Island, Georgia (AMNH 309281); Louisiana (USNM 189184); Matagorda Bay, Texas (USNM 159242); Texas (USNM 6057). Colombia—Cartagena (USNM 364332). Brazil—Maceio (FURG 38517); Ilha Grande, RJ (FURG 34387); Angra dos Reis (MZUSP 63172); São Paulo (MZUSP 663, 22440, 22441, 22444, 45016, 45017, 45175, 57000, 61552, 77959); USNM 125466); Peruíbe (MZUSP 22448); São Sebastião (MZUSP 22442, 22443, 22450, 81815); Santos (USNM 359299; MZUSP 22445, 22446, 22447); Ubatuba (FURG 46995, 11812; MZUSP 22439, 44258); Alcatrazes (FURG 12549); Praia do Saí, Paraná (MZUSP 22449); Porto Belo (FURG 47842); Campeche (FURG 31298).

Distribution. From Massachusetts, USA, to Porto Belo, Santa Catarina, Brazil.

Remarks. *Anatina* Schumacher, 1817 (Mactridae) has priority over *Anatina* Lamarck, 1818 (Laternulidae). Lamarck (1818) latinized the French name "Anatine" previously published (Lamarck, 1809). However, some authors (e.g. Olsson, 1961; Vokes, 1967) considered *Anatina* Lamarck sensu Bosc (1816) as valid who mentioned correctly the genus of Lamarck but citing in vernacular only one species (*le solen canard*, *nomen nudum*). The nomenclatorial problem of this genus was resolved by Keen (1961).

Anatina anatina (Spengler, 1802) is a valid mactrid species living along the western Atlantic Ocean. The examination of the type material and original illustrations confirm that *Anatina pellucida* Schumacher, 1817 (Fig. 11A), *Lutraria lineata* Say, 1822 (Figs. 11B–D), *Mactra papyracea* Lamarck, 1818 (not Gmelin, 1791), *Mactra recurva* Wood, 1828 (Fig. 11E–H) and *Mactra nuttallii* Reeve, 1854 (vol. 8, pl. 21, sp. 125, not Conrad, 1837) are synonymous species names. The Pacific species *Anatina cyprinus* (Wood, 1828) had been cited widely as synonym of *A. anatina* (see, e.g., Dall, 1894b; Wilkins, 1957; Keen, 1958; Olsson, 1961). However, *A. cyprinus* from the Eastern Pacific coast is more subcircular, less elongated and has smaller posterior gap than the Atlantic *A. anatina* (Figs. 11I–J).

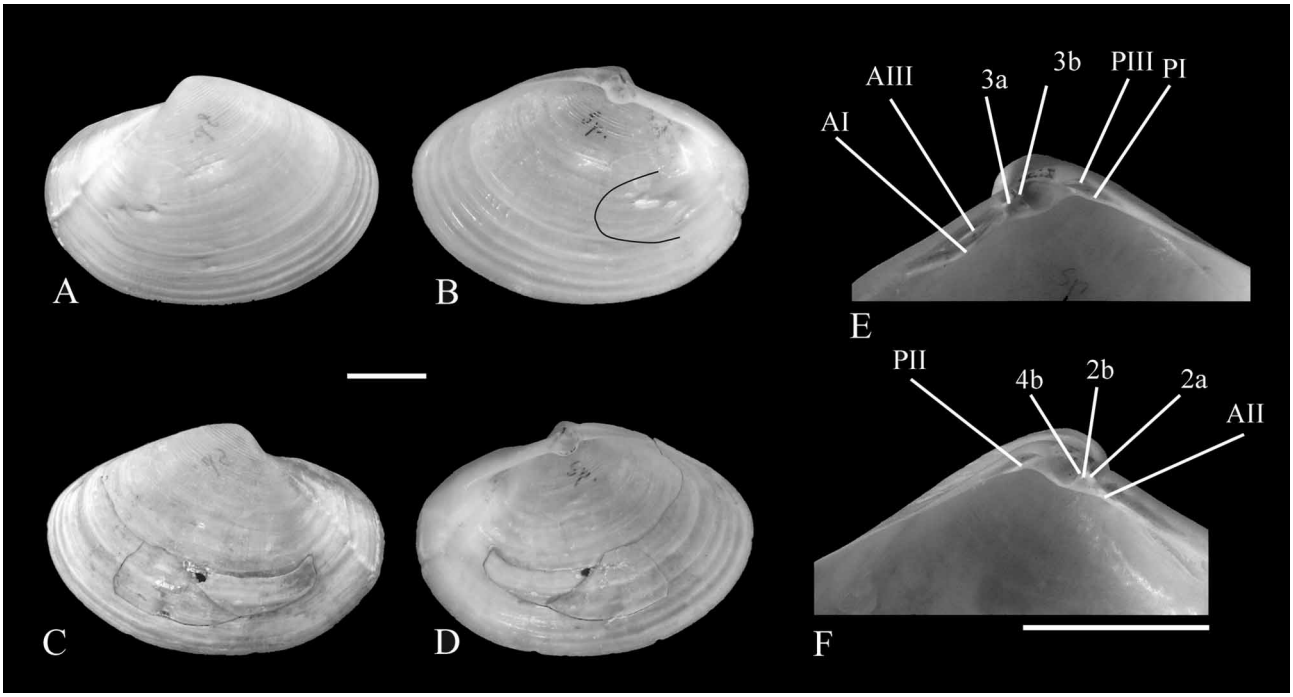

FIGURE 10. *Anatina anatina* (Spengler, 1802), A–D: syntype (ZMUC, unnumbered); E–F: hinge description by using the nomenclature developed by Bernard and Munier Chalmas, E: RV, F: LV, scale bar = 1 cm.

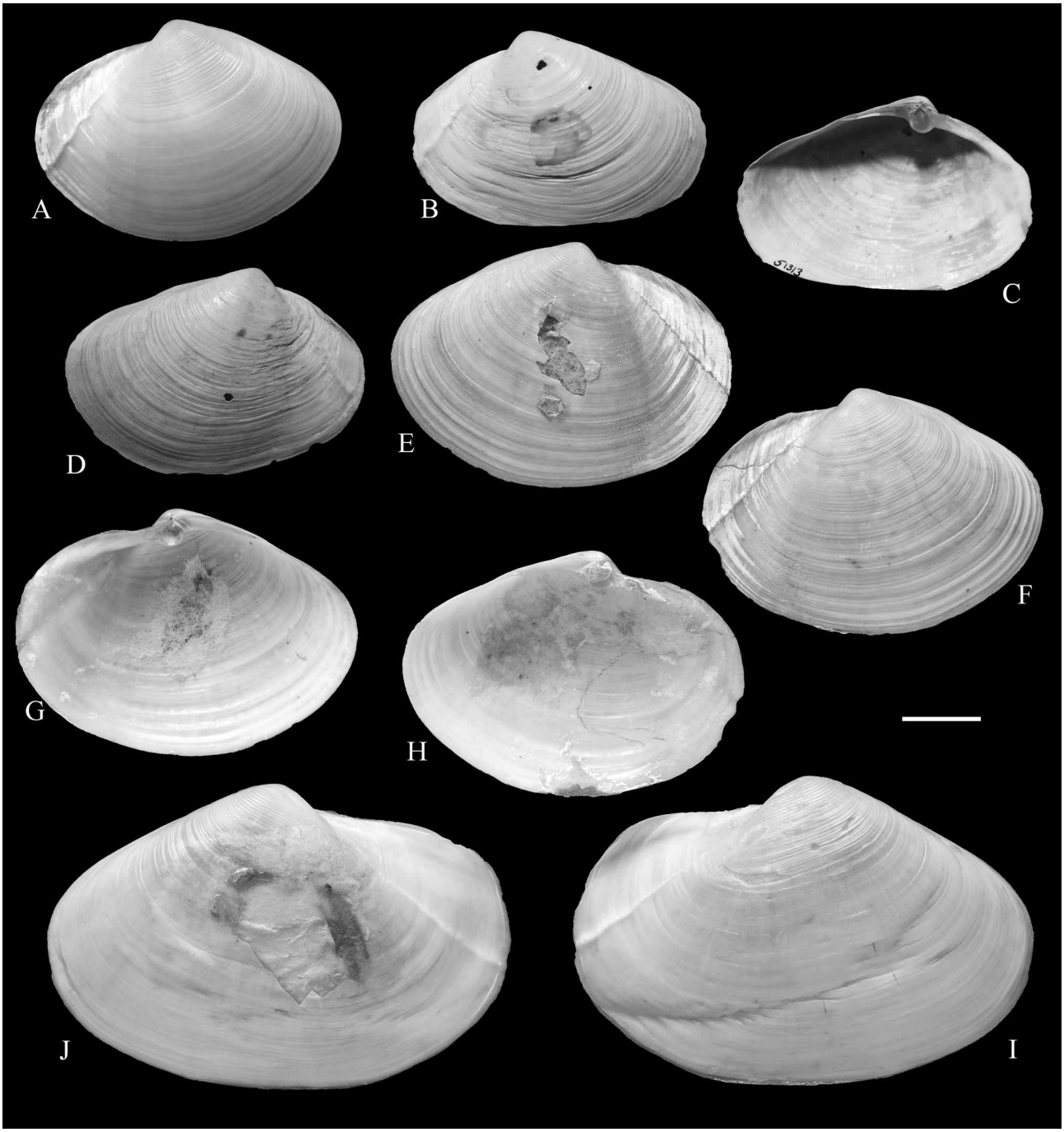

FIGURE 11. *Anatina anatina* (Spengler, 1802). A: *Anatina pellucida* Schumacher, 1817, syntype (ZMUC unnumbered); B–D: *Lutraria lineata* Say, 1822, syntypes (ANSP 51313); E–H: *Mactra recurva* Wood, 1828 (holotype NHMUK 2010–0621); I–J: *Mactra cyprinus* Wood, 1828 (NHMUK 2010–0608), scale bar = 1 cm.

Discussion

The present revision of type material and museum specimens carves out the valid names for Brazilian Mactridae (Table 1). It shows that the examination of types is a fundamental task to be carried out with all species (see also, Signorelli & Scarabino 2010). The inclusion of the Recent species *Mactrella iheringi* into the hitherto fossil genus *Trinitasia* is another example. Species misconceptions as became evident here are largely due to a lack of comprehensive comparisons of type material, and this task should not be overlooked in taxonomic papers. The present results rely on the examination of types and additional material deposited in 17 institutions in Europe, United States of America, and South America. The mactrid fauna along the Brazilian coast is represented by eleven species,

grouped into eight genera. The valid species *Mactra guidoi* Signorelli & Scarabino, 2010, *Mactra isabelleana* d´Orbigny, 1846, *Mactra marplatensis* Doello-Jurado, 1949, *Mactra petitii* d´Orbigny, 1846, *Mactrella janeiroensis* (Smith, 1915) and *Raeta plicatella* (Lamarck, 1818) are represented along the southern coast of Brazil, and their taxonomy was reviewed by Signorelli & Scarabino (2010) and Signorelli & Pastorino (2012). The genus *Mactra* includes four valid species; all others are monospecific. The distribution of the southwestern Atlantic mactrids clearly fits in with the usually recognized zoological provinces. In fact, *M. isabelleana*, *M. guidoi*, *M. marplatensis and M. petitii*, with Cape Frio (Rio de Janeiro, Brazil) as their northern limit, are clear representatives of the Argentine zoological province (Fig. 1). *Trinitasia iheringi*, *Mactrellona alata*, *Mactrotoma fragilis* and *Anatina anatina*, with Santa Catarina, Brazil, as southern limit, belong to the Brazilian zoological province (Fig. 1). The latter group of species also occurs in the Caribbean Sea and along the southwestern coast of the United States (Fig. 1). The southern limit of the Brazilian province, accepted by different researchers, is Cape Frio, where the Argentine province starts (Woodward 1856; Boschi 1979, 2000). The "Brazilian" mactrids found between Cape Frio and Santa Catarina extend their distribution to the Argentine province. The Argentine and the Magellanic provinces overlap between Peninsula Valdés and Santa Catarina State, but the Magellanic fauna is only represented in greater depths. Nevertheless, *Mactrella janeiroensis* and *Raeta plicatella*, living from the Caribbean Sea to Argentina, and *Mulinia cleryana* which reaches southward to Rio Grande do Sul constitute exceptions. A molecular approach of these three taxa possibly reveals the presence of morphotypes or species complexes.

TABLE 1. Taxa attributed to the family Mactridae living along the study area.

Valid species	Nominal species considered synonymous
Mactra guidoi Signorelli & Scarabino, 2010	*Mactra patagonica* authors, not d´Orbigny, 1846 (revised in Signorelli & Scarabino, 2010).
Mactra isabelleana d´Orbigny, 1846	(revised in Signorelli & Pastorino, 2012).
Mactra patagonica d´Orbigny, 1846	(revised in Signorelli & Scarabino, 2010, [fossil]).
Mactra petitii d´Orbigny, 1846	*Mactra richmondi* Dall, 1894; *Mactra symmetrica* Deshayes, 1854 (revised in Signorelli & Pastorino, 2012).
Mactra marplatensis Doello–Jurado, 1949	(revised in Signorelli & Pastorino, 2012).
Mactrella janeiroensis (Smith, 1915)	*Mactra surinamensis* Altena, 1968; *Mactra miskito* Petuch, 1998 (revised in Signorelli & Pastorino,2012).
Mactrellona alata (Spengler, 1802)	*Mactra (Mactrella) subalata* Mörch, 1861; *Mactra carinata* Lamarck, 1818; *Mactra concentrica* Valenciennes in Bory de Saint Vincent, 1827 [in Bruguière *et al.* (1791–1827)]; *Mactra laevigata* Schumacher, 1817.
Mactrotoma fragilis (Gmelin, 1791)	*Mactra anserina* Guppy, 1875; *Mactra bilineata* Reeve, 1854; *Mactra braziliana* Lamarck, 1818; *Mactra oblonga* Say, 1822; *Mactra oblongata* Ravenel, 1834; *Mactra ovalina* Lamarck, 1818; *Lutraria candida* Lamarck, 1818.
Mulinia cleryana (d'Orbigny, 1846)	*Gnathodon cantrainei* Récluz ms., Sowerby in Reeve, 1873; *Mactra donacaeformis* Krebs, 1864: 105 (non Gray, 1837, *Mulinia donaciformis* Gray, 1837, p. 376); *Mactra guadelupensis* Récluz, 1852; *Mulinea portoricensis* Shuttleworth, 1856; *Mulinia branneri* Dall, 1901; *Mulinia carinulata* Deshayes in Reeve, 1854.
Trinitasia iheringi (Dall, 1897)	*Mactra inceri* Petuch, 1998; *Mulinia kempfi* Cauquoin, 1969b.
Anatina anatina (Spengler, 1802)	*Anatina pellucida* Schumacher, 1817; *Lutraria lineata* Say, 1822; *Mactra recurva* Wood, 1828; *Lutraria papyracea* Lamarck, 1818 (not Gmelin, 1791); *Mactra nuttallii* Reeve, 1854: fig. 125 (not Conrad, 1837).
Raeta plicatella (Lamarck, 1818)	*Lutraria canaliculata* Say, 1822; *Mactra campechensis* Gray, 1825; *Raeta perspicua* Hutton, 1873; *Lavignon papyracea* d´Orbigny, 1846 (non *Lutraria papyracea* Gmelin, 1791) (revised in Signorelli & Pastorino, 2012).
Nominal species excluded from the synonymy list of valid South American Mactrids.	
Mactra ambigua Weinkauff, 1884; *Mactra compressa* Spengler, 1802; *Mactra dealbata* Pulteney, 1799; *Mactra tellinoides* Pulteney, 1813; *Mactra cyprinus* Gray in Wood,1828; *Mactra grandis* Lamarck. Conrad, 1868; *Mactra lamarckii* Philippi, Conrad, 1868; *Mactra scalpellum* Dall, 1895 (not Deshayes in Reeve, 1854); *Mactra angusta* Deshayes, 1855a (last two species checked in Signorelli & Pastorino, 2012).	
Total nominal species found in the literature: 54.	

In a global context, the biodiversity of Brazilian Mactridae is similar to that from the Pacific coast of North America with eleven species (Coan *et al*. 2000), and 15 species living in Thailand and Singapore (Wong 2009) whereas there are approximately 40 species in Oceania (Smith 1914; Kershaw 1958). There are no records of living mactrids from Polar regions, however, despite their great diversity at the northern and southern tips of the American continent.

Acknowledgments

Special thanks to Eike Neubert (NMBE), Kathie Way (NHMUK), Ole Tendal (ZMUC), Paul Callomon and Gary Rosenberg (ANSP), Mark Florence and Yolanda Villacampa (USNM), Paula Mikkelsen and Gregory Dietl (PRI), and Virginie Heros (MNHN) for their assistance in the revision of the type material. We are very grateful to Nikolaus Malchus, Paula Mikkelsen and Fabrizio Scarabino for their valuable comments that improved an early version of the manuscript. Javier Signorelli acknowledges the Ernst Mayr Award in 2008 from the Museum of Comparative Zoology, Harvard University, to visit the malacological collection of the NHMUK. We are grateful to CONICET of Argentina, to which G.P. belongs as a member of the research carrier and J.H.S. as fellow. This contribution was partially supported by the projects PICT 942 and PICT 0323 from the Agencia Nacional de Promoción Científica y Tecnológica (Argentina).

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