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Leiosolenus (Labis) patagonicus (Bivalvia: Mytilidae) from Argentinean sea, taxonomic revision and anatomical notes

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Abstract. The taxonomic status and anatomy of *Leiosolenus (Labis) patagonicus* (d'Orbigny, 1846 in 1834-1847) has been revised. This boring bivalve, belonging to the family Mytilidae, is the only Lithophaginae species distributed along the Argentinean coast. None of the fossil species mentioned for this area must be considered as a synonym of d'Orbigny´s species. *Leiosolenus patagonicus* is characterized by a thin shell, longitudinally elongated, with subterminal umbos and commarginal striae. The calcareous depositions on the outer surface of the shell are extended beyond the posterior margin. This species has well developed purple siphons, well differentiated morphologically from each other. Incurrent siphon is wider than excurrent, opened at the ventral edge and provided with a basal siphon valve at the base. Two pairs of demibranchs type B (1) from Atkins were observed. The shell characters and internal morphology were compared with other related species of the genus living along the South American coast. Finally, repository, type locality and habitat conditions were informed.

Keywords. *Lithophaga;* Boring bivalve; Morphology; Argentina.

INTRODUCTION

The family Mytilidae Rafinesque, 1815 is a cosmopolitan group, worldwide distributed (Bernard *et al.,* 1993; Coan *et al.,* 2000; Coan & Valentich-Scott, 2012; Von Cosel & Gofas, 2019; Huber 2010, 2015; Rios, 2009; Valentich-Scott *et al.,* 2020) with more than 300 valid species (MolluscaBase, 2022). This is a diverse group adapted from shallow to deep waters. The supra-generic classification of Mytilidae has been modified during the years. One of the first modern revisions was made by Soot-Ryen (1955) who recognized more than twenty genera without subfamily divisions. However, this first approach has been modified significantly (Soot-Ryen, 1969; Scarlato & Starobogatov, 1979a, 1979b; Boss, 1982; Bernard, 1983; Starobogatov, 1992; Coan *et al.,* 2000). Bieler *et al.* (in Bouchet & Rocroi, 2010) included eight subfamilies within Mytilidae, while Carter *et al.* (2011) suggested the presence of ten subfamilies. However, phylogenetic studies suggested the polyphyletic nature of many mytilid subfamilies (Owada, 2007; Liu *et al.,* 2018; Lee *et al.,* 2019; Audino, *et al.,* 2020). More recently, Valentich-Scott *et al.* (2020) suggested that some traditional subfamilies are polyphyletic and it is necessary to complement morphological analyzes with phylogenetic ones to resolve this classification.

Some mytilid genera, such as *Adula* H. Adams & A. Adams, 1857 (in 1853-1858), *Botula* Mörch, 1853, *Leiosolenus* Carpenter, 1857 and *Lithophaga* Röding, 1798 are boring bivalves belonging to the subfamily Lithophaginae H. Adams & A. Adams, 1857. Several authors pointed out that *Lithophaga, Leiosolenus* and *Botula* are chemical borers of calcareous materials, whereas *Adula* is a mechanical borer (Yonge, 1955; Wilson & Tait, 1984; Kleemann, 1990; among others). The species included within *Lithophaga* and *Leiosolenus* represent the 70% of boring mytilids (Kleemann, 1990). Recent phylogenetic studies based on molecular evidence (Owada, 2007; Liu *et al.,* 2018; Audino *et al.,* 2020) suggested that convergent evolution is common among marine mussels. The classification based on morphology differs from that suggested by molecular analysis. In this way, the subfamilies Mytilinae, Modiolinae, and Lithophaginae are not monophyletic. However, species belonging to *Lithophaga* and *Leiosolenus* show morphological similarities such as an antero-posteriorly elongated shell, cylindrical, cov-

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ered by brownish periostracum and poor byssus corsage demonstrating an evolutionary convergence to the boring habit. Precisely, these similarities led Carpenter (1857) to locate *Leiosolenus* as a subgenus of *Lithophaga.* During more than a century, this taxonomic relation between both genera was not modified (Soot-Ryen, 1969; Habe, 1977; Kleemann, 1977, 1980, 1984, 2008, 2009a, b). However, the presence of calcareous depositions over periostracum, their smaller size and calcified perforations allow *Leiosolenus* to be treated as a valid genus (Hodgkin, 1962; Wilson, 1979; 1984; Barthel *et al.,* 1981; Huber, 2010). Kleemann & Maestrati (2012) redefined again *Leiosolenus* as a subgenus of *Lithophaga* recognizing that generic separation was still confusing. Despite this, Huber (2015) continued treating *Leiosolenus* as a valid genus based on genetic analysis made by different authors (Owada, 2007; Liu *et al.,* 2018; Audino *et al.,* 2020).

The suggested subgenera included within *Leiosolenus* are not definitive. Huber (2015) recognized the subgenera *Leiosolenus s. s., Diberus* Dall (1898), *Labis* Dall (1916), *Myoforceps* P. Fischer (1886 in 1880-1887) and *Stumpiella* Soot-Ryen (1955) based on the pattern of calcareous depositions that cover shell´s surface. The biodiversity of boring Mytilidae was widely studied and their shell morphology was defined by Owada (2007) as lithophagiform based on the relation of different measures, such as length, height, width and vectors related to the byssal retractor muscles. The observed results showed differences between the retractor muscles distance that was significantly different in lithophagiform taxa than mytiliform and modioliform taxa.

In the Argentinean Sea only the presence of *Leiosolenus (Labis) patagonicus* (d'Orbigny, 1846 in 1834-1847) has been mentioned in literature (Carcelles, 1944; Carcelles & Williamson, 1951; Castellanos, 1957, 1970; Rios, 1966, 2009; Pastorino, 1995; Scarabino, 2003; Scarabino *et al.,* 2006; Zelaya, 2016). Turner & Boss (1962) included this species within the subgenus *Labis* based on smooth valves, with a very thin layer of calcareous depositions, posteriorly thicker and rounded or triangular calcareous projections. Morphological variation of *L. patagonicus* was studied by Márquez *et al.* (2017). The study revealed that *L. patagonicus* shows significant differences in shell size and shape between subtidal specimens housed in empty shells and those extracted at intertidal area from the clay rocky shore. These results reveal that phenotypic plasticity is apparently conditioned by the type of substrate (composition and hardness) and other environmental conditions (Bagur *et al.,* 2013).

Finally, it is important to mention the importance of *L. (L.) patagonicus* at ecological level. Boring bivalves have a special role because they are considered ecosystem engineers. When they drill the substrate they are also modifying the natural landscape. However, studies carried out with this local species show that the volume of rock eroded by physical agents, such as waves and the movement of pebbles is 70 times greater than that generated by biological effects (Bagur *et al.,* 2013). At the same time, the presence of this species increases species richness along the intertidal area (Arribas *et al.,* 2016) due to the fact that, when the bivalves die, they leave the holes that give shelter to other organisms.

Despite the presence of this species in local and foreign catalogues, it had not been reviewed in detail. Hence, in this work the anatomy and taxonomic status of *L. patagonicus* is revised.

MATERIAL AND METHODS

A total of 82 lots and 500 specimens of *L. patagonicus* were studied in this work. Material deposited in the following institutions were examined: Instituto de Biología de Organismos Marinos (CNP-INV); Museo de Ciencias Naturales "Bernardino Rivadavia" (MACN); Museo de La Plata (MLP) and London Natural History Museum (NHMUK). Additionally, 229 specimens were sampled from rocky substrate by using hammers and chisels in different localities of Argentinean coast (Fig. 1). Living specimens were immediately immersed in filtered seawater to be studied and photographed alive under a stereomicroscope. To facilitate the dissection, animals were previously relaxed with magnesium chloride tablets (10% in sea water) by 30 minutes. All digital photographs were taken by a Nikon D5000 with a 60 mm Nikkor micro-lens. Sampled specimens were fixed in ethanol 96% and deposited in the CNP-INV (see additional material examined section). Comparisons with congeneric species were based on available information from the literature.

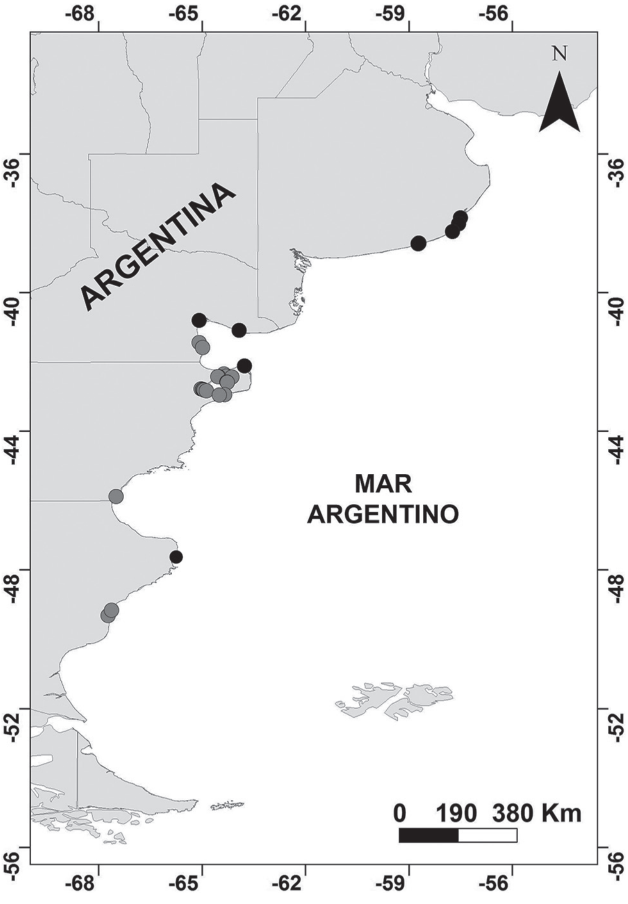

Figure 1. Distribution map of *L. patagonicus.* Black dots: lots from institutions, grey dots: sampled specimens.

RESULTS

Family Mytilidae Rafinesque, 1815
Subfamily Lithophaginae

H. Adams & A. Adams, 1857 in 1853-1858 [= Lithodominae Gray, 1857; Botulinae Scarlato & Starobogatov, 1979a].

Genus *Leiosolenus* Carpenter, 1857

Diagnosis: Shell thin, cylindrical, longitudinally elongated, umbos subterminal or terminal, with rounded ends, sculpture of commarginal striae; calcareous depositions on outer surface; in some species they are extended beyond the posterior margin; hinge edentulous; shelter covered by calcareous conical tubes.

Type species: *Leiosolenus spatiosus* Carpenter, 1857, by monotypy.

Distribution: Almost cosmopolitan, Pacific and Atlantic coast of North America, Central America and South America; Red Sea; Eastern Atlantic from Europe to Angola; Indo Pacific from Eastern Africa to Australia and New Zealand (Rios, 2009; Huber, 2010; Coan & Valentich-Scott, 2012; Kleemann & Maestrati, 2012; Von Cosel & Gofas, 2019; Valentich-Scott *et al.,* 2020; MolluscaBase, 2022).

Remarks: Currently, species with outer calcareous deposition are included within *Leiosolenus,* and those without calcareous depositions in *Lithophaga.* Huber (2015) treated both genera as valid based on genetic and morphological results previously mentioned (Owada, 2007; Liu *et al.,* 2018; Audino *et al.,* 2020). At the moment, *Leiosolenus* includes 35 valid species widely distributed (Huber, 2010, 2015; Coan & Valentich-Scott, 2012; Velásquez *et al.,* 2017; MolluscaBase, 2022, among others).

Leiosolenus (Labis) patagonicus
(d'Orbigny, 1846 in 1834-1847)
(Figs. 2A-K, 3A-G, 4A-I)

Lithodomus patagonicus d'Orbigny, 1846 in 1834-1847: 650, pl. 82, figs. 24, 25, pl. 85, figs. 19-20 – Rochebrune & Mabille, 1889: 119.

Lithophaga patagonica d'Orbigny – Dunker, 1882: 9, pl. 6, figs. 6-7; Ihering, 1900: 96-97; Carcelles & Williamson, 1951: 328; Castellanos, 1957: 9, 10, pl. 2, fig. 9, pl. 4 fig. 10; 1970: 213, pl. 17, fig. 10; Bernard, 1983: 21; Pastorino, 1995: 13, pl. 3, fig. 18a, b; Scarabino, 2003: 232; Scarabino *et al.,* 2006: 62; Rios, 2009: 490, fig. 1375.

Lithodomus patagonica d'Orbigny – Charcot *et al.,* 1903-1905: 16.

Lithophaga (Diberus) patagonica d'Orbigny – Carcelles, 1944: 272, pl. 6, figs. 58-63.

Lithophaga (Labis) patagonica d'Orbigny – Turner & Boss, 1962: 102-104, pl. 68, figs. 1-4; Rios, 1966: 29.

Leiosolenus (Labis) patagonicus d'Orbigny – Huber, 2010: 121.

Leiosolenus patagonicus d'Orbigny – Zelaya, 2016: 253.

Type locality: Ensenada de Ross, Río Negro province, Argentina.

Type material: NHMUK 1854.12.4.790, holotype. The examined material consists of the substrate where the valves studied by d'Orbigny were found. No valves were found into the type cabinet (Figs. 2A-C).

Additional material examined: Argentina: Buenos Aires coast: MACN 15801, 25 complete specimens, subtidal. MACN 15223, 1 empty shell; Santa Clara del Mar: MLP 4206, 16 empty shells and 13 complete specimens; Mar del Plata: MACN 9361, 4 empty shells; MACN 16869, 1 empty shells; MACN 12201-1, several valves with calcareous conical tubes; MACN 2399-1, 1 complete specimen; Miramar: MLP 1246, 2 complete specimens; MACN 10036, 1 empty shell; MACN 29444, 20 empty shells; MACN 13107-1, 9 empty shells; Necochea: MACN 9368-2, 1 empty shell; Puerto Quequén: CNP-INV 2864, 20 complete specimens, intertidal; MACN 18506, 13 empty shells and 30 complete specimens. Río Negro, Caleta de los Loros: MACN 39037, specimens extracted from oysters; Bahía Creek: MLP 4071-3, several complete specimens; San Matías gulf: MACN 21284, 2 complete specimens; MACN 30799, 1 complete specimen; MLP 4169, 2 empty shells; CNP-INV 2870, 8 empty shells. Chubut, Punta Norte: MACN 11504, 3 empty shells with calcareous conical tubes; MACN 11504b, shells with calcareous conical tubes; San José gulf: MACN 24475, 4 empty shells, MACN 26488, 4 complete specimens; MACN 9179-1, 5 empty shells; Villarino: CNP-INV 2866, 2 empty shells, intertidal; CNP-INV 2865, 4 empty shells, intertidal; CNP-INV 2863, 19 empty shells, intertidal; Isla de los Pájaros: MLP 3777, 4 empty shells and 1 complete specimen; Punta Gales: CNP-INV 2876, 3 empty shells, intertidal; CNP-INV 2877, 14 empty shells, intertidal; CNP-INV 2875, 15 empty shells; Bahía Fracasso: CNP-INV 2883, 7 empty shells, intertidal; Puerto Pirámides: MLP 4233, 4 empty shells and 2 complete specimens; Punta Pardelas: CNP-INV 2892, 2 empty shells, intertidal; CNP-INV 2893, 1 specimen, intertidal; CNP-INV 2871, 7 complete specimens; MLP 50053, 10 complete specimens; MLP 50054, 6 empty shells and 2 complete specimens; MLP 50056, 1 complete specimen; Puerto Madryn: MLP 1933, 5 empty shells and 2 complete specimens; MLP 1939, several complete specimens; MLP 4915, 2 empty shells and 1 complete specimen; MACN 10336, 4 complete specimens within coral algae (Order Corallinales); MACN 23242, 8 empty shells; MACN 9172-8, 4 empty shells and 1 complete specimen; MACN 9219-1, 2 empty shells; MACN 9281-1, 1 complete specimen; Punta Cuevas: CNP-INV 2884, 2 articulated shells and 6 complete specimens, intertidal; Punta Este: CNP-INV 2873, specimens with calcareous conical tubes, intertidal; CNP-INV 2885, 6 pairs of articulated shells, intertidal; CNP-INV 2878, 33 complete specimens and habitats, intertidal; CNP-INV 2881, 5 com-

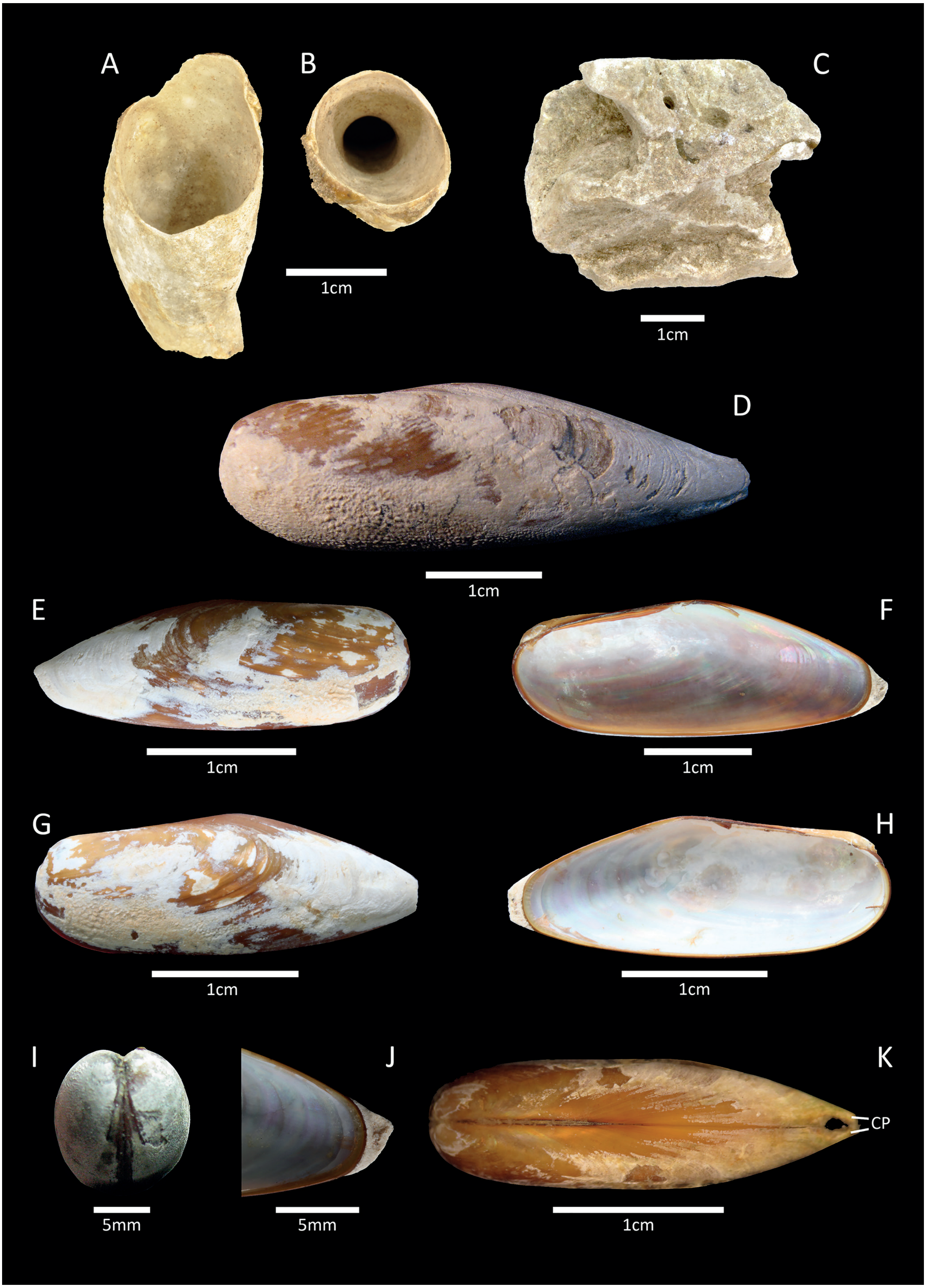

Figure 2. *L. patagonicus.* Shell morphology. (A-C) substrate belonging to the holotype (NHMUK 1854.12.4.790, not found); (D-K) internal and external view of shell (CNP-INV 2887).

plete specimens, subtidal; Paraná Beach: CNP-INV 2861, several specimens, intertidal; CNP-INV 2887, 2 complete specimens, intertidal; CNP-INV 2888, 1 complete specimen, intertidal; CNP-INV 2880, 1 complete specimen, intertidal; Cerro Avanzado: MLP 13083, 20 complete specimens; CNP-INV 2862, 25 complete specimens, intertidal; CNP-INV 2890, 1 complete specimen, intertidal; CNP-INV 2891, 1 empty shell, intertidal; CNP-INV 2872, several specimens, intertidal; Cracker Bay: MLP 13019, 2 complete specimens; MACN 26489, several specimens; Punta Ninfas: CNP-INV 2886, 6 complete specimens, intertidal; CNP-INV 2882, 1 complete specimen, intertidal; Comodoro Rivadavia: MACN 6840, 8 complete specimens. Santa Cruz, Puerto Deseado: MACN 33643, 1 empty shell; Puerto San Julián: CNP-INV 2889, 2 complete specimens, intertidal; CNP-INV 2868, 20 complete specimens, intertidal; CNP-INV 2869, 1 complete specimens, intertidal.

Diagnosis: Shell oval, medium size, with smooth calcareous projections behind posterior end; calcareous depositions on the outer surface of the shell with a granular appearance.

Description

Shell – equivalve, thin, fragile, oval, rounded ends, circular in cross section, length up to 40 mm. (MACN 15801); umbo prosogyrate, anterior, poorly developed; dorsal margin slightly arched, ventral margin straight, poorly defined concentric and irregular growth lines, covered by calcareous granular depositions on the posterior and ventral area of the external surface, hiding juvenile ridges; smooth calcareous projections extending beyond the limits of posterior end of valves (Figs. 2H, J); inner surface blue to violet, vitreous luster; pallial sinus and scar adductor muscles poorly visible; hinge plate adonta, extremely small teeth; opisthodetic ligament (Figs. 2F, H).

Internal anatomy – mantle folds with purple coloration (Fig. 3A); middle mantle fold smaller than others; siphons

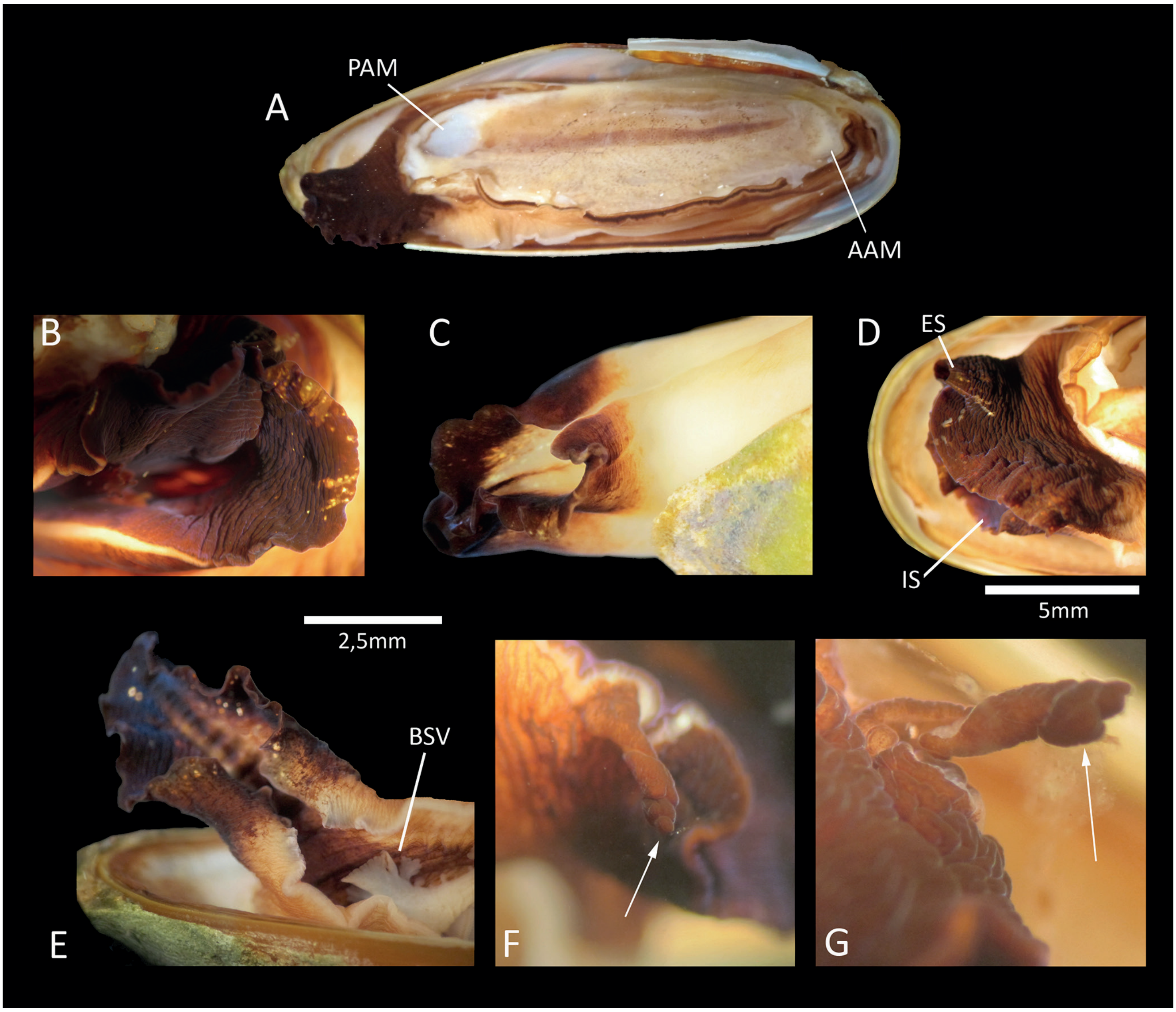

Figure 3. *L. patagonicus.* Mantle cavity organs of the specimen deposited as CNP-INV 2873. (A) general view of the organism after removal of the left valve; (B-D) detail of the siphon morphology; (E) basal siphonal valve. (F-G) tubular structure secreting mucous substance. Abbreviations: AAM = anterior adductor muscle; BSV = basal siphonal valve; ES = excurrent siphon; IS = incurrent siphon; PAM = posterior adductor muscle.

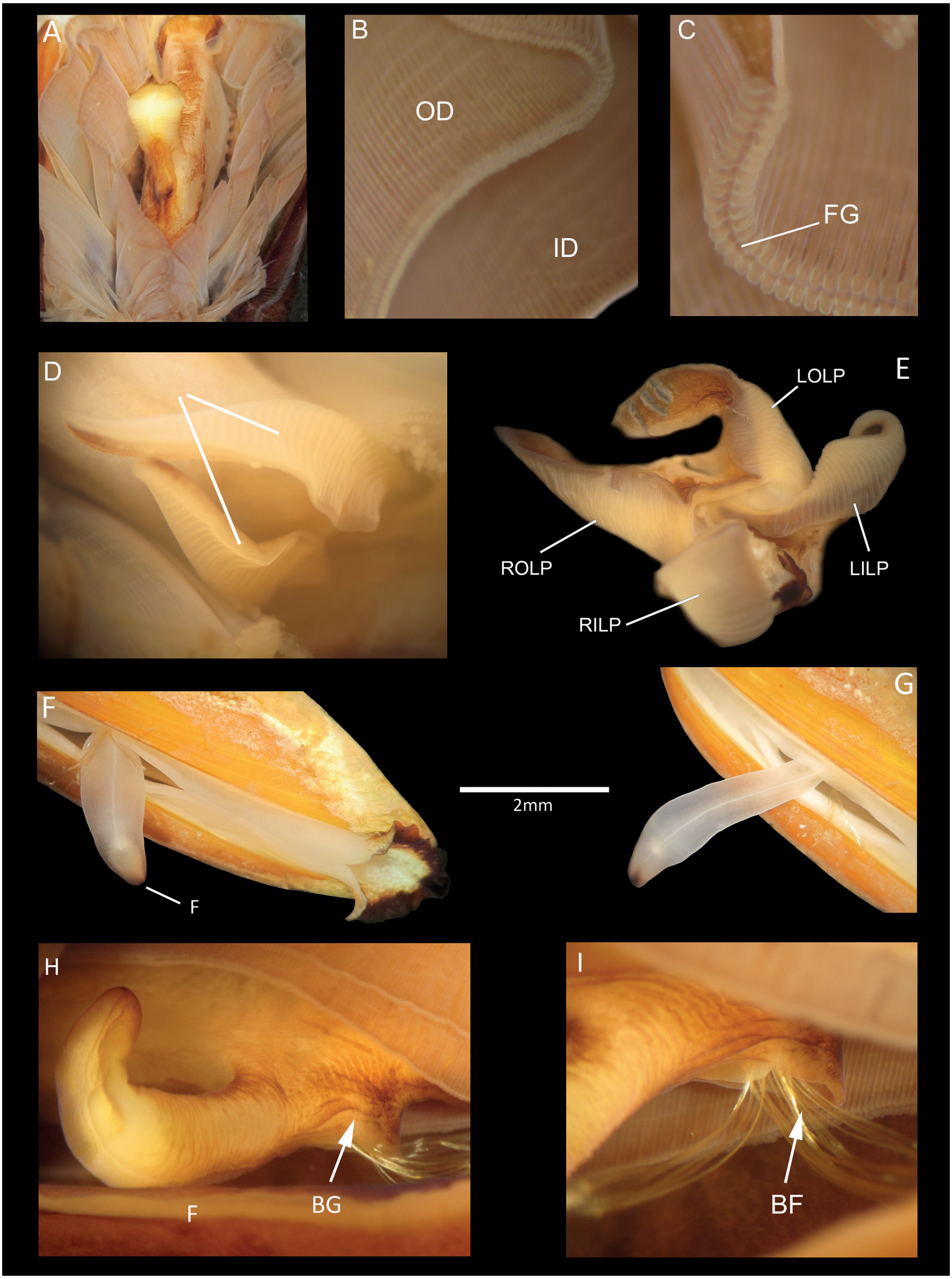

Figure 4. *L. patagonicus.* Mantle cavity organs of the specimen deposited as CNP-INV 2873. (A) ventral view, observing the foot and gills on sides; (B) external and internal demibranch details; (C) detail of food groove over the distal edge of outer demibranch; (D-E) labial palps; (F-G) morphology of the foot; (H-I) byssus gland. Abbreviations: BF = byssal filaments; BG = byssus gland; F = foot; FG = Food groove; ID = inner demibranch; LILP = left inner labial palp; LOLP = left outer labial palp; OD = outer demibranch; RILP = right inner labial palp; ROLP = right outer labial palp.

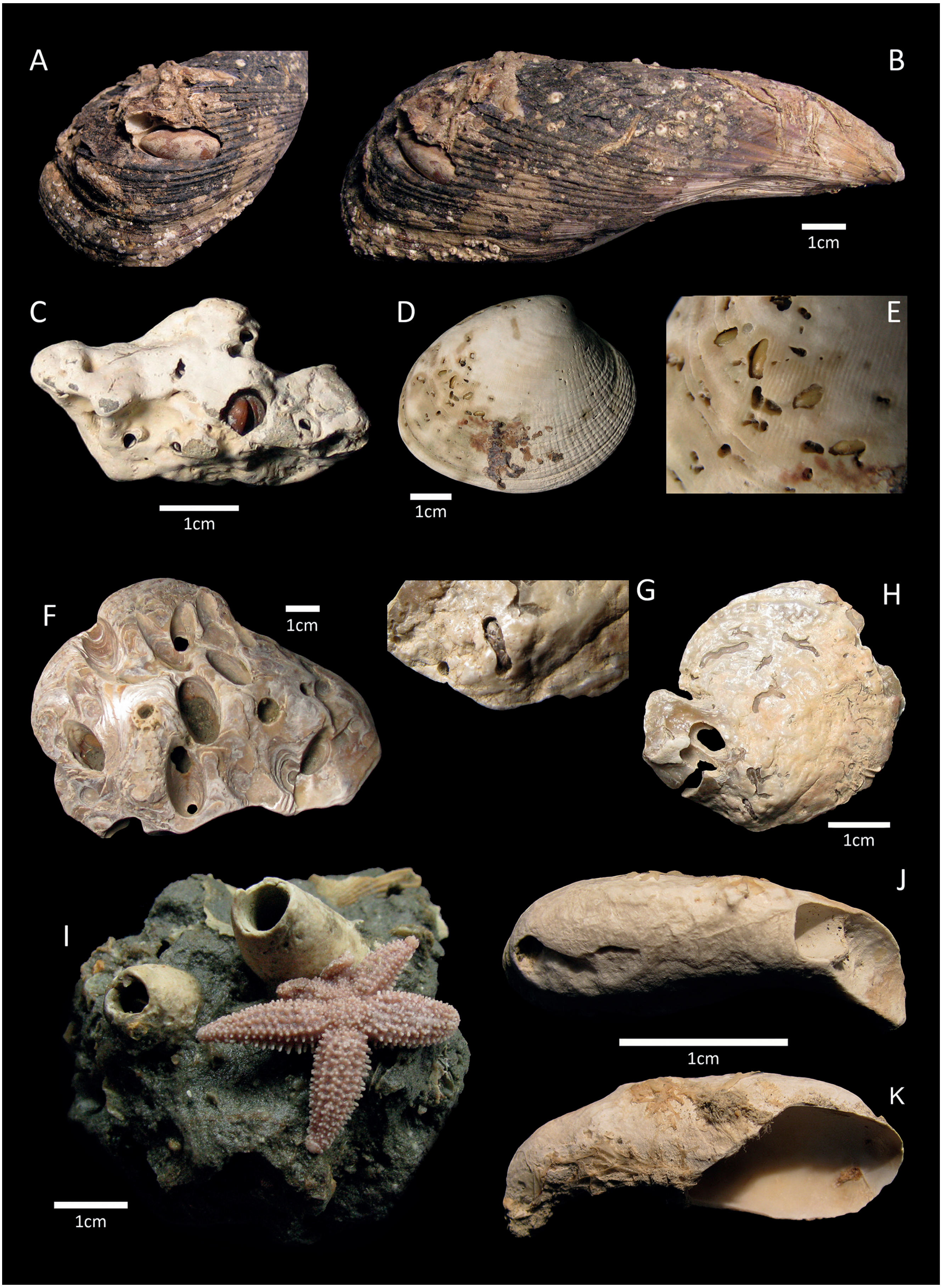

Figure 5. Different substrates where *L. patagonicus* can be sampled. (A-B) *Aulacomya atra* (MACN-29479); (C) Corallinacea algae; (D-E) *Ameghinomya antiqua* (P.P. King, 1832) (CNP-INV 2877); (F-H) *Ostrea puelchana* d'Orbigny, 1844 (CNP-INV 2877); (I) sedimentary rock with tubes (CNP-INV 2877); (J-K) detail of tubes (CNP-INV 2864).

well developed, different in size and shape, usually with a purple coloration (Figs. 3B-D); fused at the base, excurrent siphon smaller than incurrent, free of tentacles over the opening ring; incurrent siphon free of tentacles, opened along ventral edge, with a basal siphonal valve, flap-like with finger-like edges, placed at the base (Fig. 3E); some specimens provided with a tubular structure, over the edge of incurrent siphon, which secreted a whitish and viscous substance (Figs. 3F-G); two pairs of demibranchs along antero-posterior axis; internal and external demibranchs equals in length, filibranch type B (1) from Atkins (1937) (Figs. 4A-C), filaments connected by vascular connections give reticulate appearance (Fig. 4B); food groove present at distal border of each demibranch (Fig. 4C); labial palps longer than wide, triangular in shape, smooth external surfaces, internal provided of transverse folds (Figs. 4D-E); foot poorly developed, longer than wide (Figs. 4F-H); anterior adductor muscle smaller than posterior, lenticular shape, closely located to dorsal edge; posterior adductor muscle oval (Fig. 3A); byssal pit relatively deep, with golden filaments of byssus, placed posteriorly to the foot (Figs. 4H-I).

Habitat and Ecology

Leiosolenus patagonicus is distributed from the intertidal zone to shallow subtidal, covering horizontal and vertical hard substrates. Also, it can be found inside other types of hard substrates such as shells of other species of bivalves (*Aulacomya atra, Ameghinomya antiqua* or *Ostrea puelchana*) or Corallinaceas algae (Fig. 5).

Distribution: *Leiosolenus patagonicus* was reported from Santa Catarina, Brazil, to Magellan region and Malvinas/Falklands islands (Rochebrune & Mabille, 1889; Pastorino, 1995; Rios, 1994, 2009). Specimens from Santa Clara del Mar, Buenos Aires province, to Puerto San Julián, Santa Cruz province, were herein examined.

Remarks: *Leiosolenus patagonicus* has been historically included within the genus *Lithophaga* (Dunker, 1882; Ihering, 1900; Carcelles, 1944; Carcelles & Williamson, 1951; Turner & Boss, 1962; Rios, 1966; Huber, 2010; among others). However, the presence of calcareous depositions on the external surface of the shell and posterior projections places it within *Leiosolenus*. In addition, fine and smooth calcareous projections place it within the subgenus *Labis* (Huber, 2010). Morton (1993) described for *Leiosolenus aristatus* (Dillwyn, 1817) that calcareous depositions and posterior projections are secreted by glands located in middle mantle folds and, in adult stages, siphons may smooth these depositions. A similar process may occur in *L. patagonicus*. Two junior synonyms have been mentioned in literature (Carcelles, 1944; Parodiz, 1996, among others): *Lithodomus patagonicus dalli* Ihering, 1907 and *Lithophagus platensis* Philippi, 1893. The first one was described from lower Miocene deposits exposed at Rada Tilly, San Jorge gulf, and the second one from Miocene deposits of Parana Formation (del Río & Martínez, 1998; Coan & Kabat, 2017). Parodiz (1996) mentioned that both are close, but Genta Iturrería (2014) considered both as valid species. Type material of Ihering (MACN-PI 320, holotype) do not show calcareous depositions or external radial ornamentation. The types of Philippi were not found, therefore, in this work, both species are not considered synonymous of *L. patagonicus* until new material confirm or reject the synonymy.

DISCUSSION

Leiosolenus patagonicus shows a characteristic external morphology clearly different from other species of the genus that inhabit South American waters (Table 1). It differs from *L. attenuatus* (Deshayes, 1836) and *L. peruvianus* (d'Orbigny, 1846 in 1834-1847) by having a less elongate shell, less pointed posterior end and broader calcareous depositions. External ornamentation separates *patagonicus* from tropical western Atlantic species, *L. bisulcatus* (d'Orbigny, 1853), and eastern Pacific species *L. plumula* (Hanley, 1843 in 1842-1856). Crossed calcareous projections observed in *L. aristatus* (Dillwyn, 1817) and the absence of posterior projection and little size of *L. spatiosus* (Carpenter, 1857) clearly distinguish these two species from *patagonicus*. Regarding morphology of soft tissues, Simone & Gonçalves (2006) have studied the internal anatomy of *L. aristatus*. In general terms, both species are anatomically very similar. However, *L. aristatus* slightly differs from *L. patagonicus* by having more flattened anterior adductor muscle and both siphons are totally fused being only internally separated by a septum. In addition, morphological characters of three Thailand species included within *Leiosolenus* illustrated by Valentich-Scott & Tongkerd (2008) showed differences, mainly on labial palps and shape and size of adductor muscles. In this way, *L. lima* (Jousseaume *in* Lamy, 1919) showed large ellipsoidal labial palps, smaller anterior adductor muscle and more ovate and larger posterior adductor muscle; *L. malaccanus* (Reeve, 1857) showed more elongated and pointed labial palps, smaller anterior and posterior adductor muscles; and *L. obesus* (Philippi, 1847) showed larger and longer labial palps, narrower, with anterior adductor muscle ovate-elongated and posterior adductor muscle circular. These morphological differences between species of the same genus but with different distributions may be the result of differential environmental pressures operating over individuals.

All substrates were the specimens of *L. patagonicus* were sampled are sedimentary rocks and shells, rich in calcium. They can be found in high density (Olivier *et al.,* 1966; Pastorino, 1995; Bagur *et al.,* 2013, among others) appearing as clusters formed by the cementation of the tubes secreted by organisms (Bagur *et al.,* 2013). These conical tubes are secreted by each specimens, covering the posterior end of specimens. These specimens have not only developed the ability to create tubes but also revoke inner walls of the shelter. All this is possible thanks to the ability of specimens of this species to secrete calcite. In this way specimens protect themselves from the external environment (Bagur *et al.,* 2013).

Table 1. Seven species belonging to the genus *Leiosolenus* found in South American waters, with comparison of main morphological characters.

Species	External sculpture	Anterior end	Morphology of calcareous projection	Maximum shell length	Distribution
Leiosolenus (Labis) patagonicus (d'Orbigny, 1846 in 1834-1847)	Smooth with thin calcareous incrustations	Rounded	Trigonal, flattened, extended beyond the posterior	45 mm	Santa Catarina, Brazil to Magellan region and Malvinas/Falkland Islands
Leiosolenus (Labis) attenuatus (Deshayes, 1836)	Smooth with pustulose incrustations	Rounded	Narrowly pointed, not feather-like, extended beyond the posterior end in both valves	111 mm	Eastern Pacific, from California, USA to Peru
Leiosolenus (Labis) peruvianus (d'Orbigny, 1846 in 1834-1847)	Smooth with pustulose incrustations	Broadly rounded	Narrowly pointed, feather-like prolonged beyond the posterior end in both valves	79 mm	Lambayeque, Peru to Valparaíso, Chile
Leiosolenus spatiosus (Carpenter, 1857)	Over anterior part and anterolateral valve, vertical irregular wrinkles	Rounded	without posterior projection	63 mm	San Felipe, Gulf of California, USA to Bocapán, Perú
Leiosolenus (Diberus) bisulcatus (d'Orbigny, 1853)	Divided in two sections by a sulcus; regular growth lines on the anterior disc, posterior area usually with a second sulcus and covered by calcareous incrustations	Anterior end rounded and higher than the posterior	Incrustation extended beyond the end and smoothly rounded	41 mm	Western Atlantic from North Carolina, USA to Vitoria, Brazil. Eastern Atlantic in St. Helen Island.
Leiosolenus (Diberus) plumula (Hanley, 1843)	Radial ornamentation extending from the umbos to the posterior margin of the valves	Rounded	Feather-like incrustations beyond the posterior end	70 mm	California, USA to Ecuador, reported as introduced in Philippines and Australia
Leiosolenus (Myoforceps) aristatus (Dillwyn, 1817)	Concentric growth lines covered by calcareous deposit.	Truncate	Pointed, Crossed	52 mm	Cosmopolitan, Eastern Pacific from California, USA to Ecuador; Western Atlantic from North Carolina to Brazil, Eastern Atlantic from Bay of Biscay to Southern Angola; Southern Mediterranean

In relation to basal siphonal valve, also called proximal siphonal valve or siphon membrane, it was described in other mytilids. Apparently, it has functions related to regulation of water flow or the cleaning of the mantle cavity (Soot-Ryen, 1955; Carter *et al.,* 2012). We believe that this is a character of taxonomic importance, so its description deserves to be taken into account.

CONCLUSION

In this work *L. patagonicus* (d'Orbigny, 1846 in 1834-1847) was re-described. This is a valid species without synonyms. After revision of type material, *Lithodomus patagonica dalli* Ihering, 1907 and *Lithodomus platensis* Philippi, 1893 are not considered synonymous of *L. patagonicus* until new material confirm or reject the synonymy. Morphological characters of congeneric species distributed along the southwestern Atlantic and southeastern Pacific Ocean were compared (Table 1). Currently, the species with calcareous depositions over the shell and projections beyond the posterior end are placed within *Leiosolenus* and the species provided with smooth projections are placed within the subgenus *Labis.* In a regional context, the genus *Leiosolenus* is represented by seven species in South American waters. The anatomical characters herein revised state the bases to compare our local species with other boring bivalves currently unstudied. Finally, the wide distribution of valid species suggest that the biogeographical history of the genus is far to be resolved. In the southwestern Atlantic, the genus is only represented by *L. patagonicus.*

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REFERENCES

Adams, H. & Adams, A. 1853-1858. *The genera of recent Mollusca; arranged according to their organization*. London, John van Voorst, Paternoster Row.

Arribas, L.P.; Bagur, M.; Soria, S.A.; Gutiérrez, J.L.C. & Palomo, M.G. 2016. Competition between mussels at the rocky intertidal zone of La Lobería, Río Negro, Argentina. *Revista del Museo Argentino de Ciencias Naturales,* 18(1): 1-7.

Atkins, D. 1937. On the ciliary mechanisms and interrelationships of Lamellibranchs: Part III: Types of Lamellibranch Gills and their Food Currents. *Journal of Cell Science,* 2(315): 375-421. https://doi.org/10.1242/jcs.s2-79.315.375.

Audino, J.A.; Serb, J.M. & Marian, J.E.A.R. 2020. Phylogeny and anatomy of marine mussels (Bivalvia: Mytilidae) reveal convergent evolution of siphon traits. *Zoological Journal of the Linnean Society,* 190(2): 592-612. https://doi.org/10.1093/zoolinnean/zlaa011.

Bagur, M.; Richardson, C.A.; Gutiérrez, J.L.; Arribas, L.; Doldan, M.S. & Palomo, M.G. 2013. Age, growth and mortality in four populations of the boring bivalve *Lithophaga patagonica* from Argentina. *Journal of Sea Research,* 81: 49-56. https://doi.org/10.1016/j.seares.2013.04.003.

Barthel, K.W.; Gomez, C.E.; Birkeland, R.W.; Buddemeier, R.E.; Johannes, J.A. & Tsuda, R.T. 1981. *Lithophaga obesa* (Philippi) reef-dwelling and cementing pelecypod – A survey of its boring. *In*: *International Coral Reef Symposium,* 4º. *Proceedings*. Manila, University of the Philippines. v. 2, p. 649-659.

Bernard, F.R. 1983. Catalogue of the living bivalvia of the eastern Pacific Ocean: Bering Strait to Cape Horn. *Canadian Special Publication of Fisheries and Aquatic Sciences = Publication Spéciale Canadienne des Sciences Halieutiques et Aquatiques,* 61: 1-102.

Bernard, F.R.; Cai, Y.Y. & Morton, B. 1993. *A catalogue of the living marine bivalve molluscs of China.* Hong Kong, Hong Kong University Press.

Bieler, R.; Carter, J.G. & Coan, E.V. 2010. Classification of bivalve families. *In:* P. Bouchet and J.P. Rocroi, 2010. Nomenclator of bivalve families. *Malacologia,* 52(2): 1-184. https://doi.org/10.4002/040.052.0201.

Boss, K.J. 1982. Mollusca. *In:* Parker, S.P. (Ed.). *Synopsis and classification of living organisms.* New York, McGraw-Hill Book Company. p. 945-1166.

Carcelles, A.R. 1944. Catálogo de los moluscos marinos de Puerto Quequén: *Revista del Museo de La Plata (NS), Zoología,* 3: 233-309.

Carcelles, A.R. & Williamson, S. 1951. Catálogo de los moluscos marinos de la provincia magallánica. *Revista del Instituto Nacional de Investigación de las Ciencias Naturales. Zoológia,* 2(5): 225-383.

Carpenter, P. 1857. *Catalogue of the collection of Mazatlan shells in the British Museum: collected by Frederick Reigen.* London.

Carter, J.G.; Altaba, C.R.; Anderson, L.C.; Araujo, R.; Biakov, A.S.; Bogan, A.E.; Campbell, D.C.; Campbell, M.; Chen, J.H.; Cope, J.C.W.; Delvene, G.; Dijkstra, H.H.; Fang, Z.; Gardner, R.N.; Gavrilova, V.A.; Goncharova, I.A.; Harries, P.J.; Hartman, J.H.; Hautmann, M.; Hoeh, W.R.; Hylleberg, J.; Jiang, B.; Johnston, P.; Kirkendale, L.; Kleemann, K.; Koppka, J.; Kříž, J.; Machado, D.; Malchus, N.; Márquez-Aliaga, A.; Masse, J.P.; McRoberts, C.A.; Middelfart, P.U.; Mitchell, S.; Nevesskaja, L.A.; Özer, S.; Pojeta, J.; Polubotko, I.V.; Pons, J.M.; Popov, S.; Sánchez, T.; Sartori, A.F.; Scott, R.W.; Sey, I.I.; Signorelli, J.H.; Silantiev, V.V.; Skelton, P.W.; Steuber, T; Waterhouse, J.B.; Wingard, G.L. & Yancey, T. 2011. A Synoptical Classification of the Bivalvia (Mollusca). *Paleontological Contributions,* 4: 1-47. https://doi.org/10.17161/PC.1808.8287.

Carter, J.G.; Harries, P.; Malchus, N.; Sartori, A.; Anderson, L.; Bieler, R.; Bogan, A.; Coan, E.; Cope, J. & Cragg, S. 2012. *Illustrated Glossary of the Bivalvia.* Treatise Online no. 48: Part N, Revised, 1(31): 1-209. https://doi.org/10.17161/to.v0i0.4322.

Castellanos, Z.J.A.d. 1957. *Los mitílidos argentinos*. Buenos Aires, Ministerio de Agricultura y Ganadería, Departamento de Investigaciones Pesqueras.

Castellanos, Z.J.A.d. 1970. Catálogo de los moluscos marinos bonaerenses. *Anales de la Comisión de Investigaciones Científicas de la Provincia de Buenos Aires,* 8: 9-365.

Charcot, J. 1903-1905. Le "Français" au Pôle sur. *Journal de l'expédition antarctique française,* Paris, 1903, 1905.

Coan, E.V. & Kabat, A.R. 2017. The malacological contributions of Rudolph Amandus Philippi (1808-1904). *Malacología,* 60(1-2): 31-322. https://doi.org/10.4002/040.060.0108.

Coan, E.V. & Valentich-Scott, P. 2012. *Bivalve seashells of tropical west America.* Marine bivalve mollusks from Baja California to Peru. Santa Barbara, Santa Barbara Museum of Natural History. 1258p.

Coan, E.V.; Valentich-Scott, P. & Bernard, F.R. 2000. *Bivalve seashells of western North America.* Marine bivalve mollusks from Arctic Alaska to Baja California. Santa Barbara Museum Natural of History. 764p. (Santa Barbara Museum of Natural History monographs; no. 2 Studies in biodiversity no. 2)

Dall, W.H. 1898. Contributions to the Tertiary fauna of Florida: with especial reference to the Miocene Silex-beds of Tampa and the Pliocene beds of the Caloosahatchie River, including in many cases a complete revision of the generic groups treated and of their American Tertiary Species. *Transactions of Wagner Free Institute of Science of Philadelphia,* 3: 571-947.

Dall, W.H. 1916. Diagnoses of new species of marine bivalve mollusks from the northwest coast of America in the collection of the United States National Museum. *Proceedings of the United States National Museum,* 52(2183): 393-417. https://doi.org/10.5479/si.00963801.52-2183.393.

del Río, C.J. & Martinez, S.A. 1998. Moluscos marinos miocenos de la Argentina y del Uruguay. *Monografías de la Academia Nacional de Ciencias Exactas, Físicas y Naturales,* 15: 1-151.

Deshayes, G.P. & Milne-Edwards, H. 1836. *Histoire Naturelle des Animaux sans Vertèbres, présentant les caractères généraux et particuliers de ces animaux, leur distribution, leurs classes, leurs familles, leurs genres, et la citation des principales espèces qui s'y rapportent, par J.B.P.A. de Lamarck*. 2.ed. Tome septième. *Histoire des Mollusques.* Paris, J.B. Baillière. https://www.biodiversitylibrary.org/item/130259#page/7/mode/1up.

Dillwyn, L.W. 1817. *A descriptive catalogue of recent shells: arranged according to the Linnaean Method; with Particular Attention to the Synonymy.* London, John .and Arthur Arch. v. 2. https://www.biodiversitylibrary.org/item/41315#page/9/mode/1up.

d'Orbigny, A. 1834-1847. Mollusques. *In:* Bertrand CP (Ed.). *Voyage dans l'Amerique Meridionale (Le Bresil, La Republique Orientale de L'Uruguay, La Republique Argentine, La Patagonie, La Republique du Chili, La Republique de Bolivia, La Republique du Perou), execute pendant les annees 1826, 1827, 1828, 1829, 1830, 1831, 1832 et 1833*. Paris, Chez Ve. Levrault.

Dunker, W.B.R.H. 1882. *Index molluscorum maris Japonici, conscriptus et tabulis iconum XVI illustratus.* Kassel, T. Fischer.

Fischer, P. 1880-1887. *Manuel de conchyliologie et de paléontologie conchyliologique, ou histoire naturelle des mollusques vivants et fossiles suivi d'un Appendice sur les Brachiopodes par D.P. Oehlert. Avec 23 planches contenant 600 figures dessinées par S.P. Woodward*. Paris, F. Savy. Published in 11 parts (fascicules), xxiv + 1369p.

Genta Iturrería, S. 2014. *Revisión de la Familia Mytilidae (Mollusca, Bivalvia) en el Cenozoico de Patagonia: sistemática, paleoecología y paleobiogeografía*. PhD thesis. Universidad Nacional de La Plata, Facultad de Ciencias Naturales y Museo (UNLP, FCNyM).

Habe, T. 1977. *Systematics of Mollusca in Japan. Bivalvia and Scaphopoda.* Tokyo, Hokuryukan. 372p.

Hanley, S. 1842-1846. *An illustrated and descriptive catalogue of recent bivalve shells,* by Sylvanus Hanley, B.A., F.L.S. The plates forming a third edition of the Index Testaceologicus, by William Wood. London.

Hodgkin, N.M. 1962. Limestone boring by the mytilid *Lithophaga. The Veliger,* 4(3): 123-129.

Huber, M. 2010. *Compendium of Bivalves.* A full-color guide to 3,300 of the World's Marine Bivalves. A status on Bivalvia after 250 years of research. Hackenheim, Germany, ConchBooks.

Huber, M. 2015. *Compendium of Bivalves II.* A full-color guide to the remaining seven families. A systematic listing of 8500 Bivalve species and 10500 synonyms. Harxheim, ConchBooks.

Ihering, H.V. 1900. On the south American species of Mytilidae. *Proceedings of the Malacological Society of London,* 4(2): 84-98. https://doi.org/10.1093/oxfordjournals.mollus.a065793.

Ihering, H.V. 1907. Les Mollusques fossiles du Tertiaire et du Cretace superieur de l'Argentine. *Anales del Museo Nacional de Buenos Aires, Serie 3,* (7): 1-611.

Kleemann, K.H. 1977. A new species of *Lithophaga* (Bivalvia) from the Great Barrier Reef, Australia. The Veliger, 20(2): 151-154.

Kleemann, K.H. 1980. Boring bivalves and their host corals from the Great Barrier Reef. *Journal of Molluscan Studies,* 46(1): 13-54. https://doi.org/10.1093/oxfordjournals.mollus.a065519.

Kleemann, K.H. 1984. *Lithophaga* (Bivalvia) from dead coral from the Great Barrier Reef, Australia. *Journal of Molluscan Studies,* 50(3): 192-230. https://doi.org/10.1093/oxfordjournals.mollus.a065864.

Kleemann, K.H. 1990. Evolution of chemically-boring Mytilidae (Bivalvia). *In:* Morton, B. (Ed.). The Bivalvia – *Proceedings of a Memorial Symposium in Honour of Sir Charles Maurice Yonge (1899-1986),* Edinburgh, 1986. Hong Kong, Hong Kong University Press, p. 111-124.

Kleemann, K.H. 2008. *Lithophaga (Leiosolenus) purpurea* (Bivalvia: Mytilidae): one species becomes three. *Club Conchylia Informationen,* 39(3/4): 32-45.

Kleemann, K.H. 2009a. *Botula kleemanni* Valentich-Scott, 2008 actually a member of *Lithophaga (Leiosolenus). The raffles Bulletin of Zoology,* 57(1): 233-235.

Kleemann, K.H. 2009b. *Lithodomus bisulcata* Orbigny, 1853, a junior synonym of *Modiola appendiculata* Philippi, 1846. *Club Conchylia Informationen,* 40(1/2): 23-27.

Kleemann, K.H. & Maestrati, P. 2012. Pacific *Lithophaga* (Bivalvia, Mytilidae) from recent French expeditions with the description of two new species. *Bollettino Malacologico,* 48: 73-102.

Lamy, É. 1919. Les Lithodomes de la Mer Rouge (d'après les matériaux recueillis per M. le Dr. Jousseaume). *Bulletin de Muséum d'Histoire Naturelle,* Paris, 25(4): 252-257.

Lee, Y.; Kwak, H.; Shin, J.; Kim, S.C.; Kim, T. & Park, J.K. 2019. A mitochondrial genome phylogeny of Mytilidae (Bivalvia: Mytilida). *Molecular Phylogenetics and Evolution,* 139: 1-8. 106533. https://doi.org/10.1016/j.ympev.2019.106533.

Liu, J.; Liu, H. & Zhang, H. 2018. Phylogeny and evolutionary radiation of the marine mussels (Bivalvia: Mytilidae) based on mitochondrial and nuclear genes. *Molecular Phylogenetics and Evolution,* 126: 233-240. https://doi.org/10.1016/j.ympev.2018.04.019.

Márquez, F.; Frizzera, A.C. & Vázquez, N. 2017. Environment-specific shell shape variation in the boring mytilid *Leiosolenus patagonicus. Marine Biology Research,* 13(2): 246-252. https://doi.org/10.1080/17451000.2016.1248848.

MolluscaBase eds. 2022. *MolluscaBase.* Available: https://www.molluscabase.org. Available: 04/08/2022. https://doi.org/10.14284/448.

Mörch, O.A.L. 1853. Acephala. Annulata. Cirripedia. Echinodermata. *In*: *Catalogus conchyliorum quae reliquit D. In: Alphonso d'Aguirra et Gadea Comes de Yoldi.* Hafniae, Typis Ludovici Kleinii. https://www.biodiversitylibrary.org/item/46690#page/7/mode/1up.

Morton, B. 1993. How the 'forceps' of *Lithophaga aristata* (Bivalvia: Mytiloidea) are formed. *Journal of Zoology,* 229(4): 609-621. https://doi.org/10.1111/j.1469-7998.1993.tb02659.x.

Olivier, S.R.; Escofet, A.; Orensanz, J.M.; Pezzani, S.E.; Turro, A.M. & Turro, M.E. 1966. Contribución al conocimiento de las comunidades bénticas de Mar del Plata. I. El litoral rocoso entre Playa Grande y Playa Chica. *Anales Comisión de Investigaciones Científicas,* 7: 185-206.

Owada, M. 2007. Functional morphology and phylogeny of the rock-boring bivalves *Leiosolenus* and *Lithophaga* (Bivalvia: Mytilidae): a third functional clade. *Marine Biology,* 150(5): 853-860. https://doi.org/10.1007/s00227-006-0409-y.

Parodiz, J.J. 1996. The taxa of fossil Mollusca introduced by Hermann von Ihering. *Annals of the Carnegie Museum,* 65: 183-296.

Pastorino, G. 1995. Moluscos costeros recientes de Puerto Pirámide, Chubut, Argentina. Miscelanea *Academia Nacional de Ciencias,* Córdoba, 93: 1-30.

Philippi, R.A. 1847. *Abbildungen und Beschreibungen neuer oder wenig gekannter conchylien, unter mithülfe mehrer deutscher conchyliologen.* Cassel, Verlag Theodor Fischer. v. 2.

Philippi, R.A. 1893. Descripción de algunos fósiles Terciarios de la República Argentina. *Anales del Museo Nacional de Chile. Tercera sección: Mineralogía, Geología, Paleontología,* 10: 1-16.

Reeve, L.A. 1857-1858. *Monograph of the genus Lithodomus. In:* Conchologia Iconica, or, illustrations of the shells of molluscous animals. London, Lovell Reeve. v. 10. https://www.biodiversitylibrary.org/item/36226#page/9/mode/1up.

Rios, E.C. 1966. Provisional list of Rio Grande do Sul marine mollusks. *Notas e Estudos da Escola de Geologia,* 1(2): 15-40.

Rios, E.C. 1994. *Seashells of Brazil.* Rio Grande, Editora da Fundaçao Universidade do Rio Grande.

Rios, E.C. 2009. *Compendium of Brazilian Sea Shells.* Rio Grande, Editora Evangraf.

Rochebrune, A.T. & Mabille, J. 1889. Mision Scientifique du Cap Horn 1882-1883. *In: Ministeres de la Marine et del´Instruction Publique, Mollusques.* Paris, Gauthier-Villars et fils. v. 6., p. 1-129.

Röding, P.F. 1798. *Museum Boltenianum* sive Catalogus cimeliorum e tribus regnis naturæ quæ olim collegerat Joa. Fried Bolten, M.D. p.d. per XL. annos proto physicus Hamburgensis. Pars secunda continens Conchylia sive Testacea univalvia, bivalvia & multivalvia. Hamburg, Trapp.

Scarabino, F. 2003. Lista sistemática de los Bivalvia marinos y estuarinos vivientes de Uruguay. *Comunicaciones de la Sociedad Malacológica del Uruguay,* 8(81): 229-259.

Scarabino, F.; Zaffaroni, J.C.; Clavijo, C.; Carranza, A. & Nin, M. 2006. Bivalvos marinos y estuarinos de la costa Uruguaya: faunística, distribución, taxonomía y conservación. *In:* Menafra R, Rodríguez-Gallego, L.; Scarabino, F. y Conde, D. (Eds.). *Bases para la conservación y el manejo de la costa uruguaya*. Uruguay, Vida Silvestre. p. 157-169.

Scarlato, O.A. & Starobogatov, Y. 1979a. The system of the suborder Mytileina (Bivalvia). Molljuski. *Osnoynye rezultalty ikh izuchenija, Leningrad, Nauka,* 6: 22-25.

Skarlato, O.A. & Starobogatov, Y. 1979b. General evolutionary patterns and the system of the class Bivalvia. *Trudy Zoologicheskogo Instituta AN SSSR,* 80: 5-38.

Simone, L.R.L. & Gonçalves, E.P. 2006. Anatomical study on *Myoforceps aristatus,* an invasive boring bivalve in SE Brazilian coast (Mytilidae). *Papéis Avulsos de Zoologia,* 46(6): 57-65. https://doi.org/10.1590/S0031-10492006000600001.

Soot-Ryen, T. 1955. A report on the family Mytilidae (Pelecypoda). University of Southern California, Allan Hancock Foudation, *Report Allan Hancock Pacific Expeditions,* 20(1): 1-261.

Soot-Ryen, T. 1969. Superfamily Mytilacea Rafinesque, 1815. *In:* Moore, R.C. (Ed.). *Treatise on invertebrate paleontology.* Part N, Mollusca 6, Bivalvia 1 (of 3). Lawrence, Geological Society of America Inc. and University of Kansas Press p. 271-280.

Starobogatov, Y. 1992. Morphological basis for phylogeny and classification of Bivalvia. *Ruthenica,* 2: 1-25.

Turner, R.D. & Boss, K.J. 1962. The genus *Lithophaga* in the western Atlantic. *Johnsonia,* 4(41): 81-116.

Valentich-Scott, P. & Tongkerd, P. 2008. Coral-boring bivalve molluscs of southeastern Thailand, with the description of a new species. *Raffles Bulletin of Zoology,* (Suppl.18): 191-216.

Valentich-Scott, P.; Coan, E.V. & Zelaya, D. 2020. Bivalve seashells of Western South America marine bivalve mollusks from Punta Aguja, Perú to Isla Chiloé, Chile. Santa Barbara Museum of Natural History Monographs, 8. (Studies in Biodiversity, n. 6).

Velásquez, M.; Valentich-Scott, P. & Capelo, J.C. 2017. Marine boring bivalve mollusks from Isla Margarita, Venezuela. *The Festivus,* 49(3): 247-269.

Von Cosel, R. & Gofas, S. 2019. Marine bivalves of tropical west Africa: from Rio de Oro to southern Angola. Paris, IRD, Muséum national d'Histoire naturelle, Marseille. 1104p. (Faune et Flore tropicales 48).

Wilson, B.R. 1979. A revision of Queensland Lithophagine mussels (Bivalvia, Mytilidae, Lithophaginae). *Records of the Australian Museum,* 32(13): 435-89. https://doi.org/10.3853/j.0067-1975.32.1979.470.

Wilson, B.R. & Tait, R. 1984. Systematics, anatomy and boring mechanisms of the rockboring mytilid bivalve Botula. *Proceedings of the Royal Society of Victoria,* 96: 113-125.

Yonge, C.M. 1955. Adaptation to rock boring in Botula and k (Lamellibranchia, Mytilidae) with a discussion on the evolution of this habit. *Quarterly Journal of Microscopical Science,* 96(3): 383-410. https://doi.org/10.1242/jcs.s3-96.35.383.

Zelaya, D.G. 2016. Marine bivalves from the Argentine coast and continental shelf: species diversity and assessment of the historical knowledge. *American Malacological Bulletin,* 33(2): 245-262. https://doi.org/10.4003/006.033.0204.

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