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# *Limatula chilensis* sp. nov. A new Limidae (Mollusca: Bivalvia) from northern Chile

*Limatula chilensis* sp. nov. Un nuevo Limidae (Mollusca: Bivalvia) en el norte de Chile

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**Resumen.-** *Limatula chilensis* sp. nov. se describe en base a la morfología de la concha y tejidos blandos. Los especímenes estudiados se obtuvieron periódicamente entre junio de 2008 y enero de 2009 desde fondos blandos someros submareales en Punta Coloso, norte de Chile, a profundidades entre 22 y 33 m. La morfología de la concha es diferente a la de las 4 especies de *Limatula* descritas para las costas del Pacífico de Sudamérica y Península Antártica (5°-65°S). Las características más evidentes de *L. chilensis* fueron el tamaño 3,50 mm (rango 2,36-4,42, DE  $\pm$  0,60, n = 34), número de costillas radiales 16-21 (moda = 20, DE = 1,69, n = 8) y una fuerte oblicuidad de la concha. *L. chilensis* es la única especie conocida del género, para las costas del norte de Chile.

**Palabras clave:** Sistema de Corriente de Humboldt, Chile, nueva especie

**Abstract.-** *Limatula chilensis* sp. nov. is described on the basis of shell morphology and soft tissue anatomy. Studied individuals were obtained periodically between June 2008 and January 2009 from sublittoral soft-sediments off Punta Coloso in northern Chile at depths of 22 to 33 m. Shell morphology of the new species differs from the 4 described species of *Limatula* from the Pacific coast of South America and Antarctic Peninsula (5°-65°S). Main characteristics of *L. chilensis* include an average height of 3.50 mm (range 2.36-4.42, SD  $\pm$  0.60, n = 34), number of radial ribs 16-21 (mode = 20, SD= 1.69, n = 8) and greater shell obliqueness. *L. chilensis* is the only known species of the genus found off northern Chile.

**Key words:** Humboldt Current system, Chile, new species

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## INTRODUCTION

Limid bivalves, known as 'file clams', can be free-living organisms or can live attached to the substratum using byssal threads. Their distribution is worldwide at depths from 5 to 3,000 m (Fleming 1978, Dell 1990, Allen 2004).

Four species of *Limatula* have been recorded from the Pacific coast of South America, and three of them are distributed between 36°S and 66°S: *L. pygmaea* (Philippi, 1845) from the Magellan Strait and Beagle Channel (Linse 1999); *L. ovalis* Thiele, 1912, from the Antarctic Peninsula and *L. hodgsoni* (Smith, 1907) from the Magellan region (Page 2001, Page & Linse 2002, Ríos *et al.* 2003), which constitutes the most northern record of the genus along the Chilean coast (Fig. 1). The fourth species, *L. similaris* (Dall, 1908), was described from the Gulf of Panamá and has been reported from northern Peru (5°S) (Paredes *et al.* 1999, Ramirez *et al.* 2003). There are not information about *Limatula* in the northern Chilean coast and central south Peru.

Our research reports the discovery of *Limatula chilensis* sp. nov. based on descriptions of shell morphology and soft tissue anatomy. In addition, an external morphological comparison with *Limatula* spp. in the southeastern Pacific was done.

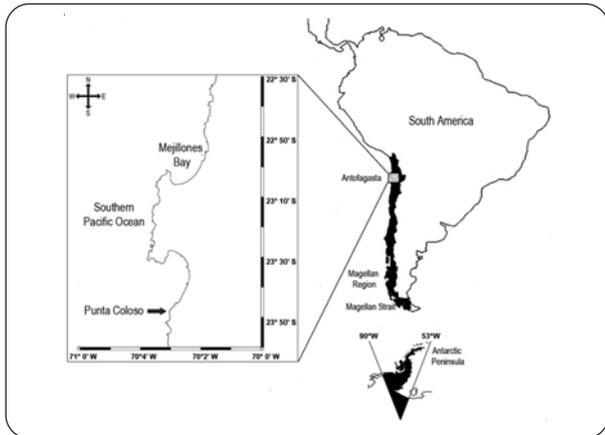
## MATERIALS AND METHODS

Sixty-three triplicate samples of sandy, soft-bottom benthic communities were obtained between June 2008 and January 2009 using a van Veen drag (0.1 m<sup>2</sup>) from 9 stations at depths of 22 to 33 m off Punta Coloso (23°45'S; 70°28'W) (Fig. 1). Maximum height and length of the valves were measured using a calliper ( $\pm$ 0.1 mm precision) and scanning electron microscope photographs, using a JSMT300 JEOL brand SEM, were used to describe valve morphology. Soft body tissues were stained with Gomori's Trichrome, then dissected and identified according to the characters given by Allen (2004).

## DESCRIPTION

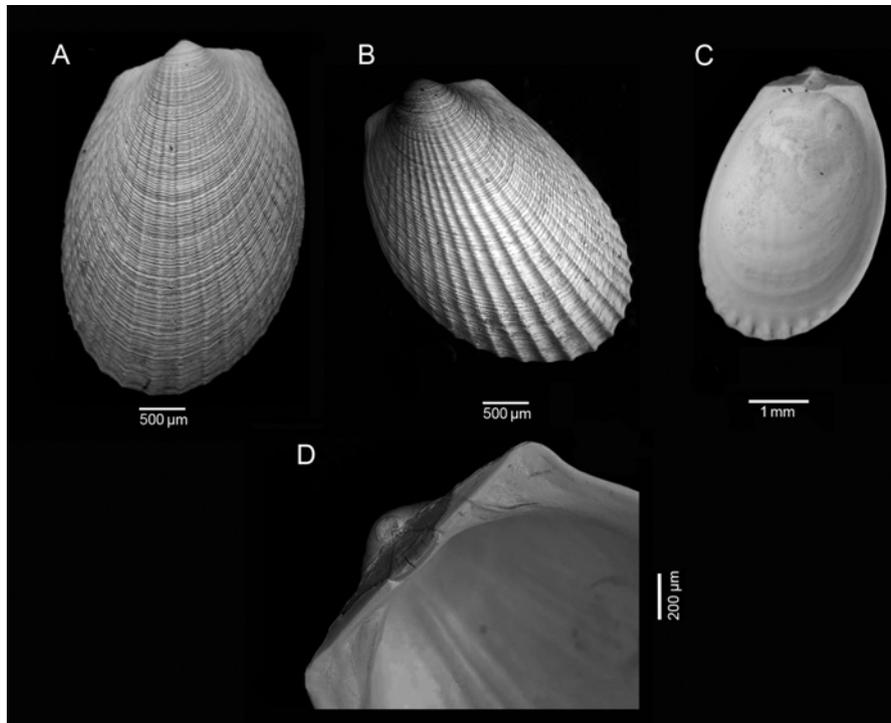
*Limatula chilensis* sp. nov.

Type Locality: Live-taken Holotype (MNHNCL<sup>1</sup> 6666) and paratypes (MNHNCL 6667- MNHNCL 6670) collected from soft bottom at 27-29 m depth. Punta Coloso Bahía San Jorge, northern Chile (23°45'S; 70°28'W) (Fig. 1).



**Figure 1. Study area and distribution of *Limatula* spp. at Chilean coast / Área de estudio y distribución de *Limatula* spp. en las costas de Chile**

Shell Morphology: Description based on 34 individuals. The shell is small, thin, white, slightly translucent, inflated, oval, inequilateral, and opisthocline. The average height is 3.50 mm (SD  $\pm$  0.60 mm, range 2.36-4.43), and the height/length ratio is 1.48 (SD  $\pm$  0.08 mm, range 1.33-1.65). Shell sculpture is mostly ornamented with prominent radial ribs (*ca.*, 16-21; mode = 20), lateral ribs are less prominent than central ribs, and narrow growth lines are more strongly marked on the ventral region, forming a slim reticulated shape. The ventral margin is crenulated by radial ribs pattern, lateral margins even more toward dorsal region. In the same specimen, the radial ribs are more pronounced on right valve (Fig. 2B) than on left one (Fig. 2A), and, as a consequence, the ventral margin is also more crenulated (Fig. 2B). Small ears are similar in size. Posterior subauricular sinus is more pronounced, anterior sinus is barely visible (Fig. 2A). Umbos are prominent and central to the hinge line (Fig. 2B and 2C). The hinge is without teeth, central and triangular ligament, extending laterally by dorsal margin of the shell (Fig. 2D).



**Figure 2. Scanning Electron Microscope photographs of *Limatula chilensis* sp. nov. shell: A) external view of left valve; B) external view of right valve; C) internal view of shell; and D) hinge plate / Microscopía electrónica de Barrido de *Limatula chilensis* sp. nov. concha: A) Vista externa de valva izquierda; B) Vista externa de valva derecha; C) vista interna de la concha y D) placa de articulación**

<sup>1</sup>Abbreviations MNHNCL: Museo Nacional de Historia Natural Chile (National Museum of Natural History Chile)

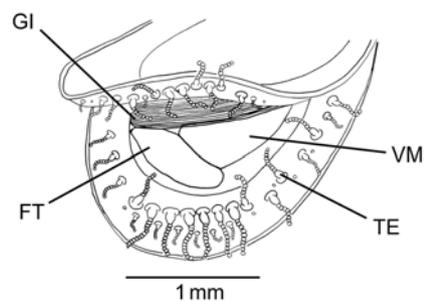
**Anatomy:** The mantle is thin and translucent, except at the margin. The developed sensory fold has approximately 27 tentacles that differ in size. Tentacles may extend over the shell margin, and ventral and posterior tentacles are more developed than tentacles located in the anterior region (Fig. 3). At the postero-dorsal region near the fusion area of the mantle lobules exists two highly developed anal tentacles (one on each lobule), which extend to the middle area of the posterior adductor muscle. The gill axis runs from dorsal to the ventral region; gills are formed by wide demibranches with ascendant and descendent lamellas (Fig. 4). The digestive system starts at the mid-anterior region of the soft body tissue with the mouth surrounded by an upper and lower lip, continued by a short oesophagus, and a small dorsal stomach is covered by a large digestive gland. Details of the course of the gut through the digestive gland were not observed; the course through the visceral mass was partially observed. The ascending intestine is located at the posterior edge of the visceral mass. The hindgut extends over the mid-dorsal surface of the posterior adductor muscle. The anus is located at the mid-posterior surface of the same muscle. The foot is ventral and elongated with a visible byssal groove at the anterior part of the foot (Fig. 5).

## DISCUSSION

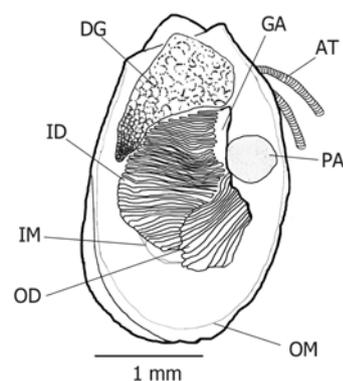
### TAXONOMIC REMARKS

Unfortunately, all described species of *Limatula* from the Pacific coast of South America have been based on few (even 1) specimens and only shell have been described but not soft tissues. In addition no variability on morphometric measures was given.

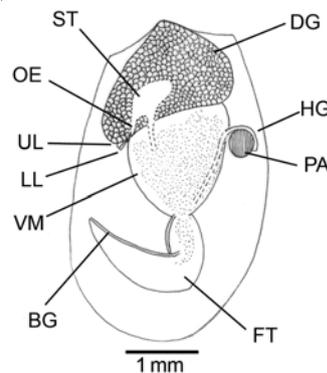
*Limatula chilensis* sp. nov. shows differences in size and shell sculpture compared with *Limatula* spp. described from the Chilean coast (Fig. 6). *L. chilensis* shell size is the smallest of the published species from the Pacific coast of South America (Table 1) and most resembles *L. similis* from Panamá and northern Perú. According to the original description of Dall (1908) length of shell is 4.7 mm but from a picture kindly send us by Valentich-Scott (Santa Barbara Museum of Natural History, (Fig. 6 D), length of the shell is more than 2.0 cm. The general form of the shell is clearly different of the new species. In addition *L. similis* has ears that are less developed, a more pronounced subauricular sinus, wider base of ligament shape, shorter hinge line, and less obliqueness of the shell. Table 1 shows the geographical



**Figure 3.** *Limatula chilensis* sp. nov. internal view of location of sensory tentacles. Abbreviation in annex / *Limatula chilensis* sp. nov. Vista interna de posición de tentáculos sensoriales. Abreviaciones en anexo



**Figure 4.** *Limatula chilensis* sp. nov. left side view of soft tissue. Abbreviation in annex / *Limatula chilensis* sp. nov. vista izquierda de tejidos blandos. Abreviaciones en anexo



**Figure 5.** *Limatula chilensis* sp. nov. Mantle cavity and internal partial view of digestive system. Abbreviation in annex / *Limatula chilensis* sp. nov. Cavidad del manto y vista parcial del sistema digestivo. Abreviaciones en anexo

**Table 1. Main characteristic of described species of *Limatula* from the Pacific coast of South America / Características más importantes de las especies de *Limatula* descritas en las costas del Pacífico de Sud América**

	<i>L. hodgsoni</i>	<i>L. pygmaea</i>	<i>L. ovalis</i>	<i>L. similaris</i>	<i>L. chilensis</i>
Height (mm)	10.0-15.5 <sup>1</sup> > 27 <sup>2</sup>	5.5 <sup>3</sup>	4.1 <sup>2</sup> 6.0 <sup>5</sup>	4.5	3.6
Length (mm)	1.5	4.5	5.0 <sup>2</sup> 4.3 <sup>5</sup>	2.7	2.4
Radial ribs	32	15 <sup>4</sup> 18-20 <sup>2</sup>	~ 22	~ 16	16-20
Ears size	anterior larger	similar	similar	similar	similar
Obliqueness	ophistocline	acline			ophistocline
Shape	subtriangular	subcircular	subcircular	oval	oval
Distribution	53°S	53-55°S	62°-66°S	5°S	23°S
Depth (m)	9-732	6-598	665	55-106	22-32

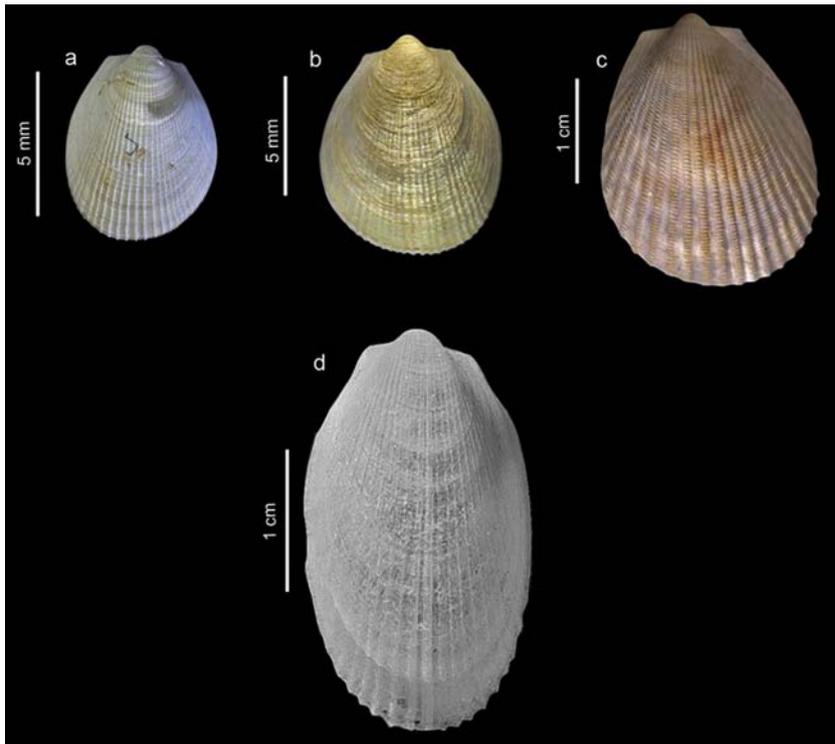
<sup>1</sup>Original description (Smith 1907)

<sup>2</sup>According to Fleming (1978)

<sup>3</sup>Juvenile shell according to Fleming (1978)

<sup>4</sup>According to Dall (1908) original description

<sup>5</sup>According to Thiele (1912), original description



**Figure 6. Species of *Limatula* described from the Pacific coast of South America. a) *Limatula ovalis*<sup>1</sup>, b) *Limatula pygmaea*<sup>2</sup>, c) *Limatula hodgsoni*<sup>3</sup>, d) *Limatula similaris*<sup>4</sup> / Especies de *Limatula* descrita para las costas del Océano Pacífico de Sudamérica. a) *Limatula ovalis*<sup>1</sup>, b) *Limatula pygmaea*<sup>2</sup>, c) *Limatula hodgsoni*<sup>3</sup>, d) *Limatula similaris*<sup>4</sup>**

<sup>1</sup>USNM 896029, Smithsonian National Museum of Natural History, <[http://invertebrates.si.edu/antiz/taxon\\_view.cfm?taxon=7387](http://invertebrates.si.edu/antiz/taxon_view.cfm?taxon=7387)>

<sup>2</sup>USNM 898433, Smithsonian National Museum of Natural History, <[http://invertebrates.si.edu/antiz/specimen\\_detail.cfm?irn=573068](http://invertebrates.si.edu/antiz/specimen_detail.cfm?irn=573068)>

<sup>3</sup>Smithsonian National Museum of Natural History, <[http://invertebrates.si.edu/antiz/specimen\\_detail.cfm?irn=571992](http://invertebrates.si.edu/antiz/specimen_detail.cfm?irn=571992)>

<sup>4</sup>Photographs kindly send us by Paul Valentich-Scott, Santa Barbara Museum of Natural History. [pvsconfig@sbnature2.org](mailto:pvsconfig@sbnature2.org)

distribution and main taxonomic characters of *Limatula* spp. from the Pacific coast of South America (Chile-Peru). As stated in Table 1, the new species differ from *L. hodgsoni* in the ear size, obliqueness, number of radial ribs and shape; from *L. pygmaea* in obliqueness and shape and from *L. ovalis* in shape.

There are few studies considering the soft tissue anatomy in addition to shell morphology to describe species in the genus *Limatula*. Stuardo (1968) described, in an unpublished Doctoral Dissertation, the new species, *Limatula araucana*, using this methodology, unfortunately this species is nomenclatorically not valid. A similar study was conducted by Allen (2004), in which the internal and external morphology of nine species of *Limatula* from the Atlantic was analysed. Six of them were new species for the genus, showing differences among themselves in shell morphology, foot size, and number and size of sensorial tentacles.

#### DISTRIBUTIONAL REMARKS

Lee *et al.* (2008) conducted a comprehensive literature review of the free-living benthic fauna of the Chilean coast. They found 4,553 species of which 219 were bivalves, representing 4.8% of the species richness. Of these species, just five belonged to Limidae and one to the genus *Limatula*. Although other *Limatula* living at the southern Chilean coast and Antarctic Peninsula (Linse 1999, Page 2001, Page & Linse 2002, Ríos *et al.* 2003) have been reported, they are still scarce. Laudien *et al.* (2007) described soft-bottom communities from Bahía Mejillones (*ca.*, 70 km north of Punta Coloso) on the basis of a data set over the course of seven years (78 van Veen grab samples). The main finding included sparse bivalve fauna that represented 7% of the species richness in the area, and no Limidae were found in the study area. In addition, some descriptive studies of malacofauna off the central and northern Chilean coast did not report species of this genus (Ramorino 1968, Marincovich 1973, Guzmán *et al.* 1998). *L. chilensis* could be an example of a rare species, as it represents between 0.02-0.23% of all molluscs found in 63 samples obtained from the area. Similar results were obtained in the California Gulf, where *Limatula similaris* had a density of 0.013 ind l<sup>-1</sup>, corresponding to 1.3% of the samples in which the species was found (Zamorano *et al.* 2007). Zuschin & Piller (1997) indicated that *Lima lima* was found in densities of 0.25 and 0.50 ind m<sup>-2</sup>, representing 4.69% and 6.67% of the total fauna obtained at stations where the individuals appeared. The low densities of these bivalves could be a good example of what have considered as hidden biodiversity.

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**Annex. Abbreviation in Figures 3-5 / Abreviaciones usadas en Figuras 3-5**

- |   |  |
|---|--|
| <b>AT = anal tentacle</b> / tentáculo anal  | <b>OD = outer demibranch</b> / demibranquias externa               |
| <b>BG = byssal groove</b> / surco del biso  | <b>OE = oesophagus</b> / esófago                                   |
| <b>DG = digestive gland</b> / glándula digestiva                                  | <b>OM = outer mantle of pallial curtain</b> / manto externo paleal |
| <b>FT = foot</b> / pie  | <b>PA = posterior adductor</b> / aductor posterior                 |
| <b>GA = gill axis</b> / eje branquial   | <b>PM = pallial muscle</b> / músculo paleal                        |
| <b>GI = gill</b> / branquias  | <b>ST = stomach</b> / estómago                                     |
| <b>HG = hind gut</b> / estómago anterior  | <b>TE = tentacle</b> / tentáculo                                   |
| <b>ID = inner demibranch</b> / demibranquias interna                              | <b>VM = visceral mass</b> / masa visceral                          |
| <b>IM = inner margin of the pallial curtain</b> / margen interno del manto paleal | <b>UL = upper lip</b> / labio superior                             |
| <b>LL = lower lip</b> / labio inferior  |  |

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