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CREPIDULA CACHIMILLA (MOLLUSCA: GASTROPODA), A NEW SPECIES FROM PATAGONIA, ARGENTINA

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ABSTRACT

A new species, *Crepidula cachimilla*, is described based on a population from 15 m depth in San Antonio Oeste, Argentina. Shell length ranged from 5.4 to 28.5 mm for males and from 9.6 to 52.2 mm for females. The minimum shell length recorded for a brooding female was 23.5 mm, and the maximum shell length was 49.3 mm. A detailed anatomical description is given, showing as main characters of the species a relative thick columellar muscle, a greater closure of the pallial cavity aperture by a fusion of the mantle border, a very small osphradium, with about 16 broad filaments, endostyle divided by a middle longitudinal furrow, very large salivary glands, duplication of both gastric ducts to the digestive gland, male seminal vesicle very long and with irregular walls, pallial oviduct with a broad vaginal duct and a tall papilla originating both from pallial floor and roof. Brood egg masses of mature females contained from 15 to 65 egg capsules. The triangular-shaped egg capsules measured between 2.2 and 3.4 mm in length and between 2.3 and 3.8 mm in width. Each egg capsule contained between 129 and 563 eggs. The number of eggs per capsule and the egg diameter did not correlate with female shell length. Uncleaved eggs measured between 180 and 200 µm in diameter. They all developed synchronously within the egg capsules. Prehatching veliger shells measured between 260 and 300 µm in length. After hatching at the veliger stage, protoconch length during metamorphosis ranged between 700 and 800 µm. These parameters neither coincide with those reported by Hoagland (1977) for the similar Californian *Crepidula onyx*, nor with the reproductive characters reported by Miloslavich & Penchaszadeh (2001) for *Crepidula aplysioides*, which supposedly occurs in the region.

Key words: *Crepidula cachimilla*, new species, Calyptraeoidea, anatomy, reproduction, southwestern Atlantic, Patagonia, hermaphroditism.

INTRODUCTION

According to Dall (1909: 234), *Crepidula onyx* (G. B. Sowerby I, 1824) occurs along the Pacific coast from North America to Chile. Based on shell and radular morphology, Parodiz (1939) reported this species on the Atlantic coast of Argentina, from San Matías Gulf to Punta Norte, and Aguirre & Farinati (2000) recorded fossils of this species from the Quaternary period in northeastern Argentina. Hoagland (1977) suggested that the Atlantic material studied by Parodiz (1939) should be attributed to *C. aplysioides*. *Crepidula aplysioides* has been defined both anatomically (Simone, 2002) and by reproductive patterns (Miloslavich & Penchaszadeh, 2001). Based on the differences with the studied sample, we conclude that our material from San Antonio Oeste, Argentina, belongs to an undescribed species. In this paper, we describe this new species, which is restricted to an area of Patagonia, southwestern Atlantic.

The study on the calyptraeids has grown considerately in the last few years with the addition of knowledge on the anatomy (e.g., Simone, 2002), molecular biology (e.g., Collin, 2000), and reproductive strategies (e.g., Miloslavich & Penchaszadeh, 2001). From the eastern coast of Americas, knowledge of the informally defined "*Crepidula plana* complex" is of particular importance (Collin, 2000; Simone, 2002, submitted; Simone et al., 2000), of which this paper is a part.

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MATERIALS AND METHODS

Three samples were collected in March, May, and August 2001 at 15 m depth at Playa Orengo, San Antonio Oeste (40º53'S, 64º36'W), Argentina, by SCUBA diving. The animals were attached to the bivalves *Atrina seminuda* (d'Orbigny, 1846) and *Aulacomya atra* (Molina, 1782) and to stones. Approximately 370 specimens were collected.

Live individuals were carried to the laboratory, carefully detached from their substratum, measured to the nearest 0.1 mm precision with a digital vernier calliper, and some specimens dissected for anatomical description in vivo.

Shell parameters were measured following Hoagland's (1977) definitions. "D" refers to the length of the shell arc, whereas convexity is the relation between shell arc and shell length; "SL" refers to shell length.

The sexual characteristics of the population were determined by the presence or absence of a penis.

A total number of 47 egg masses was found and fixed in 5% seawater-formalin. Four randomly chosen egg capsules per egg mass were detached, and their length and width were measured under a stereomicroscope. Eggs and embryos contained within these egg capsules were counted and measured, and the presence or absence of cannibalism or nurse eggs was analyzed with a Kruskal-Wallis test.

Settlement size was estimated by measuring the protoconch length under SEM.

Simple linear regression type 2 following natural logarithmic (ln) transformations was carried out to identify the parameters of taxonomic value.

Radular characteristics of six individuals of different sizes were also studied with SEM.

The anatomical study was performed using standard methodology, with non-narcotized specimens fixed in 70% ETOH. Dissections were performed under a stereomicroscope, with the specimens immersed in fixative. All drawings were done with the aid of a camera lucida.

Abbreviations of anatomical structures are as follows: aa, anterior aorta; ab, auricle region beyond ventricle connection; ac, anterior extremity of gill on mantle border; ad, adrectal sinus; af, afferent gill vessel; ag, albumen gland; an, anus; ap, aperture of visceral vas deferens into pallial cavity; au, auricle; bg, buccal ganglion; ce, cerebro-pleural ganglia; cg, capsule gland; cm, columellar muscle; cv, ctenidial vein; dd, duct to digestive gland; dg, digestive gland; di, septum separating haemocoel from visceral mass; dm, dorsal shell muscle; dp, posterior duct to digestive gland; en, endostyle; es, esophagus; ey, eye; fd, foot dorsal surface; ff, female folds of genital papilla; fg, food groove; fl, female papilla; fp, female pore; gd, gonopericardial duct; gf, gastric fold; gi, gill; gp, pedal ganglion; gs, gastric shield; ig, probable ingesting gland; in, intestine; iu, "U"-shaped loop of intestine on pallial roof; ki, kidney; ll, left lateral expansion (flap) of neck; lm, lateral shell muscle; m1–m14, odontophore muscles; mb, mantle border; ml, mantle region restricting pallial cavity; mo, mouth; ne, nephrostome; ng, nephridial gland; nr, nerve ring; od, odontophore; os, osphradium; ov, pallial oviduct; oy, ovary; pb, proboscis; pc, pericardium; pd, penis sperm groove; pe, penis; pp, penis papilla; pr, propodium; py, pallial cavity; rg, repugnatorial gland; rl, right lateral expansion (flap) of neck; rn, radular nucleus; rs, radular sac; rt, rectum; sa, salivary gland duct; sd, pallial sperm groove; se, subesophageal ganglion; sg, salivary gland; si, siphon-like fold; sr, seminal receptacles; ss, style sac; st, stomach; su, supraesophageal glangion; sv, seminal vesicle; sy, statocyst; te, cephalic tentacle; tg, integument; tm, net of transversal muscles of haemocoel; ts, testis, ve, ventricle; vg, vaginal duct; vm, visceral mass; vo, visceral oviduct.

Abbreviations of institutions: AMNH, American Museum of Natural History, New York, New York, USA; FMNH, Field Museum of Natural History, Chicago, Illinois, USA; MACN, Museo Argentino de Ciencias Naturales "B. Rivadavia", Buenos Aires, Argentina; MZSP, Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil.

RESULTS

Crepidula cachimilla, new species
(Figs. 1–44)

Crepidula onyx Sowerby: Parodiz, 1939: 701, pl. 1, fig. 1; Scarabino, 1977: 185, pl. 3, fig. 5 (*non* G. B. Sowerby I, 1824).

Crepidula aplysioides Reeve: Hoagland, 1977: 369 (Argentinean material only) (*non* Reeve, 1859).

Type Material

Holotype: AMNH 306947. Paratypes: AMNH 306957 to 306961, 14 paratypes (5 dry speci-

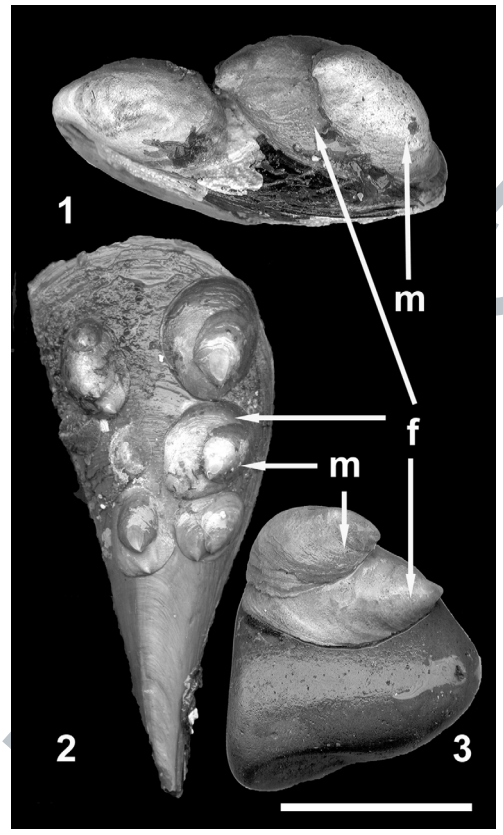
mens); AMNH 306948 to 306956, 9 paratypes (4 females, 5 males preserved in ethanol).

Type Locality

Río Negro, San Antonio Oeste, Playa Orengo, Argentina (40º53'S, 64º36'W), 15 m depth, on shells of *Atrina seminuda* and *Aulacomya atra* and on stones (Figs. 1–3).

Etymology

The name of the species alludes to the mapuche word meaning great friend and is dedicated to our colleagues at the Invertebrates I Laboratory of the Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires.



FIGS. 1–3. *Crepidula cachimilla* on different substrata. Fig. 1: *Aulacomya atra*. Fig. 2: *Atrina seminuda*. Fig. 3: Rock. Scale bar = 3 cm. f: female; m: male.

Diagnosis

Shell outer surface smooth, lacking periostracum; apex projecting posteriorly, slightly away from posterior shell edge. Columellar muscle somewhat thick. Pallial cavity aperture restricted at right by a closure of mantle edge. Osphradium small, approximatgely 1/8 of mantle aperture length, with about 16–17 broad, closely spaced filaments. Endostyle divided by a middle longitudinal furrow. Hypobranchial gland greatly reduced. Transversal fold of kidney at level of nephrostome. Salivary glands very large, slightly larger than haemocoel. Both gastric ducts to digestive gland duplicated. Male seminal vesicle very large, coiled, wall markedly irregular. Female seminal receptacles reunited in a same region, mostly 4–5; vaginal duct long, broad; genital papilla tall, with a pair of separate longitudinal folds, ending subterminally.

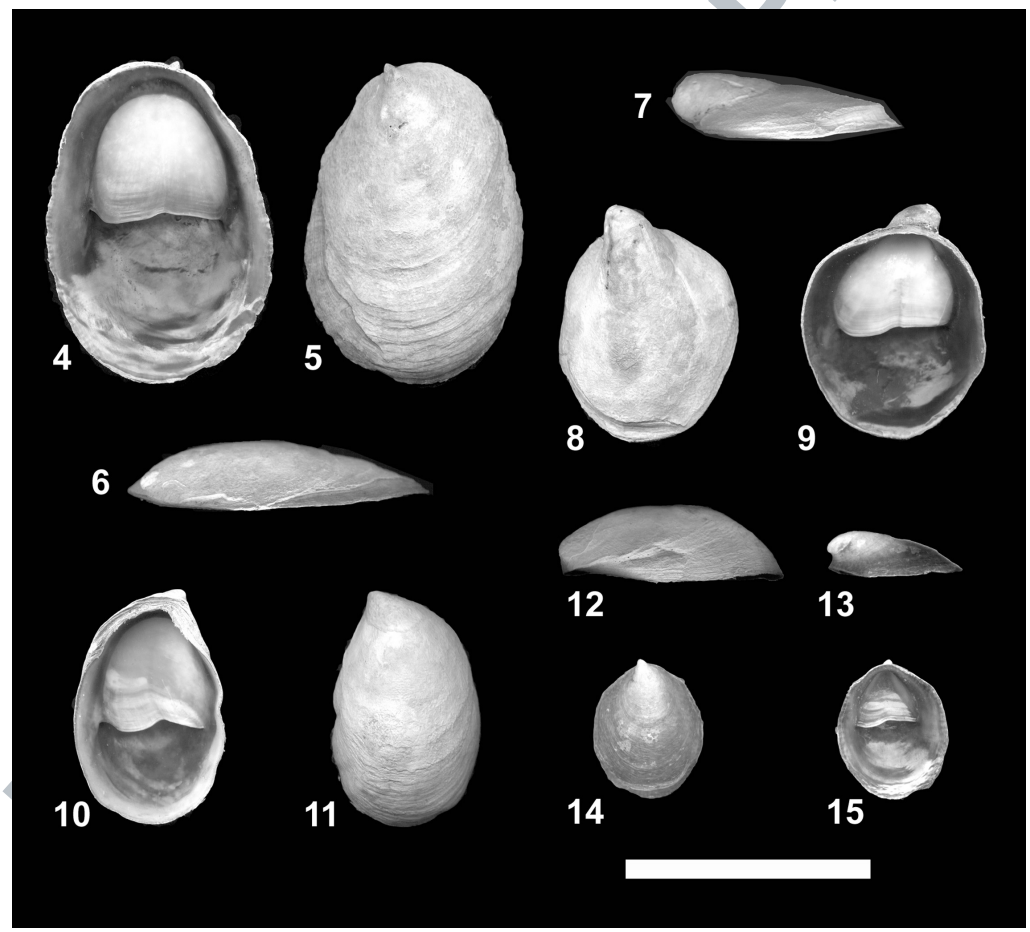
Description

Shell (Figs. 1–15): To 50 mm in length and 38 mm in width; walls with 0.46–0.60 mm thick; slightly to strongly convex (convexity = 1.095–1.350) (Table 1, including other measurements). Growth lines covering entire shell and septum. Color opaque-brown, internally bright-chocolate brown. In males, always opaque-brown externally and bright-brown internally. Few individuals (about 1%) with a white shell. Periostracum totally deciduous. Male specimens with very thin, brittle, flattened shells (Figs. 4–15). Protoconch smooth, with 1.4 whorls; transition to teleoconch not clearly defined. Aperture elliptical or subcircular. Apex solid, generally prominent, turned to right in females, almost central in males, slightly above margin, never reaching margin in males, extending beyond it in females. Flattened septum never convex, ridge central, margin with a clear central notch, covering less than half of ventral surface. Septal edge translucent, sinuous, slight turned towards right. Muscle scars inconspicuous.

Head-Foot (Figs. 16–18): Head differentiated, on long, dorsoventrally flattened neck, about half length of foot. Proboscis short, cylindrical. Tentacles long, stubby, apex somewhat bifid. Eyes dark, small, located on obsolete ommatophores in basal region of lateral margin of tentacles. Neck with pair of lateral, flattened lappets (nuchal lobes); left

expansion narrower than right; right expansion bringing low food groove along its dorsal limit with head (Fig. 17: fg). Foot very ample, occupying about 3/4 of shell concavity, dorsoventrally greatly flattened, thin; clear longitudinal inner sinus running in median line; shell septum as dorsal foot limit. Mantle fusing with dorsal surface of foot, protruding beyond its borders. Furrow of pedal glands transverse, in anterior margin of foot; anterior margin of foot covered dorsally by posterior region of neck ventral surface. Columellar muscle somewhat reduced, small, but somewhat thickened, contouring whole anterior border of shell septum, slightly taller at right (Figs. 17, 40: cm). Inner haemocoel cavity narrow, running approximately in center of neck region. Inner space almost filled by great quantity of transverse, very slender muscular fibers; these fibers connecting ventral surface of dorsal haemocoel wall with dorsal surface of its ventral wall, contouring salivary glands and esophagus (Fig. 18: tm). No vestiges of operculum except in very young specimens, being circular, paucispiral, thin, semi-transparent, flexible.

Mantle Organs (Figs. 16, 19–22): Mantle border thick, slightly hollow due to broad collar sinuses (Fig. 21). Mantle border surrounding entire shell ventral margin, free in anterior third, attaching to foot borders in posterior 2/3, situated slightly away from foot edge, connecting



FIGS. 4–15. *Crepidula cachimilla*. Figs. 4–6: Female holotype, AMNH 306947. Figs. 7–9: Female paratype 1, AMNH 306949. Figs. 10–12: Female paratype 2, AMNH 306950. Figs. 13–15: Male paratype 5, AMNH 306955. Scale bar for Figs. 4–12 = 4 cm. Scale bar for Figs. 13–15 = 2 cm.

to it by a thin, semi-transparent portion. Mantle border without appendages, but entirely edged by series of minute repugnatorial glands, immersed in central region of mantle edge (Fig. 21: rg). Mantle border with special arrangement of folds in middle region of pallial cavity aperture, a somewhat narrow fold located from gill anterior end running towards left, decreasing and disappearing abruptly at level of osphradium, its broader region with a broad central furrow, its posterior edge expanding weakly beyond mantle border covering ventrally anterior region of gill, its anterior edge slightly projecting, but not extending beyond mantle edge (Figs. 19, 20, 22).

Dorsal shell muscle well developed (Fig. 16: dm), origin small, in about middle-right region of shell, just anterior to septum, its fibers running anteriorly, spraying like fan, inserting in adjacent anterior region of dorsal surface of pallial cavity. Lateral shell muscle (Figs. 16, 19, 20: lm) small, fan-like, located close to right side of mantle border, in region where pallial cavity penetrates shell septum chamber, with a differentiated muscular branch running towards mantle border, thickness restricting pallial aperture (Fig. 20). Pallial cavity aperture occupying about 2/3 of right-anterior half of shell border (compared to a clock in dorsal view, with head at 12 o'clock, pallial aperture from 11 to 2 o'clock) (Fig. 19); right region of pallial cavity aperture restricted by a broad closure of mantle border, forming a transverse septum (Fig. 20). Pallial cavity deep, broad, triangular, arched, dorsoventrally flattened. Anterior extremity of pallial cavity a little larger than its aperture because of closure in left and right extremities produced by fusion of mantle and foot (Figs. 19, 20: ml). Pallial cavity narrowing gradually towards posterior, penetrating at left of visceral mass; cavity length about 2/3 length of animal (Figs. 16, 19).

Osphradium small, monopectinate, located between anterior half of gill and mantle border, at some distance from gill anterior end, located about in left region of pallial aperture somewhat perpendicular to longitudinal axis of body (Figs. 19, 20). Osphradium length little more than 1/8 of pallial aperture length, in form of a small fold, attached to mantle, separated from gill structures. Osphradium leaflets cylindrical, close from each other, somewhat

TABLE 1. Measurements in mm of the holotype and paratypes.

Specimen	Total length (L)	Height	Width	D	Septum length	Septum free shell length	Convexity (D/L)
Holotype AMNH 306947 (female)	52.5	8.5	36.4	59.3	24.9	18.35	1.13
Paratype 1 AMNH 306948 (female)	30.9	8.4	21.8	35.4	12.2	16.1	1.14
Paratype 2 AMNH 306949 (female)	42.8	9.2	29.5	47.5	28.8	22.3	1.11
Paratype 3 AMNH 306950 (female)	38.7	7.8	27.4	41.3	11.3	19.1	1.07
Paratype 4 AMNH 306951 (female)	31.9	12.6	19.8	42.1	13.3	15.8	1.34
Paratype 5 AMNH 306952 (male)	20.1	6.4	14.7	23.8	8.8	9.3	1.18
Paratype 6 AMNH 306953 (male)	23.3	5.7	17.7	25.7	10.9	10.3	1.10
Paratype 7 AMNH 306954 (male)	15.3	3.7	11.6	17.2	5.8	8.3	1.12
Paratype 8 AMNH 306955 (male)	12.3	3.9	10.2	14.2	3.9	6.4	1.15
Paratype 9 AMNH 306956 (male)	26.6	8.2	20.2	30.9	12.1	13.3	1.16