TAXONOMY, MORPHOLOGY AND DISTRIBUTION OF ANCYLINAE (GASTROPODA: PULMONATA: PLANORBIDAE) IN ARGENTINA

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Abstract *The Ancylinae (Planorbidae) comprise freshwater limpets that inhabit limnic environments. This study provides data on taxonomy, general shell morphology, muscle scars and radula of the seven species recorded from Argentina, as well as new distributional records. Shell apex morphology, protoconch sculpture and muscles scar morphology are diagnostic characters for both species and genera in Ancylinae. On the basis of general shell morphology three groups and six genera are recognised. Distribution patterns are presented according to geopolitical divisions with reference to ecoregions. Most species are widely distributed, only a few have restricted ranges. The southernmost records are for* Anisancylus *in the southwest of Río Negro province. The genus* Uncancylus *is widely distributed,* Hebetancylus *is concentrated in the north of Argentina whereas the genus* Sineancylus *is restricted to few localities.*

Key words *Planorboidea, anatomy, freshwater snails, limpets, South America.*

INTRODUCTION

Ancylids are small (to 15 mm), pulmonate, patelliform snails that inhabit limnic environments throughout the world, including the neotropics (Santos, 2003). Morphologically, ancylids are sinistral with the main body openings (mantle cavity and reproductive system) situated on the left side of the body (Burch, 1982). A secondary respiratory organ, the pseudobranch, is present in the reduced mantle cavity (Basch, 1963). They are commonly known as "freshwater limpets" but the patelliform shell is also found in other freshwater pulmonate families; Latiidae Hutton, 1982, Acroloxidae Thiele, 1931, Lymnaeidae Rafinesque, 1815 (genus *Lanx* Clessin, 1882) and Planorbidae Rafinesque 1815 (genus *Patelloplanorbis* Hubendick, 1967).

The taxonomic position of ancylids is controversial. They have been considered as a tribe (Bouchet & Rocroi, 2005; Lacerda *et al*., 2013), family (Hubendick, 1964, 1967; Fernández, 1981; Lanzer, 1996; Santos, 2003; Albrecht *et al*., 2007; Walther *et al*., 2006; Lacerda *et al*., 2011; Ovando *et al*., 2011; Simone *et al*., 2012) or a subfamily within Planorbidae (Albrecht *et al*., 2007; Walther *et al*., 2010). Many authors have proposed the proximity of ancylids to planorbids (Pelseneer, 1901; Hubendick 1947, 1955). Ancylidae and Planorbidae were joined by Hubendick (1978) under the name "Ancyloplanorbidae", on the similarity of gonad and prostate characters. However, Hubendick's taxonomic arrangement was rejected (Boss, 1982) and for a long time these families have been kept separate (Planorbidae and Ancylidae). Hodgson & Healy (1998) recognized the close resemblance of ancylids spermatozoa to those of various species of planorbids and they suggested a common origin for ancylids and planorbids. Bouchet & Rocroi (2005) following Hubendick (1978), with some nomenclatorial modifications, classified ancylids as a tribe of Planorbidae. Tribes Bulinini Fischer & Crosse 1880 (= Laevapecinae Hannibal, 1912) and Miratestini Sarasin, 1897 (= Ferrissiinae Walker, 1917) included ancylids taxa. More recently, Albretch *et al*. (2007) proposed a new arrangement for Planorboidea (= Ancyloplanorboidea) and considered the ancylids as a subfamily of Planorbidae, with tribes Ancylini (*Ancylus* +*Ferrissia*) and Laevapecini (*Gundlachia* +*Hebetancylus* +*Laevapex*).

In the traditional sense, Ancylinae has a widespread distribution, being most abundant in Australia, Africa (Hubendick, 1967; Walker, 1926), the Pacific area (Burch, 1962) and Neartic and Neotropical regions (Bourguignat, 1853;

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Hubendick, 1967; Basch, 1963). In the Neotropical region eight genera with a total number of 18 species have been described: *Anisancylus* Pilsbry, 1924; *Burnupia* Walker, 1912; *Ferrissia* Walker, 1903; *Gundlachia* Pfeiffer, 1849; *Hebetancylus* Pilsbry, 1913, *Laevapex*, Walker, 1903, *Uncancylus* Pilsbry, 1913 (Hubendick, 1967; Lanzer, 1996; Santos, 2003) and the genus *Anancylus* described by Gutiérrez Gregoric (2012) for Argentina, this name being recently replaced by *Sineancylus* (Gutiérrez Gregoric, 2014).

Within the current freshwater molluscan fauna of Argentina (Rumi *et al*., 2006; 2008; Núñez *et al*., 2010; Gutiérrez Gregoric, 2012), seven species of Ancylinae are recorded: *Anisancylus obliquus* (Broderip & Sowerby, 1832); *Gundlachia ticaga* (Marcus & Marcus, 1962); *G. radiata* (Guilding, 1828); *Hebetancylus moricandi* (d'Orbigny, 1837); *Ferrissia* sp.; *Sineancylus rosanae* (Gutiérrez Gregoric, 2012) and *Uncancylus concentricus* (d'Orbigny, 1835) (Rumi *et al*., 2008; Ovando *et al*., 2011; Ovando & Santos, 2011; Gutiérrez Gregoric, 2012). *Anisancylus obliquus* and *G. ticaga* are considered species with restricted distributions (Rumi *et al*., 2006; 2008). *Hebetancylus moricandi* was recorded in Northern Argentina (Corrientes, Chaco, Salta, Jujuy and Formosa provinces) and Central-Eastern region (Buenos Aires, Santa Fé and Entre Ríos provinces) (Fernández, 1981; Rumi *et al*., 2008) while *U. concentricus* was recorded from Salta to Buenos Aires provinces (Fernández, 1981; Castellanos & Landoni, 1995; Lanzer, 1996; Rumi *et al*., 2008) and for Santa Cruz province by Castellanos & Miquel (1991). Taxonomic studies on Ancylinae in Argentina are few. Hylton Scott (1953) was the first to provide anatomical information on Argentinean Ancylinae species and synonymized *Hebetancylus* with *Gundlachia* on the base of the basal septum. This author considered three genera for the country, *Hebetancylus*, *Anisancylus* and *Uncancylus*. Castellanos (1982) and Castellanos & Landoni (1995) grouped all Argentinean species within *Gundlachia* and mentioned only two species for the country, *G. concentrica* and *G. moricandi*. Lanzer (1996) made the first proper record of *Gundlachia* in Argentina recording *Gundlachia ticaga* for Misiones and Corrientes provinces. Gutiérrez Gregoric *et al*. (2006) confirmed the presence of *G. ticaga* for Misiones and mentioned an unidentified species of *Laevapex*. Ovando *et al*. (2011) recorded *G. radiata*, for the first time, from Northwestern Argentina. Recently, Gutiérrez Gregoric (2012) established a new genus of Ancylinae, *Sineancylus* based on material labelled as "*Laevapex* sp." from Misiones.

Ecological and distributional studies include those by Darrigran & Lagreca (2005); Rumi *et al*. (2006); Tietze & De Francesco (2010) and Martín & Díaz (2012) but with few exceptions, sufficient taxonomic or distributional information concerning Ancylinae in Argentina does not exist. The aim of this present study is to provide information on taxonomy, shell, general morphology, muscle scars and radula as well as to report new records of occurrence in order to help identification and improving faunistic studies.

Material and Methods

This study was based on material deposited in the following institutional collections: Museo de La Plata, Buenos Aires, Argentina (MLP), Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Ciudad Autónoma de Buenos Aires, Argentina (MACN), Instituto Miguel Lillo, Tucumán, Argentina (IFML), Instituto de Biodiversidad Neotropical Tucumán (IBN), Museo Nacional de Historia Natural de Montevideo, Uruguay (MNNHM), Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (MZUSP), Instituto Oswaldo Cruz, Rio de Janeiro, Brazil (FIOCRUZ) and Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil (Col. Mol. UERJ).

Type material of almost all species was examined in the Natural History Museum, London, UK (NHMUK). For most species the type material was found but in some cases the types are not present, notably for some described by L. Guilding. Additional information was added to clarify the geographic location and to give more precision to type locality.

Additionally, fieldwork was carried out in the northwest region of Argentina (Jujuy, Salta and Tucumán provinces) and central region (Córdoba province) during the spring-summer seasons from 2008 to 2011. Samples were deposited in the Malacological Collection of IFML.

The latitudinal position of Argentina lying between the Tropic of Capricorn and Antarctica confers great climatic and ecoregional diversity (Brown & Pacheco, 2006) with seventeen ecological units recognised by Olson *et al*. (2001). These

ecoregions and the geopolitical boundaries were used as overlays to produce dot maps of the distributions based on 169 records. Software Diva Gis was used to produce the maps. The layer of administrative areas of Argentina was obtained from DIVA resource (http://www.diva-gis.org/gdata). Localities without exact geographic coordinates in the original source were georeferenced using GEOLocate web application (http://www.museum.tulane.edu/geolocate/web/webgeoref. aspx).

Shell dimension measurements (TL total length, H height, TW total width) (Fig. 1) of both adults and juveniles were made under a binocular microscope fitted with a graduated micrometre grid. Soft parts were separated from the shell after relaxation in menthol for 24 hours and preserved in 96º alcohol. Mantle pigmentation and muscle scars were observed using a Leica MZ6 and Olympus SMZ800 stereomicroscopes and drawings were made with the aid of a *camera lucida*. The radulae were extracted from the buccal mass following the methodology explained in Lanzer (1994) and examined together with the shells using a JEOL 35 CF electron microscope at Centro Integral de Microscopía Electrónica.

RESULTS

Planorbidae Rafinesque, 1815

Ancylinae Rafinesque, 1815
Genus ***Sineancylus*** Gutiérrez Gregoric, 2014

Anancylus Gutiérrez Gregoric, 2012: 107. [Homonymous of *Anancylus* Thompson, 1864].
Sineancylus Gutiérrez Gregoric, 2014: 243. [*nomem novum* pro *Anancylus* Gutiérrez Gregoric].

Type species Anancylus rosanae Gutiérrez Gregoric, 2012 by monotypy.

Type locality Upper Iguazú River, Iguazú National Park, Misiones Province, Argentina.

Original diagnosis "Shell patelliform, usually low, circular apex located along midline at anterior end of shell. Three adductor muscles present: large posterior (twice length of anterior muscles) and two tear-shaped anterior muscles. Adhesive epithelium between two anterior muscles. Radula with more than one hundred rows of teeth. Central tooth asymmetric, tricuspid. First lateral tooth tricuspid, tall endocone. Jaw plates low and wide, undifferentiated. Free edge of plates denticulate. Genital system: tubular ovotestis thick flagellum (three times longer than prepuce), tubular prolongation of uterus three times longer than ovotestis" (Gutiérrez Gregoric, 2012).

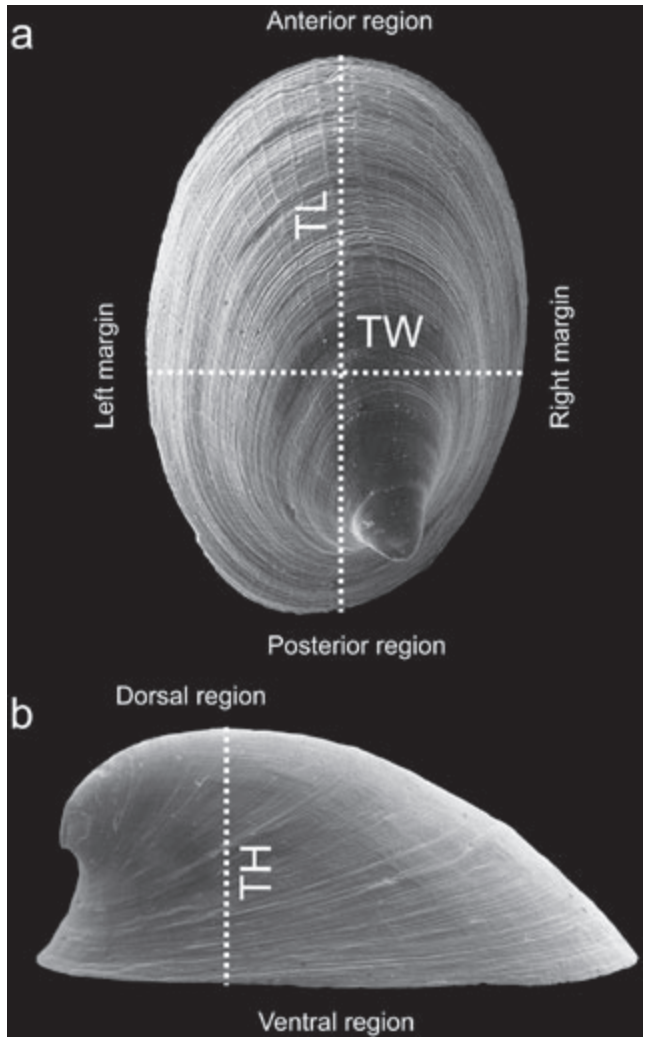

Figure 1 Shell measurements. **a** Dorsal view showing the total length (TL) and total width (TW). **b** lateral view showing the height (H).

Remarks The type species of genus *Sineancylus* has been described recently, for this reason its description is not included in this study. For more detail see Gutiérrez Gregoric (2012).

Distribution in Argentina and habitat (Fig. 5a, b) Upper Iguazú River, Iguazú National Park, Misiones Province (Fig. 5). In rapids environments such as Apepú; Irene; León; Mbigua; Ñandú; Rivadavia and San Martín; Tacuara.

Genus *Anisancylus* Pilsbry, 1924

Ancylus Müller, 1774: 199 [partim]
Gundlachia–Castellanos & Landoni, 1995: 777–Santos, 1994: 153–Lanzer, 1996: 185 [partim].
Anisancylus Pilsbry, 1924: 76–Hubendick, 1964: 17–Fernández, 1981: 107–Santos, 2003: 205–Rumi *et al*., 2008: 83.

Type species Ancylus obliquus Broderip & Sowerby, 1832 by original designation.

Type locality streams around Santiago, Chile.

Generic diagnosis Shell elevated, strongly convex, aperture sub rounded to rounded. Apex prominent curved backward, positioned slight right of the median line, on the posterior quadrant of shell. Apical sculpture with numerous pits; radial wrinkles sometimes present among pits. Rachidian tooth with one or two main long cusps, the left one longer, reaching the base; mesocone at lateral teeth longer than endocone and ectocone.

Anisancylus obliquus (Broderip & Sowerby, 1832)

Ancylus obliquus Broderip & Sowerby, 1832: 202.
Ancylus gayanus d'Orbigny, 1837: 356.
Anisancylus gayanus obliquus Biese, 1948: 229.
Ancylus gayanus var. *maximus* Biese, 1948: 231.
Gundlachia oblicua–Castellanos, 1982: 102–Castellanos & Miquel, 1991: 11, fig. 5.
Gundlachia gayana–Castellanos & Miquel, 1991: 11, fig. 5.
Gundlachia obliqua–Hubendick, 1967: 36–Ohlweiler & Lanzer 1993: 121–Lanzer, 1996: 175.
Anisancylus obliquus–Fernández, 1981: 107–Santos, 2000: 995–Santos, 2003: 206– Rumi *et al*., 2006: 207–Rumi *et al*., 2008: 83–Núñez *et al*., 2010: 52–Martello, 2014: 37.

Type material Lectotype and Paralectotype (NHMUK 1992123) designated by Ohlweiler & Lanzer (1993).

Type locality "…in Chili in rivulis…" (Broderip & Sowerby, 1832).

The precise site where the specimens were collected is not specified by Broderip & Sowerby (1832) in the original description. Santos (2003) restricts the type locality to streams around Santiago in Chile.

Derivation of name Although not explained in the original description, *obliquus* probably was used to refer to the oblique position of the shell apex.

Material examined **Córdoba Province**. **IFML 16269**, Los Reartes River, 31º57'51'' S, 64º42'07'' W, 887 m, 26/11/2008, Romero, F. leg. **IFML 16267**, Anisacate River, near La Bolsa, 31º43'47'' S, 64º51'09'' W, 586 m, 25/11/2008, Romero, F. leg. **IFML 16268**, La Cumbrecita, del Medio River, 31º53'09'' S, 64º46'0'' W, 1372 m, 26/11/2008, Romero, F. leg. **IFML 16270**, Yacanto stream, Romero, F. leg. **MACN-In 36388**, Calamuchita, January 1955, Viamo, S. M. leg. **MACN-In 14504**, Córdoba city, Brethes, J. leg. **MACN-In 9777**, Las Rosas, Primero River, Doering, A. leg. **MLP 4541**, Cabana, August 1950, Birabén, M. leg. **MLP 4534**, Los Reartes River, Altos Pampa, 27/02/1950, Birabén, M. leg. **MLP 4538**, Calamuchita. **MLP 4544**, Primero River. **MLP 2154**, La Tablada, Primero River. **MLP 7037**, San Roque River, 28/01/2000. Río Negro Province. **MLP 4416**, Niño stream, San Carlos de Bariloche, 22/09/1981, Alfonso leg.; **Neuquén Province**. **FIOCRUZ 1903**. Collón Cura River, Piedra del Aguila. **FIOCRUZ 1912**. San Martín de los Andes.

*Measurement*s **IFML 16269**: N=6; TL: 8.9–4.6 (mean: 5.9); TW: 5.5–3.4 (mean: 4.03); H: 4.1–2.9 (2.61). **IFML 16267**: N= 9; TL: 8.8–6.6 (mean: 6.84); TW: 6.3–4.7 (mean: 5.35); H: 3.8–3.3 (mean: 3.3). **IFML 16268**: N= 5; TL: 8.4–5.9 (mean: 6.86); TW: 6.1–3.8 (mean: 4.86); H: 3.8–2.7 (mean: 3.26). **MLP 4541**: N= 8; TL: 9.9–7.9 (mean: 8.87); TW: 6.1–5.1 (mean: 5.66); H: 3.7–2.6 (mean: 3.35). **MLP 2154**: N= 9; TL: 8.2–6.6 (mean: 7.13); TW: 5.3–4.4 (mean: 4.73); H: 4.0–2.6 (mean: 3.15). **MLP 4544**: N= 4; TL: 7.3–6.1 (mean: 6.77); TW: 5.0–4.0 (mean: 4.5); H: 3.5–2.5 (mean: 2.77). **FIOCRUZ 1903**: N= 14; TL: 3.85–7.25 (mean: 5.6); TW: 2.7–5.2 (mean: 4.04); H: 1.15–2.55 (mean: 1.79). **FIOCRUZ 1912**: N=15: TL: 2.7–4.15 (mean: 3.31); TW 1.4–2.05 (mean: 1.72); H: 0.95–1.35 (mean: 1.15).

Diagnosis Shells elevated, rounded. Apex conical, prominent, wide, curved down. Apical sculpture with numerous pits; radial wrinkles present among pits. Right anterior muscle scar curved, longer than wide, reaching the middle right of the mantle length. Asymmetric rachidian tooth with one main cusp, the left one longer than the right one, frequently reaching the margin of the

basal plate; two or three accessory smaller cusps besides the main cusps are present; basal plate rectangular long, thin.

Shell (Fig. 2) Elevated, dorsally depressed, aperture oval to rounded, convex, as wide as high. Shell apex on the posterior region, prominent, conical, wide, obtuse, and curved backward, slightly to the right. Protoconch sculpture with a circular central shallow depression (diameter about 22 µm) followed by an area of punctae irregularly ordered that soon become orderly arranged near the margin of protoconch. Punctae are crossed by numerous tight radial wrinkles and spiral growth lines. Teleoconch sculpture with continuous radial wrinkles, prominent, spaced, crossed by delicate concentric lines well marked specially on the anterior shell portion.

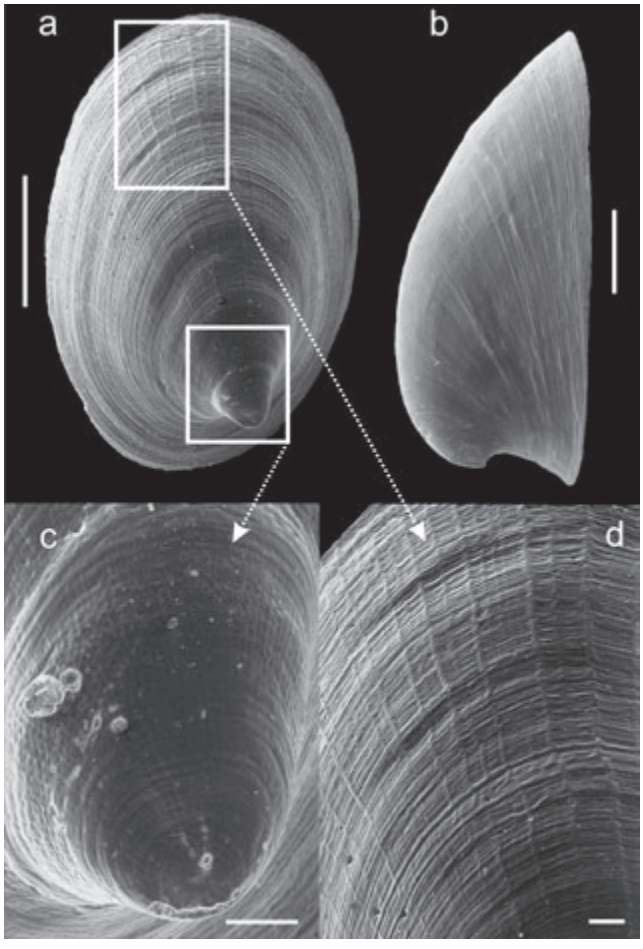

Figure 2 *Anisancylus obliquus* shell. **a** Dorsal view. **b** Lateral view. **c** Dorsal view showing apical sculpture with numerous pits. **d** Teleoconch sculpture of radial lines crossed by circular growth lines. Scale bars=100 µm.

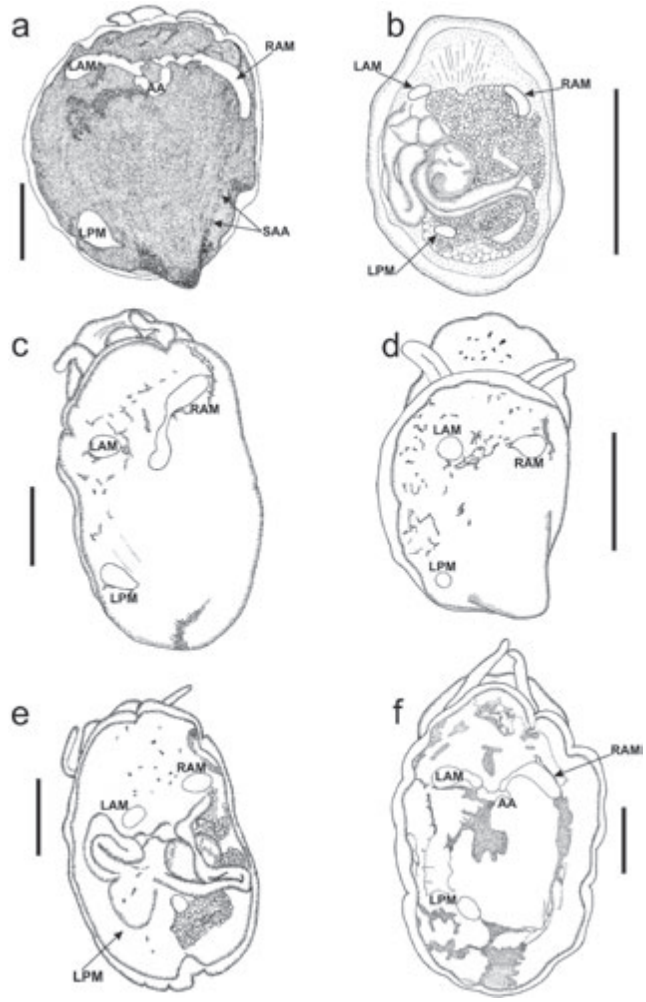

Figure 3 Soft parts of the six species of the Ancylinae, dorsal views showing the pigmentation pattern and morphology of muscle scars. **a** Strongly pigmented specimen of *Anisancylus obliquus* **b** *Ferrissia irrorata* **c** *Gundlachia radiata*, pigmentation concentrated around the anterior muscle scars **d** *Gundlachia ticaga* with sparce pigmentation on left side. **e** *Hebetancylus moricandi*. **f** *Uncancylus concentricus* with pigmentation on the mantle surface.
Abbreviations **AA**, anterior adhesive area; **LAM**, left anterior muscle scar; **LPM**, left posterior muscle scar; **RAM**, right anterior muscle scar; **SAA**, small adhesive area. Scale bars=1 mm.

External morphology (Fig. 3a) Animal strongly pigmented, sometimes almost black, mantle border with grey pigmentation or colourless. The mantle margin in general rounded. Muscle scar surfaces white grey colour or colourless; right anterior muscle scar curved, elongated, C shaped, longer than wide, reaching the middle of mantle length; left anterior muscle scar oval-shaped, shorter than the left posterior muscle

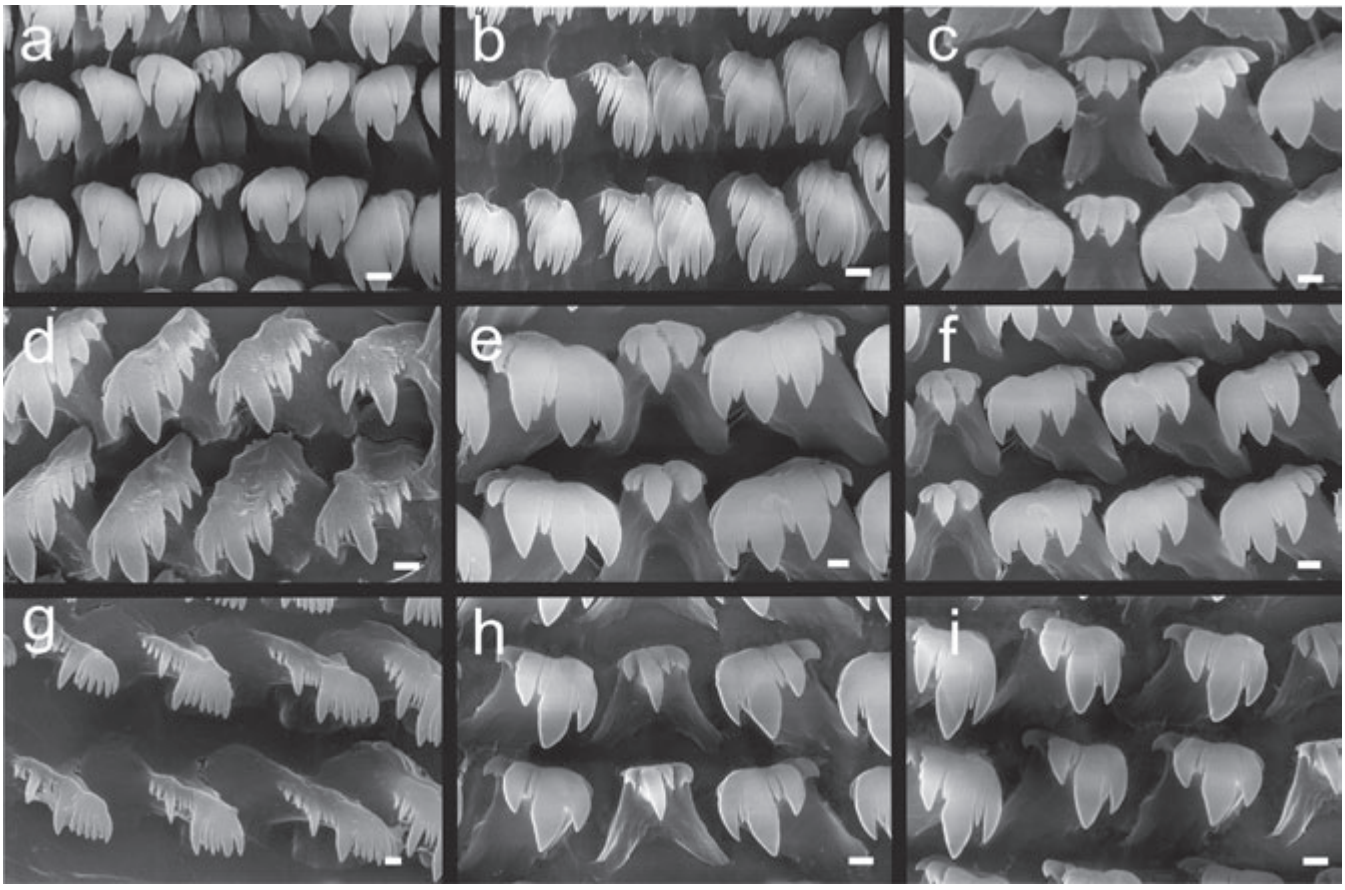

Figure 4 Radula of Ancylinae species. **a–b** *Anisancylus obliquus*, **a** rachidian tooth and three first lateral teeth, **b** marginal teeth. **c–d** *Ferrissia irrorata*, **c** rachidian tooth and first lateral tooth, **d** marginal teeth. **e–g** *Gundlachia radiata*, **e** rachidian tooth and first lateral tooth, **f** three first lateral teeth, **g** marginal teeth. **h–i** *Gundlachia ticaga*, **h** rachidian tooth, **i** three first lateral teeth. Scale bars=1 μm.

scar rounded. Adhesive area V-shaped located between right and left anterior muscle scars. Small adhesive areas of diverse sizes are present between right anterior muscle scar and left posterior muscle.

Radula (Fig. 4a, b) Rachidian tooth with rectangular basal plate, showing one main cusp, slender, sharpened in its distal portion; the left cusp is longer than the right; there are three smaller cusps in both side of main cusp. Lateral tooth with triangular basal plate and three principal cusps, mesocone larger than ectocone and endocone; mesocone could show a subdivision, seeming bifid; between ectocone-mesocone and endocone-mesocone there is one small thin additional cusp. Marginal teeth with short basal plate, somewhat quadrangular, and nine to thirteen long thin cusps, mesocone, endocone and ectocone almost undifferentiated. Teeth decrease in size whereas the number of cusps increases towards radula margin.

Distribution in Argentina and habitat (Fig. 5a, b) This species was recorded from numerous localities from Córdoba, Río Negro and Neuquén provinces (Fig. 5a). In localities from Córdoba this species was found in shallow rivers, with stony substrate, attached to big stones. In Córdoba these localities correspond to Dry Chaco and Espinal ecoregions whereas those from Río Negro and Neuquén were located in Patagonian steppe and Valdivian temperate forest ecoregions (Fig. 5b).

Remarks The lectotype and paralectotype, present in the NHMUK, were designated by Ohlweiler & Lanzer (1993) based on material collected by Broderip & Sowerby (1832). The precise location for this species in Argentina was first made by Lanzer (1996), previously Fernández (1981) had mentioned this species in the country but gave no exact locality. Specimens of *A. obliquus* from Argentina are very similar to those from Chile (Lanzer, 1996; Santos, 2000). *Anisancylus obliquus* differs from its congeneric

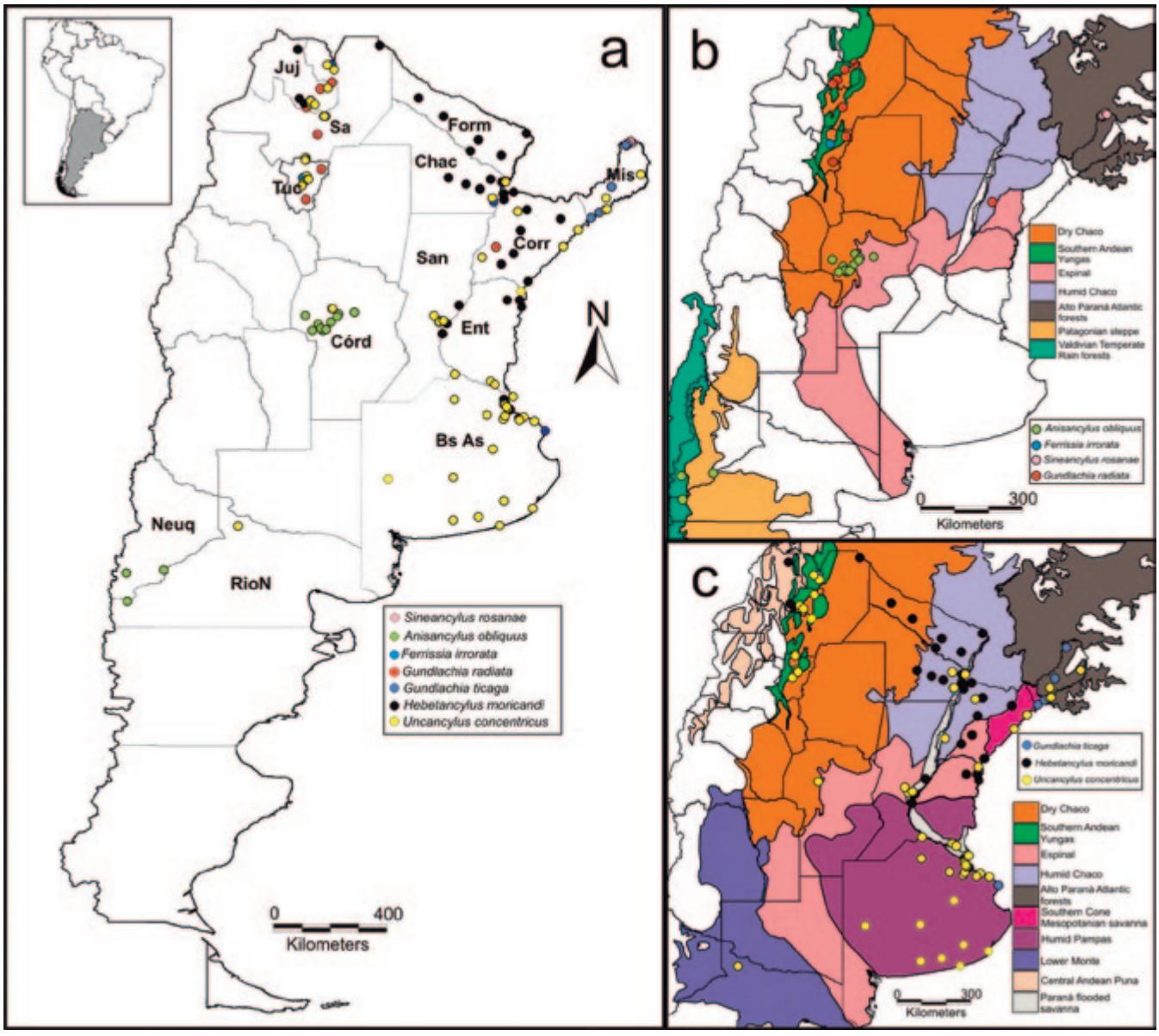

Figure 5 Distribution map of Ancylinae species in Argentina. **a** Political divisions. **b, c** By ecoregions. *Abbreviations* **Bs As**, Buenos Aires; **Chac**, Chaco; **Córd**, Córdoba; **Corr**, Corrientes; **Ent**, Entre Ríos; **Form**, Formosa; **Juj,** Jujuy; **Tuc**, Tucumán; **Sa**, Salta; **San**, Santa Fé; **Mis**, Misiones; **Neuq**, Neuquén, **RioN**, Río Negro.

species from northwest Brazil, *A. dutrae* (Santos, 1994) in protoconch sculpture. We found, in accordance with Ohlweiler & Lanzer (1993), Lanzer (1996) and Santos (2003), numerous small pits or punctuations, in a tight arrangement, situated between radial wrinkles at the apical sculpture in *A. obliquus* whereas in *A. dutrae* the shell apex sculpture exhibits only deep pits, and lacks radial wrinkles (Santos, 1994). In *A. obliquus* the right muscle scar is elongated whereas in *A. dutrae* it is elongated with a constriction in its middle portion (Santos, 1994). This species is similar in general shell morphology to *U. concentricus*, but differs in apex morphology, apical sculpture and absence of periostracal hairs.

Genus ***Ferrissia*** Walker, 1903

Ancylus Müller, 1774: 199 [partim].
Ferrissia Walker, 1903: 25–Basch, 1963: 426–Harry & Hubendick, 1964: 66–Hubendick, 1964: 24–Lanzer, 1991: 703–Lanzer, 1996: 201–Santos, 2003: 208.

Type species *Ancylus rivularis* Say, 1817 by original designation

Type locality Delaware and Susquehanna rivers, Pennsylvania, United States.

Generic diagnosis Shells small, oval or sub rounded. Apex rounded, blunt or flattened. Apical sculpture with radial grooves, parallel each to other, variable in thickness and number.

Ferrissia irrorata (Guilding, 1828)

Ancylus irroratus Guilding, 1828: 535.
Ferrissia irrorata–Harrison, 1983: 7–Hubendick, 1967: 44–Harry & Hubendick, 1964: 66 –Gómez *et al*., 2004: 440.

Type material Syntypes (NHMUK 1839.9.15.107–117) 35 specimens.

Type locality "…fossarum Sti. Vicentii…" (Guilding, 1828).

The type locality "Sti. Vicentii" corresponds with the Saint Vincent Island located in the Lesser Antilles

Derivation of name in the original description, Guilding (1828) did not mention the derivation of the species name. Nevertheless the Latin word *irroratum* that means "drop by drop" in reference to the shell morphology and its size.

Material examined **Tucumán Province**. **IFML 16405**, Tafí Viejo Dept., Parque Sierra de San Javier, way to La Cascada, Los Noques stream, 26º47'09.5'' S, 65º23'15.5'' W, 890 m, Mitrovich, M. & Ovando, X. leg.

Measurements **IFML 16405**, N=16; TL: 4.3–2.6 (mean: 3.54); TW: 2.5–1.7 (mean: 2.11); H: 1.1–07 (mean: 0.91).

Diagnosis Shell apex wide, blunt, located on posterior portion of shell to the right. Protoconch sculpture with numerous radial wrinkles tight around a small deep central circular depression. Right muscle scar transversely elongated. Rachidian tooth symmetric, with two main cusps and two small accessory cusps on each side, long trapezoid basal plate.

Shell (Fig. 6) Oval, small, fragile, colourless to faint brown, length twice the width, anterior shell region convex; posterior concave below apex. Shell apex rounded, flattened, blunt.

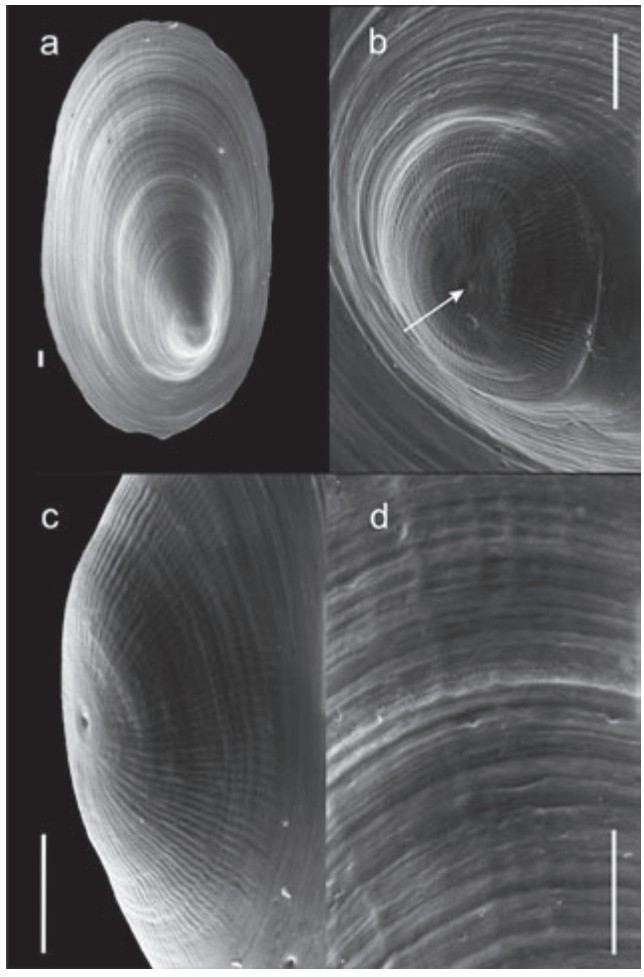

Figure 6 *Ferrissia irrorata* shell. **a** Dorsal view. **b** Protoconch showing apical sculpture. **c** as b but in lateral view. **d** Teleoconch sculpture of radial lines. Scale bars=100 µm.

Protoconch sculpture with a small circular deep central depression (about 20 µm in diameter), closely spaced, radial grooves of regular thickness extend to about 140 µm from the small central depression. Teleoconch sculpture with circular growth lines, well marked, thin, tight, crossed by radial grooves arranged at regular intervals from each other, more evident on the anterior of the shell. Aperture oval slightly rounded at posterior end, smooth-edged and sharp.

External morphology (Fig. 3b) Body elliptical, depressed. Dorsal mantle surface with sparse pigmentation, translucent revealing inner organs. In some specimens (not drawn), a dark blotch of pigment is present between the anterior muscles scars and sometimes another small blotch is present near the left posterior muscle scar. Right muscle scar slightly elongated. Left

anterior and posterior muscle scars roundish in shape.

Radula (Fig. 4c–d) Rachidian teeth, with trapezoid, elongate basal plate, with symmetrical main cusps; two smaller accessory cusps at each side of main cusps, with similar size. Main cusps long, slender, triangular in their distal portion, with an additional small cusp between them. Lateral teeth with rectangular basal plate; first lateral tooth with six or seven cusps, being three main cusps, the mesocone slightly greater and larger than ectocone and endocone; between ectocone and mesocone an additional cusp, thin, slender, is present. Other lateral teeth similar in size to the first, decreasing in size towards margin. Marginal teeth with thin quadrangular basal plate, with nine to ten oblique cusps, being three main cusps; one or two smaller cusps are present between the main cusps; three to four smaller cusps occurs after ectocone.

Distribution in Argentina and habitat (Fig. 5) This species was only found in one locality in Tucumán province and this is the first record for Argentina (Fig. 5a). The locality is situated inside a protected area called Sierra de San Javier Provincial Park. The samples were collected from a mountain stream with stony substrate under stones or attached to fallen tree leaves in the Yungas ecoregion (Fig. 5b). We found some septate shells with complete and incomplete septae.

Remarks The protoconch sculpture agrees with that described by Hubendick (1964) and Harrison (1983) for *F. irrorata* from the Antilles. This species differs from *Ferrissia gentilis* Lanzer, 1991 in shell sculpture and radula. In *F. irrorata* the apex wrinkles are numerous, well marked, of regular thickness and closely spaced while in *F. gentilis*, the wrinkles are thin and widely spaced (Lanzer, 1991). In *F. irrorata* the anterior portion of the teleoconch sculpture shows circular growth lines and radial grooves while in *F. gentilis*, the latter are absent (Lanzer, 1991; Santos, 2003). The rachidian tooth in *F. irrorata* has one small cusp between the two main cusps, whereas in *F. gentilis* there are two or three cusps between the main cusps. Both species have a small cusp between ectocone and endocone in the lateral teeth. The first South American record of *F. irrorata* came from Colombia (Gómez *et al*., 2004). The recent record in Argentina suggests that this is more widespread, passing unnoticed due to its small size and delicacy and could be a cryptic invasive species in South America similar to *Ferrissia fragilis* in Europe (Walther *et al*., 2006, 2010; Son, 2007).

Genus ***Gundlachia*** Pfeiffer, 1850 ["1849"]

Gundlachia Pfeiffer, 1850 [1849]: 97.
Gundlachia–Martens, (1890–1901): 403–Pilsbry, 1924: 55–Zilch, (1959–1960): 127–Hubendick, 1964: 29–Hubendick, 1978: 40–Castellanos & Landoni, 1995: 777–Santos, 2003: 208–Gutiérrez Gregoric *et al*., 2006: 51–Rumi *et al*., 2006: 207–Rumi *et al*., 2008: 83–Núñez *et al*., 2010: 52.
Uncancylus–Marcus & Marcus, 1962: 217 [partim].

Type species *Gundlachia ancyliformis* 1850 [1849] (=*Ancylus radiatus* Guilding, 1828) by original designation.

Type locality Saint Vincent, Antilles

Generic diagnosis Shells slightly elevated or depressed, oval – elliptical. Apex rounded, slightly elevated. Shell apex sculpture with a shallow central apical depression followed by a smooth area and by another area with shallow pits irregularly arranged. Teleoconch sculpture with growth lines well marked overall. Right anterior muscle scar with different grades of curvature of its inner portion.

Gundlachia radiata (Guilding, 1828)

Ancylus radiatus Guilding, 1828: 536.
Ancylus havanensis Pfeiffer, 1839: 350.
Ancylus ancyliformis Pfeiffer, 1849: 98.
Gundlachia radiata–Hubendick, 1964: 29–Harry & Hubendick, 1964: 62–Harrison, 1983: 12–Lanzer, 1996: 188–Santos, 2003: 208–Pointier, 2008: 52–Ovando *et al*., 2011: 263–Lacerda *et al*., 2013: 125.

Diagnosis Shells elliptical to rounded. Apex slightly elevated. Shell apex sculpture with wide smooth area followed by an area with scarce, small pits, irregularly arranged. Anterior right muscle scar elliptical, larger than the anterior left, with a pronounced curvature of its inner portion. Rachidian tooth with mesocone elongate, basal plate inverted U shaped; three or four accessory cusps.

Type material the type material was "not found at NHMUK in 2012" (Ablett pers. com.).

... "During 1838–1840, the extensive collections of Natural History made by the Rev. Lansdown Guilding, at St. Vincent and other islands of the West Indies were sold at Messrs. Stevens' auction rooms. The Museum acquired a large number of specimens, some of which are of special interest, being either the actual types or co- types of the various species described by Mr. Guilding"… (Smith, 1896).

Type locality "cum praecedente; pulchra species." (Guilding, 1828).

The locality corresponds to Saint Vincent Island (same locality of *Ferrissia irrorata*). Similar to other species described by Guilding, the exact site where specimens were collected was not detailed in the original descriptions.

Derivation of name Although not indicated in the original description, it is probably linked to the radial lines on the teleoconch.

Material examined **Jujuy Province. IML 15292**, Calilegua Dept., lagoon on Route 34, returning to Bananal, 23º33'43'' S, 64º23'33'' W, 350 m, 12/05/2009, Ovando, X. & Molineri, C. leg. **IML 15991**. Calilegua Dept., returning to Bananal, 12/05/2009, Ovando, X. & Molineri, C. leg. **IML 15298**, Zapla, pond on the way to Zapla River, 24º13'10.2'' S, 65º06'3.9''W, 1030 m, 09/05/2009, Ovando, X. leg. **IML 15299**, Zapla, River, 24º13'10.2'' S, 65º06'3.9'' W, 1030 m, 09/05/2009, Ovando, X. leg. **MLP 6547**, El Carmen Dept., 8 Km. to El Carmen, 12/12/2001, 1190 m, Ituarte, C. leg. **Salta Province. IFML 16409,** Metán Dept., unnamed stream way to Piedras river, 25º19'24.5'' S, 64º52'43.6'' W, 663 m, 08/05/2009, Ovando, X. leg. **IFML 16274**, El Rey National Park, pond on the way to Aguas Negras, 24º42'28.7''S 64º38'20.6'' W, 930 m, Ovando, X. leg. Tucumán Province. **IFML 16407**, Burruyacú Dept., on the way to Timbó Nuevo, Salí River, Noviembre de 1996, Ituarte, C. leg. **Corrientes Province**. **MLP 7332**, marsh from Santa Lucía River, Route 12, 21/07/2000, Gutiérrez Gregoric, D. & Roche, A. leg.

Measurements **IML 15299**: N=10; TL: 10.0–5.9 (mean: 7.71); TW: 5.4–3.1 (mean: 3.84); TH: 3.0–1.5 (mean: 2.07). **IML 15292**: N= 8; TL: 6.4–5.5 (mean: 5.98); TW: 3.3–2.7 (mean: 2.98); H: 2.7–1.6 (mean: 2.0).

Shell (Fig. 7) Rounded to elliptical, thin, pale brown. Apex obtuse, slightly raised, somewhat rounded, slightly inclined to right, but not exceeding the right margin of shell. Protoconch with a central depression (diameter about 14 µm), surrounded by a wide smooth area (radius about 60 µm), continuing with an area of scattered, shallow, irregularly shaped pits. Teleoconch with concentric growth lines, crossed by radial wrinkles, more evident in the anterior side of shell. Aperture longer than wide. Septate shells with a basal septum partially closing the shell aperture are found in some populations.

External morphology (Fig. 3c) Body oval, elongated, following the shape of the shell (Fig. 7a).

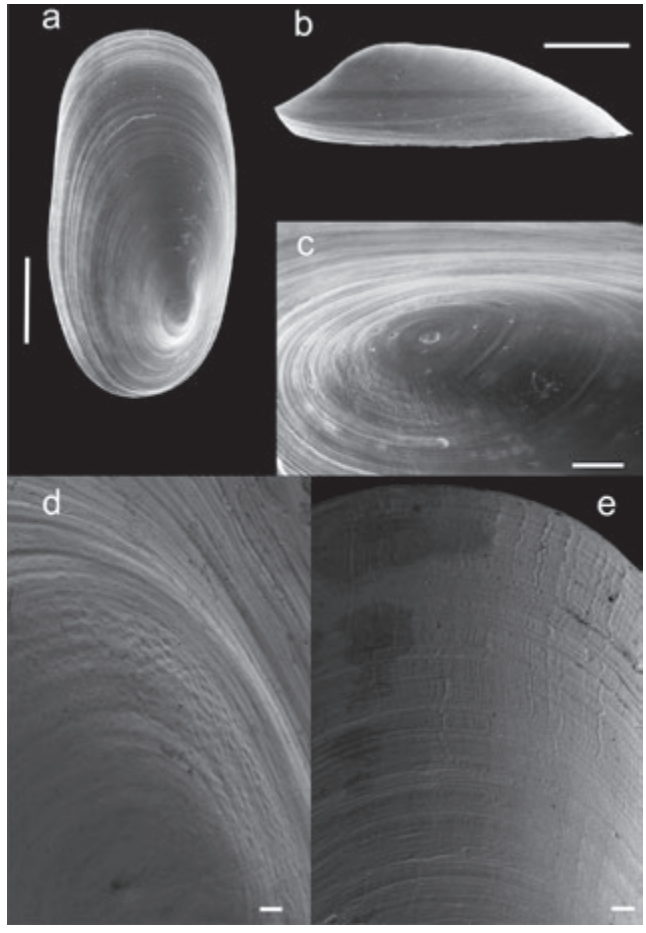

Figure 7 *Gundlachia radiata* shell. **a** Dorsal view. **b** Lateral view. **c** Protoconch in dorsal view showing the sculpture of a smooth area followed by another with irregularly arranged, shallow pits. **d** Higher magnification of apex sculpture. **e** Teleoconch sculpture of radial lines. Scale bars a, b=1000 µm; c, d, e=100 µm.

Mantle surface with dark areas concentrated around the adhesive areas of the adductor muscles. In most specimens studied, one or two obvious dark spots are located on the right side of mantle surface near the right anterior muscle scar; another is on the end posterior side of mantle surface. In some specimens, these spots can become joined to form a wide continuous band. Small spots may be present on the anterior and left mantle region. Cephalic region rounded, pigmented with dark grey streaks, arranging radially on the dorsal surface of the head. Right anterior muscle scar elliptic, larger than the left anterior muscle scar, with a pronounced curvature of its inner portion; left posterior muscle scar rounded. Well marked elongated adhesive area between the two anterior muscle scars (Fig. 3c).

Radula (Fig. 4e–g) Rachidian teeth with five cusps, of two asymmetrical main cusps, the left longer than the right, somewhat triangular; two smaller cusps are present left of the bigger main cusp; one smaller cusp is present besides the right main cusp; basal plate inverted U shaped. Lateral teeth very similar in shape, decreasing in size towards radula margin, with eight or nine cusps, of three main triangular cusps almost the same size and shape; the mesocone is a little more developed, slightly longer, elongate, lanceolated; ectocone more developed than the endocone; ectocone sometimes bifid; smaller cusps are present between endocone-mesocone and mesocone-ectocone. Two or three accessory cusps are seen besides ecotocone; basal plate of lateral teeth approximately rectangular, flat, oblique insertion. Marginal teeth pectiniform, with numerous cusps, eleven to fifteen cusps; the six to seven inner cusps are longer and bigger than the others, the outermost cusp of this first series the strongest and longest; basal plate slender, short.

Distribution in Argentina and habitat (Fig. 5a, b) Jujuy, Salta, Tucumán and Corrientes provinces. In Jujuy province, numerous specimens with basal septum were collected from temporal ponds, with muddy substrates. The specimens were attached under fallen leaves of Eucalyptus and grasses obscured by aging (Ovando *et al*., 2011). In Tucumán province, this species was collected in a river, attached to leaves of marginal vegetation. Localities from Jujuy, Salta and Tucuman are located in the Yungas and Dry Chaco ecoregions. In Corrientes *G. radiata* inhabits swamps and marshes in the Humid Chaco ecoregion.

Remarks *Gundlachia radiata* was first recorded in Argentina by Ovando *et al*. (2011), extending its distribution range to the southernmost part of South America. At first sight the shell of *G. radiata* is similar to *Hebetancylus moricandi,* which may confuse identification exemplified by material from Corrientes province previously identified by Gutiérrez Gregoric *et al*. (2006) as *Hebetancylus moricandi*. *Gundlachia radiata* differs from *G. ticaga* in shell characters, muscle scars and pigmentation pattern of the mantle surface. The protoconch sculpture of *G. radiata* shows a central depression followed by a smooth area and an area with irregularly shaped shallow, scattered pits, whereas *G. ticaga* has a shorter smooth area followed by numerous shallow pits irregularly distributed on all over the protoconch surface (Santos, 2003). The right anterior muscle scar in *G. radiata* is elliptic, larger than the left anterior muscle scar, with a pronounced projection of its inner portion unlike that in *G. ticaga,* which presents a slight curve of its inner portion similar in shape to a raindrop.

Gundlachia ticaga (Marcus & Marcus, 1962)

Uncancylus ticagus Marcus & Marcus, 1962: 217. *Gundlachia ticaga*–Ohlweiler & Lanzer 1993: 129–Lanzer, 1996: 192–Thiengo *et al*., 2001: 178–Thiengo *et al*., 2002:43–Thiengo *et al*., 2004: 99–Santos, 2003: 210–Gutiérrez Gregoric *et al*., 2006: 54–Rumi *et al*., 2006: 207–Rumi *et al*., 2008: 83–Núñez *et al*., 2010: 52–Lacerda *et al*., 2011: 334–Simone *et al*., 2012: 21.

Diagnosis Elevated shells, higher than long, aperture oval, apex projected, flexed to right, rounded. Apical sculpture with a small smooth area followed by an area with irregularly distributed, numerous, shallow pits. Right anterior muscle scar larger than anterior left with a small curvature of the inner portion like a raindrop. Rachidian tooth with one mean cusp, slender, more developed, oblique; basal plate trapezoid, broad in its base.

Type material Syntypes (MZSP 43745) 35 specimens, and (MZSP 64118) 2 specimens.

Type locality "... aquários no Departamento de Zoologia da Faculdade de Filosofia, Ciências e Letras da Universidade de São Paulo..." (Marcus & Marcus, 1962).

Derivation of name Not explained in the original description. People who knew Dr. E. Marcus stated that he liked wordplay, creating words with no logical roots.

Material examined **Salta Province**. **IFML 15294**, Orán Dept., Pescado river, 22º57'28.5'' S 64º23'6.7'' W, 350 m, 10/05/2009, Molineri, C. & Ovando, X. leg. **IFML 16275**, El Rey National Park, ponds next to Aguas Negras River, 24º41'41,1''S, 64º36'42,8'' W, 865 m, 17/03/2009, Ovando, X. leg. **Jujuy Province**. **MLP 11909**, unnamed stream, Complejo Termal Caimancito, Route 11, 23º44'46'' S 64º31'29'' W, 18/11/2004, Ituarte, C. leg. **IFML 16273**, Ledesma Dept., Complejo Termal Caimancito, 23º44'46''S, 64º31'29'' W, 1100 m, 18/11/2004, Cuezzo, M. G. leg. Tucumán Province. **IBN 201**, Chicligasta, Rio Chico, 27º31'16.7'' S 65º16'00.4'' W, 11/11/2010, Mitrovich, M. & Ovando, X. leg. **Corrientes Province**. **MLP 7341**, Alvear, 14/09/2002, Rumi, A. & Gutiérrez Gregoric, D. leg. **Chaco Province**. **MLP 7344**, Timbó lagoon, Bermejo port, 18/07/2000, Gutiérrez Gregoric, D. & Roche, A. leg. **Buenos Aires Province MLP 7390**, La Matilde stream near to Punta Piedras, Abril de 2003, Brusa, F. leg.

Measurements **IFML 15294**: N= 6; TL: 4.5–3.6 (mean: 4.15); TW: 3.0–2.5 (mean: 2.83); H: 1.5–1.4 (mean: 1.45).

Shell (Fig. 8) Elevated, oval, brown to dark grey. Apex prominent, rounded, curved downwards to the right, sometimes surpassing the right edge of shell. Protoconch with deep central depression (radius about 10 µm) followed by a smooth area (diameter about 50 µm), and a wide area with numerous small pits in circular arrangement. Teleoconch with concentric grooves, sometimes interrupted by delicate ridges on the anterior portion.

External morphology (Fig. 3d) Body oval to rounded, dome-shaped, high, with scarce pigmentation on mantle, concentrated over left side as tiny and grey patches and also in the cephalic region. Cephalic region with dark grey blotches, slim, well pronounced, arranged on the anterior head from tentacles. Anterior muscles scars approximately round, the right one bigger and raindrop shaped; posterior muscle scar round.

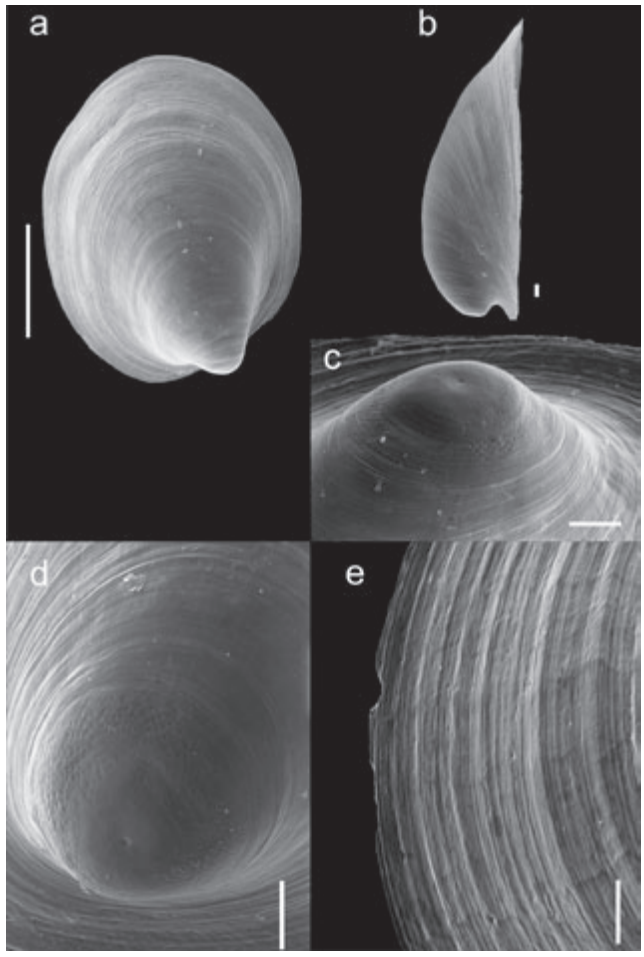

Figure 8 *Gundlachia ticaga* shell. **a** Dorsal view. **b** Lateral view. **c** Protoconch in dorsal view showing the sculpture. **d** Higher magnification of protoconch showing the smooth area and zone with numerous pits. **e** Teleoconch sculpture. Scale bars a, b=1000 µm; c, d, e=100 µm.

Radula (Fig. 4h–i) Rachidian tooth with one mean cusp, slender, more developed than the other rachidian cusps, oblique; basal plate trapezoid, short, broad in its base. Lateral teeth with three main cusps, mesocone larger and longer than the others. Accessory tiny cusps between endocone-mesocone and mesocone-ectocone. Endocone sharp, fang-like, with a shorter accessory cusp located at inner side; ectocone thin, smaller than endocone, with an accessory cusp located at outer side.

Distribution in Argentina and habitat (Fig. 5 a, c) Misiones, Buenos Aires, Chaco, Corrientes, Salta,

Tucumán and Jujuy provinces (Fig. 5a). The specimens collected in Northwestern Argentina came from a stream and a river with sandy substrate. From the Northeastern region the material was collected in marshes located inside the Paranaense rainforest, Alto Paraná Atlantic forests, Paraná flooded savannah and Southern Cone Mesopotamian savannah ecoregions. The locality in Buenos Aires corresponds to the Humid Pampas ecoregion and those from the Northwest region were collected in environments from Southern Andean Yungas and Dry Chaco Ecoregions (Fig. 5c).

In most of the specimens the shell surface was covered by a dark and hard layer of organic material. The scattered distribution of this species on the Argentinean localities is remarkable, and could represent a recent introduction, as it is absent in old museum collections.

Remarks In the original description, Marcus & Marcus (1962) using conchological characters placed *Gundlachia ticaga* into the genus *Uncancylus*. Lacerda *et al*. (2011) found that some specimens of *G. ticaga* have a projected apex curved to right, in accordance with Ohlweiler & Lanzer (1993). The specimens analysed here of *Gundlachia ticaga* do not show the typical radial wrinkles of *Uncancylus* or periostracal hairs over the shell surface, although some Brazilian populations show radial lines on the teleoconch (Lacerda *et al*., 2011). *Gundlachia ticaga* is similar in general morphology to *G. radiata*, differing by muscle scar morphology, apical shell sculpture and radula. *Gundlachia ticaga* seems to be the most widespread freshwater limpet in south-eastern (Santos, 2003) and central-western regions of Brazil (Thiengo *et al*., 2005). The present record of *G. ticaga* in Argentina extends its previously known range distribution.

Genus ***Hebetancylus*** Pilsbry, 1913

Ancylus Müller, 1774: 199 –d'Orbigny, 1835: 24 [partim].
Hebetancylus Pilsbry, 1913: 671–Hubendick, 1964: 33–Fernández, 1981: 103.
Gundlachia–Hubendick, 1967: 27–Hylton Scott, 1953: 467–Lanzer, 1996: 178. [partim].

Type species *Ancylus moricandi* d'Orbigny, 1837 by original designation.

Type locality Corrientes province, Argentina

Generic diagnosis Shell oval to oval-elongated, low or depressed. Apex obtuse, rounded. Apical sculpture smooth. Teleoconch sculpture with concentric, thin growth lines; sometimes radial lines are present on teleoconch surface. Muscle scars small, rounded, similar in shape and size.

Hebetancylus moricandi (d'Orbigny, 1837)

Ancylus moricandi d'Orbigny, 1837: 355.
Ancylus plaearius Bourguignat, 1862: 213.
Ancylus aorus Bourguignat, 1862: 216.
Ancylus lemoinei Ancey, 1901: 103.
Hebetancylus moricandi Pilsbry, 1913: 671.
Gundlachia nordenskiöldi Pilsbry, 1924: 57.
Gundlachia moricandi–Hylton Scott, 1953: 467–Hubendick, 1967: 30–Castellanos, 1982: 101–Miquel, 1988: 127–Castellanos & Miquel, 1991: 11 Fig. 5–Castellanos & Landoni, 1995: 777.
Hebetancylus moricandi–Hubendick, 1964: 33–Fernández, 1981:103–Santos, 2003:211–Thiengo *et al*., 2004: 99–Gutierréz Gregoric *et al*., 2006: 547–Rumi *et al*., 2006: 52–Rumi *et al*., 2008: 83.t

Diagnosis Shell oval, elongated. Apex on posterior region of shell, depressed, rounded, not acute. Protoconch sculpture smooth, without pits. Teleoconch sculpture with concentric, thin, growth lines. Muscle scars small, rounded, approximately similar in size.

Type material the type material was "not found in the NHMUK collection in 2012" (Ablett pers. com.).

Type locality … "des ruisseaux qui se déchargent dans Paraná, bien au-dessus de Corrientes, dans la province de ce nom…" (d'Orbingy, 1837).

Derivation of name in honour of Mr. M. Moricand from Genève.

Material examined **Buenos Aires Province**. **MACN 9529**, Río Santiago, 8/12/1918, Doello Jurado leg. **MACN 9939**, Río Santiago, 15/03/1914, Doello Jurado leg. **MACN 10207**-a, Río Santiago, 29/10/1919, Doello Jurado leg.; **MACN 4556**, Río Santiago, La Plata, Alba, A. leg. **MACN 11835–1**, Atalaya, 18–19/09/1920, Carcelles, A. leg. **MACN 11870**, 11/05/1920, Isla Maciel, Doello Jurado leg.; **MACN 11884**, Punta Lara, 04/12/1920, Doello Jurado leg. **MACN 28689**, Punta Lara, November 1915,

Doello Jurado leg. **MACN 14139**, Paraná de las Palmas river, Carcelles, A. leg. **Chaco Province**. **FIOCRUZ 1982**, ponds in Lapachito, Paraense, W. L. leg. **FIOCRUZ 1985**, Presidencia de la Plaza, Paraense, W. L. leg. **FIOCRUZ 1988**, pond in Presidente Roque Saenz Peña, Paraense, W. L. leg. **MLP 7330**, General Vedia, 18/07/2000, Gutiérrez Gregoric, D. & Roche, A. leg. **MLP 7338**, pond near Selva del Río de Oro, 15/07/2000, Gutiérrez Gregoric, D. & Roche, A. leg. **MLP 7337**, Selva del Río de Oro, 15/07/2000, Gutiérrez Gregoric, D. & Roche, A. leg. **MLP 7339**, on the road to Selvas del Río de Oro, 15/07/2000, Gutiérrez Gregoric, D. & Roche, A. leg. **Corrientes Province**. **FIOCRUZ 1822**, Porá stream, Paraense, W. L. leg. **MACN** 4557, Paso de los Libres, 04/11/1948, Birabén, M. leg. **FIOCRUZ 1835**, Primer Coronda stream, Paraense, W. L. leg. **MLP 4532**, Itati, 01/1965, Apostol, I. leg. **MLP 12682**, Corrientes river, Itatí Rincón, Soneira, P. Leg. **MNHNM 12389**, Timbó stream, Paso Nuevo, 06/08/1977, Olazarri, J. & Boiry, L. leg. **MNHNM 14467**, Tacuaral, 30/07/1978, Olazarri, J. & Roberto, N. leg. **MACN 4553**, Corrientes city, 1965, Apostol, I. leg. **MLP 7327**, Route 12 and Pehuajó stream, 22/07/2000, Gutiérrez Gregoric, D. & Roche, A. leg. **MLP 7328**, Route 12 and Machuca stream, 22/07/2000, Gutiérrez Gregoric, D. & Roche, A. leg. **MLP 7333**, Colonia Pando, Rumi, A. & Gallari, C. leg. **MLP 7334**, Goya, Route 12, 21/07/2000, Gutiérrez Gregoric, D. & Roche, A. leg. **MLP 7336**, Route 12 between Goya and Esquina, 21/07/2000, Gutiérrez Gregoric, D. & Roche, A. leg. **MLP 7156**, entry to Paso de la Patria, 17/07/2000, 29º19' S 58º34'W, Roche, A. & Gutiérrez Gregoric, D. leg. **MLP 7160**, Route 12, 12 kilometers north to San Roque, 21/07/2000, 28º28'S 58º43'W, Roche, A. & Gutiérrez Gregoric, D. leg. **Entre Ríos Province**. **MNHNM 12275**, Isthilart stream, 24/06/1977, Olazarri, J & Boiry, L. leg. **MNHNM 14326**, Mandosoví stream, Olazarri, J., Marchesi, E. & Boiry, L. leg. **MNHNM 14447**, Gualeguay river, Paso Gallo, 21/08/1978, Olazarri, J. leg. **MACN 22935**, San Cosme, Daguerre, J. B. leg., Diamante Dept. **MACN 4550**, Paraná River, 1995, Bonetto leg. **MACN 4552**, delta del Paraná, 1953, Bachmam leg. **MACN 4561**, Pajarito stream, delta del Paraná; **MLP 7331**, Federación, Route 14, 13/09/2002, Rumi, A. & Gutiérrez Gregoric, D. leg. **MLP 7329**, Uruguay river, International Bridge Unzué, 11/09/2002, Rumi, A. & Gutiérrez Gregoric, D. leg. **MLP 7335**, Gualeguaychú, Ñandubaysal Park, Uruguay river, 11/09/2002, Rumi, A. & Gutiérrez Gregoric, D. leg. **Formosa Province**. **IBN 166**, Torhué stream, 10 Km to Formosa, 02/12/1986, Domínguez, E. leg. **FIOCRUZ 1964**, Los Chiriguanos pond, Paraense, W. L. leg. **FIOCRUZ 1969**, Las Lomitas pond, Paraense, W. L. leg. **FIOCRUZ 1974**, Apeadero Bruchard, Paraense, W.L. leg. **FIOCRUZ 1976,** Los Matacos pond, Paraense W. L. leg. **FIOCRUZ 1977**, San Hilario, Paraense, W. L. leg. **MLP 12187**, Bellaco stream, 25/09/2005, Lunaschi, L. leg. **MLP 11863**, ditch roadside between Laguna Blanca and Clorinda, 25º17.28'S 57º48.46' W, Ituarte, C. leg. **Jujuy Province**. **FIOCRUZ 1952**, Paraense, W. L. leg. **FIOCRUZ 1955**, Paraense, W. L. leg. **MLP 12891**, Los Alisos dam, 23/09/1999, Tassara, M. leg. **Salta Province**. **FIOCRUZ 1918**, San Carlos, Paraense, W. L. leg.; 1949, Comedero lagoon, Paraense, W. L. leg. **Santa Fé Province**. **MNHNM 5065**, Don Pepe stream, 20/10/1960, Olazarri, J. & Bonetto, A. leg.; Garay Dept. **MACN 4445**, Helvecia, 15/10/1979.

Measurements **FIOCRUZ 1822**: N= 8; TL: 7.65–9.95 (mean: 8.44); TW: 3.90–5.50 (mean: 4. 51); H: 1.10–1.75 (mean: 1.39). **FIOCRUZ 1835**: N= 13; TL: 5.70–10.40 (mean: 8.67); TW: 3.70–5.85 (mean: 4.73); H: 1.00–1.85 (mean: 1.47). **FIOCRUZ 1952**: N= 75; TL: 5.45–12.75 (mean: 8.8); TW: 2.75–6.75 (mean: 4.36); H: 1.25–2.90 (mean: 2.04).

Shell (Fig. 9) Oval elongated, depressed, almost flat, three times longer than wide; anterior portion wider than posterior. Apex almost flat, obtuse, rounded, near the mid-line. Protoconch sculpture with small shallow central depression surrounded by a smooth area (radius about 330 µm), with scarce delicate radial striations not visible under the optical microscope, without pits or similar structures. Teleoconch sculpture of numerous, concentric, thin, irregularly spaced growth lines. Periostracal hairs absent.

External morphology (Fig. 3e) Mantle surface scarcely pigmented, pigmentation concentrated as small dark spots on the right side, one between the anterior muscle scars and the other near the left posterior muscle; others very small are seen at lateral margins of mantle. In some specimens the pigmentation is concentrated over the middle portion. The three muscle scars are rounded,

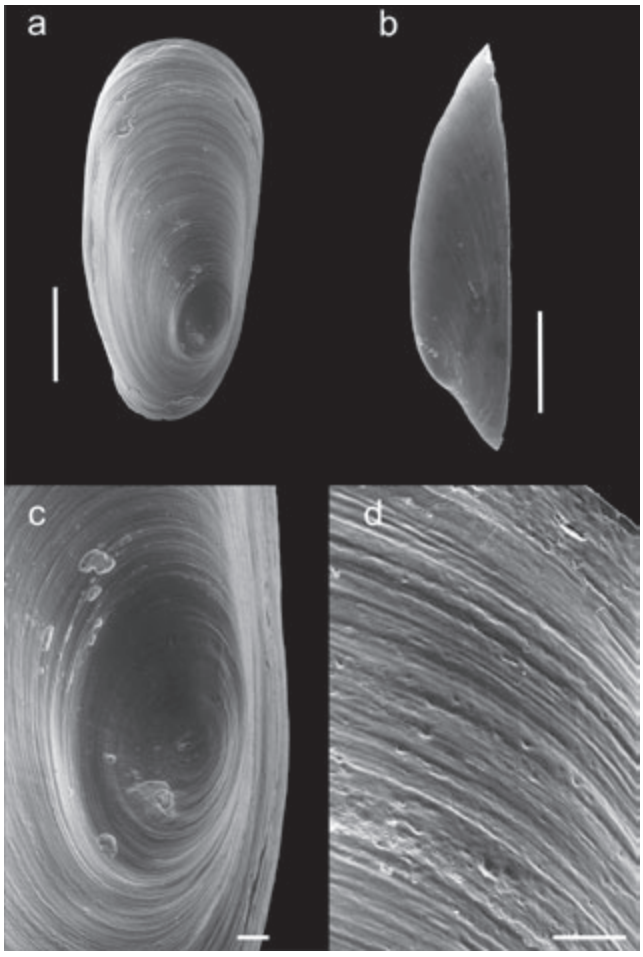

Figure 9 *Hebetancylus moricandi* shell. **a** Dorsal view. **b** Lateral view. **c** Protoconch showing the absence of sculpture. **d** Teleoconch sculpture. Scale bars a, b=1000 µm; c, d=100 µm.

similar in size with the right anterior muscle somewhat elliptical.

Radula (Fig. 10a–c) Rachidian tooth with five cusps, with one strongly asymmetric, main cusp; the first right accessory cusp is bigger than the right main cusp; the first left accessory cusp is the same size of the right main cusp; the outer accessory cusps are almost one third the size of the right main cusp. Basal plate rectangular, longer than wide, inverted V shaped (Fig. 10a). Lateral teeth with three main wide cusps of similar shape and size; accessory tiny thin cusp between endocone-mesocone and mesocone-ectocone; two small, curved cusps on the outer side of lateral teeth; basal plate oblique (Fig. 10b). Marginal teeth multicuspid, from ten to thirteen thin cusps; the inner six to seven cusps are bigger than the subsequent teeth; teeth size decreases towards radula margin, but the sixth-seventh teeth are always the most prominent and blunt-ended; basal plate square (Fig. 10c).

Distribution in Argentina and habitat (Fig. 5a, c) *Hebetancylus moricandi* inhabits Northeastern Argentina (Chaco, Corrientes, Entre Ríos, Formosa and Santa Fé provinces), Buenos Aires, Salta and Jujuy provinces (Fig. 1a). This species is frequently found in lotic environments of rivers and streams from mountain and plain regions. Most numerous records are from the Humid Chaco and Humid Pampas ecoregions followed by those from the dry Espinal ecoregion. The specimens collected by Dr. Lobato Paraense were from the Southern Andean Yungas and Central Andean Puna ecoregions (Fig. 5c).

Remarks Argentinean specimens of *H. moricandi* show the same morphology described by Lanzer (1996) and Santos (2003). The shell morphology is similar in shape to some specimens of *Gundlachia radiata*, but they differ in shell sculpture. The protoconch of *Gundlachia radiata* shows a smooth area followed by numerous small pits while in *H. moricandi* the pits are absent. In *G. radiata* the teleoconch radial lines are well marked, whereas in *H. moricandi* the teleoconch lacks radial lines.

Dr. Lobato Paraense collected this species in Salta and Jujuy provinces, but the exhaustive field works made in these areas did not provide any new records for this species.

Genus ***Uncancylus*** Pilsbry, 1913

Ancylus Müller, 1774: 199 –d'Orbigny, 1835: 24–Pilsbry, 1897: 298. [partim].
Uncancylus Pilsbry, 1913: 670.
Ancylastrum (*Uncancylus*)–Thiele, 1931–Zilch, (1959–1960): 127.
Gundlachia (*Uncancylus*) Hubendick, 1964: 63.
Uncancylus–Fernández, 1981: 105–Santos, 2003: 212–Rumi *et al.*, 2008: 83–Santos *et al.*, 2009: 513.

Type species *Ancylus barilensis* Moricand, 1845 by original designation.

Type locality Bahia, Brazil

Generic diagnosis Apex projected, acute, pointed, flexed to right and curved backwards. Protoconch with numerous shallow pits around a well-marked central depression, crossed by radial grooves, more evident near margin of

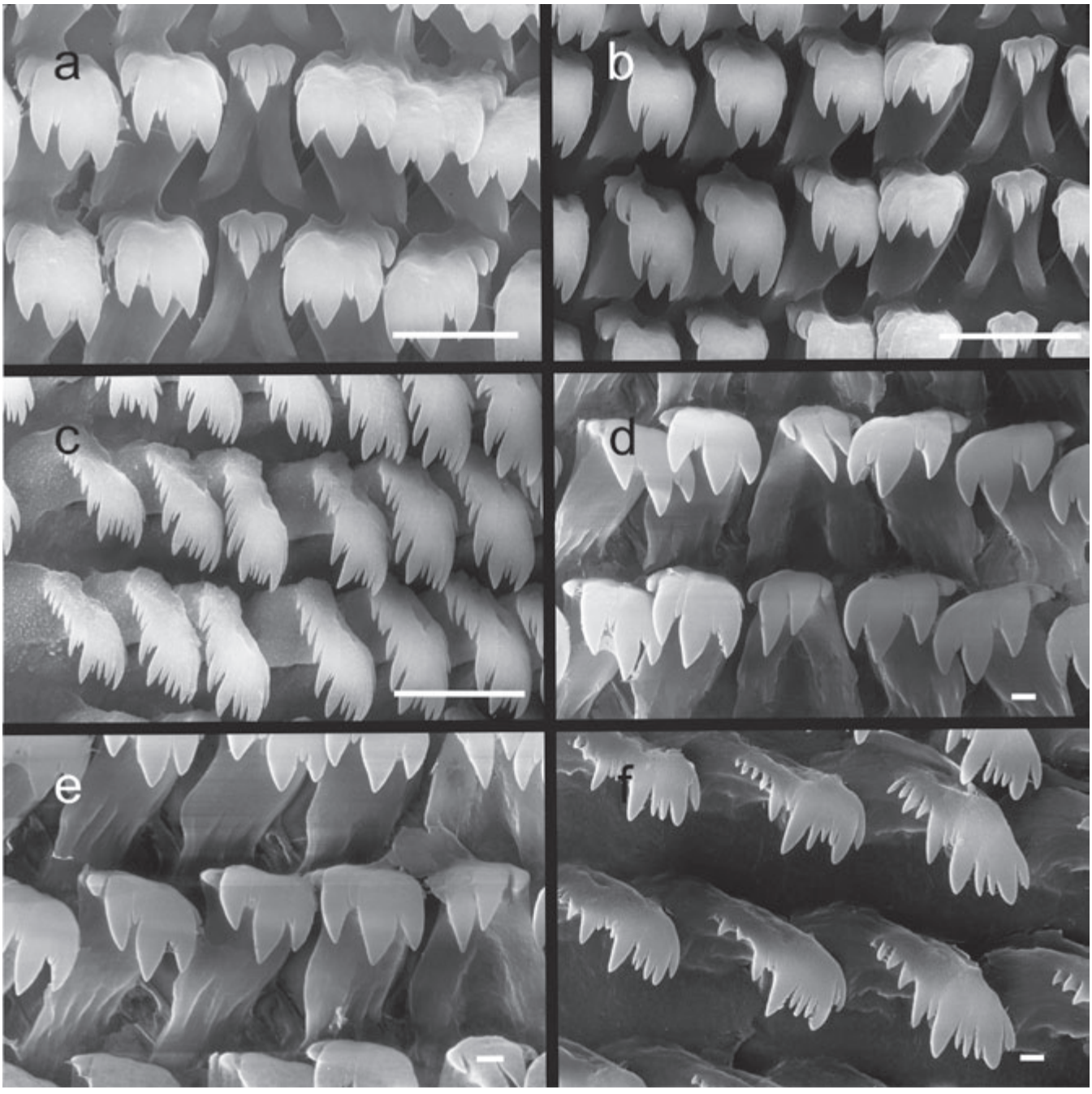

Figure 10 Radula of Ancylinae species. **a–c** *Hebetancylus moricandi*, **a, b** rachidian tooth and first lateral teeth, **c** marginal teeth. **d–f** *Uncancylus concentricus*, **d, e** rachidian tooth and first lateral teeth, **f** marginal teeth. Scale bars =1 μm.

protoconch. Teleoconch with distinct radial grooves, concentric lines and periostracal hairs. Right anterior muscle scar transversely elongated; left muscle scar oval and left posterior scar elliptical.

Uncancylus concentricus (d'Orbigny, 1835)

Ancylus concentricus d'Orbigny, 1835: 24–d'Orbigny, 1837: 354.
Ancylus barilensis Moricand, 1845: 159.
Ancylus plagioxus Bourguignat, 1862: 217.
Ancylus concentricus bonariensis Strobel, 1874: 51.
Ancylus rushi Pilsbry, 1897: 298.
Ancylus uncinatus Ancey, 1897: 21.
Uncancylus ameliae Pilsbry, 1920: 9.
Uncancylus calverti Pilsbly, 1920: 7.
Ancylus patagonicus Biese, 1948: 235.
Hebetancylus concentricus Pilsbry, 1913: 65.

Gundlachia concentrica–Hubendick, 1964: 30–Hubendick, 1967: 39–Lanzer, 1994: 27–Castellanos & Miquel, 1991:11, fig 5–Castellanos & Landoni, 1995: 777–Lanzer, 1996: 198–Ohlweiler & Veitenheimer-Mendes, 1995: 575.
Uncancylus concentricus–Wurtz, 1951: 129–Fernández, 1981:106–Santos, 2003: 213–Gómez *et al*., 2004: 440–Gutiérrez Gregoric, 2006: 57–Rumi *et al*., 2006: 207–Rumi *et al*., 2008: 83–Santos *et al*., 2009: 514–Núñez *et al*., 2010: 52–Martín & Díaz, 2012: 65.

Type material Syntypes (NHMUK 1854.12.4.279) 15 specimens.

Type Locality "…Montevideo (republica Uruguayensi orientali)." (d'Orbigny, 1835). Later, d'Orbigny (1837) adds this following information: "… Montevideo, de l´autre côté du port, aux sources d´un ruisseau qui se jette á la mer prés de l´ile aux Rats…".

Derivation of name probably in reference to concentric lines on the shell surface.

Material examined **Buenos Aires Province**. **MACN 10207-b**, Río Santiago, 29/10/1919, Doello Jurado leg. **MACN 10276**, Mar del Plata, Dubois, L. A. leg. **MACN 11559**, Tapalqué stream, 30/08/1920, Rsaglievisch, L. leg. **MACN 11835 b**, Atalaya, 18/09/1920, Doello Jurado, M. Leg. **MACN 12133**, Olivos, 15/05/1921, Doello Jurado, M. leg. **MACN 14824**, Quequén river, La Dulce, 12/1924, Doello Jurado leg.; **MACN 14861**, Las Rosas, December 1923, Doello Jurado, M. Leg. **MACN 18633**, Vital stream, 12/1959, Gándara, F.C.S. leg. **MACN 28692**, San Fernando, 11/11/1929, Doello Jurado, M. leg. **MACN 20087**, stream from Estancia Gómez Saravia, near to La Plata, November 1931, Pazzi, A. leg. **MACN 28688**, Esperanza. **MACN 28690**, Punta Lara, 11/1931. **MACN 28691**, del Gato stream, 1931, Castellanos & Daguere leg.; **MACN 29362**, Laguna de Monte, 7/10/1965, Paraense, L. W. leg. **MACN 37801**, stream near to Primera Conscripción monolith, 08/11/2008, Bonard, A. leg. **MLP 4541**, Cabaña, August 1950, Birabén, M. leg. **MACN 4533,** Arroyo Matos, La Mendieta, 29/11/1950, Birabén, M. col. **MACN 4548**, Quequén river, 1969, Balech leg. **MLP 4555**, Laguna de Monte. **FIOCRUZ 1868**, Lisandro Olmos, Paraense, W.L. leg. **FIOCRUZ 1880**, Vala Rosa, Paraense, W. L. leg. **FIOCRUZ 1884**, Videla stream, Paraense, W. L. leg. **FIOCRUZ 1887**, Segundo Brazo de los Tres Arroyos, Paraense,W. L. leg. **FIOCRUZ 1196**, Ezeiza, Paraense, W. L. leg. **FIOCRUZ 1199**, Belgrano park, Paraense, W. L. leg. **FIOCRUZ 1202**, Sarandi stream, San Isidro, Paraense, W. L. leg. **FIOCRUZ 1208**, del Monte lagoon, San Miguel del Monte, Paraense, W. L. leg. **FIOCRUZ 1840**, San Nicolás de los Arroyos, Paraense, W. L. leg. **Chaco Province**. **MLP 7345**, Resistencia Dept, "Chaco Golf Club" lagoon, 17/07/2000, Gutiérrez, D. & Roche. leg. **Entre Ríos Province**. **MACN 4531**, Santo Tomé, Hylton Scott, M. I. leg. **MLP 4540**, Santo Tomé, 06/11/1948, Birabén, M. leg. **MACN 19633**, Santo Tomé Dept, Paranacito, 10/11/1931, Daguerre, J. B. leg. **Formosa Province**. **MLP 4567**, Paraguay river, 03/12/1954, Biraben, M. leg. **Jujuy Province**. **IFML 15293**, Zapla river, Palpalá, stream that flows into river, 24º16'03'' S, 65º07'10'' W, 1940 m, 31/05/2000, Cuezzo, M. G. Leg. **IFML 16406**,Palpalá Dept., Route 56 to San Pedro de Jujuy, 24º16'03´´ S 65º07'09´´ W, 965 m, 22/03/1999, Cuezzo, M. G. Leg. **IFML 16408**, stream that flows into Zapla, 24º10'1.8'' S, 65º07'12.5'' W, 700 m, 09/05/2009, Ovando, X. leg. **Misiones Province**. **MLP 7342,** San Javier, marshe outside the Uruguay river, 15/09/2002, Rumi, A. & Gutiérrez, D. leg. **Río Negro Province**. **MLP 4535**, General Roca, October 1964, Bachmann, A. Leg. **Salta Province**. Anta Dept. **IFML 15295**, El Rey National Park, La Escondida lagoon, 24º42'15'' S, 64º39'06,8'' W, 925 m, 19/03/2009, Pero, E.; Cuezzo, M. G.; Nieto, C. & Ovando, X. leg. **IFML 12297**, El Rey National Park, Pozo del anillo pond, S 24º42'32,5'' W 64º38'47,9'', 933 m, 19/03/2009, Pero, E.; Cuezzo, M. G. & Ovando, X. leg. **MLP 4563**, Oran Dept., 8/12/1950. **MLP 11917**, Charco al costado del Corral de Piedras river, S 22º57'32'' W 64º 33'19'', 11/11/2004, Ituarte, C. leg. **FIOCRUZ 1945**, El Tala stream, Paraense, W. L leg. **MLP 5327**, El Tala, El Tala stream, 21/11/1996, Ituarte, C. leg. **Tucumán Province**. Capital Dept. **IFML 16281**, IML garden, 430 m, 05/05/1967, Weyrauch, W. leg. **IFML 16280**, IML garden, 430 m, 05/05/1967, Weyrauch, W. leg. **IFML 16279**, on the way to Famaillá, 21/10/1967, Weyrauch, W. leg. **FIOCRUZ 1938**, Arroyo Calimayo, Paraense, W. L. leg. **FIOCRUZ 1943**, San Miguel lake, 9 de Julio Park, 04/05/1973, Paraense, W. L. leg. Trancas Dept. **IFML 16411**, Cross Route 9 and entering to Trancas, 26º11'28.8'' S, 65º17'1.8'' W,

915 m, 12/03/2009, Cuezzo, M. G. & Ovando, X. leg. **IFML 16410**, Pozo del Pescado, 26º11'27.9'' S, 65º17'19.7'' W, 788 m, 26/05/2009, Ovando, X. & Powell, P. leg.

Measurements **IFML 16406**, N=8; TL: 6.7–4.6 (mean: 5.28); TW: 3.3–2.9 (mean: 3.1); H: 1.5–1.2 (mean: 1.31). **IFML 15295**: N= 6; TL: 4.5–3.8 (mean: 4.23); TW: 2.7–2.2 (mean: 2.53); H: 1.4–1.1 (mean: 1.26). **IFML 15293**: N=10; TL: 8.0–6.1 (mean: 6.71); TW: 4.5–3.5 (mean: 4); H: 2.0–1.6 (mean: 1.7). **MACN 18633**: N=8; TL: 11.1–8.9 (mean: 10.1); TW: 6.5–4.9 (mean: 5.5); H: 3.2–2.6 (mean: 2.7). **MACN 17328**: N=3; TL: 6.3–4.4 (mean: 5.6); H: 1.5–1.3 (mean: 1.4). **MACN 20087**: N=10; TL: 9.1–6.2 (mean: 7.16); TW: 5.2–3.5 (mean: 4.17); H: 2.7–2.0 (mean: 2.2).

Diagnosis Shell oval, thin, colourless, periostracum yellowish to brown. Apex thin, acute, curved downwards, with a small dorsal flattening. Apical sculpture with faint pits irregularly arranged. Right muscle scar moon-shaped.

Shell (Fig. 11) Elevated, oval-elongated. Apex thin, acute, rounded end, curved down as a hook, located on posterior right quadrant of the shell without projecting over the edge. Protoconch sculpture with a tiny, deep, central depression followed by a smooth area (radius about 30 µm), continuing in an area of numerous irregular pits, crossed by circular growth lines. Teleoconch sculpture with growth lines crossed by closely spaced radial grooves, more prominent near the shell apex, arranged over the whole teleoconch surface. Periostracal hairs, small, thin, numerous, located on radial grooves.

External morphology (Fig. 3f) Mantle surface with many dark spots, variable in size and shape, and randomly located on the mantle surface; a bigger spot is present on the posterior region. Right anterior muscle scar arched, moon-shaped, while the left anterior and left posterior muscle scars are elliptical.

Radula (Fig. 10d–f) Rachidian tooth asymmetric, with two main thin cusps, sharply pointed; two accessory lateral cusps on each side of the main cusps. Basal plate of rachidian tooth slender, trapezoidal, insertion region divided in two portions forming an inverted V (Fig. 10d). Lateral tooth with ectocone and endocone similar in shape and size, smaller than mesocone; mesocone as long as wide, sharply pointed. An accessory cusp between mesocone-endocone and mesocone-ectocone; two smaller but strongly hooked cusps are present beside ectocone, transversely positioned in relation to the three main cusps. Basal plate of lateral tooth slender, thin, almost rectangular, obliquely inserted (Fig. 10e). Marginal teeth multicuspid (ten to twelve cusps), pectiniform; external cusps of marginal teeth smaller than inner cusps; basal plate wider than long, in same plane of tooth (Fig. 10f).

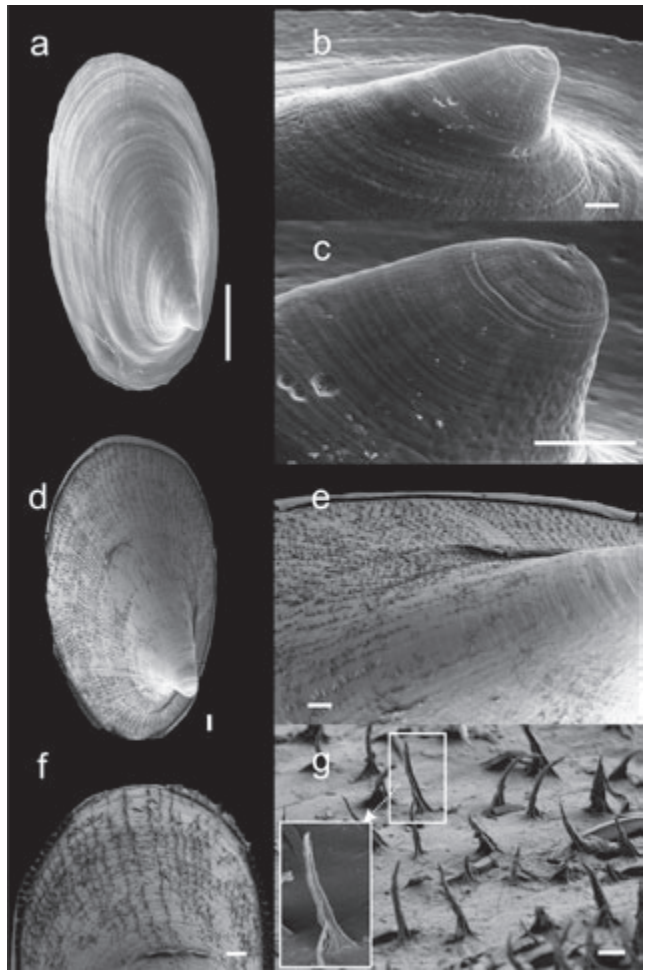

Figure 11 *Uncancylus concentricus* shell. **a** Dorsal view of a shell without periostracum. **b** Protoconch in lateral view showing the sculpture. **c** Detail of protoconch sculpture. **d** Dorsal view of a shell with periostracum showing the arrangement of periostacal hairs. **e–f** Same shell showing the periostracal hairs on the right side and anterior region. **g** Detail of periostracal hairs. Scale bars a=200 µm; b, c=100 µm; d=10 µm; e, f=2 µm.

Distribution in Argentina and habitat (Fig. 5a, c) Chaco, Entre Ríos, Formosa, Buenos Aires, Salta, Tucumán and Rio Negro provinces (Fig. 5a).

Uncancylus concentricus was taken from both lotic (sandy substrate) and lentic environments (muddy substrate) frequently attached to fallen leaves. This species has a wide distribution and is abundant not only in the humid environments of Humid Pampas, Humid Chaco and Southern Andean Yungas forests but also in the transitional dryer forests of Dry Chaco and Espinal (Fig. 5c).

Remarks Of all the freshwater limpets *U. concentricus* is one of the easiest to identify due to its hooked shell apex and well-marked radial sculpture. The morphology of Argentinean specimens agrees with that described by Lanzer (1996), Santos (2003) and Santos *et al*. (2009). Periostracal hairs were detected only in specimens where the periostracum was not eroded and they were located on radial wrinkles of the teleoconch. The periostracal hairs are more prominent on the anterior and posterior sides in juvenile specimens. According to Hubendick (1967) these structures are present only in *U. concentricus* while Santos (2003) considers the periostracal hairs as diagnostic characters of genus *Uncancylus* and present in the other co-generic species.

DISCUSSION

From the taxonomic revision, six genera of Ancylinae are recognised to be present in Argentina. On the basis of general shell morphology three groups are proposed:

1. those with the shell apex on the anterior region of the shell and restricted to the apparently endemic genus *Sineancylus*
2. those with an elevated shell (*Gundlachia*, *Uncancylus*, *Anisancylus*)
3. those with flattened shells (*Hebetancylus*, *Ferrissia*).

The second and third groups show the typical shell morphology of Ancylinae where the apex is posteriorly placed and slightly inclined to right side.

The apex morphology, muscles scars and adhesive areas allow the identification of genera and species. The genus *Gundlachia* and *Anisancylus* shows a prominent rounded apex, but this is never curved down as in *Uncancylus* whereas in *Hebetancylus* and *Ferrissia* the apex is obtuse almost flattened. In accordance with Burch & LoVerde (1974) and Lanzer (1996), we found that both the apex shell morphology and sculpture are diagnostic characters for Ancylinae species. *Hebetancylus moricandi*, *Gundlachia radiata* and *G. ticaga* show similar general shell morphology but differ from each other in apex sculpture and muscle scars morphology, in *Gundlachia radiata* and *G. ticaga* in the protoconch sculpture distinguishes a smooth and followed by other with pits while in *H. moricandi* the apex is smooth. *Anisancylus obliquus* presents numerous pits crossed by radial grooves on all apical protoconch surface whereas in *Ferrissia irrorata* exhibits radial wrinkles parallel to each other. All species showed a small central depression in the apex shell although it varies in diameter and depth.

In *Gundlachia radiata* and *G. ticaga* anterior muscle scars are elliptical; the right is larger than the left with a curvature on its inner portion contrary to *H. moricandi* where all muscle scars have similar shape and size. Right anterior muscle scar is elongated in *A. obliquus* and *Uncancylus concentricus* with an adhesive area in V shape between the anterior muscle scars. From the total species studied, *Anisancylus obliquus* was the only with small adhesive areas between right anterior and left posterior muscle scars. According to Santos (2003) other Ancylinae species such as *Anisancylus dutrae* (Santos, 1994) and *Laevapex fuscus* (Adams, 1841) have also small adhesive areas. In the past these areas were used by Burch (1962) to separate the subfamily Laevapecinae with three muscular scars and small between the muscles mentioned above. Also, the morphology of muscle scars differentiates Ancylinae from other freshwater limpet taxa, such as Acroloxidae. In the latter, the posterior adductor is located on right side of the longitudinal body axis (Shirokaya & Röpstor, 2004) is elongated or in C shape, reaching the middle of mantle length or well is located parallel to the end edge of foot (Hubendick, 1962). In most Ancylinae species, except *Sineancylus rosanae*, the posterior adductor muscle is always located on the left side. *Sineancylus rosanae* is the great exception among Ancylinae due to the posterior muscle being situated on the longitudinal body axis but otherwise showing the typical sinistral anatomy of Ancylinae; a similar pattern has been described in some Baikalan Acroloxids (Shirokaya & Röpstor, 2004).

The radula of most Argentinean species has an asymmetrical rachidian tooth with a variable number cusps, and the basal plate varies from rectangular (*A. obliquus* and *H. moricandi*)

to trapezoid (*Ferrissia irrorata*, *Gundlachia radiata*, *G. ticaga* and *U. concentricus*). On the contrary, following the description provided by Gutierrez Gregoric (2012) in *Sineancylus rosanae* the rachidian tooth is poorly developed and has only three cusps on the left side, while the shape of the marginal teeth do not resemble any of the known species of Ancylinae.

Concerning the distribution of Ancylinae in Argentina, many authors (Fernández, 1981; Rumi *et al*., 2008; Núñez *et al*., 2010) cited *H. moricandi* for Northwestern Argentina and there exists material in museums identified as *H. moricandi*. Nevertheless, intensive fieldwork carried out in this area could not detect live specimens or shells to confirm the validity of records from the Northwestern Argentina. Instead, *Gundlachia radiata* was found in the Northwest region and these records are the first for Argentina (Ovando *et al*., 2011). Now, we report the first record of *G. radiata* in Northeastern Argentina (Corrientes province). These new records of *G. radiata* and *G. ticaga* enhance the data on the distribution of these species considered to have a restricted distribution in Argentina.

The Ancylinae are distributed in Argentina within a latitudinal and longitudinal range 22º29'43.03''–40°55'08.2''S and 53º52'03.34''–71º11'52.35''W. The southernmost occurrence is in the southwest of Rio Negro province. Previously, Ancylinae species has been recorded in Santa Cruz province by Castellanos & Miquel (1991) (without specifying exact locality). Despite the exhaustive research in malacological collections, we were unable to find any material and therefore could not verify these records.

Uncancylus concentricus is widely distributed and present in eight of the seventeen ecoregions with numerous records. This is followed by *Hebetancylu*s with records concentrated in northern Argentina. *Sineancylus* is restricted to few localities in the Paranaense ecoregion (Misiones province). *Hebetancylus moricandi* has the northernmost record in Argentina while *Anisancylus obliquus* has the southernmost. While *H. moricandi* can be found in both lotic and lentic environments, *A. obliquus* is typical from lotic environments similar to habitats for *Sineancylus*. *Anisancylus obliquus* shows disjunctive areas of distribution, the first one is located in Córdoba province while the second is located on the southwestern border of Río Negro and Neuquén provinces. *Ferrissia irrorata*, a species originally described by Saint Vincent (Lesser Antilles), is now recorded for the first time in the northwestern region (Tucumán province). It is documented that some aquatic molluscs are dispersed by winged vectors such as water birds and insects (Kappes & Haase, 2012). Johnson (1904) suggested that insects play an important role in the local dispersal of molluscs. *Laevapex fuscus* (Adams, 1841) and *Ferrissia parallelus* (Haldemann, 1841) have been found attached to the elytra of water beetles of genus *Dytiscus* (Dytiscidae) (Johnson, 1904; Rosewater, 1970). Bird-mediated transport is another important mechanism in the distribution of many invertebrates (Green & Figuerola, 2005). Similar to the proposal of Raposeiro *et al*. (2011), we suggest, as a possible pathway for arrival of *F. irrorata* to Tucumán province, neartic and neotropical migratory birds such as Buff-breasted Sandpiper (*Tryngites subruficollis*), White-faced Whistling Duck (*Dendrocygna viduata*) and Rosy-billed Pochard (*Netta peposaca*). In spring, Buff-breasted Sandpipers migrate from North America to South America through the Central Amazonia flyway whereas the White-faced Whistling Duck and Rosy-billed Pochard migrate within the neotropical region.

Finally, we propose that morphological characters such as apex morphology and sculpture together with the muscle scars and rachidian tooth morphologies are diagnostic to identify genera and species of Ancylinae. It is necessary to continue with the comparative anatomical studies including other neotropical taxa together with molecular studies to resolve the phylogenetic relationships this group.

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REFERENCES

ALBRECHT C, KHUN K & STREIT B 2007 A molecular phylogeny of Planorbidea (Gastropoda: Pulmonata): insights from enhanced taxon sampling. *Zoologia Scripta* **36**(1): 27–39.

ANCEY MCF 1897 Viaggio del Dott. Alfredo Borelli nel Chaco boliviano e nella Repubblica Argentina. XI. Resultats malacologiques accompagnées d'une notice sur les espèces précédemment recueillis par ce voyageur. *Bolletino dei Musei di Zoologia ed Anatomia comparata della Reale Università di Torino* **12**:1–22.

ANCEY MCF 1901 Notes sur divers mollusques de L'Amérique du Sud accompagnées de descriptions d'espéces nouvelles**.** *Le Naturaliste* **23**: 103–104.

BASCH PF 1963 A review of the recent freshwater limpet snails of North America *Bulletin of the Museum of Comparative Zoology at Harvard College*. **129**: 401–461.

BIESE WA 1948 Revisión de los moluscos terrestres y de agua dulce provistos de concha do Chile. *Boletín do Museo Nacional de Historia Natural de Chile* **24**: 217–239.

BOSS KJ 1982 Mollusca. *In* S. P. Parker (ed.) *Synopsis and Classification of Living Organisms* 945–1166, McGraw Hill, New York.

BOUCHET P & ROCROI JP 2005 Classification and nomenclator of gastropod families. *Malacologia* **47**: 1–397.

BOURGUIGNAT J 1853 Descriptions d' Ancyles nouveaux, de la collection de M. Cuming, précédes d'une courte notice sur le genre *Ancylus*, et d'un catalogue complet des espèces qui le composent. *Proceedings of the Zoological Society of London* **21**: 76–93.

BOURGUIGNAT JR 1862 Étude synonymique sur le genre *Ancylus*. *In* Bourguignat JR *Les specileges malacologiques* 139–263, Bailliers et Fils, Paris.

BRODERIP WP & SOWERBY GB 1832 Characters of new species of Mollusca and Conchifera, collected by Mr. Cuming. *Proceedings of the Committee of Science and Correspondence of the Zoological Society of London* **2**: 194–202.

BROWN AD, MARTINEZ ORTIZ U, ACERBI M & CORCUERA A 2006 *La situación ambiental de la Argentina 2005*. Fundación Vida Silvestre, Buenos Aires, Argentina 587 pp.

BURCH JB 1962 Notes on the classification of freshwater limpets. *Annual Report of the American Malacological Union* **1962**: 8–9.

BURCH JB 1982 North American freshwater snails: identification keys, generic synonymy, supplemental notes, glossary, references, index. *Walkerana* **4**: 1–365.

BURCH JB & LO VERDE PT 1974 Apical shell sculpture of some North American freshwater limpets (Gastropoda: Basommatophora). *Occasional Papers on Mollusks, Harvard* **4**: 39–49.

CASTELLANOS ZA 1982 Estado actual de Ancylidae neotropicales. *Neotropica* **28**: 101–102.

CASTELLANOS ZA & LANDONI N 1995 Mollusca Pelecypoda y Gastropoda *In* C. Lopretto & G. Tell (eds.) *Ecosistemas de aguas continentales. Metodologías para su estudio*, Ediciones Sur, La Plata **2**: 759–801, Argentina.

CASTELLANOS ZA & MIQUEL SE 1991 Distribución de los Pulmonata Basommatophora. *Fauna de Agua Dulce de la República Argentina*, 15(9): 3–11. PROFADU (CONICET), Buenos Aires.

DARRIGRAN G & LAGRECA M 2005 *Moluscos litorales del estuario del Río de la Plata*. Probiota, FCNy M, UNLP serie técnica didáctica **8**: 41 pp.

D'ORBIGNY A 1835 Sinopsis terrestrium et fluviatilium molluscorum, in suo per American Meridionalem itinere collectorum. *Magazín de Zoologie* **5**(61–62): 1–44.

D'ORBIGNY A 1837–1841 Pulmonés Aquatiques. *Voyage dans L' Amerique Meridionale*, A. Bertrand, Paris 5(3): 758p.

FERNÁNDEZ D 1981 Mollusca Gastropoda Ancylidae. *Fauna de Agua Dulce de la República Argentina* **15**(7): 99–1014. PROFADU (CONICET), Buenos Aires.

GÓMEZ MI, SANTOS SB & ROLÁN G 2004 Ancylidae from the Department of Antioquia–Colombia, with new records (Pulmonata, Basommatophora). *Caldasia* **26**(2):439–443.

GREEN AJ & FIGUEROLA J 2005 Recent advances in the study of long distance dispersal of aquatic invertebrates via birds. *Diversity and Distributions* **11**: 149–156.

GUILDING L 1828 Observations on the zoology of the Caribbean Islands. *Zoological Journal* **3**: 527–544.

GUTIÉRREZ GREGORIC DE, NÚÑEZ V, RUMI A & ROCHE MA 2006 Freshwater gastropods from the Plata Basin, Argentina. Checklist and new locality records. *Comunicaciones de la Sociedad Malacológica del Uruguay* **9**(89): 51–60.

Gutiérrez Gregoric DE 2012 *Anancylus rosanae* (Gastropoda: Pulmonata), new genus and new species, from Iguazú National Park, Argentina. *Malacologia* **55**: 107–115.

Gutiérrez Gregoric DE 2014 *Sineancylus* nom. nov.: a replacement name for *Anancylus* Gutiérrez Gregoric, 2012 (Gastropoda, Ancylidae). *Malacologia* **57**: 243.

Harrison AD 1983 Identity of *Ferrissia irrorata* and *Gundlachia radiata*, Guilding's species of Ancylidae from St. Vincent. W. I. *Archiv für Molluskenkunde* **113**: 7–15.

Harry HW & Hubendick B 1964 The freshwater pulmonate Mollusca of Puerto Rico. *Göterborgs Kungliga Vetenkaps- och Vitterhets Samhälles Handlingar* **9**: 60–72.

Hartmann JW 1821 System der Erd- und Flußschnecken der Schweiz. Mit vergleichender Aufzählung aller auch in den benachbarten Ländern, Deutschland, Frankreich und Italien sich vorfindenden Arten. *Neue Alpina* **1**: 194–268.

Hodgson AN & Healy JM 1998 Comparative sperm morphology of the pulmonate limpets *Trimusculus costatus*, *T. reticulatus* (Trimusculidae) and *Burnupia stenochorias* and *Ancylus fluviatilis* (Ancylidae). *Journal of Molluscan Studies* **64**: 447–460.

Hubendick B 1947 Phylogenetic relations between the higher limnic Basommatophora. *Zoologische Beitrage aus Uppsala* **25**: 141–164.

Hubendick B 1955 The anatomy of the Gastropoda: The Percy Sladen trust expedition to the Lake Titicaca. *Transactions of the Linnean Society of London* **1**: 317–320.

Hubendick B 1962 Studies on *Acroloxus* (Moll. Basomm.). *Göterborgs Kungliga Vetenkaps- och Vitterhets Samhälles Handlingar* **9**(2): 5–66.

Hubendick B 1964 Studies on Ancylidae. The subgroups. *Göterborgs Kungliga Vetenkaps- och Vitterhets Samhälles Handlingar* **9B**(6): 1–72.

Hubendick H 1967 Studies on Ancylidae. The Australian, Pacific and Neotropical form groups. *Göterborgs Kungliga Vetenkaps- och Vitterhets Samhälles Handlingar Zoologisches* **1**: 1–52.

Hubendick B 1978 Systematics and comparative morphology of the Basommatophora In V. Fretter & J. Peake (eds) *Pulmonates* 2A: Systematics, Evolution and Ecology 1–47 Academic Press, London.

Hylton Scott MI 1953 Notas sobre morfología de *Gundlachia* Pfr. Ancylidae. *Physis* **20**: 467–473.

Johnson CW 1904 Ancyli adhering to water beetles. *The Nautilus* **17**:120.

Kappes H & Haase P 2012 Slow, but steady: dispersal of freshwater molluscs. *Aquatic Sciences* **74**: 1–14.

Lacerda LEM, Miyahira IC & Santos SB 2011 Shell morphology of the freshwater snail *Gundlachia ticaga* (Gastropoda, Ancylidae) from four sites in Ilha Grande, southeastern Brazil. *Zoologia* **28**(3): 334–342.

Lacerda LEM, Miyahira IC & Santos SB 2013 First record and range extension of the freshwater limpet *Gundlachia radiata* (Guilding, 1828) (Mollusca: Gastropoda: Planorbidae) from southeast Brazil. *Check List* **9**(1): 125–128.

Lanzer RM 1991 Duas novas espécies de Ancylidae (Gastropoda: Basommatophora) para o sul do Brasil. *Revista Brasileira de Biologia* **51**: 703–719.

Lanzer RM 1994 Estudo dos Ancylidae Sul americanos (Pulmonata: Basommatophora) rádula ao microscópio eletrônico de varredura. *Biociências* **2**(2): 25–38.

Lanzer RM 1996 Ancylidae (Gastropoda: Basommatophora) na América do Sul: sistemática e distribuição. *Revista Brasileira de Zoologia* **13**: 175–210.

Marcus E & Marcus E 1962 On *Uncancylus ticagus. Boletim da Faculdade de Filosofia Ciências e Letras da Universidade de São Paulo*, *Zoologia* **24**: 217–245.

Martello AM, Hepp LU & Kotzian CB 2014 Distribution and additive partitioning of diversity in freshwater mollusk communities in Southern Brazilian streams. *Revista de Biología Tropical* **62**: 33–44.

Martens FE von 1890–1901 Gastropoda Pulmonata *In* Du Cane Godman, G & Osbert, S (eds) *Biologia Centrali-Americana Land and freshwater Mollusca* **9**: 353–403 R. H. Porter, London.

Martín SM & Díaz AC 2012 Population structure of *Uncancylus concentricus* (d'Orbigny, 1835) (Ancylidae, Pulmonata, Basommatophora) in the Multiple Use Reserve Martín García Island, Upper Río de la Plata, Argentina. *Brazilian Journal of Biology* **72**(1): 65–70

Miquel SE 1988 Estudio anatomohistológico del complejo peniano de dos especies de *Gundlachia* Pfeiffer, 1849 (Mollusca, Pulmonata, Ancylidae). *Memórias Sociedad de Ciencias Naturales La Salle* **48**: 127–131.

Moricand S 1845 Troisiéme Supplément au Mémoire sur les coquiles terrestre et fluviatiles de la province de Bahia. *Memoires de la Société de physique et d'histoire naturelle de Genève* **XI**: 537–544.

Müller OF 1774 *Vermium terrestrium et fluviatilium. seu animalium infusoriorum, helminthicorum, et testaecorum, non marinorum, succincta historia. Volumen alterum*. Havniæ & Lipsiæ: Heineck & Faber, I-XXVI pp.

Núñez V, Gutiérrez Gregoric DE & Rumi A 2010 Freshwater gastropod provinces from Argentina. *Malacologia* **53**: 47–60.

Ohlweiler FP & Lanzer RM 1993 Morfologia da concha, rádula e mandíbula de *Gundlachia obliqua* (Broderip & Sowerby, 1832) como uma contribuição à sistemática de Ancylidae. *Biociências* **1**: 121–149.

Ohlweiler FP & Veitenheimer-Mendes IL 1995 Sistema reprodutor de *Gundlachia concentrica* (Orbigny) e *Gundlachia moricandi* (Orbigny), como subsidio para a taxonomia de Ancylidae (Mollusca, Gastropoda, Pulmonata). *Revista Brasileira de Zoologia*, **12**(3): 575–578.

Olson DM, Dinerstein E, Wikramanayake ED, Burgess Nd; Powell GVN, Underwood EC, D'amico JA, Itoua I, Strand HE, Morrison JC, Loucks CJ, Allnutt TF, Ricketts TH, Kura Y, Lamoreux JF, Wettengel WWW, Hedao P & Kassem KR 2001

Terrestrial ecoregions of the world: A new map of life on earth. *BioScience* **51**(11): 933–938.

OVANDO XMC, LACERDA LEM & SANTOS SB 2011 Mollusca, Gastropoda, Heterobranchia, Ancylidae, *Gundlachia radiata* (Guilding, 1828): First record of occurrence for the Northwestern region of Argentina. *Check List* **7**(3): 263–266.

OVANDO XMC & SANTOS SB 2011. Ancylidae en el noroeste argentino: revisión sistemática y distribución. Libro de Resúmenes del VIII Congreso Latinoamericano de Malacologia. Puerto Madryn, Chubut pp.226.

PELSENEER P 1901 Études sur des gastropodes pulmonés. *Memoires de la Academie Royal de Belgique* **59**: 1–76.

PFEIFFER L 1839 Bericht über die Ergebnisse meiner Reise nach Cuba im winter 1838–1839. *Archiv für Naturgeschichte* **5**: 346–358.

PFEIFFER L 1849 Neue Molluskengattungen. *Zeistschrift für Malakozoologie* **6**: 97–105.

PILSBRY HA 1897 New species of mollusks from Uruguay. *Proceedings of the Academy of Natural Sciences of Philadelphia* **49**: 290–298.

PILSBRY HA 1913 Notes on *Gundlachia* Pfr. Appendix to Fred Baker's paper on the land and fresh-water mollusks of the Stanford Expedition to Brazil. *Proceedings of the Academy of Natural Sciences of Philadelphia* **65**: 668–671.

PILSBRY HA 1924 South American land and freshwater mollusks. Notes and descriptions. II- The South American genera of Ancylidae. *Proceedings of the Academy of Natural Sciences of Philadelphia* **76**: 54–59.

POINTIER JP 2008 *Guide to the freshwater molluscs of the Lesser Antilles*. ConchBooks, Hackenheim: 125 pp.

RAPOSEIRO PM, COSTA AC & FRIAS MARTINS A 2011 On the presence, distribution and habitat of the alien freshwater snail *Ferrissia fragilis* (Tryon, 1863) (Gastropoda: Planorbidae) in the oceanic islands of the Azores. *Aquatic Invasions* 6(1): 13–17.

ROSEWATER J 1970 Another record of insect dispersal of an ancylid snail. *The Nautilus* **83**: 144–145.

RUMI A, GUTIÉRREZ GREGORIC DE, NÚÑEZ V, CESAR I, ROCHE A, TASSARA M, MARTÍN SM & LÓPEZ ARMENGOL MF 2006 Freshwater gastropoda from Argentina: species richness, distribution patterns and evaluation of endangered species. *Malacologia* 49(1): 189–208.

RUMI A, GUTIÉRREZ GREGORIC DE, NÚÑEZ V & DARRIGRAN GA 2008 Malacología latinoamericana. Moluscos de agua dulce de la República Argentina. *Revista de Biología Tropical* 56(1): 77–111.

SANTOS SB 1994 *Gundlachia dutrae* n. sp. from northeastern Brazil (Mollusca: Basommatophora: Ancylidae). *Memórias do Instituto Oswaldo Cruz* **89**: 153–160.

SANTOS SB 2000 Morfologia do sistema muscular e do sistema reprodutor de *Anisancylus obliquus* (Broderip & Sowerby) do Chile, como contribuição à sistemática de Ancylidae (Gastropoda, Pulmonata, Basommatophora). *Revista Brasileira de Zoologia* 17(4): 996–1006.

SANTOS SB 2003 Estado atual do conhecimento dos ancilídeos na América do Sul. (Mollusca, Gastropoda, Pulmonata, Basommatophora). *Revista de Biología Tropical* 50(3): 191–224.

SANTOS SB, LACERDA LEM & MIYAHIRA IC 2009 *Uncancylus concentricus* (Mollusca, Gastropoda, Ancylidae): New occurrence in state of Rio de Janeiro, Brazil. *Check List* 5(3): 513–517.

SHIROKAYA A & RÖPSTORF P 2004 Morphology of alimentary system and shell adductor muscles in some species of endemic Baikalian Acroloxidae (Pulmonata, Basommatophora). *Ruthenica* 14(1): 57–70.

SMITH EA 1896 A list of land and freshwater Mollusca of Trinidad. *Journal of Conchology* **8**: 231–245.

SON MO 2007 North American freshwater limpet *Ferrissia fragilis* (Tryon, 1863) (Gastropoda: Planorbidae) – a cryptic invader in the Northern Black Sea Region. *Aquatic Invasions* 2(1): 55–58.

STROBEL P 1874 Materiali per una Malacostatica di terra e di acqua dolce deli' Argentina méridionale. *Biblioteca Malacologica* **4**: 42–59.

THIELE J 1931 *Handbuch der systematischen weichtierkunde.* Verlag von Gustav Fischer, Jena, 778 pp.

THIENGO SC, FERNANDEZ MA, BOAVENTURA MF, GRAULT CE, SILVA HFR, MATTOS AC & SANTOS SB 2001 Freshwater snails and schistosomiasis mansoni in the State of Rio de Janeiro, Brazil: I – Metropolitan Mesoregion. *Memórias do Instituto Oswaldo Cruz* **96**: 177–184.

THIENGO SC, FERNANDEZ MA, BOAVENTURA MF, MAGALHÃES MG & SANTOS SB 2002 Freshwater snails and schistosomiasis mansoni in the State of Rio de Janeiro, Brazil: III- Baixadas Mesoregion. *Memórias do Instituto Oswaldo Cruz* **97**: 43–46.

THIENGO SC, MATTOS AC, BOAVENTURA MF, LOUREIRO MS, SANTOS SB & FERNANDEZ MA 2004 Freshwater snails and schistosomiasis mansoni in the State of Rio de Janeiro, Brazil: V- Norte Fluminense Mesoregion. *Memórias do Instituto Oswaldo Cruz* **99**: 99–103.

THIENGO SC, SANTOS SB & FERNANDEZ MA 2005 Malacofauna límnica da área de influência do lago da usina hidrelétrica de Serra da Mesa, Goiás, Brasil. I Estudo qualitativo. *Revista Brasileira de Zoologia* 22(4): 867–874.

TIETZE E & DE FRANCESCO GD 2010 Environment significance of freshwater mollusks in the Southern Pampas, Argentina: to what detail can local environments be inferred from mollusks composition? *Hydrobiologia* **641**: 133–143.

WALKER B 1903 Notes on eastern american ancyli. *The Nautilus* **17**: 25–31.

WALKER B 1926 Notes on South African Ancylidae. *Occasional Papers of the Museum of Zoology, University of Michigan* **175**: 1–6.

WALTHER AC, TAEHWAN L, BURCH JB & FOIGHIL D 2006 *Acroloxus lacustris* is not an ancylid: A case of misidentification involving the cryptic invader *Ferrissia fragilis* (Mollusca: Pulmonata: Hygrophila). *Molecular Phylogenetics and Evolution* **39**: 271–275.

WALTHER AC, BURCH JB & FOIGHIL D 2010 Molecular phylogenetic revision of the freshwater limpet genus *Ferrissia* (Planorbidae: Ancylinae) in North America yields two species: *Ferrissia (Ferrissia) rivularis* and *Ferrissia (Kincaidilla) fragilis*. *Malacologica* **53**: 25–45.

WURTZ CB 1951 Catalogue of Ancylidae of South and Central America and the West Indies, with description of new species. *The Nautilus* **64**: 123–131.

ZILCH A 1959–1960 Ancylidae. In W.Wenz (ed) *Handbuch der Paläozoologie: Gastropoda, Euthyneura.* Gebruder Borntraeger. Berlin, **6**: 128 pp.