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First report of Euthyneura (Heterobranchia: Gastropoda) in the Early Jurassic of Southern Patagonia, Argentina

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ABSTRACT. The present paper aims at the description of two new species of Euthyneura (Heterobranchia: Gastropoda) in the Early Jurassic (early Pliensbachian) marine deposits of the Chubut Basin at southern Patagonia, Argentina. The new species *Cossmannina australis* nov. sp. and *Cylindrobullina caquelensis* nov. sp. were found at the Cerro Caquel locality located in the western slope of Sierra de Tecka and río Tecka valley. The new locality yielded the ammonite *Eoamaltheus* sp. (*E. meridianus* Hillebrandt Zone, upper part of *Ibex* Zone to *Davoei* Zone) which allowed to assign an early Pliensbachian age for the marine deposits at the studied area, providing also new evidence of the oldest record within the Early Jurassic in the Sierra de Tecka region. The new report of Euthyneura in the Chubut Basin extends the palaeobiogeographical distribution of this clade into the southern hemisphere during the earliest Pliensbachian.

Keywords: Euthyneura, Heterobranchia, Early Pliensbachian, Jurassic Chubut Basin, Patagonia.

RESUMEN. Primer registro de Euthyneura (Heterobranchia: Gastropoda) en el Jurásico temprano de la Patagonia Austral, Argentina. El presente trabajo tiene como objetivo la descripción de dos nuevas especies de Euthyneura (Heterobranchia: Gastropoda) registradas en el Jurásico temprano (Pliensbachiano temprano) de la cuenca de Chubut, en la Patagonia austral, Argentina. Las nuevas especies *Cossmannina australis* nov. sp. y *Cylindrobullina caquelensis* nov. sp. provienen de la localidad de Cerro Caquel ubicada en la ladera occidental de la Sierra de Tecka y del valle del río Tecka. En la nueva localidad también se registró el amonite *Eoamaltheus* sp. (Zona de *E. meridianus* Hillebrandt, parte superior de la Zona de *Ibex* a Zona de *Davoei*) lo que permite asignar una edad pliensbachiana temprana a los sedimentos marinos de la región, aportando asimismo nueva evidencia sobre el registro más antiguo dentro del Jurásico temprano para la Sierra de Tecka. Los nuevos hallazgos de Euthyneura en la cuenca jurásica de Chubut extienden la distribución paleobiogeográfica del grupo en el hemisferio sur durante el Pliensbachiano temprano.

Palabras clave: Euthyneura, Heterobranchia, Pliensbachiano temprano, Cuenca jurásica de Chubut, Patagonia.

1. Introduction

Updated knowledge of Early Jurassic marine gastropods from the Chubut Basin has been provided by Ferrari (2009, 2011, 2012, 2013, 2014, 2015a, b). Those contributions supplied an accurate systematic database of the gastropod taxonomic composition in the region indicating that two major taxa of gastropods are well represented in southern Patagonia, and these are Vetigastropoda and Caenogastropoda. Representatives of Euthyneura, however, have not been reported in the region so far. The Subclass Heterobranchia is one of the most diverse taxa within Gastropoda. The taxonomic position of the major clades of Heterobranchia is controversial and different proposals are found in the recent available literature (Bouchet *et al*., 2017; Kano *et al*., 2016; Dinapoli and Klussmann-Kolb, 2010; Wägele *et al*., 2008). Bouchet *et al*. (2017) grouped within Heterobranchia the Infraclass Euthyneura (Cohort Acteonimorpha) including members of the families Cylindrobullinidae Wenz, 1938 and Tubiferidae Cossmann, 1895. The phylogenetic study of Kano *et al*. (2016) which combined fossil evidence with anatomical and molecular data, showed that the stem group of Euthyneura (or "shelled opisthobranchs") first existed in the earliest Triassic (~250 Ma). This conclusion is supported by the phylogenetic analysis of Dinapoli and Klussmann-Kolb (2010), who indicated an occurrence of the Euthyneura stem line between the Middle Carboniferous and the Early Triassic and a first diversification of the clade between the Permian and the Triassic. The Early Mesozoic euthyneuran bubble snails in the extinct families Cylindrobullinidae and Tubiferidae are very similar in general shell morphology and ornamentation pattern to the extant Acteonidae and Ringiculoidea (see Kano *et al*., 2016; Ferrari and Hautmann, 2022). Thus, the common ancestor of Euthyneura might have had a thin, oval shell-shaped with a large body whorl, an elongated aperture and smooth surface with or without fine spiral cords, as is shown in early Mesozoic opisthobranchs (*e.g.*, *Cylindrobullina*, *Cossmannina*, *Conactaeon*, *Euconactaeon*, *Sinuarbullina*). Ecologically, these characters typically occur in species with an infaunal or temporarily borrowing mode of life (Ferrari and Hautmann, 2022).

The Early Jurassic Euthyneura is mainly restricted to the western Tethyan region (Gründel, 2007, 2010; Gründel *et al*., 2011; Gründel and Nützel, 1998, 2012; Nützel and Gründel, 2015) and few species of this group also occur in northern Africa (Cox, 1965; Bourrouilh, 1966). The first report of Euthyneura in the Early Jurassic of the Neuquén Basin (Argentina) has been supplied by Behrendsen (1891, 1922), Möricke (1894), Jaworski (1926), Weaver (1931) and Ferrari (2017), and it has also been reported in coeval marine deposits of Chile (Pérez, 1982; Gründel, 2001). The present paper provides the first occurrence of Euthyneura in Early Jurassic (early Pliensbachian) marine deposits of the Chubut Province. The subclass is represented in Cerro Caquel locality by two new species, namely *Cylindrobullina caquelensis* nov. sp. and *Cossmannina australis* nov. sp. The new report extends the palaeobiogeographical distribution of Euthyneura into the southern Patagonian region during the earliest Pliensbachian, suggesting the existence of a shallow marine connection between the Neuquén and Chubut basins during the earliest Jurassic, as had been previously hypothesized by Ferrari (2015b). The occurrence of the species *Eoamaltheus* sp. (*E. meridianus* Hillebrandt Zone, upper part of *Ibex* Zone to *Davoei* Zone) confirms an early Pliensbachian age for the Euthyneura-bearing deposits.

2. Geological Setting

The Early Jurassic marine sediments in the Chubut Province are exposed along a north-west to south-southeast trend between 42º30' and 44º30' S, and 69º30' and 71º W (Riccardi, 1983; Giacosa and Márquez, 2000). In the northwestern region of the Chubut Province, the Early Jurassic marine deposits crop out in the Sierra de Tecka and Tepuel regions (Fig. 1) and belong to the Lepá Formation (Rolleri, 1970; Spikermann, 1978; Turner, 1982; Gabaldón and Lizuaín, 1982; Pezzuchi and Takigawa, 1984; Vizán, 1989; Massaferro, 2001). The most important outcrops of this unit are located in the eastern slope of the Sierras de Tecka and Languiñeo, being more reduced in both margins of the Gualjaina river. In Sierra de Languiñeo and in the western slope of Sierra de Tecka, the Lepá Formation lays unconformably over late Palaeozoic rocks belonging to the Tepuel Group (Las Salinas and Moján de Hierro formations). This formation was assigned to an Early Jurassic age (Pliensbachian-Toarcian) based on *Weyla* sp., *Oxynoticeras* sp. and *Cardinia* sp. (Feruglio, 1949; Suero, 1952, in Turner, 1982; Ferrari, 2022). The

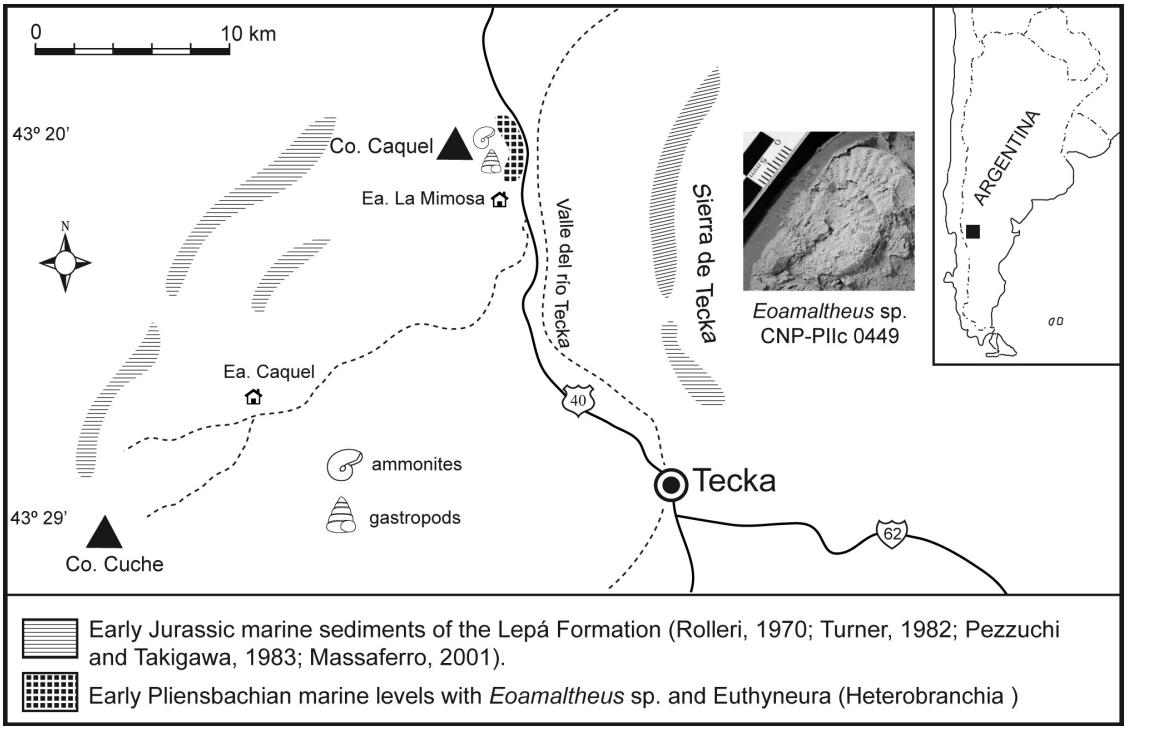

FIG. 1. Geographical map showing the northwestern region of the Chubut Province at southern Patagonia. The new Early Jurassic (earliest Pliensbachian) marine levels with Euthyneura and *Eoamaltheus* sp. are indicated in the Cerro Caquel locality (modified from Ferrari, 2022).

new euthyneuran gastropod fauna here described comes from Cerro Caquel locality situated in the western slope of Sierra de Tecka and in the western side of the río Tecka valley (Fig. 1). The species *Eoamaltheus* sp. (CNP-PIIc 0449) was also found at Cerro Caquel locality in association with the gastropod fauna. Massaferro (2001) testified the occurrence of the species *Eoamaltheus multicostatus* Hillebrandt (originally assigned to *Polymorphites* sp.) in Cerro Cuche locality which is situated very close to Cerro Caquel (Fig. 1). According to the biostratigraphic scheme proposed by Riccardi *et al*. (2011), the presence of *Eoamaltheus* ammonite fauna indicates an early Pliensbachian age (*E. meridianus* Hillebrandt Zone, upper part of *Ibex* Zone to *Davoei* Zone) for the marine deposits at Cerro Caquel and Cerro Cuche, being the oldest record within the Early Jurassic for the Sierra de Tecka region so far.

Pezzuchi and Takigawa (1984) reported an early Jurassic fossiliferous locality near Cerro Cuche and assigned these deposits to Arroyo Cajón Formation composed by pelitic levels with corals and associated bivalves of the genera *Myophorella*, *Pecten* and *Cardinia*. This unit was later included within Lago La Plata Group by Haller and Lapido (1980) and assigned to a Toarcian-Tithonian age (see Massaferro, 2001). Massaferro (2001) recognized the Pezzuchi and Takigawa's (1984) association as the oldest Jurassic (lower Pliensbachian) deposits for the Chubut Province based on the occurrence of *Eoamaltheus multicostatus* Hillebrandt (see above), *Myophorella* (*Myophorella*) cf. *araucana* Leanza and *Stylophyllopsis* sp.

Vincent (2005) suggested the existence of a late early Pliensbachian-early Toarcian transgression in the Chubut Province and accepted a marine connection between Neuquén and Chubut basins during the Toarcian. Ferrari and Bessone (2015) hypothesized that the Paleo-Pacific marine embayment of the Chubut Basin seems to have initiated early in the Pliensbachian at the Cerro Cuche locality; this hypothesis is here supported by the updated record of *Eoamaltheus multicostatus* Hillebrandt in the Cerro Cuche and *Eoamaltheus* sp. in Cerro Caquel (Fig. 1).

An accurate biostratigraphic scheme for the Early Jurassic marine sediments of the Chubut Province has not been proposed so far. However, based on the invertebrate faunal composition of ammonites and bivalves in different areas of the Chubut Basin (Piatnitzky, 1936, 1946; Feruglio, 1934; Wahnish, 1942; Musacchio and Riccardi, 1971; Blasco *et al*., 1979) the Early Jurassic marine sediments of this unit have been assigned to a late Early Jurassic age, from the early Pliensbachian to the early Toarcian, following the updated biostratigraphic zonation proposed by Riccardi *et al*. (2011) for the Neuquén Basin (Table 1).

3. Materials and Methods

The gastropod material described here was collected by Dr. Mariel Ferrari, Dr. Gabriela Massaferro and Tec. Santiago Bessone in 2016 during a fieldtrip to Sierra de Tecka in the north-western region of the Chubut Basin at southern Patagonia.

The gastropod material is stored in the IPGP (Instituto Patagónico de Geología y Paleontología, CONICET-CENPAT, Pto. Madryn) invertebrate collection (Colección Paleontología de Invertebrados e Icnología, CNP-PIIc) and was prepared by technical staff (Tec. Santiago Bessone) at IPGP laboratory. The gastropod specimens were subsequently coated with ammonium chloride to enhance sculpture details for photography. Photographs were taken using a digital camera at IPGP. The systematic classification of the gastropod taxa follows Bouchet *et al*., 2017.

Institutional abbreviations: IPGP: Instituto Patagónico de Geología y Paleontología, **CCT CONICET-CENPAT:** Centro Científico Tecnológico, Consejo Nacional de Investigaciones Científicas y Técnicas, Centro Nacional Patagónico.

4. Systematic Paleontology

Subclass Heterobranchia Burmeister, 1837
Infraclass Euthyneura
Cohort Acteonimorpha
Superfamily Acteonoidea d'Orbigny, 1843
Family Tubiferidae Cossmann, 1895
Genus *Cossmannina* Gründel and Nützel, 2012

TABLE 1. BIOSTRATIGRAPHIC SCHEME OF THE EARLY JURASSIC OF NEUQUÉN BASIN BASED ON AMMONITES AND BIVALVES FAUNAS PROPOSED BY RICCARDI *ET AL.* (2011).

Period	Age		Zone	Ammonites	Bivalves
			AALENSIS	*Dumortieria*	*Meleagrinella*
Early Jurassic	Toarcian	U	PSEUDORADIOSA		
			DISPANSUM	*Phlysegrammoceras tenuicostatum*	
			THOURSENSE	*Phymatoceras*	*Parvamussium* cf. *pumilum*
			VARIABILIS	*Collina chilensis*	
		L	BIFRONS	*Peronoceras pacificum*	
				Peronoceras largaense	
			SERPENTINUM	*Dactylioceras hoelderi*	
			TENUICOSTATUM	TENUICOSTATUM	*Posidonotis cancellata*
	Pliensbachian	U	SPINATUM	*Fanninoceras disciforme*	*Radulonectites sosneadoensis*
			MARGARITATUS	*Fanninoceras fannini*	
		L	DAVOEI	*Austromorphites behrendseni*	
				Eoamaltheus meridianus	
			IBEX	*Meridiceras externum*	*Otapiria neuquensis*
			JAMESONI	*Milloceras chilcaense*	

The red arrow indicates the stratigraphic range represented within the early Jurassic of the Chubut Basin (modified from Ferrari, 2022).

Type species. *Actaeonina* (*Ovactaeonina*) *abdominiformis* Schröder, 1995; Pliensbachian; North Germany.
Occurrence. Early Jurassic (Pliensbachian)-Middle Jurassic (Callovian); Europe, South America.
Remarks. The genus was proposed by Gründel and Nützel (2012) to include "oval, stout to elongated slender shells. Teleoconch whorls convex and lacking a subsutural ramp. Suture are distinct and whorls embracing below the suture, commonly at about mid-whorl. Spire is distinctly elevated and the shell is entirely smooth without spiral furrows… the aperture is tear-drop shaped. Broad and rounded abapically and acute adapically…". Considering these characters, the material described below is assigned to the genus *Cossmannina*.

Cossmannina australis nov. sp.
(Fig. 2A-D, F-K)

2022 *Cossmannina* sp. Ferrari; p. 697, fig. 5a-i.

Derivation of name. Referred to the first occurrence of the genus in the austral region of South America (Southern Argentina).
Material. Holotype, CNP-PIIc 0452, one teleoconch preserved as negative mould; Paratype, CNP-PIIc 0453, one teleoconch preserved as negative mould.
Additional material. CNP-PIIc 0447, one teleoconch preserved as negative mould.

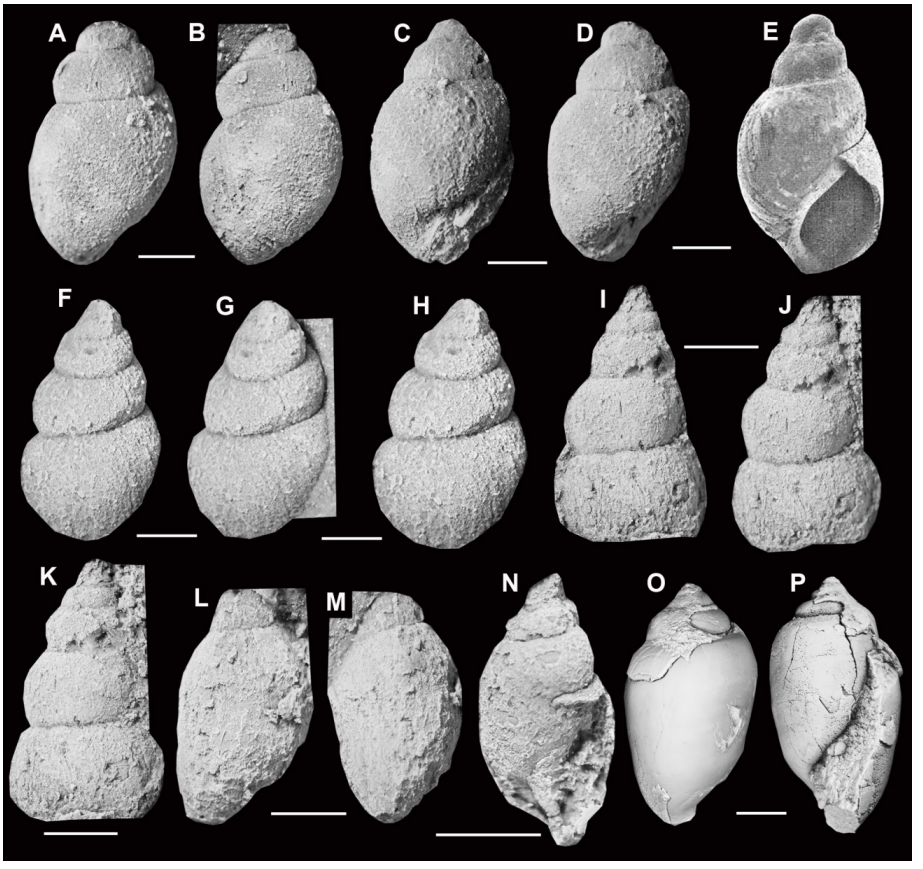

FIG. 2. **A-D, F-K.** *Cossmannina australis* sp. nov. A-D, holotype, CNP-PIIc 0452. **A-B.** lateral views. **C-D.** lateral and apertural views. **E.** *Cossmannina abdominiformis* (Schröder, 1995), lateral view (in Gründel and Nützel, 2012, p. 43, fig. 7c). **F-H.** paratype, CNP-PIIc 0453, lateral views. **I-K.** CNP-PIIc 0447, lateral views. **L-N.** *Cylindrobullina caquelensis* sp. nov. **L-M.** CNP-PIIc 0455, lateral views. **N.** holotype, CNP-PIIc 0451, lateral and apertural views. **O-P.** *Cylindrobullina ovata* (Behrendsen, 1891) MCF-PIPH 546, lateral and apertural views (in Ferrari, 2017, p. 261, fig. 4 22-23). Scale bar=5 mm.

Diagnosis. Fusiform shell; teleoconch with five convex whorls; subsutural ramp missing; ornament with orthocline to slightly opisthocline collabral lines; base convex; aperture oval.

Description. Fusiform, elongated, moderately high-spired and medium-sized shell, with a median height of 18.33 mm and a median width of 11.82 mm. The protoconch is not preserved. The teleoconch consists of five convex whorls; last whorl markedly more elongated than the spire. The subsutural ramp is not developed and sutures are incised in a spiral furrow. The outer face of whorls is strongly convex. The ornament consists of weakly developed collabral lines visible on last whorl; spiral grooves or furrows are missing. The base is convex and the aperture is oval with the columellar lip concave.

Dimensions (mm). CNP-PIIc 0453: height, 20.98* mm; width, 13.56* mm. CNP-PIIC 0452: height, 13.57*; width, 8.72* mm. CNP-PIIC 0447: height, 20.43*; width, 13.19*. *=measurements taken from incomplete specimens.

Remarks. Based on Gründel and Nützel's diagnosis (2012, p. 43), the material here described fits within *Cossmannina*. *Cossmannina australis* nov. sp. is comparable to *Cossmannina* sp. (in Ferrari *et al.*, 2021; p. 900, fig. 4T-V), from the Early Jurassic (late Toarcian) of northern England; the former species, however, has a more developed subsutural ramp, flattened and inclined 45º from sutures while the outer face become straight. *Cossmannina*? *franconica* (Kuhn, 1935) (in Gründel, 2007, p. 97, pl. 8, fig. 3 as *Ovactaeonina franconica*), from the Early Jurassic (Pliensbachian) of southern Germany, is also similar to the new species from Patagonia, although *C*.? *franconica* has weak narrow and irregularly spaced spiral furrows on the shell surface and base. *C. kalchreuthensis* (Gründel and Nützel, 1998) (p. 81 pl. 7, figs. 5-8 and Gründel, 2007, p. 96, pl. 8, fig. 7 as *Ovactaeonina kalchreuthensis*; Nützel and Gründel 2015, p. 36, pl. 21, fig. I), from the Early Jurassic (Pliensbachian) of southern Germany, differs from *Cossmannina australis* nov. sp. in being much smaller with 4 teleoconch whorls and a height of 3.2 mm, and in having a more slender shell. The new species from Patagonia also is very similar to the type species *C. abdominiformis* (Schröder, 1995) (p. 68, pl. 12, figs 1-5, pl. 15, fig. 6 and Gründel, 2007, p. 97, pl. 8, fig. 8 as *Ovactaeonina abdominiformis*; Gründel and Nützel, 2012, p. 43, fig. 7b-c; Nützel and Gründel 2015, p. 35, pl. 21 G) (Fig. 2E), from the Early Jurassic (Pliensbachian) of northern Germany, but *C. abdominiformis* is much smaller and has a more bulbous shell, with the last whorl markedly more expanded than the spire. A similar species comparable to *C. australis* nov. sp. is *Oonia acuta* Ferrari, 2017 (p. 258, fig. 4.6-4.14) from the Early Jurassic (Hettangian-Pliensbachian) of Argentina and Chile; *Oonia acuta*, however, has a spiral ornament predominantly on juvenile whorls.

Occurrence. Early Jurassic (early Pliensbachian, Zone of *E. meridianus* Hillebrandt, upper part of *Ibex* Zone to *Davoei* Zone), Lepá Formation, Cerro Caquel locality, Chubut Province, Argentina.

Family Cylindrobullinidae Wenz, 1938
Genus *Cylindrobullina* von Ammon, 1878

Type species. *Cylindrobullina fragilis* (Dunker, 1846); Lower Jurassic (Hettangian) of Northern Germany.

Occurrence. Upper Triassic-Upper Jurassic; Europe, South America.

Remarks. Following Gründel (2010) and Gründel and Nützel (2012), representatives of *Cylindrobullina* have been characterized by having a cylindrical shell shape, the whorls embrace just below the subsutural ramp, the aperture is high and narrow, the spire is low and distinct, whorls are smooth or weakly ornamented with strengthened growth lines, spiral striae or spiral threads on base, growth lines on the flanks weakly prosocyrt and on the ramp directed backward and opisthocyrt, aperture very high, and the protoconch (although unknown from the type species) is heterostrophic. Gründel and Nützel (2012) and Ferrari (2017) stated out that *Cylindrobullina* shows close resemblance with *Acteonina* and that the former could be indeed the earliest member of the *Cylindrobullina/Cylindrites* group. These authors also suggested that *Cylindrobullina* could be considered as synonymous of *Acteonina*.

Cylindrobullina caquelensis nov. sp.
Fig. 2L-N

2022 *Cylindrobullina* sp. Ferrari; p. 699, fig. 5j-k.

Derivation of name. Referred to the Cerro Caquel locality where the material was found.

Material. Holotype, CNP-PIIc 0451; teleoconch preserved as negative mould.

Additional material. CNP-PIIc 0444; CNP-PIIC 0455; two teleoconchs preserved as negative moulds.
Diagnosis. Oval to cylindrical shell; teleoconch with up to four whorls; gradate and step-like spire; last whorl elongated; base convex; strongly oval aperture with a thickened columellar lip; acute abapical channel.
Description. Dextral, oval to cylindrical shape, elongated, low-spired and small to medium-sized shell. The protoconch is not preserved. The teleoconch comprises four convex whorls. Spire whorls step-like and slightly gradate in outline; last whorl higher than the spire. The subsutural ramp is weakly horizontal in the spire whorls to slightly convex on last whorl. Sutures are impressed in a weak spiral furrow. The shell is smooth and spiral and collabral elements are not visible. The base is convex and the aperture is elongated and strongly oval with a thickened columellar lip which forms an acute abapical channel with the outer lip.
Dimensions (mm). CNP-PIIc 0444: height, 8.99 mm; width, 7.54* mm. CNP-PIIc 0455: height, 14.29* mm; width, 9.40* mm. CNP-PIIc 0451/a: height, 5.11* mm; width, 5.40* mm. CNP-PIIc 0451, holotype: height, 12.87* mm; width, 7.35* mm. *=dimensions taken from incomplete specimens.
Remarks. Based on the characterization proposed by Gründel (2010) and Gründel and Nützel (2012) the new species herein described is assigned to *Cylindrobullina*. Typical representatives of the genus were described from other Early Jurassic marine localities of Argentina. *Cylindrobullina ovata* (Behrendsen, 1891) (in Ferrari, 2017; p. 261, fig. 4. 21-27) (see Fig. 2O-P), from the Pliensbachian of the Neuquén Basin, is comparable to *Cylindrobullina caquelensis* nov. sp.; however, *C. ovata* is larger and the base is ornamented by regularly spaced spiral cords or furrows. *Cylindrobullina brevispira* Ferrari, 2017 (p. 262, fig. 4.28-29), also from the Pliensbachian of the Neuquén Basin, differs from the new Patagonian species in being larger, having a markedly more expanded sutural ramp, the flanks of whorls strongly convex, and a much lower spire. The type species, *Cylindrobullina fragilis* (Dunker, 1846) lines (in Gründel and Nützel, 2012; p. 35, fig. 1b-c), from the Hettangian of Germany, differs from *C. caquelensis* nov. sp. in having a lower-spired shell, a more developed subsutural ramp with a rounded edge as transition to the flanks. *Cylindrobullina ventricosa* Gründel *et al*., 2011 (p. 502, fig. 16A-H), from the Upper Pliensbachian of England, differs from *C. caquelensis* nov. sp. in having a much more acute spire and a subsutural ramp almost horizontal, demarcated from whorl face by deep broad spiral furrow. *Cylindrobullina dorsetensis* Gründel *et al*., 2011 (p. 500, fig. 14A-E; as *Striactaeonina dorsentensis* in Gründel and Nützel, 2012, p. 41), also from the late Pliensbachian of England, has a more slender shell with a more acute spire, subsutural ramp demarcated by spiral furrows, and spiral furrows separated by interspaced which cover the shell surface and the base. *Cylindrobullina* (*Cylindrobullina*) *avenoides* (Haas, 1953; p. 261, pl. 17, figs. 35, 36, 39-42, 46, 49-51, 58, 59), from the Late Triassic (Norian/Rhaetian) of the Pucara Group (Central Peru), has a more step-like spire, a wider subsutural ramp and regularly spaced spiral grooves on the shell surface.
Occurrence. Early Jurassic (early Pliensbachian, Zone of *E. meridianus* Hillebrandt, upper part of *Ibex* Zone to *Davoei* Zone), Lepá Formation, Cerro Caquel locality, Chubut Province, Argentina.

5. Palaeobiogeography

Early Jurassic Euthyneura (Heterobranchia) has been reported in the western Tethyan region (Gründel, 2007, 2010; Gründel *et al*., 2011; Gründel and Nützel, 1998, 2012; Nützel and Gründel, 2015; Ferrari *et al*., 2021) and few species of this clade have been also described from northern Africa (Cox, 1965; Bourrouilh, 1966). The families Cylindrobullinidae and Tubiferidae are important components of the earliest radiation of Euthyneura which took place during the earliest Mesozoic (Dinapoli and Klussmann-Kolb, 2010). *Cylindrobullina* is the type genus of the Family Cylindrobullinidae and was abundant and diverse during the Late Triassic and Early Jurassic. According to Nützel (personal communication, 2004; Frýda *et al*., 2008, Chapter 10), the earliest unequivocal heterobranch fossil is *Cylindrobullina* (240 Mya), which is also considered a basal opisthobranch lineage. During the Hettangian, the genus was restricted to the western Tethyan region with the type species, *Cylindrobullina fragilis*, reported from France at that time (Gründel, 2010; Gründel and Nützel, 2012). In the Sinemurian, *Cylindrobullina* was common in the western Tethyan region (Gründel *et al*., 2011) and also occurred in northern Africa (Morocco) (Bourrouilh, 1966) (Fig. 3). Later in the Pliensbachian the genus widespread from

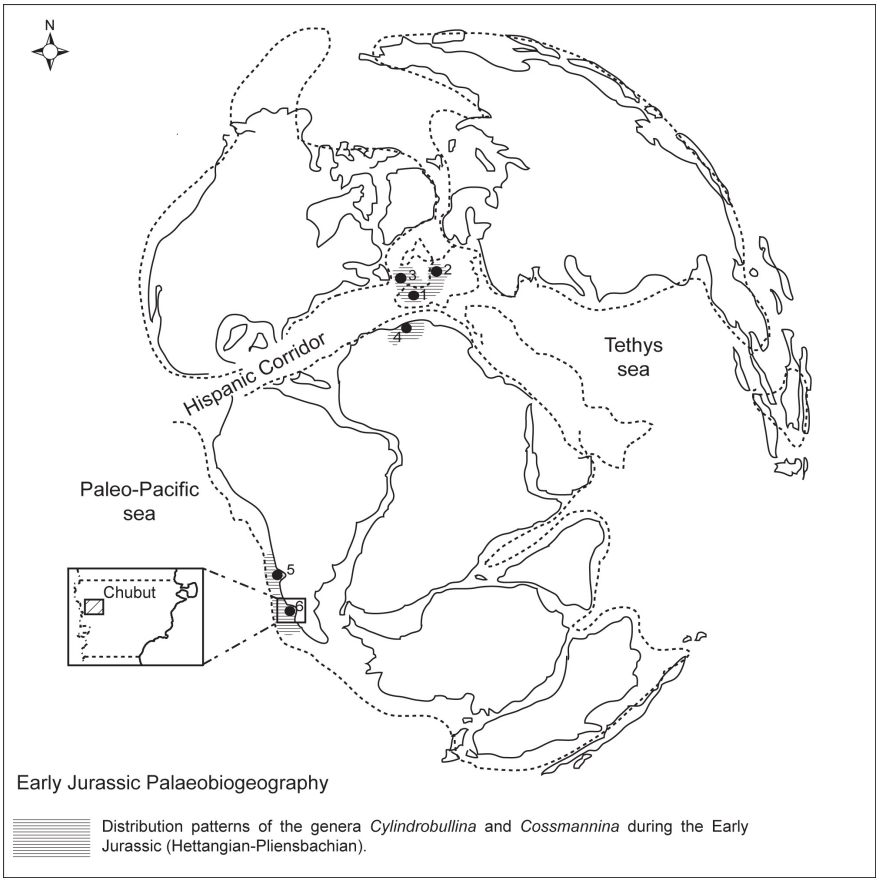

FIG. 3. Map showing the palaeogeographical distribution of *Cylindrobullina* and *Cossmannina* during the Early Jurassic. Note that the new species here described from the Early Jurassic (early Pliensbachian) of the Chubut Province extend the palaeobiogeographical distribution of Euthyneura to the Jurassic of Argentina and South America. **1.** Hettangian of France (Gründel, 2010; Gründel and Nützel, 2012). **2.** Hettangian-Pliensbachian of Germany (Gründel, 2003, 2010; Gründel and Nützel, 2012, 1998). **3.** Sinemurian-Pliensbachian of England (Gründel *et al*., 2011; Gründel and Nützel, 2012). **4.** Sinemurian of Morocco (Bourrouilh, 1966). **5.** Pliensbachian of Neuquén Basin (Behrendsen, 1891; Ferrari, 2017). **6.** Early Pliensbachian of Chubut Basin (Ferrari, 2022; Here) (modified from Ferrari, 2011).

the Tethyan region (Gründel *et al*., 2011; Gründel and Nützel, 1998, 2012) to southern South America (Behrendsen, 1891; Ferrari, 2017, 2022) (Fig. 3), although it had been previously reported in the Late Triassic of the Pucará Group (Central Peru) (Has, 1953). The Early Jurassic *Cylindrobullina* species recorded in the Neuquén and Chubut basins might represent survivors from the end- Triassic marine mass extinction event in South America, as was previously suggested by Ferrari (2015b). The author supported the idea that the ancient Paleo-Pacific seaway from Peru to Argentina was the most plausible explanation for biotic exchange of benthic gastropod faunas across the Late Triassic/Early Jurassic boundary (Ferrari, 2015b). The Late Triassic *Cylindrobullina* species from Peru showed the smallest size for the genus at that time, whereas the Pliensbachian *Cylindrobullina* of southern Patagonia showed the largest size. The Pliensbachian increased size of austral *Cylindrobullina* species was considered by Ferrari and Hautmann (2022) to be related to a Pliensbachian cooling event (Korte *et al*., 2015); thus, largest specimens of *Cylindrobullina* (up to 30 mm) stem from the Pliensbachian of high paleolatitudes (south Patagonia) with inferred cold palaeotemperatures. Ferrari and Hautmann (2022) also suggested that the post extinction size increase of *Cylindrobullina* might have resulted from ecological

opportunities due to the increased extinction of large taxa that previously competed with *Cylindrobullina*.

The genus *Cossmannina* has been restricted during the Early Jurassic to the western Tehyan region. It occurred in the Hettangian of France (see Gründel and Nützel, 2012, p. 93) and in the Pliensbachian of Germany and England (Gründel and Nützel, 1998, 2012; Gründel, 2007; Nützel and Gründel, 2015; Ferrari *et al*., 2021) (Fig. 3). Here it is supplied the first occurrence of *Cossmannina* in the southern hemisphere, extending its palaeobiogeographical distribution from the western European epicontinental seas to the southern Patagonian region during the Early Jurassic (Fig. 3).

6. Concluding Remarks

The Euthyneura (Heterobranchia) is considered a stem group of 'shelled ophistobranchs' that diversified in the early Mesozoic and had a common ancestor with a thin, oval shell-shaped, large body whorl, an elongated aperture and smooth surface with or without fine spiral cords, as is shown in early Mesozoic opisthobranchs (*e.g*., *Cylindrobullina, Cossmannina, Conactaeon, Euconactaeon, Sinuarbullina*). The Early Jurassic Euthyneura is mainly restricted to the western Tethyan region and has been previously reported in the Neuquén Basin (Argentina). The present paper provides the first occurrence of Euthyneura in the Early Jurassic (early Pliensbachian) of the Chubut Province at Cerro Caquel locality with two new species, namely *Cylindrobullina caquelensis* nov. sp. and *Cossmannina australis* nov. sp. This new occurrence extends the palaeobiogeographical distribution of the Euthyneura into the southern Patagonian region during the earliest Pliensbachian, supporting the existence of a shallow marine connection between the Neuquén and Chubut basins during the earliest Jurassic, as was previously hypothesized by Ferrari (2015a, b).

Here it is reported the occurrence of *Eoamaltheus multicostatus* Hillebrandt in Cerro Cuche locality (originally assigned to *Polymorphites* sp. by Massaferro, 2001) and *Eoamaltheus* sp. in the Cerro Caquel locality. The presence of this ammonite fauna indicate an early Pliensbachian age (*E. meridianus* Hillebrandt Zone, upper part of *Ibex* Zone to *Davoei* Zone) for the marine deposits, being the oldest record within the Early Jurassic in the Sierra de Tecka region at the Chubut Province.

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