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In memory of Chinese geo-paleontologist master Prof. Dr. Chen Pei-Ji (1936 – 2019)

Revision of Two Spinicaudatan Species from the Cañadón Asfalto Formation (Jurassic), Patagonia Argentina

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Re-examination under a scanning electron microscope (SEM) of the type material of the species described by Tasch and Volkheimer (1970) and Vallati (1986) was applied, as well as, new materials collected from different localities of the Las Chacritas Member from Cañadón Asfalto Formation (Argentina). Morphological description and new SEM images of the ornamentation pattern revealed features on carapaces that had not been recognized previously. These species are now referred to the family Eosestheriidae as *Carapacestheria taschi* (Vallati, 1986) and to the family Fushunograptidae as *Wolfestheria patagoniensis* (Tasch, in Tasch and Volkheimer, 1970). These records increase our knowledge about the Jurassic faunas from Argentina.

Key words: Conchostraca, Branchiopods, South America.

BACKGROUND

Spinicaudatans, or clam shrimps previously known as conchostracans, are branchiopod crustaceans of the Infraclass Diplostraca with short, laterally compressed bodies inside of a bivalved, lightly mineralized chitin carapace which is often the only preserved element in the fossil record (Hethke and Weeks 2020). They have been found in continental facies from the Devonian to the modern (Tasch 1969, Hegna and Astrop 2020). Spinicaudatans were diverse and abundant between Carboniferous and Cretaceous periods, and, as a result, are used as a high-resolution biostratigraphic tool in continental facies (Kozur and Weems 2010; Scholze and Schneider 2015).

The Jurassic spinicaudatans from Argentina were first recorded during the first half of the twentieth century by Windhausen (1921), Piatnitzky (1933), Frenguelli (1949) and Feruglio (1949). These records are mainly from two large geological provinces, Extra-Andean Chubut in the Chubut province and the Deseado Massif in the north of the Santa Cruz province. The Extra-Andean Chubut includes the Cañadón Asfalto Basin, that is located in the north central region of the Chubut province, and is represented mainly by the Cañadón Asfalto Formation (Fig. 1). This unit consists of the most important extensive continental volcano-sedimentary sequence from the Jurassic of South America (Cabaleri et al. 2010).

The Cañadón Asfalto Formation is divided in two members according to Silva-Nieto et al. (2007) and Cabaleri et al. (2010): Las Chacritas Member (Middle Jurassic) and Puesto Almada Member (Upper Jurassic). Gallego et al. (2010 2011), Monferran

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(2015) and Monferran et al. (2013 2016) studied several spinicaudatans species assigned to the families Afrograptidae and Fushunograptidae from the Puesto Almada Member. On the other hand, spinicaudatans previously reported from the type locality of the Las Chacritas Member (situated at the south of Cerro Condor village) have not been recently restudied. The species *Cyzicus* (*Euestheria*) *volkheimeri* Tasch and *Cyzicus* (*Lioestheria*) *patagoniensis* Tasch were published by Tasch and Volkheimer (1970). Subsequently, Vallati (1986) defined *Cyzicus* (*Euestheria*) *taschi* Vallati based on other species (*Cyzicus* (*Euestheria*) sp. A) studied by Tasch and Volkheimer (1970). However, these species have not been analyzed with scanning electron microscope and lack adequate description. For this reason, the present paper is a re-examination of the type specimens described by Tasch and Volkheimer (1970) and Vallati (1986) under a scanning electron microscope (SEM), as well as, new materials collected from different localities of the Las Chacritas Member. This study allows us to characterize the spinicaudatan faunas from the lower section of the Cañadón Asfalto Formation.

MATERIALS AND METHODS

Fossil localities

The Cañadón Asfalto Basin, located in the Extra-Andean region of the Chubut province in southern Argentina (Fig. 1), is composed of several depocenters

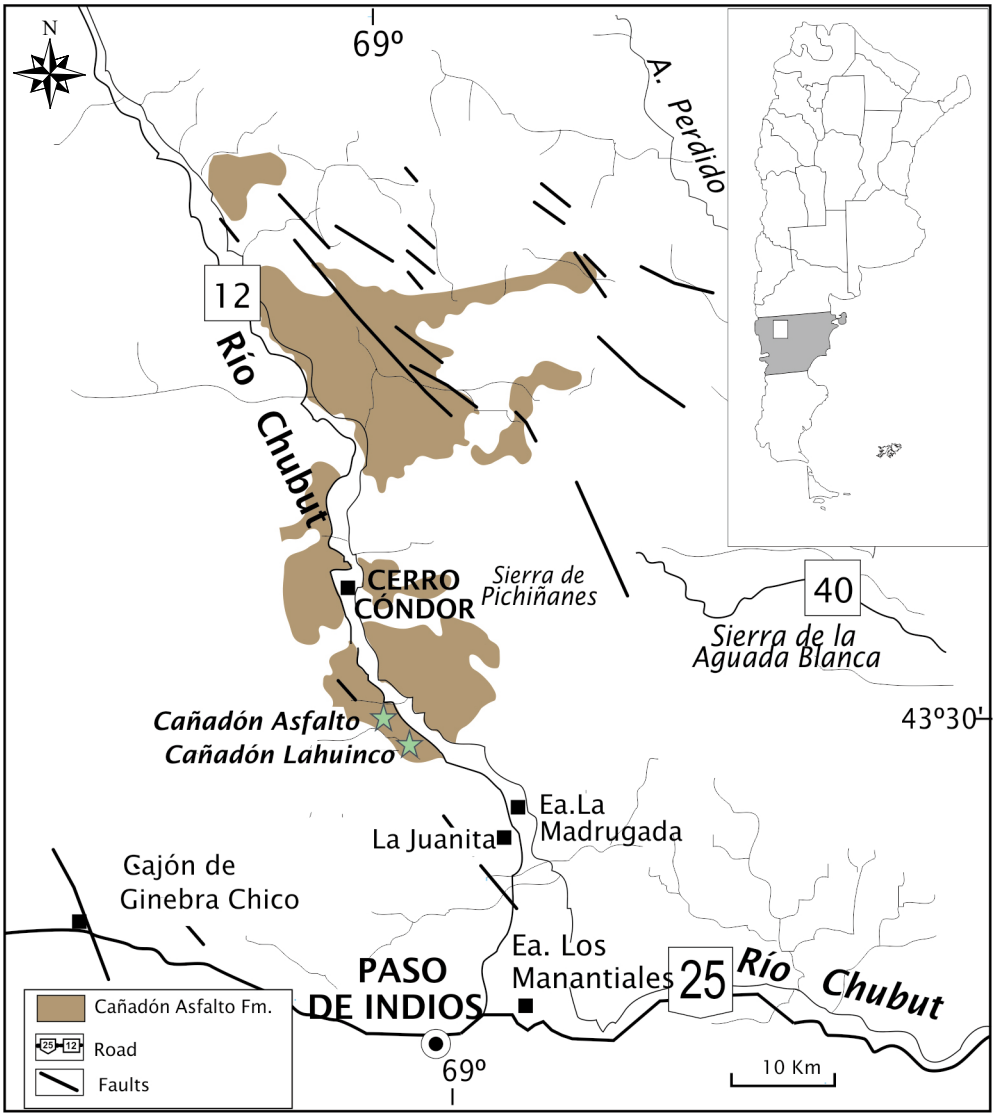

Fig. 1. Location map of the Cañadón Asfalto Formation. Localities of study of the spinicaudatans samples analyzed.

(Cabaleri et al. 2006; Silva Nieto et al. 2007). It is interpreted as pull-apart type basin related with the transcurrency of the Gastre System fault (Silva Nieto et al. 2002). The sequences associated with the filling of these depocenters make up the Cañadón Asfalto Formation. These sequences begin with lacustrine limestones associated with pyroclastic deposits and basalt flows and dykes of the Las Chacritas Member (Cabaleri and Armella 1999; Silva Nieto et al. 2003; Cabaleri et al. 2010). The Puesto Almada Member is characterized mainly by pyroclastic deposits intercalated with limestones, rhythmites, claystones, shales, sandstones and conglomerates which it represents the progradation of the lacustrine system from towards a fluvial system (Cabaleri et al. 2005). The Las Chacritas Member is assigned to the Middle Jurassic Series. Recently, Hauser et al. (2017) determined an age range of 168.2 ± 2.2 Ma using the U-Pb method. This age is similar to a K-Ar age of 170 ± 4 Ma obtained for the oldest basalt of this unit (Salani 2007). Moreover, palynomorphs and ostracods associations of this unit support an early Bajocian to early Bathonian age (Musacchio 1995 2001; Cabaleri et al. 2010).

Materials studied herein were first collected in 1967 by Wolfgang Volkheimer and published by Dr. P. Tasch in Tasch and Volkheimer (1970). Subsequently, Vallati in 1986 analyzed and distinguished other species. These samples are deposited in the Paleoinvertebrate Collections at the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" (MACN-PI, Buenos Aires) and in the collections of the Universidad Nacional de la Patagonia "San Juan Bosco" (UNPSJB-PI, Santa Cruz) respectively. During field trips in December 2007 and March 2009, the present authors collected new samples to compare with type materials of those previous studies. Therefore, we re-analyzed the species described by Tasch and Volkheimer (1970) and Vallati (1986) under scanning electron microscope (SEM), as well as, new materials collected from different localities of the Las Chacritas Member: Cañadón Asfalto and Cañadón Lahuincó localities (Fig. 1). Supplementary materials (as SEM slices) are loaned at the Paleozoological section of the Paleontological Collections "Rafael Herbst" of the Universidad Nacional del Nordeste, Corrientes, Argentina (CTES-PZ).

Observations and measurements

Specimens used in this study were observed by a stereomicroscope (Olympus SZ51) measured by a digital caliper on the Nikon Profile Projector V-12. SEM (Scanning Electron Microscope) images were obtained by JEOL JSM-5800 LV of the Secretaria General de Ciencia y Técnica of the Universidad Nacional del Nordeste, Argentina.

The taxonomy adopted here mainly follows of Chen and Shen (1985), Shen (1994), Martin and Davis (2001), Li and Batten (2004), Monferran et al. (2013) and Scholze and Schneider (2015). The taxonomy consists in important valve characteristics such as outline and margins of the carapace, ornamentation of the growth band, umbo, growth lines, and measurements such as, length, height, and curvature parameters (Fig. 2).

RESULTS

TAXONOMY

Order Diplostraca and Suborder Spinicaudata Superfamily Eosestherioidea Zhang & Chen (in Zhang et al., 1976) Family Eosestheriidae Zhang & Chen (in Zhang et al., 1976)

Genus *Carapacestheria* Shen, 1994

Type species: *Cyzicus* (*Lioestheria*) *disgregaris* Tasch, 1987, late Early Jurassic-early Middle Jurassic Ferrar Group, Transantarctic Mountains, Antarctica.

Carapacestheria taschi (Vallati, 1986) comb. nov.

(Fig. 3)

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Cyzicus (*Euestheria*) sp. A Tasch (in Tasch and Volkheimer, 1970). pag. 5–8.

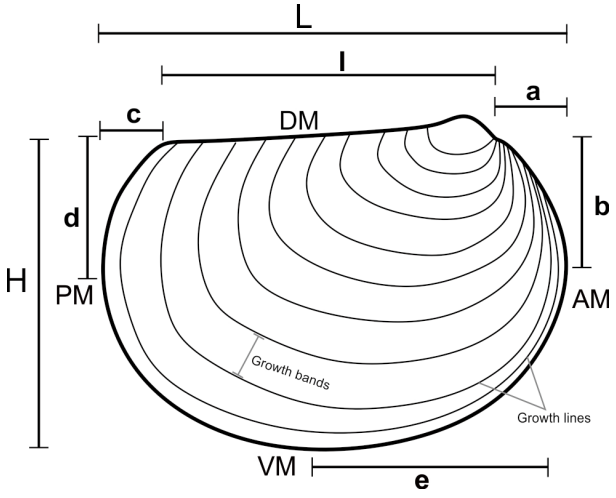

Fig. 2. Carapace terminology and parameters for measurements of the lateral valve, adapted from Scholze and Scheneider (2015).

Cyzicus (*Euestheria*) *taschi* Vallati, 1986. pag. 31–33.

Material: Holotype UNPSJB-PI 280, Paratypes: UNPSJB-PI 267, 281-86; MACN-Pi 4892; CTES-PZ 7.678, 81–84.

Geographic provenance: Chubut province (Argentina), Las Chacritas Member, Cañadón Asfalto Formation, Middle Jurassic. Cañadón Lahuincó ('Frenguelli site') locality GPS: 43°30'57.2"S, 69°8'26.7"W.

Emended diagnosis: Carapace small to very large in size with a shape varying from elongated oval to round (elliptical); umbo marginal in submedial to anterior position; dorsal margin short to long, anterior and posterior margins slightly curved to sharply curved; growth bands ornamented with irregular reticulation (0.005–0.03 mm) in dorsal to median-ventral zone to anterior zone of the valve, and change to radial lirae about 50 per mm in posterior-median zone. Cross-bars between radial lirae rarely present. Measurements (mm): L = 1.5–7, H = 0.6–6, H/L = 0.4–0.9, l = 0.6–4.8, a = 0.18–1, b = 0.1–2, c = 0.1–1.8, d = 0.5–2.7, e = 0.8–4.

Description: The carapace is small to very large in size with an outline varying from elongated oval to round (elliptical). The dorsal margin is short in round forms and long in elongated oval forms. The umbo is small marginal (0.5 mm) and projects submedial to anterior position. The anterior margin is slightly curved to curved and the posterior margin is slightly curved (c/d = 0.03–0.08) in elongated oval forms and curved to sharply curved (c/d = 0.07–0.15) in round elliptical forms. Growth lines are smooth, from 25 to 85 in number. The growth bands ornamented with irregular reticulation in anterior, dorsal to median-ventral zone (Fig. 3C–E) and radial lirae near the ventral and postero-median regions (Fig. 3F–G). The polygonal reticulation shows a diameter of the mesh of 0.005–0.03 mm. The transitional ornamentation changes laterally from the reticulation to the radial lirae in the same growth band near to posterior-median area (Fig. 3G). Radial lirae (50 per mm) are count with 0.004–0.007 mm width and filling 20% of the carapace surface. The presence of cross-bars between radial lirae is rare (Fig. 3G).

Remarks: *Carapacestheria taschi* (Vallati) was defined originally by Tasch as *Cyzicus* (*Euestheria*) sp. A (Tasch and Volkheimer 1970). Subsequently, Vallati (1986) analyzed this material and defined as *Cyzicus* (*Euestheria*) *taschi* with polygonal reticulation in growth bands that changed to radial ornamentation in ventral carapace zone. Later, *Cyzicus* (*Euestheria*) *taschi* was interpreted as an eosestheriid by Gallego (2010), as well as, *Cyzicus* (*Euestheria*) sp. 1 from the Manantial Pelado Formation (Vallati 1986).

According to the new SEM images, several specimens including the holotype have well developed reticulate ornamentation changing laterally to radial lirae in the same growth band near to posterior-median area. Therefore, these features support transferring this species from genus *Euestheria* to the Family Eosestheriidae. *Euestheria* is easily distinguished from the eosestheriid spinicaudatans in having only a fine reticulation and lacking radial lirae on the growth bands. Furthermore, this ornamentation pattern incorporating both reticulate and radial ornamentation is diagnostic of *Carapacestheria* Shen, 1994, a genus defined from the Early to Middle Jurassic of Antarctica. In *Carapacestheria*, the carapace is of small or moderate size, and the reticulation shows a mesh diameter of 0.02–0.036 mm and radial lirae about 40 per mm. Minute punctae occur within the reticulation and between the radial lirae. In addition, the presence of cross-bars between radial lirae is observed for *Carapacestheria disgregaris* in figure 2 of Shen (1994). These characteristics match the Las Chacritas specimens.

Another similar genus is *Menucoestheria* from Triassic of Argentina (Gallego and Covacevich 1998) and Poland (Olempska 2004, considered by Kozur and Weems 2010 that belong to the genus *Gregoriusella*). It resembles *Carapacestheria* in the presence of the transitional ornamentation changing laterally from reticulation to radial lirae in the same middle growth bands. However, *Menucoestheria* is characterized by meshes with 0.01 to 0.05 mm in diameter and 30 to 80 radial lirae per millimeter without cross-bars. In *Pseudograpta*, *Yanjiestheria*, *Abrestheria*, *Nothocarapacestheria* and *Eosestheria* the change from reticulation on the dorsal region to radial lirae on the ventral region is in the same growth bands and ventrally, and also, the radial lirae ornamentation are thinner.

Superfamily Estheriteoidea Zhang and Chen (in Zhang et al., 1976)
Family Fushunograptidae Wang (in Hong et al., 1974)

Genus *Wolfestheria* Monferran et al. 2013

Type species: *Wolfestheria smekali* Monferran et al., 2013 Cañadón Asfalto Formation,

Puesto Almada Member, Late Jurassic, Chubut, Argentina.

*Wolfestheria patagoniensi*s Tasch (in Tasch and Volkheimer, 1970) comb. nov.

(Fig. 4)

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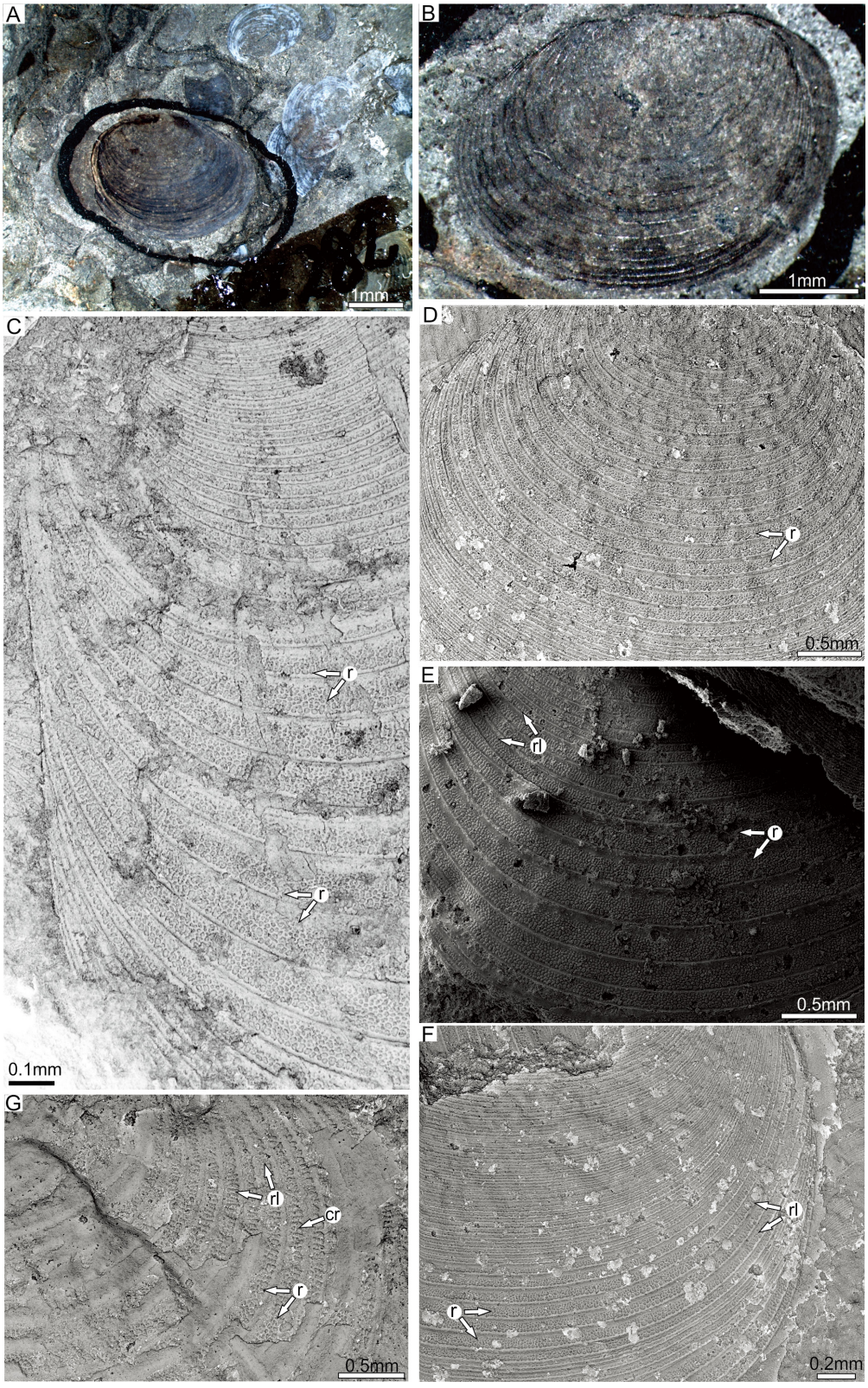

Fig. 3. *Carapacestheria taschi* (Vallati) from the Las Chacritas Member, Cañadón Asfalto Formation. General carapace morphology; (A) UNPSJB-PI 282 paratype oval valve; (B) UNPSJB-PI 283 oval valve; SEM micrographs: (C) Details of the ornamentation from anterior area; (D) Ornamentation from dorsal area; (E) Details of the mid-dorsal ornamentation; (F) Ornamentation from postero-ventral area; (G) details of the postero-dorsal ornamentation. cr, cross bars; r, reticulate; rl, radial lirae.

Cyzicus (*Lioestheria*) *patagoniensis* Tasch (in Tasch and Volkheimer, 1970).

Material: Holotype MACN-Pi 4895; Paratypes: CTES-PZ-7.690, MEF-PI 1889.

Geographic provenance: Chubut province (Argentina), Las Chacritas Member, Cañadón Asfalto Formation, Middle Jurassic. Cañadón Asfalto locality GPS: 43°30'4.3"S, 69°10'34.6"W.

Emended diagnosis: Carapace medium to large in size with a shape varying from elongated oval to round (elliptical); short and small umbo marginal in submedial to anterior position; dorsal margin short to long, anterior and posterior margins curved to sharply curved; growth bands ornamented with punctae mesh on the dorsal part of the carapace changing to irregular radial lirae with numerous cross-bars. Thick radial lirae with fewer cross-bars restricted to ventral zone of the carapace. Measurements (mm): L = 3.3–5, H = 2.5–4.3, H/L = 0.6–0.86, l = 1.3–3.3, a = 0.3–0.7, b = 1–2, c = 0.8–1.1, d = 1.2–1.3, e = 2–2.6.

Description: The carapace is medium to large in size with an outline varying from elongated oval to round (elliptical). The dorsal margin is short in round forms and long in elongated oval forms. The umbo is short/small marginal (0.4 mm) and projects anterior position. The anterior margin slightly curved to curved and posterior margin is curved to sharply curved (c/d = 0.06–0.2). Growth lines smooth, from 30 to 60 in number. Growth bands ornamented with evenly distributed punctae mesh (about 5 μm in diameter) on the dorsal-median part of the carapace (Fig. 4B–D), changing to irregular radial lirae (7.5 μm in width) with numerous cross-bars from the median-dorsal to ventral part of the carapace (Fig. 4E–F), and finally the radial lirae is thick (13.3 μm in width) with fewer cross-bars restricted to ventral zone of carapace and the interspaces between the radial lirae are wider (20 μm).

Remarks: *Wolfestheria patagoniensis* (Tasch, in Tasch and Volkheimer, 1970) was defined originally by Tasch as *Cyzicus* (*Lioestheria*) *patagoniensis* Tasch (in Tasch and Volkheimer 1970). According to the new SEM images, the morphological features allow us to define this species as belong to the Family Fushunograptidae and to the genus *Wolfestheria*. This genus was defined by Monferran et al. (2013) from the Upper Jurassic Puesto Almada Member of the Cañadón Asfalto Formation. *Wolfestheria patagoniensis* show similarities with the type species *W. smekali* Monferran et al., 2013, in that species the outline varying from elongated oval to round and the radial lirae show numerous cross-bars from the median-dorsal to median-ventral part of the carapace changing to fewer cross-bars on ventral part. However, *W. patagoniensis* exhibits punctate mesh on the dorsal part, whereas *W. smekali* exhibits a lattice-like reticulation originated by abundant cross-bars. Also, in *W. patagoniensis*, the irregular radial lirae reach the upper part of the growth bands and the fewer cross-bars are limited to a few growth bands from ventral part of carapace. Comparisons with another fushunograptid genera, *Cratostracus* Huang, 1977, shows different outlines and growth lines pronounced with slightly serrated lower margin (Li and Batten 2004). *Qinghaiestheria* Wang, 1983 from the Upper Jurassic Hongshuigou Formation in Qinghai and the Penglaizheng Formation in Sichuan (Wang 1983; Shen and Chen 1982; Li 2004) also has serrate structure along the lower margin of the growth lines.

DISCUSSION

Jurassic spinicaudatan faunas from Gondwana have been studied by Tasch in 1987 with more of the 70 species identified. In this work, Tasch (1987) and recently actualized by Gallego et al. (2020) mentioned 19 spp. from Brazil, Colombia, Venezuela and only few species from Argentina. We propose that the low diversity and rather sparse fossil record of Jurassic spinicaudatans in Argentina is due to the presence of palaeogeographic barriers (along with other sources of error such as collection biases).

In Argentina, the records of Jurassic continental invertebrate faunas come from only two Patagonian areas (Deseadean Massif, La Matilde Formation and Extra-Andean Chubut, Cañadón Asfalto Formation). Piatnitzky (1933), Feruglio (1949) and Frenguelli (1949) also published early reports of Jurassic invertebrates (as "*Estheria*" sp.) from the Chubut and Santa Cruz provinces (Gallego 1994). Since the first publication of spinicaudatan descriptions from the Cañadón Asfalto Formation by Tasch and Volkheimer (1970), a total of around 10 species of Jurassic spinicaudatans have been described (Vallati 1986; Gallego 1994; Gallego and Rinaldi 2001; Gallego et al. 2010; Monferran et al. 2013). In this work, the species analyzed belong to the families Eosestheriidae and Fushunograptidae. Table 1 shows the species described at the moment where the Argentina Jurassic spinicaudatan records show a large number of fushunograptid species, however, some taxa require systematic revision.

There are many Gondwana records of species belonging to the family Fushunograptidae (Lioestheriidae *sensu* Tasch, 1969). In most of the South American records these are referred to as "lioestheriids" (also "bairdestheriids", according to Gallego and Martins-Neto 2006) and many of these probably belonging to the Eosestherioidea-Estheriteoidea group

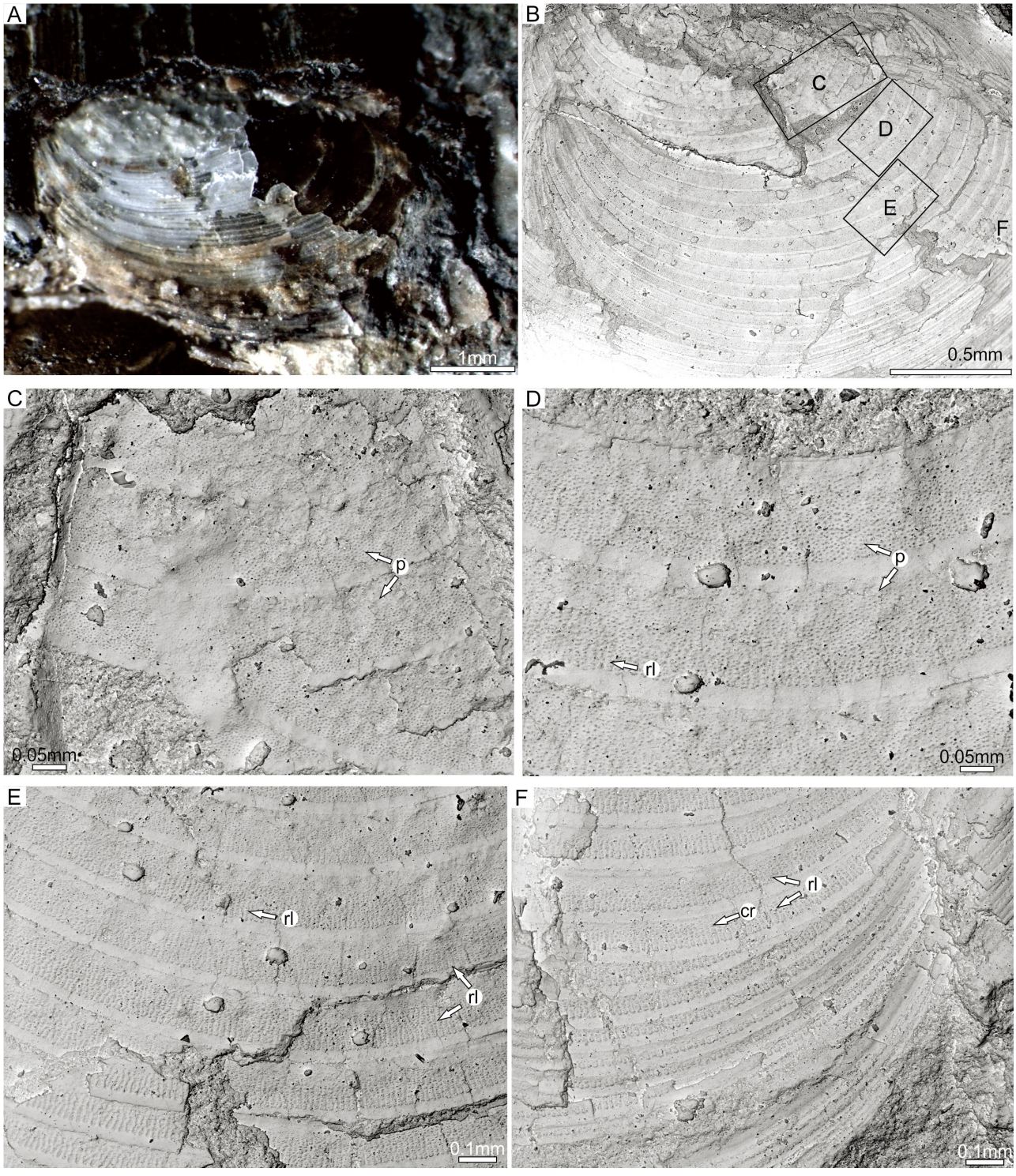

Fig. 4. *Wolfestheria patagoniensis* (Tasch) from the Las Chacritas Member, Cañadón Asfalto Formation. General carapace morphology; (A) CTES-PZ –7.690 paratype elongate valve; SEM micrographs: (B) General view of elongated oval valve, the rectangles delineate the sites of images C–F; (C) Ornamentation from dorsal area; (D) Details of the mid-dorsal ornamentation; (E) Ornamentation from middle area; (G) Details of the ventral area ornamentation. cr, cross bars; p, punctae; rl, radial lirae.

from Chen and Shen's systematics scheme. Argentina Jurassic Estheriteoidea records increase during Jurassic and decline in Cretaceous with a genus belonging to the Jilinestheriidae (Volkheimer et al. 2009). This group appeared during the Late Triassic based upon records of *Estheriellites zavattieriae* Gallego and Tassi (in Tassi et al. 2015), *Polygrapta troncosoi* (Gallego and Covacevich 1998; Gallego et al. 2005) and *Bairdestheria barbosai* Almeida, 1950 (with a doubtful Cretaceous record).

The eosestheriid fauna is also an important component of the biota from west Gondwana. The oldest records are *Menucoestheria terneraensis*, *M. puquenensis* (both of Late Triassic from Chile) (Gallego and Covacevich 1998, Gallego et al. 2005), and *M. wichmanni* (from the Late Triassic of southern Argentina). On the other hand, *Carapacestheria disgregaris* and *C. balli* Shen, 1994 are recorded from the Middle Jurassic of Antarctica. Then, only some taxa have been mentioned as Eosestheriidae, the species analyzed in this paper *Cyzicus* (*Euestheria*) *taschi* was interpreted as eosestherid by Gallego (2010), as well as, *Cyzicus* (*Euestheria*) sp. 1 from the Manantial Pelado Formation (Vallati 1986). Furthermore, Shen (1994) suggested that *Cyzicus* (*Lioestheria*) *malacaraensis* Tasch, 1987 from the La Matilde Formation (Middle-Upper Jurassic) of Santa Cruz Province, Argentina, could be an eosestheriid or fushunograptid also supported by Monferran et al. (2013).

Several occurrences of species of the families Fushunograptidae and Eosestheriidae provide geographic context for the evolution of the spinicaudatan fauna. Late Triassic and Early Jurassic records of eosestheriids extended back the stratigraphical distribution in relation to the original range of Late Jurassic to Early Cretaceous records from China. The

Table 1. Spinicaudatan records from the Jurassic of Argentina (modified from Monferran et al. 2013, the position of the geological units do not represent the stratigraphic position and age of them)

Geological Units	Localities	Taxa/Authors	Main diagnostic features	Current taxonomic status
Cañadón Asfalto Formation Chubut province	Cañadón Asfalto	*Wolfestheria patagoniensis* (Tasch, in Tasch and Volkheimer, 1970) nov. comb.	Subcircular-subtriangular outline, sub-central umbo, growth bands with puncta mesh and irregular radial lirae with numerous cross-bars.	Family Fushunograptidae
	Cañadón Lahuincó	*Carapacestheria taschi* (Vallati, 1986) nov. comb.	Elongated oval to round (elliptical); umbo marginal in submedial to anterior position; growth bands ornamented with irregular reticulation and change to radial lirae.	Family Eosestheriidae
	Cañadón Las Chacritas	*Cyzicus* (*Lioestheria*) sp. C Tasch and Volkheimer 1970	Form similar to the species *W. patagoniensis* with anterodorsal margin strongly rounded than posterodorsal one.	Family Fushunograptidae
	Colan Conhué	*Cyzicus* (*Lioestheria*) sp. B Tasch and Volkheimer 1970	Slightly convex dorsal margin, subterminal umbo and pustulate ornamentation.	Family Fushunograptidae
	Cerro Cóndor and Cerro Bayo	*Carapacestheria taschi* (Vallati, 1986) nov. comb.	Elongated oval to round (elliptical) umbo marginal in submedial to anterior position; growth bands ornamented with irregular reticulation and change to radial lirae.	Family Eosestheriidae
		Cyzicus (*Euestheria*) *volkheimeri* Tasch and Volkheimer, 1970	Carapace ovate-elongate with polygonal/granule pattern ornamentation.	Family Euestheriidae
	Estancia La Sin Rumbo	*Wolfestheria smekali* Monferran et al., 2013	Subcircular-subtriangular outline, sub-central umbo, growth bands with irregular, thick radial lirae with numerous cross-bars changing to straight thin radial lirae.	Family Fushunograptidae
	Sierra de la Manea, Estancia El Torito and Cañadón Los Chivos	*Congestheriella rauhuti* Gallego et al., 2010	Small carapace with ovate outline; umbo anteriorly, growth bands ornamented by around 40 weak interrupted radial lirae.	Family Afrograptidae
La Matilde Formation Santa Cruz province	Estancia El Malacara	*Cyzicus* (*Lioestheria*) *malacaraensis* Tasch, 1987	Elliptical outline, anterior umbo and strong radial lirae ornamentation.	Family Fushunograptidae
	Gran Bajo de San Julian	*Cyzicus* (*Lioestheria*) *santacrucensis* Gallego, 1994	Ovate-subcircular pteriforme outline, straigth to slightly convex dorsal margin, areolar to radial striated ornamentation pattern.	Family Palaeolimnadiopseidae

African records of this family from the Late Triassic, Early Jurassic and Early Cretaceous (Zhang et al. 1976; Shen 2003; Everman 2007; Stigall et al. 2014; Gallego et al. 2020) further support that the oldest findings in the Southern Hemisphere mentioned by Shen (1994) and Gallego (2010). The eosestheriid spinicaudatans from South America and Antarctica share many characters indicating close taxonomic and evolutionary relationships. From the 'euestheriid-loxomegaglyptid' ancestral forms, menucoestheriid type spinicaudatans probably evolved (as proposed Gallego 2010 based on Chen and Hudson 1991), and this latter group probably gave rise to the *Carapacestheria* types (that share reticulate ornamentation occupying nearly the whole surface of the carapace) as hypothesized by Gallego et al. (2005). The new record of genus *Carapacestheria* extended the biogeographical distribution from Antarctic to Argentina restricted to Early Jurassic-Middle Jurassic. On the other hand, the genus *Wolfestheria* was defined by Monferran et al. (2013) from Upper Jurassic of Argentina. With the new record of *W. patagoniensis*, the genus remains restricted to Argentina with a new stratigraphical distribution from Middle Jurassic to Upper Jurassic. The presence of fushunograptids in the Jurassic of South America allows us to correlate our sequences with Jurassic ones from Asia, and mainly to correlate our faunas with coeval ones that characterize biostratigraphical units from China and Asia, where this group is diverse for Late Jurassic included within the "*Eosestheriopsis dianzhongensis*" (Chen et al. 2007; Li 2004) and *Eosestheriopsis* fauna from SW China (Li and Matsouka 2012). Future studies about biostratigraphy and evolution context are need deeply analyzed, and a systematic revision of taxa that lacking SEM studies.

CONCLUSIONS

A morphological reexamination of species studied by Dr. P. Tasch in Tasch and Volkheimer (1970) and new material collected from different localities of the Las Chacritas Member from Cañadón Asfalto Formation (Argentina) allow referral of the material originally defined to *Cyzicus* (*Euestheria*) *taschi* Vallati be referred to *Carapacestheria taschi* (Vallati, 1986) nov. comb. The taxon originally defined as *Cyzicus* (*Lioestheria*) *patagoniensis* is now referred to *Wolfestheria patagoniensis* (Tasch, 1970) nov. comb. Therefore, these species belong within families Eosestheriidae and Fushunograptidae, respectively. The new record of the genus *Carapacestheria* extends the distribution of this genus from Antarctica to Argentina within the Early Jurassic-Middle Jurassic. The new record of *Wolfestheria* extends back the stratigraphical distribution of this genus from the Upper Jurassic to the Middle Jurassic. At the moment, Argentina Jurassic spinicaudatan records include four fushunograptid species, however, some taxa are in need of systematic revision.

List of abbreviations

L, valve length.
H, valve height.
l, hingeline length.
a, distance from anterior end of the dorsal margin to the anterior end of the valve.
b, distance from maximum anterior bulge to dorsal margin.
c, distance from the posterior end of the dorsal margin to the posterior end of the valve.
d, distance from maximum posterior bulge to dorsal margin.
e, distance from maximum ventral bulge to the anterior end of the valve.
DM, Dorsal margin.
PM, posterior margin.
AM, Anterior margin.
VM, ventral margin.

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