



## Scientific Note

### First occurrence of the interstitial polychaete *Saccocirrus pussicus* (Saccocirridae, Polychaeta) in exposed beaches of Uruguay

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**Abstract.** This paper reports the first occurrence of the family Saccocirridae, (*Saccocirrus pussicus*), in exposed sandy beaches of Uruguay. 981 individuals, with densities between 20 and 18,080 ind/m<sup>2</sup> and mean density of 163.5±362.9 ind/m<sup>2</sup> were found, mainly in the swash zone, with a clearly patchy distribution.

**Key words:** Saccocirridae, distribution, swash zone, sandy beaches

**Resumen. Primera ocurrencia del poliqueto intersticial *Saccocirrus pussicus* en playas expuestas de Uruguay.** Se registra la primera ocurrencia de Saccocirridae, (*Saccocirrus pussicus*) en playas arenosas expuestas de Uruguay. Se encontraron 981 individuos, con densidades variando entre 20 y 18080 ind/m<sup>2</sup> y una media de 163,5±362,9 ind/m<sup>2</sup>, principalmente en la zona de swash y con una clara distribución parcheada.

**Palabras clave:** Saccocirridae, distribución, zona de swash, playas arenosas

Saccocirridae are small interstitial polychaetes, common in the surf zone of coarse sand reflective beaches, usually in the retention zone (Rouse & Fauchald 1997, Brown 1981, Di Domenico *et al.* 2009). Despite hostile environmental conditions, the well-oxygenated retention zones of reflective beaches may provide an ideal environment for well-adapted interstitial animals such as species of *Saccocirrus* (Di Domenico *et al.* 2009). Saccocirrids are indeed mostly recorded in the intertidal zone of reflective sandy beaches (Martin 1977, Brown 1981, Sasaki 1981, Sasaki & Brown 1983) and have been reported in high densities in these heavy hydrodynamic zones in a recent study in Brazil (Di Domenico *et al.* 2009) and Australia (Brown 1981). These polychaetes usually measure between 2 and 10 mm in length and are about 500 µm wide. They present reduced parapodia and are considered truly interstitial organisms, unable to dig through fine sediments (Lee & Correa 2004). Saccocirridae is

distributed worldwide, most likely containing many undescribed species and occasionally poorly described species. The species recorded in this study, *Saccocirrus pussicus* (Marcus 1948), is recently re-described from Brazil (Di Domenico *et al. in prep*). There are no previous records of this family in Uruguay, so this paper records the first occurrence of the species and family in this region of the Southwestern Atlantic.

On January 13 2011, samples were collected in three beaches in the area of La Angostura, department of Rocha (Fig. 1), Atlantic coast of Uruguay. The two western beaches, La Esmeralda and La Base, can be considered as reflective, with a gentle slope, which contrasts with their coarse grain size and sediment composed primarily of coarse and very coarse sand, with a significant proportion of crushed shell. At the eastern end of the study area, La Viuda is a dissipative beach, with almost zero slope and fine sand and silt sediment. The sampling

design consisted of five transects (one in La Esmeralda, three in La Base and one in La Viuda) perpendicular to the coastline, from the surf line to the middle region of the swash zone, in which five stations were distributed at equal intervals. Samples were taken with a corer of 0.05m<sup>2</sup>, to a depth of 20 cm, and sieved on site with a mesh opening of 0.5 mm. Organisms were preserved in 70% alcohol until their sorting and counting under binocular microscope in the laboratory. The preserved specimens are deposited in the collection of Sección Oceanografía y Ecología Marina, Facultad de Ciencias, UdelaR.

981 saccocirrids were found. Only one species was recorded, namely *Saccocirrus pussicus* (Fig. 2). It occurred in three of the five transects (the eastern-most two in La Base and the one in La Viuda) (Table 1), with densities between 20 and 18.080 ind/m<sup>2</sup> and an average of 163.5 ± 362.9 ind/m<sup>2</sup>. There were no individuals in La Esmeralda, and in transect 1 of La Base. *Saccocirrus pussicus* always appeared in the swash zone, except for transect 3, Level 3, in La Base. *Saccocirrus pussicus* individuals collected from the Atlantic coast of Uruguay have a hyaline brownish body, with 40 to 80 segments; last 6-8 segments smaller and achaetous. Body long and robust, up to 12 mm

long and 250 µm wide. Prostomium with paired small pigmented eyes and long filiform palps (Fig. 2A). First segment without ciliary patches or pharynx. Parapodia with three types of chaetae: 1-2 long chaetae, symmetrically bifurcated, 2-3 medium oar-shaped chaetae, and 2-3 short thin chaetae (Fig. 2E). Paired pygidial lobes with 1-3 ventral transverse adhesive ridges (Fig. 2F). Bilateral ovaries in segments 19-50 of females, each with 2-3 large oocytes per ovarie (Fig. 2D, Di Domenico *et al.* in prep). Spermathecae absent. Bilateral seminal vesicles in segments 21-40 of males (Fig. 2C, Di Domenico *et al.* in prep). The *Saccocirrus pussicus* has a patchy distribution and, although it prefers the swash zone, it can be occasionally found at higher levels. The characteristic dense grouping of *Saccocirrus pussicus* in a narrow strip of the mesolittoral may facilitate internal fertilisation and the dispersal of planktotrophic larvae, which can then be transported by littoral drift currents and waves (Di Domenico, Martínez, Worsaae and Lana, personal observations). The importance of its appearance in Uruguay is that the same species has been found in southern and southeastern coasts of Brazil by Di Domenico (2012), suggesting a broad regional distribution



**Figure 1.** Study area showing the location of the five surveyed sites (yellow stars) in the three beaches and nearby towns and geographical features.

**Table I.** Total density (black) and density of *Saccocirrus pussicus* (red) (individuals/m<sup>2</sup>) in the five sites surveyed, showing in which replicates and levels the organisms were recorded.

	La Esmeralda			La Base 1			La Base 2			La Base 3			La Viuda		
<b>Level 1(dune)</b>	700	80	20	20	20	0	200	0	60	400	1820	40	60	140	120
<b>Level 2</b>	120	160	140	40	20	20	160	40	780	0	2260	260	60	300	700
<b>Level 3</b>	180	200	220	560	320	160	320	1160	80	920/20	360	420	460	100	140
<b>Level 4</b>	80	100	660	20	80	180	1100	280	20	40	980	460	20	180	3820
<b>Level 5(swash)</b>	20	100	160	80	120	180	380	840/580	80	440/180	460/260	18300/18080	0	0	680/25

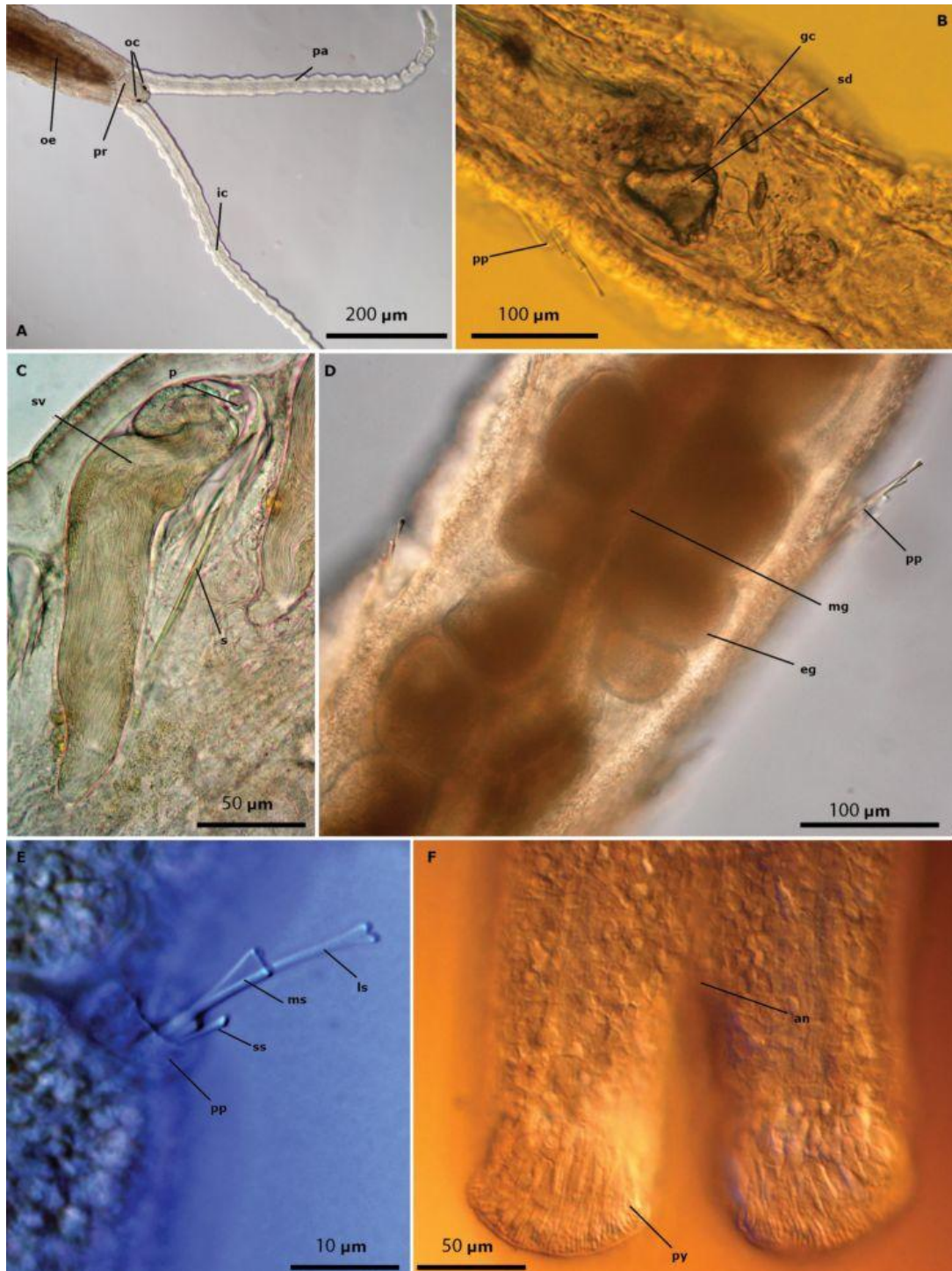
Saccocirridae include 22 nominal species belonging to *Saccocirrus* Bobretzky 1871 (Jouin & Gambi 2007). The most complete revisions were provided by Brown (1981) and Jouin & Gambi (2007). Species of *Saccocirrus* have been divided in two groups by several authors (Wu & Yang 1962, Gray 1969, Jouin 1971, Martin 1977, Brown 1981, Sasaki 1981, Sasaki & Brown 1983, Jouin & Rao 1987, Purschke & Jouin 1988, Bailey-Brock *et al.* 2003, Jouin & Gambi 2007): the “papillocercus group” (see Jouin & Rao 1987) and the “krusadensis group” (Jouin 1971). The “papillocercus group” consists of 10 species distributed worldwide, including *Saccocirrus pussicus*, all with bilateral gonads (see Jouin & Gambi 2007), no muscular pharyngeal organs nor ventral ciliation, the longest chaetae have short prongs and the medium chaetae have an oar-shaped tip. They are probably carnivorous. The remaining 12 described species of *Saccocirrus*, all from the Indo-Pacific, are included in the “krusadensis group”, with unilateral gonads, pharyngeal muscular organ and an anterior ventral ciliation. The longest chaetae are deeply bifid at the tip and the medium chaetae have a deep median notch at the tip. Species of this group are presumably detritivorous, being bacteria-diatom browsers, with an Indo-Pacific distribution (see Brown 1981, Jouin & Gambi 2007). *Saccocirrus pussicus* is included into the “papillocercus group” due to the longest chaetae having short prongs and the medium chaetae having an oar-shaped tip, and the presence of bilateral gonads and absence of a pharyngeal bulb. Within the group, it resembles *S. papillocercus* Bobretzky 1871 and *S. heterochaetus* Jouin 1975. *Saccocirrus pussicus* differs from *S. papillocercus* (Jouin & Gambi 2007) in the (1) smaller number of segments, (2) shorter body, (3) smaller number of pygidial ridges, (4) less fertile segments and *Saccocirrus pussicus* differs from *S. heterochaetus* in the presence of (1) eggs twice larger in the first; (2) 6 versus 4 eggs per segment; and (3) absence of hooks found in the fertile region of *S. heterochaetus*. Two species of *Saccocirrus* have been described from Brazil, *S. gabriellae* du Boys-Reimond Marcus 1946 and *S. pussicus* d.B-R. Marcus 1946. *Saccocirrus gabriellae* belongs to the “krusadensis group”. *Saccocirrus pussicus* report from Uruguay resembles *S. pussicus sensu* d.B-R. Marcus 1946 in the presence of bilateral seminal vesicles with terminal pencil-shaped penis, 4-5 oocytes per segment and the chaetal

arrangement, with 1-2 long bifurcated chaetae, 2-3 sturdy oar-shaped medium chaetae and 1-2 thin short chaetae. Those resemblances allow these specimens collected from Uruguay to be identified as *S. pussicus* (Di Domenico, Martínez, Worsaae and Lana, personal observations). Despite these resemblances, *S. pussicus* from Uruguay differs from the Brazilian populations in the presence of less body segments (65 versus 120 segments in *S. pussicus* d.B-R. Marcus 1946), (2) less pygidial ridges (3 versus, 12 pygidial ridges in *S. pussicus sensu* d.B-R. Marcus 1946), and (3) less fertile segments in *Saccocirrus pussicus* (20 versus 36 fertile segments in *S. pussicus sensu* d.B-R. Marcus 1946) (Di Domenico, Martínez, Worsaae and Lana, personal observations).

It would be interesting to determine whether *Saccocirrus pussicus* is present in other beaches east and west of the study area. The characteristics of La Viuda that allow the presence of *Saccocirrus pussicus* despite it being a dissipative beach with fine sediments should also be investigated. The re-recent re-description of *Saccocirrus pussicus* from Brazil highlights the importance of morphological studies, preferably through Scanning Electron Microscopy, as well as DNA data in order to describe and identify species and populations of the genus. Future studies of population genetics is necessary to test the similarity between the specimens collected in Uruguay and southern and southeastern Brazil and define the level of population structure of the species as well as aspects of adaptation to different environments. The exchange forces between boundary currents, La Plata River intrusions, local winds, swells and tides may provide significant genetic exchanges between *Saccocirrus pussicus* populations. The oceanic circulation over the southwestern Atlantic shelf is influenced by substantial freshwater discharges, high wind speeds and most importantly by its proximity to two of the largest western boundary currents of the world oceans: the Brazil and Malvinas currents (Matano *et al.* 2010). The exchanges between the Brazil Current and the South Brazil Bight are characterized by the intermittent development of eddies and meanders of the Brazil Current at the shelfbreak (Matano *et al.* 2010). However, it is argued that this is not the only –nor the most important –influence of the Brazil Current on the shelf. Although the region has no significant freshwater inputs, the southern portion of the bight

shows intrusions of low-salinity waters from the La Plata River (Piola *et al.* 2000). The influence of local winds, tides, swells on the shelf circulation has marked regional variations. The inner shelf is predominantly driven by local winds while the

middle and outer shelves are more influenced by the Brazil Current (Palma & Matano 2009). Among these oceanographic forces, *S. pussicus* larvae from Uruguay or Brazil may find suitable places to recruit in south or north directions.



**Figure 2.** *Saccocirrus pussicus* (from Di Domenico, Martinez, Worsaae, Lana, in prep) (A) Anterior end, dorsal view, (B) Content in midgut, internal view (C) Details of the seminal vesicle (D) eggs arranged bilaterally, (E) Lateral view of parapodium, showing chaeta. (F) Pygidium, fixed, dorsal view. Abbreviations: an, anus; eg, egg; mg, midgut; gc, gut contents; ic, palp intern canal; ls, longest setae; ms, medium setae; oe, oesophagus; oc, ocelli; p, penis; pa, palp; pp, parapodium, pr, prostomium; py, pygidium; s, setae; sd, sand; sv, seminal vesicle; ss, shortest setae.

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### References

- Bailey-Brock, J. H., Dreyer, J. & Brock, R. E. 2003. Three new species of *Saccocirrus* (Polychaeta: Saccocirridae) from Hawaii. **Pacific Science**, 57: 463-478.
- Brown, R. 1981. Saccocirridae (Annelida: Archiannelida) from the central coast of New South Wales. **Australian Journal of Marine and Freshwater Research**, 32: 439-456.
- Di Domenico, M. 2012. Poliquetas intersticiais da costa sul e sudeste do Brasil. **PhD. Thesis**. Universidade Federal do Paraná, Curitiba, Brasil, 226 p.
- Di Domenico, M., Lana, P. C. & Garraffoni, A.R.S. 2009. Distribution patterns of interstitial polychaetes in sandy beaches of southern Brazil. **Marine Ecology**, 30:47-62.
- Gray, J. S. A. 1969. New species of *Saccocirrus* (Archiannelida) from the West Coast of North America. **Pacific Science**, 23:238-251.
- Jouin, C. 1971. Status of the knowledge of the systematics and ecology of Archiannelida. In: Hulings, N.C. (ed.). **Proceedings of the First International Conference on meiofauna**. Smithsonian Contributions to Zoology, 76: 47-56.
- Jouin, C. & Gambi, C. 2007. Description of *Saccocirrus goodrichi* sp. nov. (Annelida: Polychaeta: Saccocirridae), a new Mediterranean species and new data on the chaetae of *S. papillocercus* and *S. major*. **Cahiers de Biologie Marine**, 48:381-390.
- Jouin, C. & Rao, G. C. 1987. Morphological studies on some Polygordiidae and Saccocirridae (Polychaeta) from the Indian Ocean. **Cahiers de Biologie Marine**, 28: 389-402.
- Lee, M. R. & Correa, J. A. 2004. Copper mine tailings disposal: consequences for the interstitial polychaete *Saccocirrus sonomacus* (Canalipalpata: Protodrilida). **Journal of the Marine Biological Association of the United Kingdom**, 84: 603-606.
- Martin, G. G. 1977. *Saccocirrus sonomacus* sp. nov., a new archiannelid from California. **Transactions of the American Microscopical Society**, 96:97-103.
- Matano, R. P., Palma, E. D. & Piola, A. R. 2010. The influence of the Brazil and Malvinas Currents on the southwestern Atlantic shelf circulation. **Ocean Science Discussions**, 7:837-871.
- Palma, E. D. & Matano, R. P. 2009. Disentangling the upwelling mechanisms of the South Brazil Bight. **Continental Shelf Research**. 29: 1525–1534,
- Piola, A. R., Campos, E. J. D., Moller, O. O., Charo, M. & Martinez, C. 2000. Subtropical shelf front of eastern South America, **Journal of Geophysical Research**, 105(C3): 6566–6578.
- Purschke, G. & Jouin, C. 1988. Anatomy and ultrastructure of the ventral pharyngeal organ of *Saccocirrus* (Saccocirridae) and *Protodriloides* (Protodriloidae fam. nov.) with remarks on the phylogenetic relationships within the Protodrilida (Annelida: Polychaeta). **Journal of Zoology (London)**, 215: 405-432.
- Rouse, G. W. & Fauchald, K. 1997. Cladistics and polychaetes. **Zoologica Scripta**, 26: 139-240.
- Sasaki, S. & Brown, R. 1983. Larval development of *Saccocirrus uchidai* from Hokkaido, Japan and *Saccocirrus krusadensis* from New South Wales, Australia (Archiannelida, Saccocirridae). **Annotationes Zoologicae Japonenses**, 56: 299-314.
- Sasaki, S. 1981. A new species of the genus *Saccocirrus* (Archiannelida) from Hokkaido, Northern Japan. **Annotationes Zoologicae Japonenses**, 54: 259-266.
- Wu, B. L. & Yang, D. J. 1962. The taxonomy and distribution of the genus *Saccocirrus* Bobretzky (Archiannelida) (Russian abstract). **Oceanologia et Limnologia Sinica**, 4:169-179.

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