



## Rediscovering *Fibulia myxillioides* (Burton, 1932) (Porifera, Poecilosclerida) in the SW Atlantic Ocean

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**Abstract:** *Fibulia* Carter, 1886 is a rare genus within the Order Poecilosclerida, at present it includes ten species: six have been reported from the Pacific Ocean (Australia and New Zealand), two from Antarctica and two from the southern Atlantic Ocean. Species of this genus have a plumose or confused skeleton composed of multispicular tracts and arcuate or reduced isochelae as microscleres. Ten specimens of *Fibulia myxillioides* (Burton, 1932) were collected during three expeditions on board RV “Puerto Deseado” to the first Argentinian off-shore Marine Protected Area Namuncurá/ Burdwood Bank. Herein we provide new records and update the bathymetric and latitudinal ranges of this rare and endemic species. Photographs of fresh specimens together with scanning electron micrographs and photomicrographs of the spicules and skeletal architecture of *F. myxillioides* are provided for the first time for this species and genus.

**Key words:** deep-sea, Burdwood Bank, sponges, taxonomy, Argentina.

**Redescubriendo a *Fibulia myxillioides* (Burton, 1932) (Porifera, Poecilosclerida) en el Atlántico Sudoccidental** **Resumen:** *Fibulia* Carter, 1886 es un género poco común del Orden Poecilosclerida que actualmente incluye 10 especies: Seis registradas en el Océano Pacífico (Australia y Nueva Zelanda), dos en la Antártida y dos en el sur del Océano Atlántico. Las especies de este orden están caracterizadas por la presencia de un esqueleto plumoso o confuso compuesto por haces multiespiculares y con isoquelas arqueadas o reducidas. Como resultado de tres expediciones a bordo del buque “Puerto Deseado” en la primera Área Marina Protegida de la Argentina llamada Namuncurá/ Banco Burdwood y localizada en aguas de la plataforma continental, se colectaron 10 especímenes que fueron identificados como *Fibulia myxillioides* (Burton, 1932). En este trabajo se proveen nuevos registros para esta rara especie endémica, a la vez que se actualizan tanto los rangos latitudinales como batimétricos de su distribución. Además, se proveen por primera vez para la especie y el género imágenes de los ejemplares frescos, de su arquitectura esquelética y de las espículas, incluidas imágenes de microscopía electrónica de barrido.

**Palabras clave:** mar profundo, Banco Burdwood, esponjas, taxonomía, Argentina.

### Introduction

*Fibulia* Carter, 1886 is a rare genus within the Order Poecilosclerida which at present includes only ten species (de Voogd *et al.* 2021): six have been reported from the Pacific Ocean (Australia and New

Zealand), two from Antarctica and two recorded from the southern part of the Atlantic Ocean. Species of this genus have a plumose or confused skeleton of multispicular tracts with arcuate or reduced isochelae as microscleres (van Soest 2002).

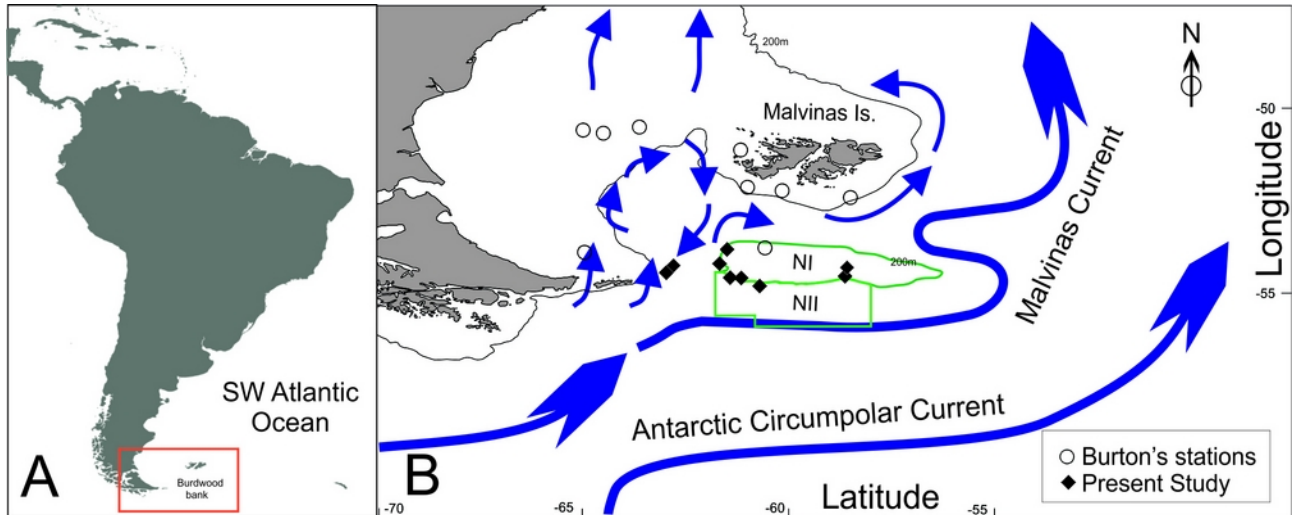
Specifically, *Fibulia myxillioides* was originally described by Burton (1932) as *Plumocolumella myxillioides* from samples collected from 9 sites (Table I, Fig. 1) during an expedition onboard RRS “William Scoresby” 1927–1928. The holotype is deposited in the Natural History Museum of London (BMNH 1928.2.15.321; Additional material BMNH 1928.2.15.788) from the Malvinas (Falkland) Islands. The recorded distribution of this species comprised Malvinas (Falkland) Islands and Burdwood Bank in the SW Atlantic Ocean. Burton’s original description consisted in a synthetic paragraph and illustrations of two specimens (Figure 2B), with only a few measurements and no illustrations of the spicules or skeleton. There were no further records of this species until recent times (see López Gappa & Landoni 2005 for a review). The only additional information regarding this species concerned its generic assignation, it was transferred to *Xytopsaga* (de Laubenfels, 1936) and later to *Fibulia* (van Soest, 2002).

About 90 years after the “William Scoresby” Expedition, several research cruises surveyed Burdwood Bank and surrounding areas between

2013 and 2018. The main objectives of these expeditions were to obtain biological, ecological and oceanographic information for the first Argentinian off-shore Marine Protected Area (MPA) Namuncurá/ Burdwood Bank I (Figure 1), which was established in 2013 (Argentina, Law 26875) (see Schejter *et al.* 2016, 2017a, 2020a, b, Falabella *et al.* 2017, Schejter & Albano, 2021). During these cruises, rich benthic communities were recorded and large densities of sponges were observed especially at the plateau of the bank at <200 m depth (Schejter *et al.* 2016, 2017a, 2019, Schejter & Albano, 2021). Many sponges were found inhabiting the slopes along with cold water corals (Schejter *et al.* 2017b, 2019, 2020a, b; Schejter & Bremec 2019). Sponge specimens that fit Burton’s description of *Fibulia myxillioides* were separated and herein studied and reported. The objectives of the present study were to complement some aspects of the original description of *Fibulia myxillioides* and to update the latitudinal and bathymetric ranges. We also provide for the first time, photographs of living specimens and scanning electron micrographs and photomicrographs of its skeleton and spicules.

**Table I.** *Fibulia myxillioides* records reported by Burton (1932) (Expeditions developed in 1927 and 1928) and from the present study (Expeditions developed in 2013, 2016 and 2017). Coordinates (Latitude, Longitude) correspond to the start of the haul.

Expedition	Year	Station	Depth (m)	Latitude (S)	Longitude (W)
William Scoresby	1927	79	131–132	51°01'30"	64°59'30"
William Scoresby	1927	80	152–156	50°57'	63°37'30"
William Scoresby	1927	81	81–82	51°30'30"	61°10'
William Scoresby	1927	83	129–137	52°30'	60°09'30"
William Scoresby	1927	86	147–151	53°53'30"	60°34'30"
William Scoresby	1927	88	96–127	54°	64°57'30"
William Scoresby	1928	243	141–144	51°06'	64°30'
William Scoresby	1928	246	208–267	52°25'	61°
William Scoresby	1928	248	210–242	52°40'	58°30'
Puerto Deseado	2013	6	235	54° 16' 39"	61° 40' 41"
Puerto Deseado	2016	17	202	54° 37' 29"	61° 9' 9"
Puerto Deseado	2016	18	607	54° 49' 15"	60° 42' 12"
Puerto Deseado	2016	36	185	53° 55' 47"	61° 29' 44"
Puerto Deseado	2016	40	415	54° 37'	61° 25' 14"
Puerto Deseado	2016	38	135	54° 35' 19"	58° 32' 49"
Puerto Deseado	2016	26	137	54° 24' 56"	58° 30' 54"
Puerto Deseado	2017	13	460	54° 32' 39"	63° 0' 42"
Puerto Deseado	2017	14	486	54° 24' 19"	62° 49' 16"
Puerto Deseado	2017	43	392	54° 37' 21"	61° 27' 33"



**Figure 1.** A. Location of the study area (red rectangle) in the SW Atlantic Ocean. B. Reported distribution of *Fibulia myxillioides* from Burton (1932) (white circles) and from the present study (black diamonds). Currents (in blue) were taken from Falabella *et al.* (2017). The areas of the MPAs Namuncurá/ Burdwood Bank I and II (NI and NII, respectively) are delimited by the green polygons.

## Material and Methods

Sponge samples were collected by trawling during two expeditions onboard the RV “*Puerto Deseado*” (March 26–April 25, 2016; April 22–May 12, 2017). An additional specimen (previously unidentified) acquired during a previous expedition of the RV “*Puerto Deseado*” (2013) was also studied (Table I). Sponge samples were sorted from the total catch, photographed, labelled and preserved by freezing onboard the ship. They were then transported and studied at the Benthos Laboratory of the Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP), Mar del Plata, Argentina. Taxonomic work on the sponges used the classical methodology described in Rützler (1978) and Hajdu *et al.* (2011). For the identification of the species, small pieces of tissue were digested in a sodium hypochlorite solution to clean the spicules, and consecutively washed with water and ethanol. Spicules were mounted using synthetic Canada balsam. In order to study the skeleton, sections of sponge tissue were cut by hand perpendicular and tangentially to the sponge surface using a razor blade. The sections were dehydrated using xylene then mounted in synthetic Canada balsam. The spicules and skeletal architecture were observed and measured using a Leica DM 1000 stereomicroscope with a Leica ICC50 HD camera and a Leica MZ 8 stereomicroscope with a Leica IC80 HD camera at the Benthos Laboratory (INIDEP). Spicule sizes of each specimen are based on approximately 20–25 measurements for each spicule category, comprising minimum, average, and maximum lengths by

minimum and maximum width in micrometres ( $\mu\text{m}$ ).

For the Scanning Electron Microscope (SEM) images, small fragments of sponge tissue were heat-dissolved in nitric acid, rinsed in water, and dehydrated in ethanol; the spicules were mounted on stubs and sputter-coated with gold. We used the SEM microscope JEOL JSM 6460 LV at the Mar del Plata University, Argentina.

In the present contribution, we follow the Porifera classification proposed by Morrow & Cárdenas (2015) and the World Porifera Database (de Voogd *et al.* 2021).

## Results

### Taxonomy:

- Phylum Porifera Grant, 1836
- Class Demospongiae Sollas, 1885
- Subclass Heteroscleromorpha Cárdenas, Pérez and Boury-Esnault, 2012
- Order Poecilosclerida Topsent, 1928
- Family Dendoricellidae Hentschel, 1923
- Genus *Fibulia* Carter, 1886
- Fibulia myxillioides* (Burton, 1932)

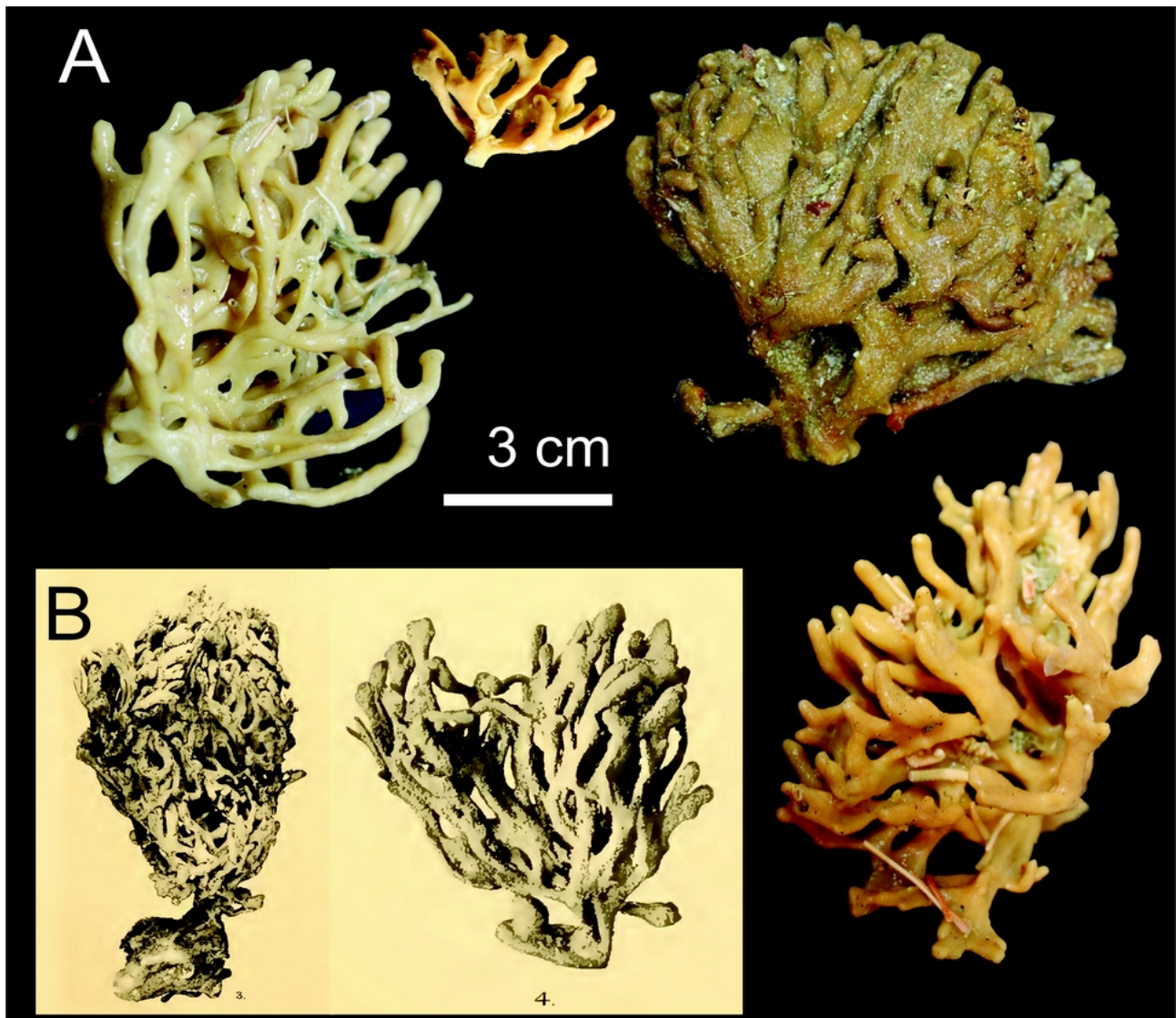
**Material studied:** 10 specimens were collected at the locations mentioned in Table I, Figure 1. Voucher specimens were deposited at the Museo Argentino de Ciencias Naturales “Bernardino Rivadavia” (MACN) under the collection numbers MACN-In 43538, 43539, 43540, 43541, 43542, 43543, 43544.

**Description:** The studied specimens reached up to 12 cm in height. They have an erect and arborescent morphology, with flattened anastomosed branches

(Fig. 2). The majority of the specimens were detached from the substratum, probably due to the collection methodology (trawling). However, one small specimen was found attached to a dead coral skeleton of *Balanophyllia* (*Balanophyllia*) *malouinensis* Squires, 1961, the most common scleractinian species in the area (see Schejter & Bremec 2019). Another specimen was growing on a dead stylasterid skeleton (probably *Errina* sp.) which is also common in the area (Schejter *et al.* 2020b) (Fig. 3). Living specimens were usually a bright yellow-brownish color and the surface was slippery and smooth (Fig. 2A). In the dried specimens, large subdermal canals are evident under the transparent ectosome (Fig. 4B, C). The skeleton is composed of branches and bundles of

oxeotetorota running longitudinally (Fig. 4A, B, D) with scattered isochelae, that are more evident in the transparent ectosome (Fig. 4B).

Spicules are hastate usually straight oxeotetorota, with pointed ends, ranging in length 310–530  $\mu\text{m}$  by 7.5–10  $\mu\text{m}$  in width, and robust arcuate, tridentate isochelae which range from 25–35  $\mu\text{m}$  (Figure 5). Table II gives details of the spicule measurements of the studied specimens. These measures are in accordance with the measurements in the original description. The photographs provided represent the first images of this species, previously there were only two drawings illustrating the general morphology of the species (Burton, 1932 and Figure 2B).

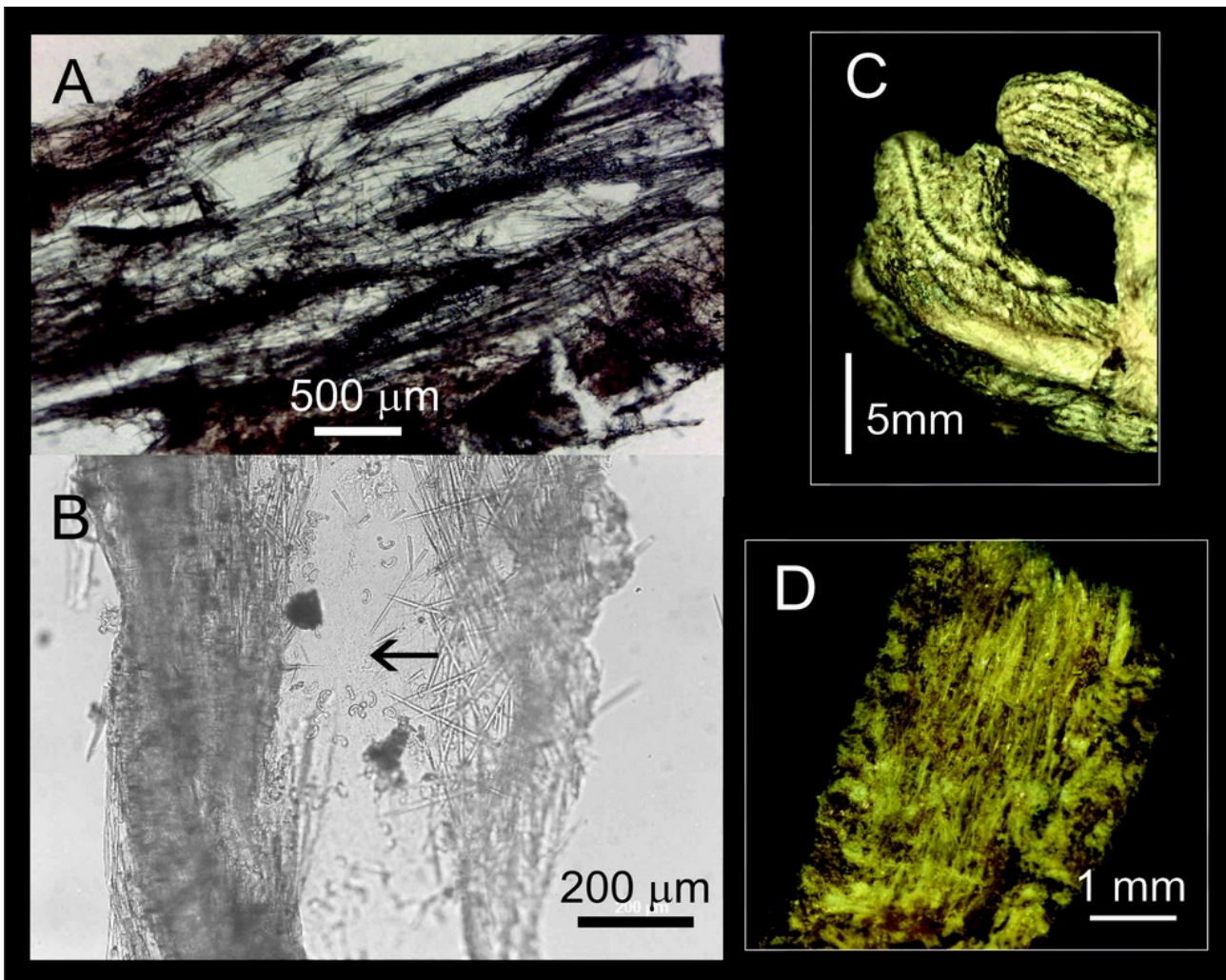


**Figure 2.** A. *Fibulia myxillioides*. General morphology of the specimens recorded in the present study showing the live colour. B. Draws of *F. myxillioides* (taken from Burton 1932).



**Figure 3.** Settlement substrate in *Fibulia myxillioides* specimens: **A.** on the skeleton of the scleractinian *Balanophyllia (Balanophyllia) malouinensis*, **B.** on the skeleton of a dead stylasterid coral (probably *Errina* sp.).

*Remarks:* According to our results, *F. myxillioides* is distributed in the Malvinas region and at the MPA Namuncurá/ Burdwood Bank I (depth <200m), but also at the MPA Namuncurá/ Burdwood Bank II, located in the southern slope, at depths >200m (Figure 1), here considered as a deep-sea area, according to the definition given by Kaiser *et al.* (2011). The original bathymetric range of *F. myxillioides* reported by Burton (1932) was 81–267m. According to our findings, the bathymetric range is here updated to 608 m (Table I). We also provide the southernmost record of this species (54° 49' 15"S) at station 18 of the 2016 Expedition (Table I), at the MPA Namuncurá/ Burdwood Bank II (created in 2018, National Law 27490).



**Figure 4.** *Fibulia myxillioides*. **A.** Skeleton. Longitudinal branches of oxetotornota. **B.** Transparent ectosoma with scattered isochelae (arrow) between two branches and bundles of oxetotornota. **C.** Macroscopic view of part of a dried specimen showing subdermal canals. **D.** Longitudinal and macroscopic view of the interior of one branch, with columns of oxetotornota running longitudinally.

**Table II.** *Fibulia myxillioides*. Spicule dimensions of the studied specimens.

Expedition	Year	Station	Oxeotetornota ( $\mu\text{m}$ )	Arcuate Isochelae ( $\mu\text{m}$ )
Puerto Deseado	2013	6	315 (388) 430 x 7.5–10	25 (30) 35
Puerto Deseado	2016	17	360 (397) 410 x 7.5–10	25 (30) 35
Puerto Deseado	2016	18	390 (437) 490 x 7.5–10	30 (31) 35
Puerto Deseado	2016	26	350 (407) 450 x 7.5–10	25 (27) 30
Puerto Deseado	2016	36	350 (407) 470 x 7.5–10	25 (30) 35
Puerto Deseado	2016	38	310 (352) 400 x 7.5–10	25 (27) 30
Puerto Deseado	2016	40	450 (494) 530 x 10	30 (34) 35
Puerto Deseado	2017	13	440 (458) 490 x 10	30 (31) 35
Puerto Deseado	2017	14	440 (465) 530 x 10	27 (29) 30
Puerto Deseado	2017	43	380 (428) 470 x 7.5–10	25 (30) 35

**Figure 5.** Scanning Electron Microscope (SEM) images of the spicules of *Fibulia myxillioides*. Oxeotetornote, detail of the tip of an oxeotetornote and arcuate isochelae tridentate.

## Discussion

López Gappa & Landoni (2005) published a complete review of the sponges recorded in Argentinian waters. Since then, only a few studies reporting new sponge species and distributions were published in the coastal region, the continental shelf and slope of Argentina (Bertolino *et al.* 2007, Urteaga & Pastorino 2007, Schejter *et al.* 2006, 2011, 2014, 2017b, Ríos & Cristobo 2018, Gastaldi *et al.* 2018), including Malvinas (Falkland) coastal waters (Goodwin *et al.* 2011, 2016). None of the afore mentioned studies recorded *F. myxillioides*. Given the paucity of records of *F. myxillioides* and taking into account that the species is probably easy to identify according to its morphology and the characteristic spicules and skeleton, we conclude that it may be considered an endemic species to the

Malvinas/ Burdwood Bank region. The Malvinas current and oceanographic conditions of the area (Piola & Gordon 1989, Matano *et al.* 2019) are probably influencing this particular distribution (Fig. 1) in subantarctic waters of the SW Atlantic Ocean. Species having restricted distributional ranges are likely to have small environmental tolerances or restricted dispersal ability (Ellingsen *et al.* 2007). Considering that several fisheries are developed in the Malvinas (Falkland) region and that the area is currently gaining interest for the exploration and exploitation of hydrocarbons (i.e. Allega *et al.* 2020, Palomares & Pauly 2015), the fact that this rare species is found within the MPAs will hopefully contribute to its conservation.

The species of *Fibulia* described to date were discovered at the end of the 19<sup>th</sup> century and the

beginning of the 20<sup>th</sup> century, all of them from the southern hemisphere, in the Antarctic or Subantarctic region (4 species), Australia (5 species) and one in southern Africa and Buenos Aires shelf region. Table III presents a comparison of the ten recognized species in terms of depth, external morphology and spicular composition. Its forms are varied from encrusting, branched, cylindrical arborescent or cauliform. Only one, *F. cribriporosa* (Burton, 1929), does not present chelae, two of them have sigma like microsclera, *F. conulissima* (Whitelegge, 1906) and *F. hispidosa* (Whitelegge, 1906) and the rest present isochelae as microsclera. It is important to note that in the present study it is the first time that photographs of skeletal elements have been published using scanning electron microscope (SEM) for one species of this genus. In this sense, this study represents an important taxonomic contribution to the knowledge of this uncommon genus.

### Acknowledgements

The authors would like to thank the scientists and technicians who kindly assisted with sampling procedures during the expeditions. We also thank Mónica Oppedisano (Mar del Plata University) for the technical assistance during SEM image acquisition and Cristina Boza from the Gijón Oceanographic Center (IEO) for her help with the search for information on *Fibulia* species. The authors are also grateful to Christine Morrow for critically reviewing the manuscript's English use. The suggestions of the anonymous reviewers helped to improve the final version of this article. This study was partially financed by INIDEP, MPA Namuncurá/ Burdwood Bank Law 26.875/2013 and by PICT 2019-4233 to LS. This is INIDEP Contribution N°2261 and MPA Namuncurá/ Burdwood Bank Contribution N°59.

**Table III.** Comparison of accepted species of the genus *Fibulia* according to de Voogd *et al.* (2021).

	<b>Distribution</b>	<b>Reference</b>	<b>Depth (m)</b>	<b>Shape</b>	<b>Megascleres (µm)</b>	<b>Microscleres (µm)</b>
<i>Fibulia anchorata</i> (Carter, 1881)	Australia	Carter, 1881	?	Cauliform	Oxeas 298x12.7	Isochelae 15-20
<i>Fibulia carnosus</i> Carter, 1886	Australia	Carter, 1886	9-33	Cilindrical	Oxeas 155-245x10-15	Isochelae 8-15
<i>Fibulia conulissima</i> (Whitelegge, 1906)	Australia	Whitelegge, 1906	?	Branched	Oxeas 170x10	Sigma 25-100
<i>Fibulia cribriporosa</i> (Burton, 1929)	Antarctica	Burton, 1929	90-372	Cilindrical branched	Oxeas 480x12	No chelae
<i>Fibulia hispidosa</i> (Whitelegge, 1906)	Australia	Whitelegge, 1906		Arborescent	Oxeas 180-200x8-10	Sigma 15-120
<i>Fibulia intermedia</i> (Dendy, 1896)	Australia	Dendy, 1896	?	Branched	Oxeas 250x10	Isochelae 16
<i>Fibulia maeandrina</i> (Kirkpatrick, 1907)	Antarctica, South Georgia	Kirkpatrick, 1907	182.8	Cilindrical	Oxeas 579x39	Isochelae 26x15.8
<i>Fibulia myxillioides</i> (Burton, 1932)	Patagonian Shelf Malvinas /Falklands	Burton, 1932	81-267	Arborescent	Oxeas 248-333x5-8	Isochelae 26-33
<i>Fibulia myxillioides</i> (Burton, 1932)	Burdwood Bank	This work	135-607	Arborescent	Oxeas 310-530 x 7.5-10	Isochelae 25-35
<i>Fibulia novaezealandiae</i> (Brøndsted, 1924)	New Zealand	Brøndsted, 1924	14.6	Encrusting	Oxeas 350x6	Isochelae 12-14
<i>Fibulia ramosa</i> (Ridley & Dendy, 1886)	Agulhas Bank	Ridley & Dendy, 1886	91-137	Branched	Oxeas 600x22	Isochelae 20
<i>Fibulia ramosa</i> (Ridley & Dendy, 1886)	South Africa	Levi, 1963	274,32	Branched	Oxeas 450-500 x 18-25	Isochelae 11-12/ 15-15
<i>Fibulia ramosa</i> (Ridley & Dendy, 1886)	South Africa and Marion Island	Koltun 1964	91-274	Branched	Oxeas 600x22	Isochelae 20
<i>Fibulia ramosa</i> (Ridley & Dendy, 1886)	Buenos Aires shelf	Cuartas, 1992	80	Branched	Oxeas 370-400 x 8-10	Isochelae 22.30

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Received: December 2020

Accepted: November 2021

Published: April 2022