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Sponges (Porifera: Demospongiae) recorded at the South Shetland Islands and near the Antarctic Peninsula during the Argentinian Summer Antarctic Expedition in 2012

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Abstract: The Argentinian 2012 Summer Antarctic Expedition took place in the Austral summer of 2012. One of its main goals was the study of the benthic communities, considering the biodiversity and the distribution of the species around the Antarctic Peninsula and neighbouring islands. Samples were mainly collected by bottom trawling at eight locations. Sponges were sorted from total catch, photographed, labeled and frozen onboard, while identification was carried out using the classical methodology at the Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP, Argentina). In this preliminary study we provide data on sponges belonging to the Demospongiae Class. A total of 34 samples were collected and at least 24 species were identified. The most represented Order was Poecilosclerida with 18 species (*Isodictya erinacea, I. lankesteri, I.* cf. *verrucosa, Mycale (Oxymycale) acerata, M. (M.)* cf. *tridens, Phorbas glaberrimus, P. acantochela, Lissodendoryx (Ectyodoryx) anacantha, L. (E.) ramilobosa, L. (L.) flabellata, Artemisina apollinis, Myxodoryx hanitschi, Clathria (Axosuberites) nidificata, Tedania charcoti, Iophon unicorne, I.* cf. *aceratum, Myxilla (M.) mollis, Kirkpatrickia* aff. *coulmani*), followed by Haplosclerida with 5 species (*Haliclonissa verrucosa, Haliclona* sp., *Calyx* cf. *arcuarius, Microxina charcoti, Hemigellius* cf. *pilosus*). The most frequently recorded species was *Mycale (O.) acerata* followed by species of the genus *Isodictya* and *Lissodendoryx*. Some of the recorded species such as *Phorbas glaberrimus, Myxodoryx hanitschi, Phorbas* cf. *acanthochela* and *Raspailia (Hymeraphiopsis) hentscheli* have only scarce records in this region. The results of this study greatly contribute to the knowledge on the distribution and biodiversity of Antarctic sponges, a very important component of the benthic communities.

Keywords: Sponges; Demospongiae; Biodiversity; Species distribution; Benthic communities; Antarctica; South Shetland Islands.

1. Introduction

The marine benthic Antarctic communities are often dominated by sessile suspension-feeders such as sponges, cnidarians, bryozoans, ascidians and some bivalves as well [1]. Particularly, sponges are one of the most important components, especially in some regions [2]. In addition, they offer shelter and protection to a great variety of small organisms, from prokaryotic and eukaryotic unicellular organisms to small fish, polychaetes, mollusks, and crustaceans [3].
Comprising more than 8553 species, the Class Demospongiae is by far the largest within the phylum Porifera. From Antarctica and adjacent areas, currently, more than 352 species were reported and this number is expected to be even larger due to other recent discoveries [4].
Since the 19th century, several scientific expeditions have been developed in different regions of Antarctica , nevertheless there are still some areas unsatisfactory sampled that will probably add further data in regards to biodiversity, abundance and distribution of Antarctic sponges [5, 4].
For the mentioned reasons, the aim of this work is to contribute to the knowledge on the distribution and biodiversity of sponge species in areas of the Antarctic Peninsula and neighbouring islands.

2. Material and Methodology

Samples were collected at 8 sites during the Argentinean Antarctic Expedition onboard RV "Puerto Deseado" (Figure 1, Table 1), performed between February 13rd and March 24th in 2012 (CAV 2012). All necessary permits for sampling and observational field studies in Antarctica have been obtained by the authors from the competent authorities before the cruises (Dirección Nacional del Antártico, Argentina).

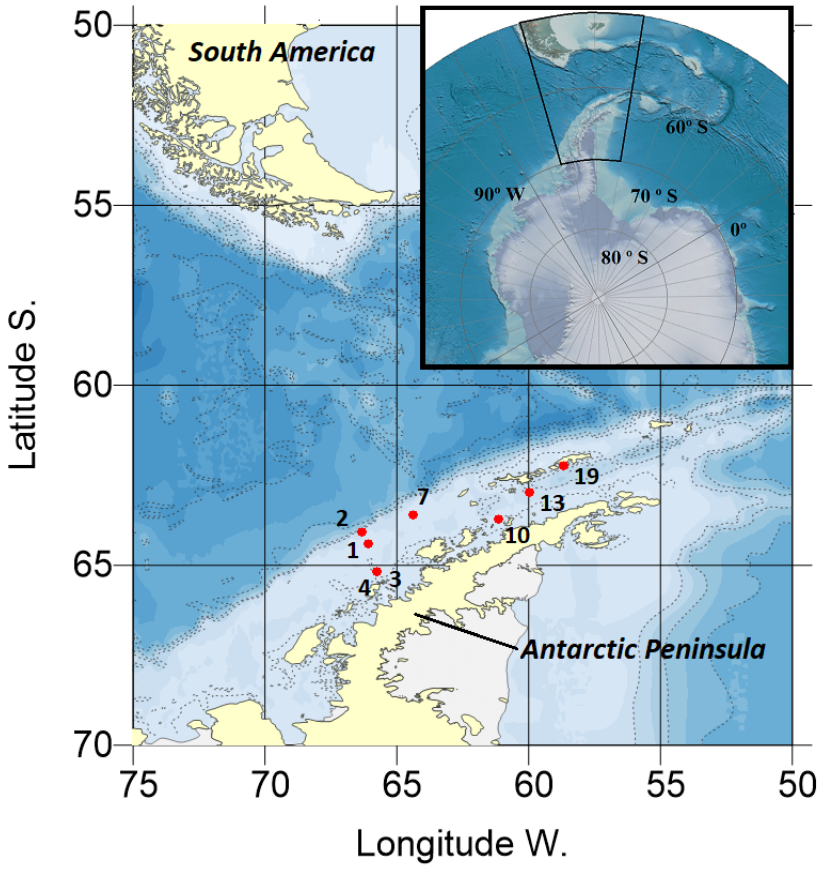

Figure 1. Study area and location of the stations sampled during the 2012 Argentinian Summer Antarctic Expedition. Antarctica map modified from NOAA (see https://www.arcgis.com/home/item.html?id=d13b9d10219e4429974e48368b64e41f)

Sampling was mainly performed using a bottom trawl net (6 m total length, with a 25 mm mesh on the wings and 10 mm in the cod end). Samples from station 19 were obtained as bycatch using a home-made longline, in coastal waters in front of "Carlini" Station (Argentina). General characterization of the catches of CAV 2012 was provided by Schejter [6]. Sponge specimens were separated from total catches, photographed and frozen on board. Live colour and complementary data were also acquired during the cruise. Later, in the laboratory (Benthos Laboratory, INIDEP, Argentina), the samples were preserved in a formaldehyde solution or dried for spicule and skeleton preparations.

Identification of the species was performed using the classical taxonomical methodology. In order to study the spicules, the organic matter was digested with a sodium hypochlorite solution, and consecutively washed with water and ethanol according to the known standard procedures before mounting on microscope slides [7]. Spicules were measured and examined with a Leica DM 1000 stereomicroscope. The data for spicule sizes are based on about 25–30 measurements for each spicule category. The skeletal architecture was also studied by light microscopy using a Leica MZ 8 stereomicroscope.
General classification system adopted in this work is the one proposed by Morrow and Cárdenas [8] as followed by the World Porifera Database (http://www.marinespecies.org/porifera/).

3. Results and Discussion

For the present study, we considered 34 sponge samples belonging to Class Demospongiae. Samples corresponded to 3 orders, 12 families, 16 genus and at least 24 species (Table 1, Figure 2).

Table 1. Location of the sampling sites and sponge species recorded during the present study.

Station	LAT (S)	LONG (W)	Depth (m)	Recorded Taxa
1	64º 24.740′	66º 05.420′	327	*Calyx* cf. *arcuarius*
2	64º 53.639′	66º 20.000′	404	*Raspailia (Hymeraphiopsis) hentscheli, Haliclona* sp.
3	65º 10.297′	65º 44.207′	187	*Mycale (Oxymycale) acerata, Haliclonissa verrucosa*
4	65º 11.134′	65º 45.827′	196	*Hemigellius* cf. *pilosus, Lissodendoryx (Ectyodoryx) anacantha, Microxina charcoti, Clathria (Axosuberites) nidificata, Isodictya* cf. *setifera, Haliclona* sp., *Mycale (Oxymycale) acerata, Lissodendoryx (Ectyodoryx) ramilobosa*
7	63º 36.182′	64º 21.809′	355	*Isodictya* cf. *verrucosa, Lissodendoryx (Ectyodoryx) anacantha, Haliclona* sp.
10	63º 43.092′	61º 07.402′	142	*Kirkpatrickia* aff. *coulmani, Mycale (Oxymycale) acerata, Isodictya lankesteri, Tedania (Tedaniopsis) charcoti, Myxodoryx hanitschi, Phorbas acantochela, Lissodendoryx (Lissodendoryx) flabellata, Artemisina apollinis, Phorbas glaberrimus, Myxilla (Myxilla) mollis, Iophon unicorne*
13	62º 59.310′	59º 57.246′	989	*Mycale (Mycale)* cf. *tridens, Iophon* cf. *aceratum, Iophon unicorne*
19	62º 13.873′	58º 39.919′	43	*Isodictya erinacea, Mycale (Oxymycale) acerata*

The most represented Order was Poecilosclerida with 18 species (*Isodictya erinacea, I. lankesteri, I.* cf. *verrucosa, Mycale (Oxymycale) acerata, M. (M.)* cf. *tridens, Phorbas glaberrimus, P. acantochela, Lissodendoryx (Ectyodoryx) anacantha, L. (L.) flabellata, L. (E.) ramilobosa, Artemisina apollinis, Myxodoryx hanitschi, Clathria (Axosuberites) nidificata, Tedania (Tedaniopsis) charcoti, Iophon unicorne, I.* cf. *aceratum, Myxilla (Myxilla) mollis*, *Kirkpatrickia* aff. *coulmani*), followed by Haplosclerida with 5 species (*Haliclonissa verrucosa, Haliclona* sp., *Calyx* cf. *arcuarius, Microxina charcoti, Hemigellius* cf. *pilosus*).

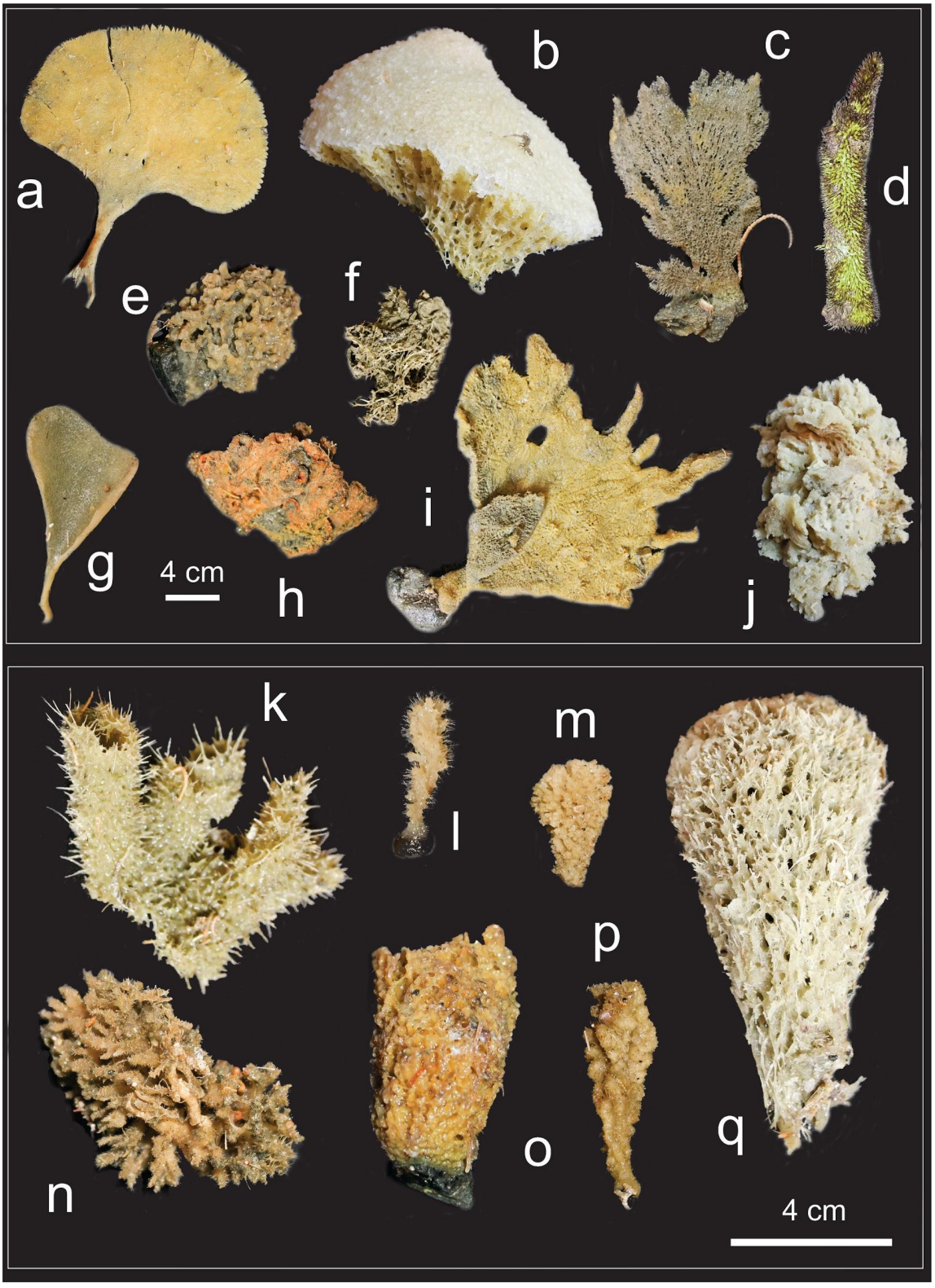

Figure 2. Photographs of several sampled species. a) *Isodictya lankesteri;* b) *Mycale (O.) acerata*; c) *Kirkpatrickia* aff. *coulmani*; d) *Isodictya erinacea*; e) *Tedania (T.) charcoti*; f) *Mycale (M.)* cf. *tridens*; g) *Calyx* cf. *arcuarius*; h) *Artemisina apollinis*; i) *Lissodendoryx (L.) flabellata*; j) *Haliclonissa verrucosa*; k) *Microxina charcoti;* l) *Raspailia (H.) hentscheli*; m) *Lissodendoryx (E.) anacantha*; n) *Clathria (A.) nidificata*; o) *Myxodoryx hanitschi*; p) *Lissodendoryx (E.) ramilobosa*; q) *Hemigellius* cf. *pilosus*.

The most frequently recorded species was *Mycale (Oxymycale) acerata* (Kirkpatrick 1907) (Figure 2b), reported in 50% of the sampled sites (stations 3, 4, 10, 19). This is a very common and conspicuous species in Antarctica and our specimens perfectly fit the descriptions previously provided by Ríos and Göcke & Janussen [5, 4].

Lissodendoryx (Ectyodoryx) anacantha (Hentschel, 1914) (Figure 2m) was recorded twice, in stations 4 and 7, in the distributional range previously reported by Hentschel [9], Koltun [10] and Burton [11]. Our specimens perfectly fit the description and spicule dimensions provided in the mentioned literature.

The sponge *Iophon unicorne* (Topsent, 1907) was also recorded twice, at stations 10 and 13. This is a very frequently reported species in Antarctic and subantarctic waters, having a high morphological variability [5, 10, 4].

Some of the recorded species (*Microxina charcoti* (Topsent 1916), *Isodictya erinacea* (Topsent, 1916), *I.* cf. *setifera*, *I.* cf. *verrucosa*, *Tedania (Tedaniopsis) charcoti* (Topsent 1907), *Clathria (Axosuberites) nidificata* (Kirkpatrick, 1907), *Artemisina apollinis* (Ridley & Dendy, 1886), *Myxilla (Myxilla) mollis* (Ridley & Dendy, 1886), *Calyx* cf. *arcuarius, Haliclonissa verrucosa* (Burton, 1932), *Lissodendoryx (Ectyodoryx) ramilobosa* (Topsent, 1916); Figure 2) were commonly reported in Antarctica or have their records mainly in our study area [12, 10, 5, 4]. In these cases, our specimens fit very well with the descriptions provided in the mentioned references.

On the other hand, we also recorded some species that were only scarcely reported or were reported for other regions in Antarctic waters, as follows:

- *Lissodendoryx (Lissodendoryx) flabellata* (Burton, 1929) (Figure 2i). Reported by Koltun [10] and Vacelet & Arnaud [13]. It was recorded at station 10 in the present study. Our specimen is erect and flabellate, beige in color, with a conulose surface. It was settled on a rock. The skeleton is reticulate, with a dermal skeleton conformed by tornota. Spicules are styles of 460-510 by 20-30 μm; tornota with spiny ends of 290-340 by 7.5-10 μm; arcuate isochelae 20-22.5 μm. This is the first report of this species in this Antarctic sector.

- *Raspailia (Hymeraphiopsis) hentscheli* (Van Soest & Hooper, 2020) (Figure 2l). Reported previously by Hentschel [9], Ríos [5] and Göcke & Janussen [4] in Antarctic areas. Our specimens, collected at station 2, are small, were settled on pebbles, and presented an erect morphology of about 2-3 cm height, having a hispid surface. They perfectly fit the description provided by Ríos [5], and have long styles of about 2250 μm, a second category of styles of 490 by 15 μm, and the characteristic acanthostyles of the genus, of 175-350 by 12-20 μm.

-*Kirkpatrickia* aff. *coulmani* (Figure 2c). Reported in the literature after its description by Koltun [10]; Burton [11]; Vacelet & Arnaud [13]; Ríos [5], but not reported in our study area. Our specimen, collected at station 10, has an erect, flabellate, fan morphology, very soft, beige in color, and it was settled on a pebble, sharing the substrate with a primnoid octocoral. Its surface is conulose, and presents a plumoreticulate skeleton. Spicules are smooth styles of 510-590 by 20 μm and tornota with mucronate ends of 310-370 by 7.5 μm. Our specimen is in accordance with the description provided by Burton [11] and Koltum [10], having smooth styles instead of the microspinulated acanthostyles described by Kirkpatrick [14]. However, the original description shows micro spines, also mentioned by Ríos [5]. Hence, this identification should be taken with caution.

-*Phorbas glaberrimus* (Topsent, 1916). Previously reported in Antarctic and subantarctic waters by Goodwin *et al*. [15, 16], Koltun [10] and Ríos [5]. It was collected in station 10. It is a massive sponge, beige to peach in color, with a surface covered with papillae. Spicules are acanthostyles from 180-340 by 10 μm, straight fusiform oxea/tornota of 430-520 by 10 μm and isochelae 20-28 μm. Our specimens are in accordance with the descriptions provided in the references.

-*Myxodoryx hanitschi* (Kirkpatrick, 1907) (Figure 2o). Reported by Hentschel [9], Topsent [17], Koltun [10] and Göcke & Janussen [4]. Our specimens were collected at station 10, are massive, beige in color and were settled on pebbles. They fit very well with the extended description provided by Göcke & Janussen [4], and have smooth styles of 360-520 by 12.5-15 μm, acanthostyles of 200-275 by 7.5-10 μm and tornota of 215-345 by 7.5-10 μm.
-*Phorbas* cf. *acanthochela*. This species is only known from its original description, made by Koltun [10]. This massive, beige specimen with a verrucose surface was collected at station 10. It has styles ranging from 412-590 by 15-20 μm, acanthostyles (some with an enlarged base) of 155-207 by 7.5-10 μm and robust chelae 25-43 μm. Although our specimen is in accordance with Koltun's description and figures, we prefer to keep the identification with caution, due to the rarity of the species, until more measurements could be done.
- *Haliclona* sp. At least 3 specimens from stations 2, 4 and 7 presented the characteristic skeleton and oxea of the genus, with no microscleres. More measurements and comparisons should be done before the specific identification could be provided.
-*Hemigellius* cf. *pilosus* (Figure 2q). This rare species was previously reported by Kirckpatrick [14], and Goodwin *et al.* [16] and some Antarctic local field guides. Our specimen is a fragment, beige in color, erect, with a hispid or pilose surface, that was collected at station 4. Spicules are oxeas 490-600 by 15-20 μm and C sigmae of 20-45 μm. If we finally confirm the identification, the bathymetric range should be updated from shallow waters up to 196 m.
- *Mycale (Mycale)* cf. *tridens*. Our specimen was collected at station 13, and it is a fragmented and bad preserved specimen (Figure 2f). The morphology and skeleton are typical of the genus *Mycale* (see Ríos [5]), and have mycalostyles of 640-750 by x 15 μm, anisochelae of 100 μm and sigmae of 80 μm. We need to take more measurements of the specimen, to look for the anisochelae II and sigmae II to confirm the identification.
-*Iophon* cf. *aceratum*. This species was reported by Hentschel [9], Burton [18] and Koltun [10], and it was not previously reported in our study area. Our specimen was collected at station 13, and it is a massive fragment, dark brown in color and with a pilosus surface. The sizes of the spicules are in accordance with the original description made by Henstchel [9], with mucronate styles 530-640 by 20-25 μm, acanthotylotes of 370-405 by 10 μm and anisochelae of 25-30 μm. However, we couldn't find bipocilli, perhaps due to the small size described (12-13 μm in the original description). We should confirm the presence of these microscleres before confirming the specific identification and updating the distributional range in Antarctica.

4. Conclusions

The results of this study greatly contribute to the knowledge on the distribution and biodiversity of Antarctic sponges, a very important component of the benthic communities. Sectors near the stations 4 and 10 should probably require more studies regarding sponge fauna, as it was demonstrated that the highest richness of this study was reported in both areas.

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Conflicts of Interest: No competing interests declared

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