biology and life sciences forum

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Proceeding Paper

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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† Presented at the 1st International Electronic Conference on Biological Diversity, Ecology and Evolution, 15–31 March 2021; Available online: https://bdee2021.sciforum.net/.
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Abstract: The Argentinian 2012 Summer Antarctic Expedition took place in the austral summer of 2012. One of its 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 the total catch, photographed, labelled, 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 morphospecies were identified. The most represented Order was Poecilosclerida with 18 taxa (*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 (Tedaniopsis) charcoti*, *Iophon unicorne*, *I.* cf. *aceratum*, *Myxilla (M.) mollis*, and *Kirkpatrickia* aff. *coulmani*), followed by Haplosclerida with 5 taxa (*Haliclonissa verrucosa*, *Haliclona* sp., *Calyx* cf. *arcuarius*, *Microxina charcoti*, and *Hemigellius* cf. *pilosus*). The most frequently recorded species was *Mycale (O.) acerata* followed by species of the genera *Isodictya* and *Lissodendoryx*. Some of the recorded taxa 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 of 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

Citation: Fernández, A.A.; Lemiña, N.A.; Schejter, L. Sponges (Porifera: Demospongiae) Recorded at the South Shetland Islands and near the Antarctic Peninsula during the Argentinian Summer Antarctic Expedition in 2012. *Biol. Life Sci. Forum* **2021**, 2, 38. https://doi.org/10.3390/BDEE2021-09470

Academic Editor: Luc Legal

Published: 16 March 2021

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]. In particular, sponges are one of the most important components, especially in some regions [2]. They offer shelter and protection to a great variety of small organisms, from prokaryotic and eukaryotic unicellular organisms to small fish, polychaetes, molluscs, and crustaceans [3].

From Antarctica and adjacent areas, more than 352 demosponge species were reported in a revision made by Sará [4], and this number has continued to increase (i.e., [5–9]. Since the 19th century, there have been several scientific expeditions developed in different

regions of Antarctica aiming to acquire knowledge of multiple features such as its geology, biodiversity, evolution, connectivity, climate change, and conservation, among others [10]. Nevertheless, there are still some areas unsatisfactorily sampled that will probably add further data in regards to these tasks, and particularly to the biodiversity, abundance, and distribution of Antarctic sponges [4,5,7,9].

For that reason, the aim of this work was to contribute to the knowledge on the distribution and biodiversity of sponge species in areas close to the Antarctic Peninsula and neighbouring islands.

2. Material and Methodology

The Argentinean Antarctic Expedition onboard the RV "Puerto Deseado" was conducted between 13 February and 24 March 2012 (CAV 2012) and had the multiple objectives of not only obtaining samples and biological data but also to supply inputs to Argentinian Antarctic Stations and acquire seafloor data for mapping purposes, among others. All the necessary permits for sampling and observational field studies in Antarctica were obtained by the authors from the competent authorities before the cruise (Dirección Nacional del Antártico, Argentina). During the expedition, benthic biological samples were collected at 8 sites in the study area (Figure 1, Table 1). The original station denominations were kept to allow comparisons with other studies.

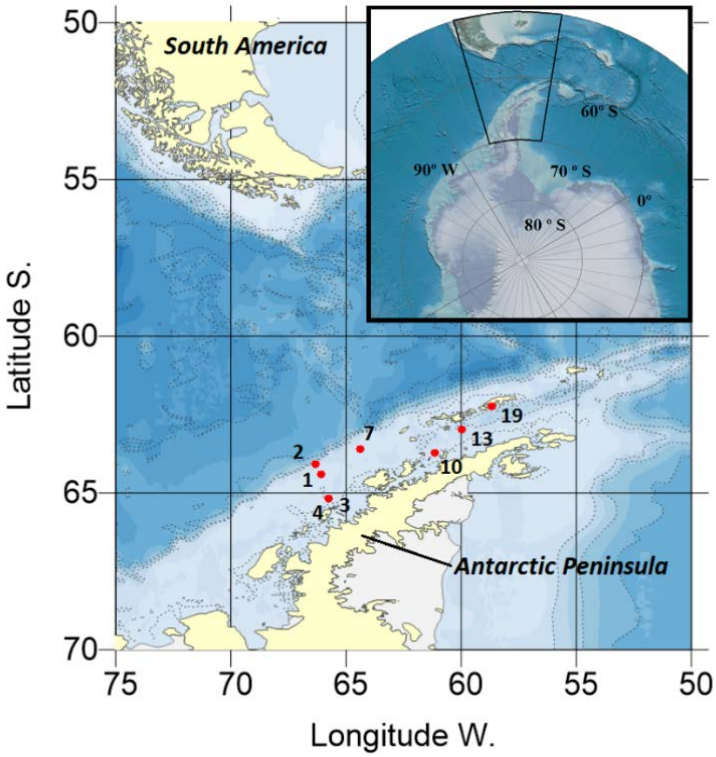

Figure 1. Study area and location of the stations sampled during the 2012 Argentinian Summer Antarctic Expedition. Antarctica map modified from NOAA (see https://www.arcgis.com/home/item.html?id=d13b9d10219e4429974e48368b64e41f, accessed by 15 March 2021).

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	64°24.740′	66°05.420′	327	*Calyx* cf. *arcuarius*
2	64°53.639′	66°20.000′	404	*Raspailia (Hymeraphiopsis) hentscheli*, *Haliclona* sp.
3	65°10.297′	65°44.207′	187	*Mycale (Oxymycale) acerata*, *Haliclonissa verrucosa*
4	65°11.134′	65°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	63°36.182′	64°21.809′	355	*Isodictya* cf. *verrucosa*, *Lissodendoryx (Ectyodoryx) anacantha*, *Haliclona* sp.
10	63°43.092′	61°07.402′	142	*Kirkpatrickia* aff. *coulmani*, *Mycale (Oxymycale) acerata*, *Isodictya lankesteri* (2 specimens), *Tedania (Tedaniopsis) charcoti*, *Myxodoryx hanitschi* (2 specimens), *Phorbas acantochela*, *Lissodendoryx (Lissodendoryx) flabellata*, *Artemisina apollinis*, *Phorbas glaberrimus*, *Myxilla (Myxilla) mollis*, *Iophon unicorne*
13	62°59.310′	59°57.246′	989	*Mycale (Mycale)* cf. *tridens*, *Iophon* cf. *aceratum*, *Iophon unicorne*
19	62°13.873′	58°39.919′	43	*Isodictya erinacea*, *Mycale (Oxymycale) acerata*

Benthic biological 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). Samples from stations 3, 10, and 13 were acquired using a Blake dredge. Although the sampling was not designed for the study of sponges, the collected samples contributed to the knowledge on benthic biodiversity. The general characterization of the catches of CAV 2012 was provided by Schejter [11]. Sponge specimens were separated from the 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 [12]. The spicules were measured and examined with a Leica DM 1000 stereomicroscope. The data for spicule sizes were 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.

The general classification system adopted in this work was the one proposed by Morrow and Cárdenas [13] as followed by the World Porifera Database (http://www.marinespecies.org/porifera/, accessed by 15 March 2021).

3. Results and Discussion

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

The most represented Order was Poecilosclerida with 18 morphospecies (*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*, *and Kirkpatrickia* aff. *coulmani*), followed by Haplosclerida with 5 morphospecies (*Haliclonissa verrucosa*, *Haliclona* sp., *Calyx* cf. *arcuarius*, *Microxina charcoti*, and *Hemigellius* cf. *pilosus*).

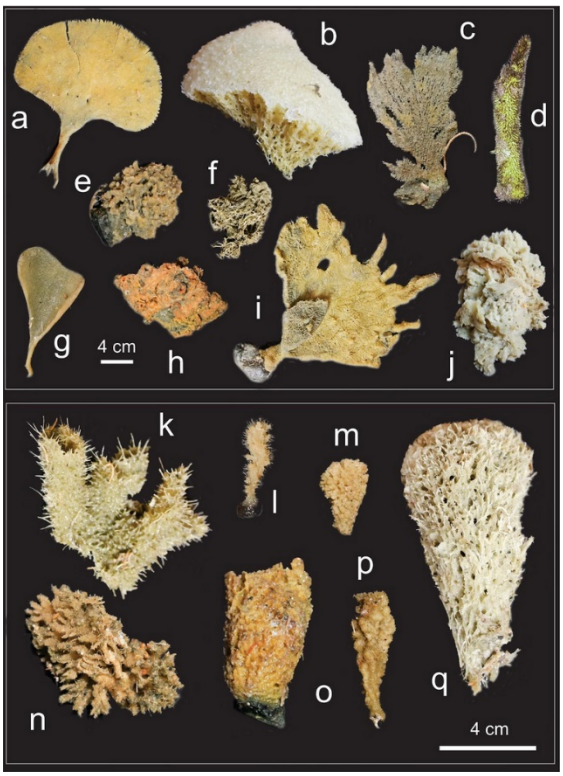

Figure 2. Photographs of several sampled morphospecies. (**a**) *Isodictya lankesteri*; (**b**) *Mycale (O.) acerata*; (**c**) *Kirkpatrickia* aff. *coulmani*; (**d**) *Isodictya erinacea*; (**e**) *Tedania (T.) charcoti*; (**f**) *Mycale (M.)* cf. *tridens*; (**g**) *Calyx* cf. *arcuarius*; (**h**) *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*; and (**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, and 19). This is a very common and conspicuous species in Antarctica. Other commonly reported species in Antarctica also found in our samples were *Lissodendoryx (Ectyodoryx) anacantha* (Hentschel, 1914) (Figure 2m), *Iophon unicorne* (Topsent, 1907) (here, reported in a wide bathymetric range), *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), and *Lissodendoryx (Ectyodoryx) ramilobosa* (Topsent, 1916) (Figure 2) (see [5,14–17] for general information on the distribution of these species).

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

- *Lissodendoryx (Lissodendoryx) flabellata* (Burton, 1929) (Figure 2i). This was previously reported by Koltun [15] and Vacelet and Arnaud [18]. It was recorded at station 10. Our specimen was erect and flabellate, beige in colour, with a conulose surface. It was settled on a rock. The skeleton was reticulate, with a dermal skeleton conformed by tornota. The spicules were styles of 460–510 by 20–30 μm; the tornota had spiny ends of 290–340 by 7.5–10 μm; and the arcuate isochelae were 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). This is a rare species reported previously only by Hentschel [14], Ríos [6], and Göcke and Janussen [5] in Antarctic areas. Our specimens, collected at station 2, were small, settled on pebbles, and presented an erect morphology of about 2–3 cm in height, having a hispid surface. The specimen had 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). This specimen has been reported in the literature after its description by Koltun [15], by Burton [16], Vacelet and Arnaud [18], and Ríos [6]; however, it has not been reported in our study area. Our specimen, collected at station 10, had an erect, flabellate, fan morphology, very soft, beige in colour, and it was settled on a pebble, sharing the substrate with a primnoid octocoral. Its surface was conulose, and it presented a plumoreticulate skeleton. The spicules were smooth styles of 510–590 by 20 µm, with tornota with mucronate ends of 310–370 by 7.5 µm. Our specimen accorded with the description provided by Burton [16] and Koltum [15], having smooth styles instead of the microspinulated acanthostyles described by Kirkpatrick [19]. However, the original description shows microspines, also mentioned by Ríos [6]. Hence, this identification should be made with caution.
- *Phorbas glaberrimus* (Topsent, 1916). It was previously reported in Antarctic and subantarctic waters by Goodwin et al. [9,20], Koltun [15], and Ríos [6]. It was collected at station 10. It was a massive sponge, beige to peach in colour, with a surface covered with papillae. The spicules were acanthostyles from 180 to 340 by 10 µm, straight fusiform oxea/tornota of 430–520 by 10 µm, and isochelae of 20–28 µm.
- *Myxodoryx hanitschi* (Kirkpatrick, 1907) (Figure 2o). This specimen was reported by Hentschel [14], Topsent [21], Koltun [15], and Göcke and Janussen [5]. Our specimens were collected at station 10, massive, beige in colour, settled on pebbles, with 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 [15]. This massive beige specimen with a verrucose surface was collected at station 10. It had styles ranging from 412 to 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 tentatively identify it, due to the rarity of the species, until more measurements can be conducted.
- *Haliclona* sp. At least three 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 conducted before a specific identification is provided.
- *Hemigellius* cf. *pilosus* (Figure 2q). This rare species was previously reported by Kirkpatrick [19], Goodwin et al. [9], and some Antarctic local field guides. Our specimen was a fragment, beige in colour, erect, with a hispid or pilose surface, collected at station 4. The spicules were oxeas 490–600 by 15–20 µm and C sigmae of 20–45 µm. If we confirm the identification, the bathymetric range would be updated from shallow waters up to 196 m.
- *Mycale (Mycale)* cf. *tridens*. Our specimen was collected at station 13, and it was a fragmented and badly preserved specimen (Figure 2f). The morphology and skeleton were typical of the genus *Mycale* (see Ríos [6]), and it had mycalostyles of 640–750 by ×15 µm, anisochelae of 100 µm, and sigmae of 80 µm. We need to take more measurements of the specimen, to find the anisochelae II and sigmae II to confirm the identification.
- *Iophon* cf. *aceratum*. This species was reported by Hentschel [14], Burton [22], and Koltun [15], and it was not previously reported in our study area. Our specimen was collected at station 13, and it was a massive fragment, dark brown in colour, with a pilosus surface. The sizes of the spicules were in accordance with the original

description made by Henstchel [14], with mucronate styles 530–640 by 20–25 µm, acanthotylotes of 370–405 by 10 µm, and anisochelae of 25–30 µm. However, we could not 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.

According to previous investigations [23], a combination of temperature and depth are probably the main variables that significantly influenced the species composition and distribution at the study area.

4. Conclusions

Although the sampling design of the expedition was not developed for the study of Porifera in particular, the results of this study contribute to improving the knowledge of the richness and distribution of sponges in this peculiar Antarctic habitat, today subjected to climate change and other threats. Sectors near stations 4 and 10 require more attention regarding sponge fauna, considering the high richness reported in both sites, including the presence of some rare or previously unreported species for the area. Although in the study area several previous expeditions revealed the existence of a rich benthic community, the current results demonstrated that we are still underestimating the real values regarding species richness.

Author Contributions: This study was the final project for the "Biological Oceanography" Course (Universidad de Buenos Aires, Argentina) developed by A.A.F. and N.A.L., directed by L.S. All authors contributed to the writing and revising of the paper. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Dirección Nacional del Antártico (Argentina), INIDEP and PICT 2019-4233.

Institutional Review Board Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: We are grateful to the anonymous reviewer who provided useful comments and suggestions to improve the final version of this contribution.

Conflicts of Interest: The authors declare no conflict of interest.

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