



# The Value of By-Catch: Can We Use Commercial Species Stock Assessment Cruises for the Study of Non-Target Species? The Case of Sponges <sup>†</sup>

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**Abstract:** The contribution of sponges to benthic communities in three areas of the Argentine continental shelf and slope (North, Central and South), between 34° and 55° S and between 47 and 551 m, is presented here. Sponges were recorded as components of the invertebrate by-catch in 51% of the studied sites (133 hauls). On average, sponges constituted 18.01% of the benthic community (47.91 kg/mn<sup>2</sup>, in terms of density), reaching more than 90% of the by-catch and more than 500 kg/mn<sup>2</sup> at some particular sites. A total of 34 sponge taxa were recorded. *Tedania* spp., *Clathria* (C.) *microxa* and Callyspongidae (*Siphonochalina fortis* + *Callyspongia* sp.) were the only taxa shared among the three sampled areas. Sixty percent (60%) of the sponge species were recorded only at one or two sites.

**Keywords:** Porifera; Argentina; SW Atlantic Ocean; biodiversity; *Tedania*; *Clathria*; Callyspongidae; incidental capture; benthic communities



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## 1. Introduction

Traditionally, countries have invested large sums of money in the stock assessment of their fishery resources, focusing only on commercial species. Non-target species were discarded since they were often simply considered “garbage”. Fortunately, this approach has changed in recent decades in many countries, including Argentina, since it was demonstrated that all species in an ecosystem play important roles and are interrelated. Consequently, legislation has been enacted to protect species and the environment in which they live [1,2]. Also, the non-target species of a fishery could be the target species of others, as well as important components of the habitat through providing substrates, refuge or food to many other species, including target, vulnerable or even endangered species [3–5].

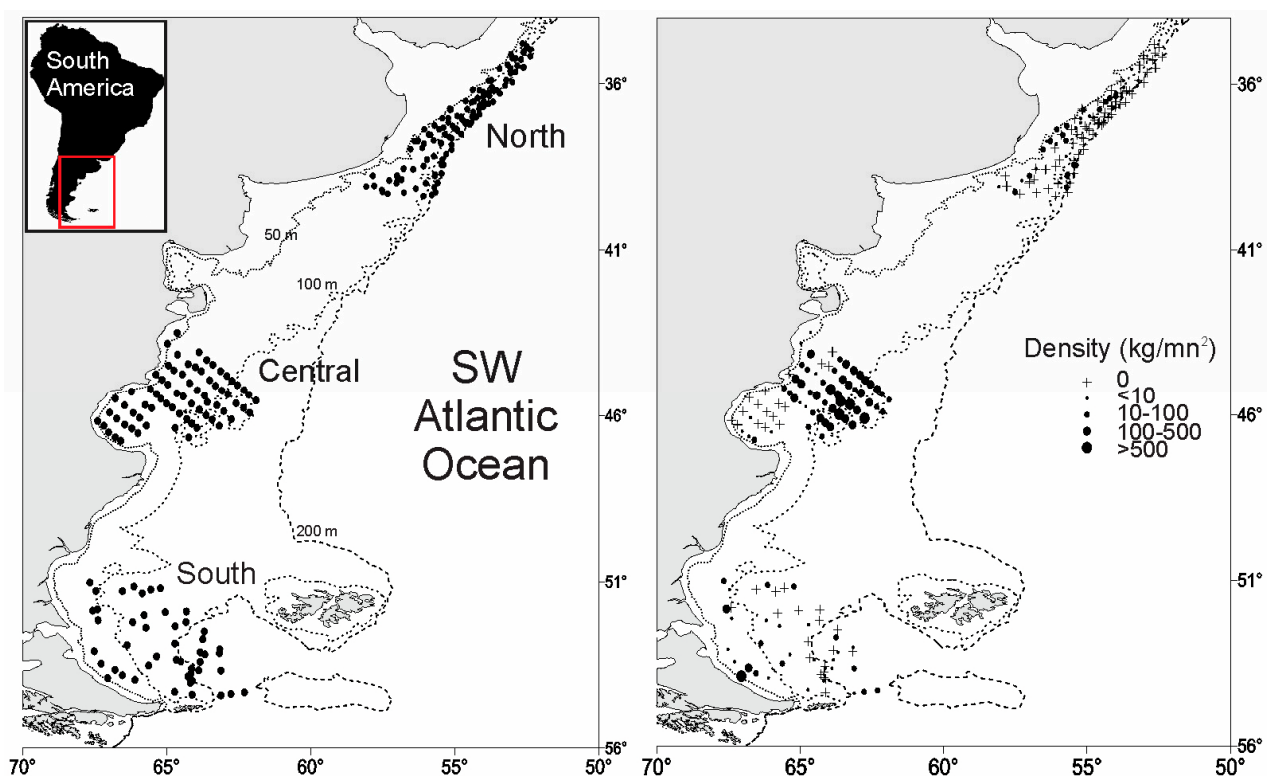
In Argentina, non-target species, often collected as by-catch species, have been identified and studied in many fisheries (e.g., [6,7]) and, particularly, since the obtention of an international certification for an exploited commercial resource gained interest (e.g., [8]). Due to the high costs of a research campaign, it is very difficult to obtain financial support for the study of non-target organisms, especially if they are not associated with a fishing resource or with a particular area of interest (i.e., a marine protected area). Therefore, by studying the organisms that constitute the by-catch of fisheries, it is possible to obtain samples of and data on organisms without commercial value but that still play important

roles in the ecosystem. This strategy allows for the deepening of studies on the biodiversity and distribution of many species of the SW Atlantic, inhabiting Argentinian territory (i.e., [9–11]).

In particular, sponges may be important components of benthic communities worldwide [12]. When they are found in large aggregations or grounds, sponges increase habitat complexity and the local biodiversity levels and are considered indicators of Vulnerable Marine Ecosystems [13,14]. In many regions of the continental shelf and slope of Argentina, they are found at a high biomass and richness, conforming to habitats of particular characteristics (e.g., [14,15]). Considering the importance of this group in benthic habitats, the aim of this research is to study the contribution of sponges to benthic communities in three different regions of the Argentine continental shelf and slope, between 34° and 55° S and between 47 and 551 m, by means of their richness, occurrence frequency, biomass and density from by-catch data of stock assessment cruises performed by the Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP).

## 2. Materials and Methods

The invertebrate by-catch was recorded during five (5) stock assessment cruises of the Argentine hake (*Merluccius hubbsi*) and the longtail hake (*Macruronus magellanicus*) in a total of 262 hauls between 2021 and 2024. The cruises were conducted in the North (EH 04/21, EH 03/22 and VA 06/23), Central (VA 01/24), and South areas (VA 02/22) of the continental shelf and slope of Argentina (Figure 1).



**Figure 1.** Study area showing the three main areas, the sampling sites and the estimated density of sponges (in kg wet weight/mn<sup>2</sup>).

The Engel bottom trawl net was employed in all the cruises. The sampler had a top headline of 35.5 m and a bottom headline of 50 m and was equipped with 1200 kg polyvalent doors, a mesh size at the cod-end of 100 mm and an internal liner with a mesh size of 24 mm. The effective towing time for each haul was approximately 30 min. Based on

the towing time and the swept area, the density of organisms was estimated in kilograms (wet weight) per square nautical mile.

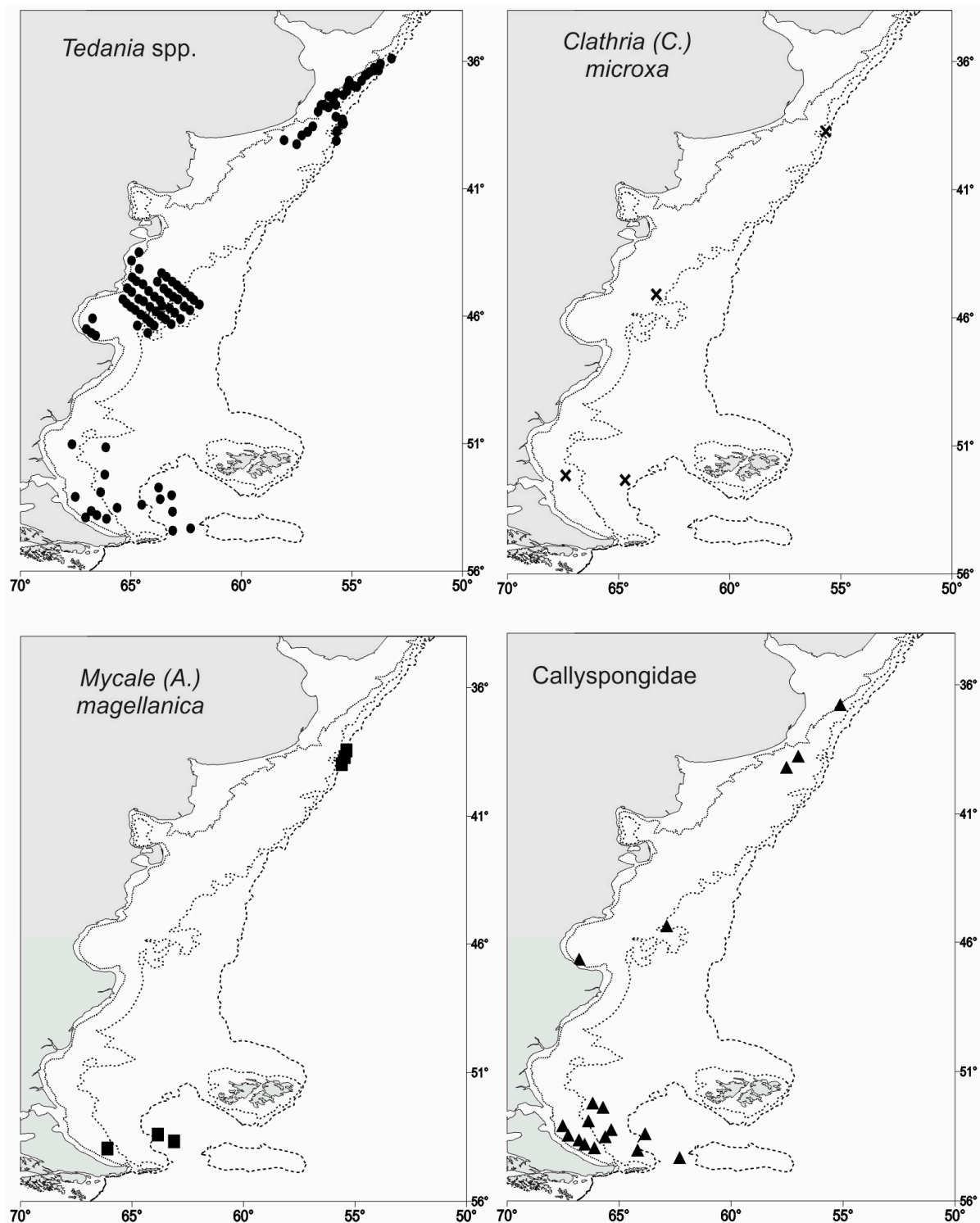
The invertebrate by-catch was sorted and weighted on board, and voucher specimens were preserved frozen and transported to the Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP) for further analysis. Sponge separation and preliminary identification on board was based on morphotypes, while voucher specimens were preserved, studied and stored at the Benthos Laboratory for a more accurate identification of the species using the classical methodology for this group, described in Hajdú et al. [16]. Species identification was performed following the classification of Morrow and Cárdenas [17], using also local bibliography, with identification being checked using the “World Porifera Database” website [18]. The reference vouchers are deposited at the Benthos Laboratory (INIDEP, Mar del Plata, Argentina).

### 3. Results and Discussion

Sponges were recorded as components of the invertebrate by-catch in 51% of the studied sites (133 hauls) (Figure 1). Their contribution in biomass to the benthic community sampled varied among areas (North, Central and South), but also between sites in the same region (Table 1, Figures 1 and 2). In the South area, the sponges represented, on average, 20.46% of the invertebrate by-catch, which, in terms of density, is about 43.88 kg/mn<sup>2</sup>. However, there were sites at which sponge contribution was less than 1% and others at which it was more than 90%, reaching densities of up to 1462 kg/mn<sup>2</sup> in one site (at 53.6453° S, 66.7944° W, 78.6 m depth). In the North area, the contribution of sponges to the benthic community was lowest, averaging 5.43 kg/mn<sup>2</sup>, which corresponds to 6.8% of the invertebrate biomass. Moreover, sponges were only recorded in 34% of the sampled sites. The Central area showed the highest occurrence frequency of sponges in the benthic community, and they were present in 76.3% of the sampled sites, also with the highest average contribution in terms of density of 133.82 kg/mn<sup>2</sup>. These values correspond to 38.31% of the biomass of the benthic community (Table 1, Figure 1). Echinoderms, molluscs, crustaceans and tunicates were the most frequent and abundant (in terms of biomass) invertebrate by-catch taxa recorded alongside the sponges, a finding also reported in previous years (e.g., [6,19,20]).

**Table 1.** Sampled sites and sponge contribution to biomass and richness by area in the present study.

|   | North     | Central    | South      | Total     |
|---|-----------|------------|------------|-----------|
| N° analyzed cruises   | 3         | 1          | 1          | 5         |
| Total hauls   | 141       | 72         | 49         | 262       |
| Total hauls with sponges  | 48 (34%)  | 55 (76.4%) | 30 (61.2%) | 133 (51%) |
| Average contribution of sponges to total by-catch (in %)                            | 6.8       | 38.31      | 20.46      | 18.01     |
| Average contribution of sponges to total by-catch (in density, kg/mn <sup>2</sup> ) | 5.43      | 133.82     | 43.88      | 47.91     |
| Total taxa richness   | 10        | 10         | 21         | 34        |
| Taxa richness per site (average; range)   | 0.57; 1–4 | 1.12; 1–3  | 1.53; 1–5  | 0.9; 1–5  |



**Figure 2.** Recorded distribution of the main sponge taxa reported in the present study.

At least 34 sponge taxa were recorded (Table 2, Figure 3): 10 taxa from the North area, 10 from the Central area and 21 from the South area (Table 1). An average of 0.9 sponge taxa per site was recorded in the whole study area, although there were sites that registered up to 5 sponge taxa. Only three taxa were shared among the three areas—*Tedania* spp., *Clathria* (C.) *microxa* and Callyspongidae (*Siphonochalina fortis* + *Callyspongia* sp.)—while *Mycale* (*Aegogropila*) *magellanica*, a common species from Argentina [21], was shared only among the North and South areas (Figures 2 and 3). The most frequently recorded taxon was *Tedania* spp., mainly represented by the species *Tedania* (*Tedaniopsis*) *mucosa* (Figure 2).

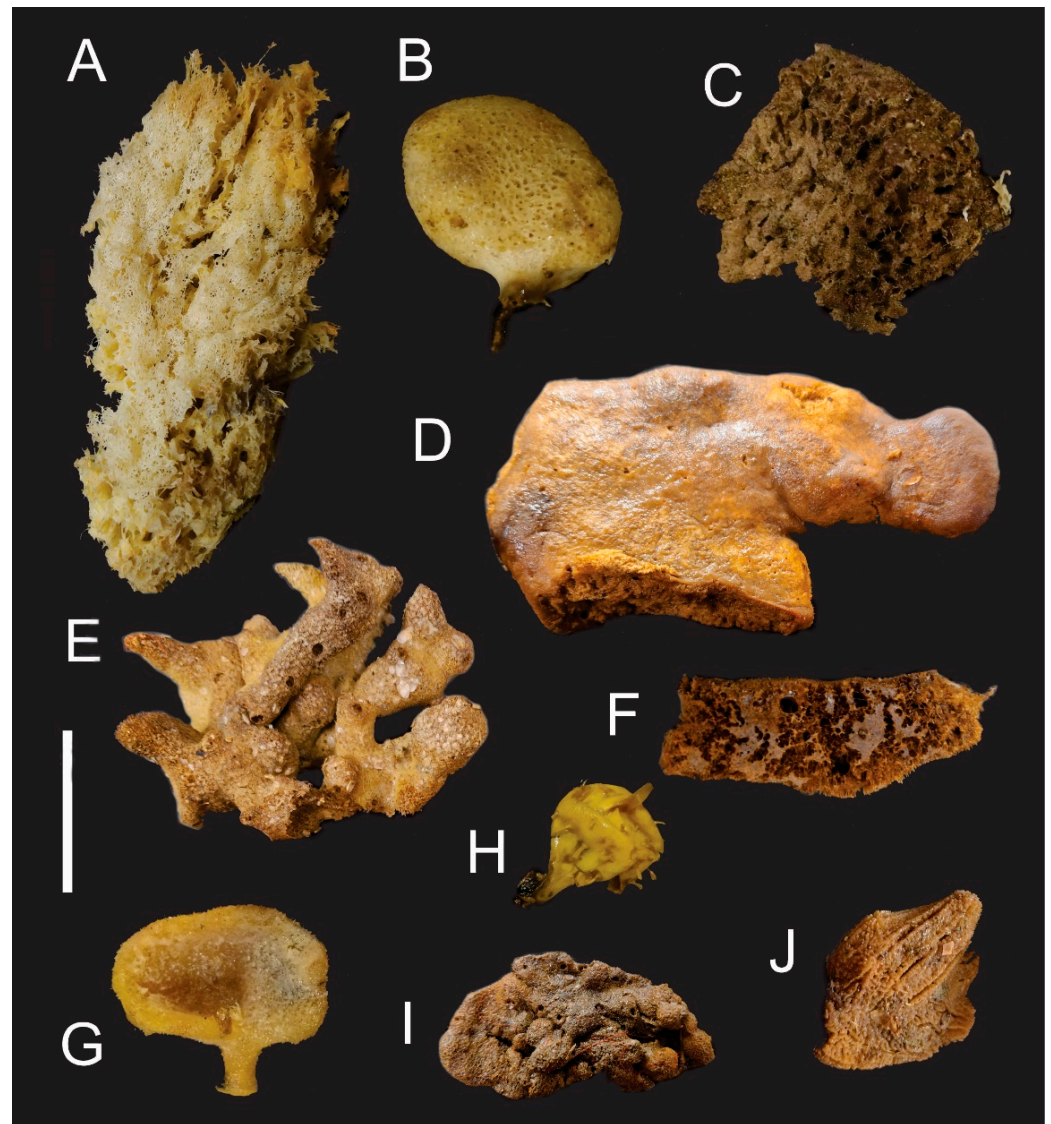
The morphological variability of many *Tedania* species makes it difficult to properly identify all the *Tedania* species on board the research vessels, although voucher specimens were transported and stored at the laboratory and the existence of at least two other *Tedania* morphotypes was confirmed. Therefore, we preferred to use *Tedania* spp. to properly assess the importance of the species of this genus in the study area. In this regard, *Tedania* spp. were recorded in 111 hauls (out of 262 total hauls), which represents 42% of the hauls in which the by-catch was composed of invertebrates (Figure 2). Similarly, it is very difficult to distinguish between the species of the genus *Callyspongia* mentioned for this region and *Siphonochalina fortis* on board. Reference vouchers confirmed the presence of *S. fortis* and at least one species of *Callyspongia*, so we preferred to maintain the reference at the family level (Callyspongiidae). Sixty percent (60%) of the sponge species were recorded only at one or two sites, with Callyspongiidae, *Dasychalina validissima*, *Mycale* (*A.*) *magellanica* and Dictyoceratida 3 being the most frequently recorded taxa after *Tedania* spp., with 18, 12, 8 and 8 records at the different sites, respectively (Figures 2 and 3).

**Table 2.** Sponges recorded in the present study in the three studied areas in alphabetical order. \* Comprises *Siphonochalina fortis* and *Callyspongia* sp.; # mainly *Tedania* (*Tedaniopsis*) *mucosa*, but at least two other morphotypes of *Tedania*.

| Taxa   | North | Central | South | Taxa  | North | Central | South |
|--|-------|---------|-------|---|-------|---------|-------|
| <i>Amphilectus</i> sp.                             |       |         | x     | Hexactinellida  |       |         | x     |
| <i>Antho</i> ( <i>Plocamia</i> ) <i>bremecae</i>   |       |         | x     | <i>Inflatella belli</i>                                 |       |         | x     |
| <i>Asbestopluma</i> sp.                            |       |         | x     | <i>Iophon proximum</i>                                  |       | x       |       |
| Callyspongiidae *                                  | x     | x       | x     | <i>Isodictya verrucosa</i>                              |       | x       |       |
| <i>Clathria</i> ( <i>Clathria</i> ) <i>microxa</i> | x     | x       | x     | <i>Latrunculia</i> sp.                                  |       |         | x     |
| <i>Clathria discreta</i>                           |       | x       |       | <i>Mycale</i> ( <i>Aegogropila</i> ) <i>magellanica</i> | x     |         | x     |
| <i>Clathria</i> sp. 1                              | x     |         |       | <i>Myxilla mollis</i>                                   |       |         | x     |
| <i>Clathria</i> sp. 2                              |       |         | x     | <i>Phakellia</i> sp. 1                                  |       |         | x     |
| <i>Cliona</i> sp.                                  |       | x       |       | <i>Phakellia</i> sp. 2                                  |       |         | x     |
| <i>Craniella</i> sp.                               |       |         | x     | Porifera unident. 1                                     | x     |         |       |
| <i>Dasychalina validissima</i>                     | x     |         |       | Porifera unident. 2                                     |       |         | x     |
| Dictyoceratida 1                                   | x     |         |       | <i>Pyloderma latrunculioides</i>                        |       |         | x     |
| Dictyoceratida 2                                   | x     |         |       | Raspaillidae  |       |         | x     |
| Dictyoceratida 3                                   |       |         | x     | <i>Stelodoryx argentinae</i>                            | x     |         |       |
| <i>Dragmacidon</i> sp.                             |       |         | x     | Suberitidae   |       | x       |       |
| Hadromerida  |       | x       |       | <i>Tedania</i> spp. #                                   | x     | x       | x     |
| <i>Halicionissa sacciformis</i>                    |       | x       |       | Tetillidae  |       |         | x     |

The North area is probably a better-known region regarding sponge fauna [21–23] compared to the other sampled regions, most likely as a consequence of a very unequally distributed sampling effort, mainly concentrated at the subtidal and offshore Buenos Aires Province [23] and at the shelf-break [22]. The species recorded mostly belong to the species that are largely known and most widely studied. Contrarily, the samples of several taxa recorded in the South and Central areas (i.e., Hadromerida, *Phakellia* spp., *Amphilectus* sp., *Dragmacidon* sp., *Asbestopluma* sp.) will require more detailed taxonomic studies, as these species may increase our knowledge of sponge biodiversity and richness in Argentina by adding valuable information regarding rare species or may even constitute new species for science.





**Figure 3.** Some of the sponge species recorded in the present study. (A) *Mycale* (*Aegogropila*) *maggellonica*; (B) *Dasychalina validissima*; (C) *Clathria* (*Clathria*) *microxa*; (D) *Tedania* (*Tedaniopsis*) *mucosa*; (E) *Siphonochalina fortis* (Callyspongiidae); (F) *Isodictya verrucosa*; (G) *Antho* (*Plocamia*) *bremecae*; (H) *Inflatella belli*; (I) Dictyoceratida 3; (J) *Clathria* (*Clathria*) *discreta*. Scale bar: 4 cm.

Data on by-catch of invertebrates can be used to deepen the study of many non-commercial species that represent important components for ecosystem functioning. Particularly for sponges, these data provided us with the opportunity to compare the contribution and densities of Porifera to benthic communities in several regions of Argentina and provided valuable samples for the study of uncommon species that may even constitute new species for science.

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