

## Hidden biodiversity in the Southwestern Atlantic Ocean: ophiuroids from the Mar del Plata Submarine Canyon, Argentina

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**Abstract:** Among the phylum Echinodermata, the class Ophiuroidea is the most diverse, with ophiuroids being widely distributed across benthic environments worldwide. However, this trend is not consistently observed in the Southwestern Atlantic, where other echinoderm classes are reported to be more prevalent. The apparent low biodiversity may be due to insufficient studies and sampling in the deep sea, particularly in small and localized environments like submarine canyons. These geomorphic features of the continental margins are known to support unique marine communities and high biodiversity, as evidenced by oceanographic expeditions to the Argentine continental slope on the research vessel Puerto Deseado (CONICET) conducted over a decade ago. These expeditions significantly expanded our knowledge of benthic fauna diversity in the Southwest Atlantic. Subsequent studies have reported new fauna records and species, revealing a complex and largely uncharacterized environment, particularly with regard to ophiuroids, a topic still pending thorough study in this area. This study aims to enhance our understanding of ophiuroid species richness in deep-sea environments, providing essential data for broader and biogeographic studies globally. The study area encompasses the Argentine Continental Slope, including the Mar del Plata Submarine Canyon in the Southwestern Atlantic Ocean. We examined samples from 64 stations at depths ranging from 200 to 3,447 meters. Ophiuroids were identified in 81% of the surveys, with approximately 6,000 specimens collected. The study area reveals a potential richness of 56 ophiuroid species, including 28 validly recognized species (12 new records for the Argentine Sea) and 28 unidentified or partially identified species. These data more than doubles the known ophiuroid species in the region, underscoring the importance of deep-sea environments as biodiversity hotspots and suggesting that the ophiuroid diversity in the Southwestern Atlantic Ocean is underestimated and may be significantly diverse as in other regions.

**Key words:** Ophiuroidea, deep sea, South Atlantic, submarine canyons, new records

**Resumen:** Biodiversidad oculta en el Océano Atlántico Suroccidental: ofiuroideos del Cañón Submarino de Mar del Plata, Argentina. Dentro del filo Echinodermata, la clase Ophiuroidea es la más diversa, con las estrellas frágiles ampliamente distribuidas en los ambientes bentónicos de todo el mundo. Sin embargo, esta tendencia no se observa consistentemente en el Atlántico Sudoccidental, donde se ha reportado a otras clases de equinodermos como más prevalentes. Esta aparente baja biodiversidad puede deberse en realidad a la escasez de estudios y de muestreos para aguas profundas, particularmente en entornos pequeños y localizados como los cañones submarinos. Estas características geomorfológicas de los márgenes continentales son conocidas por dar soporte a comunidades marinas únicas y de alta biodiversidad, como se demostró en las expediciones oceanográficas al Talud Continental de Argentina a bordo del buque de investigación Puerto Deseado (CONICET), realizados hace más de una década. Los resultados de estas exploraciones expandieron significativamente nuestro conocimiento de la diversidad de la fauna bentónica en el Atlántico Sudoccidental. Estudios posteriores han reportado nuevos registros de fauna y nuevas especies, revelando un entorno complejo y en gran medida poco caracterizado, especialmente en lo que respecta a las estrellas frágiles, un tema que aún está pendiente de un estudio exhaustivo en esta área. El presente estudio tiene como objetivo mejorar nuestra comprensión de la riqueza de especies de ofiuroideos en este entorno de mar profundo, proporcionando datos esenciales para estudios más amplios y de biogeografía a nivel global. El área de estudio abarcó el Talud Continental Argentino, incluido el Cañón Submarino de Mar del Plata en el Océano Atlántico Sudoccidental. Examinamos muestras de 64 estaciones que cubren un rango de profundidad de 200 a 3.447 metros. Los ofiuroideos estuvieron presentes en el 81% de los muestreos (52

de 64), con aproximadamente 6.000 especímenes recolectados. En total, el área de estudio soporta una riqueza potencial de 56 especies de ofiuroides, incluyendo 28 especies válidamente reconocidas (12 de las cuales son nuevos registros para el Mar Argentino) y 28 especies no identificadas o identificadas sólo a nivel de género o familia. Estos datos duplican con creces las especies de ofiuroides conocidas en la región, lo que pone de manifiesto que los entornos de aguas profundas son puntos clave de biodiversidad y sugiere que la diversidad de ofiuroides en el Océano Atlántico Sudoccidental está subestimada y puede ser tan diversa como en otras regiones.

**Palabras clave:** Ophiuroidea, mar profundo, Atlántico Sur, cañones submarinos, nuevos registros

## INTRODUCTION

In benthic communities, echinoderms stand out for their prevalence in terms of both biomass and diversity. They inhabit all oceans around the world, from shallow waters to abyssal depths (Hendler 2005; Pawson 2007), and play a fundamental role in the structure and functioning of marine ecosystems (McClintock 1994; Josefson & Conley 1997). The most diverse class within this phylum is Ophiuroidea (Stöhr *et al.* 2012), commonly known as brittle stars, basket stars, and snake stars, with more than 2,100 valid species currently recognized (Stöhr *et al.* 2024). Despite the existence of numerous studies that have reported high ophiuroid species richness in various regions and ecosystems around the world (O'Hara & Poore 2000; Chiantore *et al.* 2006; O'Hara 2007; Alvarado *et al.* 2010; Alvarado 2011; Ventura *et al.* 2013; Solís-Marín *et al.* 2014; Granja-Fernandez *et al.* 2016), it has been generally presumed that this biodiversity is rather underestimated than overestimated (Stöhr *et al.* 2012; Boissin *et al.* 2017). A comprehensive understanding of biodiversity and species richness is crucial for global assessments, the delineation of biogeographical regions, and the study of the evolutionary processes involved in the current distribution of species (Granja-Fernández *et al.* 2024; Victorero *et al.* 2023). To date, only 32 species of Ophiuroidea have been documented in the Argentine Sea, with the majority of records from intertidal areas and to the continental shelf, at depths not exceeding 200 meters (Bernasconi & D'Agostino 1977; Brogger *et al.* 2013; Brogger & O'Hara 2015). Notwithstanding their success and significant representation in both benthic and benthopelagic deep-sea fauna (Gage & Tyler 1991), species inhabiting the deep sea remain understudied.

Considering the limited amount of sampling conducted in deep sea habitats in relation to their vast extent (Ramirez-Llodra & Billet 2006), it is probable that the number of species is significantly underestimated. The deep sea is home to a vast array of habitats, including expansive

abyssal plains and numerous smaller, more localized environments such as submarine canyons. These are major geomorphic features of the continental margins (Harris *et al.* 2014), supporting unique marine communities (De Leo *et al.* 2010; Bianchelli & Danovaro 2019). Further investigation is essential to comprehend their influence on deep-sea ecosystem structure and productivity, as well as to provide scientific knowledge necessary for effective management and conservation (Fernandez-Arcaya *et al.* 2017).

More than 70 canyons have been identified along the slope of the Argentine continental margin (Lonardi & Ewing 1971), which can be grouped into five major submarine canyon systems: Río de la Plata, Bahía Blanca, Ameghino, Patagonian, and Tierra del Fuego (Lonardi & Ewing 1971; Hernández-Molina *et al.* 2009; Bozzano *et al.* 2021). The Mar del Plata Submarine Canyon (MPSC) is the largest of the Río de la Plata Canyon System (Lonardi & Ewing 1971), starting at 900 meters depth and extending to 3,900 meters (Krastel *et al.* 2011). Before the CONICET Talud Continental surveys of the MPSC and its surroundings, conducted in 2012 and 2013, the marine fauna of MPSC had not been studied. This exploration resulted in a notable expansion of our knowledge regarding benthic fauna diversity in the Southwest Atlantic. Numerous studies have been published since the aforementioned campaigns, reporting new fauna records and their reproductive traits (Ocampo *et al.* 2014; Penchaszadeh *et al.* 2019; Doti *et al.* 2020; Rumbold *et al.* 2022; Chiesa *et al.* 2024) and describing new species across various taxonomic groups (Sganga & Roccatagliata 2016; Maggioni *et al.* 2018; Bernal *et al.* 2019; Laurretta & Martinez 2019; Pereira *et al.* 2019; Laurretta *et al.* 2020; Risaro *et al.* 2020; Siegwald *et al.* 2020; Pereira *et al.* 2021). Echinoderms were also the subject of extensive study, resulting in new data for all classes (Berecoechea *et al.* 2017; Martinez & Penchaszadeh 2017; Rivadeneira *et al.* 2017, 2020; Martinez *et al.* 2018, 2019, 2020; Flores *et al.* 2019, 2021; Pertossi *et al.* 2019; Pertossi & Martinez 2022). Despite this, the diversity of

ophiuroids has not yet been studied in this area. Therefore, the aim of this study was to enhance our understanding of ophiuroid species richness in the Argentine Continental Slope (ACS), including the MPSC deep-sea environment.

## MATERIALS AND METHODS

The study area included the ACS, with particular focus on the MPSC, located in the southwestern Atlantic Ocean. The MPSC is situated on the northern margin of the ACS, at a distance of over 250 km from the coast. Sedimentation in MPSC is shaped by the interaction of ocean currents, which drive erosion, transport, and deposition processes, influencing canyon geomorphology (Violante *et al.* 2017; Warratz *et al.* 2019; Steinmann *et al.* 2020). In particular, ocean circulation in this area is strongly influenced by the Brazil-Malvinas Oceanic Confluence Zone where the convergence of Malvinas Current and Brazil Current creates optimal conditions for phytoplankton proliferation, making the waters in their confluence zone the most productive along the continental slope (Brandini *et al.* 2000; Rivas *et al.* 2006).

Sampling was conducted during the oceanographic expeditions “Talud Continental I, II, and III” on board the research vessel Puerto Deseado (CONICET) in 2012 and 2013. The sampling followed a transect perpendicular to the ACS, between 37°52'S and 38°8'S, and 53°4'W and 55°9'W (Fig. 1). The study encompassed 64 stations at depths ranging from 200 meters to 3,447 meters (Table 1). Marine benthic samples were collected using different sampling devices, including fishing nets and a dredge trawls carrying two joint fishing nets with two different pore-size: an external one of 3x3 cm (large), and an internal one of 1x1 cm (small).

The ophiuroids were separated and manually collected from each sampler, and were initially sorted by morphotypes. Some specimens were initially fixed in a 5% formalin-seawater solution, while others were fixed in 96% alcohol. In the laboratory, the formalin-fixed specimens were transferred to 70% ethanol for long-term storage.

Taxonomic determinations were based on the examination of external morphological characters of the adult stages by comparison to original descriptions and using identification keys (Mortensen 1927; Bernasconi & D'Agostino 1971; Clark & Rowe 1971; Paterson 1985; Goharimanesh *et al.* 2021). The most recent revisions

and new descriptions were also considered (Okanishi *et al.* 2011; Baker 2016; O'Hara *et al.* 2018). Ophiuroid taxa were identified to the lowest possible taxonomic level and quantified. The classifications were arranged according to the records in the World Register of Marine Species (WoRMS, 2024).

## RESULTS

We examined samples from 64 stations covering a depth range of 200 meters to 3,447 meters. Ophiuroids were present in 81% (52 out of 64; Table 1) of the samples, with approximately 6,000 specimens collected in total. The species were classified into five orders, 12 families, and 25 genera (Table 2). In total, the study area potentially hosts 56 species of ophiuroids, including 28 validly recognized species and 28 unidentified or genus- or family level identified species.

The identified orders included Amphilepidida, Euryalida, Ophiacanthida, Ophioscolecida, and Ophiurida. The Ophiurida order was the most well-represented, both in terms of the number of families (four) and the number of individuals (4,843). Within this order, the families with the highest frequency of occurrence were Ophiuridae and Ophiopyrgidae (Fig. 2), present primarily at depths exceeding 700 meters. In contrast, Ophioscolecida exhibited the lowest representation, with a single family (Ophioscolecidae) and one species, *Ophiolycus nutrix*, present at 852 meters depth.

Regarding the generic and specific richness of each of the 12 ophiuroid families present in the study area, three families accounted for 52% of the diversity of genera (Ophiacanthidae with six genera, Ophiopyrgidae with four, and Amphiuridae with three). These families also represented 66% of the total number of recorded species, with 15 species, 13 species, and nine species, respectively (Fig. 3).

A significant proportion of the genera (80%) were represented by genera comprising one or two species each, collectively accounting for nearly 44.6% of the species diversity. The remaining 55.4% was attributed to five genera that are particularly species-rich: *Amphiura*, *Ophiacantha*, *Ophioplinthus*, *Ophiura*, and *Ophiuroglypha*.

Twenty-two species, including *Amphioplus* sp., *Amphipholis squamata*, *Amphiura belgicae*, *Amphiura* (*Amphiura*) *magellanica*, *Astrodiad* sp., *Astrophiura* sp., *Ophiacantha* cf. *inconspicua*, *Ophiacantha frigida*, *Ophiacantha opulenta*, *Ophiacantha* sp. 1, *Ophiacantha* sp. 2,

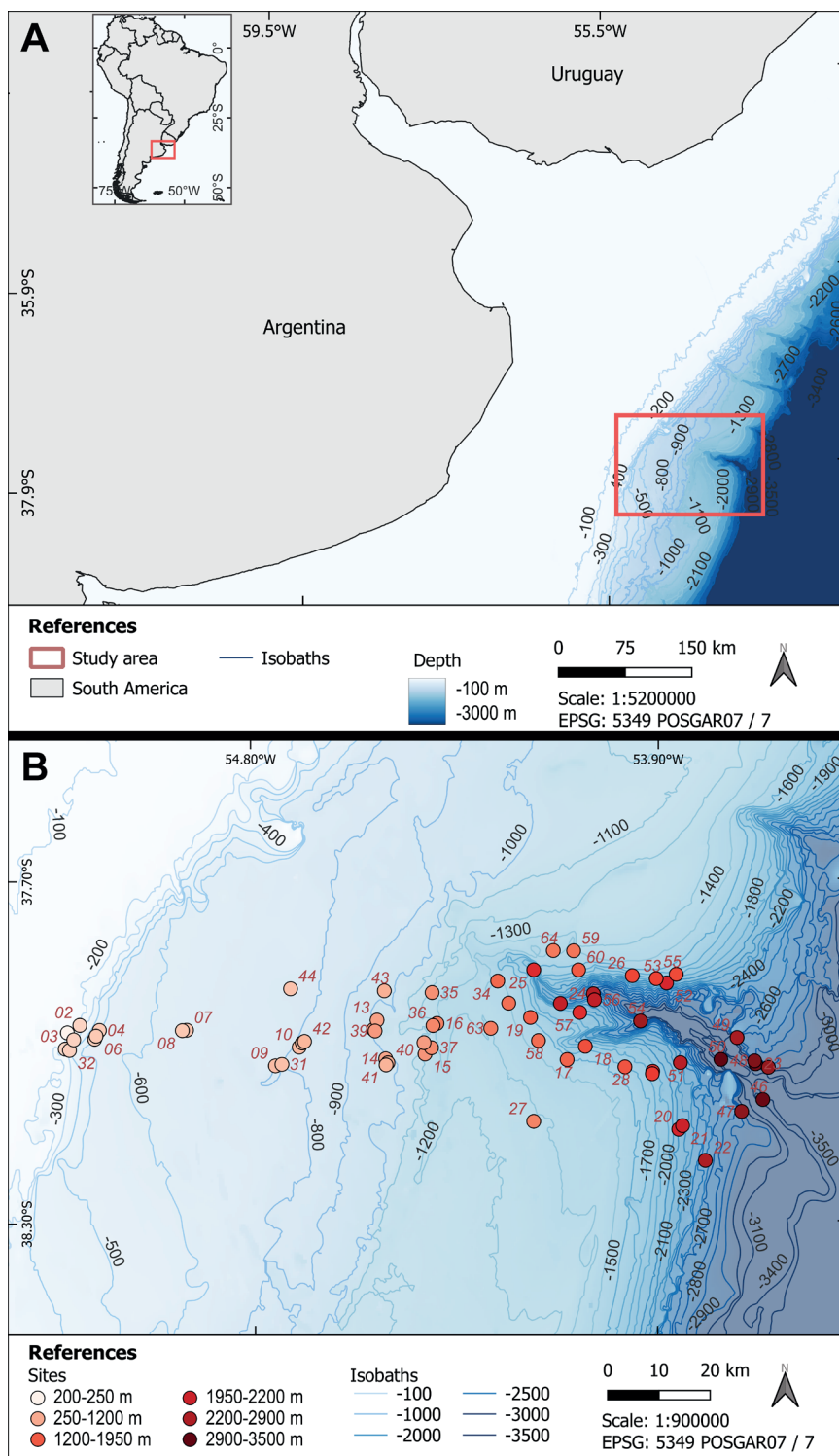


Fig. 1: Argentine Continental Slope and the Mar del Plata Submarine Canyon in the Southwestern Atlantic Ocean. (A) Location of the Mar del Plata Submarine Canyon study area (red square). (B) Detailed bathymetric map of the Mar del Plata Submarine Canyon area with the 64 stations analyzed in this study.

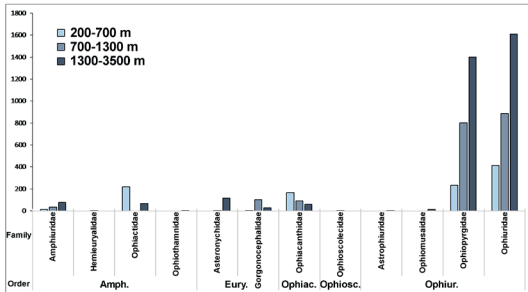


Fig. 2: Number of specimens recorded for each family, according to their different bathymetric ranges. Orders abbreviations: Amph., Amphilepididae; Eury., Euryalidae; Ophiac., Ophiacanthidae; Ophiosc., Ophioscolecidae; and Ophiur., Ophiuridae.

*Ophiacantha* sp. 3, *Ophiacantha* sp. 4, *Ophiogona doederleini*, *Ophioteles* sp., *Ophiolytus nutritus*, *Ophiomusa constricta*, *Ophiophycis* sp., *Ophiophyllum umbonatum*, *Ophiozonella hexactis*, *Ophiura* sp. 2, and *Ophiuroglypha irrorata irrorata* were found at specific locations, with records at only one or two stations and a limited number of specimens (Table 2). In contrast, *Ophiocten amitinum* was the most frequently observed species, recorded at 44% of the sampled stations and found across a wide bathymetric range (201 to 2,420 meters depth). This was followed by *Astrotoma agassizii*, recorded at 19% of the sampled stations (528 to 1,398 meters depth), and *Ophiosabine vivipara*, recorded at 12.5% of the sampled stations (201 to 1,308 meters depth). Despite its restricted distribution to shallower stations, *Ophiactis asperula* exhibited a higher frequency of occurrence than other species (Table 2).

The following eight genera were recorded for the first time in the study area: *Asteronyx*, *Astrodia*, *Astrophysa*, *Ophiogona*, *Ophioteles*, *Ophiolimna*, *Ophiophycis*, and *Ophiophyllum*. At the species level, 12 were identified as new records for the Argentine Sea: *Asteronyx lovei*, *Ophiacantha frigida*, *Ophiacantha opulenta*, *Ophiactis amator*, *Ophiogona doederleini*, *Ophiolimna antarctica*, *Ophiomusa lymani*, *Ophiophyllum umbonatum*, *Ophioplinthus scissa*, *Ophiozonella hexactis*, *Ophiura ljunghmani*, and *Ophiuroglypha irrorata irrorata*.

## DISCUSSION

Surveys conducted in the Argentine Sea have typically been restricted to areas of the extensive continental shelf, where depths do not exceed 200 meters. In general, the focus of these surveys

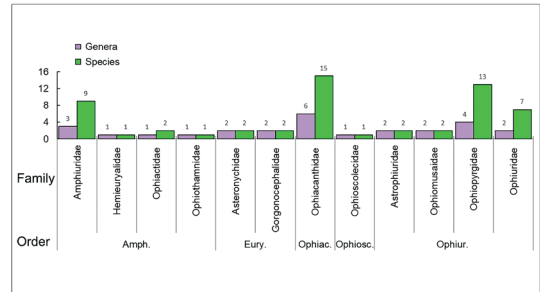


Fig. 3: Generic and specific richness within each of the 12 ophiuroid families registered in the present study. Orders abbreviations: Amph., Amphilepididae; Eury., Euryalidae; Ophiac., Ophiacanthidae; Ophiosc., Ophioscolecidae; and Ophiur., Ophiuridae.

has been on characterizing benthic assemblages (Olivier *et al.* 1968; Roux *et al.* 1987; Bastida *et al.* 1992) or on groups of organisms of commercial importance (Roux *et al.* 1995; Schejter & Bremec 2007; Escolar & Bremec 2015). Consequently, the presence of ophiuroids has generally been observed incidentally or as a secondary finding. Few studies have investigated the composition of benthic species in the deep-sea habitats of Argentina (Bremec & Schejter 2010; Hurtado-García & Manjón-Cabeza 2022). Our study was the first to focus on the diversity of a previously little-explored group, spanning a wide bathymetric range (200 to 3,447 meters) within the deep marine environment of the Argentine continental margin.

In this study, ophiuroids were collected in 81% of the sampled stations, with only 12 out of 64 stations showing no occurrence. Although studies were not conducted to determine whether there is a relationship between the sampling method and the presence of ophiuroids in our study, previous research have demonstrated that the choice of sampling methodology and the measurement of species diversity influence our understanding of biodiversity (Gage & Tyler 1991, Granja-Fernández *et al.* 2016). On the other hand, the absence of ophiuroids at these 12 stations may reflect localized environmental factors, such as unsuitable substrate types, hydrodynamic conditions or ecological interactions, which may limit their distribution.

A total of 56 species were recorded in ACS and MPSC, with 12 representing new records for the Argentine Sea. This increases the number of known species in the Argentine Sea from 32 to 44. Including the 28 newly registered but unidentified species suggests that the potential number of species in the area may reach 72, ap-

proximately 3.4% of the total species described worldwide (Stöhr *et al.* 2024). This notable increase in recorded species may be attributed to the taxonomic examination of samples from previously unexplored depths, as well as the unique geomorphological, oceanographic, and ecological characteristics of submarine canyon systems. These systems are known to support diverse and highly abundant invertebrate communities (De Leo *et al.* 2010; Fernandez-Arcaya *et al.* 2017; Bianchelli & Danovaro 2019) due to their complex topography, which creates microhabitats with varying environmental conditions, such as temperature, salinity, and substrate type (Callow *et al.* 2014). Additionally, submarine canyons act as conduits for organic matter and nutrients, enhancing productivity and serving as hotspots for benthic and pelagic biodiversity (Demopoulos *et al.* 2017; Robertson *et al.* 2020). Studies of submarine canyons worldwide have revealed high concentrations of filter feeders alongside motile invertebrates, such as crustaceans and echinoderms (Vetter 1995; Vetter & Dayton 1999). The new records from the Argentine Sea suggest an emerging alignment with global trends, where the class Ophiuroidea is recognized as the most speciose group within Echinodermata (Stöhr *et al.* 2012). However, further studies focusing on the other echinoderm classes in the region are still necessary to comprehensively understand the diversity and distribution patterns of the phylum in the Argentine Sea.

In accordance with global patterns of ophiuroids diversity reported by Stöhr *et al.* (2012), the most speciose families are Amphiuridae, Ophiacanthidae, and Ophiuridae. Several factors may contribute to these results. Firstly, the high species richness in Amphiuridae and Ophiacanthidae may be attributed to their broad ecological adaptability, as these families inhabit diverse substrates and depth ranges. Additionally, their reproductive strategies, which include a mix of planktotrophic and lecithotrophic larval development, likely enhance their dispersal potential and facilitate colonization across various habitats. Furthermore, it has been documented that shelf and bathyal habitats collectively support a comparable number of species, although their specific composition differs (O'Hara *et al.* 2011).

In the present study, 16 of the 56 recorded species had been previously reported in works from nearby areas of the continental shelf (Bastida *et al.* 1992; Bremec & Schejter 2010). Among these, the most frequently reported spe-

cies were *Astrotona agassizii*, *Gorgonocephalus chilensis*, *Ophiactis asperula*, *Ophiosabine vivipara*, and *Ophiuroglypha lymani* (Bremec & Schejter 2010; Escolar *et al.* 2013; Souto *et al.* 2014; Escolar & Bremec 2015). These similarities likely reflect the wide distribution and ecological adaptability of these species across different benthic environments. However, some species reported in previous studies were not observed in our work, which may be attributed to differences in sampling methodologies, geographic coverage, or specific environmental conditions in the surveyed areas. In contrast, the discovery of additional species not previously reported highlights the importance of expanding sampling efforts to less-explored regions and utilizing a broader range of collection techniques to better capture local biodiversity.

At shallow stations, *Ophiactis asperula* was the dominant species, a finding consistent with those of Escolar *et al.* (2013), who identified it as the most widespread species in the Patagonian scallop fishing grounds between 80 and 140 meters depth. Additionally, the authors report *Ophiosabine vivipara* as another relevant species in the Argentine continental shelf, which aligns with our findings where it was observed with the highest frequency. At depths exceeding 700 meters, the species with the highest frequency of occurrence was *Ophiocten amitinum* in our study. In accordance with the present results, previous studies have demonstrated a wide bathymetric range and high abundance for this species (Manso 2010).

The species recorded in the present study, *Gorgonocephalus chilensis*, *Ophiuroglypha lymani*, *Ophiocten amitinum* and *Astrotona agassizii*, appear to have a wide distribution, as they have also been reported in the Southern Ocean (Martín-Ledo & López-Gonzalez 2014) and the Pacific Ocean (Manso 2010). However, at least *Ophiuroglypha lymani* and *Astrotona agassizii* have been proposed as cryptic species (Hunter & Halanych 2008, 2010; Sands *et al.* 2015), highlighting the importance of integrating both morphological and molecular taxonomy in diversity studies. This is further supported by an increasing number of studies demonstrating the existence of numerous cryptic species and species complexes within this class (Stöhr *et al.* 2009; Boissin *et al.* 2010; Okanishi *et al.* 2018; Stöhr *et al.* 2020).

Although the results reported here are preliminary, additional taxonomic work is needed on certain specimens to determine if their discovery

constitutes new scientific information. Among the unidentified specimens were individuals that were too damaged to allow for reliable identification, those exhibiting morphological characteristics that did not clearly align with known species descriptions, and specimens with features that suggest they may represent species not yet described. Ambiguous characteristics include inconsistencies in key diagnostic traits, such as arm structure or skeletal elements, which could not be confidently matched to existing taxonomic keys. These challenges highlight the need for further detailed morphological and genetic analyses to resolve their taxonomic status and evaluate their potential novelty.

The total number of potentially new ophiuroid records for Argentina, including 12 new records and 28 yet unidentified species, stands at 40. The number of ophiuroid species recorded in Argentina would reach a total of 72. This number more than doubles the known ophiuroid diversity in the Argentine Sea (32 species), offering significant new insights into benthic biodiversity in deep waters. Future studies with enhanced sampling efforts in this and other canyon systems are likely to uncover even more invertebrate taxa, further enriching our understanding of deep-sea and strengthening the baseline for future research.

Table 1: Sampling stations information collected aboard the research vessel Puerto Deseado in the Mar del Plata Canyon area. Lat.: latitude; Long.: longitude. Stations where no ophiuroids were collected are shown in bold font (stations: 9, 13, 17, 27, 28, 30, 35, 40, 52, 54, 56 and 57).

| Sampling stations | Lat. (S)           | Long. (W)          | Depth (m)   | Date             | Collecting method           |
|-------------------|--------------------|--------------------|-------------|------------------|-----------------------------|
| 1                 | 37° 57.953'        | 55° 12.731'        | 201         | 8-10-2012        | Dredge trawl (large)        |
| 2                 | 37° 57.182'        | 55° 11.060'        | 291         | 8-10-2012        | Dredge trawl (large)        |
| 3                 | 37° 59.657'        | 55° 13.050'        | 250         | 8-10-2012        | Fishing net                 |
| 4                 | 37° 57.736'        | 55° 8.456'         | 529         | 8-10-2012        | Dredge trawl (large)        |
| 5                 | 37° 58.651'        | 55° 9.104'         | 528         | 8-10-2012        | Fishing net                 |
| 6                 | 37° 58.337'        | 55° 8.915'         | 530         | 8-10-2012        | Dredge trawl (small)        |
| 7                 | 37° 57.815'        | 54° 56.848'        | 652         | 8-10-2012        | Dredge trawl (large)        |
| 8                 | 37° 57.857'        | 54° 57.406'        | 647         | 8-10-2012        | Fishing net                 |
| <b>9</b>          | <b>38° 1.648'</b>  | <b>54° 45.032'</b> | <b>823</b>  | <b>8-11-2012</b> | <b>Dredge trawl (large)</b> |
| 10                | 37° 59.706'        | 54° 41.854'        | 852         | 8-11-2012        | Fishing net                 |
| 11                | 37° 59.258'        | 54° 41.436'        | 854         | 8-11-2012        | Dredge trawl (large)        |
| 12                | 37° 57.907'        | 54° 31.921'        | 1144        | 8-11-2012        | Dredge trawl (small)        |
| <b>13</b>         | <b>37° 56.917'</b> | <b>54° 31.441'</b> | <b>1025</b> | <b>8-11-2012</b> | <b>Dredge trawl (large)</b> |
| 14                | 38° 0.984'         | 54° 30.326'        | 1006        | 8-11-2012        | Fishing net                 |
| 15                | 38° 0.500'         | 54° 25.069'        | 1200        | 8-12-2012        | Dredge trawl (large)        |
| 16                | 37° 57.288'        | 54° 23.456'        | 1308        | 8-12-2012        | Fishing net                 |
| <b>17</b>         | <b>38° 1.129'</b>  | <b>54° 6.116'</b>  | <b>1498</b> | <b>8-12-2012</b> | <b>Dredge trawl (small)</b> |
| 18                | 37° 59.734'        | 54° 3.694'         | 1650        | 8-13-2012        | Dredge trawl (large)        |
| 19                | 37° 56.688'        | 54° 10.997'        | 1508        | 8-13-2012        | Fishing net                 |
| 20                | 38° 8.460'         | 53° 51.218'        | 2010        | 8-13-2012        | Dredge trawl (large)        |
| 21                | 38° 8.07'          | 53° 50.702'        | 2082        | 8-13-2012        | Fishing net                 |
| 22                | 38° 11.730'        | 53° 47.647'        | 2503        | 8-14-2012        | Fishing net                 |
| 23                | 38° 1.549'         | 53° 40.967'        | 3006        | 8-14-2012        | Dredge trawl (large)        |
| 24                | 37° 54.206'        | 54° 2.616'         | 2420        | 8-14-2012        | Fishing net                 |
| 25                | 37° 51.688'        | 54° 10.550'        | 1950        | 8-15-2012        | Dredge trawl (large)        |
| 26                | 37° 52.303'        | 53° 57.433'        | 1738        | 8-15-2012        | Fishing net                 |
| <b>27</b>         | <b>38° 7.619'</b>  | <b>54° 10.595'</b> | <b>1301</b> | <b>8-15-2012</b> | <b>Dredge trawl (large)</b> |
| <b>28</b>         | <b>38° 1.899'</b>  | <b>53° 58.404'</b> | <b>1601</b> | <b>8-16-2012</b> | <b>Fishing net</b>          |
| 29                | 38° 2.366'         | 53° 54.700'        | 1783        | 8-16-2012        | Fishing net                 |
| <b>30</b>         | <b>38° 2.615'</b>  | <b>53° 54.757'</b> | <b>1770</b> | <b>8-16-2012</b> | <b>Dredge trawl (large)</b> |
| 31                | 38° 1.499'         | 54° 44.171'        | 819         | 8-16-2012        | Fishing net                 |
| 32                | 37° 59.800'        | 55° 12.479'        | 319         | 8-17-2012        | Dredge trawl (large)        |
| 33                | 37° 58.698'        | 55° 11.899'        | 308         | 8-17-2012        | Fishing net                 |
| 34                | 37° 52.852'        | 54° 15.352'        | 1451        | 5-25-2013        | Fishing net                 |
| <b>35</b>         | <b>37° 54.045'</b> | <b>54° 24.091'</b> | <b>1245</b> | <b>5-25-2013</b> | <b>Dredge trawl (large)</b> |
| 36                | 37° 57.508'        | 54° 23.989'        | 1289        | 5-25-2013        | Fishing net                 |
| 37                | 37° 59.848'        | 54° 24.206'        | 1275        | 5-25-2013        | Dredge trawl (small)        |
| 38                | 37° 59.308'        | 54° 25.207'        | 1099        | 5-25-2013        | Fishing net                 |

| Sampling stations | Lat. (S)           | Long. (W)          | Depth (m)   | Date             | Collecting method           |
|-------------------|--------------------|--------------------|-------------|------------------|-----------------------------|
| 39                | 37° 58.054'        | 54° 31.715'        | 1144        | 5-25-2013        | Dredge trawl (small)        |
| <b>40</b>         | <b>38° 01.412'</b> | <b>54° 30.026'</b> | <b>1002</b> | <b>5-26-2013</b> | <b>Fishing net</b>          |
| 41                | 38° 01.631'        | 54° 30.275'        | 997         | 5-26-2013        | Fishing net                 |
| 42                | 37° 59.110'        | 54° 41.136'        | 877         | 5-26-2013        | Dredge trawl (large)        |
| 43                | 37° 53.837'        | 54° 30.458'        | 998         | 5-26-2013        | Fishing net                 |
| 44                | 37° 53.557'        | 54° 42.941'        | 780         | 5-26-2013        | Fishing net                 |
| 45                | 38° 1.913'         | 53° 39.268'        | 2934        | 9-05-2013        | Fishing net                 |
| 46                | 38° 5.310'         | 53° 39.988'        | 3282        | 9-05-2013        | Dredge trawl (small)        |
| 47                | 38° 6.571'         | 53° 42.827'        | 2950        | 9-06-2013        | Fishing net                 |
| 48                | 38° 1.243'         | 53° 41.108'        | 2958        | 9-06-2013        | Dredge trawl (large)        |
| 49                | 37° 58.795'        | 53° 43.458'        | 2711        | 9-06-2013        | Dredge trawl (small)        |
| 50                | 38° 1.098'         | 53° 45.601'        | 3447        | 9-07-2013        | Dredge trawl (large)        |
| 51                | 38° 1.447'         | 53° 51.011'        | 2212        | 9-07-2013        | Fishing net                 |
| <b>52</b>         | <b>37° 53.071'</b> | <b>53° 52.868'</b> | <b>1970</b> | <b>9-07-2013</b> | <b>Fishing net</b>          |
| 53                | 37° 52.614'        | 53° 54.246'        | 1763        | 9-08-2013        | Fishing net                 |
| <b>54</b>         | <b>37° 57.073'</b> | <b>53° 56.330'</b> | <b>2845</b> | <b>9-08-2013</b> | <b>Dredge trawl (small)</b> |
| 55                | 37° 52.154'        | 53° 51.582'        | 1712        | 9-08-2013        | Fishing net                 |
| <b>56</b>         | <b>37° 54.840'</b> | <b>54° 2.470'</b>  | <b>2204</b> | <b>9-09-2013</b> | <b>Dredge trawl (large)</b> |
| <b>57</b>         | <b>37° 56.177'</b> | <b>54° 4.430'</b>  | <b>1853</b> | <b>9-09-2013</b> | <b>Dredge trawl (small)</b> |
| 58                | 37° 59.128'        | 54° 9.942'         | 1444        | 9-09-2013        | Fishing net                 |
| 59                | 37° 49.688'        | 54° 5.236'         | 1398        | 9-10-2013        | Fishing net                 |
| 60                | 37° 51.700'        | 54° 4.583'         | 1584        | 9-10-2013        | Dredge trawl (large)        |
| 61                | 37° 55.219'        | 54° 7.010'         | 2161        | 9-10-2013        | Dredge trawl (large)        |
| 62                | 37° 55.184'        | 54° 13.895'        | 1404        | 9-11-2013        | Fishing net                 |
| 63                | 37° 57.830'        | 54° 16.292'        | 1310        | 9-11-2013        | Dredge trawl (small)        |
| 64                | 37° 49.661'        | 54° 7.943'         | 1395        | 9-11-2013        | Dredge trawl (large)        |

Table 2: Ophiuroid species found at each sampling station during the 2012 and 2013 research cruises to the Argentine Continental Slope and the Mar del Plata Submarine Canyon in the Southwestern Atlantic Ocean.

| Order         | Family            | n   | Species                                                               | Sampling stations                             |
|---------------|-------------------|-----|-----------------------------------------------------------------------|-----------------------------------------------|
| Amphilepidida | Amphiuridae       | 10  | <i>Amphioplus</i> sp.                                                 | 64                                            |
|               |                   | 4   | <i>Amphipholis squamata</i> (Delle Chiaje, 1828)                      | 12, 49                                        |
|               |                   | 1   | <i>Amphiura belgicae</i> Koehler, 1900                                | 12                                            |
|               |                   | 9   | <i>Amphiura eugeniae</i> Ljungman, 1867                               | 6, 12, 59                                     |
|               |                   | 2   | <i>Amphiura</i> ( <i>Amphiura</i> ) <i>magellanica</i> Ljungman, 1867 | 2                                             |
|               |                   | 12  | <i>Amphiura</i> sp.1                                                  | 1, 5, 6, 8, 12                                |
|               |                   | 8   | <i>Amphiura</i> sp.2                                                  | 12, 16                                        |
|               |                   | 55  | <i>Amphiura</i> sp.3                                                  | 25, 38, 43, 26, 51, 53, 55, 59, 61            |
|               |                   | 14  | Amphiuridae sp.                                                       | 2, 64                                         |
|               | Hemieuryalidae    | 2   | <i>Ophiozonella hexactis</i> Stöhr, 2011                              | 12                                            |
|               | Ophiactidae       | 66  | <i>Ophiactis amator</i> Koehler, 1922                                 | 24, 26, 45, 46, 47, 49, 50, 55                |
|               |                   | 350 | <i>Ophiactis asperula</i> (Philippi, 1858)                            | 1, 2, 3, 5, 32, 33                            |
|               | Ophiothamnidae    | 1   | cf. <i>Ophiothamnus</i>                                               | 59                                            |
| Euryalida     | Asteronychidae    | 130 | <i>Asteronyx loveni</i> Müller & Troschel, 1842                       | 20, 21, 26, 29, 45, 53, 55, 61                |
|               |                   | 2   | <i>Astrodia</i> sp.                                                   | 46                                            |
|               | Gorgonocephalidae | 132 | <i>Astrotoma agassizii</i> Lyman, 1875                                | 5, 10, 11, 14, 15, 16, 31, 37, 38, 41, 42, 59 |
|               |                   | 3   | <i>Gorgonocephalus chilensis</i> (Philippi, 1858)                     | 3, 33, 59                                     |

| Order          | Family          | n    | Species                                                            | Sampling stations                                                                                               |
|----------------|-----------------|------|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Ophiacanthida  | Ophiacanthidae  | 3    | <i>Ophiacantha</i> cf. <i>inconspicua</i> Lütken & Mortensen, 1899 | 47                                                                                                              |
|                |                 | 3    | <i>Ophiacantha frigida</i> Koehler, 1907                           | 45, 50                                                                                                          |
|                |                 | 8    | <i>Ophiacantha</i> cf. <i>frigida</i> sp.2                         | 22                                                                                                              |
|                |                 | 2    | <i>Ophiacantha opulenta</i> Koehler, 1907                          | 45, 50                                                                                                          |
|                |                 | 3    | <i>Ophiacantha</i> sp.1                                            | 49, 47                                                                                                          |
|                |                 | 2    | <i>Ophiacantha</i> sp.2                                            | 49, 47                                                                                                          |
|                |                 | 1    | <i>Ophiacantha</i> sp.3                                            | 5                                                                                                               |
|                |                 | 3    | <i>Ophiacantha</i> sp.4                                            | 15                                                                                                              |
|                |                 | 58   | <i>Ophiacantha</i> sp.5                                            | 25, 31, 38, 41, 47, 48                                                                                          |
|                |                 | 9    | <i>Ophiochondrus stelliger</i> Lyman, 1879                         | 5, 10, 12, 31, 38, 42, 51, 59                                                                                   |
|                |                 | 1    | <i>Ophiolebes</i> sp.                                              | 11                                                                                                              |
|                |                 | 11   | <i>Ophiolimna antarctica</i> (Lyman, 1879)                         | 11, 38                                                                                                          |
|                |                 | 7    | <i>Ophiosabine densispina</i> (Mortensen, 1936)                    | 5, 16, 41                                                                                                       |
|                |                 | 190  | <i>Ophiosabine vivipara</i> (Ljungman, 1871)                       | 1, 2, 3, 5, 11, 16, 31, 33                                                                                      |
|                |                 | 30   | <i>Ophiosemonotes</i> cf. <i>pachybactra</i> (H.L. Clark, 1911)    | 5, 26                                                                                                           |
| Ophioscolecida | Ophioscolecidae | 3    | <i>Ophiolycus nutrix</i> (Mortensen, 1936)                         | 10                                                                                                              |
| Ophiurida      | Astrophriuridae | 1    | <i>Astrophriura</i> sp.                                            | 47                                                                                                              |
|                |                 | 2    | <i>Ophiophycis</i> sp.                                             | 59                                                                                                              |
|                | Ophiomusaidae   | 4    | <i>Ophiomusa constricta</i> (Mortensen, 1936)                      | 24, 53                                                                                                          |
|                |                 | 9    | <i>Ophiomusa lymani</i> (Wyville Thomson, 1873)                    | 18, 22, 51                                                                                                      |
|                | Ophiopyrgidae   | 4    | <i>Ophiogona doederleini</i> (Koehler, 1901)                       | 14                                                                                                              |
|                |                 | 1    | <i>Ophiophyllum umbonatum</i> Okanishi & Mah, 2020                 | 47                                                                                                              |
|                |                 | 250  | <i>Ophioplinthus inornata</i> (Lyman, 1878)                        | 5, 7, 10, 14, 19, 22, 31                                                                                        |
|                |                 | 26   | <i>Ophioplinthus martensi</i> (Studer, 1885)                       | 8                                                                                                               |
|                |                 | 389  | <i>Ophioplinthus scissa</i> (Koehler, 1907)                        | 24                                                                                                              |
|                |                 | 600  | <i>Ophioplinthus</i> sp.1                                          | 42, 44, 51, 53, 55, 59, 62                                                                                      |
|                |                 | 44   | <i>Ophioplinthus</i> sp.2                                          | 4, 5                                                                                                            |
|                |                 | 70   | <i>Ophioplinthus</i> sp.3                                          | 38, 49, 64                                                                                                      |
|                |                 | 183  | <i>Ophioplinthus</i> sp.4                                          | 25, 41, 42, 43, 44, 45, 53, 55                                                                                  |
|                |                 | 405  | <i>Ophiuroglypha</i> cf. <i>migrans</i> (Hertz M, 1927)            | 5, 24, 45, 49, 50                                                                                               |
|                |                 | 2    | <i>Ophiuroglypha irrorata irrorata</i> (Lyman, 1878)               | 45, 50                                                                                                          |
|                |                 | 120  | <i>Ophiuroglypha lymani</i> (Ljungman, 1871)                       | 3, 4, 5, 6, 8, 33, 41, 43, 44                                                                                   |
|                |                 | 24   | <i>Ophiuroglypha</i> sp.                                           | 19, 25, 48, 53, 64                                                                                              |
|                | Ophiuridae      | 1500 | <i>Ophiocten amitinum</i> Lyman, 1878                              | 1, 3, 4, 10, 12, 14, 15, 19, 24, 26, 31, 32, 33, 34, 36, 37, 38, 41, 42, 43, 44, 51, 53, 55, 58, 59, 62, 63, 64 |
|                |                 | 481  | <i>Ophiura</i> cf. <i>fraterna</i> (Lyman, 1878)                   | 24                                                                                                              |
|                |                 | 447  | <i>Ophiura ljunmani</i> (Lyman, 1878)                              | 45, 47, 50                                                                                                      |
|                |                 | 253  | <i>Ophiura</i> sp.1                                                | 12, 19, 45, 46, 47                                                                                              |
|                |                 | 2    | <i>Ophiura</i> sp.2                                                | 10                                                                                                              |
|                |                 | 27   | <i>Ophiura</i> sp.3                                                | 21, 22                                                                                                          |

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