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Short Communication

In situ imaging of benthic fauna at the Argentine shelf break front, SW Atlantic Ocean

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ABSTRACT. This study presents the first *in situ* images of benthic invertebrates and fishes inhabiting the shelf break front of Argentina, in the SW Atlantic Ocean. Obtained over a soft-sandy substrate, these images represent the first live visual records of several species of invertebrates and fish commonly found in this area, where the Patagonian scallop (*Zygochlamys patagonica*), the Argentine hake (*Merluccius hubbsi*), and the Argentine squid (*Illex argentinus*) fishery fleet operate. These images reveal the structure of these very rich benthic communities, in which echinoderms, mainly ophiuroids, are one of the dominant groups.

Keywords: marine benthic communities; invertebrates; fishes; submarine images; Argentina

INTRODUCTION

Exploration of the SW Atlantic Ocean and the study and exploitation of the marine species that inhabit it have been ongoing for several centuries. Angelescu & Sánchez (1997) conducted an extensive review of the Argentine Jurisdictional Waters (up to 200 nm from the coast) in the SW Atlantic, identifying distinct periods of exploration linked to varying interests, particularly emphasizing historical efforts related to fisheries resources. One of their main conclusions was that coastal environments have received more attention due to the logistical challenges and technological demands involved in studying species inhabiting deeper, offshore areas.

Knowledge of benthic communities, especially those associated with the Argentine shelf break front, has grown exponentially in recent decades (for revisions see Schejter et al. 2017a, Giberto et al. 2024). Early studies primarily aimed to evaluate the commercial potential of the Patagonian scallop *Zygochlamys patagonica* (P.P. King, 1832) (Walossek 1991, Lasta & Bremec 1998).

With the beginning of this fishery in 1996, research also began to focus on the associated benthic fauna, as this was one of the components outlined in the initial management proposal (Bremec et al. 1998, Bremec & Lasta 2002, Campodónico et al. 2019). The first studies of the benthic fauna on the shelf break front aimed to document the presence and distribution of the main faunal components. To date, more than 250 benthic species have been recorded in this region located roughly between 37 and 45°S and between depths of 80 to 120 m (Schejter & Bremec 2007, López-Gappa & Landoni 2009, Sánchez et al. 2011, Schejter et al. 2011, 2012, 2025, Brogger et al. 2013). Many of these species have been the subject of targeted studies on population dynamics, reproductive biology, and ecological interac-

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tions, among others (e.g. Campodónico et al. 2008, Schejter et al. 2010, 2025, Escolar et al. 2011, 2013, Schejter & Mantelatto 2011, 2015, Schejter & Escolar 2013, Escolar & Bremec 2015). Available information has been compiled to develop a comprehensive understanding of the dynamics and complex interactions within these benthic communities (Schejter et al. 2017a, Giberto et al. 2024). However, until now, no underwater imagery of these organisms in their natural habitat at the shelf break front had been available, as all previous studies relied on samples collected by bottom trawls and dredges during research cruises. This study, which emerged as a by-product of two different filming efforts, presents, for the first time, underwater images of organisms of the benthic community at the shelf break front in their natural environment, using still frames extracted from recorded videos.

Two different underwater filming efforts were carried out along the slope front:

1) A pilot study conducted on November 29th and 30th in 2016, aboard the fishing vessel "Atlantic Surf III", during a survey aimed at stock assessment of the Patagonian scallop (Campodónico et al. 2017). A stainless-steel frame, designed by the Fishing Gear Development and Capture Methods Program at INIDEP (Fig. 1a), was deployed for two separate trials. The frame was equipped with a Kongsberg-Simrad OE SIT 1324 video camera, a programmable OE 8357 recorder (also by Kongsberg-Simrad), and a hydrophone. As no artificial lighting was used during this trial, careful planning was necessary to take advantage of optimal natural light conditions, specifically around 12:00 h for maximum sunlight penetration, and to ensure calm sea conditions (e.g. low wave activity). The device remained stationary on the seafloor (39°15'S, 55°47'W) for 90 min at approximately 112 m depth. In a second deployment at the same location, the frame was submerged to the seafloor and allowed to drift for several minutes (Roth & Campodónico 2017; see technical data in the cruise report).

The images obtained (Fig. 2), although in monochromatic scale, allowed for *in situ* observation of two fish species commonly recorded in the area: the hairy conger *Bassanago albescens* (Barnard, 1923) and the longtail southern cod *Patagonotothen ramsayi* (Regan, 1913) (Schejter et al. 2012), that approached the device during the first trial while it remained stationary on the sandy seafloor. Several ophiuroids, including *Ophiactis asperula* (Philippi, 1858) and *Ophiosabine vivipara* (Ljungman, 1871), were observed, along with the asteroids *Diplasterias brandti* (Bell, 1881) and *Ctenodiscus australis* Loven in Lütken, 1871, and the hairy snail *Fusitriton magellanicus* (Röding, 1798). Numerous specimens of the Patagonian scallop were also documented.

It is necessary to mention that the surface covered by the camera was about 0.8 m^2. However, because the edge regions were blurred, the reported images were cropped to optimize visualization of the area actually in focus.

2) The second set of images was obtained during another Patagonian scallop stock assessment survey conducted aboard the research vessel "Víctor Angelescu" between August 17th and September 2nd, 2020 (Campodónico et al. 2020 for the technical report of the cruise VA 02/2020). A GoPro underwater camera was mounted at the center of the dredge mouth, secured to the upper panel (Fig. 1b-c), to conduct preliminary observations of the dredge's behavior on the seafloor. As a secondary outcome of this deployment (conducted at 38°48'S and 55°35'W at a depth of 128 m), the video captured during the tow also provided images of benthic invertebrates along the dredge's path across the seafloor.

This second trial also recorded many of the species that were observed in the previous trial, along with additional benthic invertebrates, with improved image resolution and color definition (Fig. 3). Among the echinoderms, in addition to the ophiuroid species already mentioned that are very common and abundant in the area (Escolar et al. 2013, Escolar & Bremec 2015), it was possible to get images of the yellow asteroid *Diplasterias brandti*, the basket star *Gorgonocephalus chilensis* (Philippi, 1858), and also a small-sized, unidentified asteroid. Several *Z. patagonica* individuals were observed with epibiotic organisms. Many hermit crabs, *Sympagurus dimorphus* (Studer, 1883), in symbiosis with zoanthids *Epizoanthus paguricola* Roule, 1900 (Schejter & Mantelatto 2011), a nudibranch, and various sea anemones were also recorded (Fig. 3). Due to the taxonomic complexity of the latter groups, species-level identification could not be confirmed based solely on imagery.

Although neither trial was designed to capture scaled images for precise size reference or density estimations, previous knowledge of this benthic community (Bremec et al. 2003, Schejter et al. 2017a) allows us to reasonably estimate that the observed individuals range in size from approximately 2 to 10 cm, except for the fishes, which may exceed 30 cm in the case of the hairy conger. Notably, none of the images revealed bare substrate; rather, multiple benthic species were consistently present, with ophiuroids

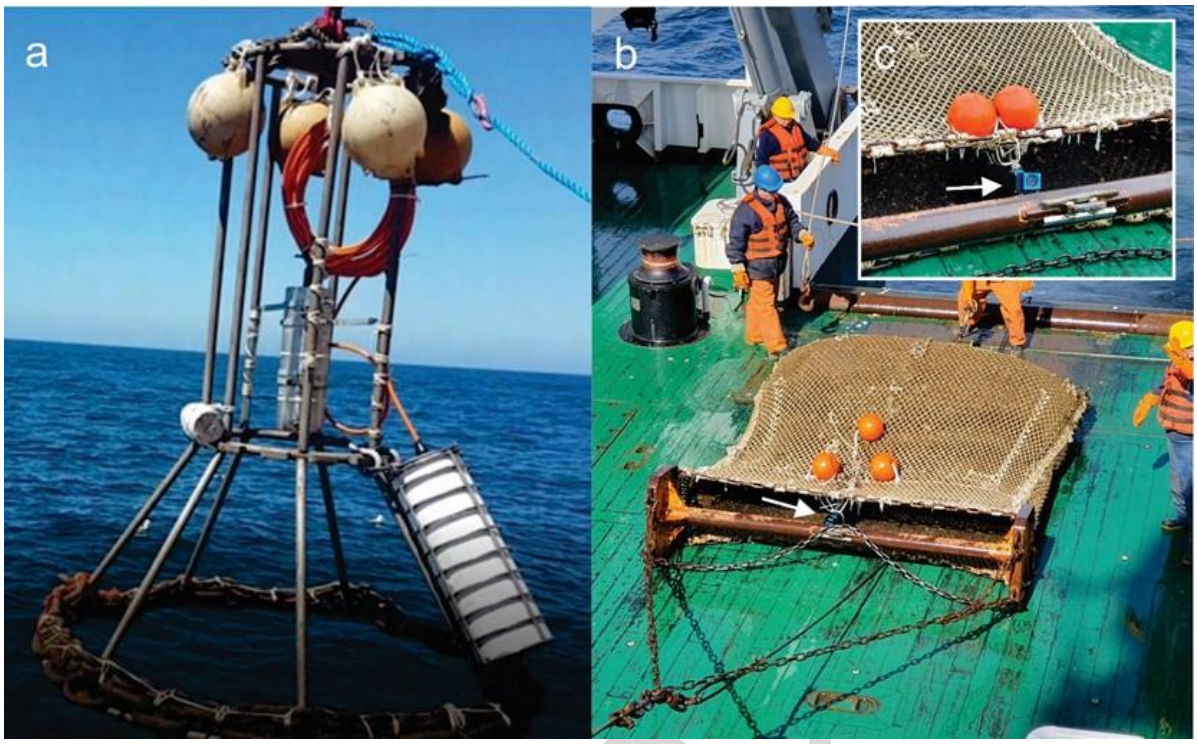

Figure 1. a) Stainless steel frame equipped with an underwater camera, image recorder, and hydrophone (adapted from Roth & Campodónico 2017), b) GoPro camera mounted on the dredge, c) close-up view of the camera's position (adapted from Campodónico et al. 2020). Arrows show the position of the GoPro Camera.

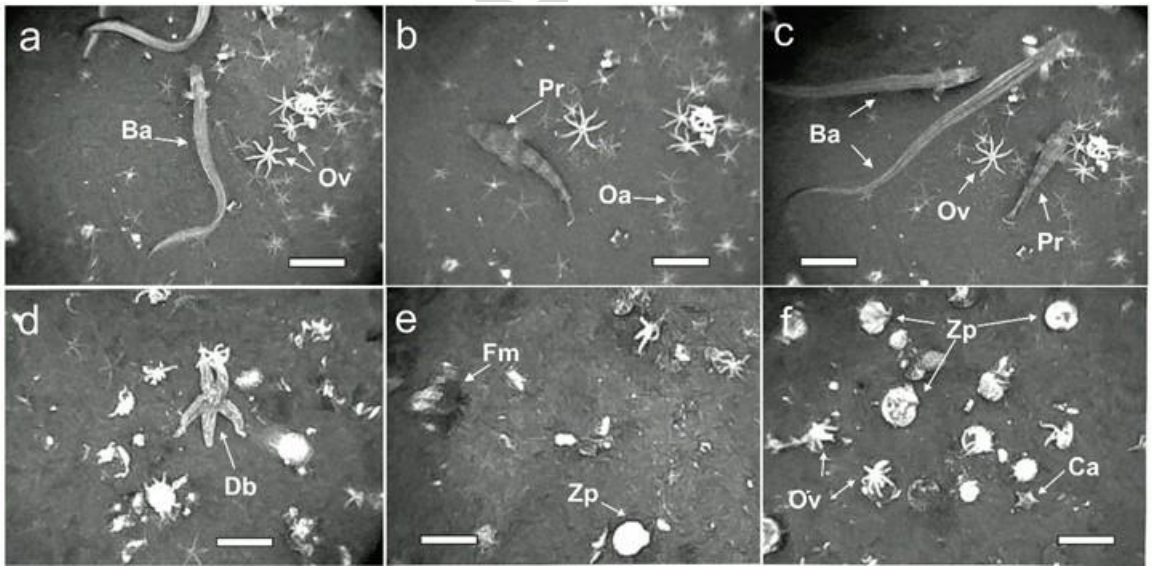

Figure 2. a-f) Images of benthic organisms observed in the first experience in 2016, at depths between 112 and 120 m. Ba: hairy conger *Bassanago albescens*, Pr: *Patagonotothen ramsayi*, Ov: brittle star *Ophiosabine vivipara*, Oa: brittle star *Ophiactis asperula*, Zp: scallop *Zygochlamys patagonica*, Db: sea star *Diplasterias brandti*, Ca: asteroid *Ctenodiscus australis*, Fm: hairy snail *Fusitriton magellanicus.* Scale bar: 6 cm (only as a reference value).

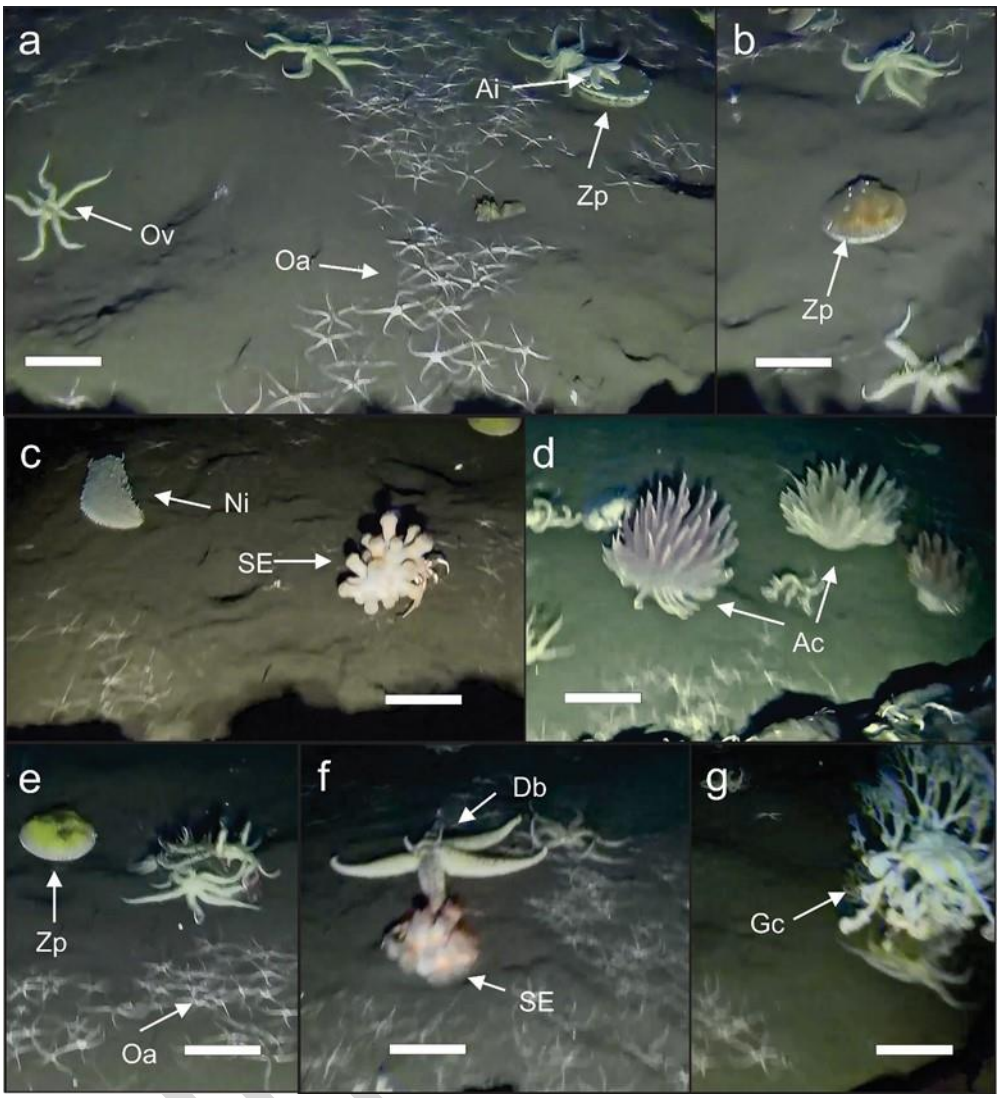

Figure 3. a-g) Underwater images obtained in the second survey in 2020 (VA 02/2020) at 128 m depth. Zp: Patagonian scallop *Zygochlamys patagonica*, Ov: brittle star *Ophiosabine vivipara*, Oa: brittle star *Ophiactis asperula*, Ai: unidentified asteroid, Gc: basket star *Gorgonocephalus chilensis*, Ni: unidentified nudibranch, SE: hermit crab *Sympagurus dimorphus* in association with *Epizoanthus paguricola*, Ac: unidentified sea anemones (Actiniaria), Db: asteroid *Diplasterias brandti*. Scale bar: 5 cm (only as a reference value).

particularly abundant, indicating the ecosystem's resilience. Ophiuroids were consistently reported in close association with the Patagonian scallop in this region, with high biomass and abundance (e.g. Escolar et al. 2013, Bremec et al. 2015). The bottoms in the studied area are mostly dominated by fine sands, with a notable presence of invertebrate remains (gastropod shells, scallop valves, and echinoid tests) that act as bioclast producers. Previous fauna-sediment correlation analyses did not indicate any particular granulometric preference by the benthic species (Bremec et al. 2014).

The Argentine shelf break front is one of the most productive and hydrographically complex regions of the southwestern Atlantic, where the interaction between shelf waters and the Malvinas Current generates strong thermal and salinity gradients that enhance nutrient availability and primary production (Acha et al. 2024). The resulting high flux of particulate organic matter promotes the development of soft-bottom benthic communities characterized by elevated biomass and species richness (Lasta & Bremec 1998, Schejter & Bremec 2007, Schejter et al. 2017a). Near-

bottom currents and variable sedimentation rates contribute to fine-scale habitat heterogeneity, supporting diverse assemblages of infaunal and epifaunal organisms (Sánchez et al. 2011, Giberto et al. 2024). Within this context, the Patagonian scallop (*Z. patagonica*) functions as an ecosystem engineer, increasing local species diversity by providing more available hard substrate for sessile species. In contrast, epibiotic colonization on living organisms and shell remains of other species (e.g. molluscs, crustaceans, brachiopods) further contributes to benthic habitat complexity and biodiversity (e.g. Schejter et al. 2011, 2025, Romero et al. 2017). These combined oceanographic and ecological processes indicate that the shelf break front can be considered a regional biodiversity hotspot in the southwestern Atlantic (Acha et al. 2024).

Obtaining underwater imagery, especially in deep and offshore areas, is always challenging. These operations usually require expensive equipment, proper lighting, and favorable weather and oceanographic conditions to ensure successful deployment. Furthermore, the costs of equipment are typically very high, and its use is limited to suitable platforms or vessels that must usually meet a series of essential technological requirements and may require cooperative projects among industry and scientists (e.g. Bell et al. 2022). Nonetheless, a first approach could be to use simple, cost-effective setups that are often highly useful for capturing *in situ* images of benthic organisms (e.g. Peirano et al. 2016, Schejter et al. 2017b), which is precisely the case in the present study, which for the first time provides underwater images of the most common benthic organisms inhabiting the shelf break front area in Argentina. These exploratory trials serve as a valuable baseline for the design of equipment and future studies aimed at acquiring more refined qualitative and quantitative information on the species present in this region, using less invasive methods than conventional bottom trawl sampling.

Credit author contribution

L. Schejter: conceptualization, image processing, illustration, writing-original draft and reviewing; R. Roth & J. García: methodology on board, video acquisition, writing and reviewing draft; M. Escolar: methodology on board, writing original draft and reviewing; S. Campodónico: methodology on board, supervision, reviewing draft.

Conflict of interest

The authors declare no potential conflict of interest.

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