



LETTER TO THE EDITOR

Benthic diversity in a submarine canyon in the Argentine sea

Diversidad bentónica en un cañón submarino en el mar argentino

CLAUDIA BREMEC^{1, 2, *} & LAURA SCHEJTER^{1, 2}¹ Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP), Paseo Victoria Ocampo N° 1, Mar del Plata, B7602HSA, Argentina² Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina

*Corresponding author: cbremec@inidep.edu.ar

INTRODUCTION

The extensive Argentinean continental shelf is dominated by soft sediments, mainly composed of sand with minor quantities of shells and mud. Its external edge, where the continental slope starts, varies between 110 and 165 m depth approximately and usually associated with the 200 m isobath. The continental slope shows many recognized deep submarine canyons, varying in depth and extension (Parker et al. 1997). The characterization of benthic assemblages in the Argentine sea mainly comes from shelf areas (Bastida et al. 1992, 2007, Roux et al. 1993, 2005). More recent contributions deal with the invertebrate by-catch associated with the Patagonian scallop *Zygochlamys patagonica* (King & Broderip, 1832) fishery in shelf-break frontal areas (Bremec & Lasta 2002, Bremec et al. 2000, 2008, Schejter & Bremec 2007, Schejter et al. 2006, 2008, Escolar et al. 2009), mainly between 90 and 140 m depth.

The current knowledge of bottoms deeper than 200 m in the Argentine sea is scarce (see Bremec 1992, Bastida et al. 2007). The faunal composition from locations sampled during different cruises and distributed along the wide latitudinal gradient between 39° and 53° S was included in the ecological analysis of data from the Buenos Aires (one sampling site, Roux et al. 1993) and Patagonian shelves (seven sampling sites, Roux et al. 2005).

During a monitoring cruise (BIP "Oca Balda", INIDEP) developed in 2005 for stock assessment of *Z. patagonica*, two submarine canyons were detected by means of a multibeam SIMRAD EM1002 sonar and one of them was sampled. The aims of this paper are

to communicate novel information about the benthic species composition in deep Argentinean bottoms and to discuss faunal affinities with the neighbouring Patagonian scallop fishing grounds located at lower shelf depth.

The material was collected in April 2005 at a canyon located at 43°35' S and 59°33' W, 325 m depth, on board the BIP Oca Balda (INIDEP). A sample of 39 kg was obtained using a 2.5 m mouth opening dredge, 10 mm mesh size. Material was frozen on-board and fully sorted at laboratory. The species were identified, quantified and weighted.

Eighty six taxa of mega and macroinvertebrates were found in the surveyed canyon (Table 1). Twenty echinoderm species were collected in the canyon at 325 m depth, together with tunicates, brachiopods, pycnogonids, foraminifers and bryozoans. *Z. patagonica* contributed with nearly 20 % of the total biomass; other small bivalves and gastropods reached only 0.5 %. Echinoderms and sponges followed molluscs in wet weight (16 % and 10 %, respectively). Cnidarians, decapods and tubes of the worm *Chaetopterus* sp. reached nearly 5 % of the total sample biomass. Mollusc shells represented 7.5 % of the sample in wet weight; the main species identified were *Z. patagonica*, *Eurhomalaea exalbida* (Reeve, 1836), *Ameghinomya antiqua* (King, 1832), *Adelomelon ancilla* (Solander, 1786), Volutidae, *Fusitriton magellanicus* Röding, 1798, *Buccinanops* sp., *Petricola dactylus* d'Orbigny, 1823, *Calyptrea pileolus* (d'Orbigny, 1841), *Limatula pygmaea* (Philippi, 1845) and Mactridae. Damaged biological material, composed by rests of invertebrates,

reached 30 % (nearly 10 kg) of the total sample.

The faunal composition found in the surveyed canyon is similar to that referred in adjacent external shelf areas, mainly between 90 and 130 m depth. Nearly 90 % of the identified taxa are currently collected in the Patagonian scallop beds influenced by a shelf-break productive front (Bremec & Lasta 2002, Schejter & Bremec 2007). However, taxonomic richness inside canyon was higher than in the surrounding fishing ground identified in the Patagonian scallop fishery as "Unidad 9" (Res. 9/2006, CFP), considering the colonial fauna as single taxa (sponges, Hydroids, bryozoans and ascidiaceans) (Bremec et al. 2009). Due to its topography, fishery vessels do not trawl the canyon or surrounding areas, which remained undisturbed. Many studies have been performed regarding comparisons of faunal composition and community structure in marine canyons and adjacent areas, but whether the richness and biomass of fauna inside the canyon was higher (Ramírez-Llondra et al. 2008), similar (Houston & Hendrich 1994, Ramírez-Llondra et al. 2010) or lower (Maurer et al. 1994) than in the adjacent area depended on differences in environmental and habitat factors such as fishing disturbance, rate of organic matter deposition and sea floor morphology. In this study case, the biomass of Patagonian scallops in the fishing grounds distributed along the 100 m isobath in the Argentinean shelf usually exceeds 20 % of the total caught in commercial hauls, estimation that varies due to the patchy distribution of the species.

Regarding molluscs of commercial value distributed in deep waters, only *Z. patagonica* was previously found at 960 m depth (Waloszek 1991), and occasionally the gastropods of the genus *Adelomelon*, *Odontocymbiola* and *Zidona* in locations deeper than 200 m (Bremec et al. 2001 and references therein), without showing exploitable densities. Among Echinoderms, only the ophiuroids *Gorgonocephalus chilensis* (Philippi, 1858) and *Ophiacantha vivipara* Ljungman, 1870 were previously recorded between 212 and 256 m depth in seven sampling locations in Patagonian waters between 47° and 53° S, together with other Magellanic species (Roux et al. 2005).

In general, the identified bioclasts correspond to species frequently distributed in coastal or middle shelf waters, what suggests their transport to deeper areas through the submarine canyons (Parker et al. 1997), phenomenon already described in other regions (i.e., Shepard et al. 1979, Puig et al. 2003, Turcheto et al. 2007, Flexas et al. 2008). Usually, submarine canyons are very active and productive systems in the ocean hosting a wide variety of benthic, demersal and pelagic taxa; they provide favourable areas of recruitment and maintenance of benthic megafauna species (Sardá et al. 1994, Zuñiga et al. 2009) not only because of the high production rates due to currents, oceanographical features and morphology itself, but also because they provide refuges and protected areas in some cases where fishing disturbance is not acting. This seems to be the present study case, in which the provided results represent the only information about fauna in submarine canyons of the Argentine sea.

In septentrional Argentinean shelf areas, the composition of benthic species also indicates its Magellanic origin and wide distribution in depths higher than 90 m. The invertebrates *Epicodakia falklandica* Dell, 1964, *Amphiura eugeniae* (Ljungman, 1867), *Pseudechinus magellanicus* (Philippi, 1857) and *Hiatella meridionalis* (d'Orbigny, 1846) characterized areas located at 39°03' S - 55°41' W, nearly 200 m depth (Roux et al. 1993). The latter two species were also recorded in the studied canyon, where both Magellanic and Antarctic components were found. For example, the ophiurid *Astrotoma agassizi* Lyman, 1875 (Table 1) was the most frequent species in the macrobenthic assemblage collected around South Georgia and Shag Rocks during 1994 (Roux et al. 2002), and the sponge *Guitarra dendyi* (Kirkpatrick, 1907) (Table 1) was only known from Antarctica (Bertolino et al. 2006) before the present sampling.

ACKNOWLEDGEMENTS

We acknowledge M. Tripode, G. Alvarez Colombo and A. Madirolas for acoustic information. This study was partially supported by INIDEP 1608, CONICET, PICT 2007 2200 and PICT 2008 1119.

TABLE 1

Taxa collected in the submarine canyon, Argentina.

Taxa colectados en canon submarine, Argentina.

Porifera	<i>Zygochlamys patagonica</i> (King & Broderip, 1832)
<i>Craniella leptoderma</i> (Sollas, 1886)	Naticidae unid.
<i>Guitarra dendyi</i> (Kirkpatrick, 1907)	Nudibranchia unid.
<i>Myxilla mollis</i> Ridley & Dendy, 1886	Polyplacophora unid.
<i>Pseudosuberites cf. antarcticus</i> Carter, 1876	Bivalvia unid.
<i>Stelodoryx argentinae</i> Bertolino et al., 2007	Gastropoda unid.
<i>Tedania charcoti</i> Topsent, 1907	Crustacea
<i>Tedania massa</i> Ridley & Dendy, 1886	<i>Pagurus comptus</i> White, 1847
<i>Tedania mucosa</i> Thiele, 1905	<i>Serolis polaris</i> Richardson, 1911
<i>Tedania sarai</i> Bertolino et al., 2007	<i>Serolis schytei</i> Lutken, 1858
Cnidaria	<i>Sympagurus dimorphus</i> (Studer, 1882)
<i>Acryptolaria conferta</i> (Allman, 1877)	Antarcturidae unid.
<i>Actinostola crassicornis</i> (Hertwig, 1882)	Sphaeromatidae unid.
<i>Alcyonium digitatum</i> Linnaeus, 1758	Isopoda unid. 1
<i>Campanularia</i> sp.	Isopoda unid. 2
<i>Filellum serratum</i> (Clarke, 1879)	Isopoda unid. 3
<i>Plumularia insignis</i> Allman, 1883	Echinodermata
<i>Sertularella</i> sp.	<i>Astrotoma agassizi</i> Lyman, 1875
<i>Symplectoscyphus</i> sp.	<i>Astrocidaris canaliculata</i> (A. Agassiz, 1863)
<i>Thouarella</i> sp.	<i>Ctenodiscus australis</i> Lutken, 1871
<i>Tulpa tulipifera</i> (Allman, 1888)	<i>Diplasterias brandti</i> Bell, 1881
Actiniaria unid.	<i>Gorgonocephalus chilensis</i> (Philippi, 1858)
Stylasteridae unid.	<i>Odontaster penicillatus</i> (Philippi, 1870)
Cnidaria unid.	<i>Ophiacanta vivipara</i> Ljungman, 1870
Polychaeta	<i>Ophiactis asperula</i> (Philippi, 1858)
<i>Chaetopterus</i> sp.	<i>Ophiomyxa vivipara</i> Studer, 1876
<i>Idanthyrsus armatus</i> Kinberg, 1867	<i>Ophiura lymani</i> (Ljungman, 1871)
<i>Serpula narconensis</i> Baird, 1865	<i>Porania</i> sp.
Serpulidae unid.	<i>Pseudechinus magellanicus</i> (Philippi, 1857)
Brachiopoda	<i>Pseudocnus dubiosus leoninus</i> (Semper, 1868)
<i>Lyothirella uva</i> (Broderip, 1833)	<i>Solaster</i> sp.
<i>Magellania venosa</i> (Solander, 1786)	<i>Sterechinus agassizi</i> Mortensen, 1910
<i>Terebratella dorsata</i> (Gmelin, 1790)	<i>Trypilaster philippii</i> (Gray, 1851)
Mollusca	Comatulida unid.
<i>Admete magellanica</i> Strebel, 1905	Pterasteridae unid.
<i>Calliostoma</i> sp.	Asteroidea 1
<i>Calyptraea pileolus</i> (d'Orbigny, 1841)	Asteroidea 2
<i>Capulus compressus</i> Smith, 1891	Asciacea
<i>Entodesma</i> sp.	<i>Alloeocarpa incrustans</i> (Herdman, 1886)
<i>Epitonium magellanicum</i> (Philippi, 1845)	<i>Didemnum</i> sp.
<i>Fuegotrophon pallidus</i> (King & Broderip, 1832)	<i>Paramolgula gregaria</i> (Lesson, 1830)
<i>Hiatella meridionalis</i> (d'Orbigny, 1846)	Sycozoa sp.
<i>Lamellaria</i> sp.	Asciacea unid.
<i>Limatula</i> sp.	Others
<i>Marginella warreni</i> Marrat, 1876	Bryozoa
<i>Odontocymbiola magellanica</i> Gmelin, 1791	Foraminifera
<i>Paraeuthria</i> sp.	Pycnogonida
<i>Trophon ohlini</i> Strebel, 1905	

LITERATURE CITED

- BASTIDA R, A ROUX & D MARTÍNEZ (1992) Benthic communities of the Argentine continental shelf. *Oceanologica Acta* 15: 687-698.
- BASTIDA R, M ZAMPONI, C BREMEC, A ROUX, R ELIAS & G GENZANO (2007) Las comunidades bentónicas del mar argentino. In: Carreto J & C Bremec (eds) *El mar argentino y sus recursos pesqueros*, Tomo V: 89-123. INIDEP, Mar del Plata, Argentina.
- BERTOLINO M, L SCHEJTER, B CALCINAI, C CERRANO & C BREMEC (2007) Sponges from a submarine canyon of the Argentine sea. In: Custódio-Marcio R, E Hadju, G Lobo-Hadju & G Muricy (eds) *Porifera research: Biodiversity, innovation and sustainability*: 189-201. Proceedings of the 7th International Sponge Symposium, Buzios, Brasil.
- BREMEC C (1992) Benthic research in Argentina. *Oebalia* 18: 95-107.
- BREMEC C & M LASTA (2002) Epibenthic assemblage associated with scallop (*Zygochlamys patagonica*) beds in the Argentinean shelf. *Bulletin of Marine Science* 70: 89-105.
- BREMEC C, N FERNÁNDEZ & G VERAZAY (2001) Los organismos bentónicos registrados en la región de la plataforma continental argentina y adyacencias, comprendida entre 35° S y 55° S y profundidades mayores de 50 metros. INIDEP Technical Report 34, Mar del Plata, Argentina.
- BREMEC C, M ESCOLAR, L SCHEJTER & G GENZANO (2008) Primary settlement substrate of *Zygochlamys patagonica* spat in fishing grounds at the Argentine sea. *Journal of Shellfish Research* 27: 273-280.
- BREMEC C, T BREY, M LASTA, J VALERO & L LUCIFORA (2000) *Zygochlamys patagonica* beds on the Argentinian shelf. Part I: Energy flow through the scallop bed community. *Archive of Fishery and Marine Research* 48: 295-303.
- BREMEC C, A MARECOS, M ESCOLAR, V SOUTO & L SCHEJTER (2009) Riqueza específica en los bancos comerciales de vieira patagónica (*Zygochlamys patagonica*) a lo largo del frente de talud. Período 2008. INIDEP Technical Report 41, Mar del Plata, Argentina.
- ESCOLAR M, M DIEZ, D HERNÁNDEZ, A MARECOS, S CAMPODÓNICO & C BREMEC (2009) Invertebrate bycatch in Patagonian scallop fishing grounds: A study case with data obtained by the On Board Observers Program. *Revista de Biología Marina y Oceanografía* 44: 369-377.
- FLEXAS M, D BOYER, M ESPINO, J PUIGDEFA BREGAS, A RUBIO & J COMPANY (2008) Circulation over a submarine canyon in the NW Mediterranean. *Journal of Geophysical Research* 113: C12002.
- HOUSTON K & R HAEDRICH (1984) Abundance and biomass of macrobenthos in the vicinity of Carson Submarine Canyon, Northwest Atlantic Ocean. *Marine Biology* 82: 301-305.
- MAURER D, D DIENER, G ROBERTSON & T GERLINGER (1994) Comparison of community structure of soft-bottom macrobenthos of the Newport Submarine Canyon, California and adjoining shelf. *Internationale Revue der Gesamten Hydrobiologie und Hydrographie* 79: 519-603.
- PARKER G, M PATERLINI & R VIOLANTE (1997) El fondo marino. In: Boschi E (ed) *El mar argentino y sus recursos pesqueros*, Tomo I: 65-87. INIDEP, Mar del Plata, Argentina.
- PUIG P, A OGSTO, B MULLENBACH, C NITTROUER & R STERNBERG (2003) Shelf-to canyon sediment transport processes on the Eel Continental Margin (northern California). *Marine Geology* 193: 129-149.
- RAMIREZ-LLODRA E, M BALLESTEROS, J COMPANY, L DANTART & F SARDA (2008) Spatio-temporal variations in the diversity, biomass and abundance of bathyal invertebrates in the Catalan Sea (Western Mediterranean). *Marine Biology* 153: 297-309.
- RAMIREZ-LLODRA E, J COMPANY, F SARDA & G ROTLLANT (2010) Megabenthic diversity patterns and community structure of the Blanes submarine canyon and adjacent slope in the Northwestern Mediterranean: A human overprint? *Marine Ecology* 31: 167-182.
- ROUX A, R BASTIDA & C BREMEC (1993) Comunidades bentónicas de la plataforma continental argentina. *Campañas Transección BIP Oca Balda 1987/88/89*. Boletín do Instituto Oceanográfico São Paulo 41: 81-94.
- ROUX A, J CALCAGNO & C BREMEC (2002) Macrobenthic assemblages from demersal fishing grounds around South Georgia Islands. R/V Eduardo Holmberg Survey, February-March 1994. *Archive of Fishery and Marine Research* 49: 231-241.
- ROUX A, C BREMEC, L SCHEJTER & D GIBERTO (2005) Benthic invertebrates by-catch of demersal fisheries: A comparison between Subantartic and Antarctic shelf waters (45° S-57° S). *Berichte Zur Polar- und Meeresforschung* 507: 179-181.
- SARDA F, J CARTES & J COMPANY (1994) Spatio-temporal variations in megabenthos abundance in three different habitats on the Catalan deep-sea (Western Mediterranean). *Marine Biology* 120: 211-219.
- SCHEJTER L & C BREMEC (2007) Benthic richness in the Argentine continental shelf: The role of *Zygochlamys patagonica* (Mollusca, Bivalvia, Pectinidae) as settlement substrate. *Journal of the Marine Biological Association UK* 87: 917-925.
- SCHEJTER L, B CALCINAI, C CERRANO, M BERTOLINO, M PANSINI, D GIBERTO & C BREMEC (2006) Porifera from the Argentine sea: Diversity in Patagonian scallop beds. *Italian Journal of Zoology* 73: 373-385.
- SCHEJTER L, C BREMEC & D HERNÁNDEZ (2008) Comparison between disturbed and undisturbed areas of the Patagonian scallop (*Zygochlamys patagonica*) fishing ground "Reclutas" in the Argentine sea. *Journal of Sea Research* 60: 193-200.
- SHEPARD F, N MARSHALL, P MCLOUGHLIN & G SULLIVAN (1979) Currents in submarine canyons and other seavalleys. *The American Association of Petroleum Geologists Studies in Geology* 8: 1-171.
- TURCHETTO M, A BOLDRIN, L LANGONE, S MISEROCCHI, T TESI & F FOGLINI (2007) Particle transport in the Bari Canyon (Southern Adriatic Sea). *Marine Geology* 246: 231-247.
- WALOSZEK D (1991) *Chlamys patagonica* (King &

Broderip, 1832), a long “neglected” species from the shelf of the Patagonian coast. In: Shumway S (ed) An international compendium on scallops biology and aquaculture: 256-263. National Shellfisheries Association, Washington DC.

ZUÑIGA D, M FLEXAS, T CALAFAT, A SANCHEZ-

VIDAL, J COENJAERTS et al. (2009) Particle fluxes dynamics in Blanes submarine canyon (Northwestern Mediterranean). Progress in Oceanography, doi: 10.1016/j.pocean.2009.07.002.

Received June 9, 2010; accepted June 18, 2010

