Latin American Journal of Aquatic Research
E-ISSN: 0718-560X
lajar@ucv.cl
Pontificia Universidad Católica de Valparaíso
Chile

Cañete, Juan I.; Häussermann, Verena
Colonial life under the Humboldt Current System: deep-sea corals from O'Higgins I seamount
Latin American Journal of Aquatic Research, vol. 40, núm. 2, julio, 2012, pp. 467-472
Pontificia Universidad Católica de Valparaíso
Valparaiso, Chile

Available in: http://www.redalyc.org/articulo.oa?id=175024254023

Lat. Am. J. Aquat. Res., 40(2): 467-472, 2012
DOI: 10.3856/vol40-issue2-fulltext-23

Short Communication

Colonial life under the Humboldt Current System: deep-sea corals from O'Higgins I seamount

Juan I. Cañete[1] & Verena Häussermann[2,3]
[1]Facultad de Ciencias, Universidad de Magallanes, P.O. Box 113-D, Punta Arenas, Chile
[2]Escuela de Ciencias del Mar, Pontificia Universidad Católica de Valparaíso
Avda. Altamirano 1480, Valparaíso, Chile
[3]Fundación San Ignacio de Huinay, P.O. Box 462, Puerto Montt, Chile

ABSTRACT. A benthic community constituted by an assemblage of at least four species of deep-sea corals collected in only one trawl carried-out on the summit of the O'Higgins I seamount, central Chile. The corals were collected in only one trawl carried-out during a Chilean-Japanese cruise onboard the R/V" Koyo Maru" in December 29, 2004. Presence of oxygenated and cold Antarctic Intermediate Water (>400 m depth) on the plateau was recorded under of the Equatorial Subsurface Water associated to the oxygen-minimum zone (OMZ, <1 mL O_2 L^{-1}). The biogeographic origin of the fauna evidenced a mix of Subantarctic and central Chile continental margin species. The assemblage is represented by two species of anthipatarians (*Leiopathes* sp. and *Chrysopathes* sp.), one unidentified species of Paragorgiidae and one species of Isididae (*Acanella chilensis*). The study demonstrated that deep-water corals of the O'Higgins seamount provide crucial habitat for commercially important crustacean exploited along continental margin off central Chile such as nylon shrimp (*Heterocarpus reedi*). This resource as well as some fishes such as alfonsino (*Beryx splendens*) and orange roughy (*Hoplostethus atlanticus*) could drawing the commercial fishing industry to these fragile areas poorly known Chilean marine benthic communities. Due to a strong economic pressure, fast actions for marine conservation of seamounts are required in Chile.

Keywords: benthic megafauna, deep-sea benthos, deep-sea corals, Chile.

La vida colonial bajo el sistema de la corriente de Humboldt: corales de aguas profundas en el monte submarino O'Higgins I

RESUMEN. Se describe una comunidad bentónica constituida por un ensamble de cuatro especies de corales de profundidad recolectados mediante un lance de arrastre efectuado sobre el margen de la meseta del monte submarino O'Higgins I, Chile central. Sobre la meseta se detectó la presencia de agua oxigenadas frías correspondientes al Agua Intermedia Antártica (>400 m de profundidad) y sobre ésta, el Agua Ecuatorial Subsuperficial asociada a la zona de mínimo de oxígeno (OMZ, <1 mL O_2 L^{-1}). La fauna muestra un origen biogeográfico de tipo subantártico sumado a la presencia de fauna típica del margen continental de la zona central de Chile. Este ensamble está representado por dos especies de Antipataria (*Leiopathes* sp. y *Chrysopathes* sp.), una especie no identificada de la familia Paragorgiidae y una especie perteneciente a la familia Isididae (*Acanella chilensis*). Este estudio muestra que este ensamble de corales de profundidad provee un hábitat crítico para el camarón nailon (*Heterocarpus reedi*), crustáceo de importancia pesquera. La presencia de este crustáceo más algunos peces como el alfonsino (*Beryx splendens*) y orange roughy (*Hoplostethus atlanticus*) podrían atraer la atención de la industria sobre estas frágiles, singulares y escasamente conocidas comunidades bentónicas chilenas y por lo tanto se requiere con urgencia acciones para su conservación.

Palabras clave: megafauna bentónica, bentos mar profundo, corales de profundidad, Chile.

Corresponding author: Juan I. Cañete (ivan.canete@umag.cl)

Approximately half of the described coral species inhabit deep, cold and dark waters and their study represents cutting-edge research worldwide (Roberts & Hirshfield, 2004). Their bathymetric distribution down over 200 m complicates their study. Thus, their biology and the role played in the deep-water

ecosystem is poorly understood (Andrews *et al.*, 2002). Studies showed that coral associations form a habitat for many invertebrate and vertebrate species of commercial value (Alper, 1998); among them the alfonsino (*Beryx splendens*) and orange roughy (*Hoplostethus atlanticus*) (Yáñez *et al.*, 2009). Along the Chilean coast, the role that these communities could play at seamounts and along the continental margins is still unknown (Koslow *et al.*, 2001; Levin, 2002), but recent efforts began to discover evidence of deep corals in the southeastern Pacific coast (Häussermann & Försterra, 2007a).

During an international cruise, performed in December, 2004 to O'Higgins I seamount (Fig. 1), an important evidence of the presence of massive colonial life on the plateau was recorded (Fig. 2). These findings represent a very important discovery because attention in Chilean benthic research has been focused on sublittoral communities such as the continental shelf and slope (Gallardo, 1977; Gallardo *et al.*, 1994, 1996, 2004; Palma *et al.*, 2005; Quiroga *et al.*, 2009; Sellanes *et al.*, 2010). In the present study we demonstrate with graphic evidence that under the Humboldt Current System, some seamount have important assemblages of deep-water corals, showing as for example, the O'Higgins I seamount. This biotope, its fauna and the functional relationships could stimulate new research opportunities around seamounts off the Chilean coast. Features of the colonial life are indeterminate growth, reproduction through fission and budding, slow growth, suspension-feeding or micro-carnivorous and an evident functional specialization of different individuals within a colony (Jackson, 1985).

This paper represents the first reference on only one large colonial assemblages generating habitat for others non-colonial species, still unknown marine benthic species collected on the O'Higgins I seamount, off central Chile.

Sampling was conducted in December, 29, 2004, with a bottom traw net (50 mm mesh size and approx. 30 m width), 74 min of bottom trawling, during the Chilean-Japanese cruise onboard R/V "Koyo Maru" on the plateau of the O'Higgins I seamount, off central Chile (start position: 32º54.3'S, 73º55.4'W; final position: 32º54.2'S, 73º52.8'W) (Fig. 1) (Zuleta & Hamano, 2004; Hamano, *pers. comm.*). The deep-sea coral material was collected (Fig. 2), including the megafauna associated (>40 mm). Dry coral samples were sent to specialists for their identification: Dr. Dennis Opresko (Antipatharia and Paragorgiidae) and Dr. Juan Sánchez (Isididae). The height of some complete coral specimens was measured to estimate their importance as habitat.

Further sampled marine invertebrates were identified using Andrade (1986) and specialized literature on echinoids (Antarctic Invertebrates Catalogue of Smithsonian Institution; http://invertebrates.si.edu) and Chilean crustaceans (Retamal, 2000).

The water column above the seamount was stratified, and had a mixed layer of approx. 40 m depth. The temperature ranged between 17.7°C (surface) and 5.6°C (bottom; 820 m), salinity varied between 34.31 (surface) and 34.586 psu (200 m). Oxygen levels varied widely throughout the water column, averaging 5.2 mL O_2 L^{-1} at the surface and decreasing to <0.5 mL O_2 L^{-1} between 130 and 280 m depth. Scarce oxygen levels reflect the influence of the Equatorial Subsurface Water (ESSW) associated to an oxygen-minimum zone (OMZ). Below this layer, the Antarctic Intermediate Water (IAW) is responsible for low temperatures and higher oxygen levels, which increased to a maximum of almost 4 mL O_2 L^{-1} around 550 m depth (Chiang & Quiñones, 2007). On the summit of O'Higgins I seamount (400 to 500 m depth), oceanographic conditions were: temperatures from 5.8 to 6.9ºC, dissolved oxygen from 2 to 3 mL O_2 L^{-1} and the salinity ≈34.3 psu (Chiang & Quiñones, 2007).

A total of 220 colonies or sections were collected in a single bottom trawling (Fig. 2), belonging to five species, four of which are described and photographed in this paper (Figs. 3a and 3d). The collected deep-sea corals were identified as: *Leiopathes* sp. (Fig. 3a), belonging to family Leiopathidae Haeckel, 1896 and *Chrysopathes* sp. (Fig. 3b) belonging to family Cladopathidae Brook, 1889, both are members of the subclass Hexacorallia, Order Antipatharia (black corals). The genus *Crysopathes* was established by Opresko (2003). The other two species belong to the subclass Octocorallia and are *Acanella chilensis* (Fig. 3c) and an unidentified member of the family Paragorgidae (Fig. 3d). The most abundant subclass was Hexacorallia (75%).

The rest of megafauna were constituted by six species of crustaceans *Heterocarpus reedi* (n = 330), *Projasus bahamondei* (n = 130), *Munida propinqua* (n = 8), *Uroptychus parvulus* (abundance no recorded), *Chirostylus hendersoni* (n = 32) and the stomatopod *Pterygosquilla armata* (n = 47), two species of ophiuroids (*Gorgonocephalus chilensis* and *Astrotoma agassizi;* n = 14 and 102, respectively), an unknown species of asteroid (n = 1) and one species of Anthozoa *Hormathia* cf. *pectinata* (n = 2).

Deep-water corals of the O'Higgins I seamount can provide crucial habitat and reproductive grounds for commercially and potential important mid water

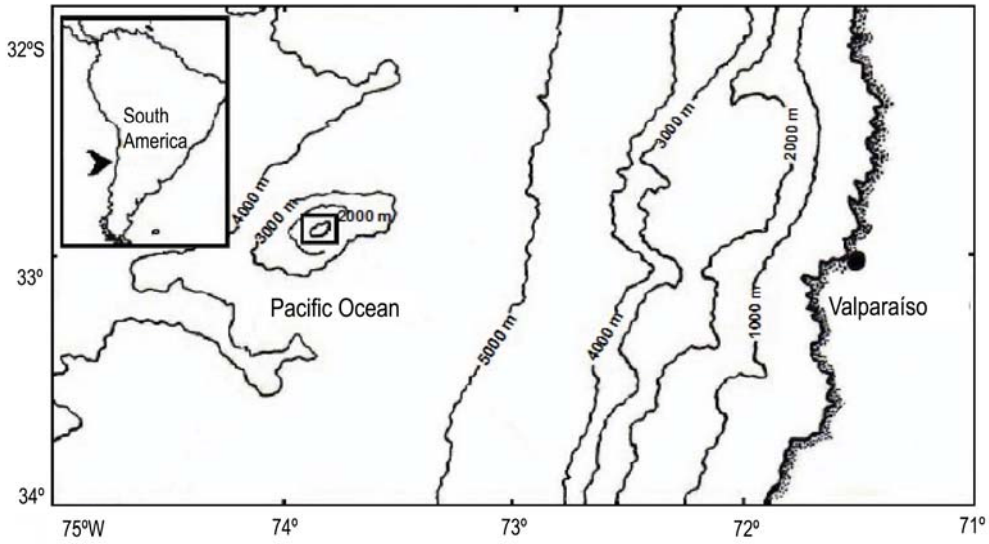

Figure 1. Geographic location of O'Higgins I seamount, central Chile (modified from Chiang & Quiñones, 2007).

Figura 1. Ubicación geográfica del monte submarino O'Higgins I, Chile central (modificado de Chiang & Quiñones, 2007).

Figure 2. Deep-sea coral assemblage and megafauna collected on the margins of the O'Higgins I seamount, central Chile. The legs belong to the anomuran crustacean *Chirostylus hendersoni*. All corals have approx. 60 cm of height (Photographed by Juan I. Cañete).

Figura 2. Ensamble de corales de profundidad recolectados en uno de los márgenes de la meseta del monte submarino O'Higgins I. Los apéndices pertenecen al crustáceo anomuro *Chyrostilus hendersoni*. Todos los corales presentaron una altura homogénea no superior a 60 cm (Fotografía de Juan I. Cañete).

resources such as the fish orange roughy (*Hoplostethus atlanticus*) and alfonsino (*Beryx splendens*) and crustaceans such as the nylon shrimp (*Heterocarpus reedi*) and the deep-sea tiny lobster (*Projasus bahamondei*). The most significant finding of this study was the capture of the atypical sea urchin *Dermechinus horridus* (Cactus sea urchin; 30 cm length; n = 28), which has been previously collected near the Southern Pacific Polar Front (B. David, *pers. comm.*) and recently in a new seep site over the upper slope off central Chile (J. Sellanes, *pers. comm.*). Thus, the biogeographic origin of the collected fauna evidenced a mix of species from Sub Antarctic and central Chilean continental margin (Sellanes *et al.*, 2008; Häussermann & Försterra, 2009).

These colonial deep-sea corals are fragile due to their slow growth, they are micro carnivorous, suspension-feeders and play an important role for benthic fauna as substrate, mostly for larger ophiuroids *G. chilensis* and *A. agassizi* as well as some small galatheids crabs (*M. propinqua* and *U. parvulus*). Previous studies on deep-sea corals associated to trawling fishery of the crustaceans *Cervimunida johni* and *Pleuroncodes monodon* off central Chile (Andrade, 1986) (250 to 500 m depth), cited the presence of four species of gorgonians (*Callogorgia* sp., *Muriceides* sp., *Swiftia* sp. and an unidentified species of Paramuriceidae) and the Alcyonacea, *Anthomastus* sp. The present study increase the number of deep-sea coral species described from the Chilean coast. Additionally, Gálvez-Larach (2009; *fide* Molodtsova, 2005), cited

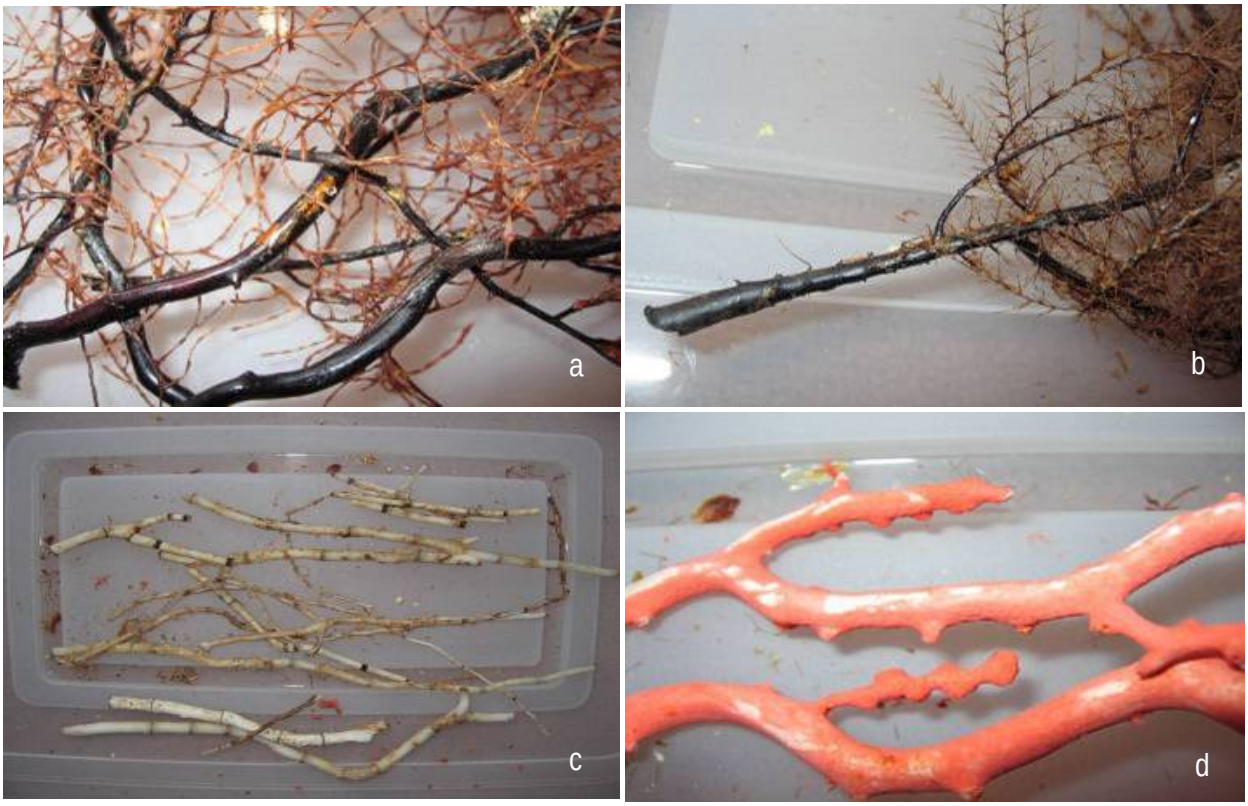

Figure 3. Deep-sea corals collected in the O'Higgins I seamount, central Chile (450 m depth). a) *Leiopathes* sp., b) *Chrysopathes* sp., c) *Acanella chilensis*, d) Paragorgiidae, indeterminated.

Figura 3. Corales de profundidad recolectados en el monte O'Higgins I, Chile central (450 m profundidad). a) *Leiopathes* sp., b) *Chrysopathes* sp., c) *Acanella chilensis*, d) Paragorgiidae, indeterminado.

the presence of 8 families and 19 genera of Antipatharia and Scleractinia in Nazca Plate and Salas y Gómez seamount. However, no common species with O'Higgins I seamount fauna was observed.

Biomass level of benthic megafauna from O'Higgins I seamount is higher if compared with other subtidal, benthic system from the Humboldt Current System, such as the central Chilean continental shelf macrobenthos and megabenthos under upwelling effects (Gallardo *et al.*, 1994, 1996, 2004), or the macrobenthic communities associated to the continental slope off Antofagasta (Cañete *et al.*, 1999) and for the different oxygen-minimum zone (OMZ) distributed around of the world (Levin, 2002). Near to 1 kg deep-sea corals, excluding the rest of the fauna, taken from three small samples 1 m² collected through of the trawl net were recorded in the present study (Fig. 2).

This preliminary study offers the opportunity to stimulate new benthic research in open oceans off Chile. Communities dominated by suspension-feeding cnidarians, forming cold-water coral reefs, have been detected in austral channels and fjords (Försterra & Häussermann, 2003; Häussermann & Försterra, 2007a, 2007b), at the Chilean continental slope (Andrade, 1986), the Weddell Sea, Antarctic (Gili *et al.*, 2000) and in numerous seamounts around the world (Gálvez-Larach, 2009). The knowledge about their ecological services has just recently started to be considered (Turner *et al*., 1999; SUBPESCA, 2006) (*e.g.* production of bio-products of pharmaceutical interest and as nursery and fishery ground of species of economical importance).

The presence of this undisturbed association of colonial cnidarians (Hughes, 1987; McFadden, 1991) and others solitary marine invertebrates on O'Higgins I seamount, allow to predict that off the Chilean coast there is probably an unknown high diversity of benthic communities for discovery. This important finding of seamount communities below the Humboldt Current System is located in an area where high endemism and biodiversity has been detected within the Pacific Ocean (De Forges *et al.*, 2000). A network of marine protected areas shouldbe developed here to inhibit the degradation or even loss of this habitat which could need centuries to recover. Oceanic seamounts could be

candidates to maintain the biodiversity, allowing the larval connectivity and acting as buffer of coastal, disturbed bottoms with overexploited resources (Turner *et al.*, 1999).

ACKNOWLEDGEMENTS

We thank the taxonomic specialists for identification: Dennis Opresko (National Museum of Natural History, Smithsonian Institution) and Juan Sánchez (Universidad de los Andes, Colombia). Thanks to Prof. Patricio Arana (Pontificia Universidad Católica de Valparaíso, Chile), for a copy of the paper of Andrade (1986). Special thanks to Prof. Alejandro Zuleta (CEPES, Universidad Austral de Chile) for the facilities to participate in the international cruise onboard of "Koyo Maru" and the Dean of Faculty of Sciences and the University of Magallanes, providing funds to participate in this cruise.

REFERENCES

Alper, J. 1998. Ecology: ecosystem engineers shape habitats for other species. Science, 280: 1195-1196.

Andrade, H. 1986. Observaciones bioecológicas sobre invertebrados demersales de la zona central de Chile. En: P. Arana (ed.). La pesca en Chile. Universidad Católica Valparaíso, Valparaíso, pp. 41-56.

Andrews, A.H., E.E. Cordes, M.M. Mahoney, K. Munk, K.H. Coale, G.M. Cailliet, J. Heifetz. 2002. Age and growth and radiometric age validation of a deep-sea, habitat-forming gorgonian (*Primnoa resedaeformis*) from the Gulf of Alaska. In: L. Wartling & M. Risk (eds.). Biology of cold water corals. Hydrobiologia, 471: 101-110.

Cañete, J.I., H.A. Sievers, P. Báez & C. Valdovinos. 1999. Macrobenthos of the continental slope off Mejillones Peninsula, northern Chile: results of the Atacama Trench International Expedition (September, 1997). Instituto Scienze Ambientali Marine, Facoltá di Scienze, Matemathiche Fisiche e Naturali. Report, 56: 67-74.

Chiang, O.E. & R.A. Quiñones. 2007. Relationship between viral and prokaryotic abundance on the Bajo O'Higgins Seamount, Humboldt Current System off Chile. Sci. Mar., 71: 37-46.

De Forges, R., J.A. Koslow & G.C.B. Poore. 2000. Diversity and endemism of the benthic seamount macrofauna in the Southern West Pacific. Nature, 405: 944-947.

Försterra, G. & V. Häussermann. 2003. First report on large scleractianian (Cnidiaria: Anthozoa) accumulations in cold temperate shallow water of south Chilean fjords. Zool. Verh. Leiden, 345: 117-128.

Gallardo, V.A. 1977. Large benthic microbial communities in sulphide biota under Peru-Chile Subsurface Countercurrent. Nature, 268: 331-332.

Gallardo, V.A., F.D. Carrasco, R. Roa & J.I. Cañete. 1994. Ecological patterns in the benthic macrobiota across the continental shelf off Central Chile. Ophelia, 40: 167-188.

Gallardo, V.A., R. Roa, F.D. Carrasco, J.I. Cañete, S. Enríquez-Briones & M. Baltazar. 1996. Bathymetric and seasonal patterns in the benthic sublittoral megafauna off central Chile. J. Mar. Biol. Assoc. UK, 76: 311-326.

Gallardo, V.A., M. Palma, F.D. Carrasco, D. Gutiérrez, L.A. Levin & J.I. Cañete. 2004. Macrobenthic zonation caused by the oxygen minimum zone on the shelf and slope off central Chile. Deep-Sea Res., 51: 2475-2490.

Gálvez-Larach, M. 2009. Montes submarinos de Nazca y Salas y Gómez: una revisión para el manejo y conservación. In: P. Arana, J.A.A. Pérez & P.R. Pezzuto (eds.). Deep-sea fisheries off Latin America. Lat. Am. J. Aquat. Sci., 37: 479-500.

Gili, J.M., C. Orejas, J. Ros, P. López & W.E. Arntz. 2000. La vida en los fondos antárticos. Investigación y Ciencia, 290: 64-74.

Häussermann, V. & G. Försterra. 2007a. Larges assemblages of cold-water corals in Chile: a summary of recent findings and potential impacts. In: R.Y. George & S.D. Cairns (eds.). Conservation and adaptive management of seamount and deep-sea coral ecosystems. Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, pp. 195-207.

Häussermann, V. & G. Försterra. 2007b. Extraordinary abundance of hydrocorals (Cnidaria, Hydrozoa, Stylasteridae) in shallow water of the Patagonian fjord region. Polar Biol., 30: 487-492.

Häussermann, V. & G. Försterra. 2009. Fauna marina bentónica de la Patagonia chilena. Nature in Focus, Puerto Montt, 1000 pp.

Hughes, R.N. 1987. The functional ecology of clonal animals. Funct. Ecol., 1: 63-69.

Jackson, J.B.C. 1985. Distribution and ecology of clonal and aclonal benthic invertebrates. In: J.B.C. Jackson, L.W. Buss & R.E. Cook (eds.). Population biology and evolution of clonal organisms. Yale University Press, Yale, pp. 297-355.

Koslow, J.A., K.G. Holmes, J.K. Lowry. 2001. Seamount benthic macrofauna off southern Tasmania:

community structure and impacts of trawling. Mar. Ecol. Prog. Ser., 213: 111-125.

Levin, L.A. 2002. Deep-ocean life where oxygen is scarce. Am. Sci., 90: 436-444.

McFadden, C.S. 1991. A comparative demographic analysis of clonal reproduction in a temperate soft coral. Ecology, 72: 1849-1866.

Molodtsova, T.N. 2005. A new species of *Saropathes* (Cnidaria, Anthozoa, Antipatharia) from the Norfolk Ridge (south-west Pacific, New Caledonia). Zoosystema, 27(4): 699-707.

Opresko, D.M. 2003. Revision of the Antipatharia (Cnidaria: Anthozoa). Cladopathidae. Zool. Meded., 77: 495-536.

Palma, M., E. Quiroga, V.A. Gallardo, W. Arntz, D. Gerdes, W. Schneider & D. Hebbeln. 2005. Macrobenthic animal assemblages of the continental margin off Chile (22º to 42ºS). J. Mar. Biol. Assoc. U.K., 85: 233-245.

Quiroga, E., J. Sellanes, D. Gerdes, W. Arntz, V.A. Gallardo & D. Hebbeln. 2009. Demersal fish and megafaunal assemblages of three bathyal areas off Chile (22º-42º). Deep-Sea Res. II, 56: 1112-1123.

Retamal, M.A. 2000. (CD-Rom). Decápodos de Chile. ETI-Universidad de Concepción. Springer-Verlag, Berlin.

Roberts, S. & M. Hirshfield. 2004. Deep-sea corals: out of sight, but not longer out of mind. Front. Ecol. Environ., 2: 123-130.

Sellanes, J., E. Quiroga & C. Neira. 2008. Megafauna community structure and trophic relationships at the recently discovered Concepcion methane seep area, Chile, similar to 36ºS. ICES J. Mar. Sci., 7: 1102-1111.

Received: 2 August 2011; Accepted: 7 June 2012

Sellanes, J., C. Neira, E. Quiroga & N. Teixido. 2010. Diversity patterns along and across the Chilean margin: a continental slope encompassing oxygen gradients and methane seep benthic habitats. Mar. Ecol. Evol. Persp., 31: 111-124.

Subsecretaría de Pesca (SUBPESCA). 2006. Sinopsis de ecosistemas marinos vulnerables y propuesta de cierre de áreas al arrastre de fondo y redes de enmalle. Documento Trabajo, Informe Técnico, Resolución Pesquera N°069, Subsecretaría de Pesca, Valparaíso, 36 pp.

Turner, S.J., S.F. Thrush, J.E. Hewitt & V.J. Cummings. 1999. Fishing impacts and the degradation or loss of habitat structure. Fish. Manage. Ecol., 6: 401-420.

Williams, G.C. 2001. Octocoral Research Center Web Site. Available on-line at http://www.calacademy.org/research/izg/orc_home.html. Reviewed: 5 July 2011.

Yáñez, E., C. Silva, R. Vega, F. Espíndola, L. Álvarez, N. Silva, S. Palma, S. Salinas, E. Menschel, V. Häussermann, D. Soto & N. Ramírez. 2009. Seamounts in the southeastern Pacific Ocean and biodiversity on Juan Fernandez seamounts, Chile. In: P. Arana, J.A.A. Pérez & P.R Pezuto (ed.). Deep-sea fisheries off Latin America. Lat. Am. J. Aquat. Res., 37: 555-570.

Zuleta, A. & A. Hamano. 2004. Exploración científica del B/E Koyo Maru al monte submarino Bajo O'Higgins frente a Chile. Informe de Crucero, 22 pp.