

EUNICE PENNATA (POLYCHAETA: EUNICIDAE) FROM ACTIVE AND PASSIVE COLD SEEP SITES IN CENTRAL AND SOUTHERN CHILE (36°- 46°S).

EUNICE PENNATA (POLYCHAETA: EUNICIDAE) EN SITIOS DE FILTRACIÓN DE METANO ACTIVOS Y PASIVOS DEL CENTRO Y SUR DE CHILE (36°- 46°S).

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RESUMEN

El análisis de material obtenido durante la Expedición INSPIRE 2010 abordo del B/C Melville permitió el registro de una especie de poliqueto *Eunice pennata* (O.F. Müller 1776). Esta especie fue recolectada con una rastra Agassiz (AGT) en siete estaciones en el centro y sur de Chile (36° - 46°S) en profundidades entre 460 y 906m. Esta especie habita en grietas y tubos asociados a costras carbonáticas derivado de la actividad antigénica en sitios activos y pasivos de filtración de metano. Esta especie difiere de las otras especies con que está relacionada por presentar branquias que se inician en el setígero 3 y por la presencia de una base en forma de anillo en el notopodio posterior. Esta es la primera mención de la especie en aguas del Pacífico Suroriental, siendo formalmente citado para la costa del Pacífico Sur.

Palabras clave: Aisén, Red Agassiz, Expedición INSPIRE.

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ABSTRACT

Examination of material from INSPIRE Expedition 2010 to the Chilean margin aboard the R/V Melville revealed large-bodied polychaetes of the species *Eunice pennata* (O.F. Müller 1776). It was collected with an Agassiz trawl at seven stations in central and southern Chile (36°-46°S) between 460 m to 906 m depth. This species was found living in crevices or in tubes associated to carbonate crusts derived from authigenic activity at active and passive cold seep sites. It differs from other closely related species by branchiae starting from setiger 3, and by the presence of ring-shaped bases in posterior notopodia. This is the first record of these species in waters of the Southeast Pacific shore, being formerly cited for the South Pacific coasts.

Key words: Aisén, Agassiz trawl, INSPIRE expedition.

INTRODUCTION

Marine benthic communities associated with methane seeps (also known as cold seeps) have been reported at several locations on active and passive continental margins of the world (e.g. Sibuet & Olu-LeRoy 2002, Levin 2005). In these communities, non-chemosymbiotic species also appear to be abundant, probably attracted by local organic enrichment and/or habitat heterogeneity (e.g. Quiroga & Sellanes 2009). On the continental margin of Chile, the occurrence of cold seep seepage and gas hydrates has been investigated since 2003 (Morales 2003, Sellanes *et al.* 2004, 2008). In this context, two methane seep sites have been studied until now; the Concepcion Methane Seep Area (36°S, CMSA) and the site situated off El Quisco Seep Site (33°S, QMSS, Sellanes *et al.* 2004, 2008).

During the examination of a collection of polychaetes sampled during the INSPIRE Expedition carried out at two areas off Chile; CMSA and the Chile Triple junction (CTJ) during 2010, we identified several specimens to *Eunice pennata* (O.F. Müller 1776). This species is a large-bodied polychaete living in crevices or in tubes associated to carbonate crusts derived from authigenic activity at active and passive cold seep sites at depths from 460 to 820 m, off central and south Chile. The generation of authigenic carbonate is a typical feature of the sites where methane is expelled from the seafloor. Crusts form by the precipitation of the methane-derived bicarbonate released to the pore-water during the anaerobic oxidation of methane (AOM) via sulphate reduction (Levin 2005).

Eunicid polychaetes are large worms living in crevices of rocks and corals among algae in shallow and deep waters, occasionally inhabiting soft bottoms (e.g. Hartman 1964, Fauchald 1992, Sahin & Çinar 2009). The first eunicids reported from the Chilean coast were *Eunice aenea* Blanchard 1849 and *Eunice magellanica* McIntosh 1885 and 15 species have been reported since then (Rozbaczylo 1985, Montiel *et al.* 2004, Rozbaczylo *et al.* 2006). Recently, *Eunice pennata* (O.F. Müller, 1776) was reported living in interior waters of the Chilean fjords from the Aysén area (Rozbaczylo *et al.* 2006) and South Patagonian Ice-Field (Montiel *et al.* 2004). The species of this family are recognized by morphological characters such as the distribution of branchiae, types of setae and on the relative size and shape of the several soft structures (Fauchald 1992). This is the first mention of the species in waters of the Southeast Pacific waters, being formerly cited for the Pacific coasts.

MATERIALS AND METHODS

Study area

The study area is the Chilean continental margin (Fig. 1). In this region, the most important oceanographic feature is the Gunther Current (also known as the Peru-Chile Undercurrent), transporting towards the south waters of high salinity (34.4-34.9 psu) and low dissolved oxygen in association with the ESSW (Silva *et al.* 2009). On the continental margin off Chile, the upper border of this water mass is met between 50-100m, stretching to about 350-400m water depth. Between this depth and about 1,200m the low salinity and high dissolved

TABLE 1. Megabenthos sample information. Samples were taken between 6 March and 11 March, 2010.

| Date (2010) | Station | AGT | GMT | Lat. S | Long. W | Depth (m) |
|-------------|---------|-----|-------|-----------|-----------|-----------|
| 06.03 | 26 | 1 | 5:15 | 46°55.216 | 75°34.852 | 460 |
| | | | 5:34 | 46°55.155 | 75°35.615 | 697 |
| | 27 | 2 | 7:56 | 46°54.155 | 75°35.615 | 497 |
| | | | 8:10 | 46°55.155 | 75°35.615 | 474 |
| 10.03 | 42 | 3 | 17:26 | 36°22.523 | 73°43.115 | 724 |
| | | | 17:36 | 36°22.905 | 73°43.248 | 764 |
| | 44 | 4 | 20:44 | 36°24.010 | 73°43.074 | 769 |
| | | | 20:52 | 36°24.280 | 73°43.179 | 766 |
| | 45 | 5 | 0:33 | 36°22.999 | 73°43.997 | 766 |
| | | | 0:49 | 36°23.000 | 73°44.426 | 906 |
| 11.03 | 46 | 6 | 4:21 | 36°22.425 | 73°43.073 | 753 |
| | | | 4:31 | 36°22.717 | 73°43.256 | 761 |
| | 47 | 7 | 7:46 | 36°21.937 | 73°43.099 | 840 |
| | | | 7:55 | 36°22.042 | 73°43.015 | 816 |

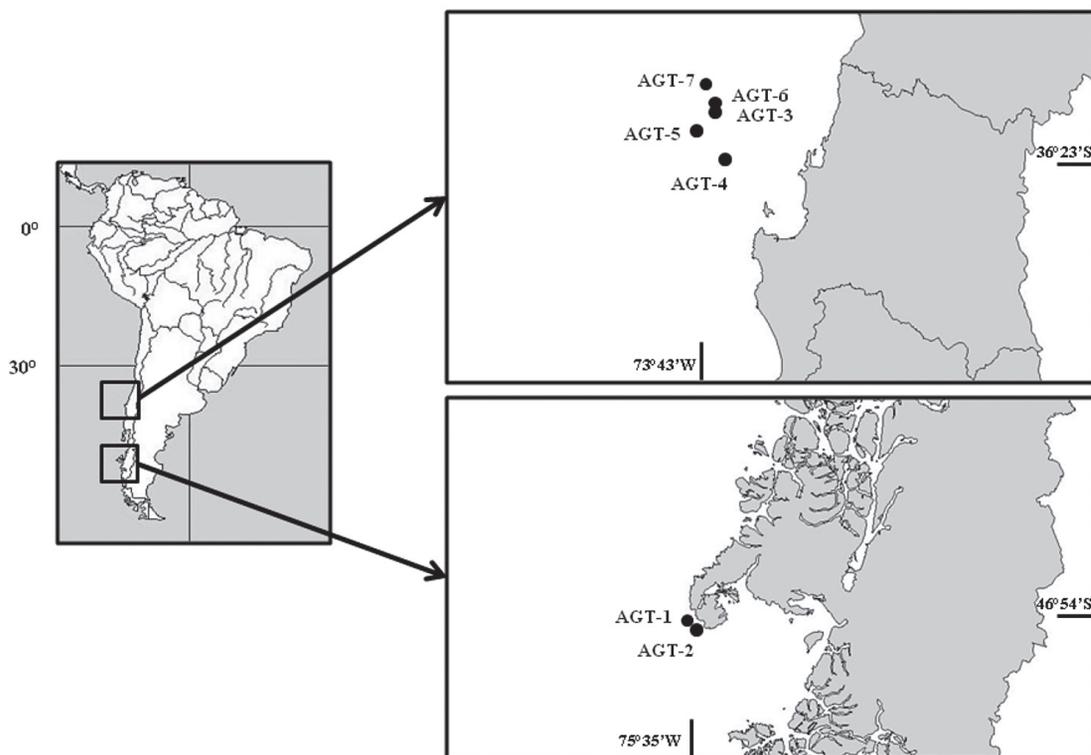


Fig. 1. Map of the study area, indicating the position of sampling stations.

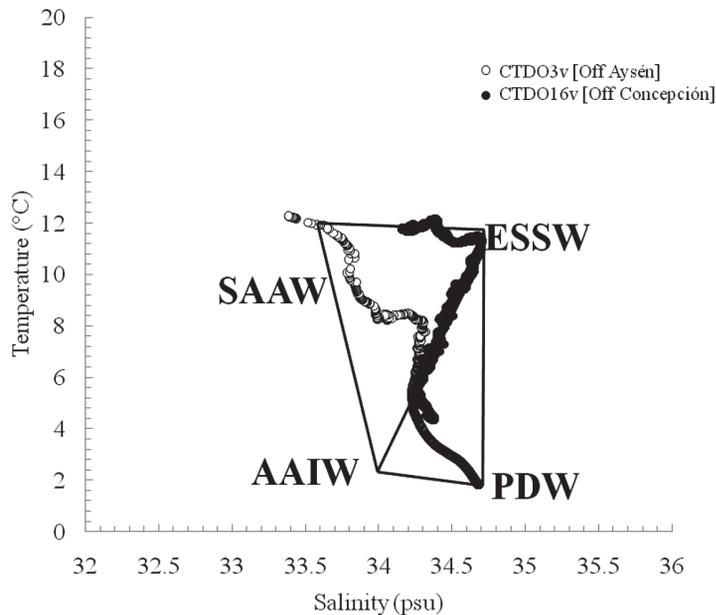


Fig. 2. TS diagram for selected CTDO3v and CTDO16v stations off Central and Southern Chile and mixing triangles. SAAW=Subantarctic Water; ESSW=Equatorial Subsurface Water; AAIW= Antarctic Intermediate Water; PDW= Pacific deep Water.

oxygen AAIW is distributed along the continental slope. Below this water mass (1,200-3,000m), the deeper slope is influenced by the PDW (Fig. 2).

Field Sampling

Samples were collected by an Agassiz trawl (AGT; mouth opening 1.5 x 0.5 m, mesh size 10 x 10 mm in the codend), in 20-min hauls. Animals were sorted from the non-biological material and preserved onboard using appropriate methods for later analysis (e.g. frozen, buffered 10% seawater formalin, glutaraldehyde, and absolute ethanol). Animals were stained with methylene blue in order to identify body parts. Photographs were taken with a digital camera (Olympus) attached to stereo and compound microscopes. Terminology for descriptions of the species follows Fauchald (1992).

RESULTS

Eunicidae Savigny

Eunice pennata (O.F. Müller 1776)
Nereis pennata Müller 1776:217

Eunice pennata: Monro 1930: 118-119, fig. 42; Fauvel 1936:21-22; Hartman 1964:118; 1967: Orensanz 1974:93, 95 pl. 3; 1990: 66-68.pl. 17, figs. a-f, text-fig. 18, Hartmann-Schröder 1983: 267; 1986; 81 Knox and Cameron 1998: 60-61, figs. 123-125.

Material examined: Two specimens, AGT-01 (INSPIRE Expedition; 46°55.216S, 75°34.852W, 460-697 m deep, March 3, 2010, Off Peninsula Taitao (Aysén). Two specimens, AGT-04 (INSPIRE Expedition; 36°20.010S, 73°43.074W, 769-766 m deep, March 10, 2010, Concepcion Methane Seep Area (CMSA). The specimens were found in crevices of carbonate crusts (Fig. 3A-C).

Description: Specimen illustrated with 168 setigers; total length 98 mm; maximal width 7 mm. Other specimen incomplete, 47 setigers; total length 30 mm; maximal width 5 mm. Body dorsally strongly convex with flattened ventral surface, tapering abruptly frontally and slowly towards posterior end. Peristomium broad, with a pair of short, annulated tentaculate cirri (Fig. 3E-D). Branchiae present from setiger 3 to setiger 43, pectinate, distinctly longer

TABLE 2. Maxillary formula for *Eunice pennata* based on literature and during this study.

| Mx II | Mx III | Mx IV | Authors |
|-----------------|-----------|-----------|---------------------------------|
| 10+12, 7+6, 7+9 | 8+0, 10+0 | 4+6, 9-6 | Hartmann, 1964 |
| 5+6 | 7+9 | 5+7, 9+10 | Orensanz, 1975 |
| 6+7 | 9+0 | 6+11 | Fauchald, 1992 |
| n. d. | n. d. | 8+10, 7+9 | Rozbaczylo <i>et al.</i> , 2006 |
| 9+9 | 7+0 | 8+5 | Present study |

than notopodial cirri. Branchiae with single filaments from setiger 3 to setiger 8; maximally 12 filaments at setiger 20. Anal cirri slender, without articulations. Setae including marginally smooth limbate setae, pectinate setae and bidentate subacicular hooks (Fig. 4A-C). Maxillary formula (examined in one specimen only); Mx II=7+0, Mx III=9+9 and Mx IV=8+5 (Table 2, Fig. 4D-E). Specimen complete, mature female with large oocytes in body cavity (Fig. 4F).

Remarks: Müller first mentioned this species in a brief note (1776) and then expanded the description in 1779; the types are lost, but the type locality was given as Storskjaer in Christianiafjord (= Oslofjord). In the 1779 publication Müller also describes a *Nereis pinnata* from *Madrepora pertusa* reefs and refers to *Nereis noruegica* and *Nereis madreporae pertusae* of Gunnerus as synonyms of his *Nereis pennata* (Fauchald 1992). *E. pennata*

has been widely reported, is cosmopolitan in deep and cold water, and appeared at one time to have a bipolar distribution (Hartman 1964, Orensanz, 1990, Fauchald 1992, Rozbaczylo *et al.* 2006). Indeed, *E. pennata* has been reported in the Antarctic and Arctic regions (Fauchald 1992). The characteristic of the specimens studied appears to be similar to those describe by Hartman (1964), Fauchald (1992) and Rozbaczylo *et al.* (2006) in terms of the maxillary formula, but our specimens are different to that reported by Orensanz (1974), which indicates that this species exhibited a large variability in the maxillary formula, which is also common feature of the others polychaetes species. *E. pennata* resembles *E. magellanica*, but it has branchiae starting from setiger 3. In contrast, *E. magellanica* has branchiae first present from setiger 6 (Rozbaczylo *et al.* 2006). In addition, Fauchald (1992) mentioned that the most unique feature of the species is the presence

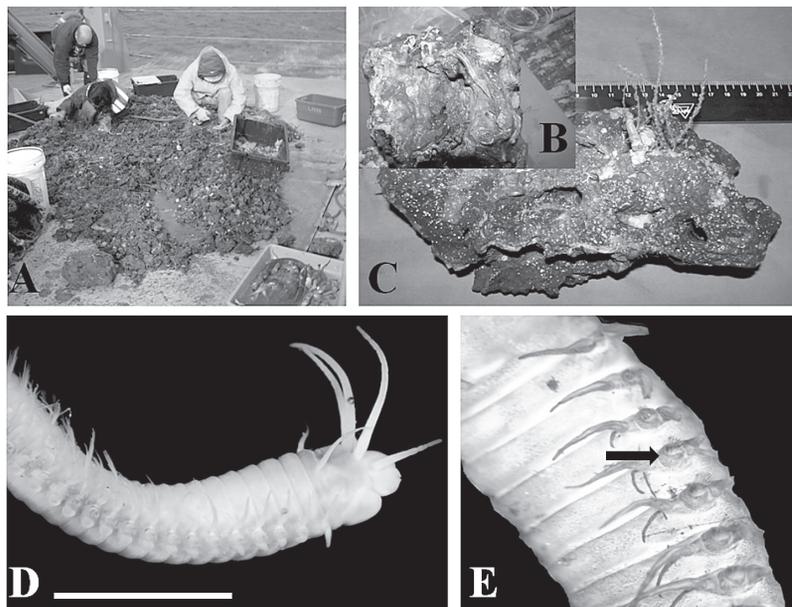


Fig. 3. (A) Trawl catches in the CMSA and CTJ stations, (B-C) carbonate crust, (D) *Eunice pennata*. Anterior end view, (E) Lateral view (arrow indicate the presence of ring-shape bases in posterior notopodia). Scale bar: E 20 mm (Stain with methylene blue).

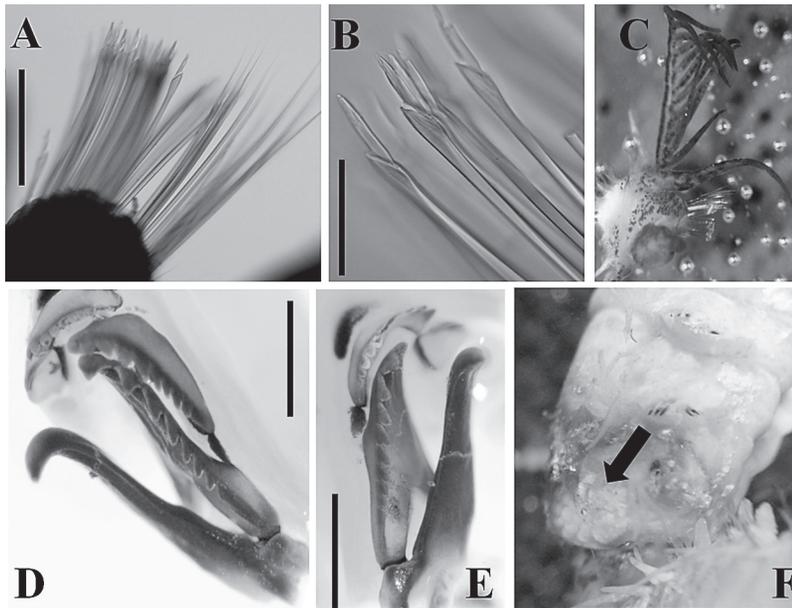


Fig. 4. (A) *Eunice pennata*, Limbate chaetae and compound falcigers parapodium 20, (B) compound falcigers, parapodium 20, (C) Branchiae from parapodium 20, (D) Left jaws, (E) Right jaws, (F) body view (arrow indicates oocytes). Scale bars: A 100 μ m, B 50 μ m, D 2 mm, E 2 mm.

of ring-shaped bases in posterior notopodia, it was also observed in our specimens (Fig. 3F). In addition, *E. antarctica* Baird, 1869, and *E. narconi* Baird, 1869, have been considered by Orensanz (1990) and Fauchald (1992) synonyms of *E. pennata*. The specimens of *E. pennata* collected from Off Peninsula Taitao and CMSA indicate that this species can be occurring in both active and passive cold seeps, due to that methane-derived authigenic carbonates provide a suitable habitat for sessile organisms and associated fauna, and this hard substratum may in turn provide a rich feeding ground for other mobile species (Sellanes *et al.* 2008, 2010).

Distribution: Arctic, north Atlantic from Davis Strait and Newfoundland to off Florida, and from Spitsbergen to the Mediterranean Sea; South Atlantic (South Georgia, South Orkney and South Shetland, Antarctic Peninsula and Drake Passage); South Africa and from Falkland Islands to Buenos Aires, Argentina (Orensanz 1974). South Chile, Aysén (Rozbaczylo *et al.* 2006) and South Ice-field sheet (Montiel *et al.* 2004). In this study: Off Peninsula Taitao (46°55'S) to Off Concepción (Concepción Methane Seep Area, 36°21'S).

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