

Macrobenthic fauna from an upwelling coastal area of Peru (Warm Temperate South-eastern Pacific province -Humboldtian ecoregion)

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Abstract

Background

A total of 162 species and subspecies of marine macroinvertebrates were recorded in the submerged soft and hard substrates around the PERU LNG marine terminal and surrounding area, in the central coast of Peru, 167 km south of Lima, Peru. The collection of specimens was carried out from June 2011 to June 2015 as part of the research studies conducted by the Biodiversity Monitoring and Assessment Program (BMAP) around the marine terminal. The area is part of the Humboldt Current Large Marine Ecosystem, one of the most important upwelling systems in the world.

New information

We identified specimens belonging to 83 families and seven phyla. The list was assembled from the taxonomic identifications made by the BMAP. We identified species and subspecies belonging to phyla Annelida, Arthropoda, Brachiopoda, Cnidaria, Echinodermata, Bryozoa and Mollusca. Phyla Annelida (60 spp.), Arthropoda (47 spp.) and Mollusca (45 spp.) exhibited the largest number of species.

Keywords

Invertebrate assemblages, macrobenthos, neritic habitats, Humboldt current ecosystem, central coast, Peru, non-native species.

Introduction

Marine studies along the coastline of Peru are largely focused on species of economic importance (Tarazona et al. 2003). Species without economic importance or smaller size species, but of great importance for the maintenance and functioning of the marine ecosystem, remain poorly studied and understood. Marine invertebrates, particularly the coastal macrobenthic fauna, are known in Peru, but the information about them arises from studies focused on the effect of El Niño Southern Oscillation (ENSO) and largely limited to the fauna from deepest areas (Tarazona 1990, Tarazona et al. 1996, Arntz et al. 2006). This is understandable because, in deeper areas, the impact of ENSO on macrobenthic communities is more evident compared to shallow areas (Tarazona et al. 2003). This has resulted in a gap of information about the diversity and dynamics of the macrobenthos inhabiting shallow coastal areas (i.e. less than 15 metres). After the collapse of the anchovy fishery in the 1970s, research on marine biodiversity became more inclusive towards species without commercial importance (Arntz and Tarazona 1990). Preliminary research was focused on taxonomic groups already reported in lists and catalogues (Chirichigno and Vélez 1998, Del Solar et al. 1970, Mendez 1981, Alamo and Milla 1997, Paredes et al. 1988), but it eventually started to include less studied groups. Now, there is a greater record of research in biodiversity for different groups including decapods and stomatopods (Moscoso 2012), holothurians (Prieto 2010), asteroidea (Morales 2011), molluscs (Ramírez et al. 2003, Paredes et al. 2011, Cardoso et al. 2016), sponges (Azevedo et al. 2015), nudibranchs (Schrödl and Hooker 2014) and echinoids (Hooker et al. 2012). This remarkable increase of biodiversity information helps understanding the general macrobenthonic diversity and encourages the compilation of geographically-focused lists to improve our understanding about species range distribution and for monitoring temporal changes.

Here, we have assembled a taxonomic list of macrobenthic species present in the shallow coastal area near the international marine terminal of company PERU LNG (PLNG), in Pampa Melchorita, on the central coast of Peru, in the southeast Pacific. The area where the terminal is located is part of the Humboldt Current Large Marine Ecosystem (HCLME), an important upwelling system encompassing submerged habitats from the southern tip of Chile to northern Peru. The HCLME is considered amongst the most productive marine ecosystems in the world and knowledge about the diversity and natural processes characterising it are in great need, given its importance in global fisheries economy (Sherman 1991, Bakun and Weeks 2008). This taxonomic list focuses both on the species inhabiting the hard and soft bottoms at intertidal and subtidal levels in the area of direct influence of the marine terminal and control sites.

Materials and methods

Study area

The checklist of benthic macrofauna species was assembled using data collected by the Biodiversity Monitoring Assessment Program (BMAP). This programme is carried out in collaboration with the Smithsonian Conservation Biology Institute and PLNG. The area of study is the area of influence of PLNG marine terminal (13°15,15'S; 76°18,5'W), situated 167 km south of Lima, Peru. The submerged area is characterised by sediment flats with scattered patches of hard bottom and new artificial hard bottom created after establishment of an 800 m-long breakwater. Sampling was carried out close to the PLNG marine terminal and surroundings from June 2011 to June 2015, with a biennial periodicity. Samples were taken in three replicates both from soft and hard substrates (Suppl. material 1). Soft substrate samples were obtained from the resurgence and saturated zone from the intertidal (Salvat 1964) and from the subtidal at depths of 8, 10, 12 and 15 m (Fig. 1a). Samples collected from artificial hard substrates (breakwaters and piles) were obtained from the intertidal level (0 m) and subtidal levels (depths of 5 to 10 m) (Fig. 1b). To collect samples from intertidal soft substrate, an 18 cm-diameter benthos hand corer was used while, for the subtidal soft substrate, a 0.05 m² Van Veen grab was used. Samples were sieved through a bag of 0.5 mm² mesh size and the retained material was fixed with 4% formaldehyde in seawater. To facilitate later triage work and taxonomic analysis, the samples were stained with 1% rose bengal. To collect samples from hard substrate, a 25 cm x 25 cm quadrat was used and samples were obtained by clearing all specimens within the quadrat using a chisel and hammer.

Identification of species and data analysis

The taxonomic identifications of collected specimens were made by the team of taxonomists from The Environment Management S.A.C (TEM). In this study, we only considered taxa identified at species or subspecies levels. Names of higher taxa as well as names of species and subspecies within them are listed alphabetically. For each of the species, we provide information about its original combination, the type of substrate (soft or hard), depth or bathymetric range, code of station where it was reported (with the name of transect and the depths in parentheses). We include remarks when necessary, particularly in the case of identified non-native species. Voucher specimens were deposited at the scientific collection of Laboratorio de Biología y Sistemática de Invertebrados Marinos (LabSIM) at Universidad Nacional Mayor de San Marcos (UNMSM).

We estimated species richness to test sampling effort using the non-parametric estimator that better fits our occurrence-data from multiple samples (Chao2, Chao 1984, Colwell and Coddington 1994), implemented in package Vegan in R (Oksanen et al. 2017). For this, we separated the species datasets sampling sites (i.e. soft-bottom and hard bottom, Fig. 1) and obtained rarefaction-based species accumulation curves.

Data resources

Data package title: Macrobenthos_bmapperu

Resource link: http://ipt.pensoft.net/resource?r=macrobenthos_bmapperu&v=1.2

Number of datasets: 1

Data set name: Macrobenthos from upwelling coastal area of Peru

Data format: Darwin Core Archive (DwC-A)

Annelida

Family Arenicolidae

Abarenicola affinis subsp. *affinis* (Ashworth, 1902)

Nomenclature:

Arenicola assimilis affinis Ashworth, 1902

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 0-15 m. Station code: BT1N(10, 12, 15); BT1S(12, 15); BT2N(0, 10, 12, 15); BT2S(12, 15); BT3N(15); BT3S(10, 15); BT4N(10, 15).

Family Capitellidae

Mediomastus branchiferus Hartmann-Schröder, 1962

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-15 m. Station code: BT1N (8, 10, 12); BT1S(8, 10, 12); BT2N(8, 10, 12, 15); BT2S(8, 12); BT3S(8); BT4N(8); D1(0, 10); D2(5, 10); D3(0, 5, 10); D4(0).

Family Maldanidae

Axiiothella rubrocincta (Johnson, 1901)

Nomenclature:

Clymenella rubrocincta Johnson, 1901

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5-10 m. Station code: D2(5, 10).

Family Cossuridae

Cossura chilensis Hartmann-Schröder, 1965

Notes: Material examined: Fig. 2. Prostomium conical or almost triangular in shape, slightly longer than width; two peristomial segments, first incomplete peristomial segment, first setiger uniramous; branchiae on setigers 3. Types of substrate: soft bottom. Depth / bathymetric range: 10-15 m. Station code: BT1N(10, 12); BT1S(10, 12); BT2N(12, 15); BT2S(12); BT4N(15).

Family Dorvilleidae

Schistomeringos annulata (Moore, 1906)

Nomenclature:

Stauronereis annulatus Moore, 1906

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(5); D2(5, 10); D3(0, 5, 10); D4(0, 5).

Family Lumbrineridae

Lumbrineris biuncinata Hartmann-Schröder, 1960

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-5 m. Station code: D1(5); D4(0, 5).

Lumbrineris lobata Hartmann-Schröder, 1960

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-10 m. Station code: BT2S(0); D1(0, 5, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 10); D5(0).

Family Onuphidae

Diopatra chiliensis Quatrefages, 1866

Notes: Material examined: Fig. 2. Prostomium rounded; Ceratophores of palps and antennae with 9-11 (some times 8-11) proximal rings and a longer distal ring. Anterior 5-6 pairs of parapodia modified, with 4-5 bidentate pseudocompound hooks and 1-2 upper simple chaetae, hooks with tiny spines on the shaft. Branchiae with up to 23 spiralled whorls, with long and thin filaments, starting from chaetiger 5. Types of substrate: soft bottom. Depth / bathymetric range: 8-15 m. Station code: BT1N(8, 10,

12, 15); BT1S(8, 10, 12, 15); BT2N(10, 12, 15); BT2S(8, 10, 12, 15); BT3N(15); BT3S(8, 10); BT4N(8, 10, 15).

***Diopatra obliqua* Hartman, 1944**

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 8-15 m. Station code: BT1N(10); BT1S(8, 10, 12, 15); BT2N(8, 10); BT2S(8, 10, 12); BT3S(8, 10); MU(17).

Family Orbiniidae

***Leitoscoloplos chilensis* (Hartmann-Schröder, 1965)**

Nomenclature:

Haploscoloplos kerguelensis chilensis Hartmann-Schröder, 1965

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8-12 m. Station code: BT1N(8, 10); BT1S(10); BT2N(12); BT2S(10, 12); BT3N(10, 12); BT3S(8).

***Leitoscoloplos kerguelensis* (McIntosh, 1885)**

Nomenclature:

Scoloplos kerguelensis McIntosh, 1885

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8-12 m. Station code: BT1N(10); BT1S(8, 10); BT2S(12); BT4N(10).

***Naineris brevicephala* Hartmann-Schröder, 1960**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D2(5); D3(0, 5, 10); D4(0, 10).

***Protoariciella uncinata* Hartmann-Schröder, 1962**

Notes: Material examined: Fig. 2. Prostomium rounded, as long as wide, a pair of eyes located in the posterior half of the prostomium; the division of the thorax and abdomen is not clear. The first two segments without chaetas. Cirrus dorsal short and digitiforms. Gills from segment 8. Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-10 m. Station code: BT3S(0); BT4N(8) ; D1(0, 5, 10); D2(0); D3(0, 5, 10); D4(0, 5).

***Scoloplos rubra* (Webster, 1879)**

Nomenclature:

Aricia rubra Webster, 1879

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 0-12 m. Station code: BT1N(0, 8); BT1S(8, 12); BT2N(0).

Family Oweniidae

Owenia collaris Hartman, 1955

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8-15 m. Station code: BT1N(8, 10, 12, 15); BT1S(8, 10, 12, 15); BT2N(8, 10, 12, 15); BT2S(8, 10, 12, 15); BT3N(8, 10, 15); BT3S(8, 10, 15); BT4N(8, 10, 15).

Family Glyceridae

Glycera americana Leidy, 1855

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 5-15 m. Station code: BT1N(0, 8, 10, 12); BT1S(8, 10, 12); BT2N(8, 10, 12, 15); BT2S(8, 10, 12); BT3N(8, 10, 12); BT3S(8); BT4N(8, 10); D3(5, 10)

Hemipodia californiensis (Hartman, 1938)

Nomenclature:

Hemipodus californiensis Hartman, 1938

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-12 m. Station code: BT1N(0, 8); BT1S(0); BT2N(0, 12); BT2S(0, 12); BT3S(0); BT4N(0); D2(0, 10).

Family Goniadidae

Goniada echinulata Grube, 1870

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 0-15 m. Station code: BT1N(8, 10, 12, 15); BT1S(0, 8, 10, 12); BT2N(8, 10, 12, 15); BT2S(0, 8, 10, 12, 15); BT3N(10); BT3S(8, 10); BT4N(8, 10).

Goniadides falcigera Hartmann-Schröder, 1962

Notes: Material examined: Fig. 2. Prostomium with 8 rings, 4 antennae with constrictions resembling annulations. Proboscis with several different types of papillae, arranged in distinct longitudinal rows and best developed in median proboscival part. Papillae long and unidentate, fang-shaped papillae with bent tip

and broad base. Papillae slightly shorter, unidentate, fang-shaped papillae with slightly bent tip and smaller base. Papillae shorter, unidentate, more or less straight, conical papillae with slender base. Papillae small, stout conical to globular. Papillae slightly smaller, stout globular. Papillae slightly smaller, stout globular to rounded papillae. First segment usually without parapodium and chaetous. Black granulations in the parapodium and part of the body. Types of substrate: soft bottom. Depth / bathymetric range: 0-10 m. Station code: BT1N(0, 8, 10); BT1S(0); BT2N(0); BT2S(0, 10); BT3S(0); BT4N(0).

Family Hesionidae

Heteropodarke heteromorpha Hartmann-Schröder, 1962

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8-10 m. Station code: BT2N(8, 10).

Oxydromus furcatus (Hartmann-Schröder, 1962)

Nomenclature:

Podarke furcata Hartmann-Schröder, 1962

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(5); D2(5, 10); D3(0, 5, 10); D4(0, 5); D5(0).

Family Nephytyidae

Nephtys ferruginea Hartman, 1940

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8-15 m. Station code: BT1N(10); BT1S(12, 15); BT2N(8, 10); BT3N(8); BT4N(8).

Nephtys impressa Baird, 1873

Notes: Material examined: Fig. 2. The prostomium is approximately pentagonal in shape and broader than long. Long proboscis, with 22 rows of papillae, each row with 6 to 7 papillae, the anterior papillae are 2 to 3 times the size of the posterior ones. Interramal cirri first present on segment 4 and continuing through of body, distinctly recurved and heavily ciliated. The neuropodium carries a superior lobe present in the anterior and posterior segments. Types of substrate: soft bottom. Depth / bathymetric range: 0-15 m. Station code: BT1N(0, 8, 10, 12, 15); BT1S(8, 10, 12, 15); BT2N(8, 10, 12, 15); BT2S(8, 10, 12, 15); BT3N(8, 10, 12, 15); BT3S(0, 8, 10); BT4N(8, 10, 15).

Family Nereididae

***Nereis callaona* (Grube, 1857)**

Nomenclature:

Nereilepas callaona Grube, 1857

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-15 m. Station code: BT1N(15); BT1S(10); BT4N(8); D1(0, 5, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 5, 10); D5(0).

***Platynereis australis* (Schmarda, 1861)**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D3(0).

***Pseudonereis gallapagensis* Kinberg, 1865**

Notes: Material examined: Fig. 2. Prostomium with entire anterior margin, wider than long. The dorsal part of the body presents a greenish-brown colour, including the prostomium and palps. One apodous anterior segment, greater than length of chaetiger 1. Tentacular cirri with distinct cirrophores, longest tentacular cirri extend back to chaetiger 3–4. The paragnath distribution: area I: 1 conical paragnath; area II: about 17-20 bar paragnaths in four rows; area III: Numerous paragnaths distributed in 4 rows; area IV: about 40–50 bar paragnaths in 4 rows, around 15 cones towards jaws and 2–4 bars next to the jaws, area V: 1 conical paragnath; area VI: 1 large triangular shield-shaped bar present; area VII and VIII: about 18–20 in two rows, anterior row with cones, posterior with bars, forming a single band of paragnaths. First two parapodia uniramous, all others biramous. Long dorsal cirrus, located at the distal end of the dorsal lobe of the notopodium from the posterior third of the body. Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(0); D3(0, 10); D4(0, 5, 10); D5(0).

Family Phyllodoceidae

***Phyllodoce parvula* Gravier, 1907**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D3(0, 5, 10); D4(0).

***Protomystides confusa* Hartmann-Schröder, 1962**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(10); D2(0, 10); D3(5, 10); D4(0).

***Protomystides lanceolata* Hartmann-Schröder, 1962**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(5); D2(0, 5, 10); D3(0, 5, 10); D4(0, 5); D5(5).

***Steggoa negra* Hartmann-Schröder, 1962**

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-12 m. Station code: BT1N(4); BT1S(8, 10); BT2N(8, 10); BT2S(8, 10, 12); BT3S(8, 10); BT4N(8); D1(0); D2(0); D3(0, 5, 10).

***Steggoa peruana* Hartmann-Schröder, 1960**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(5, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 5); D5(0).

Family Pilargidae

***Hermundura fauveli* (Berkeley & Berkeley, 1941)**

Nomenclature:

Loandalia fauveli Berkeley & Berkeley, 1941

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-15 m. Station code: BT1N(8, 10, 12, 15); BT1S(10, 12, 15); BT2N(10, 12, 15); BT2S(12, 15); BT3N(12); BT3S(0, 10, 15); BT4N(10, 15); D3(0).

***Sigambra bassi* (Hartman, 1945)**

Nomenclature:

Ancistrostylis bassi Hartman, 1945

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 10 m. Station code: BT1N(10); BT1S(10); BT4N(10).

Family Polynoidae

***Halosydna fuscomarmorata* (Grube, 1876)**

Nomenclature:

Polynoe fuscomarmorata Grube, 1876

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0); D2(5, 10); D3(0, 5, 10); D4(0); D5(0).

***Halosydna johnsoni* (Darboux, 1899)**

Nomenclature:

Lepidonotus johnsoni Darboux, 1899

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 5, 10); D5(0).

***Halosydna parva* Kinberg, 1856**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D3(0, 5, 10); D4(0).

***Harmothoe hirsuta* Johnson, 1897**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 10 m. Station code: D3(10).

***Lepidonotus crosslandi* subsp. *peruana* Hartmann-Schröder, 1962**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(10); D3(0, 5, 10); D4(0).

Family Sigalionidae

***Pholoides asperus* (Johnson, 1897)**

Nomenclature:

Peisidice aspera Johnson, 1897

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 10 m. Station code: D2(10).

***Pisione koepkei* Siewing, 1955**

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 0 m. Station code: BT1N(0); BT1S(0); BT2N(0); BT2S(0); BT3S(0); BT4N(0).

***Sthenelais helenae* Kinberg, 1856**

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 10-15 m. Station code: BT1S(10); BT4N(15).

Family Syllidae

Eusyllis liniata (Hartmann-Schröder, 1962)

Nomenclature:

Odontosyllis liniata Hartmann-Schröder, 1962

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(5, 10); D2(0, 10); D3(0, 5, 10); D4(0).

Myrianida paredesi Aguirre, San Martín & Álvarez-campos, 2015

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 10 m. Station code: D1(10); D2(10); D3(10). Remarks: This species was described recently from the study area (Aguirre et al. 2015)

Proceraea micropedata (Hartmann-Schröder, 1962)

Nomenclature:

Odontosyllis micropedata Hartmann-Schröder, 1962

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(10); D2(5, 10); D3(0, 5, 10); D4(10).

Syllis magdalena (Ehlers, 1901)

Nomenclature:

Syllis prolixa Ehlers, 1901

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(10); D2(10); D3(0, 10); D4(0).

Family Sabellidae

Paradialychone paracincta (Hartmann-Schröder, 1962)

Nomenclature:

Chone paracincta Hartmann-Schröder, 1962

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 8- 10 m. Station code: BT1N(8) ; BT2N(10) ; D3(10).

***Parasabella leucaspis* (Kinberg, 1867)**

Nomenclature:

Demonax leucaspis Kinberg, 1867

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 10 m. Station code: D1(10); D2(10); D3(10).

Family Spionidae

***Boccardia polybranchia* (Haswell, 1885)**

Nomenclature:

Polydora polybranchia Haswell, 1885

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 10).

***Carazziella carrascoi* Blake, 1979**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D3(0); D4(0).

***Dipolydora socialis* (Schmarda, 1861)**

Nomenclature:

Leucodore sociales Schmarda, 1861

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5-10 m. Station code: D2(5, 10); D3(5, 10).

***Paraprionospio pinnata* (Ehlers, 1901)**

Nomenclature:

Prionospio (*Paraprionospio*) *pinnata* Ehlers, 1901

Notes: Material examined: Fig. 2. Prostomium fusiform with rounded anterior border. Peristomium with projections that wrap dorsolaterally to the prostomium. Palp with basal sheath. Three pairs of branchiae on setigers 1–3. Each carries numerous lamellae; the lamellae of the first pair of branchiae are the largest. Notopodial postsetal lamellae elongate subtriangular on setigers 1–3, becoming low rounded posteriorly to about setiger 11 reducing in size. Anterior neuropodial postsetal lamellae ovate, distally pointed, becoming low rounded from setiger 4; lamellae

reduced to a low ridge from setiger 9. Neuropodial hooded hooks, attaining 10–13 per fascicle. Neuropodial and notopodial hooded hooks with 3–4 pairs of apical teeth above main fang. Types of substrate: soft bottom. Depth / bathymetric range: 10-12 m. Station code: BT1S(10, 12).

***Polydora aggregata* Blake, 1969**

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-12 m. Station code: BT1N(10); BT1S(8, 10, 12); D1(5); D2(0); D3(0, 5, 10); D4(0).

***Polydora websteri* Hartman in Loosanoff & Engle, 1943**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(0, 5, 10) D3(0, 5, 10); D4(0, 5). Remarks: considered as non-native species, with North American Pacific coast being its native distribution area (Cinar 2012). Considered as an invasive species in Hawaii Islands (Cinar 2012), Venezuela and Australia (Díaz and Liñero-Arana 2009), which has caused extensive damage to oysters.

***Prionospio peruana* Hartmann-Schröder, 1962**

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8-15 m. Station code: BT1N(8, 10, 12, 15); BT1S(8, 10, 12, 15); BT2N(8, 10, 12, 15); BT2S(8, 10, 12, 15); BT3N(10, 12, 15); BT3S(8, 10); BT4N(8, 10, 15).

***Rhynchospio glutaea* (Ehlers, 1897)**

Nomenclature:

Scolecopsis glutaea Ehlers, 1897

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-10 m. Station code: BT1N(10); BT1S(10); BT2N(10); BT2S(10); D3(5); D4(0).

***Scolecopsis chilensis* (Hartmann-Schröder, 1962)**

Nomenclature:

Nerine cirratulus chilensis Hartmann-Schröder, 1962

Notes: Material examined: Fig. 2. Prostomium elongated and distally pointed, continuing posteriorly as caruncle to end of setiger 1. Peristomium well developed, forming lateral wings that sometimes cover half of the prostomium. Setiger 1 reduced. Branchiae from setiger 7, fused with the dorsal lamella, leaving free only the tips of both; from the setigero 22-25, the fusion only covers half of the branchiae and lamella. Hooded hooks beginning in neuropodia from setigers 25. Types of substrate:

soft bottom. Depth / bathymetric range: 0-15 m. Station code: BT1N(0, 8); BT1S(8, 10); BT2N(8, 10, 12); BT2S(8,10, 12); BT3N(8, 10, 15); BT3S(8, 10,15); BT4N(8, 10).

***Scolelepis squamata* (O.F. Muller, 1806)**

Nomenclature:

Lumbricus squamatus O.F. Müller, 1806

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8-112 m. Station code: BT1N(10); BT1S(8, 10); BT2N(10); BT2S(8,10, 12); BT3S(8); BT4N(8).

Family Pectinariidae

***Pectinaria chilensis* Nilsson, 1928**

Notes: Types of substrate: hard and soft bottom. Depth / bathymetric range: 10-15 m. Station code: BT1N(12); BT1S(12, 15); BT2N(15); BT2S(15); BT3S(10, 15); D1(10).

Family Sabellariidae

***Phragmatopoma virgini* Kinberg, 1866**

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-10 m. Station code: BT1N(10); D1(5, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 5, 10).

Family Tereballidae

***Pista mirabilis* McIntosh, 1885**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 10 m. Station code: D3(10).

Arthropoda

Family Caprellidae

***Caprella scaura* Templeton, 1836**

Notes: Types of substrate: hard and soft bottom. Depth / bathymetric range: 5-12 m. Station code: BT1N(12); BT2N(10); BT1S(12); D2(5). Remarks: considered as non-native species, being native to the western Indian (Martínez and Adarraga 2008).

Family Corophiidae

Monocorophium acherusicum (Costa, 1853)

Nomenclature:

Corophium acherusicum Costa, 1853

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(5); D2(5, 10); D3(0, 5, 10). Remarks: considered as non-native species in Chile (Pérez-Schultheiss 2009). Its native area is not clear, probably Oriental Atlantic. Introduced probably by shipping as fouling.

Monocorophium insidiosum (Crawford, 1937)

Nomenclature:

Corophium insidiosum Crawford, 1937

Notes: Types of substrate: hard and soft bottom. Depth / bathymetric range: 0-15 m. Station code: BT1N(15) ; BT2N(15) ; BT3S(15), D1(0, 5, 10); D2(5, 10); D3(0, 5, 10); D4(0, 10). Remarks: considered as non-native species in Chile (Pérez-Schultheiss 2009). After Fofonoff et al. 2003, it is native from Oriental Atlantic. Probably introduced by shipping as fouling.

Family Ischyroceridae

Erichthonius punctatus (Bate, 1857)

Nomenclature:

Podocerus punctatus Bate, 1857

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1 (0, 5, 10); D2 (5, 10); D3(0, 5, 10); D4(0, 10).

Family Maeridae

Elasmopus rapax Costa, 1853

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-15 m. Station code: BT1S(8, 15); BT2S(10), BT3N(15); BT3S(8); D1(0, 5, 10); D2(0, 5, 10); D3(0,5,10); D4(0, 5); D5(0). Remarks: Considered as non-native species from the Pacific (Pérez-Schultheiss 2009, Hughes and Lowry 2010). After Hughes and Lowry 2010, its origin can be Mediterranean, Red Sea or the Indian Ocean. Probably introduced by shipping as fouling.

Family Stenothoidae

Stenothoe valida Dana, 1852

Notes: Types of substrate: Hard and soft bottoms. Depth / bathymetric range: 0-15 m. Station code: BT1N(15); D2(5); D3(0, 5, 10).

Family Aethridae

Hepatus lineatus Rathbun, 1898

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 10-12 m. Station code: BT1S(10); BT2S(12). Remarks: This species has a North American distribution (Hendrickx 1995) and for this reason can be considered as non-native species.

Family Albuneidae

Lepidopa deamae Benedict, 1903

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 0-8 m. Station code: BT1S(0); BT2S(8).

Family Alpheidae

Alpheus chilensis Lenz, 1902

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5 m. Station code: D3(5).

Alpheus inca Wicksten & Méndez, 1981

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5-10 m. Station code: D3(5, 10).

Synalpheus spinifrons (Milne Edwards, 1837)

Nomenclature:

Alpheus spinifrons Milne Edwards, 1837 [in Milne Edwards, 1834-1840]:

Notes: Material examined: Fig. 2. Smooth caparace whose frontal border extends on a rostriform keel above the eyes that are protected by the border of the caparace. Chelas whose dactyl has a molariform tubercle and is modified in the form of a

trigger. Periopods without epipodites. Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(5); D3(0, 5, 10).

Family Cancridae

Romaleon polyodon (Latreille, 1802)

Nomenclature:

Cancer polyodon Poëppig, 1836

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D3(0).

Family Epialtidae

Acanthonyx petiverii Milne Edwards, 1834

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D3(0).

Family Epialtidae

Pachygrapsus transversus (Gibbes, 1850)

Nomenclature:

Grapsus transversus Gibbes, 1850

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D1(0); D3(0); D5(0).

Family Hippidae

Emerita analoga (Stimpson, 1857)

Nomenclature:

Hippa analoga Stimpson, 1857

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 0-8 m. Station code: BT1N(0); BT1S(0); BT2N(0); BT2S(0, 8); BT3S(0); BT4N(0).

Family Paguridae

***Pagurus perlatus* Milne Edwards, 1848**

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8-10 m. Station code: BT1S(8); BT2N(8); BT2S(10); BT3S(8).

***Pagurus villosus* Nicolet, 1849**

Notes: Material examined: Fig. 2. Ocular acicles with single terminal spine. Antennal flagellum with long, evenly paired setae. Carpus of left cheliped with row of spines on both dorsomesial and dorsolateral margins; posterolateral telsonal plates composed of individual spinules or denticules. Types of substrate: soft bottom. Depth / bathymetric range: 8 m. Station code: BT3S(8).

Family Panopeidae

***Eurypanopeus transversus* (Stimpson, 1860)**

Nomenclature:

Panopeus transversus Stimpson, 1860

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(5); D2(0, 10), D3(0, 5, 10).

Family Pilumnoididae

***Pilumnoides perlatus* (Poeppig, 1836)**

Nomenclature:

Hepatus perlatus Poeppig, 1836

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 5, 10); D5(0).

Family Pinnotheridae

***Calyptraeotheres politus* (Smith, 1870)**

Nomenclature:

Ostracotheres politus Smith, 1870

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(10); D2(10); D3(0, 10).

***Pinnixa valdiviensis* Rathbun, 1907**

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8-15 m. Station code: BT1N(10); BT1S(15); BT2N(8, 15).

Family Platyxanthidae

***Platyxanthus orbigny* (Milne Edwards & Lucas, 1843)**

Nomenclature:

Xantho orbigny Milne Edwards & Lucas, 1843

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D2(10); D3(0, 5, 10).

Family Porcellanidae

***Allopetrolisthes angulosus* (Guérin, 1835)**

Nomenclature:

Porcellana angulosa Guérin, 1835

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-5 m. Station code: D1(5); D3(0).

***Allopetrolisthes punctatus* (Guérin, 1835)**

Nomenclature:

Porcellana punctata Guérin, 1835

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D3(0); D5(0).

***Allopetrolisthes spinifrons* (Milne Edwards, 1837)**

Nomenclature:

Porcellana spinifrons Milne Edwards, 1837

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5 m. Station code: D4(5).

***Liopetrolisthes mitra* (Dana, 1852)**

Nomenclature:

Porcellana mitra Dana, 1852

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(5); D3(0, 5, 10); D4(0, 5, 10); D5(0, 5).

***Pachycheles crinimanus* Haig, 1960**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5); D2(0); D3(0, 5, 10); D4(0); D5(5).

***Pachycheles grossimanus* (Guérin, 1835)**

Nomenclature:

Porcellana grossimana Guérin, 1835

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 10 m. Station code: D3(10).

***Petrolisthes armatus* Gibbes, 1850**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5 m. Station code: D1(5); D2(5)

***Petrolisthes desmarestii* (Guérin, 1835)**

Nomenclature:

Porcellana desmarestii Guérin, 1835

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 10 m. Station code: D3(10).

***Petrolisthes granulosis* (Guérin, 1835)**

Nomenclature:

Porcellana granulosa Guérin, 1835

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-5 m. Station code: D2(5); D3(0, 5).

***Petrolisthes laevigatus* (Guérin, 1835)**

Nomenclature:

Porcellana laevigata Guérin, 1835

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-5 m. Station code: D3(0, 5).

Family Portunidae

***Arenaeus mexicanus* (Gerstaecker, 1856)**

Nomenclature:

Euctenota mexicanus Gerstaecker, 1856

Notes: Material examined: Fig. 2. Caparace with 9 equal or subequal antero-laterales teeth. Eye peduncles much shorter than a third of the width of the caparace; deep supraorbital fissure, wide and "V" shaped. External surface of the cheliped palm with 1 or 2 well-marked spines. Types of substrate: soft bottom. Depth / bathymetric range: 8 m. Station code: D1(10); BT1S3(8).

***Cronius ruber* (Lamarck, 1818)**

Nomenclature:

Portunus ruber Lamarck, 1818

Notes: Material examined: Fig. 2. It differs from the other blue crabs with 9 antero-lateral spines in the their long and short alternations and the presence on the palm-surface with sharp and black tips. Types of substrate: hard bottom. Depth / bathymetric range: 5-10 m. Station code: D1(10); D3(5).

Family Varunidae

***Pseudograpsus setosus* (Fabricius, 1798)**

Nomenclature:

Cancer setosus Fabricius, 1798

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5-10 m. Station code: D1(10); D2(10); D3(5).

Family Xanthidae

***Gaudichaudia gaudichaudii* (Milne Edwards, 1834)**

Nomenclature:

Xantho gaudichaudii Milne Edwards, 1834

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(5); D2(5); D3(0, 10).

***Gaudichaudia tridentatus* (Lenz, 1902)**

Nomenclature:

Leptodius tridentatus Lenz, 1902

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D2(5); D3(0, 5, 10).

Family Ancinidae

***Ancinus brasiliensis* Lemos de Castro, 1959**

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 10 m. Station code: BT1N(10). Remarks: It is a species from Western Atlantic (Glynn and Glynn 1974) probably introduced by maritime traffic.

***Ancinus panamensis* Glynn & Glynn, 1974**

Notes: Material examined: Fig. 2. Uropods uniramous; pereopod I subchelate; pereopod II subchelate in male only; cephalon medially fused to first pereonite. Pleotelson with transverse depression near posterior apex; lateral margin of rostrum straight, not anteriorly expanded; male pereopod II dactyl closing midway on propus. Types of substrate: soft bottom. Depth / bathymetric range: 8 m. Station code: BT1S(8); BT2N(8, 10); BT2S(8); BT3N(8).

Family Cirolanidae

***Exciorana braziliensis* Richardson, 1912**

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 0-10 m. Station code: BT1N(0); BT1S(0); BT2N(0); BT2S(0, 10); BT3S(0); BT4N(0).

Family Idoteidae

***Edotia transversa* Menzies, 1962**

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 10-12 m. Station code: BT1N(10, 12).

Family Sphaeromatidae

***Paradella bakeri* (Menzies, 1962)**

Nomenclature:

Dynamenopsis bakeri Menzies, 1962

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5); D2(0); D3(0, 5); D4(0, 10).

Family Balanidae

***Austromegabalanus psittacus* (Molina, 1782)**

Nomenclature:

Lepas psittacus Molina, 1782

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 10); D5(0).

***Balanus laevis* Bruguière, 1789**

Notes: Material examined: Fig. 2. The plates form a conical structure, rounded border and smooth margins. There are six narrow spokes on the surface corresponding to the sutures of the tables: four anterior spokes (corresponding to their joints of the Carina-carinolateral and carino-lateral plates) and two posterior radii (corresponding to their joints of the Rostral-lateral plates). Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-10 m. Station code: BT1S(8); BT2S(8); D1(0, 5, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 5, 10); D5(0, 5).

***Megabalanus tintinnabulum* (Linnaeus, 1758)**

Nomenclature:

Balanus tintinnabulum Linnaeus, 1758

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(10) D2(0); D3(0, 5, 10).

Family Chthamalidae

Chthamalus cirratus Darwin, 1854

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-5 m. Station code: D1(0) ; D2(0) ; D3(0, 5) ; D4(0).

Notochthamalus scabrosus (Darwin, 1854)

Nomenclature:

Chthamalus scabrosus Darwin, 1854

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D2(0, 10); D3(0); D4(0); D5(0).

Brachiopoda

Family Discinidae

Discinisca lamellosa (Broderip, 1833)

Nomenclature:

Orbicula lamellosa Broderip, 1833

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-10 m. Station code: BT4N(8); D1(5, 10); D2(5, 10); D3(0, 5, 10); D4(5, 10).

Bryozoa

Family Bugulidae

Bugula neritina (Linnaeus, 1758)

Nomenclature:

Sertularia neritina Linnaeus, 1758

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 10-15 m. Station code: BT1N(10, 12); BT3N(15). Remarks: It is a biofouling species and considered as non-native in Australia and Europe (Ryland et al. 2011).

Cnidaria

Family Actiniidae

Oulactis concinnata (Drayton in Dana, 1846)

Nomenclature:

Metridium concinnatum Drayton in Dana, 1846

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-5 m. Station code: D1(5); D3(0,5).

Family Sagartiidae

Anthothoe chilensis (Lesson, 1830)

Nomenclature:

Actinia chilensis Lesson, 1830

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-10 m. Station code: BT1S(10); BT2N(10); BT2S(8, 10); BT4N(0); D1(0, 5, 10); D2(10); D3(0, 5, 10); D4(0); D5(0).

Echinodermata

Family Arbaciidae

Arbacia spatuligera (Valenciennes, 1846)

Nomenclature:

Echinus spatuliger Valenciennes, 1846

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5-10 m. Station code: D4(5, 10); D5(5).

Tetrapygius niger (Molina, 1782)

Nomenclature:

Echinus niger Molina, 1782

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 5, 10); D5(0, 5).

Family Echinometridae

***Caenocentrotus gibbosus* (L. Agassiz, in L. Agassiz & Desor, 1846)**

Nomenclature:

Echinus (Toxopneustes) gibbosus L. Agassiz & Desor, 1846

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(0, 5); D3(0); D5(5).

Family Parechinidae

***Loxechinus albus* (Molina, 1782)**

Nomenclature:

Echinus albus Molina, 1782

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5-10 m. Station code: D1(5, 10); D2(5).

Family Ophiactidae

***Ophiactis kroeyeri* Lütken, 1856**

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-12 m. Station code: BT1S(10) ; BT2S(12) ; BT4N(8, 10) ; D1(0, 5, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 5, 10); D5(0).

Molusca

Family Hiattellidae

***Hiatella arctica* (Linnaeus, 1767)**

Nomenclature:

Mytilus rugosus Linnaeus, 1767

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 10 m. Station code: D1(10); D3(10).

Family Pharidae

Ensis macha (Molina, 1782)

Nomenclature:

Solen scalprum King, 1832

Notes: Material examined: Fig. 2. The shell is large ensiform, its valves are equal, narrow and long, parallel border and surface smoothly arched. The anterior border is rounded, while the posterior border is slightly truncated. The umbos are close to the previous border. Externally the periostracum is thin, yellowish to greenish-coffee. The hinge has three cardinal teeth, two in the left valve and one in the right valve. The pallial sinus is broad and short, located towards the posterior end. Types of substrate: soft bottom. Depth / bathymetric range: 8-15 m. Station code: BT1N(8, 10); BT1S(8); BT2N(8, 12, 15); BT2S(8, 10); BT3N(8, 10, 15); BT4N(8).

Family Pholadidae

Barnea subtruncata (G. B. Sowerby I, 1834)

Nomenclature:

Pholas subtruncata G.B. Sowerby I, 1834

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 10 m. Station code: D3(10).

Family Mytilidae

Aulacomya atra (Molina, 1782)

Nomenclature:

Mytilus ater Molina, 1782

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5 m. Station code: D2(5).

Brachidontes granulatus (Hanley, 1843)

Nomenclature:

Mytilus granulatus Hanley, 1843

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-5 m. Station code: D1(0, 5); D2(0); D3(0).

***Perumytilus purpuratus* (Lamarck, 1819)**

Nomenclature:

Modiola purpurata Lamarck, 1819

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5); D2(0); D3(0, 5, 10); D4(0, 5); D5(0).

***Semimytilus algosus* (Gould, 1850)**

Nomenclature:

Mytilus algosus Gould, 1850

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-15 m. Station code: BT1N(10, 12, 15); BT1S(8, 10, 12, 15); BT2N(8, 10, 12, 15); BT2S(10, 12, 15); BT3N(10); BT3S(0, 8, 10); BT4N(8, 15); D1(0, 5, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 5, 10); D5(0).

Family Donacidae

***Donax obesulus* Reeve, 1854**

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8 m. Station code: BT1N(8); BT1S(8); BT2N(8); BT2S(8); BT3S(8).

Family Lasaeidae

***Lasaea petitiiana* (Récluz, 1843)**

Nomenclature:

Poronia petitiiana Récluz, 1843

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 5-10 m. Station code: BT1N(10); BT2N(15); D2(10); D3(5, 10).

Family Mactridae

***Mactrotoma velata* (Philippi, 1849)**

Nomenclature:

Mactra velata Philippi, 1849

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 10 m. Station code: BT3S(10).

***Mulinia edulis* (King, 1832)**

Nomenclature:

Mactra edulis King, 1832

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8-15 m. Station code: BT1N(10, 12, 15); BT1S(8, 10, 12, 15); BT2N(8, 10, 12, 15); BT2S(8, 10, 12, 15); BT3N (10, 12, 15); BT3S (8, 10, 15); BT4N(8, 10, 15).

Family Veneridae

***Petricola olssoni* Bernard, 1983**

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 0-15 m. Station code: BT1N(10, 12); BT1S(8); BT3N(15); BT3S(8, 15); D1(0, 5,10); D2(5, 10); D3(0, 5, 10); D4(0, 5).

Family Fissurellidae

***Fissurella crassa* Lamarck, 1822**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-5 m. Station code: D1(0); D2(0); D3(0); D4(0, 5).

***Fissurella latimarginata* Sowerby, 1835**

Notes: Material examined: Fig. 2. Conical shell and sharpened in the front end, medium-sized apical foramen oval, the external surface is ornamented with thin and little spaced radial striae in a dark purple background. The shell is white from the inside, with thick, uniform and purple border. The sides of the foot and mantle are of an intense black colour, with yellow prolongations in the border of the mantle. Its tentacles are deep yellow. Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5); D2(0, 10).

***Fissurella limbata* Sowerby, 1835**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5); D2(0, 5); D3(0, 5, 10); D4(0) ; D5(0).

***Fissurella maxima* Sowerby, 1834**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D2(0, 5); D3(0, 10); D4(0).

***Fissurella peruviana* Lamarck, 1822**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0); D2(0, 10); D3(0) D4(0).

Family Lottiidae

***Lottia orbigny* (Dall, 1909)**

Nomenclature:

Acmaea orbigny Dall, 1909

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D1(0); D4(0).

***Scurria ceciliana* (Orbigny, 1841)**

Nomenclature:

Patella ceciliana Orbigny, 1841

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D4(0).

***Scurria variabilis* (Sowerby, 1839)**

Nomenclature:

Lottia variabilis Sowerby, 1839

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D1(0); D4(0).

***Scurria viridula* (Lamarck, 1822)**

Nomenclature:

Patella viridula Lamarck, 1819

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D4(0).

Family Siphonariidae

***Siphonaria lessonii* Blainville, 1827**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D4(0).

Family Tegulidae

***Tegula atra* (Lesson, 1830)**

Nomenclature:

Trochus ater Lesson, 1830

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(0, 5, 10); D4(0, 5); D5(0, 5).

***Tegula euryomphala* (Jonas, 1844)**

Nomenclature:

Trochus euryomphalus Jonas, 1844

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5 m. Station code: D1(5); D2(5).

***Tegula luctuosa* (Orbigny, 1841)**

Nomenclature:

Trochus luctuosus Orbigny, 1841

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5-10 m. Station code: D1(5, 10); D2(5).

***Tegula tridentata* (Potiez & Michaud, 1838)**

Nomenclature:

Monodonta tridentata Potiez & Michaud, 1838

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-5 m. Station code: D1(0); D2(5).

Family Turbinidae

***Prisogaster niger* (W. Wood, 1828)**

Nomenclature:

Turbo niger W. Wood, 1828

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5); D2(0, 5, 10); D3(5); D4(5); D5(0, 5).

Family Caecidae

***Caecum chilense* Stuardo, 1962**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5 m. Station code: D4(5).

Family Calyptraeidae

***Crepidatella dilatata* (Lamarck, 1822)**

Nomenclature:

Crepidula dilatata Lamarck, 1822

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(0, 5, 10); D3(0, 5, 10); D4(0, 5, 10); D5(0).

***Trochita trochiformis* (Born, 1778)**

Nomenclature:

Turbo trochiformis Born, 1778

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 10 m. Station code: D1(10).

Family Littorinidae

***Echinolittorina peruviana* (Lamarck, 1822)**

Nomenclature:

Phasianella peruviana Lamarck, 1822

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D5(0).

Family Naticidae

Neverita didyma (Röding, 1798)

Nomenclature:

Albula didyma Röding, 1798

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8-15 m. Station code: BT1N(10, 12, 15); BT1S(8, 10, 12, 15); BT2N(8, 12,15); BT2S(8, 10 12, 15); BT3N(15); BT3S(8, 10, 15); BT4N(10, 15).

Sinum cymba (Menke, 1828)

Nomenclature:

Natica cymba Menke, 1828

Notes: Types of substrate: soft bottom. Depth / bathymetric range: 8-12 m. Station code: BT1S(8, 10, 12); BT3S(8).

Family Columbelloidea

Alia unifasciata (G. B. Sowerby I, 1832)

Nomenclature:

Columbella unifasciata G. B. Sowerby I, 1832

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5 m. Station code: D1(5).

Family Muricidae

Concholepas concholepas (Bruguière, 1789)

Nomenclature:

Buccinum concholepas Bruguière, 1789

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-5 m. Station code: D1(0, 5); D2(0,5).

Crassilabrum crassilabrum (Sowerby, 1834)

Nomenclature:

Murex crassilabrum Sowerby, 1834

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5-10 m. Station code: D1(5); D2(10).

***Stramonita haemastoma* (Linnaeus, 1767)**

Nomenclature:

Buccinum haemastoma Linnaeus, 1767

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(5, 10); D3(5, 10); D4(0); D5(0).

***Thaisella chocolata* (Duclos, 1832)**

Nomenclature:

Purpura chocolata Duclos, 1832

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0); D2(5, 10); D3(0, 5, 10).

***Xanthochorus buxeus* (Broderip, 1833)**

Nomenclature:

Murex buxeus Broderip in Broderip & Sowerby, 1833

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5-10 m. Station code: D1(5, 10).

Family Nassaridae

***Nassarius dentifer* (Powys, 1835)**

Nomenclature:

Nassa dentifera Powys, 1835

Notes: Types of substrate: hard and soft bottoms. Depth / bathymetric range: 8-12 m. Station code: BT1S(10); BT2N(10), BT2S(8, 10, 12); D2(10).

Family Goniadorididae

***Okenia luna* Millen, Schrödl, Vargas & Indacochea, 1994**

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 10 m. Station code: D2(10).

Family Dotidae

Doto uva Marcus, 1955

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D2(5); D3(0, 5, 10).

Family Chaetopleuridae

Chaetopleura hennahi (Gray, 1828)

Nomenclature:

Chiton hennahi Gray, 1828

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 5 m. Station code: D4(5).

Family Chitonidae

Acanthopleura echinata (Barnes, 1824)

Nomenclature:

Chiton echinatus Barnes, 1824

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0 m. Station code: D2(0).

Chiton cumingsii Frembly, 1827

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0, 5, 10); D2(0, 5, 10); D3(0, 10); D4(0).

Chiton granosus Frembly, 1827

Notes: Types of substrate: hard bottom. Depth / bathymetric range: 0-10 m. Station code: D1(0); D2(0, 10); D3(0, 10); D4(0).

Analysis

We recorded 162 species and subspecies of marine macroinvertebrates in the submerged soft and artificial hard substrates around the PERU LNG marine terminal and surrounding area between June 2011 and June 2015 (Suppl. material 2). In soft-substrate sampling sites, we recorded 71 species. For these sites, the accumulation curve appeared asymptotic (Suppl. material 3) and the richness estimator Chao2 estimated that 89.9% of expected species were detected in our sampling (Chao2=78.892, 89.99%). In hard-substrate sampling sites, we recorded 131 species during the five years of surveys. The accumulation curve appeared nearly asymptotic (Suppl. material 4) and the richness estimator indicated that 89.7% of expected species were detected by our sampling effort (Chao2=145.933, 89.76%).

The Polychaeta was the group with the highest number of species (61 spp.), followed by Crustacea and Mollusca with 47 and 45 species, respectively. Less numerous in species, but present in the study area, were the phyla Brachiopoda, Bryozoa, Cnidaria and Echinodermata (one to five species). The photographs for some of the species listed in this study are presented in Fig. 2.

Discussion

This study reports the diversity of macrobenthonic species associated with the coastal soft and hard bottom habitats around PERU LNG marine terminal in central Peru. In general, species richness and taxonomic composition observed in our study area are similar to other upwelling areas, north of the terminal, like Ancon Bay (Tarazona et al. 1988, Tarazona 1990) and Chancay (L. Quipúzcoa, pers. comm.) in Peru and south of the terminal, like Independence Bay in Peru (Tarazona et al. 1996) and Coloso Bay (Carrasco 1997) and Mejillones Bay (Laudien et al. 2007) on the coast of Chile. We observed, however, a slight increase in richness in the sampling sites immediately adjacent to the marine terminal, compared to the rest of the sampling sites. This was due to the presence of infrastructure. In general, large coastal marine infrastructure like docks, piers and breakwaters, have an important role in attracting benthic fauna, just like artificial reefs do (Lincoln-Smith et al. 1994). The three-dimensionality of the structures creates different types of microhabitats likely to be colonised by species with different habitat preferences. Similar to what other studies have observed for coastal macroinvertebrate communities, species richness decreased with depth (Tarazona et al. 1996, Tarazona 1990).

We highlight the report of a new Polychaeta species, *Myrianida paredesi*, described from specimens obtained from biofouling from main pier piles at PERU LNG marine terminal (Aguirre et al. 2015). Areas with regular maritime traffic, as is the case for our study area, are likely to be colonised by non-native biofouling species given the spatial range of microhabitats that offer these artificial structures. In this study, we have been able to

report eight species considered as non-native (*Caprella scaura*, *Elasmopus rapax*, *Monocorophium insidiosum*, *Monocorophium acherusicum*, *Polydora websteri*, *Ancinus brasiliensis*, *Hepatus lineatus*, *Bugula neritina*). The most likely vector of introduction may be the maritime traffic occurring along the coast of Peru.

We detected species in our study area (but not listed here) that were challenging to identify because their presence was limited to individuals at early developmental stages (i.e. juveniles), they were present in low numbers or because of taxonomic complexity. These putative species include *Abarenicola affinis chilensis*, *Capitella capitata*, *Cirratulus megalus*, *Dodecaceria opulens*, *Eunice pelamidis*, *Hemipodia simplex*, *Kinbergonuphis microcephala*, *K. multidentata*, *Lumbrineris annulata*, *Magelona phyllisae*, *Paleanotus chrysolepis*, *Phymactis clematis*, *Pisione oerstedii*, *Polydora pygidialis*, *Scoletoma tetraura*, *Syllis gracilis*, *Thoracophelia mucronata* and *Spiophanes norrisi*. We recommend an increased sampling effort as well as an extensive review to confirm their presence in the area. Further, the application of molecular tools (i.e. barcode sequencing) could be integrated into the analyses to help improving biodiversity assessments (e.g. Rosas et al. 2018) and for resolving taxonomic conflicts (e.g. Hebert and Gregory 2005). Molecular tools offer additional benefits like the effective detection of non-indigenous species (e.g. Zaiko et al. 2015) and improving assessment of the health of marine ecosystems (Sigamani et al. 2016). Considering the high complexity, variability and productivity of the Peruvian coastal upwelling system, this study helps to increase the understanding of the local marine biodiversity and serves as a baseline for monitoring of the spatial and temporal changes in the diversity and composition of coastal macrobenthic communities.

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Author contributions

VT designed the experiment, MEH, CA and XVZ performed the analyses and prepared the figures, RC collected the data, RC and LA conducted the taxonomic analyses, XVZ

prepared the datasets in DwC format and VT and XVZ wrote, edited and prepared the manuscript for submission.

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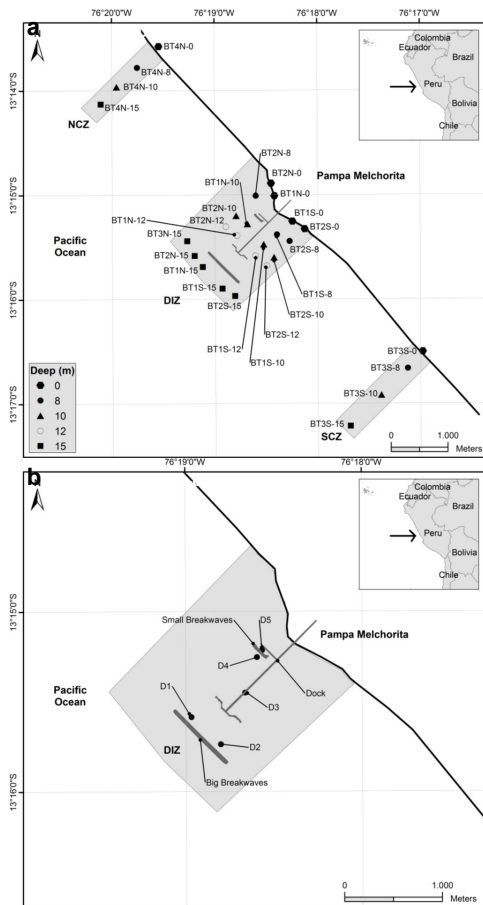


Figure 1.

Study area around the PERU LNG marine terminal including location of sampling sites. Sites are identified by a unique code followed by depth at which that site is located. Grey-shaded area at the centre is the area of direct influence of the marine terminal while grey-shaded areas at the north and south of the terminal are control sampling sites.

- a: Soft bottom sites.
- b: Hard bottom sites.

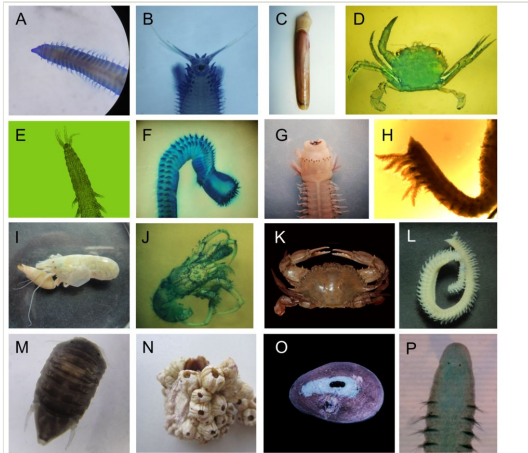


Figure 2.

Species of invertebrates from central coast of Peru in the influence area of PERU LNG marine terminal. A. *Cossura chilensis*, B. *Diopatra chiliensis*, C. *Ensis macha*, D. *Cronius ruber*, E. *Goniadides falcigera*, F. *Nephtys impressa*, G. *Pseudonereis gallapagensis*, H. *Paraprionospio pinnata*, I. *Synalpheus spinifrons*, J. *Pagurus villosus*, K. *Arenaeus mexicanus*, L. *Scolelepis chilensis*, M. *Ancinus panamensis*, N. *Balanus laevis*, O. *Fissurella latimarginata*, P. *Protoariciella uncinata*.

Supplementary materials

Suppl. material 1: Table 1. Sampling sites at central coast of Peru and influence area of PERU LNG marine terminal, including depth(s), type of substrate and geographic decimal coordinates.

Authors: V. Tasso, M. El Haddad, C. Assadi, R. Canales, L. Aguirre, X. Velez-Zuazo

Data type: Formatted text

Brief description: Word table with geographic information of sampling sites

Filename: Supplementary Material 1.docx - [Download file](#) (19.07 kb)

Suppl. material 2: Macrobenthos species occurrence list

Authors: Tasso V, El Haddad M, Assadi C, Canales R, Aguirre L, Velez-Zuazo X

Data type: Darwin Core Archive (.zip) of occurrence data and associated metadata

Brief description: Resource link: http://ipt.pensoft.net/resource?r=macrobenthos_bmapperu&v=1.2

Filename: dwca-macrobenthos_bmapperu-v1.0.zip - [Download file](#) (16.51 kb)

Suppl. material 3: Species accumulation curve using rarefaction method for macrobenthos reported at soft-bottom sampling sites. Light blue shaded area indicates 95% confidence interval.

Authors: Tasso V, El Haddad M, Assadi C, Canales R, Aguirre L, Velez-Zuazo X

Data type: image

Filename: SppAccumCurve_SoftSubst_Benthos.jpeg - [Download file](#) (31.41 kb)

Suppl. material 4: Species accumulation curve using rarefaction method for macrobenthos reported at hard-bottom sampling sites. Light blue shaded area indicates 95% confidence interval.

Authors: Tasso V, El Haddad M, Assadi C, Canales R, Aguirre L, Velez-Zuazo X

Data type: image

Filename: SppAccumCurve_HardSubst_Benthos.jpeg - [Download file](#) (30.20 kb)