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Research Article

Oceanographic mechanisms that possibly explain dominance of neritic-tropical zooplankton species assemblages around the Islas Marías Archipelago, Mexico

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ABSTRACT. The nearshore zooplankton species assemblage, identified per taxonomic groups (20) and per species for 12 selected groups, was analyzed from samples collected during November 2010 at four volcanic islands of the Islas Marías Archipelago (IMA), located 90-120 km offshore Nayarit, Mexico. From chlorophyll-*a* concentration and zooplankton biovolume perspective mesotrophic conditions prevailed in comparison with the Gulf of California during November. Crustaceans numerically dominated the zooplankton assemblage (92.3%) [Copepoda (79.2%), Decapoda larvae (4.7%), Cladocera (3.7%), Mysidacea (2.7%), and Euphausiacea (2.0%)]. The other 15 taxonomic groups (7.7% combined) accounted each one less than 1.5% of the relative abundance. Species richness of selected taxa (~56%) included 259 taxa (121 identified to species, 117 to genus, and 21 not identified). Tropical species from neritic affinity clearly dominated zooplankton assemblage around IMA. Five tropical Copepoda species [*Calanopia minor* (Dana), *Clausocalanus jobei* Frost & Fleminger, *Acrocalanus gibber* Giesbrecht, *Canthocalanus pauper* (Giesbrecht), and *Centropages furcatus* (Dana)], a cladoceran *Pseudevadne tergestina* (Claus), and a Mysidacea species (*Mysidium reckettsi* Harrison & Bowman) dominated the zooplankton assemblage (accounting about 55% of total abundance of the identified species). Except *C. furcatus*, all these species are not abundant at oceanic regions of the central and northern Gulf of California. The similarity of multiple neritic and tropical species in the zooplankton assemblage from IMA and Cape Corrientes suggests strong coastal-insular plankton connectivity. Episodic current plumes associated with anomalous intense rivers discharge during rainy years, eddies generated by coastal upwelling event that move offshore, and northward regional oceanic circulation are the most likely mesoscale oceanographic processes that cause costal tropical zooplankton drift enhancing coastal-Archipelago species connectivity in this region.

Keywords: zooplankton, assemblage, zooplankton biovolume, neritic, tropical, Islas Marías Archipelago, Mexico.

Procesos oceanográficos que posiblemente explican la dominancia de asociaciones de especies de zooplancton nerítico tropical alrededor del archipiélago de Islas Marías, México

RESUMEN. Se estudió la estructura comunitaria de zooplancton de 20 grupos taxonómicos (12 de los cuales fueron identificados a nivel de especie) recolectados en el archipiélago de Islas Marías (IMA), ubicado a 90-120 km de la costa de Nayarit, México, durante noviembre 2010. Desde la perspectiva de la concentración de clorofila-*a* y el biovolumen de zooplancton prevalecen condiciones mesotróficas en comparación con el resto del golfo de California durante noviembre. El zooplancton fue numéricamente dominado por crustáceos (92,3%) [Copepoda (79,2%), larvas de Decapoda (4,7%), Cladocera (3,7%), Mysidacea (2,7%) y Euphausiacea (2,0%)].

Los otros 15 grupos taxonómicos (7,7% combinados) representaron cada uno menos del 1,5% de la abundancia relativa. La riqueza de especies de los taxa seleccionados (~56%) incluyó 259 taxones (121 identificados a nivel de especie, 117 a nivel de género y 21 no identificados). Las especies tropicales de afinidad nerítica claramente dominaron la estructura de la comunidad de zooplancton. Cinco especies de copépodos tropicales [*Calanopia minor* (Dana), *Clausocalanus jobei* Frost y Fleminger, *Acrocalanus gibber* Giesbrecht, *Canthocalanus pauper* (Giesbrecht) y *Centropages furcatus* (Dana)], un cladócero *Pseudevadne tergestina* (Claus), y una especie de Mysidacea (*Mysidium reckettsi* Harrison & Bowman) dominaron en abundancia la asociación del zooplancton insular (55% del total de las especies identificadas). A excepción de *C. furcatus*, todas éstas especies no son particularmente abundantes en las regiones oceánicas del centro y norte del Golfo de California. La presencia de múltiples especies neríticas de zooplancton de afinidad tropical entre las asociaciones de zooplancton de IMA y la costa del Cabo Corrientes sugiere una intensa conectividad de plancton entre los ambientes costero e insular. Los procesos oceanográficos de mesoescala más probables que favorecen esta conectividad son las episódicas plumas asociadas con anomalías de intensa descarga de los ríos durante los años lluviosos, los remolinos generados por surgencia costera que se mueven hacia aguas oceánicas y la circulación hacia los polos de esta región.

Palabras clave: zooplancton, asociación, biovolumen zooplanctónico, nerítico, tropical, archipiélago Islas Marías, México.

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INTRODUCTION

Offshore zooplankton assemblages from the mouth of the Gulf of California and coastal Cape Corrientes region have been studied focused only on specific taxonomic groups, such as Copepoda (Chen, 1986; Jiménez-Pérez & Lara-Lara, 1988; Hernández-Trujillo & Esquivel-Herrera, 1989; Gómez-Gutiérrez & Hernández-Trujillo, 1994; López-Ibarra, 2008; Palomares-García *et al*., 2013), Euphausiacea (krill) (Mundhenke, 1969; Brinton, 1979; Brinton & Townsend, 1980; Gómez-Gutiérrez & Hernández-Trujillo, 1994; Färber-Lorda *et al*., 2010; Ambríz-Arreola *et al*., 2012), Amphipoda (Siegel-Causey, 1982; Gasca & Franco-Gordo, 2008; Gasca *et al*., 2012), Mysidacea (Harrison & Bowman, 1987; Price, 2004), Decapoda larvae (Naranjo *et al*., 2006), Chaetognatha (Alvariño, 1963, 1969; Ruiz-Boijseauneau *et al*., 2004), and ichthyoplankton (fish larvae) (Franco-Gordo *et al*., 1999, 2002, 2004; Aceves-Medina *et al*., 2003, 2004; Siordia-Cermeño *et al*., 2006; Silva-Segundo *et al*., 2008; Vilchis *et al*., 2009; León-Chávez *et al*., 2010, Avendaño-Ibarra *et al*., 2013, 2014). The rest of the zooplankton taxonomic groups are generally little known for Mexican waters (Brinton *et al*., 1986). Most recent efforts to understand the zooplankton assemblages have only identified relative abundance of broad zooplankton taxonomic groups or few selected species in the central and southern Gulf of California region (Siordia-Cermeño & Sánchez-Velasco, 2004, 2006; Vicencio-Aguilar & Fernández-Alamo, 2005). Fernández-Álamo & Färber-Lorda (2006) published the so far most comprehensive review about zooplankton biovolume, zoogeography, ecology, and species composition from the offshore Tropical Eastern Pacific zoogeographic region (TEP); they made emphasis on the lack of zooplankton information from tropical Mexican islands. The zooplankton assemblage represents a prominent food source for many benthic and demersal planktophagous predators that inhabit along the coastal habitats of Islas Marías Archipelago (IMA), including rocky and coral reefs, rhodolith beds, rocky pinnacles, and soft-bottom embayments (Erisman *et al*., 2011). Embryonic and larval stages of numerous invertebrates and bony fish assemblages disperse and inhabit as merozooplankton and thychoplankton around the IMA.

The Islas Marías Archipelago includes four volcanic islands (María Magdalena, María Cleofas, Isla Madre, and San Juanito) located near the slope of the continental shelf, about 90-120 km offshore the coast of Nayarit state, Mexico. The Equatorial waters and water properties from the Gulf of California influence the insular waters from this Archipelago. The oceanic circulation around the islands is associated to episodic current plumes from the continental margin (Martínez-Flores *et al*., 2011), large cyclonic and anticyclonic eddies from Cabo Corrientes region (Kurczyn *et al*., 2012; Pantoja *et al*., 2012), bottom topography (Kurian *et al*., 2011), local wind-forcing (Pares-Sierra *et al*., 1993), coastal trapped waves of equatorial origin (Zamudio *et al*., 2001, 2007) and oceanic currents (Lavín *et al*., 2006). These processes also modify local production and may influence retention and transport of zooplankton in the TEP region (Färber-Lorda *et al*., 2004, 2010; Fernández-Álamo & Färber-Lorda, 2006;

León-Chávez *et al*., 2010). Because the IMA lies near the intersection of the Cortez and the Panamic biogeographic provinces (Robertson & Cramer, 2009; Erisman *et al*., 2011) featured with mesotrophic conditions throughout the year (<0.7 mg Chl-*a* m^{-3} and low zooplankton biovolume <100 mL 1000 m^{-3}) (Fernández-Álamo & Färber-Lorda, 2006; López-Sandoval *et al*., 2009), it is expected that tropical zoogeographic affinity dominate these islands, but its oceanic or neritic origins still remains unknown.

The present study includes two objectives: 1) to describe, for the first time, the IMA near-shore zooplankton assemblage as identified per taxonomic groups and per species for 12 selected groups for which their taxonomy is relatively well known for the TEP [Copepoda, Decapoda, Cladocera, Decapoda, Euphausiacea, Mysidacea, Amphipoda, Siphonophora, Chaetognatha, Pteropoda, Appendicularia, Cephalopoda, and Pisces (fish larvae)] and 2) to compare zooplankton species structure from IMA with offshore waters of the Gulf of California mouth and the continental coast of Cape Corrientes zooplankton species, to infer if the zooplankton of the island is numerically dominated by oceanic or neritic affinity species, and also to speculate about the potential connectivity processes that maintains benthic and neritic fauna in the Archipelago. Thus, we did the characterization of the most abundant species and community structure outlining a baseline for further use as inventory of zooplankton fauna from the Islas Marías Archipelago. This is relevant because in 2000 the Islas Marías Archipelago was declared a Biosphere Reserve and in 2007 the UNESCO included it as a Natural World Heritage Serial Site (Erisman *et al*., 2011); thus a zooplankton checklist, zooplankton biovolume, and understanding how the zooplankton assemblages are structured, may be useful for conservation and management purposes for this archipelago.

MATERIALS AND METHODS

During a cruise for censing the communities of reef fish and benthic invertebrates of IMA, carried out in November 2010 (Erisman *et al*., 2011), we collected zooplankton samples to investigate the zooplankton species composition from the four volcanic islands. Performing biological studies in the IMA is difficult because it requires government permission given the restricted access and no commercial fishery in the region due to the presence of a Federal Prison colony in Isla Madre (established since 1905). Thus, this study represents an outstanding opportunity to explore zooplankton diversity around the Islas Marías Archipelago.

Satellite sea surface temperature and chlorophyll-*a* concentration

Satellite 7-days sea surface temperature composite obtained from MODIS-Terra (Moderate Resolution Imaging Spectral-Radiometer), with a 9 km spatial resolution (http://oceandata.sci.gsfc.nasa.gov/MODISA/Mapped/) and satellite 7-days composite sea surface chlorophyll-*a* concentration (mg m^{-3}) images from SeaWiFS with 4 km resolution maps (http://oceancolor.gsfc.nasa.gob/SeaWiFS) were used to create SST and Chl-*a* distribution maps around IMA region (13-19 November, 2010).

Zooplankton sampling

As part of a diving census survey and collections of coastal benthic, demersal, and pelagic fishes (Erisman *et al*., 2011), and benthic invertebrate community structure (mainly Octocorallia, Echinodermata, Mollusca and Crustacea: mostly Decapoda and Stomatopoda) (Sánchez-Ortíz *et al*., unpublished data), the zooplankton community structure of 11 sampling sites was studied at at Islas Marías Archipelago, during November 13-21, 2010 (Fig. 1). Near sea surface zooplankton samples (<2 m depth) were collected in rocky reefs, rhodolith beds, and sandy bottom habitats, with seafloor depth ranging typically between 15-30 m. Near-surface epipelagic zooplankton was collected with a conical zooplankton net (0.6 m ring diameter; 333 µm mesh net) fitted with a General Oceanic digital flow meter to estimate water volume filtered by the net (Smith & Richardson, 1977). The cruise was done with the touristic vessel Rocío del Mar and the net was towed with a Zodiac boat, following a wide semicircular trajectory during 10 min. The location of the zooplankton samples was determined with a GPS. Zooplankton samples were preserved with 96% ethanol with a complete ethanol replacement after 24 h of preservation. Zooplankton biovolume was determined using the volume displacement method (Smith & Richardson, 1977). For comparative purposes, the zooplankton biovolume collected at IMA during November 2010 was compared with near surface zooplankton tows collected on board the R/V El Puma (UNAM) with the collection method using 333 and 500 µm mesh net during 2005 (November 19-26), and 2007 (January 13-27; July 20 through August 2) at the central and northern Gulf of California regions (26-30ºN) (Tremblay *et al*., 2010) (Table 1).

Sample analysis

Fish eggs and larvae (ichthyoplankton) was sorted out, counted and analyzed from the entire zooplankton sample. The rest of the zooplankton taxonomic groups

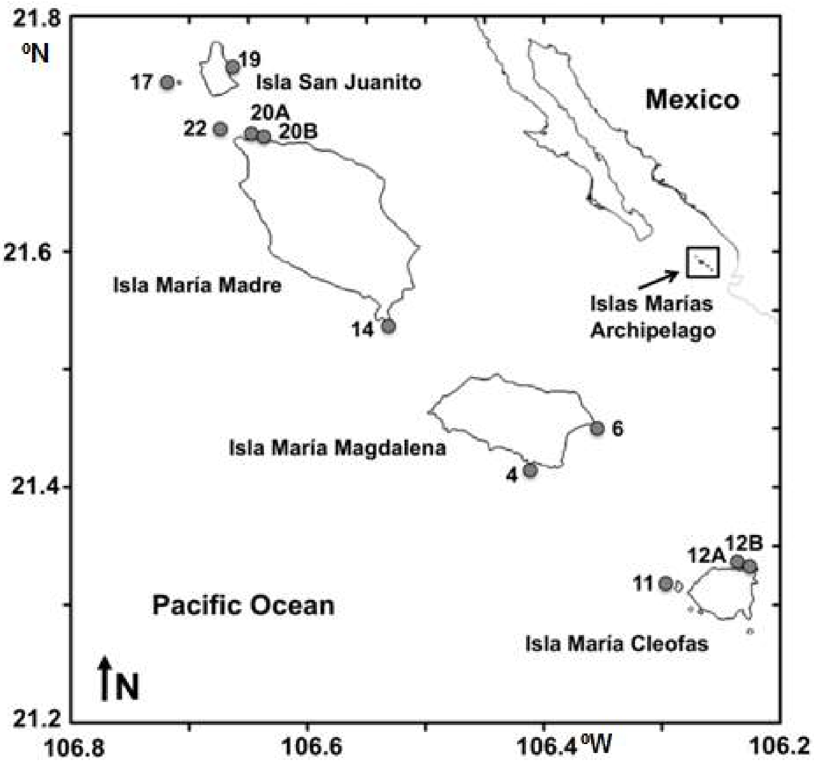

Figure 1. Surface zooplankton sampling stations collected during November 2010 at Islas Marías Archipelago in the Mexican Tropical Pacific, Mexico.

Table 1. Comparison of zooplankton biovolume (mL 1000 m^{-3}) collected with surface horizontal tows at Islas Marías Archipelago (IMA) during November 2010 and samples collected in the central and northern part of the Gulf of California during November 2005, January and July-August 2007.

Regions	IMA	Central and northern part of the Gulf of California (26-30ºN)				
Dates	14-23 Nov 2010	19-26 Nov 2005	13-27 Jan 2007		20 Jul - 02 Aug 2007	
Mesh net	333 µm	333 µm	333 µm	505 µm	333 µm	505 µm
Sample size (n)	11	23	29	27	21	24
Average	62.9	138.4	1095.2	377.4	368.0	176.5
Minimum	28.0	6.3	52.6	35.8	28.3	22.9
Maximum	159.4	522.8	3903.1	1108.3	1454.9	671.4
Standard deviation	36.9	142.0	1107.1	344.8	365.8	177.4
Standard error	11.7	29.6	205.6	66.3	79.8	36.2
Gulf of California/IMA biovolume ratio		2.2	17.4	5.9	5.8	2.7

were sorted, identified, and counted from 10 mL aliquots obtained with a calibrated Hensen Stempel pippette from a standard 240 mL bottle. We first identified all the zooplankton per large taxonomic groups (typically Order), and later several taxonomic experts helped us to identify species for the 12 selected zooplankton groups: Copepoda, Cladocera, Decapoda, Euphausiacea, Amphipoda, Mysidacea, Siphonophora, Chaetognatha, Pteropoda, Appendicularia, Cephalopoda, and Pisces (fish larvae). A second 10 mL aliquot was analyzed to count zooplankton per taxonomic groups. The abundance of organisms detected in the second aliquot, not observed in the first 10 mL, was standardized to a total 20 mL aliquot size sample. The abundance of each taxonomic zooplankton group and each species identified was standardized to number of individuals per 1000 m^{-3} using standard methods (Smith & Richardson, 1977).

Twelve zooplankton taxonomic groups were identified at the species level using as principal sources, but not exclusively, standard taxonomic keys for Copepoda (Palomares-García *et al*., 1998; Razouls *et al*., 2005-2012, http://copepodes.obs-banyuls.fr/en/), Euphausiacea (Baker *et al*., 1990; Brinton *et al*., 2000), Mysidacea (Tattersall, 1951; Ii, 1964; Mauchline, 1980; Harrison & Bowman, 1987; Deprez *et al*., 2005; NeMys webpage http://nemys.ugent.be/; Murano & Fukuoka, 2008), Decapoda (Williamson, 1957a, 1957b, 1960, 1962, 1967, 1983; MacDonald *et al*., 1957; Pike & Williamson, 1972; Fichman & Williamson, 1978; Albornoz & Wertmann, 1997; Anosov, 2000; Dos Santos & Lindley, 2001; Puls, 2001; Dos Santos & González-Gordillo, 2004), Chaetognatha (Alvariño, 1963, 1967; Casanova, 1999), Pteropoda (Seapy, 1990; Spoel, 1996; Spoel *et al*., 1997; Angulo-Campillo, 2009), Hyperiid amphipods (Vinogradov *et al*., 1996; Zeidler, 2006), and ichthyoplankton (Brogan, 1992; Moser, 1996; Beltran-León & Rios-Herrera, 2000). A relative large proportion of specimens, particularly fish and decapod larvae, were not identified to species, because their larvae have not been described yet.

Abundance per taxonomic group, and abundance per species was $\log_{10}$ (x+1) transformed to decrease abundance variability for statistical analysis (McCune *et al*., 2002). To detect spatial community structure similarities among zooplankton samples per sampling station and presence/absence of each species, a Hierarchical two-way Cluster Analysis was done using the Bray Curtis link method and Flexible Beta distance (selected value -0.250) (using a matrix coding of relative abundance per species) calculated with the PC-ORD software (version 6.0; http://home.centurytel.net/~mjm/pcordwin.htm) (McCune *et al*., 2002).

RESULTS

Satellite sea surface temperature and chlorophyll-*a* concentration

During November 2010, sea surface temperature (SST) was relatively warm (25-26.6ºC) and showed a clear longitudinal gradient with the highest SST along the Southwest coast of the Islas Marías Archipelago (IMA) and the lowest at the Northeast area of María Madre Island (Fig. 2a). Sea surface chlorophyll-*a* (Chl-*a*) concen-tration was considerably low (<0.42 mg m^{-3}) at all the study area; showing the relatively the lowest concentration offshore along the western coast of the IMA and high values along the eastern coast of the archipelago (Fig. 2b). These relatively high SST and low Chl-*a* concentrations represent mesotrophic conditions.

Zooplankton biovolume

Near surface zooplankton biovolume (ZB) was <159 mL 1000 m^{-3} with relatively small spatial variability (Mean = 63 mL 1000 m^{-3}; standard error = 12 mL 1000 m^{-3}, map not showed) during November 2010 in the Islas Marías Archipelago. IMA near surface zooplankton biovolume ranged between 2.2 and 17.4 times lower than those collected in the central and northern regions of the Gulf of California during November 2005 and January and July 2007 (Table 1). These comparisons, indicate that the near-shore habitat of the IMA could be considered as a mesotrophic coastal habitat during the sampled period.

Zooplankton identified per taxonomic groups

Zooplankton assemblage in the near-shore habitat of IMA included 13 holoplanktonic and 7 meroplanktonic taxonomic groups. Crustaceans, numerically dominated total zooplankton abundance (92.3%) (Fig. 3a, Table 2). Copepoda alone accounted for 79.2% of the total zooplankton abundance. Other crustacean groups recorded with high relative abundance were Decapoda (4.7%), Cladocera (3.7%), Mysidacea (2.7%), and Euphausiacea (2.0%). Fish eggs accounted for 1.5% of total abundance, indicating the relevance of the near-shore habitat for fish reproduction during November. Appendicularia (Order Copelata) and Chaetognatha, each one had 1.4% of total relative abundance. The rest of the 12 taxonomic groups accounted individually <0.6%, accumulating only 3.4% of the total abundance (Fig. 3a, Table 2).

Zooplankton identified per species

From 12 selected taxonomic groups a total of 259 taxa were identified in the near-shore zooplankton assemblage. Fish larvae showed the highest taxa number (107 taxa ranging from family to species) decreasing with Decapoda (56), Copepoda (35), Thecosomata (17), Amphipoda (15), Siphonophora (10), Chaetognatha (7), Euphausiacea (6), Cladocera (2), Mysidacea (2), Appendicularia (1), and Cephalopoda (1) (Table 3). Copepoda, Euphausiacea, Amphipoda, and Cladocera are relatively well-known species in the central Mexican Pacific region. The tropical Copepoda *Calanopia minor* A. Scott, *Clausocalanus jobei* Frost & Fleminger, *Acrocalanus gibber* Giesbrecht, *Canthocalanus pauper* (Giesbrecht), and *Centropages furcatus* (Dana) had abundances between 7.5 and 10.1%, all them accounting for 36% of the identified species total abundance (Fig. 3b, Table 3). None of them are numerically dominant in the central and northern Gulf of California or in offshore waters from the TEP regions. The tropical copepods *Centropages furcatus* (Dana) (5.2%) and *Oncea venusta* Phillippi (4%) also are relatively abundant in the central and north of the Gulf of California during summer.

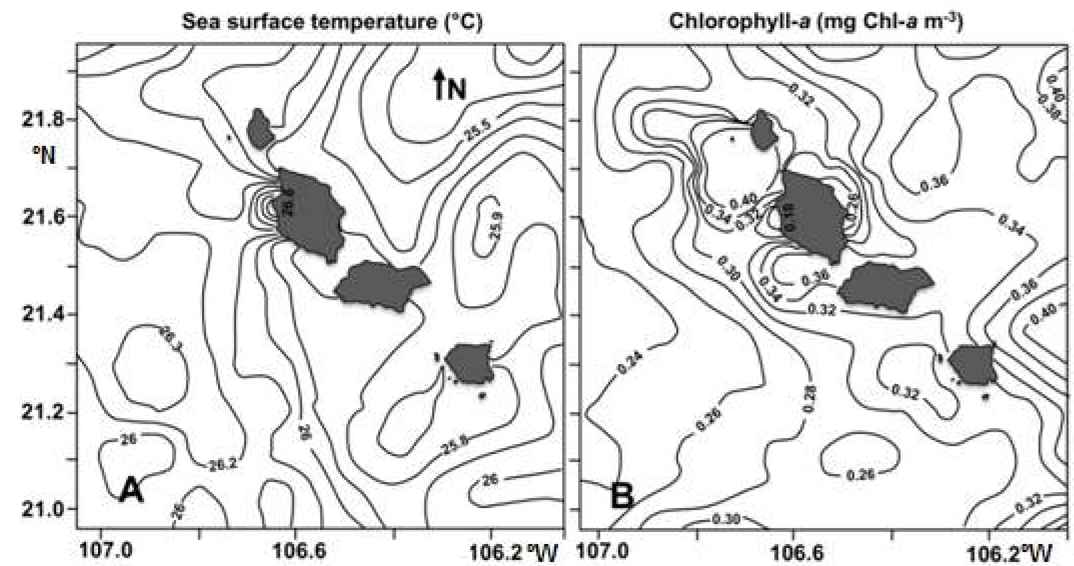

Figure 2. Satellite a) sea surface temperature (°C) MODIS and b) chlorophyll-*a* concentration SeaWIFS (mg Chl-*a* m^{-3}) recorded during November 2010 at the Islas Marías Archipelago.

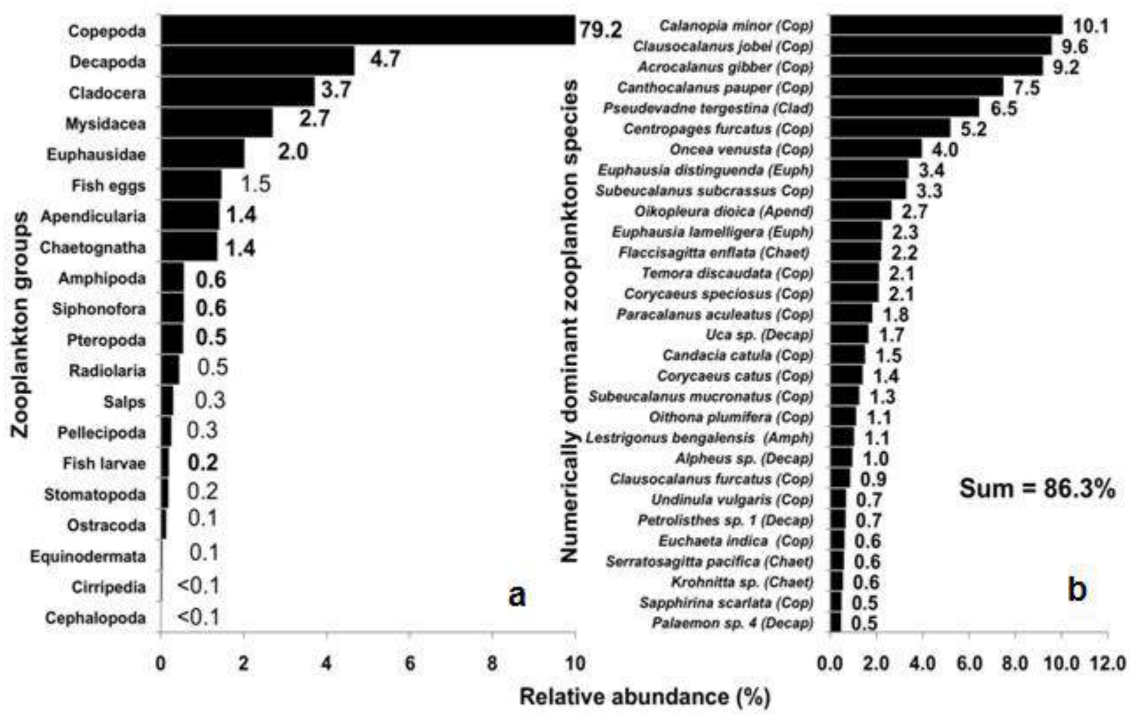

Figure 3. Relative abundance of near-shore zooplankton identified per a) zooplankton groups and b) selected numerically dominant zooplankton species that could be the most trophically relevant zooplankton species from the Islas Marías Archipelago recorded during November 2010.

The Cladocera, *Pseudevadne tergestina* (Claus) was also abundant (6.5%). Euphausiacea, mostly as larvae and juvenile phases, were relatively scarce in the IMA near-shore habitat, The TEP endemic species: [*Euphausiacea distinguenda* Hansen, 1908 (3.4%) and *Euphausiacea lamelligera* Hansen, 1911 (2.3%)] (Fig. 3b). The most abundant species from Chaetognatha (<2.3%, *Flaccisagitta enflata* (Grassi)), Decapoda

Table 2. Zooplankton abundance (ind. 1000 m^{-3}) identified per taxonomic groups collected during November 2010 in the Islas Marías Archipelago. In bold are showed the taxonomic groups that were further identified to family, genus or species level.

Islands	María Magdalena		María Cleofas			María Madre	San Juanito				María Madre	Mean	Relative
Station	4	6	11	12A	12B	14	17	19	20A	20B	22		
Date dd/mm/yy	14/11/10	15/11/10	16/11/10	17/11/10	18/11/10	19/11/10	19/11/10	20/11/10	21/11/10	21/11/10	23/11/10	abundance	abundance and
Collecting time	14:15	11:00	10:55	13:50	8:00	10:40	19:45	14:35	10:50	22:20	11:20	ind 1000 m^{-3}	frequency % (n)
Copepoda	**82862.6**	**9864.4**	**247277.0**	**30759.2**	**47137.4**	**7368.9**	**35089.4**	**27555.5**	**54327.4**	**31892.3**	**70205.7**	**58576.3**	**79.2 (11)**
Decapoda	**2804.6**	**1345.1**	**4521.2**	**4694.0**	**13490.8**	**2238.0**	**2107.8**	**128.2**	**339.5**	**4447.6**	**2009.5**	**3466.0**	**4.7 (11)**
Cladocera	**4334.3**	**448.4**	**8694.7**	**331.3**	**1766.7**	**491.3**	**124.0**	**6408.3**	**2603.2**	**217.0**	**4898.1**	**2756.1**	**3.7 (11)**
Mysidacea	**1784.7**	**56.0**	**115.9**	**6074.5**	**481.8**	**5130.9**	**8431.4**	**0.0**	**0.0**	**0.0**	**0.0**	**2006.8**	**2.7 (7)**
Euphausiacea	**5864.1**	**504.4**	**1159.3**	**165.7**	**642.4**	**491.3**	**248.0**	**128.2**	**2150.5**	**3037.4**	**2135.1**	**1502.4**	**2.0 (11)**
Fish eggs	106.2	107.4	1009.6	1909.8	240.9	284.3	1012.6	1062.7	1928.8	551.4	3820.1	1094.0	1.5 (11)
Appendicularia	**4079.4**	**952.8**	**579.6**	**165.7**	**0.0**	**163.8**	**372.0**	**1538.0**	**792.3**	**1084.8**	**1883.9**	**1055.6**	**1.4 (10)**
Chaetognatha	**3059.5**	**1064.9**	**695.6**	**1546.2**	**0.0**	**327.5**	**620.0**	**1281.7**	**792.3**	**325.4**	**1507.1**	**1020.0**	**1.4 (10)**
Siphonophora	**1784.7**	**392.3**	**0.0**	**165.7**	**80.3**	**109.2**	**620.0**	**640.8**	**339.5**	**108.5**	**376.8**	**419.8**	**0.6 (10)**
Amphipoda	**1274.8**	**448.4**	**347.8**	**0.0**	**401.5**	**218.6**	**248.0**	**128.2**	**1131.8**	**433.9**	**0.0**	**421.2**	**0.6 (9)**
Pteropoda	**1784.7**	**392.3**	**0.0**	**165.7**	**80.3**	**109.2**	**496.0**	**640.8**	**339.5**	**108.5**	**376.8**	**408.5**	**0.5 (9)**
Radiolaria	1274.8	280.2	463.7	220.9	0.0	54.6	372.0	384.5	339.5	325.4	0.0	337.8	0.5 (9)
Salps	1274.8	112.1	0.0	0.0	0.0	0.0	0.0	1025.3	0.0	0.0	125.6	230.7	0.3 (4)
Pelecypoda	0.0	56.0	347.8	165.7	401.5	0.0	124.0	0.0	339.5	108.5	628.0	197.4	0.3 (8)
Fish larvae	**478.1**	**105.1**	**19.3**	**614.4**	**23.4**	**2.3**	**15.5**	**48.1**	**0.0**	**18.1**	**345.4**	**151.8**	**0.2 (10)**
Stomatopoda	255.0	56.0	231.9	55.2	401.5	0.0	0.0	128.2	0.0	325.4	125.6	143.5	0.2 (7)
Cephalopoda	**18.8**	**0.0**	**34.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**26.5**	**17.0**	**19.1**	**10.5**	**0.2 (5)**
Ostracoda	509.9	0.0	0.0	331.3	80.3	0.0	0.0	0.0	113.2	0.0	125.6	105.5	0.1 (5)
Equinodermata	255.0	0.0	115.9	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.7	0.1 (3)
Cirripedia	254.9	0	115.9	0	0	0	0	0	0	0	0	33.7	0.0 (2)
Total	114061.1	16186.1	265729.7	47420.4	65228.9	16989.6	49880.5	41098.3	65563.6	43001.1	88582.1	73976.5	100.0

Table 3. Systematic species composition, relative abundance, mean, and standard deviation abundance (ind 1000 m^{-3}) of selected holozooplankton and merozooplankton taxonomic groups collected at Islas Marías Archipelago during November 2010. SD: standard deviation.

Large classification	Family	Genus and species	Sampling stations											Sum	Relative abundance and frequency % (n)	Statistics	
			4	6	11	12A	12B	14	17	19	20A	20B	22			Mean	SD
Phylum Arthropoda																	
Subphylum Crustacea																	
Class Maxillopoda																	
Subclass Copepoda																	
Order Calanoida	Acartiidae	*Acartia lilljeborgii* Giesbretch	0.0	0.0	0.0	920.4	752.8	0.0	258.3	0.0	0.0	0.0	130.8	2062.3	0.457 (4)	187.5	333.3
	Acartiidae	*Acartia tonsa* Dana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	113.0	0.0	113	0.025 (1)	10.3	34.1
	Calanidae	*Canthocalanus pauper* (Giesbrecht)	4249.4	583.8	3381.3	1840.8	5018.9	625.4	2970.6	2136.1	4833.8	678.0	7587.8	33905.9	7.509 (11)	3082.4	2215.4
	Calanidae	*Undinula vulgaris* (Dana)	531.2	0.0	241.5	115.0	167.3	398.0	774.9	133.5	589.5	0.0	261.6	3212.5	0.711 (9)	292.0	252.2
	Candaciidae	*Candacia catula* (Giesbrecht)	0.0	0.0	1086.8	287.6	334.6	0.0	1291.6	267.0	825.3	1130.0	1700.7	6923.6	1.533 (8)	629.4	600.7
	Candaciidae	*Candacia truncata* (Dana)	796.8	0.0	120.8	0.0	0.0	0.0	0.0	0.0	235.8	452.0	130.8	1736.2	0.384 (5)	157.8	255.4
	Centropagidae	*Centropages furcatus* (Dana)	1327.9	408.7	4226.6	1208.0	8113.9	227.4	645.8	0.0	353.7	0.0	7064.5	23576.5	5.221 (9)	2143.3	2950.6
	Clausocalanidae	*Clausocalanus furcatus* (Brady)	1859.1	58.4	483.0	172.6	0.0	0.0	0.0	934.5	117.9	0.0	392.5	4018	0.890 (7)	365.3	574.1
	Clausocalanidae	*Clausocalanus jobei* Frost & Fleminger	5577.3	58.4	9298.5	1323.0	1589.3	284.3	7103.7	4272.2	1650.6	3276.9	8896.1	43330.3	9.596 (11)	3939.1	3355.0
	Eucalanidae	*Subeucalanus mucronatus* (Giesbrecht)	2655.9	583.8	483.0	57.5	0.0	56.9	387.5	0.0	943.2	226.0	392.5	5786.3	1.280 (9)	526.0	763.9
	Eucalanidae	*Subeucalanus subcrassus* (Giesbrecht)	796.8	1809.9	3019.0	172.6	334.6	966.6	645.8	133.5	3065.3	1130.0	2878.1	14952.2	3.311 (11)	1359.3	1147.5
	Eucalanidae	*Subeucalanus subtenuis* (Giesbrecht)	0.0	116.8	0.0	0.0	0.0	0.0	258.3	133.5	235.8	0.0	654.1	1398.5	0.310 (5)	127.1	201.0
	Euchaetidae	*Euchaeta indica* Wolfenden	1062.3	291.9	0.0	0.0	0.0	227.4	129.2	0.0	471.6	339.0	392.5	2913.9	0.642 (7)	264.9	316.5
	Euchaetidae	*Euchaeta longicornis* (Giesbrecht)	0.0	0.0	0.0	0.0	0.0	56.9	0.0	0.0	0.0	0.0	130.8	187.7	0.042 (2)	17.1	41.4
	Euchaetidae	*Euchaeta rimana* Bradfort 1974	265.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	261.6	527.2	0.117 (2)	47.9	106.6
	Paracalanidae	*Acrocalanus gibber* (Giesbrecht)	3452.6	1226.0	7970.1	1208.0	1840.3	1364.6	5682.9	2803.6	11789.8	226.0	4055.6	41619.5	9.217 (11)	3783.6	3490.5
	Paracalanidae	*Calanopia minor* A. Scott	13544.8	233.5	17993.2	862.9	1087.4	227.4	2195.7	801.0	1414.8	2259.9	4840.5	45461.1	10.068 (11)	4132.8	5978.0
	Paracalanidae	*Calocalanus pavo* (Dana)	531.2	116.8	362.3	0.0	83.6	0.0	0.0	0.0	235.8	0.0	130.8	1460.5	0.323 (6)	132.8	176.9
	Paracalanidae	*Paracalanus aculeatus* (Giesbrecht)	0.0	0.0	362.3	115.0	752.8	284.3	1162.4	934.5	1886.4	1017.0	1831.5	8346.2	1.848 (9)	758.7	680.5
	Paracalanidae	*Paracalanus parvus* (Claus)	0.0	0.0	0.0	0.0	0.0	0.0	129.2	0.0	0.0	113.0	0.0	242.2	0.054 (2)	22.0	49.1
	Pontellidae	*Labidocera acuta* (Dana)	531.2	291.9	120.8	287.6	250.9	56.9	0.0	0.0	235.8	0.0	261.6	2036.7	0.451 (9)	185.2	166.7
	Pontellidae	*Labidocera diandra* Fleminger	0.0	0.0	0.0	0.0	0.0	56.9	0.0	0.0	0.0	0.0	0.0	56.9	0.013 (2)	5.2	17.2
	Scolecithricidae	*Scolecitrhix bradyi* (Giesbrecht)	531.2	0.0	0.0	0.0	0.0	56.9	258.3	267.0	0.0	0.0	130.8	1244.2	0.276 (5)	113.1	173.1
	Temoridae	*Temora discaudata* (Giesbrecht)	1062.3	116.8	724.6	460.2	836.5	511.7	387.5	0.0	3183.2	791.0	1569.9	9643.7	2.136 (10)	876.7	880.9

Continuation

Large classification	Family	Genus and species	Sampling stations											Sum	Relative abundance and frequency % (n)	Statistics	
			4	6	11	12A	12B	14	17	19	20A	20B	22			Mean	SD
Order Cyclopoida	Ointhonidae	*Oithona plumifera* Baird	1327.9	0.0	1086.8	1150.5	752.8	0.0	387.5	0.0	0.0	339.0	130.8	5175.3	1.146 (7)	470.5	517.9
Order Harpacticoida	Clytemnestridae	*Clytemnestra scutellata* Dana	0.0	0.0	0.0	0.0	83.6	0.0	0.0	0.0	0.0	0.0	0.0	83.6	0.019 (1)	7.6	25.2
	Tachidiidae	*Euterpina acutifrons* (Dana)	0.0	0.0	0.0	0.0	83.6	0.0	0.0	0.0	0.0	0.0	0.0	83.6	0.019 (1)	7.6	25.2
Order Poecilostomatoida	Corycaeidae	*Corycaeus andrewsi* Farran	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	707.4	113.0	523.3	1343.7	0.298 (3)	122.2	249.6
	Corycaeidae	*Corycaeus catus* Dahl F.	0.0	233.5	1569.9	402.7	1673.0	170.6	645.8	667.5	471.6	226.0	392.5	6453.1	1.429 (10)	586.6	549.0
	Corycaeidae	*Corycaeus speciosus* Dana	1062.3	525.4	845.3	632.8	418.2	284.3	1679.0	267.0	589.5	904.0	2354.8	9562.6	2.118 (11)	869.3	637.4
	Oncaeidae	*Oncea venusta* Phillippi	2921.4	1985.0	2052.9	805.3	1171.1	966.6	2841.5	267.0	1532.7	452.0	3009.0	18004.5	3.987 (11)	1636.8	996.4
	Sapphirinidae	*Copilia mirabilis* Dana	531.2	233.5	362.3	0.0	0.0	0.0	0.0	0.0	117.9	113.0	261.6	1619.5	0.359 (6)	147.2	180.2
	Sapphirinidae	*Sapphirina gastrica* Giesbrecht	0.0	0.0	120.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120.8	0.027 (1)	11.0	36.4
	Sapphirinidae	*Sapphirina gemma* Dana	0.0	0.0	0.0	0.0	0.0	0.0	516.6	0.0	825.3	113.0	130.8	1585.7	0.351 (4)	144.2	273.7
	Sapphirinidae	*Sapphirina scarlata* Giesbrecht	531.2	175.1	483.0	115.0	167.3	113.7	387.5	0.0	117.9	113.0	130.8	2334.5	0.517 (10)	212.2	172.8
Class Malacostraca																	
Subclass Eumalacostraca																	
Super Order Eucarida																	
Order Euphausiacea	Euphausiidae	*Euphausia distinguenda* Hansen	3187.0	700.6	603.8	0.0	572.1	1237.2	253.2	6007.7	1528.0	2033.9	130.8	15368.4	3.403 (11)	1477.7	1774.7
	Euphausiidae	*Euphausia eximia* Hansen	0.0	175.1	120.8	165.7	0.0	0.0	0.0	1335.1	117.9	0.0	0.0	1748.9	0.387 (4)	174.1	391.9
	Euphausiidae	*Euphausia lamelligera* Hansen	2390.3	58.4	362.3	0.0	0.0	0.0	0.0	3738.1	589.5	1130.0	1962.4	10231	2.266 (7)	930.1	1256.2
	Euphausiidae	*Nematoscelis gracilis* Hansen	0.0	0.0	115.9	0.0	0.0	0.0	0.0	0.0	0.0	265.6	0.0	265.6	0.059 (1)	34.7	84.1
	Euphausiidae	*Nyctiphanes simplex* Hansen	0.0	56.0	0.0	0.0	80.3	54.6	0.0	0.0	117.9	0.0	0.0	117.9	0.026 (1)	28.1	42.2
	Euphausiidae	*Stylocheiron carinatum* GO Sars	0.0	0.0	0.0	0.0	0.0	54.6	0.0	0.0	0.0	0.0	0.0	0.0	0.001 (1)	4.9	16.5
Order Decapoda																	
Suborder Dendrobranchiata																	
	Luciferidae	*Lucifer typus* H. Milne-Edwards, 1837	255.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	255.0	0.056 (1)	23.2	76.9
	Sycyoniidae	*Sicyonia* sp.	0.0	0.0	0.0	0.0	80.3	0.0	0.0	0.0	0.0	0.0	0.0	80.3	0.018 (1)	7.3	24.2
	Penaeidae	type 1	0.0	0.0	0.0	0.0	80.3	0.0	0.0	0.0	0.0	0.0	0.0	80.3	0.018 (1)	7.3	24.2
	Solenoceridae	Solenocera sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	108.5	0.0	108.5	0.024 (1)	9.9	32.7
Suborder Pleocyemata																	
	Galatheidae	type 1	0.0	0.0	0.0	55.2	80.3	0.0	0.0	0.0	0.0	0.0	0.0	135.5	0.030 (2)	12.3	28.0
	Porcellanidae	Petrolisthes sp. 1	0.0	0.0	115.9	0.0	2730.3	163.8	0.0	0.0	0.0	0.0	125.6	3135.6	0.694 (4)	285.1	813.4
	Porcellanidae	*Petrolisthes* sp. 2	0.0	56.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	56.0	0.012 (1)	5.1	16.9
	Porcellanidae	*Petrolisthes* sp. 3	255.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	255.0	0.056 (1)	23.2	76.9

Continuation

Large classification	Family	Genus and species	Sampling stations											Sum	Relative abundance and frequency % (n)	Statistics	
			4	6	11	12A	12B	14	17	19	20A	20B	22			Mean	SD
	Porcellanidae	Petrolisthes sp. 4	0.0	56.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	56.0	0.012 (1)	5.1	16.9
	Paguridae	*Pagurus* sp. 1	0.0	0.0	0.0	55.2	0.0	0.0	0.0	0.0	0.0	1410.2	0.0	1465.4	0.325 (2)	133.2	423.9
	Paguridae	*Pagurus* sp. 2	0.0	0.0	0.0	0.0	80.3	0.0	0.0	0.0	0.0	0.0	0.0	80.3	0.018 (1)	7.3	24.2
	Paguridae	*Pagurus* sp. 3	0.0	0.0	0.0	0.0	80.3	0.0	124.0	0.0	0.0	0.0	0.0	204.3	0.045 (2)	18.6	42.5
	Paguridae	*Pagurus* sp. 4	0.0	0.0	0.0	0.0	80.3	0.0	0.0	0.0	0.0	1518.7	0.0	1599.0	0.354 (2)	145.4	456.1
	Paguridae	*Pagurus* sp. 5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	867.8	0.0	867.8	0.192 (1)	78.9	261.7
	Paguridae	*Pagurus* sp. 6	0.0	0.0	0.0	0.0	160.6	0.0	0.0	0.0	0.0	108.5	0.0	269.1	0.060 (2)	24.5	55.7
	Paguridae	*Pagurus sp. 7*	0.0	0.0	0.0	0.0	722.7	0.0	0.0	0.0	0.0	0.0	0.0	722.7	0.16 (1)0	65.7	217.9
	Parapaguridae	*Parapagurus* sp.	0.0	0.0	0.0	0.0	80.3	0.0	0.0	0.0	0.0	0.0	0.0	80.3	0.018 (1)	7.3	24.2
	Callianassidae	*Callianassa* sp. 1	0.0	0.0	0.0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.2	0.012 (1)	5.0	16.7
	Callianassidae	*Callianassa* sp. 2	0.0	0.0	0.0	110.4	80.3	0.0	0.0	0.0	0.0	0.0	0.0	190.7	0.042 (2)	17.3	39.2
	Callianassidae	*Callianassa* sp. 3	0.0	0.0	0.0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.2	0.012 (1)	5.0	16.7
	Callianassidae	*Callianassa* sp. 4	0.0	0.0	0.0	0.0	642.4	0.0	0.0	0.0	0.0	0.0	0.0	642.4	0.142 (1)	58.4	193.7
	Callianassidae	*Callianassa* sp. 5	0.0	0.0	0.0	0.0	80.3	0.0	124.0	0.0	0.0	0.0	0.0	204.3	0.045 (2)	18.6	42.5
	Callianassidae	*Callianassa* sp. 6	0.0	0.0	0.0	0.0	0.0	0.0	124.0	0.0	0.0	0.0	0.0	124.0	0.027 (1)	11.3	37.4
	Callianassidae	type 1	0.0	0.0	0.0	0.0	80.3	0.0	0.0	0.0	0.0	0.0	0.0	80.3	0.018 (1)	7.3	24.2
	Bythograeidae	*Bythograea* sp.	0.0	0.0	0.0	0.0	0.0	54.6	0.0	0.0	0.0	0.0	0.0	54.6	0.012 (1)	5.0	16.5
	Atelecyclidae	*Atelecyclus* sp.	0.0	0.0	0.0	0.0	0.0	0.0	124.0	0.0	0.0	0.0	0.0	124.0	0.027 (1)	11.3	37.4
	Calappidae	type 1	255.0	0.0	115.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	370.9	0.082 (2)	33.7	81.2
	Ethusidae	*Ethusa* sp.	0.0	0.0	0.0	110.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.4	0.024 (1)	10.0	33.3
	Grapsidae	*Grapsus* sp.	0.0	0.0	0.0	0.0	481.8	0.0	0.0	0.0	0.0	0.0	0.0	481.8	0.107 (1)	43.8	145.3
	Grapsidae	*Pachygrapsus* sp.	255.0	56.0	0.0	0.0	0.0	0.0	0.0	0.0	113.2	108.5	376.8	909.4	0.201 (5)	82.7	126.3
	Homolidae	type 1	0.0	0.0	0.0	55.2	0.0	0.0	0.0	0.0	0.0	217.0	0.0	272.2	0.060 (2)	24.7	65.9
	Majoidea	type 1	0.0	0.0	0.0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.2	0.012 (1)	5.0	16.7
	Majoidea	type 2	0.0	0.0	0.0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.2	0.012 (1)	5.0	16.7
	Ocypodidae	*Uca* sp.	255.0	56.0	347.8	0.0	2810.6	1582.9	124.0	384.5	226.4	542.4	1255.9	7585.5	1.680 (11)	689.6	863.1
	Pinnotheridae	*Pinnotheres* sp.	0.0	0.0	0.0	110.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.4	0.024 (1)	10.0	33.3
	Portunidae	*Callinectes* sp.	0.0	0.0	0.0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.2	0.012 (1)	5.0	16.7
	Xanthidae	type 1	0.0	0.0	0.0	0.0	80.3	0.0	124.0	128.2	0.0	0.0	0.0	332.5	0.074 (2)	30.2	53.1
	Xanthidae	*Xantho* sp.	0.0	0.0	0.0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.2	0.012 (1)	5.0	16.7
	Xanthidae	type 1	0.0	112.1	0.0	55.2	0.0	54.6	124.0	128.2	0.0	0.0	0.0	474.1	0.105 (5)	43.1	54.7
	Alpheidae	*Alpheus* sp.	764.9	0.0	0.0	938.8	562.1	2074.2	0.0	0.0	113.2	0.0	0.0	4453.2	0.986 (5)	404.8	655.3
	Alpheidae	*Athanas* sp.	0.0	224.2	0.0	165.7	0.0	0.0	0.0	128.2	0.0	0.0	0.0	518.0	0.115 (3)	47.1	83.5
	Hippolytidae	*Evalus* sp.	0.0	0.0	0.0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	125.6	180.8	0.040 (1)	16.4	39.8
	Hippolytidae	*Nauticaris* sp.	0.0	0.0	0.0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	125.6	180.8	0.040 (1)	16.4	39.8
	Hippolytidae	type 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	125.6	125.6	0.028 (1)	11.4	37.9
	Palaemonidae	*Palaemon* sp. 1	0.0	0.0	0.0	110.4	0.0	109.2	0.0	0.0	0.0	0.0	0.0	219.6	0.049 (2)	20.0	44.4
	Palaemonidae	*Palaemon* sp. 2	255.0	0.0	0.0	55.2	160.6	0.0	0.0	0.0	0.0	0.0	0.0	470.8	0.104 (3)	42.8	85.8
	Palaemonidae	*Palaemon* sp. 3	0.0	0.0	115.9	110.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	226.4	0.050 (2)	20.6	45.8
	Palaemonidae	*Palaemon* sp. 4	0.0	0.0	115.9	110.4	2007.6	0.0	0.0	0.0	0.0	0.0	0.0	2233.9	0.495 (3)	203.1	600.2

Continuation

Large classification	Family	Genus and species	Sampling stations											Sum	Relative abundance and frequency % (n)	Statistics	
			4	6	11	12A	12B	14	17	19	20A	20B	22			Mean	SD
	Palaemonidae	*Palaemon* sp. 5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	512.7	0.0	0.0	0.0	512.7	0.114 (1)	46.6	154.6
	Palaemonidae	*Palaemon* sp. 6	0.0	0.0	0.0	0.0	160.6	0.0	0.0	0.0	0.0	0.0	0.0	160.6	0.036 (1)	14.6	48.4
	Palaemonidae	*Palaemonetes* sp.	0.0	0.0	0.0	331.3	160.6	0.0	0.0	0.0	0.0	433.9	0.0	925.9	0.205 (3)	84.2	156.8
	Palaemonidae	*Pontonia* sp.	0.0	0.0	0.0	0.0	160.6	0.0	0.0	0.0	0.0	0.0	0.0	160.6	0.036 (1)	14.6	48.4
	Pasiphaeidae	*Pasiphaea* sp.	0.0	0.0	0.0	0.0	0.0	0.0	124.0	0.0	0.0	0.0	0.0	124.0	0.027 (1)	11.3	37.4
	Processidae	*Processa* sp.	0.0	0.0	0.0	110.4	0.0	0.0	0.0	256.3	0.0	433.9	0.0	800.7	0.177 (3)	72.8	144.2
	Upogebiidae	*Upogebia* sp.	0.0	0.0	0.0	110.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.4	0.024 (1)	10.0	33.3
Suborder Reptantia																	
	Palinuridae	*Panulirus gracilis* Streets, 1871	0.0	0.0	115.9	0.0	160.6	0.0	0.0	0.0	0.0	0.0	0.0	276.5	0.061 (2)	25.1	56.8
Super Order Peracarida																	
Order Mysida	Mysidae	*Mysidium rickettsi* Harrison & Bowman	1859.1	58.4	120.8	5805.3	418.2	5319.7	8777.5	0.0	0.0	0.0	0.0	1859.1	0.412 (7)	2032.6	3118.4
	Mysidae	*Siriella pacifica* Holmes	0.0	0.0	0.0	0.0	0.0	0.0	129.2	0.0	0.0	0.0	0.0	129.2	0.029 (1)	11.7	39.0
Order Amphipoda	Hyperiidae	*Hyperietta stephenseni* Bowman	0.0	0.0	265.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	265.6	0.059 (1)	24.1	80.1
	Hyperiidae	*Hyperioides sibaginis* (Stebbing)	265.6	531.2	0.0	0.0	265.6	0.0	265.6	0.0	0.0	0.0	0.0	1328	0.294 (4)	120.7	182.6
	Lestrigonidae	*Lestrigonus bengalensis* Giles	0.0	796.8	1062.3	0.0	796.8	265.6	265.6	0.0	796.8	796.8	0.0	4780.7	1.059 (7)	434.6	416.1
	Lestrigonidae	*Lestrigonus latissimus* (Bovallius)	0.0	0.0	0.0	0.0	265.6	0.0	0.0	0.0	0.0	0.0	0.0	265.6	0.059 (1)	24.1	80.1
	Lestrigonidae	*Lestrigonus schizogeneios* (Stebbing)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	265.6	0.0	0.0	265.6	0.059 (1)	24.1	80.1
	Lestrigonidae	*Lestrigonus shoemakeri* Bowman	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	531.2	0.0	0.0	531.2	0.118 (1)	48.3	160.2
	Lycaeidae	*Lycaea* sp. *(juvenil)*	0.0	265.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	265.6	0.059 (1)	24.1	80.1
	Lycaeidae	*Simorhynchotus antennarius* Claus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	265.6	0.0	0.0	265.6	0.059 (1)	24.1	80.1
	Lycaeopsidae	*Lycaeopsis themistoides* Claus	0.0	0.0	0.0	0.0	0.0	265.6	0.0	0.0	0.0	0.0	0.0	265.6	0.059 (1)	24.1	80.1
	Oxycephalidae	*Oxycephalus clausi* Bovadillus	265.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	265.6	0.059 (1)	24.1	80.1
	Oxycephalidae	*Rhabdosoma minor* Fage	0.0	0.0	0.0	0.0	0.0	54.6	0.0	0.0	0.0	0.0	0.0	0.0	0.00001 (1)	4.9	16.5
	Parascelidae	*Schizoscelus ornatus* Claus	0.0	0.0	0.0	0.0	265.6	0.0	0.0	0.0	0.0	0.0	0.0	265.6	0.059 (1)	24.1	80.1
	Phronimidae	*Phronima sedentaria* (Forskal)	0.0	0.0	0.0	0.0	0.0	531.2	0.0	0.0	0.0	0.0	0.0	531.2	0.118 (1)	48.3	160.2
	Pronoidae	*Paralycaea gracilis* Claus	0.0	0.0	0.0	0.0	0.0	265.6	0.0	0.0	265.6	0.0	0.0	265.6	0.059 (2)	48.2	160.2
	Pronoidae	*Parapronoe parva* Claus	0.0	0.0	0.0	0.0	0.0	0.0	265.6	0.0	0.0	0.0	0.0	265.6	0.059 (1)	24.1	80.1
Class Branchiopoda																	
Order Diplostraca																	
Suborder Cladocera	Sididae	*Penilia avirostris* Dana	265.6	175.1	966.1	345.1	167.3	0.0	0.0	0.0	0.0	0.0	261.6	2180.8	0.483 (6)	198.3	286.0
	Podonidae	*Pseudevadne tergestina* (Claus)	4249.4	291.9	8090.9	0.0	1589.3	511.7	129.2	6675.3	2711.7	226.0	4709.7	29185.1	6.663 (10)	2653.2	2883.1

Continuation

Large classification	Family	Genus and species	Sampling stations											Sum	Relative abundance and frequency % (n)	Statistics	
			4	6	11	12A	12B	14	17	19	20A	20B	22			Mean	SD
Phylum Cnidaria																	
Class Hydrozoa																	
Order Siphonophorae	Abylidae	*Bassia bassensis* Quoy & Gaimard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	130.8	130.8	0.029 (1)	11.9	39.4
Suborder Calycophorae	Agalmatidae	*Agalma okeni* Eschscholtz	0.0	0.0	0.0	0.0	0.0	0.0	0.0	133.5	0.0	0.0	0.0	133.5	0.030 (1)	12.1	40.3
	Agalmatidae	*Nanomia bijuga* (Delle Chiaje)	0.0	0.0	0.0	0.0	0.0	0.0	387.5	0.0	0.0	0.0	0.0	387.5	0.086 (1)	35.2	116.8
	Diphyidae	*Chelophyes contorta* (Lens & van Reimsdijk)	0.0	0.0	0.0	0.0	0.0	113.7	0.0	0.0	0.0	0.0	0.0	113.7	0.025 (1)	10.3	34.3
	Diphyidae	*Diphyes dispar* Chamisso & Eysenhardt	265.6	350.3	0.0	115.0	0.0	0.0	129.2	534.0	117.9	0.0	130.8	1642.8	0.364 (7)	149.3	171.5
	Diphyidae	*Diphyidae* sp.	1062.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1062.3	0.235 (1)	96.6	320.3
	Diphyidae	*Eudoxoides mitra* (Huxley)	531.2	58.4	0.0	57.5	0.0	0.0	129.2	0.0	117.9	0.0	130.8	1025	0.227 (6)	93.2	155.3
	Diphyidae	*Muggiaea atlantica* Cunningham	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1130.0	0.0	1130	0.250 (1)	102.7	340.7
	Diphyidae	*Sulculeolaria turgida* (Gegenbaur)	0.0	0.0	0.0	0.0	83.6	0.0	0.0	0.0	0.0	0.0	0.0	83.6	0.019 (1)	7.6	25.2
	Unknown	Non identified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	117.9	0.0	0.0	117.9	0.026 (1)	10.7	35.5
Phylum Chaetognatha																	
Order Aphragmophora	Krohnittidae	*Krohnitta* sp.	1593.5	467.1	0.0	0.0	0.0	56.9	129.2	133.5	117.9	113.0	0.0	2611.1	0.578 (7)	237.4	469.3
	Krohnittidae	*Krohnitta subtilis* (Grassi)	0.0	0.0	0.0	0.0	0.0	0.01	0.0	0.0	0.0	0.0	0.0	0.01	0.000 (1)	0.0	0.0
	Sagittidae	*Aidanosagitta neglecta* (Aida)	0.0	58.4	0.0	57.5	0.0	0.0	0.0	0.0	117.9	0.0	0.0	233.8	0.052 (3)	21.3	39.6
	Sagittidae	*Ferosagitta robusta* (Doncaster)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	133.5	0.0	0.0	0.0	133.5	0.030 (1)	12.1	40.3
	Sagittidae	*Flaccisagitta enflata* (Grassi)	3187.0	583.8	1086.8	1553.1	585.5	227.4	258.3	667.5	353.7	0.0	1569.9	10073	2.231 (10)	915.7	914.5
	Sagittidae	*Serratosagitta pacifica* (Tokioka)	2390.3	0.0	0.0	0.0	167.3	0.0	0.0	133.5	117.9	0.0	0.0	2809	0.622 (4)	255.4	711.1
	Unknown	identified	0.0	0.0	241.5	0.0	0.0	56.9	516.6	133.5	235.8	452.0	523.3	2159.6	0.478 (7)	196.3	213.5
Phylum Mollusca																	
Class Gastropoda																	
Order Thecosomata	Cavoliniidae	*Cavolinia inflexa* (Lesueur)	531.2	0.0	120.8	0.0	0.0	0.0	0.0	0.0	117.9	0.0	0.0	769.9	0.171 (3)	70.0	160.2
	Creseidae	*Creseis virgula virgula* Rang	0.0	0.0	603.8	115.0	250.9	0.0	516.6	0.0	0.0	0.0	130.8	1617.1	0.358 (5)	147.0	220.7
	Creseidae	*Creseis chierchiae* (Boas)	0.0	0.0	0.0	230.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	230.1	0.051 (1)	20.9	69.4
	Creseidae	*Creseis conica* Eschscholtz	0.0	233.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	233.5	0.052 (1)	21.2	70.4
	Creseidae	*Creseis virgula conica* Eschscholtz	265.6	0.0	120.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	386.4	0.086 (2)	35.1	84.6
	Desmopteridae	*Desmopterus pacificus* Essenberg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	130.8	130.8	0.029 (1)	11.9	39.4

Continuation

Large classification	Family	Genus and species	Sampling stations											Sum	Relative abundance and frequency % (n)	Statistics	
			4	6	11	12A	12B	14	17	19	20A	20B	22			Mean	SD
	Limacinidae	*Limacina helicina* (Phipps)	0.0	175.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	175.1	0.039 (1)	15.9	52.8
	Limacinidae	*Limacina inflata* (D'Orbigny)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	130.8	130.8	0.029 (1)	11.9	39.4
	Limacinidae	*Limacina trochiformis* (D'Orbigny)	0.0	0.0	120.8	0.0	0.0	0.0	0.0	0.0	0.0	113.0	523.3	757.1	0.168 (3)	68.8	157.8
Order Veneroida	Montacutidae	*Planktomya henseni* Simroth	0.0	0.0	0.0	0.0	83.6	0.0	258.3	0.0	0.0	0.0	0.0	341.9	0.076 (2)	31.1	79.4
	Montacutidae	*Planktomya* sp.	265.6	175.1	0.0	0.0	0.0	284.3	0.0	0.0	0.0	0.0	0.0	725	0.161 (3)	65.9	115.9
Order Littorinimorpha	Atlantidae	*Atlanta lesueurii* J. E. Gray	0.0	116.8	120.8	0.0	0.0	0.0	129.2	0.0	0.0	0.0	0.0	366.8	0.081 (3)	33.3	57.2
	Atlantidae	*Atlanta peronii* Lesueur	0.0	0.0	0.0	0.0	0.0	113.7	0.0	0.0	235.8	0.0	0.0	349.5	0.077 (2)	31.8	75.8
	Unknown	Gasteropoda sp.	0.0	233.5	0.0	0.0	83.6	0.0	0.0	0.0	0.0	339.0	0.0	656.1	0.145 (3)	59.6	117.2
Class Cephalopoda																	
Order Octopoda	Octopodidae	*Octopus* sp.	796.8	0.0	362.3	0.0	0.0	0.0	0.0	0.0	117.9	113.0	130.8	1520.8	0.337 (5)	138.3	244.9
Phylum Chordata																	
Class Appendicularia																	
Order Copelata	Oikopleuridae	*Oikopleura dioica* Fol	4249.4	992.5	603.8	172.6	0.0	170.6	387.5	1602.1	825.3	1130.0	1962.4	12096.0	2.679 (10)	1099.6	1212.0
Subphylum Craniata																	
Superclass Gnathostomata																	
Class Actinopterygii																	
Clupeiformes	Clupeidae	*Harengula thrissina* (Jordan & Gilbert)	10.6	2.3	0.0	16.1	0.0	0.0	5.2	0.0	0.0	0.0	0.0	34.2	0.008 (11)	3.1	5.5
Stomiiformes	Phosichthyidae	*Vinciguerria lucetia* (Garman)	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Clupeidae	*Opisthonema* sp. 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	5.3	0.001 (1)	0.5	1.6
Myctophiformes	Myctophidae	*Benthosema panamense* (Tåning)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	4.5	0.001 (1)	0.4	1.4
Gadiformes	Bregmacerotidae	*Bregmaceros batymaster* Jordan & Bollman	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	5.3	0.001 (1)	0.5	1.6
Atheriniformes	Atherinopsidae	*Atherinella eriarcha* Jordan & Gilbert	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
Mugiliformes	Mugilidae	type 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	5.2	0.001 (1)	0.5	1.6
Scorpaeniformes	Scorpaenidae	type 1	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
Perciformes	Carangidae	*Caranx* sp. 1	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Carangidae	*Decapterus muroadsi* (Temminck & Schlegel)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	5.2	0.001 (1)	0.5	1.6
	Carangidae	*Decapterus* sp. 1	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.001 (1)	0.4	1.4
	Serranidae	*Epinephelus analogus* Gill	21.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.2	0.005 (1)	1.9	6.4
	Serranidae	*Paralabrax loro* Walford	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.001 (1)	0.3	1.0
	Serranidae	*Paranthias colonus* (Valenciennes)	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Serranidae	*Serranus* sp. 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	4.5	0.001 (1)	0.4	1.4
	Serranidae	type 1	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7

Continuation

Large classification	Family	Genus and species	Sampling stations											Sum	Relative abundance and frequency % (n)	Statistics	
			4	6	11	12A	12B	14	17	19	20A	20B	22			Mean	SD
	Haemulidae	type 1	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
	Haemulidae	type 2	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
	Haemulidae	type 3	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
	Haemulidae	type 4	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
	Haemulidae	type 5	21.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.2	0.005 (1)	1.9	6.4
	Haemulidae	type 6	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
	Haemulidae	type 7	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Sciaenidae	type 1	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
	Sciaenidae	type 2	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Pomacentridae	*Abudefduf troschelii* (Gill)	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.001 (1)	0.4	1.4
	Pomacentridae	*Abudefduf* sp. 1	21.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.2	0.005 (1)	1.9	6.4
	Pomacentridae	*Pomacentridae* sp.1	21.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.2	0.005 (1)	1.9	6.4
	Ammodytidae	*Ammodytoides gilli* (Bean)	10.6	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.9	0.003 (2)	1.2	3.2
	Tripterygiidae	*Axoclinus* sp. 1	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	5.2	7.5	0.002 (2)	0.7	1.6
	Tripterygiidae	*Enneanectes carminalis* (Jordan & Gilbert)	10.6	9.3	0.0	23.0	0.0	0.0	0.0	0.0	0.0	0.0	41.9	85.3	0.019 (4)	8.7	16.5
	Tripterygiidae	*Axoclinus nigricaudus* Allen & Robertson	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Tripterygiidae	*Enneanectes reticulatus* Allen & Robertson	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Tripterygiidae	*Enneanectes* sp. 1	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Tripterygiidae	*Enneanectes* sp. 2	0.0	2.3	0.0	48.3	0.0	0.0	0.0	0.0	0.0	0.0	89.0	139.6	0.031 (3)	12.7	29.1
	Tripterygiidae	*Enneanectes* sp. 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	0.0	0.0	5.2	15.9	0.004 (2)	1.4	3.4
	Dactyloscopidae	type 1	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
	Dactyloscopidae	type 2	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.001 (1)	0.4	1.4
	Dactyloscopidae	type 3	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Dactyloscopidae	type 4	0.0	0.0	0.0	16.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.1	0.004 (1)	1.5	4.9
	Dactyloscopidae	type 5	0.0	0.0	0.0	48.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.3	0.011 (1)	4.4	14.6
	Dactyloscopidae	type 6	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.2	0.002 (1)	0.8	2.8
	Dactyloscopidae	type 7	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.2	0.002 (1)	0.8	2.8
	Dactyloscopidae	type 8	0.0	0.0	0.0	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8	0.003 (1)	1.3	4.2
	Dactyloscopidae	type 9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	5.2	0.001 (1)	0.5	1.6
	Dactyloscopidae	type 10	0.0	0.0	0.0	18.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.4	0.004 (1)	1.7	5.5
	Dactyloscopidae	type 11	0.0	0.0	0.0	55.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.2	0.013 (1)	5.0	16.6
	Dactyloscopidae	*Dactyloscopus byersi* Dawson	0.0	11.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7	0.003 (1)	1.1	3.5
	Dactyloscopidae	*Dactylagnus mundus* Gill	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Dactyloscopidae	*Dactyloscopus pectoralis* Gill	0.0	18.7	0.0	34.5	0.0	0.0	0.0	0.0	0.0	0.0	5.2	58.4	0.013 (3)	5.3	11.2
	Dactyloscopidae	*Gillellus semicinctus* Gilbert	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7

Continuation

Large classification	Family	Genus and species	Sampling stations											Sum	Relative abundance and frequency % (n)	Statistics	
			4	6	11	12A	12B	14	17	19	20A	20B	22			Mean	SD
	Dactyloscopidae	*Gillellus* sp. 1	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
	Dactyloscopidae	*Gillellus* sp. 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	5.2	0.001 (1)	0.5	1.6
	Dactyloscopidae	*Gillellus* sp. 3	0.0	0.0	0.0	41.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.4	0.009 (1)	3.8	12.5
	Dactyloscopidae	*Heteristius cinctus* (Osburn & Nichols)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	5.2	0.001 (1)	0.5	1.6
	Labrisomidae	*Dialommus macrocephalus* (Günther)	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.001 (1)	0.4	1.4
	Labrisomidae	*Labrisomus* sp. 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	5.2	0.001 (1)	0.5	1.6
	Labrisomidae	*Labrisomus striatus* Hubbs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	5.3	0.001 (1)	0.5	1.6
	Labrisomidae	*Labrisomus xanti* Gill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	5.2	0.001 (1)	0.5	1.6
	Labrisomidae	*Malacoctenus* sp. 1	0.0	4.7	0.0	20.7	0.0	0.0	0.0	5.3	0.0	0.0	10.5	41.2	0.009 (4)	3.7	6.6
	Labrisomidae	*Malacoctenus* sp. 2	0.0	0.0	0.0	16.1	0.0	0.0	0.0	0.0	0.0	0.0	52.3	68.4	0.016 (3)	6.2	16.0
	Labrisomidae	*Malacoctenus* sp. 3	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	0.0	15.7	24.9	0.006 (2)	2.3	5.2
	Labrisomidae	*Malacoctenus* sp. 4	0.0	2.3	0.0	9.2	0.0	0.0	0.0	5.3	0.0	0.0	0.0	16.8	0.004 (3)	1.5	3.0
	Labrisomidae	*Malacoctenus* sp. 5	0.0	0.0	0.0	11.5	0.0	0.0	0.0	0.0	0.0	0.0	5.2	16.7	0.004 (2)	1.5	3.7
	Labrisomidae	*Paraclinus* sp. 1	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	5.2	7.5	0.002 (2)	0.7	1.6
	Labrisomidae	*Paraclinus* sp. 2	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Labrisomidae	*Starksia* sp. 1	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	0.0	10.5	19.7	0.004 (2)	1.8	4.0
	Labrisomidae	*Starksia* sp. 2	0.0	0.0	0.0	16.1	0.0	0.0	0.0	0.0	0.0	0.0	10.5	26.6	0.006 (2)	2.4	5.5
	Labrisomidae	*Starksia* sp. 3	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	10.5	15.1	0.003 (2)	1.4	3.3
	Labrisomidae	type 1	21.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.2	0.005 (1)	1.9	6.4
	Labrisomidae	type 2	21.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.2	0.005 (1)	1.9	6.4
	Chaenopsidae	*Acanthemblemaria crockeri* Beebe & Tee-Van	0.0	2.3	0.0	9.2	3.3	0.0	0.0	0.0	0.0	0.0	0.0	14.8	0.003 (3)	1.3	2.8
	Chaenopsidae	*Acanthemblemaria macrospilus* Brock	0.0	4.7	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7	0.002 (2)	0.6	1.5
	Chaenopsidae	*Coralliozetus* sp. 1	0.0	0.0	0.0	29.9	0.0	0.0	0.0	0.0	0.0	0.0	31.4	61.3	0.014 (2)	5.6	12.4
	Chaenopsidae	*Coralliozetus* sp. 2	0.0	0.0	0.0	46.0	0.0	0.0	0.0	10.7	0.0	0.0	0.0	56.7	0.013 (2)	5.2	13.9
	Chaenopsidae	*Coralliozetus* sp. 3	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.002 (1)	0.6	2.1
	Chaenopsidae	*Emblemaria piritica* Ginsburg	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Chaenopsidae	*Protemblemaria bicirrus* (Hildebrand)	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Gobiesocidae	type 1	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
	Gobiesocidae	type 2	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
	Gobiesocidae	type 3	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Gobiesocidae	type 4	0.0	2.3	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.001 (2)	0.4	0.9
	Gobiesocidae	type 5	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Gobiesocidae	type 6	0.0	2.3	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.002 (2)	0.6	1.5
	Gobiesocidae	type 7	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Gobiidae	*Elacatinus* sp. 1	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Gobiidae	*Ilypnus* sp. 1	0.0	0.0	0.0	0.0	13.4	0.0	0.0	0.0	0.0	0.0	0.0	13.4	0.003 (1)	1.2	4.0

Continuation

Large classification	Family	Genus and species	Sampling stations											Sum	Relative abundance and frequency % (n)	Statistics	
			4	6	11	12A	12B	14	17	19	20A	20B	22			Mean	SD
	Gobiidae	*Lythrypnus* sp. 1	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
	Gobiidae	type 1	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Scombridae	*Auxis* sp. 1	170.0	9.3	14.5	6.9	0.0	0.0	0.0	0.0	0.0	4.5	0.0	205.2	0.045 (1)	18.7	50.4
	Scombridae	*Euthynnus lineatus* Kishinouye	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.001 (1)	0.4	1.4
	Scombridae	*Thunnus albacares* (Bonnaterre)	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.001 (1)	0.4	1.4
	Scombridae	type 1	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Nomeidae	*Psenes sio* Haedrich	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Paralichthydae	*Citharichthys platophrys* Gilbert	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.002 (1)	0.6	2.1
	Paralichthydae	*Scyacium latifrons* (Jordan & Gilbert)	0.0	0.0	4.8	4.6	0.0	0.0	5.2	0.0	0.0	0.0	0.0	14.6	0.003 (3)	1.3	2.3
Pleuronectiformes	Cynoglossidae	type sp. 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	4.5	0.001 (1)	0.4	1.4
	Unknown	type sp. 1	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.002 (1)	1.0	3.2
	Unknown	type sp. 2	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.002 (1)	0.6	2.1
	Unknown	type sp. 3	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.001 (1)	0.3	1.0
	Unknown	type sp. 4	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	5.2	0.001 (1)	0.5	1.6
	Unknown	type sp. 5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.000 (1)	0.0	0.0
	Unknown	type sp. 6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.000 (1)	0.0	0.0
	Unknown	type sp. 7	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Unknown	type sp. 8	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7
	Unknown	type sp. 9	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.001 (1)	0.2	0.7

(<1.7%, *Uca* sp.), Amphipoda (<1.1%, *Lestrigonus bengalensis* Giles), Mysidacea (<0.4% *Mysidium ricketsi* Harrison & Bowman), Pteropoda (<0.3%, *Creseis virgula virgula* Rang), and Siphonophorae, had considerably low abundance. However, they were relatively widely distributed in the IMA near-shore habitat (Fig. 3b, Table 3). Decapoda larvae from Mexican waters are highly diverse but poorly known; they were identified typically family- genus level using taxonomic keys mostly from the California Current and the Atlantic and Mediterranean Sea (Table 3). A large number of fish larvae (75 taxa) were not possible to identify at the species level (31 to genera and 44 to family level, or morphotype) belonging to benthic cryptic and reef habitat associated tropical taxa. The fish families with larger number of species were Dactyloscopidae (19 taxa), Labrisomidae (16), Tripterygiidae (8), Haemulidae, Chaenopsidae, and Gobiesocidae (7 taxa each one). Scombridae (*Auxis* sp., 205 larvae 1000 m^{-3}) and Tripterygiidae [*Enneanectes* sp. 2 with 139.6 larvae 1000 m^{-3} and *Enneanected carminalis* (Jordan & Gilbert) with 82.5 larvae 1000 m^{-3}] were the most abundant fish larvae detected in this study. Although IMA is located near and east the shelf break, zooplankton assemblage was clearly outnumbered by tropical species from the neritic habitat, mostly crustaceans (copepods, cladocera, and mysids) suggesting a close connectivity of this archipelago with the coastal habitat from Cape Corrientes region (Table 4).

Zooplankton two-way cluster analysis

Cluster analysis applied to the 20 taxonomic groups (fish eggs and larvae were here considered as different groups) showed three groups of stations segregating two groups that separate southwest and northeast of the Archipelago (Groups 1 SW, 2NW) and a third group that includes stations from southeast and northwest (Group 3 SE-NW) (Fig. 4a). The cluster analysis for zooplankton groups showed three groups ordered from high abundance (Group 1, with 12 taxonomic groups Copepoda-Mysidacea) to medium (Group 2 Salpida-Ostracoda), and low abundance (Group 3 Cephalopoda-Cirripedia) (Fig. 4a).

Cluster analysis applied to 69 of the most abundant taxa (identified down to genus and species) showed also three groups of stations segregating two groups that separate west and south of the archipelago (1 W, 2 S) and a third group that include stations from northwest (3 NW) of the IMA (Fig. 4b). Cluster analysis was used to determine species assemblages (120 species, excluding those identified only to genus family taxonomic level) at 25% of similarity (dashed line) showed four species groups (Groups 1-4). Species

Table 4. Fish larvae (ichthyoplankton) taxonomic assemblage collected at the Mexican Tropical Pacific, Gulf of California and California Current System. nd: no data available, *: Juvenile and adult fish checklist investigation carried out diving during November 2010 survey (Erisman *et al.*, 2011).

Region	Location	Order number	Family number	Genera number	Species number	Dominant species	Sampling effort	Reference
Mexican Tropical Pacific	Islas Marías Archipelago (adults)*	18	73	197	294	7	31 locations & literature review*	Erisman *et al.* (2011)
	Islas Marías Archipelago	9	23	38	107	3	11 samples Nov 2010	This study
	Isla Isabel	8	23	25	45	3	12 samples Oct	Funes-Rodríguez (unpubl. data)
	Jalisco and Colima bays	15	43	58	98	1	72 samples; 11 monthly surveys	Silva-Segundo *et al.* (2008)
	Jalisco and Colima shelf	21	57	80	111	1	132 samples; 11 monthly surveys	Franco-Gordo *et al.* (1999, 2002)
	Sinaloa, Jalisco and Colima shelf and oceanic region	nd	57	56	131	2	100 samples; 2 months surveys	León-Chávez *et al.* (2010)
	Tehuantepec, Oaxaca	18	29	43	73	2	68 samples; 2 months surveys	López-Chávez *et al.* (2012)
Gulf of California	Gulf of California	21	95	57	283	3	465 samples; 1984-1988	Aceves-Medina *et al.* (2003)
Baja California Peninsula	West coast Baja California	nd	57	104	151	2	~275 samples; 1998-2000	Jiménez-Rosenberg *et al.* (2010)
	West coast Baja California Sur	nd	58	102	128	2	~143 samples; 1998-2000	Jiménez-Rosenberg *et al.* (2010)
California Current System	Point Conception-Punta Eugenia	nd	51	39	191	nd	11,500 samples; 1954-60	Moser *et al.* (1987)
	Oregon-southern tip of Baja California	nd	nd	nd	249	nd		Moser & Smith (1993)
	California Current and adjacent seas	25	141	340	467	nd		Moser (1996)

of Group 1 (12 taxa; *Acartia lilljeborgii* Giesbrecht–*Grapsus* sp.) were located mostly along the west coast of the archipelago. The Group 2 (7 taxa; *Pagurus* sp. 1–*Muggiaea atlantica* Cunningham) along the west coast of the archipelago. Species of Group 3 (43 taxa; *Canthocalanus pauper* (Giesbrecht)-*Diphyidae* sp.) was the most diverse and widely distributed in all the IMA including most of the numerically dominant copepod species in the zooplankton samples present in the four islands. The last Group 4 [7 taxa with very low abundance; *Euphausia eximia* Hansen–*Planktomya henseni* Simroth] had a very patchy distribution pattern. Overall, the species group assemblages at IMA showed a geographical separation (mostly a longitudinal cline likely enhanced by the presence of the shelf-break at the west of IMA) on moderates and low abundance taxa but not for species highly abundant and widely distributed among the four islands (Figs. 4a-4b).

DISCUSSION

Islas Marías Archipelago species assemblage (neritic *vs* oceanic affinity)

Our zooplankton assemblage study provides an emerging view about how the IMA show large proportion of a diverse tropical-neritic species dominated by 12 holoplanktonic taxa (mostly crustaceans) and, in less proportion, eight meroplanktonic taxa (fish eggs and larvae were here considered as separated groups), inhabiting a relatively mesotrophic habitat featured with low Chl-*a* concentration and low zooplankton biovolume (López-Sandoval *et al*., 2009; Fernández-Álamo & Färber-Lorda, 2006). Comparing IMA zooplankton community structure from IMA with those collected at offshore waters of the Gulf of California and coastal region of Cabo Corrientes we found a more similar zooplanktonic fauna with the tropical coastal species assemblage previously detected along Cape Corrientes coast, Jalisco, Mexico.

For example, Islas Marías Archipelago fish larvae species, family composition, and abundance, were similar to those detected during another zooplankton survey carried out during October 2002 in 12 sites at Isabel Island, located ~27 km offshore Nayarit coast and ~70 km East from IMA (Funes-Rodríguez *et al*., unpublished data) (Table 4). This dominant species composition is consistent with other ichthyoplanktonic studies carried out along the continental shelf of the Cabo Corrientes region, where most specious families were flatfishes (Franco-Gordo *et al*., 2002) and reef fishes (Silva-Segundo *et al*., 2008). One interesting exception of this pattern observed in the present study was the presence of *Auxis* sp. (Scombridae), as the relatively most abundant fish larvae recorded near the

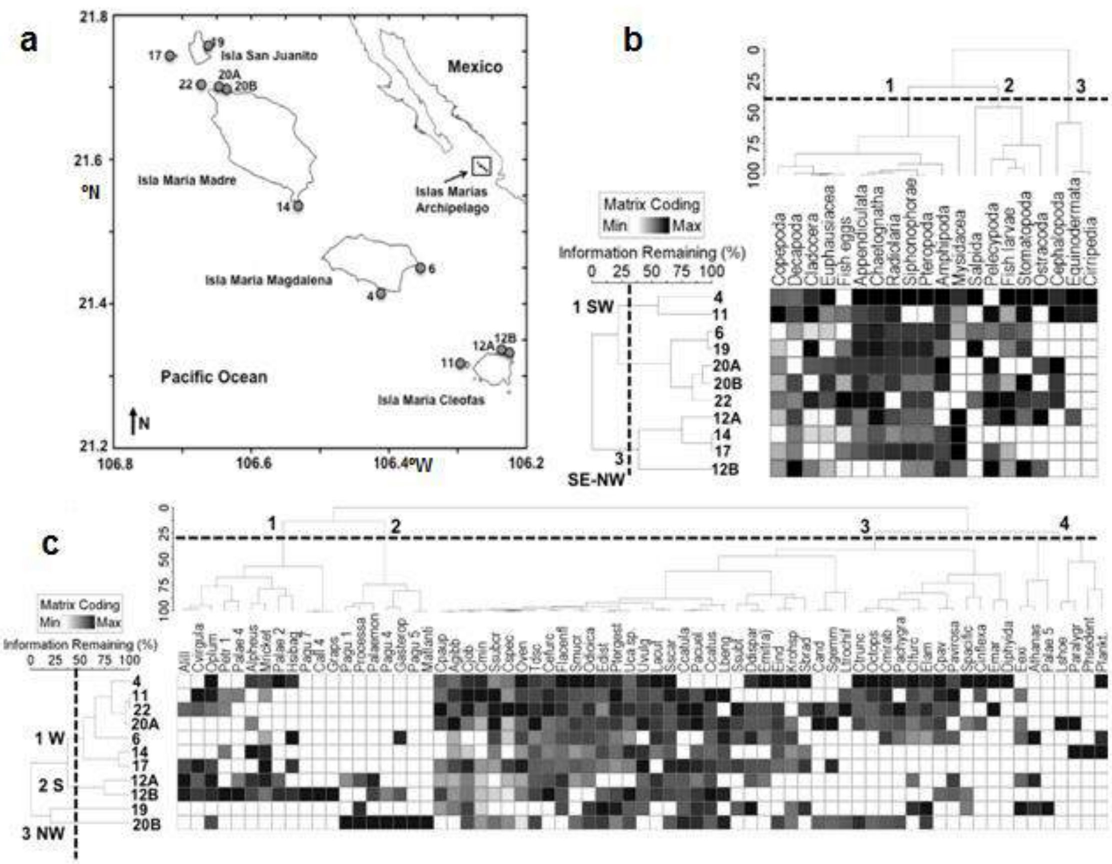

Figure 4. a) Map with station sampled, Two-way cluster analysis of zooplankton identified per b) taxonomic group, and c) dominant zooplankton species during November 2010 at Islas Marías Archipelago.

coast of IMA, because tuna are a well-known oceanic affinity species in the TEP region. Without this exception, the rest of the IMA fish larvae species were of neritic affinity (different to fish larvae typically observed at offshore regions of the mouth of the Gulf of California) numerically dominated by the tropical mesopelagic, like *Benthosema panamense* (Aceves-Medina *et al*., 2004; González-Armas *et al*., 2008; León-Chávez *et al*., 2010). In the TEP assemblages, the tropical mesopelagic *Vinciguerria lucetia* and *Diogenicthys laternatus* (Garman) species dominate the transition region in winter; while the neritic pelagic, *Bregmaceros bathymaster*, dominates the "coastal-oceanic" assemblage in autumn at Cabo Corrientes region (León-Chavez *et al*., 2010), near the coasts of Jalisco and Colima States (Siordia-Cermeño *et al*., 2006), and at Gulf of Tehuantepec (López-Chávez *et al*., 2012).

Near shore IMA region showed relatively low copepod diversity (35 species) of tropical affinity that contrasts with the about 480 copepods species recorded for the TEP region (Central America, Galapagos, Northern Perú) (Razouls *et al*., 2005-2012; Suárez-Morales & Gasca, 1998) and ≈130 species in the Gulf of California (Brinton *et al*., 1986, Hernández-Trujillo & Esquivel-Herrera, 1989; Palomares-García *et al*., 1998, 2013). This low Copepoda diversity at IMA is likely related with the shallow and coastal sampling done in the present study. Five species (*Calanopia minor, Clausocalanus jobei, Acrocalanus gibber*, *Canthocalanus pauper*, and *Centropages furcatus*) accounted for about 43% of total abundance of all the 259 identified species. As far as we know, this is the first record of *Calanopia elliptica* and *Acrocalanus gibber* in Mexican waters according with species detected in three exhaustive free-living marine Copepoda checklists (Palomares-García *et al*., 1998; Suárez-Morales & Gasca, 1998; Razouls *et al*., 2005-2012). These five copepod species are tropical and subtropical neritic species that have not been recorded or detected in very low abundances at offshore regions of the TEP, where are numerically dominated by species of oceanic affinity, like *Subeucalanus subtenuis* (Giesbrecht) (33.5%), *Subeucalanus subcrassus* (Giesbrecht) (12.8%), and *Rhincalanus nasutus* Giesbrecht (9.5%) from a copepod assemblage of 63 species (Chen, 1986). Palomares-García *et al*. (2013) detected 53 Copepoda species in the central and northern Gulf of California showing different dominant species during winter [*Pleuromamma gracilis* Claus, *Calanus pacificus* Brodsky, *R. nasutus*, and *Scolecithrix danae* (Lubbock), summing 65%] than during summer [*Centropages furcatus*, *Clausocalanus furcatus* (Brady), and *R. nasutus* 24%]. Except *Canthocalanus pauper* that also was numerically dominant during summer at northern latitudes from the Gulf of California (Palomares-García *et al*., 1998) and at IMA region, the numerically dominant copepod species composition reported in IMA were not dominant at offshore epipelagic habitats from the central and northern regions of the Gulf of California suggesting that IMA has a different zooplankton assemblage (Jiménez-Pérez & Lara-Lara, 1988; Hernández-Trujillo & Esquivel-Herrera, 1989; Palomares-García *et al*., 1998, 2013; Suárez-Morales *et al*., 2000; Siordia-Cermeño & Sánchez-Velasco, 2004; Lavaniegos *et al*., 2012).

At IMA we detected only two mysid species, *Mysidium rickettsi,* that was moderately abundant but with a patchy distribution pattern in the archipelago (63% of frequency of occurrence), and *Syriella pacifica,* detected only in one zooplankton sample in very low abundance. Harrison & Bowman (1987) described *M. rickettsi* from specimens collected by Rickets & Steinbeck in 1940 at Port Marcial, Baja California Sur and Bahía Ohiura, Sonora, and from specimens obtained in the 1980 decade through manta ray gut contents from four localities near Bahía de La Paz B.C.S. collected by Notarbartolo-di-Sciara (1988) (in fact *M. rickettsi* was the second most abundant prey from manta ray just after the euphausiid *Nyctiphanes simplex* Hansen). The presence of *M. rickettsi* at IMA is the southernmost record for this species expanding ~400 km its distribution range from previous reports (Harrison & Bowman, 1987; Notarbartolo-di-Sciara, 1988). This is also relevant evidence that IMA represents a neritic habitat suitable for mysids (mysids are not detected in offshore oceanographic cruises) even than this Archipelago is located 70-90 km offshore from Cabo Corrientes coast.

Euphausiids also suggest a neritic tropical habitat because were detected larvae and juveniles of two endemic neritic TEP krill species that dominate Cabo Corrientes region: *Euphausia distinguenda* and with less abundance *E. lamelligera*. Both species are well known from previous studies at the central Mexican Pacific coast (Mundhenke, 1969; Brinton, 1979), the mouth of Gulf of California (Färber-Lorda *et al*., 2004, 2010) and along the Jalisco-Colima coast where *E. distinguenda* (88-90%) outnumbers *E. lamelligera* (7%) (Ambríz-Arreola *et al*., 2012). This abundance pattern contrast with offshore waters where *E. lamelligera* is considerably more abundant than *E. distinguenda* (Brinton, 1979; Brinton & Townsend, 1980; Brinton *et al*., 1986; Farber-Lorda *et al*., 2010). Because we sampled only near-shore shallow seafloor (10-40 m depth) we expected to find only larvae and juvenile, since adult's distribution is related with deeper seafloor as they do large daily vertical migrations (Lavaniegos, 1996; Tremblay *et al*., 2010).

The amphipods *Lestrigonus bengalensis* and *Hyperioides sibaginis* (Stebbing) were the most abundant of 15 Amphipoda species collected at IMA. *L. bengalensis* is the most abundant amphipod in the entire Gulf of California, particularly in neritic waters, while *H. sibaginis* is considered uncommon in the gulf, but relatively abundant at IMA region (Siegel-Causey, 1982; Brinton *et al*., 1986; Gasca & Franco-Gordo, 2008; Gasca *et al*., 2012). Along the coast of Cape Corrientes, occurs a considerably more diverse amphipod assemblage (80 species, 3-48 species per oceanographic station), but also overwhelming numerically dominated by these two amphipod species (both accounting 79% of the total Hyperiidae amphipod abundance). However, *H. sibaginis* (65%) is typically more abundant than *L. bengalensis* (14%) throughout the year in Cape Corrientes (Gasca & Franco-Gordo, 2008; Gasca *et al*., 2012). If amphipod species *per se* does not give a clue about if IMA is a neritic or oceanic habitat maybe their abundances can do. Hyperiidae, particularly the most numerically dominant species, are typically more abundant inshore (1432 ind 1000 m^{-3}, 68 species) than offshore (736 ind 1000 m^{-3}, 77 species) (Gasca *et al*., 2012). This explains the relatively low mean abundance of hyperiid amphipods (917 ind 1000 m^{-3}) at IMA as an amphipod coastal-oceanic species diversity gradient, although does not explain the relatively low amphipod species richness (15 species) (sampled at locations <30 m depth). However, it is clear that Islas Marías amphipods were clearly dominated by tropical-neritic amphipod species typical from the Panamic region (Valencia & Giraldo, 2009), being considerably different from California and Baja California peninsula regions, the Gulf of California, and Central region of Mexican Pacific (Lavaniegos & Ohman, 2003; Lavaniegos & Hereu, 2009).

At IMA and Banderas Bay coast (Cape Corrientes) the Chaetognatha *Parasagitta euneritica* (Alvariño) (84%) and *Flaccisagitta enflata* (Grassi) (8.3%) were the most abundant and widely distributed species from the 7 species of Chaetognatha detected near the coast (Ruiz-Boijseauneau *et al*., 2004). *P. euneritica* is a coastal epiplanktonic species distributed along the coastal waters of the eastern Pacific Ocean, from 45°N to Baja California and inside the Gulf of California (Bieri, 1957, 1959; Alvariño, 1965, 1969; Hernández-Trujillo & Esquivel-Herrera, 1989; Ruiz-Boijseauneau *et al*., 2004; Cota-Meza, 2011). Through the Gulf of California four [*F. enflata*, *Sagitta minima* (Grassi), *P. euneritica* (Alvariño), and *Decipisagitta decipiens* (Fowler)] of the 17 Chaetognatha species are widely distributed in the region while *Flaccisagitta hexaptera* (D´Orbigny), *Aidanosagitta neglecta* (Aida), *Zonosagitta bedoti* (Beraneck) (all them originally included in the genus *Sagitta*), and *Krohnitta pacifica* Ritter-Záhony of tropical affinity were detected only in the mouth of the gulf (Alvariño, 1969). At Banderas Bay, located south of IMA region, the most common Chaetognatha species were *P. euneritica, A. neglecta, F. enflata, Z. bedoti, Serratosagitta pacifica* (Tokioka), *S. minima*, and *K. pacifica*.

Thus, with few exceptions, most of the taxonomic species group defines IMA zooplankton species assemblage as a neritic tropical habitat. However, IMA insular waters seem to have mesotropic conditions proper of offshore waters rather than relatively more productive coastal waters from Cape Corrientes coast because tropical waters from the TEP influenced the IMA region. Zooplankton biovolume at IMA (mean 63 mL 1000 m^{-3}) was comparable with the zooplankton biovolume range 50-100 mL 1000 m^{-3} throughout the year reported from oceanic epipelagic waters of the TEP from a comprehensive large-scale integration of historical data set (1955-2000) (Fernández-Álamo & Färber-Lorda, 2006). We sampled during the summer-autumn period (November 2010), when Islas Marías Archipelago usually have the lower phytoplankton biomass productivity (López-Sandoval *et al*., 2009) and considerably lower zooplankton biovolume values than those recorded from the central Gulf of California during November 2005, and January and July 2007 (Table 1, same plankton sampling method) or from the mouth of the Gulf of California and off Cape Corrientes (>300 mL 1000 m^{-3}) observed during November 2005 and March 2007 (collected with Bongo oblique tows) (León-Chávez *et al*., 2010).

Oceanographic processes that enhance coastal-insular zooplankton connectivity

Although the IMA is located relatively offshore (90-120 km), this is still located over the continental shelf near and east of the shelf-break. The similarity of multiple neritic and tropical species in the zooplankton assemblage from IMA and Cape Corrientes suggests strong coastal-insular zooplankton connectivity. However, which oceanographic processes enhance this possible coastal-insular plankton connectivity? An extensive literature review suggests that at least three mesoscale oceanographic processes could be involved in episodic events of continental-archipelago zooplankton population connectivity:

1) Intense river's plumes occurring during the hurricane season (August-October) affect the turbidity and increase Chl-*a* concentration (probably also detected with surface salinity), modifying also other physical and chemical characteristics (Martínez-Flores *et al*., 2011) and, more interestingly, sporadically transporting plankton from Cape Corrientes coast toward offshore waters. Thus, this process may facilitate the colonization of meroplanktonic organisms in the IMA benthic and demersal habitats. For example, a plume of river's discharges originated from Acaponeta, San Pedro, Santiago, and Ameca, detected in August 2004, covered an area of 44,000 km^2 reaching offshore regions, as far ~300 km offshore from the Nayarit coastline surrounding the IMA and Isla Isabel (Martínez-Flores *et al*., 2011).
2) Although it is unlikely that the IMA region becomes influenced by the regular seasonal coastal-upwelling activity detected off Cape Corrientes region (Ambríz-Arreola *et al*., 2012), because it is located far beyond the 60-km distance of influence that typically coastal upwelling events have (Bakun, 1996); recently it was proposed, with an altimeter merged data series of 18 years (October 1992-October 2010), a close connection of coastal wind-forced upwelling with the generation of large cyclonic and anticyclonic eddies (>10 weeks duration, mostly cyclonic) in the Cape Corrientes region that travel offshore with southwest direction in the TEP (Kurczyn *et al*., 2012). Mesoscale eddies in this region also can be formed through baroclinic instabilities of the near-coastal currents (Pantoja *et al*., 2012), interaction of the large-scale circulation with the bottom topography (Kurian *et al*., 2011), local wind-forcing (Pares-Sierra *et al*., 1993), or coastally trapped waves of equatorial origin (Zamudio *et al*., 2001, 2007). These long-lived eddies were mainly nonlinear and therefore can redistribute coastal waters relatively far into the open ocean. Cyclonic and anticyclonic eddies in TEP region influence retention and transport of zooplankton offshore (Fernández-Álamo & Färber-Lorda, 2006), like fish larvae (León-Chávez *et al*., 2010) and krill species assemblages (Färber-Lorda *et al*., 2004, 2010).
3) Another seasonal process that can strongly influence IMA insular zooplankton is a summer intense coastal poleward current of 90-180 km wide and 250-400 m deep with surface speed between 0.15 and 0.35 m s^{-1} (Lavín *et al*., 2006). This process

may explain why zooplanktonic fauna at IMA region during November 2010 was mostly formed by tropical affinity species, rather than having a large proportion of fauna from the northern subtropical Gulf of California (Mundhenke, 1969; Brinton, 1979; Brinton *et al*., 1986; Fernández-Álamo & Färber-Lorda, 2006).

All these three oceanographic processes might explain why insular plankton have a large component of neritic tropical zooplankton rather than typically oceanic plankton affinity that usually occur at region >70 km offshore in the Gulf of California.

Potential methodological biases

Although the present study was far to be comprehensive (11 samples collected only during November 2010), this was done in the IMA restricted access zone (a really difficult site to sample due the existence of a Federal Prison at Isla Madre) and provided an interesting new perspective about the zooplankton neritic and tropical affinity (due the uncommon effort to gather taxonomic experts on 12 taxonomic zooplankton groups). However, the present study has several methodological limitations that must be taken into account. 1) It is evident that seasonal contrasting sampling must be done if we want to understand seasonal community structure variability, reproductive periods, as well as population attributes of zooplankton fauna that interact with near-shore benthic and nektonic fauna that inhabit the Islas Marías Archipelago. 2) Near-surface plankton net tow sampling effort likely underestimate relative abundance and species diversity of epibenthic plankton like mysids. During several scuba diving carried out in rocky and rhodolith seafloor in November 2010, we observed dense epibenthic mysid swarms that seem to play a relevant trophic function for demersal and benthic local zooplanktophagous predators. 3) The IMA fish larvae species and morph composition must be biased toward a seasonal reproductive of some fish species. Even though, this study provided evidence that may complement other studies done in this archipelago in the future. It was interesting that several fish species recorded in the present study as larvae were not included in the juvenile and adult species checklist from Islas Marías (Erisman *et al*., 2011). The present work increased the fish species list in the IMA with larvae of the families: Clupeidae (*Opisthonema* sp. 1); Phosichthyidae [*Vinciguerria lucetia* (Garman)]; Myctophidae [*Benthosema panamense* (Tåning)]; Bregmacerotidae (*Bregmaceros bathymaster* Jordan & Bollman); Serranidae (*Ephinephelus analogus* Gil, *Paralabrax loro* Walford, *Paranthias colonus* Valenciennes); Ammodytidae [*Ammodytoides gilli* (Bean)]; Tripterygiidae [*Enneanectes nigricaudus* (Allen & Robertson), *E. reticulates* Allen & Robertson, *E. sexmaculatus* (Fowler)]; Dactyloscopidae [*Dactyloscopus pectoralis* Gill, *Gillellus semicinctus* Gilbert, *Heteristius cinctus* (Osburn & Nichols)]; Labrisomidae [*Dialommus macrocephalus* (Günther)]; Chaenopsidae (*Acanthemblemaria crockery* Beebe & Tee-Van), Scombridae (*Auxis* sp. 1); Nomeidae (*Psenes sio* Haedrich), and Paralichthydae (*Citharicthys platophrys* Gilbert). Clearly, these differences obey that adults of such species typically inhabit meso-pelagic, neritic, bentho-pelagic, or oceanic habitats not covered observed during the diving surveys reported in Erisman *et al.* (2011).

Although estimate species diversity is one of the most common topics in marine ecology this endeavor requires an enormous amount of taxonomic expertise knowledge to identify the entire community of organisms that interact each other in this habitat. In the present study we attempted, from a modest sample size, identify as precise as possible most of the zooplankton assemblage of the tropical Islas Marías Archipelago. As a region not previously studied we found a large proportion of fish larvae not previously observed at ichthyoplanktonic surveys done along the west coast of Baja California Peninsula, Gulf of California, or Cape Corrientes regions during the more three decades of research (1980 to 2014) (Aceves-Medina *et al*., 2003, 2004; Franco-Gordo *et al.*, 1999, 2004; Aceves-Medina *et al*., 2003, 2004; Funes-Rodríguez *et al*., 2011; Silva-Segundo *et al*., 2008; León-Chávez *et al*., 2010; Funes-Rodríguez *et al*., 2011; Avendaño-Ibarra *et al*., 2013, 2014). These are most likely fish larvae of benthic or demersal coastal fish species, which larval description and taxonomy is still highly fragmented (Brogan, 1992; Moser, 1996). Fish larvae descriptions from species distributed in the Colombian Pacific were particularly useful in the present study (Beltran-León & Ríos-Herrera, 2000), indicating the tropical zoogeographic affinity of ichthyoplanktonic fauna collected at IMA. This lack of taxonomic knowledge is prevalent in numerous taxonomic groups in Mexican waters (particularly in tropical habitats) like Decapoda, Mysidacea and all eight taxonomic groups not identified here to species level (Table 2). Therefore, define precisely the zooplankton assemblage at IMA, or in general in the Mexican TEP region, is currently an enormous scientific and taxonomic challenge if we want to understand how this small tropical Archipelago interact with processes responsible of self-maintained productivity and plankton population connectivity of this Archipelago with coastal and offshore ecosystems.

CONCLUSIONS

Insular near-shore zooplankton fauna from Islas Marías Archipelago (IMA) is dominated, in November, by species not typically captured in offshore regions of the central and northern Gulf of California regions, but they seem to be quite similar to coastal zooplankton assemblage from Cape Corrientes region. These results suggest that IMA has considerably zooplankton connectivity with the Mexican mainland coast. The most likely mesoscale oceanographic processes responsible of this coastal-insular plankton connectivity could be episodic plumes from river runoff during the seasonal hurricane season, during rainy years, eddies generated by coastal upwelling, and coastal polarward currents that result in an overall plankton drift from Cape Corrientes coast toward offshore waters. Five tropical and neritic copepod species and a Cladocera, *Pseudoevadne tergestina* dominate zooplankton species assemblage suggesting these species have a relevant tropho-dynamic role at coastal and insular habitats being available for planktophagous predators from the islands. Because ichthyoplankton (egg and larvae), mollusks and Decapoda taxonomy is poorly known in a taxonomic perspective, this represent an interesting investigation field to discover and describe the diverse cryptic, demersal, and benthic species community reported from this tropical Archipelago.

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