UNIVERSIDADE FEDERAL DE PERNAMBUCO
CENTRO DE TECNOLOGIA E GEOCIÊNCIAS
DEPARTAMENTO DE OCEANOGRAFIA
PROGRAMA DE PÓS-GRADUAÇÃO EM OCEANOGRAFIA

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ESTRUTURA, MIGRAÇÃO E FLUXO DE BIOMASSA DA COMUNIDADE ZOOPLÂNCTONICA DEMERSAL EM DUAS ÁREAS RECIFAIS DO NORDESTE BRASILEIRO

Recife
2019

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Dissertação apresentada ao Programa de Pós-Graduação em Oceanografia da Universidade Federal de Pernambuco (PPGO-UFPE), como requisito parcial para a obtenção de título de Mestre em Oceanografia.

Área de concentração: Oceanografia Biológica.

Orientador: Prof. Dr. Pedro Augusto Mendes de Castro Melo.
Coorientadora: Profa. Dra. Sigrid Neumann Leitão

Recife

2019

Catalogação na fonte
Bibliotecária: Rosineide Mesquita Gonçalves Luz / CRB4-1361 (BCTG)

F224e Farias, Gabriel Bittencourt.
Estrutura, migração e fluxo de biomassa da comunidade zooplânctonica demersal em duas áreas recifais do Nordeste brasileiro / Gabriel Bittencourt Farias. – Recife, 2019.
67 f., il., figs., gráfs. e tabs.

Orientador: Prof. Dr. Pedro Augusto Mendes de Castro Melo.
Coorientadora: Profa. Dra. Sigrid Neumann Leitão.

Dissertação (Mestrado) – Universidade Federal de Pernambuco. CTG. Programa de Pós-Graduação em Oceanografia, 2019.
Inclui Referências.

1. Oceanografia. 2. Zooplâncton demersal. 3. Recifes. 4. Biomassa. 5. Produção. 6. Armadilha de emergência. I. Melo, Pedro Augusto Mendes de Castro (Orientador). II. Leitão, Sigrid Neumann (Coorientadora). III. Título.

551.46 CDD (22. Ed.) UFPE/BCTG-2019/58

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Aprovada em: 11/02/2019.

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AGRADECIMENTOS

Agradeço a minha mãe que com todo esforço e sacrifício me ensinou que o maior bem que ela poderia me dar seria a educação. Por todo apoio e exemplo que ela me deu e continua dando, eu não teria chegado a lugar nenhum se não fosse por você Gena.

Ao meu orientador Prof. Dr. Pedro Augusto Mendes de Castro Melo, por acreditar e me orientar por toda essa jornada.

A minha co-orientadora Drª Sigrid Neumann Leitão pelas risadas e ensinamentos ao longo desses dois anos, e por ser uma luz no meio do caos da academia que reforça a importância das pessoas acima das coisas.

Agradeço a Michelle e Jeniffer, que apesar da distância de centenas de Km me acompanharam todos os dias nessa jornada, dando apoio e me atualizando das alegrias e confusões que ficaram na terra mãe.

A Simone, que foi o presente que 2018 trouxe para mim, obrigado por me completar e tornar o final desse mestrado muito mais leve.

Agradeço aos amigos do Laboratório de Zooplâncton da UFPE (Claudeilton Santana, Gabriela Figueiredo, Gleice Santos, Simone Lira, Nathalia Lins, Morgana Loyola, Ralf Cordeiro, Kaio Farias, Xiomara Díaz e Lucas Figueiredo) pela convivência e pelos inúmeros momentos de alegria que dividimos. Pelas discussões (saudáveis e não), brincadeiras, procrastinações e aprendizados. Fazendo com que esses 2 anos passassem muito mais rápido.

Ao CNPq pelo financiamento deste projeto. Agradeço também ao Departamento de Oceanografia e ao Programa de Pós-Graduação em Oceanografia.

RESUMO

A presente dissertação é composta por dois capítulos forma de manuscrito, ambos com o intuito de avaliar a comunidade mesozooplanctônica demersal de ambientes recifais, em Tamandaré (capítulo 1) e Arquipélago de Abrolhos (capítulo 2), em termos de estrutura, produção e biomassa, estimando os padrões de exportação de carbono desse compartimento para o ambiente pelágico. Em ambos estudos foram utilizadas armadilhas de emergência para a coleta do mesozooplâncton demersal, colocadas ao pôr do sol e retiradas ao nascer do sol. No capítulo 1 foi considerada a variação sazonal (seco e chuvoso) e em curta escala de tempo (dias), bem como a capacidade de dois esforços amostrais distintos (intensivo e trimestral) em avaliar essa comunidade. 72 taxas foram identificados, com o período seco apresentando uma maior densidade e diversidade a partir de um esforço intensivo, enquanto que para o esforço trimestral não foi observada diferença entre os períodos para estes parâmetros, destacando a melhor representatividade da comunidade a partir de uma maior intensidade amostral. Entre os períodos seco e chuvoso, em ambos os esforços, não foram observadas diferenças significativas para a biomassa e produção. A comunidade demersal apresentou uma grande contribuição em biomassa e produção para a teia trófica pelágica, sendo destacada a contribuição dos organismos maiores como Mysidacea e Amphipoda em detrimento de Copepoda, apesar deste último dominar em termos de abundância. Para o capitulo 2 foram considerados dois tipos de substrato (areia e recife de coral) e a variação interanual (2014 x 2016). 71 táxons foram identificados no arquipélago de Abrolhos durante os dois anos, com 2016 apresentando um maior número de táxons exclusivos e uma maior riqueza de espécies. Para os substratos foram observadas diferenças apenas para a abundância, com o recife apresentando uma abundância cerca de 3x superior a observada em fundo arenoso. Através da PERMANOVA foi possível observar que a comunidade faunística se diferiu tanto entre os substratos quanto entre os anos. Foi possível também constatar uma grande contribuição de carbono da comunidade demersal para o meio pelágico em ambos os anos independente do substrato. Através da presente dissertação foi possível destacar o papel dos organismos demersais na teia trófica pelágica, enfatizando a sua contribuição no fluxo de energia e carbono. Aqui ainda se aponta a necessidade de mais estudos específicos sobre essa comunidade, que não é corretamente amostrada utilizando redes de arrasto.

Palavras-chave: Zooplâncton demersal. Recifes. Biomassa. Produção. Armadilha de emergência.

ABSTRACT

The present dissertation is composed of two chapters in manuscript form, both with the purpose of evaluating the demersal mesozooplankton community of reef environments, in Tamandaré (chapter 1) and Abrolhos Archipelago (chapter 2), in terms of structure, production and biomass, estimating the carbon export standards of that compartment for the pelagic environment. In both studies, emergence traps were used for the collection of demersal mesozooplankton, placed at sunset and retreats at sunrise. In Chapter 1, seasonal variation (dry and rainy) and short time scale (days) were considered, as well as the capacity of two distinct sampling efforts (intensive and quarterly) to evaluate this community. 72 taxa were identified, with the dry period presenting a higher density and diversity from an intensive sampling, whereas for the quarterly sampling no difference between the periods for these parameters was observed, highlighting the better representativeness of the community from a larger sample intensity. Between the dry and rainy periods, in both samplings, no significant differences were observed for biomass and production. The demersal community presented a great contribution in biomass and production to the pelagic trophic web, mainly due to the contribution of the larger organisms like Mysidacea and Amphipoda in comparison to Copepoda, although the latter dominated in terms of abundance. For Chapter 2, two types of substrate (sand bottom and coral reef) and the interannual variation (2014 x 2016) were considered. 71 taxa were identified in the Abrolhos archipelago during the two years, with 2016 presenting a higher number of exclusive taxa and greater species richness. Differences between substrates were restricted to the abundance, with the reef having an abundance about 3x higher than the one observed in sand bottom. Through PERMANOVA, it was possible to observe that the faunistic community differed between substrates and between years. It was also possible to observe a large contribution of carbon from the demersal community to the pelagic environment in both years regardless of the substrate. Through this dissertation it was possible to highlight the role of demersal organisms in the pelagic trophic web, emphasizing their contribution to the energy and carbon flux. Here we also pointed out the need for more specific studies on this community, which is not correctly sampled using trawl nets.

Keywords: Demersal zooplankton. Reefs. Biomass. Production. Emergence trap.

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SUMÁRIO

1 INTRODUÇÃO GERAL

Recifes de coral são um dos ecossistemas mais produtivos, diversos e economicamente importantes do planeta (Connell, 1978; New, 1995; Kohn, 1997), apesar de apresentarem uma distribuição restrita às regiões tropicais e compreenderem apenas cerca de 0,09 % da superfície do oceano global (Moberg & Folke, 1999; Spalding et al., 2001). Os recifes possuem um papel importante na sobrevivência dos ecossistemas marinhos tropicais por realizarem trocas de nutrientes, água e de organismos planctônicos com os ambientes oceânicos adjacentes (Doherty & Williams, 1988; Hamner et al., 1988; Hamner et al., 2007; Lowe e Falter, 2015), assim aumentando a sua produtividade. Nesses ambientes a contribuição energética do zooplâncton apresenta grande importância para a trofodinâmica e manutenção do ecossistema (Alldredge e King, 1977; Carleton, 1993; Schnack-Schiel e Isla, 2005). Dessa forma o zooplâncton representa um dos grupos mais importantes nas teias alimentares pelágicas, agindo como um eficiente elo trófico entre os produtores primários e os consumidores superiores, além de apresentar um notável papel na ciclagem de nutrientes nas massas d’água (Ketchum, 1962; Turner et al., 2001).

A comunidade zooplanctônica nas áreas recifais se apresenta de forma distinta das adjacentes em termos de composição e número de indivíduos (Tranter e George, 1972; Renon, 1978). A existência de uma comunidade zooplânctonica residente dos recifes de coral já havia sido indicada em trabalhos iniciais como os de Motoda (1940), Johnson (1949) e Johnson (1954), mas apenas Emery (1968) com o auxílio de material de mergulho foi capaz de observar enxames de organismos zooplanctônicos sobre os recifes, e a diversificação da comunidade ao anoitecer. Essa comunidade foi posteriormente retratada por Porter (1974) como apresentando migração vertical ativa, onde permanece próxima ao substrato durante o dia e ascende a coluna d’água durante a noite, e foi definida como zooplâncton demersal. Devido a sua baixa densidade e comportamento esporádico de migração, métodos convencionais de amostragem do zooplâncton não são adequados para a coleta do zooplâncton demersal (Greene, 1990; Dahms e Qian, 2004). Estudos demonstram uma variação na comunidade ao se utilizar armadilhas e redes de arrasto para amostrar a comunidade demersal (Emery, 1968; Sale et al., 1976), destacando que as armadilhas permitem a amostragem contínua em um período de tempo em um mesmo substrato (Porter et al., 1977; Smith et al., 1979) o que abrange toda a variação de migração existente nessa comunidade.

Múltiplos trabalhos demonstram a importância do zooplâncton demersal nos ambientes recifais (Alldredge e King, 1977; Alldredge e King, 1985; Bishop e Greenwood, 1994; Melo et al., 2010), apontando seu importante papel na produção secundária e na ciclagem de nutrientes, como consumidores (grazers) da produção primária fitoplânctonica (Prins & Smaal, 1990; Turner et al., 2001; Yang et al., 2015), além de atuar no acoplamento bento-pelágico (Schnack-Schiel e Isla, 2005; Lesser, 2006), onde apresentam um papel crucial na transferência de carbono entre os ambientes bentônicos e pelágicos, servindo como presas para outros organismos, tais como corais e esponjas (Sebens, 1977; Heidelberg et al., 2004; Lesser, 2006), elasmobrânquios (Couturier et al., 2013) e outros peixes planctívoros (Robertson & Howard, 1978).

Estimativas de biomassa e produção em um dado ambiente fornecem dados essenciais para o entendimento das dinâmicas ecológicas e do fluxo de energia e carbono através das teias tróficas (Williamson e Gribbin, 1991; Webber e Roff, 1995; Nakajima et al., 2013). A maioria dos estudos sobre biomassa e produção do zooplâncton marinho enfoca em Copepoda (Magalhães et al., 2006; Miyashita et al., 2009), já que esse táxon, geralmente, é numericamente representativo de toda a comunidade (Longhurst, 1985; Boltovskoy, 1999; Schminke, 2007), mas isso pode gerar uma subestimação das informações, tornando-se importante uma análise mais abrangente da comunidade envolvendo os demais táxons. Devido ao importante papel da comunidade demersal recifal, os estudos da sua contribuição de carbono para o ambiente pelágico, são de extrema importância para o entendimento da dinâmica dessa importante comunidade.

No Brasil os sistemas coralinos são limitados as regiões Norte e Nordeste (Spalding et al., 2001; Leão et al., 2003). Dentre os recifes do Nordeste do Brasil se destacam duas áreas, os recifes de Tamandaré em Pernambuco e o banco de Abrolhos na Bahia. A área recifal de Tamandaré compreende um complexo recifal formado por recifes de arenito que segue paralelo a linha de costa (Leão et al., 2003), inserido na APA costa dos corais que compreende a maior unidade de conservação marinha do país (Maida e Ferreira, 1997). Juntamente com algas calcárias, se encontram nos recifes de Tamandaré nove das 18 espécies de corais construtores presentes no Brasil (Maida e Ferreira, 1995), formando uma estrutura recifal complexa e diversificada. O banco de Abrolhos é a formação recifal mais importante no Atlântico Sul tropical com cerca de 8900 km² de extensão, apresenta uma alta diversidade com um grau de endemismo elevado e estruturas coralinas únicas dos recifes de corais brasileiros, que apresentam formato de cogumelo denominadas de chapeirões (Leão, 1999; Leão e Kikuchi, 2005). Apesar da importância dessas regiões, estudos sobre a biomassa e produção do zooplâncton ainda são raros, principalmente no que se refere à contribuição demersal para a comunidade pelágica.

Assim, as principais questões norteadoras do presente estudo foram: (1) Existe uma variação temporal na estrutura da comunidade mesozooplanctônica demersal em ambientes recifais brasileiros? (2) Como essas comunidades atuam no transporte de carbono e energia entre os domínios bentônico e pelágico?

Dessa maneira, a presente dissertação é composta por 2 manuscritos escrito com o intuito de responder os objetivos propostos acima e dispostos da seguinte maneira:

O Manuscrito 1 teve como objetivo analisar a comunidade demersal mesozooplanctônica do ambiente recifal de Tamandaré em termos de estrutura, produção e biomassa, estimando os padrões de exportação de carbono desse compartimento para o ambiente pelágico, levando-se em conta a variação sazonal e em curta escala (dias).

O Manuscrito 2 teve como objetivo analisar a comunidade demersal mesozooplânctonica de Abrolhos em termos de estrutura, produção e biomassa, levando em consideração dois tipos de substrato e a variação anual.

2 TEMPORAL VARIATION OF THE EMERGENT MESOZOOPLANKTON ON A SOUTH ATLANTIC COSTAL REEF

ABSTRACT

Demersal mesozooplankton were captured with emergence traps in a tropical reef system to evaluate temporal variation of the community and the acuity of two sampling efforts, a quarterly sampling and an intensive sampling that was executed during the rainy (8 days) and dry (7 days) seasons. 72 taxa were identified, Copepoda was the most abundant group in both seasons and in the two samplings. A higher abundance in the dry season for the intensive sampling could be observed, with a mean abundance of 281.95 (± 388.63) ind m^{-2} in the rainy season and 299 (± 83.93) ind m^{-2} in the dry season, though no difference was observed for the abundance in the quarterly sampling, neither for the biomass and production regardless of the samplings. The mean biomass for intensive sampling was of 738.5 (± 861.39) mg C m^{-2} in the rainy season and 502.62 (± 239.16) mg C m^{-2} in the dry season and for the quarterly sampling 412.92 (± 177.05) mg C m^{-2} in the rainy season and 1665.54 (± 961.08) mg C m^{-2} in the dry season. The estimated daily production rates was of 2340.2 (± 2595.01) mg C m^{-2} d^{-1} in the rainy season and 1973.6 (± 941.6) mg C m^{-2} d^{-1} in the dry season. The community presented a clear seasonality with a greater abundance and diversity during the dry season. A short scale variation of the community could be seen only for the abundance on the dry season. The intensive sampling describes better the community presenting a higher species richness and evenness. A clear seasonal variation could be observed in this community. Furthermore the emergent fauna contribution to the pelagic system is highlighted here, with this community presenting a considerable carbon and energy increase to the pelagic trophic web.

INTRODUCTION

Coral reefs are among the most diverse and productive ecosystems (Kara *et al.*, 2000), even though are limited to tropical oceans and cover about 0.09% of the earth surface. Within this ecosystem, zooplankton plays a major role as an essential link in the food web, acting as an efficient trophic link between the producers and superior consumers. At such environments, the zooplankton's energetic contribution poses great importance to trophodynamics and maintenance of the ecosystem (Alldredge & King, 1977; Schnack-Schiel & Isla, 2005).

Inside the coral reef ecosystem a unique zooplanktonic community was described by early works (Motoda, 1940; Johnson, 1949; Johnson, 1954; Emery, 1968), these community is characterized as being active vertical migrators, remaining close to the substrate during the day and ascending the water column during the night, being defined as demersal or emergent zooplankton (Porter, J. W., 1974). Therefore these organisms has a recognized importance in the bentho-pelagic coupling (Pitt *et al.*, 2008), where it is prey to several organisms, such as sponges, jellyfish, corals and reef fishes (Robertson & Howard, 1978; Heidelberg *et al.*, 2004; Lesser, 2006; Pitt *et al.*, 2008; Couturier, L. I. *et al.*, 2013). Furthermore, demersal zooplankton plays an important role in the secondary production, cycling of nutrients and as grazers of phytoplankton (Prins & Smaal, 1990; Turner *et al.*, 2001; Yang *et al.*, 2015).

Due to the migration behavior and their low abundance, the conventional zooplankton sampling methods are usually inadequate for collecting the demersal zooplankton (Greene, 1990; Dahms & Qian, 2004). Several studies showed differences when using trawl nets or traps for collecting samples of the demersal community (Emery, 1968; Sale *et al.*, 1976) emphasizing that the traps do allow continuous sampling for a period of time in the same substrate (Porter *et al.*, 1977; Smith *et al.*, 1979) which comprehends the entire migration variation existent in this community.

Few studies on demersal zooplankton were carried out in the tropical South Atlantic, having the current works focused only on the abundance and distribution of this compartment (Silva, 2003b; Melo *et al.*, 2010). The production and carbon contribution of these communities were not approached in these studies.

In the present study, we evaluate the temporal variation of reef emergent mesozooplankton diversity, abundance, biomass, production and the carbon exportation in Tamandaré bay using two different samplings.

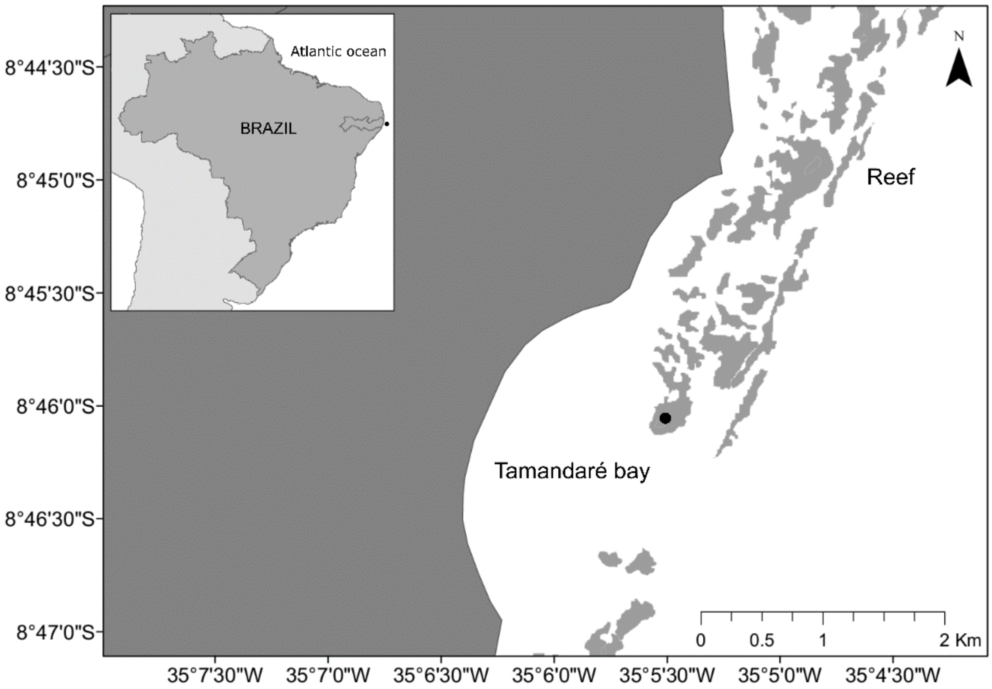
MATERIAL AND METHODS

Study area

The study was carried out on a reef system along Tamandaré Bay on the northeastern Brazilian platform (Figure 1). The shelf near the area has a reduced width (less than 35 km) and low depth, gentle slope, and the shelf break between 50 and 60 m deep and exhibit a sedimentary cover composed by terrigenous sediments and biogenic carbonates. The Tamandaré Bay is located at Latitude 08º44’ to 08º47’30’’S and Longitude 35º05’ to 35º07’W covering about 4 km² in a semicircular shape and having a depth between 7 and 10 meters. The region has a climate typically warm and wet of the AS' type, according to Köppen classification, characterized by a rainy season (April to August) and a dry season (September to March), with temperatures ranging from 25º to 30º C (Moura & Passavante, 1995).

Tamandaré Bay receives the estuarine influence of the rivers Ilhetas, Mamucabas and Una. There are three groups of reef formations, the first one located close to the beach formed by sandy structures and exposed during the low tides, the second on the lagoon between the beach and the reefs and the last one forming a barrier to the sea. The Tamandaré reef complex is part of the Marine Protected Area (MPA) Costa dos Corais, the largest Marine Conservation Unit in Brazil. This MPA was created in April 1999 by the Federal Government to preserve the biodiversity and sustainable use of natural resources on these shallow coastal reefs.

Figure 1 - Demersal zooplankton sampling area at Tamandaré Bay, Pernambuco, Brazil, with the sampling location.

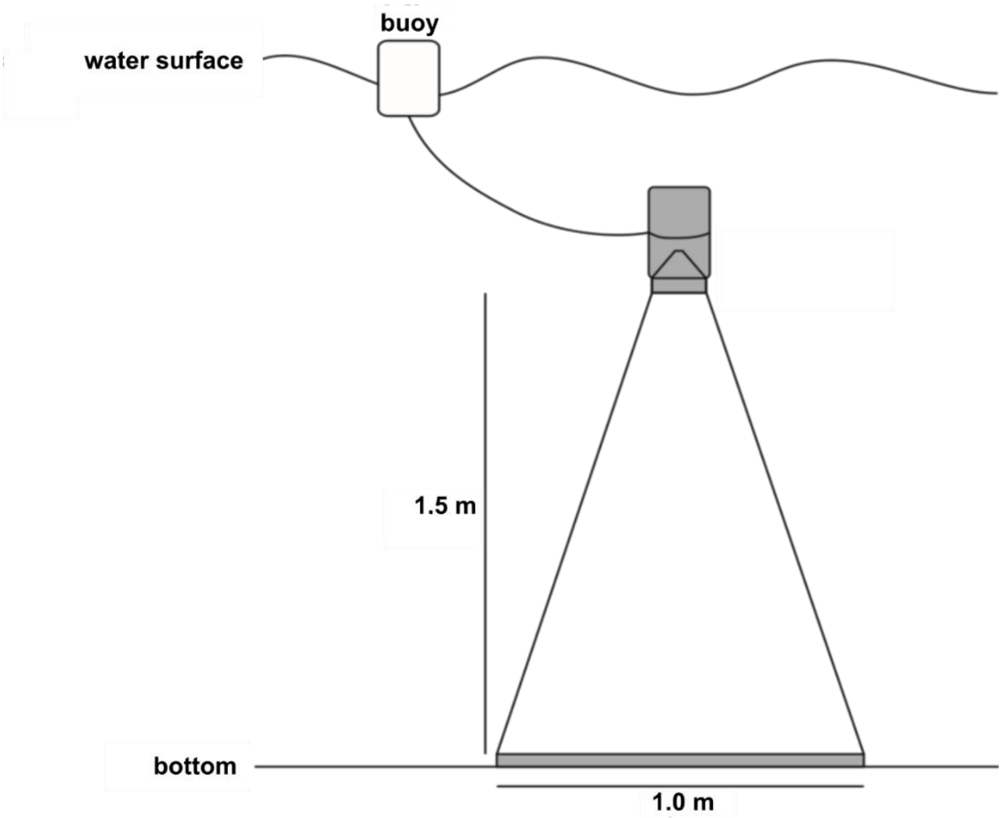


Field collection

Quarterly samplings were conducted between December 2009 and November 2010. Additionally, intensive samplings were executed on the rainy (August 2010) and dry seasons (November 2010), during 8 and 7 days respectively to verify short scale variations. The samples were collected on the reef area in Tamandaré Bay, on a station located over the reef top at approximately 4 m deep. Samplings were carried out at neap tide during the intensive sampling (dry and rainy) and the rainy season for the quarterly sampling, and at spring tide at the dry season on the quarterly sampling.

The samplings were performed with emergence traps (Figure 2) that consist of a conical net (200 µm mesh size) with a mouth of 1 m diameter and 1.5 m of high (Alldredge & King, 1985; Melo *et al.*, 2010). The traps were placed with the mouth directed to the substrate. This type of trap conducts vertically migrating animals through a conical-shaped region into a catch chamber. The traps were placed over the reefs on the dusk and removed at dawn. All the samplings were collected in replicates, totaling 36 samples. The samples were preserved with 4% formaldehyde and buffered with 4 g L^{-1} sodium tetraborate for laboratory analyses (Harris *et al.*, 2000).

Figure 2 - Scheme of the traps for the demersal zooplankton (adapted from Melo *et al.*, 2010).



Sample analyses

The samples were fractionated to a minimum of 300 individuals with a MOTODA splitter and those that presented less than 300 individuals were analyzed in their totality. The samples were analyzed in a Bogorov counting chamber under stereomicroscope. Copepoda taxa were identified to the lowest possible taxonomic level (Harpacticoida to family) using specific literature (Björnberg, 1981; Casanova & Boltovskoy, 1999; Boxshall & Halsey, 2004; Dahms *et al.*, 2006), while the other taxa were identified to general groups (Casanova & Boltovskoy, 1999).

In each sample, 30 individuals of each taxa were measured to perform biomass and production estimations. Biomass (B, µgC.m^{-2}) of a given taxa was based on its abundance (A, ind. m^{-2}) and individual carbon weight (CW, µgC): B = A * CW. The CW was defined using length-weight regressions (Table 1) available in the literature. For Copepoda the CW it was assumed to be 47% of the dry weight (Hirota, 1981), for Appendicularia it was used 44.2% (Hirota, 1986) and for the other taxa 40% (Bamstedt, 1986). Production (mg C m^{-2} d^{-1}) was obtained only for the intensive sampling, as for its calculation the local temperature in the sampling moment is required and such information was only available for the intensive sampling. The Production calculation is based on their biomass and the specific growth rates

(G, d^{-1}): $P = B * G$. The specific growth rate were estimated from previously reported regression equations (Table 2).

Table 1 - Length-weight regressions applied for biomass calculation of main mesozooplankton taxa. Length data inserted in µm.

Taxonomic group	Equation	Reference
Foraminifera*	$pgC = 0.089 * BV$	Michaels *et al.* (1995)
Bivalvia	$\log CW\ (\mu g) = -3.45 + 1.47 \times \log BL$	Hirota (1986)
Gastropoda	$\log CW\ (\mu g) = -5.85 + 2.46 \times \log TL$	Hirota (1986)
Polychaeta*	$DW = 0.005 \times TL^{2.25}$	Hirota (1986)
Polychaeta (larvae)	$\log CW\ (\mu g) = -5.97 + 2.10 \times \log TL$	Matthews & Hestad (1977)
Ostracoda*	$\ln CW\ (\mu g) = 1.03 + 1.46 \times \ln TL$	Heidelberg *et al.* (2010)
Copepoda		
Acartia lilljeborgi	$CW = 6.177 \times 10^{-9} \times PL^{3.029}$	Ara (2001)
Acartia spp.	$\ln CW = 3.09 \times \ln PL - 19.19$	Chisholm & Roff (1990)
Calanopia americana	$\ln DW = 2.67 \ln PL - 15.47$	Chisholm & Roff (1990)
Centropages furcatus	$\ln DW = -22.86 + 3.68 \times \ln PL$	Chisholm & Roff (1990)
Labidocera spp.	$DW = 1.666 \times 10^{-8} \times PL^{2.837}$	Ara (2001)
Paracalanidae	$\ln DW = 2.78 \times \ln PL - 16.52$	Webber & Roff (1995)
Pseudodiaptomus spp.	$DW = 1.306 \times 10^{-9} \times PL^{3.361}$	Ara (2001)
Scolecitrix spp.	$\ln DW = 3.57 \times \ln PL - 21.36$	Webber & Roff (1995)
Temora stylifera	$\log WW = 2.057 \times \log PL - 4.042$	Shmeleva (1965)
Temora spp.	$\ln DW = 3.34 \times \ln PL - 19.59$	Chisholm & Roff (1990)
Calanoida (others)	$\ln DW = 2.73 \times \ln PL - 15.93$	Webber & Roff (1995)
Oithonidae	$\ln DW = 1.10 \times \ln PL - 7.07$	Chisholm & Roff (1990)
Corycaeus spp.	$\ln DW = 1.7 \times \ln PL - 9.92$	Chisholm & Roff (1990)
Harpacticoida	$\log DW = -8.51 + 3.26 \times \log TL$	Hirota (1986)
Monstriloida	$\ln DW = 1.53 \ln PL - 8.7$	Webber & Roff (1995)
Copepoda (nauplius)	$\ln AFDW = 2.48 \ln TL - 15.7$	Bamstedt (1986)
Copepoda (others)	$\log DW = 2.62 \log PL - 6.4$	Imao (2005)
Cirripedia (cypris)	$\log CW = -8.64 + 3.0 \times \log BL$	Hirota (1986)
Cirripedia (nauplius)	$\log CW = -6.90 + 2.65 \times \log BL$	Nakajima *et al.* (2017)
Isopoda*	$\ln CW = 1.03 + 1.46 \times \ln BL$	Heidelberg *et al.* (2010)
Mysidacea*	$\log CW = -0.167 + 3.10 \times \log BL$	Uye (1982)
Cumacea*	$\ln CW = 1.03 + 1.46 \times \ln BL$	Heidelberg *et al.* (2010)
Amphipoda*	$\ln CW = 1.03 + 1.46 \times \ln BL$	Heidelberg *et al.* (2010)
Euphausiacea*	$\ln CW = 1.03 + 1.46 \times \ln BL$	Heidelberg *et al.* (2010)
Decapoda*	$\ln CW = 1.03 + 1.46 \times \ln BL$	Heidelberg *et al.* (2010)
Brachyura (zoea)	$\log CW = -8.68 + 3.39 \times \log CL$	Hirota (1986)
Brachyura (megalopa)	$\log CW = -4.59 + 2.19 \times \log CL$	Hirota (1986)
Chaetognatha		
Sagitta spp.*	$\log DW = 3.24 \times \log BL - 0.975$	Uye (1982)
*Paraspadella nana**	$\log CW = -0.93 + 2.79 \times \log BL$	Hirota (1986)
Appendicularia		
Oikopleura dioica	$\log DW = 2.51 \times \log BL - 6.54$	Gorsky & Palazzoli (1989)

TL – Total length; PL – Prosome Length – BL; Body Length; DW – Dry Weight; CW- Carbon Weight; AFDW – Ash Free Dry Weight; BV – Biovolume; *taxa that the length entry was in mm.

Data analysis

Abundance (ind m^{-2}), relative abundance (%), and frequency of occurrence (%) were calculated to describe the structure of the community and for the frequency of occurrence the following scale were used: abundant (>70%); frequent (70% ⊢ 30%); less frequent (30% ⊢ 10%) and rare (<10%). For the estimation of community diversity Shannon diversity index (H') (Shannon, 1948) was applied, and the evenness was calculated according to Pielou (1977).

The Kolmogorov-Smirnov normality test and the Levene's mean test were applied to test the abundance, biomass, production and ecological indices data. These data were tested for statistical significance by using *t-test* or *Mann-Whitney* to compare the different seasons on the different samplings (quarterly and intensive). Values of $p < 0.05$ were considered significant. Additionally, a permutational multivariate analysis of variance (PERMANOVA) was used to test the significant differences between mesozooplankton community groupings on the different seasons and the short scale variation on the intensive sampling. Because of the sampling replicate limitation, the analysis for the short scale variation had each two days grouped in time periods (T1, T2, T3 for the dry season and T1, T2, T3 and T4 for the rainy seasons). For this, a Bray-Curtis similarity matrix was obtained where the raw data for species abundance were transformed into fourth root, and 9999 random permutations were tested. To graphically visualize the PERMANOVA results a non-metric multidimensional scaling (MDS) was used. Furthermore, a similarity percentage analysis (SIMPER) was conducted to observe the distribution patterns of the mesozooplankton community among the seasons.

Table 2 - Regression equations for estimating instantaneous growth rate of main mesozooplankton groups.

Taxonomic group	Equation	Reference
Polychaeta	$\log G = 0.630 + 0.409 \ \log CW$	Hirst *et al.* (2003)
Copepoda		
Broadcast-spawner	$\log G = 0.0352 \ T \ 0.233 \ \log CW \ 1.230$	Hirst *et al.* (2003)
Sac-spawner	$\log G = 0.0223 \ T + 0.177 \ \log CW \ 1.644$	Hirst *et al.* (2003)
Nauplius	$\log G = 0.0370 \ T \ 0.0795 \ \log CW \ 1.3840$	Hirst & Lampitt (1998)
Crustacea (others)	$\log G = 0.0263 \ T \ 0.327 \ \log CW \ 0.919$	Hirst *et al.* (2003)
Chaetognatha	$\log G = 1.851 + 0.0367 \ T$	Hirst *et al.* (2003)
Appendicularians	$\log G = 0.495 + 0.0285 \ T$	Hirst *et al.* (2003)

G – Growth Rate (d^{-1}); T – Temperature (ºC); CW – Carbon Weight (mg).

RESULTS

A total of 72 taxa were observed in both seasons, being recognized different life stages for some groups (Table 3). Of these 43 were from Copepoda, distributed among the orders Calanoida, Cyclopoida, Harpacticoida and Monstrilloida, 14 taxa were exclusive to the

Intensive sampling while 8 were exclusive to the quarterly sampling (Table 3). Regarding the frequency of occurrence, on the intensive sampling 15 taxa were abundant (in bold), 20 taxa were frequent, 14 were less frequent and 19 were rare (Table 3). On the quarterly sampling 24 were abundant (in bold), 14 were frequent, 19 were less frequent and no rare taxa were observed (Table 3).

Table 3 - Abundance (mean, ind. m^{-2}), relative abundance (%) and frequency of occurrence (%) of the demersal mesozooplankton captured at Tamandaré Bay, PE, Brazil. Taxa with FO > 70% are in bold.

Taxa	Intensive Sampling					Quarterly Sampling				
	Abundance (ind. m²)		%		FO (%)	Abundance (ind. m²)		%		FO (%)
	Dry	Rainy	Dry	Rainy		Dry	Rainy	Dry	Rainy	
Foraminifera										
Tretomphalus bulloides	6.37	22.23	2.21	10.96	**93.33**	26.75	35.35	0.82	14.23	50.00
Globigerinidae	1.91	1.76	0.71	0.99	66.67	16.56	1.59	0.84	0.64	**75.00**
Foraminifera (others)	0.18	3.50	0.06	0.72	40.00	2.55	1.27	0.08	0.45	**75.00**
Phoronida (larvae)*		0.25		0.29	6.67					
Bivalve	0.45	2.71	0.15	1.15	46.67	2.55	5.41	0.08	2.05	**75.00**
Gastropoda	3.28	0.40	0.94	0.14	33.33	3.82	0.32	0.45	0.06	**75.00**
Nematoda	0.09	0.40	0.04	0.15	26.67	1.27		0.04		25.00
Polychaeta	6.19	1.61	2.23	1.17	**100**	17.52	0.64	0.79	0.19	**100**
Polychaeta (larvae)	0.27	0.32	0.10	0.25	26.67	2.55	0.32	0.08	0.06	50.00
Hydrozoa (larvae)	0.18		0.06		13.33	2.87		0.17		50.00
Ostracoda	9.28	3.07	2.90	1.62	**93.33**	17.52	5.73	1.45	1.71	**100**
Calanoida										
Acartia lilljeborgi	11.01	4.11	3.67	1.65	**93.33**	20.38	0.96	2.95	0.38	**75.00**
Acartia spp.	0.09		0.03		6.67	0.32		0.09		25.00
Calanopia americana	12.74		3.89		46.67	87.90		18.33		50.00
Centropages furcatus		0.24		0.07	6.67					
*Labidocera acutifrons***						1.27		0.04		25.00
Labidocera fluviatilis	0.18		0.07		6.67					
Labidocera spp.		0.25		0.29	6.67	1.27		0.04		25.00
Paracalanus spp.	36.40	84.01	11.38	14.23	**100**	1023.89	8.60	32.69	3.26	**100**
*Parvocalanus crassirostris***						26.11		1.30		50.00
Pseudodiaptomus acutus	5.73	23.41	1.70	6.50	**80.00**	123.57	5.73	5.79	1.91	**100**
*Pseudodiaptomus richardi***						43.31		1.33		25.00
Pseudodiaptomus spp.**						0.32		0.09		25.00
Scolecitrix spp.	0.36	0.08	0.11	0.01	26.67	2.55	0.32	0.08	0.06	50.00
Temora turbinata	0.36	2.39	0.12	0.66	33.33	0.64	0.32	0.19	0.13	50.00
Temora stylifera		0.08		0.03	6.67	0.64	0.32	0.19	0.13	50.00
Temora sp.**						1.27		0.04		25.00
Calanoida (nauplius)*		0.16		0.06	13.33					
Calanoida (others)*		0.96		0.34	20.00					
Cyclopoida										
Dioithona oculata	20.93	32.61	6.61	5.53	**86.67**	13.69	4.46	0.67	1.66	**100**
Oithona spp.	0.09	0.40	0.04	0.12	20.00	0.32	0.32	0.09	0.13	50.00

Corycaeus giesbrechti	0.27	1.99	0.09	0.64	33.33	4.14	0.32	0.54	0.13	**75.00**
Corycaeus spp.*	0.09		0.03		6.67					
Cyclopoida (nauplius)*	0.09		0.04		6.67					
Harpacticoida										
Cylindropsyllidae*	1.09		0.36		26.67					
Darcythompsidae*	0.09		0.04		6.67					
Ectinosomatidae*	0.18		0.07		6.67					
*Macrossetela gracilis***						0.32		0.09		
Euterpina acutifrons	0.18	1.19	0.06	0.50	46.67		2.23		0.90	25.00
Laophontidae	0.09		0.04		6.67					25.00
Longipedia sp.	46.04	2.89	15.80	2.40	**80.00**	21.02	227.39	1.81	44.30	**100**
Miraciidae**						11.46		0.35		25.00
Peltidiidae	0.36		0.14		20.00	17.20		0.69		50.00
Porcelidiidae*	0.18		0.06		6.67					
Syngastes sp.	0.18		0.07		6.67	2.55		0.08		25.00
Thalestridae sp. 1	19.20	7.47	6.45	4.65	**86.67**	7.96		0.66		50.00
Thalestridae sp. 2	1.46	5.73	0.61	2.30	40.00	2.55	17.83	0.08	7.18	50.00
Thalestridae sp. 3	0.09		0.04		6.67	2.55		0.08		25.00
Tigriopus spp.*	1.73		0.60		20.00					
Tisbe sp.	2.82	3.43	1.00	1.93	**100**	10.83	3.82	0.83	1.21	**100**
Harpacticoida (nauplius)		0.08		0.02	6.67					
Harpacticoida (others)	0.91	0.64	0.29	0.55	40.00	2.87	0.32	0.17	0.06	**75.00**
Monstrilloida**						0.32		0.09		25.00
Copepoda (others)*	0.82	0.24	0.31	0.23	33.33					
Cirripedia (cypris)*	0.09		0.04		6.67					
Cirripedia (nauplius)	0.09	0.32	0.04	0.03	13.33	1.27		0.04		25.00
Isopoda										
Gnathia spp.	0.55	0.32	0.17	0.03	33.33	0.32		0.09		**100**
Isopoda (others)	4.28	0.80	1.42	0.39	**86.67**	13.06	0.96	0.82	0.25	25.00
Mysidacea	6.10	17.44	2.21	11.24	**100**	16.88	5.10	0.93	1.52	**100**
Mysidacea (embryo)	2.55	12.18	0.76	8.56	53.33	8.92	28.03	0.27	8.83	**75**
Cumacea	37.22	1.81	12.71	1.43	**86.67**	28.66	1.91	6.70	0.57	**100**
Amphipoda										
Hyperiidae	3.00	1.11	1.05	0.91	**80.00**	14.33	0.64	1.52	0.19	**100**
Gammaridea	29.48	20.38	10.48	13.88	**100**	37.90	13.69	8.07	5.31	**100**
Euphausiacea*		0.08		0.02	6.67					
Decapoda										
*Beelzebub faxoni**	0.09		0.03		6.67					
Brachyura (zoea)	0.45	0.24	0.15	0.09	40.00	0.32	0.64	0.09	0.19	**75.00**
Brachyura (megalopa)	1.00	1.04	0.34	0.32	66.67	4.78	0.96	0.73	0.38	**75.00**
Astacidea (megalopa)		0.08		0.03	6.67		0.32		0.13	25.00
Anomura (glaucothoea)	4.82	0.36	1.54	0.26	60.00	87.26		3.18		50.00
Portunidae (megalopa)	0.18		0.07		13.33					
Decapoda (others)	0.55	1.11	0.18	0.61	40.00	16.56	0.32	0.84	0.13	**75.00**
Chaetognatha										
Sagitta spp.		0.73		0.56	26.67		1.27		0.51	25.00
Paraspadella nana	14.56	0.08	4.90	0.04	53.33	6.37		0.20		25.00
Appendicularia										

Oikopleura dioica	0.09	0.32	0.04	0.09	13.33	1.27		0.04		25.00
Teleostei	1.00	0.64	0.35	0.35	60.00	3.82	1.91	0.12	0.77	50.00
Teleostei (eggs)	1.46	0.88	0.44	1.01	46.67	32.48	1.91	2.16	0.37	**75.00**

*exclusive to intensive sampling; **exclusive to quarterly sampling

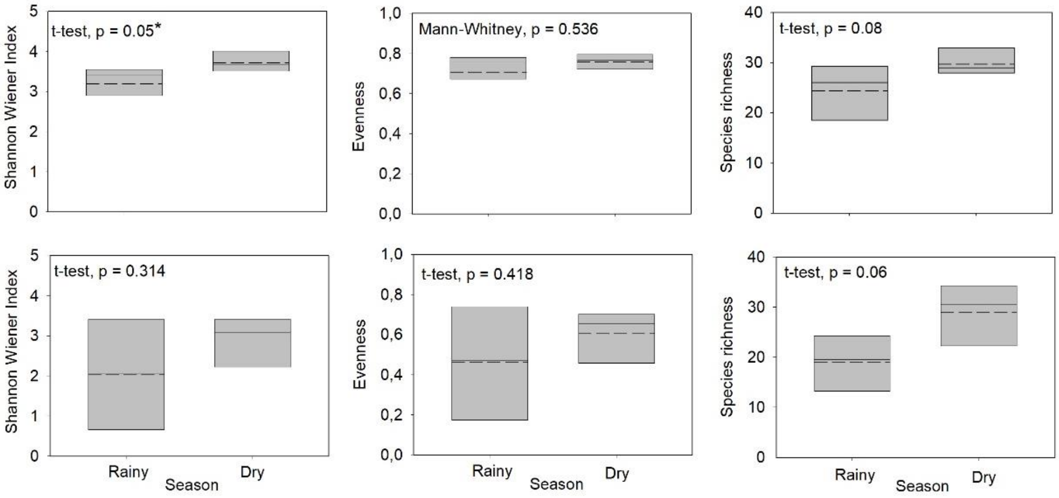
Diversity

On the intensive sampling the species diversity was higher in the dry season (*t-test*, p = 0.05). The mean species diversity was 3.20 ± 0.55 bits ind^{-1} on the rainy season and 3.71 ± 0.31 bits ind^{-1} on the dry season, characterizing the region as having a diversity between medium and high (Figure 3). There was no difference between the season’s evenness (*Mann-Whitney*; p = 0.536) and species richness (*t-test*; p = 0.08). The mean evenness was 0.71 ± 0.12 on the rainy season and 0.76 ± 0.04 on the dry season and the mean species richness was 24.38 ± 6.59 in the rainy season and 29.71 ± 3.63 on the dry season. (Figure 3).

For the quarterly sampling none of the parameters had differences between seasons (species diversity: *t-test*; p = 0.314; evenness: *t-test*; p = 0.418; and species richness: *t-test*; p = 0.06). The mean species diversity was 2.04 ± 1.43 bits ind^{-1} on the rainy season and 2.9 ± 0.64 bits ind^{-1} on the dry season (Figure 3). The mean evenness was 0.46 ± 0.29 on the rainy season and 0.6 ± 0.14 on the dry season (Figure 3) and the average species richness was 19 ± 5.72 on the rainy season and 29 ± 6.48 on the dry season.

When the two sampling efforts are compared, differences are detected on dry season. Species richness and evenness were higher on intensive sampling (t-test; p = 0.02; and t-test; p = 0.02 respectively), highlighting the benefits of this sampling strategy.

Figure 3 - Diversity indices and evenness from the demersal mesozooplankton captured with traps at Tamandaré Bay, Pernambuco, Brazil. Dashed lines represent the mean; *represents significant differences.

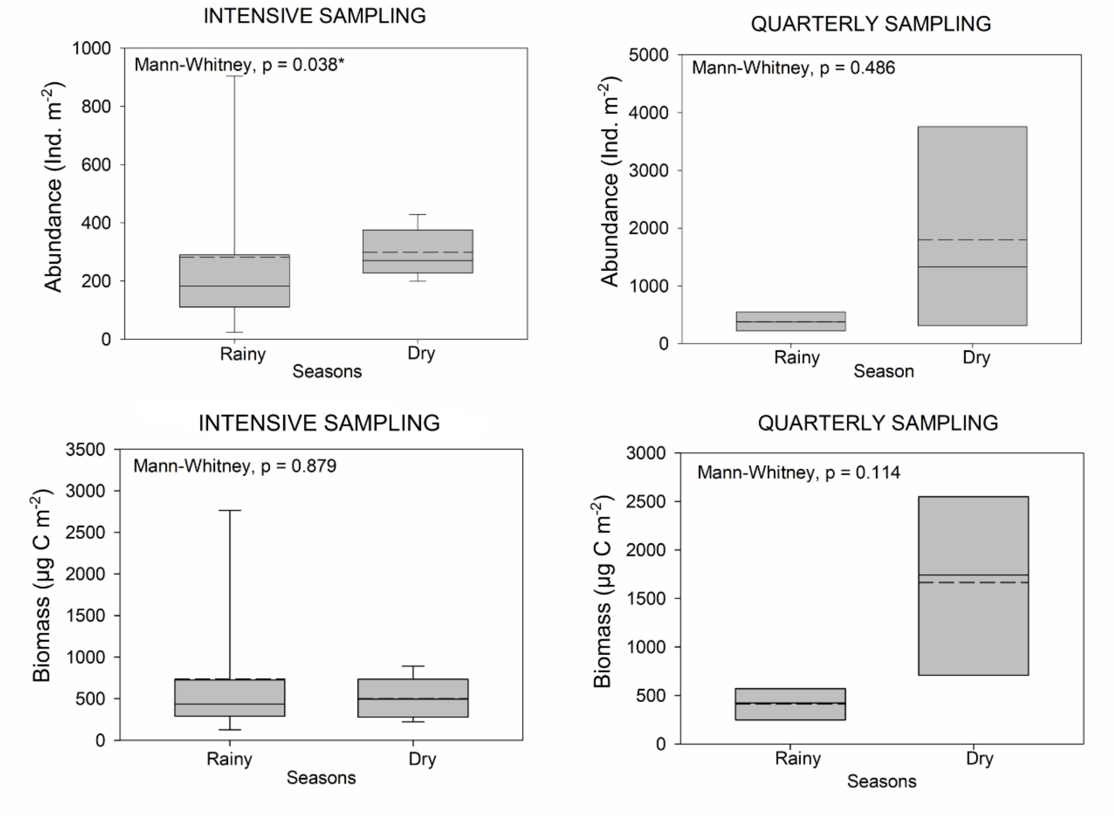


Abundance

The overall abundance of the demersal mesozooplankton was 464 ± 724 ind. m^{-2} with maximum abundance of 4260 ind. m^{-2} (during the dry season) represented primarily by a great abundance of *Paracalanus* spp. On the intensive sampling effort, the mean abundance in the rainy season was 281.95 ± 388.63 ind. m^{-2} and in the dry season was 299 ± 83.93 ind. m^{-2}. During the quarterly sampling the mean abundance was 381.21 ± 170.12 ind. m^{-2} in the rainy season and 1799.36 ± 1871.82 ind. m^{-2} in the dry season. There was difference between the abundance of the seasons in the intensive sampling effort (Mann-Whitney; p = 0.038) but not in the quarterly sampling (Mann-Whitney; p = 0.486) (Figure 4). Between the sampling efforts although a change in the results can be observed there were no statistical differences for either the rainy or the dry seasons (*Mann-Whitney*; p = 0.064; *Mann-Whitney*; p = 0.063, respectively).

Copepoda was the most abundant group in both seasons and sampling efforts, representing 43% of the community in the rainy season and 53% in the dry season during the intensive sampling and 61% in the dry season and 69% in the rainy season during the quarterly sampling (Figure 5). Copepoda was mostly represented by *Paracalanus* spp., *Pseudodiaptomus acutus*, *Dioithona oculata*, *Longipedia* spp. and Thalestridae sp. 1 (Table 3). Other characteristically demersal groups like Amphipoda, Cumacea and Mysidacea also had a relevant contribution to the community abundance (Figure 5, Table 3).

Figure 4 - Abundance (ind. m^{-2}) and Biomass (mg C m^{-2}) of demersal mesozooplankton captured with emergence traps at Tamandaré Bay, Pernambuco, Brazil. Dashed lines are the mean. *represent significant p values.

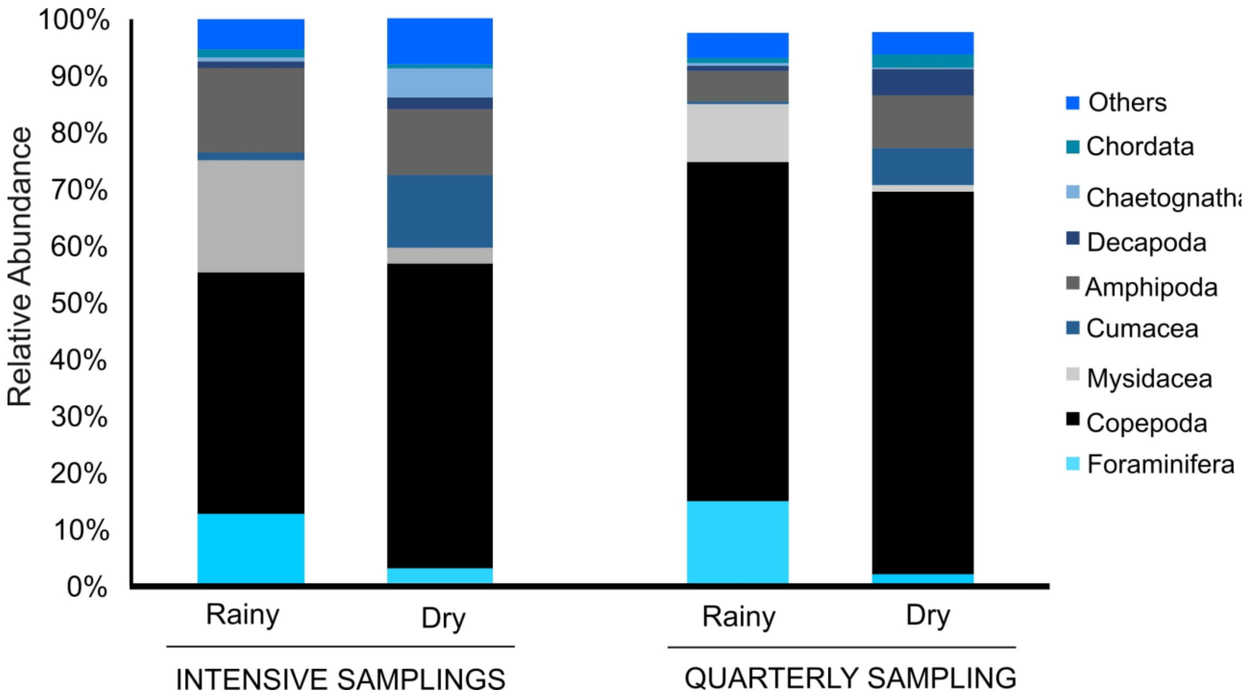


Biomass and Production

The overall biomass was 710.14 ± 735.32 mg C m^{-2}. On the intensive sampling, the mean biomass in the rainy season was 738.5 ± 861.39 mg C m^{-2} and 502.62 ± 239.16 mg C m^{-2} in the dry season. On the quarterly sampling, the mean biomass was 412.92 ± 177.05 mg C m^{-2} in the rainy season and 1665.54 ± 961.08 mg C m^{-2} in the dry season. There was no statistic difference between the data on any sampling effort (Figure 4) but it is possible to observe an inversion in the biomass when comparing the sampling efforts. This change is possibly due to the fact that in the dry period in the quarterly sampling a greater abundance of Anomura (Glaucothoea) occurred, being these organisms with a large corporeal volume that had a significant impact on the biomass.

Organisms with larger body and consequently a higher length/weight ratio such as Mysidacea and Amphipoda presented an enhancement in the relative biomass contribution compared with their contribution to total abundance (Table 3; Table 4). Copepoda that presented itself as the most representative group in terms of abundance became derisory in relation to biomass, comprising not more than 0.1% of the overall biomass. Although there was no difference between the overall season's biomass, for some groups the difference was noted (Table 4). During the intensive samplings, Ostracoda, Copopoda, Isopoda, Cumacea and Chaetognatha presented bigger biomass contributions in the dry season, whereas Mollusca, Polychaeta and Mysidacea were more representative in the rainy season. On the quarterly samplings Isopoda, Cumacea and Amphipoda presented significant difference between the seasons, displaying a greater biomass in the dry season. Comparing the sampling efforts it was possible to observe differences on the dry season (*Mann-Whitney*; p = 0.017) but not on the rainy season.

Figure 5 - Relative abundance of demersal mesozooplankton captured with emergence traps at Tamandaré Bay, Pernambuco, Brazil.



The production was estimated only for the intensive samplings, and as a function of the biomass presented similar patterns. The overall production was 2163.22 ± 1952.8 mg C m^{-2} d^{-1}. In the rainy season the mean production was 2340.2 ± 2595.01 mg C m^{-2} d^{-1} and in the dry season was 1973.6 ± 941.6 mg C m^{-2} d^{-1}. As for the biomass, it was not possible to observe statistical difference between the seasons. Although for some groups the difference was seen. Polychaeta, Ostracoda, Copepoda, Isopoda and Cumacea presented a bigger production in the dry season whereas Mysidacea presented a large production in the rainy season (Table 5).

Table 4 - Biomass (mean ± SD, mg C m^{-2}) and relative biomass (%) of main taxonomic groups of the demersal mesozooplankton captured at Tamandaré Bay, PE, Brazil. In bold is highlighted the season in which the group presented significantly higher values.

Intensive Sampling

	Biomass		%	
	Dry	Rainy	Dry	Rainy
Foraminifera	0.02 ± 0.01	0.05 ± 0.04	0.004	0.01
Mollusca	0.01 ± 0.02	**0.01 ± 0.01**	0.002	0.002
Polychaeta	0.05 ± 0.12	**0.04 ± 0.11**	0.02	0.01
Ostracoda	**20.14 ± 16.03**	4.36 ± 4.07	4.94	0.90
Copepoda	**0.37 ± 0.22**	0.3 ± 0.56	0.09	0.09
Cirripedia	9.76 × 10-5 ± 3.65 × 10^{-4}	1.75 × 10-4 ± 6.76 × 10^{-4}	1.33 × 10^{-5}	3.99 × 10^{-5}
Isopoda	**18.9 ± 11.15**	5.16 ± 7.8	4.00	1.04
Mysidacea	136.3 ± 211.21	**513.99 ± 776.43**	20.28	55.36
Cumacea	**76.65 ± 45.54**	4.82 ± 9.44	16.93	0.50
Amphipoda	190.26 ± 106.63	160.62 ± 133.36	39.65	34.02
Euphausiacea		2.27 ± 8.79		1.02
Decapoda	43.48 ± 46.5	44.92 ± 81.47	9.81	6.75
Chaetognatha	**16.46 ± 14.42**	2.02 ±3.69	4.27	0.30
Chordata	9.32 × 10^{-6} ± 3.49 × 10^{-5}	7.37× 10^{-5} ± 2.43× 10^{-4}	3.21 × 10^{-6}	3.37 × 10^{-5}

Quarterly Sampling

	Biomass		%	
	Dry	Rainy	Dry	Rainy
Foraminifera	0.07±0.08	0.05 ± 0.07	0.003	0.02
Mollusca	0.02 ± 0.02	0.01 ± 0.01	0.001	0.003
Polychaeta	0.05 ± 0.09	0.002 ± 0.001	0.003	0.001
Ostracoda	28.5 ± 29.95	8.9 ± 4.05	1.59	2.64
Copepoda	2.58 ± 2.32	0.37 ± 0.3	0.14	0.11
Isopoda	**37.34 ± 37.74**	3.62 ± 3.48	1.86	0.80
Mysidacea	168.07 ± 126.24	214.83 ± 215.41	9.21	53.60
Cumacea	**60.97 ± 93.24**	3.22 ± 2.48	5.17	0.77
Amphipoda	**406.1 ± 217.21**	99.28 ± 104.6	35.56	25.44
Decapoda	948.71 ± 958.13	80.71 ± 130.58	46.34	16.18
Chaetognatha	3.21 ± 5.19	1.98 ±2.67	0.12	0.44
Chordata	7.82 × 10-5 ± 1.56 × 10^{-4}		3.48 × 10^{-6}	

Table 5 - Production (mean ± SD, mg C m^{-2} d^{-1}) and relative production (%) of main taxonomic groups. of the demersal mesozooplankton captured at Tamandaré Bay, PE, Brazil. In bold is highlighted the season in which the group presented significantly higher values.

	Production		%	
	Dry	Rainy	Dry	Rainy
Polychaeta	**0.05 ± 0.10**	0.02 ± 0.03	4.3×10^{-3}	1.03×10^{-3}
Ostracoda	**86.08 ± 67.48**	15.8 ± 14.24	5.54	1.25
Copepoda	**2 ± 1.37**	1.46 ± 3.12	0.12	0.12
Cirripedia	$4.2 \times 10^{-4} \pm 1.57 \times 10^{-3}$	$6.5 \times 10^{-4} \pm 2.52 \times 10^{-3}$	1.47×10^{-5}	4.59×10^{-5}
Isopoda	**79.2 ± 48.5**	17.81 ± 26.6	4.25	1.09
Mysidacea	528.78 ± 810.03	**1602.06 ± 2329.18**	20.01	54.82
Cumacea	**321.02 ± 183.82**	16.65 ± 31.23	18.34	0.55
Amphipoda	772.09 ± 411.78	544.81 ± 441.77	41.44	35.21
Euphausiacea		8.15 ± 31.55		0.97
Decapoda	182.06 ± 197.12	133.19 ± 235.13	10.13	6.23
Chaetognatha	2.31 ± 1.98	0.24 ± 0.43	0.17	0.01
Chordata	$1.94 \times 10^{-5} \pm 7.25 \times 10^{-5}$	$1.48 \times 10^{-4} \pm 4.9 \times 10^{-4}$	1.70×10^{-6}	1.81×10^{-5}

Community Structure

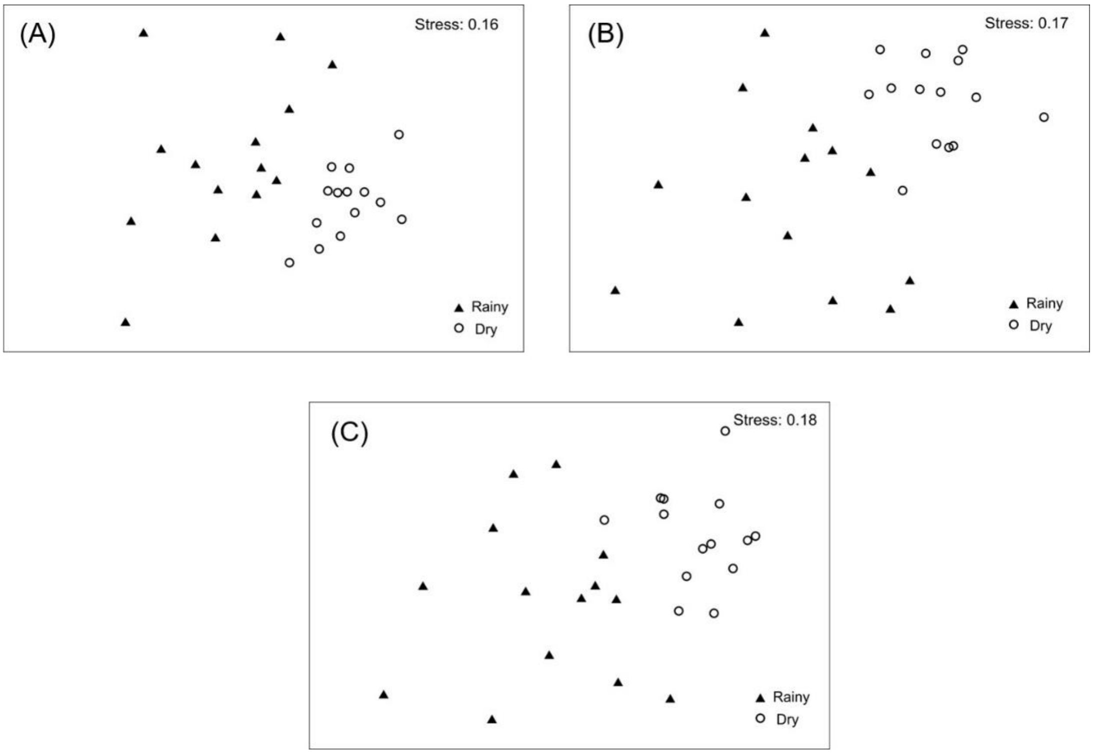
The PERMANOVA analysis were executed for the intensive samplings and demonstrate a significant seasonal difference between the community structure for the abundance, biomass and production (Table 6). Those differences were graphically corroborated by the MDS (Figure 6). The SIMPER demonstrates a dissimilarity of 52.32% between the abundance for the seasons, where the taxas *Longipedia* sp., *Paraspadella nana,* Cumacea, *Calanopia americana*, *Paracalanus* spp., *Dioithona oculata*, *Pseudodiaptomus acutus*, Thalestridae sp. 1, Mysidacea (embryo), Isopoda, *Tretomphalus bulloides*, Anomura (Glaucothoea), Thalestridae sp. 2, Polychaeta and Mysidacea contribute for 50.58% of that dissimilarity. For the biomass the SIMPER showned a dissimilarity of 46.43% where Mysidacea, Cumacea, *Paraspadella nana*, Anomura (glaucothoea), Isopoda and Hyperiidae contributed for 50.38% of that observed dissimilarity. For the production, 26 taxa accounted for a 44.61% average dissimilarity, where Cumacea, Mysidacea, Anomura (Glaucothoea), Isopoda, Hyperiidae and Ostracoda comprised 51.98% of that observed dissimilarity.

On the short scale variation the PERMANOVA showed difference only for the abundance on the dry season (Table 6), and with the SIMPER was possible to visualize 30 taxa being responsible for the average dissimilarity of 39.7% between T1 and T2, 36 taxa being responsible for the average dissimilarity of 45.43% between T2 and T3 and 32 taxa were responsible for the average dissimilarity of 39.79 T1 and T3.

Table 6 - PERMANOVA analysis for the intensive samplings based on abundance, biomass and production of the demersal mesozooplankton community structure in relation to the factors Season (Dry and Rainy), Short Scale (daily variation for the dry and rainy seasons).

	PERMANOVA analysis			
	df	MS	Pseudo-F	*p*
Abundance				
Season (Dry x Rainy)	1	7368.6	7.7126	**0.0001**
Short Scale Dry	2	1529.9	2.0319	**0.0046**
Short Scale Rainy	3	1165.8	0.91758	0.6314
Biomass				
Season (Dry x Rainy)	1	7343.3	11.2	**0.0001**
Short Scale Dry	2	589.26	1.4964	0.0948
Short Scale Rainy	3	1294.8	1.4699	0.1058
Production				
Season (Dry x Rainy)	1	6684.9	10.793	**0.0001**
Short Scale Dry	2	589.78	1.5519	0.0921
Short Scale Rainy	3	815.99	0.98366	0.5078

Figure 6 - Multidimensional scaling (MDS) plot for demersal mesozooplankton captured with emergence traps on intensive sampling at Tamandaré Bay, Pernambuco, Brazil. (A) Abundance; (B) Biomass; (C) Production



DISCUSSION

In this study we evaluated the abundance, biomass and production of the demersal zooplankton in a tropical equatorial reef system. We observed a high diversity on the reef system and a clear seasonal change on the community could be identified when using an intensive sampling methodology, with the dry season presenting higher abundance and diversity. Despite the important role of demersal fauna to the pelagic trophic web, performing a crucial role in the oceanic carbon and energy flow, amplifying the pelagic biomass, production and acting in the bentho-pelagic coupling, works within this theme are scarce, being the study of Melo *et al.* (2010) the only published work on demersal fauna for the South Atlantic. While our study is the first step to fill the knowledge gap about the energy contribution from this group to the pelagic fauna on the area.

The contribution of the emergent zooplankton to the pelagic ambient can be accessed based on the dilution of that community (measured in m^{-2}) on the water column above, as suggested by Alldredge & King (1977). Thus, we can observe that the estimated abundance contribution to the pelagic community would be in mean ≈ 43 ind. m^{-3} during the dry season and ≈ 40 ind. m^{-3} during the rainy season as considered the intensive sampling and of ≈ 257.05 ind. m^{-3} during the dry season and ≈ 54 ind. m^{-3} during the rainy season on the quarterly sampling (Table 7). Comparing to other reef areas, our finds will not generate a great abundance contribution not surpassing a 2 times increase on the pelagic zooplankton abundance (Melo *et al.*, 2002; Carrillo-Baltodano & Morales-Ramírez, 2016; Figueiredo, 2018; Neumann-Leitão *et al.*, 2018) (Table 7). Although, the biomass and production contribution would be much more conspicuous, being for biomass, ≈ 72 mg C m^{-3} during the dry period and ≈ 105 mg C m^{-3} during the rainy season for the intensive sampling and ≈ 237.93 mg C m^{-3} during the dry season and ≈ 59 mg C m^{-3} during the rainy season on the quarterly sampling, and for the production 281.94 mg C m^{-3} d^{-1} for the dry season and 334.31 mg C m^{-3} d^{-1} on the rainy season (Table 7). Nakajima *et al.* (2013) on the Malaysia reef found a nocturne increase up to 3 times of the zooplankton biomass, and pointed that to the reef-associated (demersal) zooplankton, in comparison to the total biomass found by them our study represented an addition up to 100 times of the biomass. Generally comparing to other reef environments the Tamandaré bay demersal community would represent a conspicuous increase to biomass (Table 7), the same could be seen to the production, in comparison to other reef system our results represent an increase of at least 10 times (Table 7). That clearly showed the impact that the emergent fauna presents to the energetic flow on the pelagic environment, and the importance of the Tamandaré Bay emergent fauna.

When considering the contribution of Copepoda to the water column, at the present study that group would represent an abundance of ≈ 63.53 ind. m^{-3} on the dry season and ≈ 29.36 ind. m^{-3} on the rainy season, biomass of ≈ 0.20 mg C m^{-3} on the dry season and ≈ 0.04 mg C m^{-3} on the rainy season and, production of ≈ 0.28 mg C m^{-3} d^{-1} on the dry season and ≈ 0.20 mg C m^{-3} d^{-1} on the rainy season. Comparing the Copepoda data to previous study in the area (Fidelis, 2014) our data would correspond to a ≈ 10% increase in abundance, a ≈ 17% increase in biomass and a ≈ 250% increase in production (Table 8). The higher increase to production compared to the abundance and biomass, is related to Fidelis (2014) have used only the dominant Copepoda in the production estimations, while in here the entire Copepoda community was considered being a closer representation of reality. Even though Copepoda is a great representative of the zooplankton being also pointed as the primal contributor to the biomass of the marine zooplankton (Casanova & Boltovskoy, 1999), on the bentho-pelagic it represent a small percentage of the biomass and production. That small increase highlight the importance of the large body organisms, that are pointed as one of the main prey in the reef systems (Alldredge, 1985), being the major carbon font of some planktivorous organisms (Holzman & Genin, 2005; Pitt *et al.*, 2008).

Between the sampling efforts could be seen a variation in the biomass and production seasonality. With the intensive sampling presenting a higher biomass and production in the rainy season and the quarterly sampling presenting a higher values in the dry season. That were due to the main biomass and production composers of the community. In the intensive sampling, the primal composer was the Mysidacea, presenting this group a statistical higher biomass and production value in the rainy season. In the quarterly sampling that was mainly due to Anomura Glaucothoea stages. These dacapods have a continuous reproductive phase on the dry season (Turra & Leite, 1999; Santana *et al.*, 2018), and the results suggest that the quarterly sampling covered a reproductive period, encompassing the time near the settlement of the young.

Table 7 - Summary of abundance, biomass and production of various reef environments. Emergence traps values are converted to ^{3} based on Alldredge & King (1977).

		Mesh (µm)	Abundance (ind. m^{-3})	Biomass (mg C m^{-3})	Production (mg C m^{-3} d^{-1})	Method	Source
Tamandaré, Brazil	Dry^{i}	200	42.7	71.80	281.94	E	This study
	Dry^{q}	200	257.05	237.93		E	This study
	Rainy^{i}	200	40.27	105.47	334.31	E	This study
	Rainy^{q}	200	54.46	58.85		E	This study
Tamandaré, Brazil	Dry	200	694.60	1.45	0.36	N	Fidelis (2014)
	Rainy	200	260.70	0.20	0.05	N	
Maracajaú, Brazil		300	579.00	15.71		N	Melo *et al.* (2002)
Cahuita National Park, Costa Rica		200	12847.00	10.05		N	Carrillo & Morales (2016)
Abrolhos Bank, Brazil		200	1008.50	1.02		E	Figueirêdo (2018)
		200	300.00			N	Figueirêdo *et al.* (2018)
Amazon reef system, Brazil		200	107.98			N	Neumann-Leitão *et al.* (2018)
Tioman Island, Malasya		>100	7261.00	3.42	1.80	N	Nakajima *et al.* (2013)
Sesoko Island, Japan	Summer	200	1243.00	7.00	9.10	N	Nakajima *et al.* (2017)
	Winter/Fall	200		36.50	1.80	N	
Great barrier reef, Australia		>120		266.00	21.00	N	Sorokin & Sorokin (2010)
Florida keys, USA		40	4474.00	16.5		P	Heildelberg (2010)
Moorea, French Polynesia		200	89.00			P	Alldredge & King (2009)
Tamandaré-Itamacará, Brazil		300	7113.00^{a}			L	Melo (2010)
		300	4759.00^{a}			E	

^{i} intensive sampling; ^{q} quarterly sampling; ^{a} data in ind. m^{-2} (absent depth info); E - emergence traps; L - Light Trap N - plankton nets; P - Pump

The seasons presented a distinct community's as shown by the PERMANOVA and MDS. Seasonal preference was seen for some groups. Ostracoda, Copepoda, Isopoda, Cumacea and Chaetognatha presented a greater biomass in the dry season while Mollusca, Polychaeta and Mysidacea presented a preference in the rainy season. When the quarterly sampling is considered a minor preference is noted, being observed just for Isopoda, Cumacea and Amphipoda. Showing the lesser acuity of this kind of sampling effort to detect some group seasonal patterns.

Comparisons to another emergent fauna studies need to be done with caution since a large variation of sampling methodologies and substrate that have being applied (Alldredge & King, 1977; Porter & Porter, 1977; Yahel, R. *et al.*, 2005; Alldredge & King, 2009; Heidelberg *et al.*, 2010; Melo *et al.*, 2010), presenting the published works on the emergent fauna a great variety of abundances. Although, between the variable existing sample methods, emergence traps have proven to be the most trustworthy to quantifying the number of organisms arising from a pre-determined area of substrate (Heidelberg et al 2004).

Crustacea is known as a primal component of the emergent fauna as seen by Alldredge & King (1977), Hammer & Zimmerman (1979), Melo *et al.* (2010) and in this study. Some works pointed harpacticoid copepods as the most abundant taxa between the emergent fauna (Walters & Bell, 1994; Kramer, M. J. *et al.*, 2013). Here during the intensive sampling Calanoida and Harpacticoida presented a similar importance community composition in both seasons. A different pattern was seen in quarterly sampling, on the dry season Calanoida completely dominated the community abundance with *Paracalanus* spp. while there was seen a Harpacticoida dominance in the rainy season, mainly by *Longipedia* spp.. The Paracalanidae as well as Oithonidae and Oncaeidae are dominant in the tropical copepod communities (Mckinnon & Duggan, 2014) remarkably in the inshore environment, like Tamandaré Bay. *Pseudodiaptomus acutus* and *Dioithona oculata*, were among the most abundant Copepoda. Being remarkable their presence in the emergent community (Jacoby & Greenwood, 1988; Rios-Jara & González, 2000; Melo *et al.*, 2010). Some samples presented a great abundance of *Dioithona oculata* correlated to swarms, these small Cyclopoida form swarms of millions of individuals near the reef tops during the day, dispersing to the water column at the dusk (Emery, 1968). Other classic demersal groups shown representative percentages of the community such as Cumacea, Mysidacea, Isopoda and Gammaridae amphipods being these groups between the most commonly sampled demersal organisms (Hobson & Chess, 1976; Alldredge & King, 1985; Pitt *et al.*, 2008; Melo *et al.*, 2010).

Paraspadella nana was observed with higher abundances during the dry season, that rare Chaetognatha has recently expanded its distribution (Figueirêdo *et al.*, 2017), to two distant reef areas, by using emergent traps. This highlight the importance of the use of this kind of methodology and the necessity of more works using that equipment that could change the perspective to other organisms considered to be rare and of restricted distribution.

The zooplankton community vertical migration can vary along the time by nutrient distribution, seasonality, temperature, moon phase and tides (Alldredge & Hamner, 1980; Alldredge & King, 1980; Fischer & Visbeck, 1993; Roemmich & Mcgowan, 1995). The dry season showed a greater abundance, species richness and evenness independent of the sampling effort, and although the mean community biomass and production did not shown its higher values in the dry season (mainly because of the high Mysidacea biomass and production on the rainy season), most of the groups present a statistical higher value on the dry season. For the study area several works on the reef zooplankton had presented a similar pattern, with a most diverse and abundant fauna on the dry season (Nascimento-Vieira & Neto, 2010; Fidelis, 2014; Figueirêdo, 2014). Fidelis (2014) suggested that would be a response to excessive rains that reducing the viability of light by an considerable increase in suspended particulate matter and would consequently affect food availability, thus reducing the zooplankton community. The negative influence of terrigenous materials on phytoplankton biomass had already been pointed out as one of the patterns present on the area (Eskinazi-Leça *et al.*, 1997). Silva *et al.* (2005), found higher values of phytoplankton biomass in the dry season on the Tamandaré Bay, which leads to greater zooplankton abundance. Fischer & Visbeck (1993) on the Greenland Sea, also point that a change in the light intensity due to clouds could cause variations in vertical migration, with a higher migration on the periods with more light intensity. Some works present a greater emergent fauna on the summer, and relate that to reproductive periods (Sale *et al.*, 1976; Mcwilliam *et al.*, 1981; Jacoby & Greenwood, 1988). Nevertheless, the most probable hypothesis is that rainfall is the main factor causing the seasonal variation of the community, although the probable role of light intensity in the seasonal migration patterns and the specific group reproduction phases as seen for Anomura should also affect the community. Between the days a community variation could be seen only for the abundance, since the main responsible for that variation was the small taxa, (*Dioithona oculata*, *Longipedia* sp. and *Paracalanus* sp.), which does not have a great biomass contribution. Besides there was a visible difference in the abundance between the seasons on the intensive sampling, that was not observed for the biomass, due to the continuous presence of large body organisms, that are constant in the community (Alldredge & King, 1977).

The intensive sampling effort shown a better capacity of sampling the community diversity, shown by the higher Shannon-Wiener. In addition this sampling effort present a bigger number of exclusive taxa (14 compared to 8 in quarterly sampling), allowing the sampling of rare Harpacticoida like Cylindropsyllidae, Darcythompsidae and Porcelidiidae. Species richness and evenness were different between sampling efforts, being that the intensive k showed a greater species richness and presented a more homogeneously distributed community. Although no statistical difference could be observed between sampling efforts for the abundance, a different result for the emergent fauna could be obtained using different sampling strategies. The large abundance seen during the dry season could be due to the moon phase, some taxa present difference responses depending on that (Pacheco *et al.*, 2013), being greater abundances recorded at the darker period (Gliwicz, 1986). The sampling realized during the dry season for the quarterly sampling were under the dominion of the new moon, which influenced a higher rate of migration on the demersal organisms.

CONCLUSIONS

Our research pointed a clear temporal variance on the demersal zooplankton community, mainly caused by the seasonal changes in rainfall system, meanwhile a lesser community variability could be seen in short time (days), caused by fluctuations of the small taxa. The results presented here highlight the advantage in the works increase their sampling effort, since a longer sampling could be able to observe more subtle variation in the community than a more spread one. Lastly, the demersal community shown a great contribution to the pelagic biomass, highlighting the crucial importance of this community on the pelagic trophic web. More studies on the intricate energetic relations of the pelagic trophic web are needed, focusing on the importance of the emergent fauna, since works directed to the pelagic compartment could underestimate this community that have a sporadic migration and could be predated before the trawl.

ACKNOWLEDGEMENTS

This work was supported by the Fundação de Amparo à Ciência e Tecnologia de Pernambuco - FACEPE under Grant number APQ-1239-1.08/08. We wish to express our thanks to the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) who conceded the first author’s scholarship.

3 INTERANNUAL VARIATION OF THE DEMERSAL MESOZOOPLANKTON OF A SOUTH ATLANTIC REEF SYSTEM

INTRODUCTION

The reef zooplankton community exhibit characteristics that distinguish them from other planktonic communities for both species composition and number of individuals (Motoda, 1940; Tranter & George, 1972; Renon, 1978; Carleton, 1993). In reef systems, the zooplankton comsmunity is characterized by performing daily vertical migrations, remaining close to the substrate during the day and ascending the water column at nightfall (Porter, 1974). These organisms accomplish that migration to avoid predation, both by planktivorous fishes that are more active during the day and by coral reefs that extend their tentacles at dusk (De Robertis, 2002; Yahel *et al.*, 2005). That fauna is known as demersal zooplankton, being also called as benthopelagic plankton (Vereshchaka & Anokhina, 2014), hyperbenthos (Carleton & Hamner, 2007) and emergent zooplankton (Pitt *et al.*, 2008). The organisms that present these kind of vertical migration represent an important role in the benthic-pelagic coupling, serving as prey for several fishes, sponges and other reef dwellers (Robertson & Howard, 1978; Heidelberg, *et al.*, 2004; Schnack-Schiel & Isla, 2005; Lesser, 2006). Besides being important in the consumption of phytoplankton primary production acting as grazers (Turner *et al.*, 2001) and the cycling of nutrients (Prins & Smaal, 1990).

Although being more abundant and diverse in reef systems (Alldredge & King, 1977), demersal zooplankton can be found at estuarine and coastal waters across the globe being presents in seagrass (Alldredge, 1985; Melo *et al.*, 2010), gravel (Melo *et al.*, 2010), kelp forests (Hammer, 1981), and other soft-bottom substrates (Alldredge & King, 1980; Jacoby & Greenwood, 1989; Pacheco *et al.*, 2014; Figueirêdo, 2018).

Even though the demersal community plays an important service in the shallow waters tropical habitats, very few studies were performed over this aspect on the South Atlantic Ocean (Silva, 2003; Melo *et al.*, 2010), existing to Abrolhos bank only one unpublished work related to this community (Figueirêdo, 2018). The Abrolhos Bank is the most important reef formation in the Tropical South Atlantic, with about 8900 km² of extension, presents high diversity with high degrees of endemism and unique coral reef structures from Brazilian corals, presenting a mushroom-like shape called “chapeirões” (Leão, 1999; Leão & Kikuchi, 2005). Despite how important these regions are, zooplankton biomass and production studies are still rare (Figueirêdo, 2018), mainly regarding the demersal contribution to the pelagic community.

Zooplankton populations can vary across a wide range of time scales, being observed seasonal, inter-annual, decadal and multidecadal variations (Valdés *et al.*, 2007). These variations cause fluctuations in abundance, biomass, species composition, and vertical migration (Mackas & Beaugrand, 2010), being induced by nutrient distribution, seasonality, temperature, moon phase and tides (Alldredge & Hamner, 1980; Alldredge & King, 1980; Fischer & Visbeck, 1993; Roemmich & Mcgowan, 1995). Time related studies on the emergent fauna are mostly dedicated to daily and moon cycle variations (Alldredge & King, 1980; Hammer, 1981; Anokhina, 2006; Heidelberg *et al.*, 2010), with few studies that observed the interannual variation of this community (Yahel *et al.*, 2005).

The objective of the present work was to evaluate the interannual and substrate variation of the abundance, diversity, community structure and biomass of the demersal mesozooplankton in the Abrolhos archipelago.

MATERIAL AND METHODS

Study area

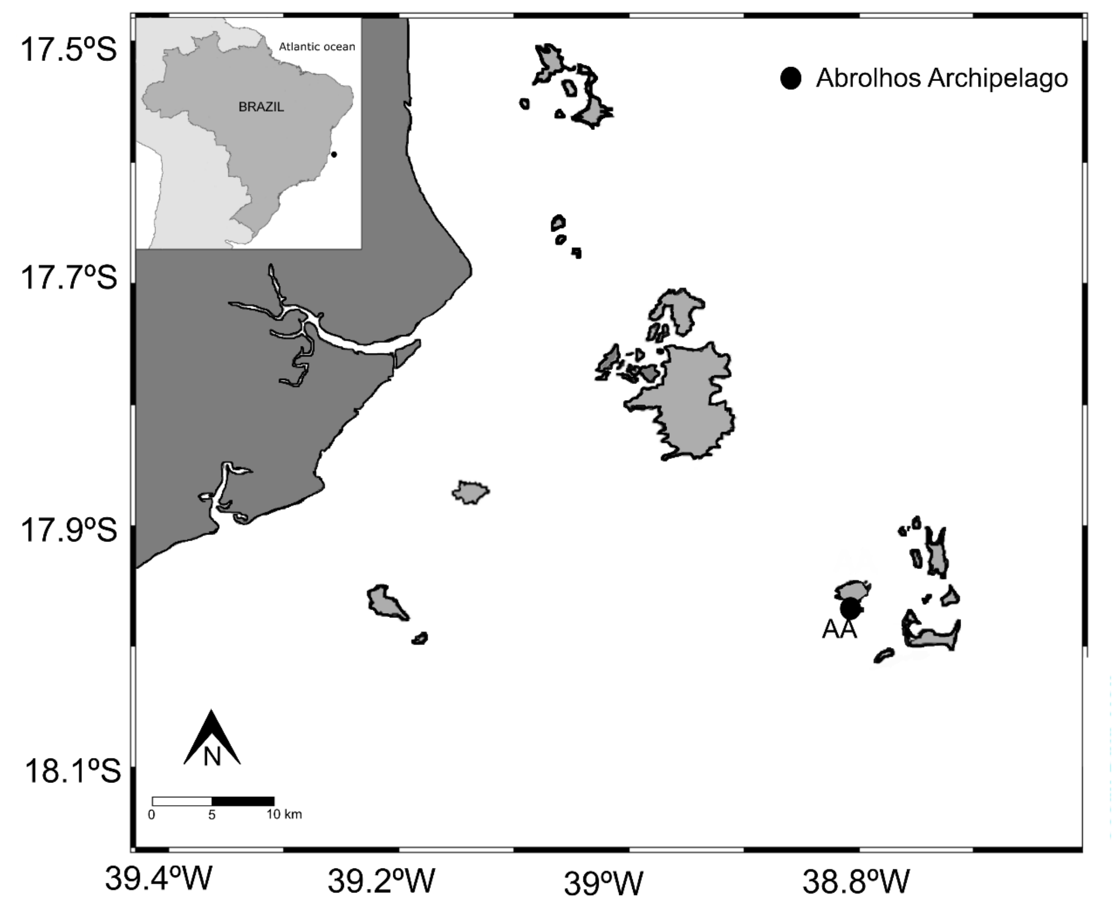
The Abrolhos bank is located on the Brazilian continental shelf adjacent to the city of Caravelas, Bahia. It occupies an area of approximately 6000 Km², between 17º20'-18º10'S and 38º35'-39º20'W (Figure 1), composed of coral reefs, volcanic islands, shallow banks and channels. In the reef area the platform presents a low depth, not surpassing 30 m (Leão, 1999). The Abrolhos bank presents an enormous diversity of structures, encompassing seagrass beds, sand and mud bottoms, rhodolith beds and coral reefs (Leão & Kikuchi, 2001; Leão *et al.*, 2006; Amado-Filho *et al.*, 2012; Moura *et al.*, 2013), consisting mainly by "chapeirões", unique coralline mushroom-shaped pinnacles ranging from 5 to 25 m in height and 5 to 50 m in diameter, but also features structures such as fringe reefs, found in the islands of Abrolhos (Hetzel & Castro, 1994; Werner *et al.*, 2000; Leão *et al.*, 2019).

The middle and outer platforms of the region are dominated by carbonate sediments, with the dominance of thick sediments rich in bryozoans in the southern part of the Abrolhos bank and siliciclastic sediments on the inner platform, while the coastal reefs are surrounded by muddy sediments that have 40 to 70% of quartz sands and clay minerals (Leão *et al.*, 1988; Leão, 1999).

The region climate is humid, with an average surface temperature of 27.5°C in the summer, and an annual mean rainfall of 1750 mm (Marchioro *et al.*, 2005). The region tides are semi-diurnal with a maximum of 2.3 m during the spring tide and a minimum of 0.5 m during neap tides (Coutinho *et al.*, 1993).

The Abrolhos bank is divided in two arcs. The inner or coastal arc that is located at 10-20 Km from the coast, and are mainly formed by coalescent reef tops (Leão & Kikuchi, 2001), and the outer arc (our sampling area) that is located at about 70 Km from the coast, eastward from the Abrolhos Archipelago (Leão & Kikuchi, 2001; Moura *et al.*, 2013). The Abrolhos Archipelago is formed by five islands all boarded by fringing reefs (Leão & Kikuchi, 2001; Moura *et al.*, 2013; Leão *et al.*, 2019), presenting giant coralline pinnacles with depths superior to 20 m.

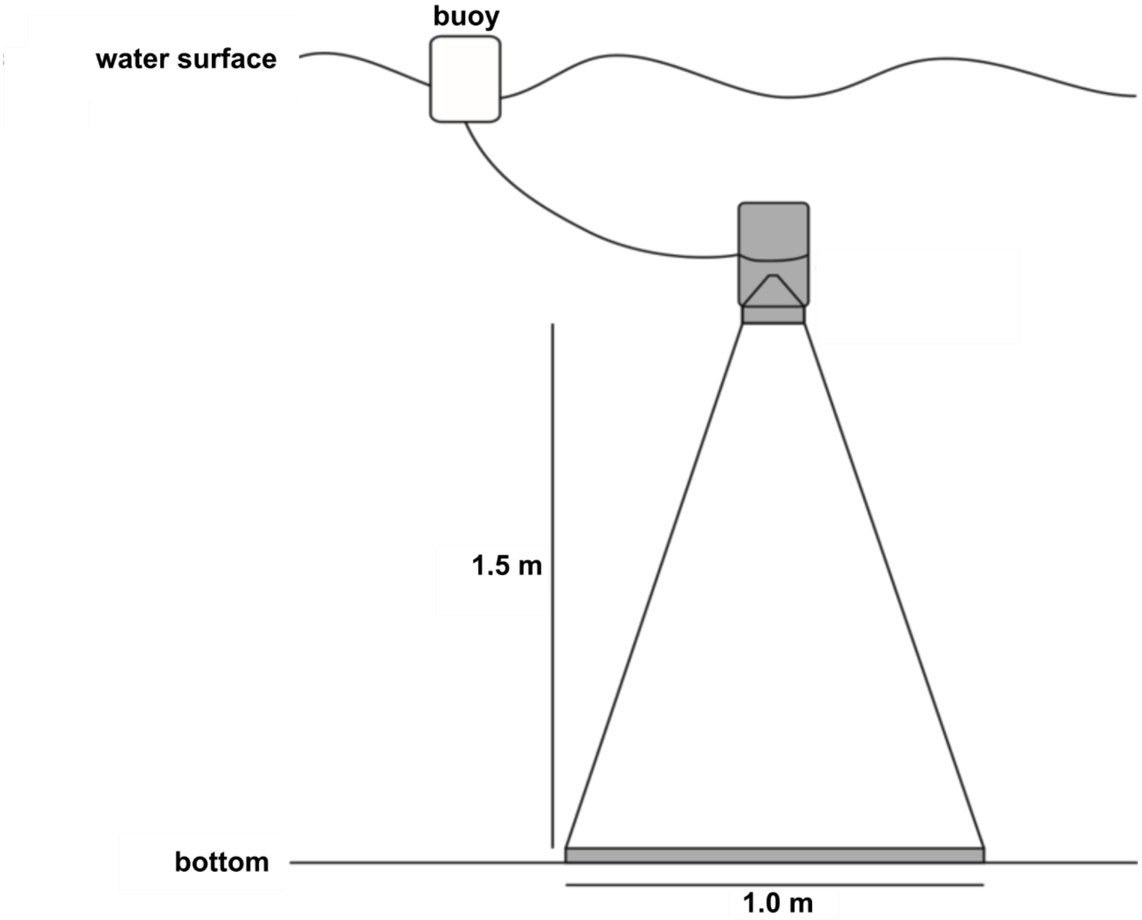
Figure 1 - Sampling location of demersal zooplankton at Abrolhos bank, Bahia, Brazil.



Field collection

The samplings were carried out during the summer of 2014 (February) and 2016 (April) on the Abrolhos Archipelago (AA) (≈ 6 m depth). Two stations were defined in both years, a hard bottom reef station, over the Abrolhos Archipelago fringing reef and a soft bottom station, at a sand bottom adjacent to the reef formations. The samplings were performed using emergence traps (Figure 2), consisting of a conical net (200 µm mesh size) with 1.5 m of high and a mouth of 1 m diameter (Alldredge & King, 1985; Melo et al., 2010). The traps were installed at dusk and removed from the substrate at sunrise. After withdrawals, the samples were transferred to sample flasks and fixed with 4% buffered formalin. The samplings were carried out during the full moon in 2014 and during the waning crescent in 2016. Three replicates were executed in each station from both years and substrates. In 2016 the samples were carried out in three consecutively days and since no differences were observed between them, the mean value was used for the year. The 2014 samples were analyzed by Figueirêdo (2018) and provided to compose the present study.

Figure 2 - Scheme of the traps for the demersal zooplankton (adapted from Melo *et al*., 2010).



Sample analysis

The mesozooplankton samples were fractionated for at least 300 individuals as recommended by Omori & Ikeda (1984), with those presenting less than this analyzed in their totality. Analyses were carried out under a stereomicroscope. The taxa were identified to the least possible taxonomic groups using specific literature (Björnberg, 1981; Casanova & Boltovskoy, 1999; Boxshall & Halsey, 2004; Dahms et al., 2006), 30 individuals of each identified taxas were measured to obtain biomass estimations. The biomass (B, mg C m^{-2}) was defined by the equation, B = A * CW, were A is the taxa abundance and CW the individual carbon weight. The CW estimations were obtained using length-weight regression (Table 1) available for the specific taxon or for the nearest taxonomic group available in the literature (Matthews & Hestad, 1977; Uye, 1982; Bamstedt, 1986; Hirota, 1986; Chisholm & Roff, 1990; Michaels *et al.*, 1995; Webber & Roff, 1995; Ara, 2001; Imao, 2005; Heidelberg *et al.*, 2010). For Copepoda the CW was assumed to be 47% of the dry weight (Hirota, 1981), for Appendicularia it was used 44.2% (Hirota, 1986) and for the other taxa 40% (Bamstedt, 1986).

Table 1 - Length-weight regressions applied for biomass calculation of main mesozooplankton taxa. Length data inserted in µm.

Taxonomic group	Equation	Reference
Foraminifera	$pgC = 0.089 * BV$	Michaels *et al.* (1995)
Bivalvia	$\log CW\ (\mu g) = -3.45 + 1.47 \times \log BL$	Hirota (1986)
Gastropoda	$\log CW\ (\mu g) = -5.85 + 2.46 \times \log TL$	Hirota (1986)
Polychaeta	$DW = 0.005 \times TL^{2.25}$	Hirota (1986)
Polychaeta (larvae)	$\log CW\ (\mu g) = -5.97 + 2.10 \times \log TL$	Matthews & Hestad (1977)
Ostracoda *	$\ln CW\ (\mu g) = 1.03 + 1.46 \times \ln TL$	Heidelberg *et al.* (2010)
Copepoda		
Calanopia americana	$\ln DW = 2.67 \ln PL - 15.47$	Chisholm & Roff (1990)
Labidocera spp.	$DW = 1.666 \times 10^{-8} \times PL^{2.837}$	Ara (2001)
Paracalanidae	$\ln DW = 2.78 \times \ln PL - 16.52$	Webber & Roff (1995)
Pseudodiaptomus spp.	$DW = 1.306 \times 10^{-9} \times PL^{3.361}$	Ara (2001)
Temora stylifera	$\log WW = 2.057 \times \log PL - 4.042$	Shmeleva (1965)
Temora spp.	$\ln DW = 3.34 \times \ln PL - 19.59$	Chisholm & Roff (1990)
Calanoida (others)	$\ln DW = 2.73 \times \ln PL - 15.93$	Webber & Roff (1995)
Oithonidae	$\ln DW = 1.10 \times \ln PL - 7.07$	Chisholm & Roff (1990)
Corycaeus spp.	$\ln DW = 1.7 \times \ln PL - 9.92$	Chisholm & Roff (1990)
Harpacticoida	$\log DW = -8.51 + 3.26 \times \log TL$	Hirota (1986)
Monstriloida	$\ln DW = 1.53 \ln PL - 8.7$	Webber & Roff (1995)
Copepoda (nauplius)	$\ln AFDW = 2.48 \ln TL - 15.7$	Bamstedt (1986)
Copepoda (others)	$\log DW = 2.62 \log PL - 6.4$	Imao (2005)
Cirripedia (cypris)	$\log CW = -8.64 + 3.0 \times \log BL$	Hirota (1986)
Cirripedia (nauplius)	$\log CW = -6.90 + 2.65 \times \log BL$	Nakajima *et al.* (2017)
Isopoda *	$\ln CW = 1.03 + 1.46 \times \ln BL$	Heidelberg *et al.* (2010)
Mysidacea *	$\log CW = -0.167 + 3.10 \times \log BL$	Uye (1982)
Cumacea *	$\ln CW = 1.03 + 1.46 \times \ln BL$	Heidelberg *et al.* (2010)
Amphipoda *	$\ln CW = 1.03 + 1.46 \times \ln BL$	Heidelberg *et al.* (2010)
Euphausiacea *	$\ln CW = 1.03 + 1.46 \times \ln BL$	Heidelberg *et al.* (2010)
Decapoda *	$\ln CW = 1.03 + 1.46 \times \ln BL$	Heidelberg *et al.* (2010)
Brachyura (zoea)	$\log CW = -8.68 + 3.39 \times \log CL$	Hirota (1986)
Brachyura (megalopa)	$\log CW = -4.59 + 2.19 \times \log CL$	Hirota (1986)
Chaetognatha		
Sagitta spp. *	$\log DW = 3.24 \times \log BL - 0.975$	Uye (1982)
Paraspadella nana *	$\log CW = -0.93 + 2.79 \times \log BL$	Hirota (1986)
Appendicularia		
Oikopleura dioica	$\log DW = 2.51 \times \log BL - 6.54$	Gorsky & Palazzoli (1989)

TL – Total length; PL – Prosome Length – BL; Body Length; DW – Dry Weight; CW- Carbon Weight; AFDW – Ash Free Dry Weight; BV – Biovolume. *taxa that the length entry was in mm.

Data analysis

To describe the community, abundance (ind m^{-2}), relative abundance (%), frequency of occurrence (%), Shannon diversity index (H') (Shannon, 1948) and Pielou evenness (Pielou, 1977) were calculated. For the frequency of occurrence four classes were defined as abundant (>70%); frequent (70% ⊢ 30%); less frequent (30% ⊢ 10%) and rare (<10%).

Before testing the data, the Kolmogorov-Smirnov normality test and the Levene's mean test were applied to the ecological indices, abundance and biomass information. These data were tested for differences between the substrates (Coral reef x Sandy bottom) and years (2014 x 2016) using t-test or Mann-Whitney. To access variability in the community structure among substrate and years a PERMANOVA was executed. A similarity percentage analysis (SIMPER) was conducted to observe the distribution patterns of the mesozooplankton community among the years and different substrates. To graphically visualize the PERMANOVA results a MDS was used. Values of $p < 0.05$ were considered significant

RESULTS

A total of 71 taxa were observed in the Abrolhos archipelago, comprising, Foraminifera, Cnidaria, Mollusca, Annelida, Sipuncula, Crustacea, Pycnogonida Echinodermata, Chaetognatha and Chordata. Crustacea was the most diverse group, being mainly represented by Copepoda with 37 taxa. At 2014, 11 groups were abundant, 10 were frequent, 9 were less frequent and no rare taxa were observed, 2014 presented 5 exclusive taxa. 2016 presented a higher taxa number, at where 21 were abundant, 11 were frequent, 17 were less frequent and 9 were rare, and presented 36 exclusive taxa (Table 2).

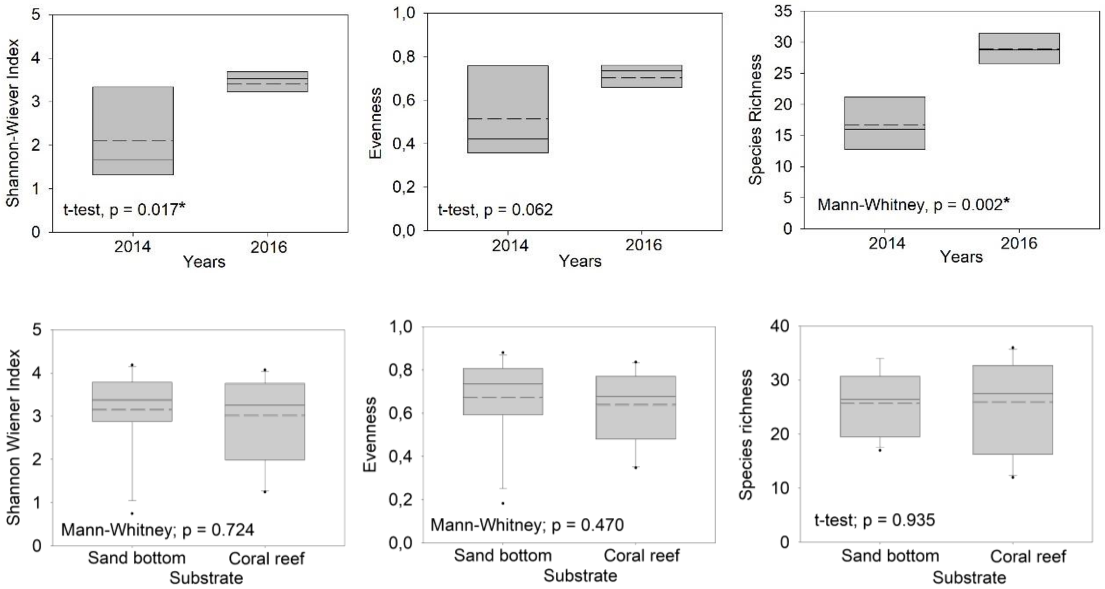
Diversity

The species richness (*M-W*, $p = 0.002$) and diversity (*t-test*, $p = 0.017$) were higher in 2016 compared to 2014, whereas evenness did not present variation among the years (*t-test*, $p = 0.062$). The mean species diversity was 2.11 ± 0.99 bits ind^{-1} in 2014 and 3.41 ± 0.76 bits ind^{-1} in 2016. The mean species richness was 16.67 ± 4.50 in 2014 and 28.94 ± 5.13 in 2016. The mean evenness was 0.51 ± 0.19 in 2014 and 0.70 ± 0.15 in 2016.

When consider the different substrates no differences were found on neither species diversity (*M-W*; $p = 0.624$), species richness (*t-test*; $p = 0.935$) and evenness (*M-W*; $p = 0.470$).

The mean species diversity on the sand bottom was 3.15 ± 0.9 bits ind^{-1}, while in the coral reef bottom was 3.02 ± 1.02 bits ind^{-1}. The mean species richness was 25.75 ± 6.01 on the sand bottom and 26 ± 8.68 on the coral reef. The mean evenness was 0.67 ± 0.19 on the sand bottom and 0.63 ± 0.17 on the coral reef.

Figure 3 - Species richness, evenness and Shannon-Wiener Index for the demersal mesozooplankton captured on different substrates in 2014 and 2016 at Abrolhos Archipelago, BA, Brazil. Dashed lines represent the means.

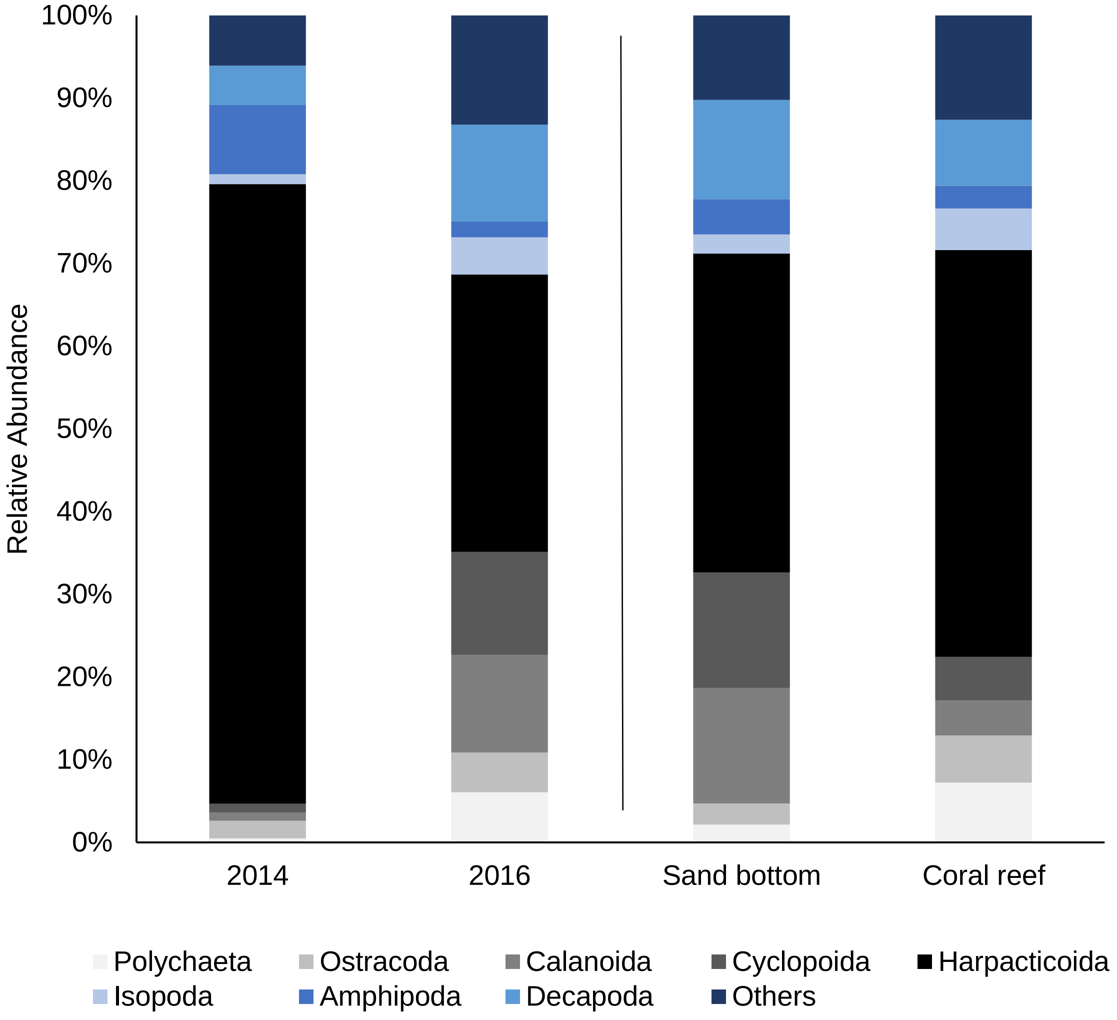


Abundance

The mean abundance in 2014 was 1877.66 ± 723.32 ind. m^{-2}, whereas in 2016 the mean abundance was 1797.05 ± 1839.38 ind. m^{-2}. There was no difference in the abundance when considering the years (*t-test*, p = 0.893) (Figure 4). The dominant groups varied remarkably over the years. Copepoda was the most abundant group in both years nonetheless, a variability in the orders could be noted. In 2014 Harpacticoida represented 75% of the community whereas in 2016 these dominance decreased, 35% of the community. The orders Calanoida and Cyclopoida presented a considerable increase from 2014 to 2016, Calanoida from 0.9% to 11% and Cyclopoida from 1% to 12%. Other representative groups had a higher relative abundance in 2016, as Polychaeta, Ostracoda, Decapoda and Isopoda. Amphipoda had the same pattern observed for Harpacticoida decreasing from 2014 to 2016 (Figure 4).

There was a clear difference for the abundance between substrates, being higher on coral reef (2601.83 ± 1802.58 ind. m^{-2}) than the sand bottom (1032.58 ± 936.34 ind. m^{-2}) (*M-W*; p = 0.012) (Figure 4). Although abundance almost triples from one substrate to another, no composition variation was detected. Copepoda was the most abundant group in both substrates, representing 66% of the community in the sand bottom and 58% in coral reef. Harpacticoida composed more than 70% of the Copepoda community in both substrates, mainly by the Thalestridae family (Table 2; Figure 4).

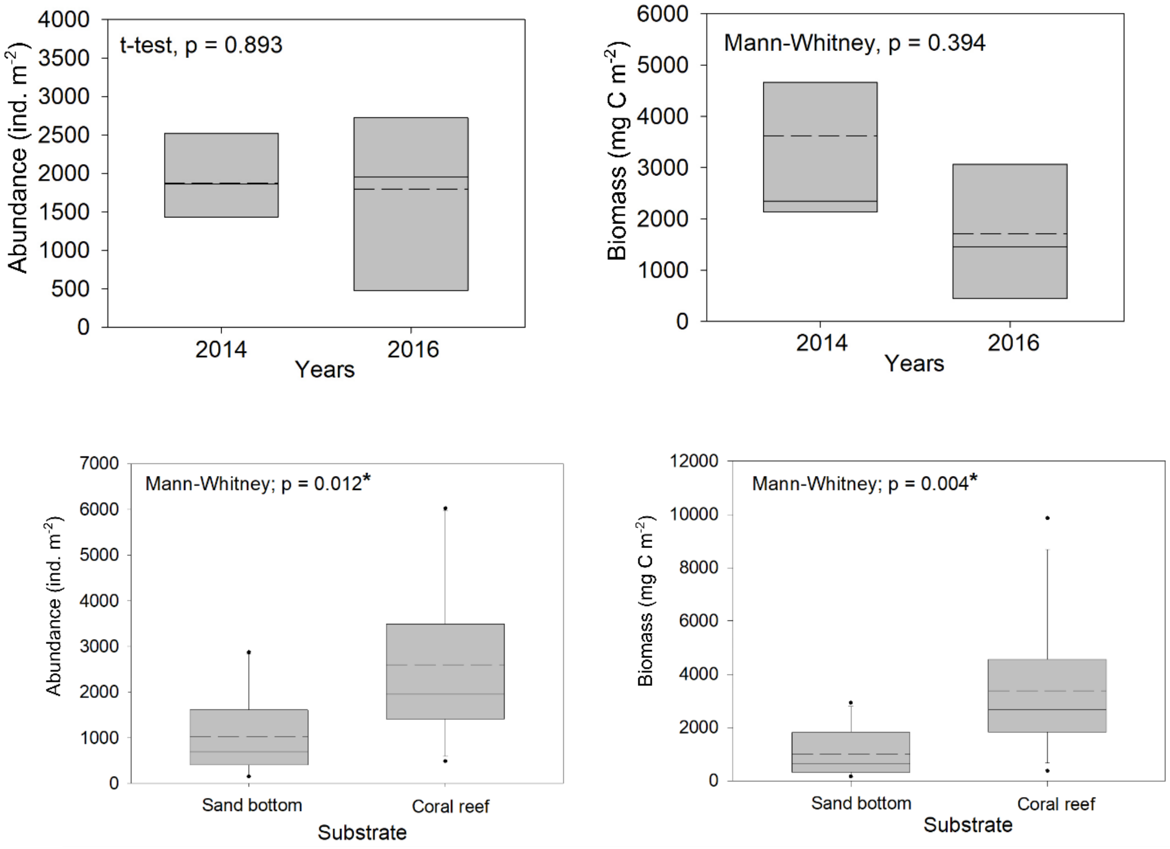
Figure 4 - Relative abundance of demersal mesozooplankton captured with traps at Abrolhos Archipelago, BA, Brazil, from both substrate and years.



Biomass

The biomass not presented differences among 2014 (3623.84 ± 3070.69 mg C m^{-2}) and 2016 (1708.24 ± 1740.53 mg C m^{-2}) (*M-W*, p = 0.394). When considering the different substrates, the coral reef (3379.49 ± 2431.82 mg C m^{-2}) presented a biomass almost four times higher than the sand bottom (994.79 ± 956.97 mg C m^{-2})(Mann-Whitney; p = 0.004) (Figure 4, Table 2). The main contributors to biomass in both years and substrates were Amphipoda, Mysidacea, Isopoda, Cumacea and Ostracoda. Despite dominate in abundance as considered both factors (substrate and year) Copepoda not comprehended more than 1% of the biomass (Table 3).

Figure 5 - Abundance (ind. m^{-2}) and biomass (mg C m^{-2}) for the demersal mesozooplankton captured on different substrates in 2014 and 2016 at Abrolhos Archipelago, BA, Brazil. Dashed lines represent the means.



Community Structure

The community differs between years (PERMANOVA; MS = 6935.2; Pseudo-F = 10.64; p = 0.002). Among the substrates was seen a clear variability among the community structure, presenting two distinct demersal zooplankton communities (PERMANOVA, MS = 5504.5; Pseudo-F = 3.730; p = 0.001). Those differences in both factors could be graphically seen by the MDS (Figure 6). The SIMPER demonstrates a dissimilarity of ≈ 60% for both substrates and year. Forty taxa were responsible for dissimilarity between 2014 and 2016, being Thalestridae (11.86%), Brachyura (Zoea) (7.06%), *Dioithona oculata* (5.37%), Amphipoda (3.76%), Polychaeta (3.35 %), *Pseudocyclops* sp. 1 (3.08 %), Longipedidae (3.03%), *Paracalanus quasimodo* (2.97%), Isopoda (2.96%), Harpacticoida (others) (2.86%), Decapoda (2.73%) and *Calanopia americana* (2.39%), responsible for 50% of this dissimilarity. Among the substrates a similar group was responsible for 50% of the observed dissimilarity, being them Thalestridae (11.83%), Brachyura (Zoea) (5.44%), *Dioithona oculata* (5.4%), Polychaeta (4.67%), Isopoda (4.24%), Ostracoda (3.74%), Amphipoda (2.79%), Foraminifera (2.76%), Decapoda (2.73%), Tegastidae (2.7%), Cumacea (2.64%) and Peltidiidae (2.54%).

Figure 6 - Multidimensional scaling (MDS) plot for the demersal mesozooplankton captured on different substrates in 2014 and 2016 at Abrolhos Archipelago, BA, Brazil. Dashed lines represent the means.

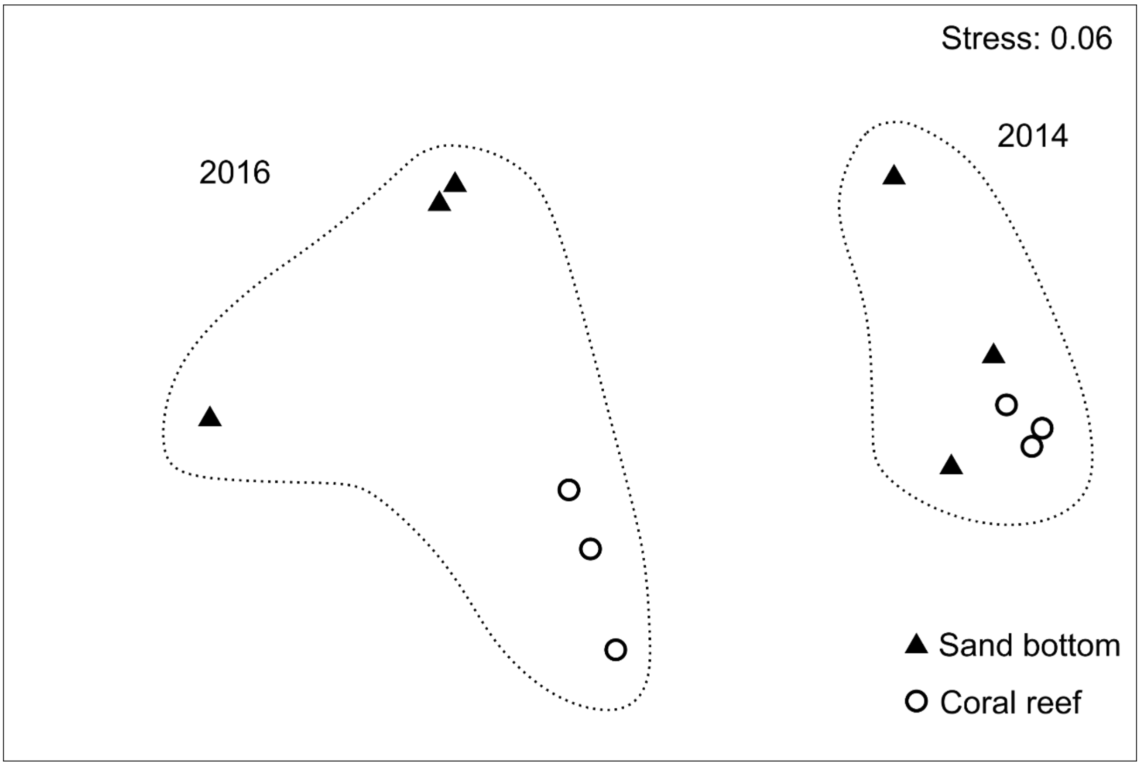


Table 2 - Abundance (mean, ind. m^{-2}), relative abundance (%) and frequency of occurrence (%) of the demersal mesozooplankton captured at Abrolhos Archipelago, BA, Brazil.

	2014					2016				
	Sand bottom		Coral reef			Sand bottom		Coral reef		
	Abundance	%	Abundance	%	FO	Abundance	%	Abundance	%	FO
Foraminifera						0.42	0.28	58.17	3.32	44.44
Bivalve								1.42	0.05	11.11
Gastropoda	18.68	1.13			50	1.98	0.78	37.93	1.92	66.67
Nematoda						1.13	0.41	2.26	0.05	22.22
Sipuncula								1.13	0.03	5.56
Polychaeta	18.68	0.94			50	15.57	2.53	288.89	9.63	88.89
Hydrozoa (larvae)						3.11	0.49	2.69	0.10	50
Echinodermatha (larva)	3.39	0.12			16.67					
Ostracoda	30.57	1.88	47.56	2.423	100	15.57	2.78	134.04	6.79	88.89
Crustacea (nauplius)								5.38	0.37	11.11
Calanopia americana						22.08	4.25	16.42	0.94	88.89
Calanopia spp.						0.57	0.08			11.11
Labidocera acutifrons						0.57	0.10			11.11
Paracalanus quasimodo						25.19	4.42	51.10	1.74	88.89
Paracalanus parvus						12.60	2.10	0.57	0.03	22.22
Paracalanus spp.	1.69	0.26			16.67			6.79	0.12	11.11
Pseudocyclops lerneri	20.38	1.11			16.67					
Pseudocyclops sp. 1						38.64	5.59	37.65	1.65	88.89
Temora stylifera						5.52	1.08	14.72	0.87	77.78
Temora sp.						2.41	0.44	6.79	0.11	44.44
Undinula vulgaris	1.69	0.26			16.67					
Calanoida			6.79	0.33	33.33					
Calanoida (nauplius)						0.57	0.02	2.26	0.04	16.67

Corycaeus giesbrechti	1.69	0.26			16.67	4.81	0.70	10.90	0.45	77.78
Corycaeus sp.						0.42	0.08	7.08	0.17	33.33
Oithona nana	5.09	0.79	3.39	0.18	33.33	3.40	0.60			16.67
Oithona simplex								0.28	0.06	5.56
Oithona spp.	3.39	0.18	10.19	0.41	33.33					
Dioithona oculata						115.92	16.53	319.04	6.02	83.33
Oncaea latimana								5.38	0.19	22.22
Oncaea media						0.28	0.19			5.56
Oncaea venusta	1.69	0.26			16.67	0.00	0.00	1.13	0.02	5.56
Ectinosomatidae	1.69	0.26			16.67	0.99	0.08	1.13	0.03	16.67
Laophontidae	6.79	0.37			16.67	4.53	1.10	36.66	1.00	72.22
Longipedidae						42.89	8.12	19.82	0.95	88.89
Metidae	28.87	2.92	10.19	0.47	83.33	0.28	0.17	20.95	0.98	44.44
Peltidiidae	52.65	4.55	20.38	0.95	83.33	1.84	0.30	48.27	1.70	77.78
Thalestridae	957.96	44.91	1589.81	78.92	100	86.91	15.31	764.47	26.91	100
Tegastidae	73.03	4.52	13.59	0.69	100	12.03	1.78	88.04	3.52	88.89
Tisbidae	25.47	2.11	16.99	0.87	100	4.39	0.73	38.92	1.60	94.44
Hamondidae	13.59	0.68	16.99	0.96	66.67	0.42	0.04			5.56
Harpacticidae	20.38	1.39			50	0.14	0.03			5.56
Harpacticoida (others)	50.95	2.68	57.75	2.6	83.33	4.53	1.49	15.85	0.28	61.11
Harpacticoida (nauplius)						2.83	0.83	3.96	0.10	50.00
Monstriloida						0.14	0.04	0.14	0.03	11.11
Cirripedia (cypris)								2.26	0.12	11.11
Cirripedia (nauplius)						0.57	0.15	4.81	0.20	33.33
Isopoda (others)	10.19	0.55	37.37	1.83	66.67	11.18	2.88	198.87	6.10	88.89
Mysidacea	42.46	2.24	23.78	1.25	100	7.64	2.02	27.46	1.97	88.89
Mysidacea (embryo)						2.83	0.52	1.42	0.07	38.89
Cumacea	71.33	4.32	27.17	1.39	100	13.73	2.25	88.75	3.65	94.44
Amphipoda	120.59	10.79	118.89	5.91	100	9.62	2.09	40.76	1.68	100

Nebaliacea								2.26	0.05	11.11
Stomatopoda (Phyllosoma)								3.96	0.12	11.11
Decapoda	132.49	8.81	13.58	0.76	83.33	9.48	1.64	60.86	2.51	88.89
Decapoda (Protozoea)						0.14	0.02			5.56
Brachyura (Zoea)						294.69	11.07	149.19	5.52	72.22
Brachyura (Megalopa)						0.71	0.17	0.57	0.03	33.33
Porcelanidae (Zoea)						0.42	0.10	60.30	2.29	55.56
Anomura (Megalopa)						0.28	0.04	1.13	0.03	16.67
Belzebub faxoni						0.14	0.04			5.56
Pycnogonida								0.57	0.03	5.56
Chaetognatha	3.4	0.12			16.67	0.57	0.08	4.53	0.08	27.78
Paraspadella nana	6.79	0.71			33.33	0.28	0.04	7.08	0.19	33.33
Oikopleura spp.	8.49	0.51			33.33	0.28	0.03	3.54	0.09	22.22
Ascidiacea (larvae)						2.12	0.37	22.79	1.10	50
Teleostei (larvae)	6.79	0.31			33.33	1.27	0.17	29.30	1.06	61.11
Teleostei (eggs)						7.93	2.83	36.80	1.35	72.22
TOTAL	1740.97		2014.43			796.60		2797.45		

Table 3 - Biomass (mean ± SD, mg C m^{-2}) and relative biomass (%) of main taxonomic groups of the demersal mesozooplankton captu at Abrolhos bank, BA, Brazil. In bold are the groups that presented a higher biomass in the Coral reef.

	2014				2016			
	Sand bottom	%	Coral reef	%	Sand bottom	%	Coral reef	%
Foraminifera					2.60×10^{-3}	1.57×10^{-3}	0.03	1.47×10^{-3}
Mollusca			0.04	1.09×10^{-3}	0.01	3.44×10^{-3}	0.18	8.63×10^{-3}
Polychaeta			0.44	0.02	1.80	0.32	25.37	0.91
Cnidaria					1.20×10^{-4}	2.1×10^{-5}	1.09×10^{-4}	4.18×10^{-6}
Ostracoda	131.33	5.44	86.83	1.90	44.86	8.53	373.23	13.77
Calanoida	0.03	1.24×10^{-3}	0.06	1.53×10^{-3}	0.28	0.07	0.26	0.01
Cyclopoida	6.43×10^{-3}	2.81×10^{-4}	7.67×10^{-3}	242×10^{-4}	0.04	6.92×10^{-3}	0.43	0.01
Harpacticoida	3.40	0.14	2.13	0.08	0.30	0.06	2.38	0.09
Monstriloida					4.31×10^{-4}	4.98×10^{-4}	7.73×10^{-4}	2.09×10^{-4}
Copepoda (nauplius)					5.65×10^{-4}	1.98×10^{-4}	1.38×10^{-3}	3.96×10^{-5}
Cirripedia					1.16×10^{-4}	2.83×10^{-5}	3.10×10^{-3}	8.06×10^{-5}
Isopoda	163.00	6.73	13.5	0.14	67.22	16.67	905.30	26.42
Mysidacea	588.93	23.57	2548.33	28.13	173.49	32.20	629.28	23.08
Cumacea	276.39	10.17	399.14	7.38	22.54	4.40	157.57	5.23
Amphipoda	1200.53	48.32	984.07	34.68	85.25	22.53	305.80	12.48
Stomatopoda							78.39	1.91
Decapoda	155.77	5.63	287.33	9.72	88.29	14.81	441.66	15.77
Chaetognatha			406.40	17.95	2.52	0.39	10.02	0.30
Chordata			6.23×10^{-3}	2.83×10^{-4}	3.76×10^{-15}	6.88×10^{-16}	2.13×10^{-13}	4.19×10^{-14}
TOTAL	2519.39		4728.28		489.59		2929.89	

DISCUSSION

This study presented an evaluation of the demersal mesozooplankton in a fringing reef area in the Southwest Atlantic Ocean in summer samplings realized during two years with comparisons between a coral reef and an adjacent sand bottom. Although works has been performed from the emergent fauna regarding its abundance, diversity and substrate preference (Alldredge & King, 1977; Smith, 2016; Smith *et al.*, 2016) little is known about the role of this community in the Southwest Atlantic coastal environments, and who it varies over time. We observed an interannual variability in the diversity and community structure of the Abrolhos archipelago, further an increase in abundance and at least three times in biomass of community in coral reef as compared to adjacent sand bottom substrate.

In the present study we found 71 taxa, being mainly composed by Crustacea as the great majority of the emergent fauna studies (Sale *et al.*, 1976; Alldredge & King, 1977; Porter *et al.*, 1977; Melo *et al.*, 2010; Vu *et al.*, 2017). Farias (Cap. 1) observed a similar diversity from Tamandaré Bay, with 72 taxa, although a higher Copepoda diversity (43) could be observed there in comparison to our (37). Furthermore the species richness found here was higher than the one found by Heidelberg *et al.* (2010) at Florida Keys coral reef. Although it was less than 88 taxa found by Melo *et al.* (2010) in the northwest Brazilian coastal habitats and 114 taxa found by Sale *et al.* (1976) in the Great Barrier Reef.

Harpacticoida was the main group of the emergent fauna in the Abrolhos archipelago, represented by 10 families in both years and substrates. The Harpacticoida dominance in the emergent community was already pointed by several works (Bell *et al.*, 1987; Sebens *et al.*, 1996; Gheerardyn *et al.*, 2008; Kramer *et al.*, 2013), although in 2014 Thalestridae was dominant, representing almost 80% of the total abundance in the coral reef. Thalestridae dominated the community in some areas, composing up to 70% of the Harpacticoida assemblages in some phyt al systems (Hicks, 1980), being also recognized as a plague in some environments (Ho & Hong, 1988; Park *et al.*, 1990; Shimono *et al.*, 2004). The other Harpacticoida families were negatively influenced by the dominance of Thalestridae, families that are known in the coral reef environments such as Tisbidae, Tegastidae and Peltidiidae (Gheerardyn *et al.*, 2006; Suarez-Morales *et al.*, 2006; Chertoprud *et al.*, 2009; Sarmento & Santos, 2012), and which presented greater abundance in the reef area in the 2016, and a reduced abundance in 2014, being higher in the sand bottom, or even not present in the coral reef environment as seen for Laophontidae.

Dioithona oculata was absent in the demersal community in 2014, being also not found in the net hauls made simultaneously (Figueiredo 2018). This small Cyclopoida was found in both substrates in 2016, although a higher in the coral reef areas was noted. *Dioithona oculata* assemblages are known for forming swarms over the reefs, that present better shelter conditions to these organisms (Emery, 1968; Omori & Hammer, 1982), as observed previously in Brazilian reefs by Melo *et al.* (2010). In both years member of the genus *Pseudocyclops* could be found, with *Pseudocyclops lerneri* occurring in 2014 with a small frequency and *Pseudocyclops* sp.1 (different from *P. lerneri*) in 2016 found much more commonly. These two representatives are the first occurrence of the family Pseudocyclopidae in the South Atlantic Ocean, and these finds highlight the necessity of more works related to this community and the potential for new occurrences and possible new species to be found.

The emergent fauna normally present itself variable among several substrate types, sand bottom, gravel, mud bottom, dead coral and coral reef (Kramer *et al.*, 2014). Among these a most abundant and diverse community was found in the coral reef community, being that an environment with more structural complexity that allow more shelter places for that community that stays in contact with the bottom during the day to avoid predation. In our study although a diversity and species richness variation could not be seen, with the same taxa composing both communities, some groups preferred the coral reef environment (Table 3), having a higher abundance and biomass than the sand bottom, being this the primal reason for the community structure variation observed. The variation in the community observed between the years was partially directed by the several exclusive groups from 2016, as *Dioithona oculata*, Longipedidae and *Calanopia americana* that are commonly recorded in coastal and reef environments (Emery, 1968; Zaleha *et al.*, 1996; Suárez-Morales & Gasca, 2000; Figueiredo, 2018), yet other main responsible were the groups that presented a higher variation in the abundance among years, between them Thalestridae that was the major community component in 2014.

The main variation between the years occurred from the species richness, with 2016 presenting in average 10 taxa more than 2014, and with a higher number of exclusive taxa, although this difference was not reflected in the density, since the majority of these taxa occurred sporadically and in low density and the main abundance composers were recurrent in both years. There was no great variation in the surface temperature of the water between the years when observing satellite data (Copernicus - Marine Environment Monitoring Service), being seen for the period an average of 28ºC in 2014 and 29ºC in 2016. However, that variation could be enough to affect zooplankton and coral organisms metabolic rates (Hienle, 1969; Hoegh-Guldberg *et al*, 2007), thus influencing the emergence fauna migration. Although the variation seen here could be related to the different moon periods from both years, with 2014 sampling presenting a higher moonlight intensity with could discourage some taxa migration as seen for Alldredge & King (1980). Nevertheless, the variations found here may also be related to the regime of trade winds, reproductive cycles, tides, substrate complexity, phytoplankton availability, variation in current intrusions and prey predator relationships (Alldredge & King, 1977, Youngbluth 1980; Okolodkov *et al*, 2011; Marcolin *et al*, 2015). Thus, more detailed studies are necessary to identify which factors would be influencing the large interannual fluctuation in numbers of taxa observed here.

In the coral reef communities an increase in the night abundance and biomass is noted (Yahel et al., 2005; Nakajima et al., 2008; Heidelberg et al., 2010), caused by the advection of organisms from the adjacent oceanic waters and by the contribution from the vertical migration of the emergent community (Alldredge & King, 1977; Nakajima et al., 2009). The contribution from the emergent fauna to the pelagic environment in a study can be realized through estimates of dilution of this community on the above water column (Alldredge & King, 1977). In Abrolhos archipelago the emergent fauna could contribute in 433.63 ± 300.43 ind. m^{-3} for the coral reef pelagic community and in 172.09 ± 156.06 ind. m^{-3} for the sand bottom pelagic community. For the biomass, the contribution would be of 563.26 ± 405.3 mg C m^{-3} for the coral reef community and 165.8 ± 159.5 mg C m^{-3} in the sand bottom community. Farias (Cap 1) found a smaller contribution of emergent community in summer on Tamandaré bay in comparison to our community, which was almost threefold superior in abundance and to fourfold in biomass. Furthermore, the dominance of the large body taxa in the demersal community biomass as seen in several studies (Kramer *et al.*, 2013; Vu *et al.*, 2017) was observed here, with Isopoda, Amphipoda, Mysidacea and Cumacea being the largest contributors to biomass. Those large body organisms are the main prey of several planktivorous taxa (Porter, 1974; Hobson, 1975; Couturier *et al.*, 2013), being the members of the emergent fauna with largest migration amplitude, thus becoming a carbon source in the upper regions of the water column. This highlight the importance of the emergent fauna in the reef trophic web as an agent in the benthic-pelagic coupling.

CONCLUSIONS

Our results pointed to a visible interannual variability in the demersal zooplankton diversity and community structure in the Abrolhos archipelago, mainly represented by variations in the abundance of dominant taxa. Also as seen in several works a clear higher abundance and biomass to the fauna associated with coral reef areas could be noted, highlighting the potential production of these environments. Furthermore here we evidence the contribution of the demersal community to the pelagic fauna in the most important Southwest Atlantic reef environment. Lastly we indicate the necessity of more studies regarding this community, which should include to the Southwest Atlantic taxa not yet registered and new species for science.

ACKNOWLEDGEMENTS

We wish to express our thanks to the CAPES and CNPq (PROABROLHOS) for their financial support, the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) who conceded the author’s scholarship.

4 CONSIDERAÇÕES FINAIS

A presente dissertação teve como objetivo observar a variação temporal na comunidade mesozooplanctônica demersal em duas áreas recifais, bem como observar como essa parcela da comunidade atua no transporte de carbono do ambiente bentônico para o ambiente pelágico. Inicialmente pode-se ressaltar a visível variação temporal que foi observada nas duas áreas, tanto na questão sazonal em Tamandaré quanto em questão interanual em Abrolhos, apesar de não ter sido possível destacar os fatores ambientais que direcionam essa variação. Além disso aqui se destacou a maior abundância e biomassa presente em áreas de substrato recifal, bem como a contribuição em biomassa da fauna emergente.

Apesar do zooplâncton ser bastante estudado, a parcela demersal ainda se apresenta desconhecida em algumas áreas. Os organismos emergentes são muitas vezes sub-amostrados e negligenciado em estudos recifais. Arrastos noturnos muitas vezes não são capazes de capturar toda a comunidade emergente que tem uma característica esporádica ao longo do período noturno e que eventualmente pode ser predada antes da realização dos arrastos, visto que a maioria dos organismos verdadeiramente demersais apresentam um maior tamanho corpóreo, como Mysidacea e Cumacea. Aqui ressalta-se a importância desse grupo nas duas áreas, destacando seu papel na disponibilização de carbono para o ambiente pelágico. Sendo visto que apesar de apresentarem baixa densidade, organismos maiores são os grandes contribuintes da biomassa demersal. Isto pôde ser observado para os Copepoda, que apesar de ser o grupo mais abundante em ambas as áreas, em nenhum momento ultrapassou 1% da biomassa total.

Entre as áreas foi possível observar um número semelhante de taxa, sendo observados 72 em Tamandaré e 71 em Abrolhos. Isso se refletiu também para a diversidade de Copepoda, sendo observadas 19 famílias nas duas áreas, apesar de algumas variações, como Pseudocyclopidae, Oncaeidae e Hamondidae que ocorreram apenas no arquipélago de Abrolhos enquanto que Cilindropsyllidae, Darcythompsidae e Porcelidiidae ocorreu apenas na área recifal de Tamandaré. Apesar da diversidade semelhante a abundância e a biomassa nas duas áreas diferiram bastante, com o arquipélago de Abrolhos apresentando uma abundância 4 vezes maior e uma biomassa 3 vezes maior que Tamandaré. Estes resultados são justificados por Abrolhos apresentar uma estrutura recifal muito mais complexa que Tamandaré, com uma maior diversidade de corais construtores o que gera uma maior disponibilidade de abrigos. Entre as áreas foi possível também observar uma grande variação na abundância de Mysidacea, sendo muito mais representativo em Tamandaré, principalmente no período chuvoso. A maioria dos Mysidacea em ambiente recifal se apresentam como detritívoros (Carleton & Mckinnon, 2007), uma vez que os recifes de Tamandaré são muito mais próximos da costa, com uma maior influência da descarga de rios, e alta concentração de material em suspensão, se tornam um ambiente mais propicio para esse grupo.

De forma geral os resultados obtidos aqui possibilitaram um maior conhecimento sobre a fauna zooplânctônica recifal emergente na costa brasileira. Ressalta-se o notório desconhecimento dessa comunidade não só na costa brasileira, mas em todo o Atlântico Sul, com uma pequena quantidade de trabalhos focados nesse compartimento. Assim a ampliação de estudos usando uma metodologia adequada para a coleta desses organismos em diferentes áreas e escalas temporais se torna fundamental para o conhecimento da fauna brasileira além da ampliação da compreensão do papel dessa comunidade no acoplamento bento-pelágico e suas interações tróficas com a teia pelágica.

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