Arquivos de Ciências do Mar

ARTIGO DE REVISÃO

A BRIEF SCENARIO OF THE ESTUARINE MESOZOOPLANKTON IN NORTHEASTERN BRAZIL: A TOOL FOR CONSERVATION

Um breve cenário do mesozooplâncton estuarino no Nordeste do Brasil: uma ferramenta para a conservação

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ABSTRACT

The Brazilian coast stretches itself along the western Atlantic Ocean, covering 7,367 km, being sorted out into five sectors, three of which are located in the northeastern region. In these sectors, estuaries can be classified as permanent or temporary, the latter holding estuarine characteristics only during part of the year. Studies carried out on estuarine mesozooplankton in that region have been conducted since the 1960s. In the rainy season, the marine species penetrate into the estuary during the high tide, whereas during the low tide limnetic species inhabit this ecosystem. In the dry season, there is a smaller freshwater contribution to the estuary with a more pronounced marine influence; under these conditions the zooplanktonic community is composed by euryhaline marine organisms. This approach should be encouraged, as well as studies throughout the whole of the Northeast region, since there are still many estuaries where this taxonomic group has never been investigated.

***Keywords**: mesozooplankcton, estuary, literature survey, conservation, Northeast Brazil.*

RESUMO

A costa brasileira se estende por todo o Oceano Atlântico ocidental, abrangendo 7.367 km, sendo dividida em cinco setores, dos quais três estão localizados na região Nordeste. Nesses setores, os estuários podem ser classificados como permanentes ou temporários, estes últimos com características estuarinas apenas durante parte do ano. Estudos sobre o mesozooplâncton estuarino nessa região têm sido realizados desde 1960. Durante a estação chuvosa, as espécies marinhas penetram no estuário durante a maré alta, enquanto ma maré baixa as espécies límnicas habitam esse ecossistema. Na estação seca, há uma contribuição menor de água doce para o estuário, com influência marinha mais pronunciada; nessas condições a comunidade zooplanctônica é composta por organismos marinhos eurialinos. Esta abordagem deve ser incentivada, assim como os estudos no âmbito de toda a região Nordeste, pois existem muitos estuários onde esse grupo taxonômico nunca foi investigado.

***Palavras-chaves**: mesozooplâncton, estuário, revisão bibliográfica, conservação, Nordeste do Brasil.*

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INTRODUCTION

The estuarine environment is a semi-closed coastal body of water (Schmiegelow, 2004), characterized by having a constantly changing mixture of salt and fresh water, and being dominated by fine sedimentary material coming from the sea and rivers, which accumulates in the estuary to form mudflats (McLusky, 1989*a*). Its waters are biologically richer than those from the river and the adjacent sea (Miranda et al., 2002) and boast high primary and secondary productivities (Kennish, 1986). Because of these qualities and the availability of shelter sites to organisms, estuaries are important feeding and breeding areas for many species of vertebrates and invertebrates (Tundisi, 1970).

Among the organisms that inhabit this environment, there can be highlighted the zooplankton, which is mainly known as a vital part in the food web in coastal and oceanic waters, and the link between primary producers (phytoplankton) and secondary consumers (Kennish, 1986). The knowledge of the variability of the estuarine zooplankton composition and abundance at different temporal scales is a requirement to the understanding of ecosystem dynamics (Araújo et al., 2008) since, especially in estuaries, their taxa are influenced by physical, chemical and biological properties of such water bodies (Villate, 1997). Therefore, changes in those factors can cause temporal changes in the zooplankton distribution and abundance (Gómez-Erache et al., 2000) and consequently on their population dynamics (Sterza & Fernandes, 2006).

In the Intertropical Zone, rainfall emerges as a factor of great ecological importance in controlling population characteristics (Bacon, 1973), and together with tide cycle influences the distribution of salinity in the estuary, as a result of differences between the periods of rain and drought (Neumann-Leitão *et al*., 1996, Eskinazi-Sant'anna, 2000, Sterza & Fernandes, 2006, Cavalcanti *et al*., 2008). The seasonal variation of salinity defines the distribution of the zooplankton community that tends to increase near the river mouth and decrease upstream (Souza-Pereira and Camargo, 2004), and accounts for the dominance of euryhaline species of marine origin (Lansac-Tôha & Lima, 1993, Silva *et al*., 1996, Eskinazi-Sant'anna, 2000). In general, the estuaries of northeastern Brazil can be classified as temporary, with characteristics of typical estuarine circulation and mixing (Miranda *et al*., 2002), although there is no measurable dilution of the water throughout the year (Day, 1980).

The variability of rainfall distribution in the Northeast region is related to configuration changes of large-scale atmospheric circulation and ocean-atmosphere interactions in the Pacific and Atlantic Oceans (Coelho, 2010). Due to the low infiltration capacity and water retention, combined with the potential evapotranspiration and the existence of long periods of drought, an important part of the watercourses are of an intermittent character (MMA, 2004).

The policies implemented in Brazil have historically given priority to the accumulation of water from rainfall in reservoirs in order to ensure supplies, fish farming, agriculture, fisheries, industry and leisure. Given the urgency of offering water and promoting development, government interventions have tended to focus on specific water works (construction of dams, pipelines, drilling of wells and implementation of irrigation projects), detached from the actual process of developing an integrated and sustainable for the region (MMA, 2004). The government-built dams have enabled the perpetuation of 3,320 km of intermittent rivers in the semi-arid Northeast (Gondim Filho, 1994).

However, dams change the characteristics of the water by affecting its hydrology from the physical, chemical and biological viewpoints (Friedl and Wüest, 2002), and significantly impairing the environmental sustainability of these ecosystems (Pinheiro & Morais, 2010). As a rule, river damming leads to the advancement of saltwater intrusion, increased residence time in estuaries, increased salinization and reduction of sediment and nutrients to the coastal zone (Pinheiro *et al*., 2004, Araújo *et al*., 2006, Morais *et al*., 2008). Another problem commonly observed in northeastern estuaries is related to domestic sewage, thus closely linked to human population density, mainly those that are close to cities (Neumann-Leitão & Matsumura-Tundisi, 1998, Silva *et al*., 2003, Araújo *et al*., 2008).

Scenarios such as the ones herein displayed simultaneously demonstrate the nature of the ecological services carried out by coastal ecosystems, as well as create the context within which select management options could be made available to mitigate the anthropogenic causes of deterioration of the ecosystems involved and to apply conservation programs.

MATERIAL AND METHODS

Study area

Due to its length and geographic distribution, the Brazilian coastline has been divided into five

sectors, based on climatic and geomorphological criteria, namely Quaternary North Coast, Semi-arid Northeast Coast, Northeast-East Wet Coast, South Granitic Coast and Quaternary South Coast (Lacerda, 2005). The Brazilian northeastern region is represented in three of these areas: Quaternary North Coast, Semi-arid Northeast Coast and Northeast-East Wet Coast (Figure 1).

Figure 1 – Brazil's Northeastern region showing its five sectors: Quaternary North Coast (Maranhão – MA, Piauí - PI), Semi-arid Northeast Coast (Ceará - CE, Rio Grande do Norte - RN, Paraíba - PB, Pernambuco-North - PE) and Northeast-East Wet Coast (Pernambuco-South - PE, Alagoas - AL, Sergipe - SE, Bahia - BA).

Quaternary North Coast spans the states of Maranhão and Piauí). Semi-arid Northeast Coast ranges from Ceará state (3º65'S) to northern Pernambuco state (7º30'S), where the coastal features are dominated by sandy beaches, wind deflation fields, recent and ancient dunes, reefs close to the lines of estuaries, lagoons and coastal lagoons. Northeast-East Wet Coast corresponds to the area from southern Pernambuco State (latitude 07º30'S) through Bahia State, which is characterized by extensive quaternary sandy flats (IDEMA, 2005, Maia *et al*., 2006).

METHODS

This paper is a literature-based research that used data from zooplankton works were published in journals but also the "gray literature" (theses, dissertations, abstracts) is also considered, the whole of this material being studied and analyzed. The focus of this literature review is to summarize and synthesize the arguments and ideas about estuarine zooplankton researches in Northeastern Brazil. The access to most information was so difficult that it is not the authors's intention to provide a complete review of all the estuarine literature, as long as the data are satisfactory to give a general scenario of the estuarine zooplankton.

RESULTS AND DISCUSSION

Studies on estuarine zooplankton in northeastern Brazil has been conducted since 1960s (Neumann-Leitão, 1994/95), yet in some states little information is known about this community (Figure 2).

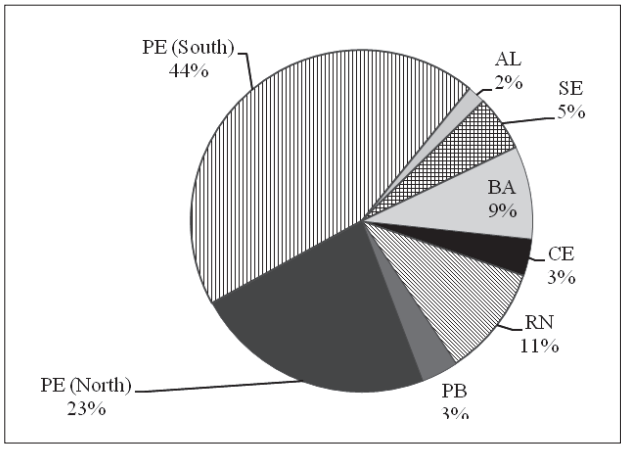

Figure 2 - Percentage of studies on estuarine zooplankton in each state of Semi-arid Northeast Coast (Ceará - CE, Rio Grande do Norte - RN, Paraíba - PB, Pernambuco-North - PE) and Northeast-East Wet Coast (Pernambuco-South - PE, Alagoas - AL, Sergipe - SE, Bahia - BA).

Some of these finding were published in national journals (60%), in international journals (20%) or in the form of theses (20%). As the tropical region of Brazil has the rain and dry seasons well defined, many studies use this approach for the zooplankton community (Table I).

Table I - Publications about specific themes of the estuarine zooplankton in Semi-arid Northeast Coast and in Northeast-East Wet Coast of Brazil.

Themes	Reference	
	Semi-arid Northeast Coast	Northeast-East Wet Coast
Temporal distribution	(Lucas et al., 2008), (Silva et al., 2003), (Porto Neto et al., 1999), (Santos et al., 2009), (Silva et al., 2009), (Dutra, 2008), (Nordi, 1982)	(Araújo, 2006), (Pessoa, 2009), (Santos, 2008), (Cabral, 2009), (Neumann-Leitão & Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Eskinazi-Sant'Anna & Tundisi, 1996), (Neumann-Leitão et al., 1999), (Nascimento-Vieira, 1987/89)
Horizontal distribution	(Serpe et al., 2010), (Pekala, 1980), (Silva et al., 2009), (Nordi, 1982)	(Araújo, 2006), (Pessoa, 2009), (Neumann-Leitão & Matsumura-Tundisi, 1998), (Pessoa et al., 2009), (Santos, 2007)
Diel cycle	(Silva et al., 2003), (Porto Neto et al., 1999), (Melo et al., 2008)	(Araújo et al., 2008)
Larval ecology	*Larvae of decapod crustaceans (Sankarankutty* et al., *1995), (Schwamborn* et al., *2008), (Schwamborn* et al., *2001), (Schwamborn* et al., *2002), (Schwamborn & Bonecker, 1996)*	-
Distribution and ecology of specific taxa	*Pseudodiaptomus trihamatus (Medeiros* et al., *2006), Copepoda (Magris* et al., *2011), Rotifera (Medeiros* et al., *2010), (Melo Júnior* et al., *2007a), (Neumann-Leitão* et al., *1992), Oikopleura dioica (Esnal* et al., *1985)*	Copepoda (Dias et al., 2009), Cladocera (Paranaguá et al., 2005)
Physiology and biomass	*(Schwamborn & Silva, 1996), (Melo Júnior* et al., *2007b)*	-
Biodiversity	*(Nordi, 1982), (Fonsêca & Klein, 1976)*	-

In addition to the variations associated with rainfall, the density of holoplanktonic organisms throughout the day is also influenced by the tide cycle (McLusky, 1989b), since its phases may bring about changes in water volume and sediment transport as well as in the physicochemical conditions of the estuary (Pekala, 1980, Neumann-Leitão *et al*., 1996). In the rainy season, the marine species enter the estuary during high tide in spite of inhabiting the limnetic environment during the low tide (Dutra, 2008). In the dry season, as there is a small contribution from fresh water into the river estuary, the marine influence is most pronounced, and the zooplankton community is shown now to be comprised of euryhaline marine organisms (Silva *et al*., 2003). In general, species distributions along the tidal cycle reflected an overlap occurrence of different patterns of marine and estuarine species (Araújo *et al*., 2008).

Zooplankton plays a key role in the ecosystem structure due to its quick response to abiotic conditions, especially in impacted environments (Neumann-Leitão *et al*., 1999). In Tabatinga River estuary (Northeast-East Wet Coast - Bahia State), the lower numbers and density of most taxa, concerning zooplankton and ichthyoplankton, may reflect its poor water quality conditions due to organic pollution caused by the disposal of shrimp farms effluents (Marcolin *et al*., 2010).

Water-related variations in temperature, salinity and dissolved oxygen characterize an estuarine semidiurnal tidal cycle (Bacon, 1973). In tropical environments, there are very small fluctuations in water temperature (Nordi, 1982; Sankarankutty *et al*., 1995; Almeida, 2006; Santos *et al*., 2009; Serpe *et al*., 2010), whereas according to the physical characteristics of estuaries, it is possible to find large variations in salinity so that in the rainy season values equal or close to zero and dry values higher than 35 may be reached (Ara, 2002). Thus, the zooplankton distribution is mainly related to a horizontal gradient of salinity (Matsumura-Tundisi, 1972; Almeida, 2006).

Some information about variations in plankton biomass is known so far as tide cycle and climate season are concerned, namely in Santa Cruz Channel (Semi-arid Northeast Coast - Pernambuco State): (a) it ranged from 1.4 mg $\cdot m^{-3}$ (01:00h) to 374.7 mg $\cdot m^{-3}$ (13:00h) both during flood tide, with average biomass of 47.4 mg $\cdot m^{-3}$; (b) in dry season biomass ranged from 0.92 mg $\cdot m^{-3}$ (diurnal low tide) - 10:00h) to 408.19 mg $\cdot m^{-3}$ (diurnal ebb tide - 7:00h), with an average biomass of 57.9 mg $\cdot m^{-3}$ (Silva *et al*., 2003). Likewise, the fluxes in zooplankton biomass are also important (Melo Júnior *et al*., 2007*b*).

The zooplankton fauna can vary in abundance and density of species, yet Copepoda is the most representative group in Brazilian estuaries, accounting for more than 70% of the mesozooplankton (Fonsêca & Klein, 1976; Santos, 2007; Lucas *et al*., 2008; Melo *et al*., 2008; Cabral, 2009; Pessoa, 2009; Santos *et al*., 2009).

The copepods may have herbivorous, carnivorous, omnivorous or detritivorous feeding diets (Schwamborn & Bonecker, 1996; Schwamborn *et al*., 2002), so that carnivorous and omnivorous species have diversified food habits, ranging from the ingestion of particles adhering to marine debris and aggregates (including bacteria, microalgae and protists) to predation on fish larvae (Brandini *et al*., 1997). The herbivorous zooplankton provides energy for high trophic level organisms, but the fact most species are omnivorous adds up to the complexity in estuarine food web structures (Kennish, 1986, Silva *et al*., 2004).

Among the species of copepods that occur in Semi-arid Northeast Coast and Northeast-East Wet Coast (Table II), *Acartia (Odontacartia) lilljeborgi*, *Calanopia americana*, *Pseudodiaptomus acutus*, *Pseudodiaptomus marshi*, *Pseudodiaptomus richardi*, *Temora turbinata, Euterpina acutifrons* and *Oithona hebes* are often mentioned (*e.g*., Pekala, 1980, Nascimento-Vieira, 1987/89, Silva *et a*l., 2004, Dias *et al*., 2009).

Table II - Copepoda often mentioned in publications about zooplankton in Semi-Arid Northeast Coast and in Northeast-East Wet Coast of Brazil. Distribution(Björnberg, 1981, Bradford-Grieve et al., 1999): E - estuarine, N - neritic, C - coastal, O - ocean, L - límnetic, NI - non-indigenous.

Taxa	Distribution	Reference	
		Semi-arid Northeast Coast	Northeast-East Wet Coast
CALANOIDA			
Acartia (Odontacartia) lilljeborgi	E, C?	(Lucas et al., 2008), (Silva et al., 2003), (Porto Neto et al., 1999), (Santos et al., 2009), (Melo et al., 2008)	(Araújo, 2006), (Pessoa, 2009), (Santos, 2008), (Cabral, 2009), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Eskinazi-Sant'Anna and Tundisi, 1996), (Nascimento-Vieira, 1987/89), (Pessoa et al., 2009), (Dias et al., 2009)
Calanopia Americana	N	(Silva et al., 2003), (Lucas et al., 2008), (Dutra, 2008), (Melo et al., 2008), (Almeida, 2006)	(Araújo, 2006), (Pessoa, 2009), (Santos, 2008), (Cabral, 2009), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Nascimento-Vieira, 1987/89), (Pessoa et al., 2009), (Dias et al., 2009)
Centropages velificatus	C,O	(Dutra, 2008), (Melo et al., 2008), (Almeida, 2006)	(Araújo, 2006), (Pessoa, 2009), (Cabral, 2009), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Eskinazi-Sant'Anna and Tundisi, 1996), (Dias et al., 2009)
Clausocalanus furcatus	O	(Silva et al., 2003), (Santos et al., 2009)	(Araújo, 2006), (Pessoa, 2009), (Santos, 2008), (Cabral, 2009), (Santos, 2007)
Labidocera fluviatilis	N	(Santos et al., 2009), (Melo et al., 2008), (Dutra, 2008)	(Araújo, 2006), (Pessoa, 2009), (Santos, 2008), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Eskinazi-Sant'Anna and Tundisi, 1996), (Pessoa et al., 2009)
Paracalanus aculeatus	O?	(Santos et al., 2009), (Dutra, 2008), (Melo et al., 2008)	(Araújo, 2006), (Pessoa, 2009), (Araújo et al., 2008), (Santos, 2007), (Dias et al., 2009)
Paracalanus Quasimodo	C	(Porto Neto et al., 1999), (Almeida, 2006)	(Araújo, 2006), (Cabral, 2009), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Eskinazi-Sant'Anna and Tundisi, 1996), (Dias et al., 2009)
Parvocalanus crassirostris	C?	(Silva et al., 2003), (Porto Neto et al., 1999), (Santos et al., 2009), (Dutra, 2008), (Almeida, 2006)	(Araújo, 2006), (Pessoa, 2009), (Santos, 2008), (Cabral, 2009), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Eskinazi-Sant'Anna and Tundisi, 1996), (Neumann-Leitão et al., 1999), (Nascimento-Vieira, 1987/89), (Pessoa et al., 2009),(Dias et al., 2009)
Pseudodiaptomus acutus	E	(Lucas et al., 2008), (Porto Neto et al., 1999), (Santos et al., 2009), (Dutra, 2008), (Almeida, 2006)	(Araújo, 2006), (Santos, 2008, Pessoa, 2009), (Santos, 2008), (Cabral, 2009), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Eskinazi-Sant'Anna and Tundisi, 1996), (Pessoa et al., 2009), (Dias et al., 2009)
Pseudodiaptomus marshi	E	(Lucas et al., 2008), (Silva et al., 2003), (Dutra, 2008), (Almeida, 2006)	(Araújo, 2006), (Pessoa, 2009), (Santos, 2008), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Neumann-Leitão et al., 1999)
Pseudodiaptomus richardi	E	(Lucas et al., 2008), (Silva et al., 2003), (Porto Neto et al., 1999), (Almeida, 2006)	(Araújo, 2006), (Pessoa, 2009), (Araújo et al., 2008), (Santos, 2007)
Subeucalanus pileatus	O	-	(Araújo, 2006), (Pessoa, 2009), (Cabral, 2009), (Araújo et al., 2008), (Santos, 2007), (Eskinazi-Sant'Anna and Tundisi, 1996), (Dias et al., 2009)
Temora stylifera	C,O	(Silva et al., 2003), (Santos et al., 2009), (Almeida, 2006)	(Araújo, 2006), (Santos, 2008), (Cabral, 2009), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Nascimento-Vieira, 1987/89), (Pessoa et al., 2009), (Dias et al., 2009)
Temora turbinate	NI	(Lucas et al., 2008), (Silva et al., 2003), (Porto Neto et al., 1999), (Santos et al., 2009), (Dutra, 2008), (Melo et al., 2008), (Almeida, 2006)	(Araújo, 2006), (Pessoa, 2009), (Santos, 2008), (Cabral, 2009), (Araújo et al., 2008), (Santos, 2007), (Pessoa et al., 2009), (Dias et al., 2009)

CYCLOPOIDA			
Onychocorycaeus giesbrechti	O	(Silva et al., 2003), (Dutra, 2008)	(Pessoa, 2009), (Santos, 2008), (Cabral, 2009), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Pessoa et al., 2009), (Dias et al., 2009)
Hemicyclops thalassius	L	(Silva et al., 2003)	(Cabral, 2009), (Araújo et al., 2008), (Santos, 2007), (Eskinazi-Sant'Anna and Tundisi, 1996), (Dias et al., 2009)
Oithona hebes	C, E	(Lucas et al., 2008), (Silva et al., 2003), (Porto Neto et al., 1999), (Santos et al., 2009), (Melo et al., 2008)	(Araújo, 2006), (Pessoa, 2009), (Santos, 2008), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Eskinazi-Sant'Anna and Tundisi, 1996), (Pessoa et al., 2009), (Dias et al., 2009)
Oithona nana	N, C, E	(Porto Neto et al., 1999), (Santos et al., 2009)	(Araújo, 2006), (Santos, 2008), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Pessoa et al., 2009)
Oithona oswaldocruzi	C, E	(Lucas et al., 2008), (Silva et al., 2003), (Porto Neto et al., 1999)	(Araújo, 2006), (Pessoa, 2009), (Santos, 2008), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Santos, 2007), (Eskinazi-Sant'Anna and Tundisi, 1996), (Neumann-Leitão et al., 1999)
HARPACTICOIDA			
Euterpinaacutifrons	C	(Silva et al., 2003), (Porto Neto et al., 1999), (Santos et al., 2009), (Dutra, 2008), (Melo et al., 2008)	(Pessoa, 2009), (Santos, 2008), (Cabral, 2009), (Neumann-Leitão and Matsumura-Tundisi, 1998), (Araújo et al., 2008), (Santos, 2007), (Eskinazi-Sant'Anna and Tundisi, 1996), (Nascimento-Vieira, 1987/89), (Pessoa et al., 2009), (Dias et al., 2009)

Acartia (Odontacartia) lilljeborgi is an estuarine and coastal species (Björnberg, 1981) usually found in Brazilian estuaries (Matsumura-Tundisi, 1972; Eskinazi-Sant'Anna & Tundisi, 1996; Silva *et al*., 2004; Eskinazi-Sant'Anna & Björnberg, 2006; Santos *et al*., 2009). *T. turbinata* occurs in coastal and oceanic environments (Bradford-Grieve *et al*., 1999) and it is a non-indigenous species to the Brazilian coast probably introduced via ballast water (Araújo & Montú, 1993; Lopes, 2004), therefore being found in several estuaries (Ara, 2002, Silva *et al*., 2003, 2004; Araújo, 2006; Sterza & Fernandes, 2006; Pessoa *et al*., 2009). The copepods of the genus *Pseudodiaptomus* are the ones typically estuarine (Björnberg, 1981). *P. acutus*, *P. marshi* and *P. richardi* are common in these environments in Brazil (Silva *et al*., 2003; Santos, 2008; Magalhães *et al*., 2009; Marcolin *et al*., 2010) and *P. trihamatus* is a non-indigenous one (Medeiros *et al*., 2006). *Oithona hebes* is found in coastal and estuarine areas (Bradford-Grieve *et al*., 1999), and *E. acutifrons* inhabits the coastal region and may occur within the estuary (Björnberg, 1981).

Other species are also common holoplankton in estuarine environments of the Northeast, such as the crustacean *Lucifer faxoni* (Porto Neto *et al*., 1999, Silva *et al*., 2003, Araújo *et al*., 2008, Santos *et al*., 2009), the arrow worm *Parasagitta tenuis* (Araújo *et al*., 2008, Santos *et al*., 2009), and the appendicularian *Oikopleura (Coecaria) longicauda* (Araújo *et al*., 2008; Lucas *et al*., 2008; Santos *et al*., 2009) and *Oikopleura (Vexillaria) dioica* Fol, 1872 (Esnal *et al*., 1985; Araújo *et al*., 2008; Lucas *et al*., 2008; Santos *et al*., 2009; Silva *et al*., 2003, 2009). The Cladocera have been cited in many studies (Silva *et al*., 2003; Araújo *et al*., 2008; Cavalcanti *et al*., 2008) and detailed information can be found in (Paranaguá *et al*., 2005). Rotifers have been subject of investigation by Neumann-Leitão *et al*. (1992) and Medeiros *et al*. (2010) with the euryhaline *Brachionus plicatilis* being dominant in most estuarine systems.

In relation to the meroplankton, the density varies with the reproductive period of benthic and nectonic species (Tundisi, 1970). The occurrence of larval stages are already expected because of the richness of benthic species in estuarine environments (Kennish, 1986, McLusky, 1989b). The zoea larvae of Brachyura is easily found in this environment (Schwamborn *et al*., 2001; Silva *et al*., 2003; Cavalcanti *et al*., 2008; Schwamborn *et al*., 2008; Santos *et al*., 2009). These larvae are exported to adjacent coastal areas, affecting the marine pelagic food webs (Melo *et al*., 2008). Gastropoda and Bivalvia veliger, Hydromedusae, Polychaeta larvae, nauplii of Cirripedia, Cyphonautes (Bryozoa) larvae are also common in estuarine environments in northeastern Brazil (Porto Neto *et al*.; 1999, Silva *et al*., 2003; Lucas *et al*., 2008; Santos *et al*., 2009).

Although the biological investigations in estuaries of the Brazilian Coast have produced information on zooplankton, most of these studies are restricted to assess seasonal or tidal changes. In Brazil, there is little information on variations of zooplankton in long-term studies (Lopes, 2007; Magris *et al*., 2011). Time series analyses show abrupt changes in abundance of plankton and the correlations with diversity, productivity, trophic level and

meteorological data (Souissi et al., 2007). However, knowledge of the zooplankton in long-term studies are based on examples derived from temperate waters and since these cannot be readily translated to communities of tropical environments, related studies should be undertaken so as to fill the gaps in standard specialized literature (Magris *et al*., 2011).

In general, it is possible to assume that the zooplankton community in the northeast estuaries may show some kind of change in direct response to environmental changes. Such changes may be related to increase marine influence, promoting the displacement of the estuarine environment upstream. These changes will bring modifications in the occurrence and spatial distribution of population limnetic, estuarine or marine. It is also important to encourage the study throughout the Northeast because there are still many estuaries where the zooplankton community has never been studied. Information of species and populations, biomass, and ecological relationships are unknown.

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