Meroplankton composition and abundance in Ambon Bay, Maluku

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Meroplankton composition and abundance in Ambon Bay, Maluku

Fismatman Ruli[1,3], Nining Betawati Prihantini[2], Sem Likumahua[3], Tri Widodo[3], Malik Sudin Abdul[3] and Iskandar Abd Hamid Pelupesy[3]

[1] Graduate Program in Marine Science, Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Indonesia, UI Campus, Depok 16424, Indonesia
[2] Department of Biology, Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Indonesia, UI Campus, Depok 16424, Indonesia
[3] Research Center for Deep Sea – National Research and Innovation Agency (BRIN), Ambon, Indonesia

E-mail: nining@sci.ui.ac.id; fismatman.ruli@gmail.com

Abstract. Here we present the study of meroplankton in Ambon Bay. This study aims to determine the composition and abundance of meroplankton in Ambon Bay. Sixteen stations (eight in the IAB and eight in the OAB) were sampled in March 2022. A plankton sampling was carried out using a plankton net with a mesh size of 300 microns and a diameter of 30 cm drawn at a depth of 10 meters to the surface. The study results showed that the meroplankton in Ambon Bay at the time of observation consisted of fish larvae, fish eggs, Echinodermata larvae, gastropoda larvae,cirripedia larvae, stomatopoda larvae, bracyura larvae (megalopa), bracyura larvae (zoea), nauplius crustacea, sea anemone larvae, other crustacea larvae and annelida larvae. The abundance of meroplankton in the IAB is higher than in the OAB. ANOSIM showed significant differences between IAB and OAB ($p < 0.05$). SIMPER analysis showed that the mean dissimilarity between IAB and OAB was of 56.16%. The meroplankton group was dominated by Echinodermata larvae, which were found to dominate at all research stations, especially in the inner bay of Ambon, with the highest abundance found at station 4, which was 120.31 ind.m^{-3}.

1. Introduction

Meroplankton are temporary plankton or organisms that are spend only in their early life stage (eggs and larvae) as plankton. When they are adults, they will turn into benthic organisms or nekton. Their duration in the plankton can vary from hours to several weeks depending on the taxonomic group, food availability and environmental conditions [1-3]. The existence of meroplankton is highly dependent on the spawning time, benthic and nekton population and advective dispersal [4]. So that at certain times it can be found in very abundant quantities and used as an indicator of the spawning area of a certain organism [2]. Furthermore, meroplankton also have important role in marine ecosystem as a source food for other planktonic predator (i.e fish) [3].

Ambon Bay is the waters on Ambon Island which is divided into two parts, namely the inner Ambon Bay (IAB) and the outer Ambon Bay (OAB). In this area there are various kinds of ecosystems that are home to various kinds of marine life such as coral reefs, seagrass and mangrove ecosystems [5]. In the IAB there are mangrove and seagrass ecosystems as well as coral reefs, but the condition of the coral

reef ecosystem in the area is classified as poor [6], meanwhile, in the OAB, the coral cover was medium category [7]. In addition, IAB waters tend to be closed and tend to be influenced by land activities, while OAB waters tend to be open and face to face with Banda waters. The existence of these differences allows for differences in terms of the composition of the organisms that live in it and also directly affects the meroplankton community.

Meroplankton studies have been carried out in several locations in Indonesian waters, for example by Nusalaut (Maluku) waters [8], Ambon Bay [9], Jakarta Bay [10], Pulau Seribu [11]. Research on Meroplankton in Ambon Bay had previously been carried out by [9] in transitional season 1 and east monsoon (may to June) which focused on the waters of the IAB. But in March or season monsoon has not been done. To complete the data, this research was conducted. The study of meroplankton seasonally can help us to understand the timing of reproduction the marine organism. This study aims to determine the composition and abundance of meroplankton in Ambon Bay (Inner and Outer of Ambon Bay) during the march 2022.

2. Methods

The research was carried out in Ambon Bay in March 2022. The number of meroplankton samplers was 16 stations consisting of eight stations in the inner of Ambon Bay and 8 stations in the outer of Ambon Bay (Figure 1). Sampling used a plankton net with a mesh size of 300 microns and a net mouth diameter of 30 cm. Sampling was carried out by lowering the plankton net to a depth of 10 meters and then pulling it up to the surface. The collected plankton samples were then put into bottles and then preserved using formalin to a final concentration of 4%.

Sample analysis was carried out at the Marine Plankton Laboratory, Research Centre for Deep Sea - BRIN. To make it easier to identify, first do sorting to separate groups of meroplankton and non-meroplankton in a petri dish. Furthermore, the samples that have been sorted are then identified and grouped by group. Identification of Meroplankton refers to the book [12] and [13].

The calculation of meroplankton abundance (ind/m^{-3}) following the equation:

$$Ind.m^{-3} = (n \times k)/v \quad (1)$$

Where:
n : The number of counts (n)
k : The part of the sample counted (k)
v : The amount of water filtered (m^3)

ANOSIM (Analysis of similarity) was used to test the significant difference in the meroplankton community in IAB and OAB based on the abundance. SIMPER (similarity percentage analysis) was used to calculate the contribution of each species (%) to the dissimilarity between IAB and OAB. All tests were peformed using PAST (Palaeontology statistical analysis) software [14].

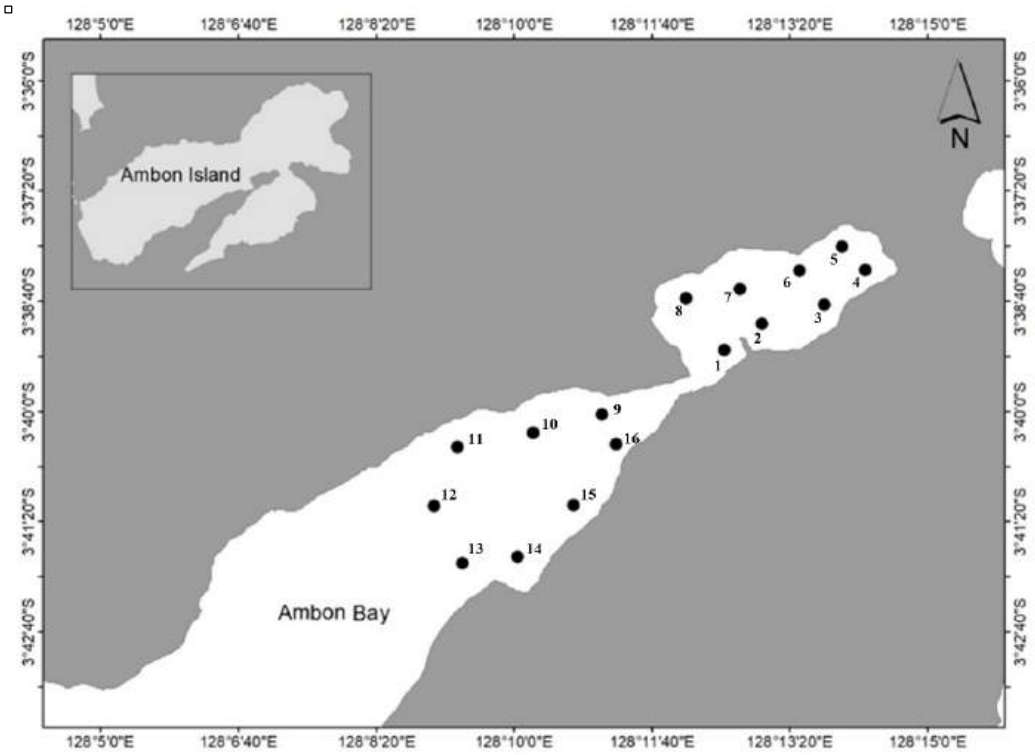


Figure 1. Sampling location.

3. Results

3.1. Composition of meroplankton in Ambon Bay

The results showed that meroplankton in Ambon Bay obtained in March 2022 was grouped into 11 groups consisting of eight groups in the OAB and ten groups in the IAB (Table 1 and Table 2) (Figure 2). The presence of meroplankton at each station ranged from 2-7 groups in IAB and 4-7 in OAB. This number is less than that found by [15] in May, June, and July (2008 and 2009) in Ambon Bay and Nusa Laut [8]. There were no Bivalvia and Cephalopoda Larvae in this study, as found by [8,15]. However, this number is higher than Jakarta Bay and Seribu Island [11].

Echinodermata larvae were found in all research stations in the IAB and OAB. This result shows that Echinodermata larvae are widely distributed in the waters of Ambon Bay. The presence of Echinodermata larvae in Ambon Bay was reported [15]. In addition, research on adult echinoderms has also been carried out by [16], who found 16 species of echinoderms in Ambon Bay waters. Consequently, it is possible to find echinoderm larvae in these waters.

Figure 2. Several meroplankton in Ambon Bay, Echinodermata larvae (a), Brachyura larvae (Megalopa) (b), Stomatopoda larvae (c), Brachyura larvae (Zoea) (d), Fish larvae (e), Cirripedia larvae (f).

Other crustacea larvae (shrimp) were found in all stations in IAB and absent in one station in OAB, followed by Brachyura larvae (zoea) were only absent at 1 location in the inner bay and 3 locations in the outer bay. Fish eggs and Cirripedia larvae were more commonly found in the outer bay than in the inner bay. At the same time, other meroplankton groups distribution is not as comprehensive as other groups (Table 1). This group of organisms is supported by the existence of three main ecosystems, namely mangrove, seagrass, and coral reef ecosystems in Ambon Bay [6,17] as habitats for benthic organisms and nekton. In addition, that ecosystem is also a place for nursery ground so that larvae (meroplankton) can be found in these waters. Several studies have also reported that Ambon Bay is home to fish, coral, shellfish, gastropods, barnacles, bivalvia, crabs, and echinoderms [5,18,19]. Suyadi et al. (2021) found 25 species (16 genera, nine families) of crabs and 33 species (19 families) of molluscs in Ambon Bay, 16 species of echinoderm [5,16]. So that in the Ambon Bay area, we will also find these organisms larvae (meroplankton).

Table 1. Composition and abundance of meroplankton in Inner of Ambon Bay in each location sampling: x < 10 ind. m^{-3}; xx 10–100 ind.m^{-3} ; xxx > 100 ind.m^{-3}.

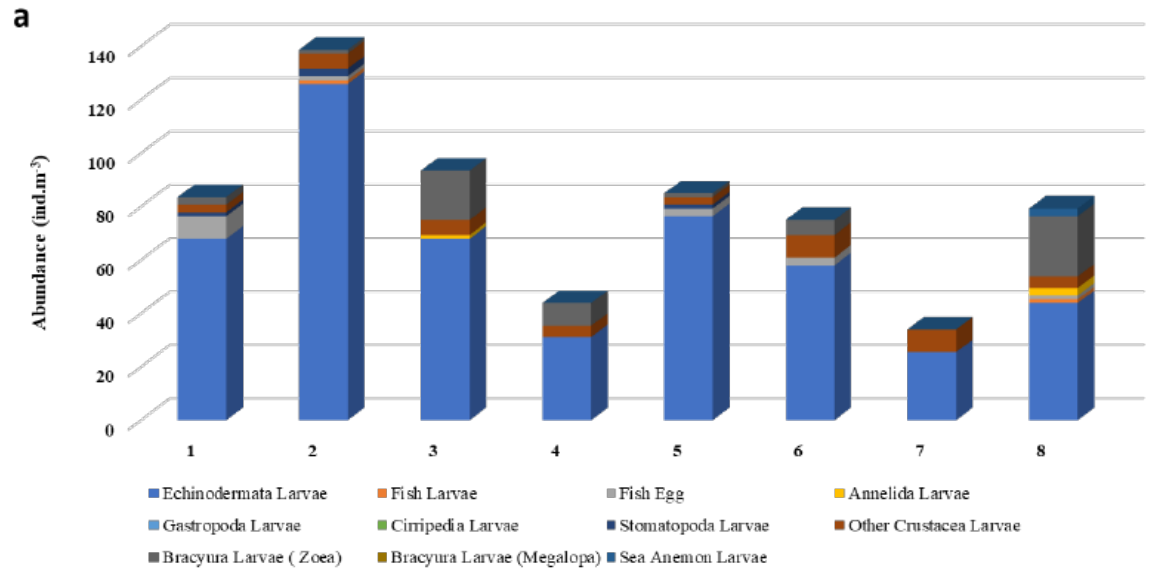
Meroplankton Group	1	2	3	4	5	6	7	8
Echinodermata larvae	xx	xxx	xx	xx	xx	xx	xx	xx
Fish larvae		x						x
Fish egg	x	x			x	x		x
Annelida larvae			x					x
Stomatopoda larvae	x	x			x			
Other Crustacea larvae	x	x	x	x	x	x	x	x
Brachyura larvae (Zoea)	x	x	xx	x	x	x		xx
Sea Anemone larvae								x

Table 2. Composition and abundance of meroplankton in Outer of Ambon Bay in each location sampling: x < 10 Ind. m^{-3}; xx 10–100 ind.m^{-3} ; xxx > 100 ind.m^{-3}.

Meroplankton Group	9	10	11	12	13	14	15	16
Echinodermata larvae	xx	x	x	xx	xx	xx	x	x
Fish larvae					x		x	x
Fish egg	x	x	x		xx	xx		xx
Annelida larvae	x		x			x	x	x
Gastropoda larvae				x	x			
Cirripedia larvae		x		x	xx	x	xx	x
Stomatopoda larvae			x					x
Other Crustacea larvae	x	x		x	x	x		
Brachyura larvae (Zoea)	x		x	x	x	x		xx
Brachyura larvae (Megalopa)	x							

3.2. Meroplankton abundance in Ambon Bay

The abundance of meroplankton in Ambon Bay is different for each station and location (Inner and Outer Bay) (Figure 3), varying from 19,82-138.71 ind.m^{-3}, with average abundance 59.09 ind.m^{-3}. In the IAB, the high abundance of meroplankton was found in station 2 (138.71 ind.m^{-3}), the lowest in station 7 (33.97 ind.m^{-3}) (average abundance 79.09 ind.m^{-3}). The Abundance in the OAB varied from 21.23 to 76.43 ind.m^{-3} (average 39.10 ind.m^{-3}). The highest number was recorded in station 13 and the lowest was in station 12. The meroplankton abundance in Ambon Bay in this study (March 2022) was lower than that found by [20] and [15], who conducted research in May, June, and July (2007 and 2008) and [21] in March 2015 in Ambon Bay. This difference can be caused by differences in the spawning time of the parent biota. According to [22], Meroplankton abundance fluctuated seasonally, but patterns varied across taxa. The research result by [8] In Nusa Laut water, found that fish eggs dominated the meroplankton group (May 2009, while in April 2014 it was dominated by echinoderm larvae. In Jakarta Bay (April and June), meroplankton from the shrimp group (crustaceans) dominated in the waters of the Jakarta Bay [10].



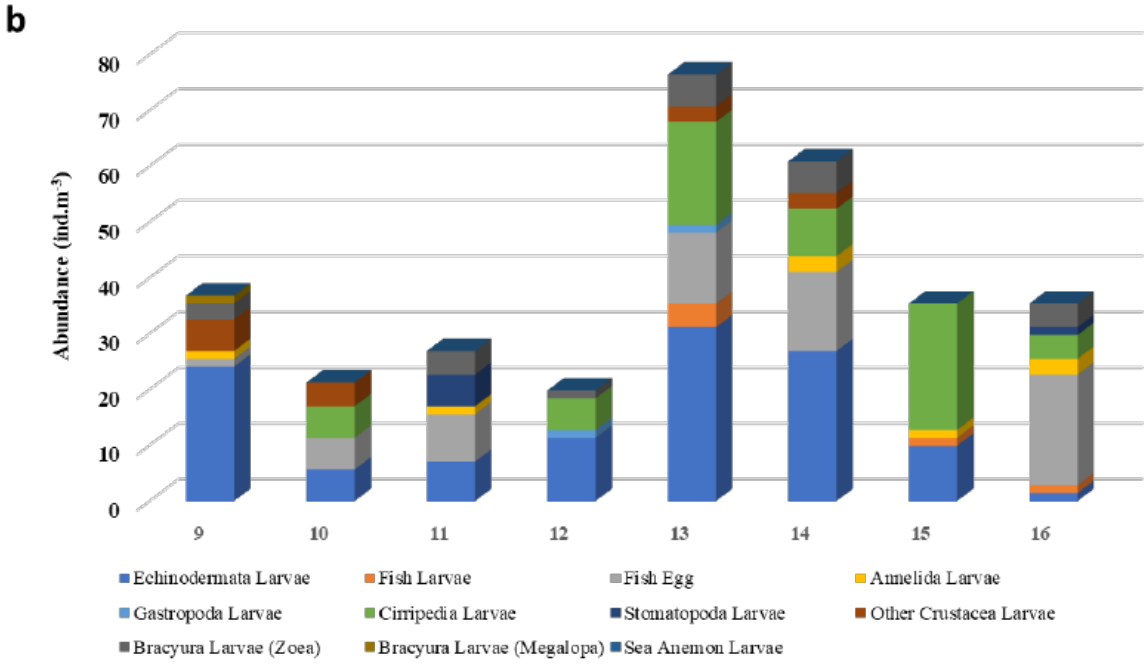


Figure 3. Abundance of meroplankton each station in OAB (a) and IAB (b).

Based on Figure 3 and 4, the Echinoderm larvae group dominated the meroplankton abundance in the IAB. The highest abundance was 129.97 ind.m^{-3} in Station 2. The average abundance of this group in the IAB was 62.10 ind.m^{-3} or 78.52% of the total composition of meroplankton. In contrast, the abundance of other meroplankton groups is below 10%. The abundance presentations were Brachyura larvae (Zoea), Other Crustacea Larvae, Fish Egg, Annelida Larvae, Fish Larvae, and Sea Anemone Larvae. The highest abundance of meroplankton in the OAB was found at station 9 (89.17 ind.m^{-3} and the lowest at station 12 (22.65 ind.m^{-3}), with an average abundance of 39.10 ind.m^{-3}. Echinoderms dominated, on average, the abundance of meroplankton in the OAB. The abundance of Echinoderms was 14.69 ind.m^{-3} or 33.47% of the total abundance of meroplankton groups in the OAB. The subsequent highest average abundance presentations were Cirripedia larvae and Fish eggs, with 18.55% (8.14 indm^{-3}) and 17.75 % (7.78 ind.m^{-3}), while other meroplankton groups were below 10%. The lowest abundance was Brachyura larvae (Megalopa), only found at 0.18 ind.m^{-3}. The type of meroplankton that dominates Echinoderm larvae in Ambon Bay has also been reported by [9], who conducted research from May to June 2007. This study explained that the abundance of Echinodermata larvae dominated up to 94.62% of the meroplankton composition found, and the highest abundance of Echinodermata larvae was reported to reach 2550 ind/m^{3}. In another region, such as the Barent Sea, [22] found that echinoderm larvae also dominated the waters. The predominance of echinoderm larvae can also be due to mostly appearing in the upper water layer (0–15 m) [23], where this study takes samples from 0 to 10 meters. In addition, Echinoderms produce vast numbers of larvae [24]. As a result, they can be found in abundance in the waters.

Cirripedia larvae and fish eggs were the second and third dominance of meroplankton in OAB. Although most meroplankton has a short life cycle, Cirripedia larvae can represent a zooplankton community in certain seasons [25]. Even though fish egg has the third-highest abundance, it is still much lower than in Nusa Laut found by [8]. In the study conducted, the abundance of fish larvae dominated in May 2019. The presence of fish eggs in Ambon Bay was also reported by [15] from May to July 2007 and 2008.

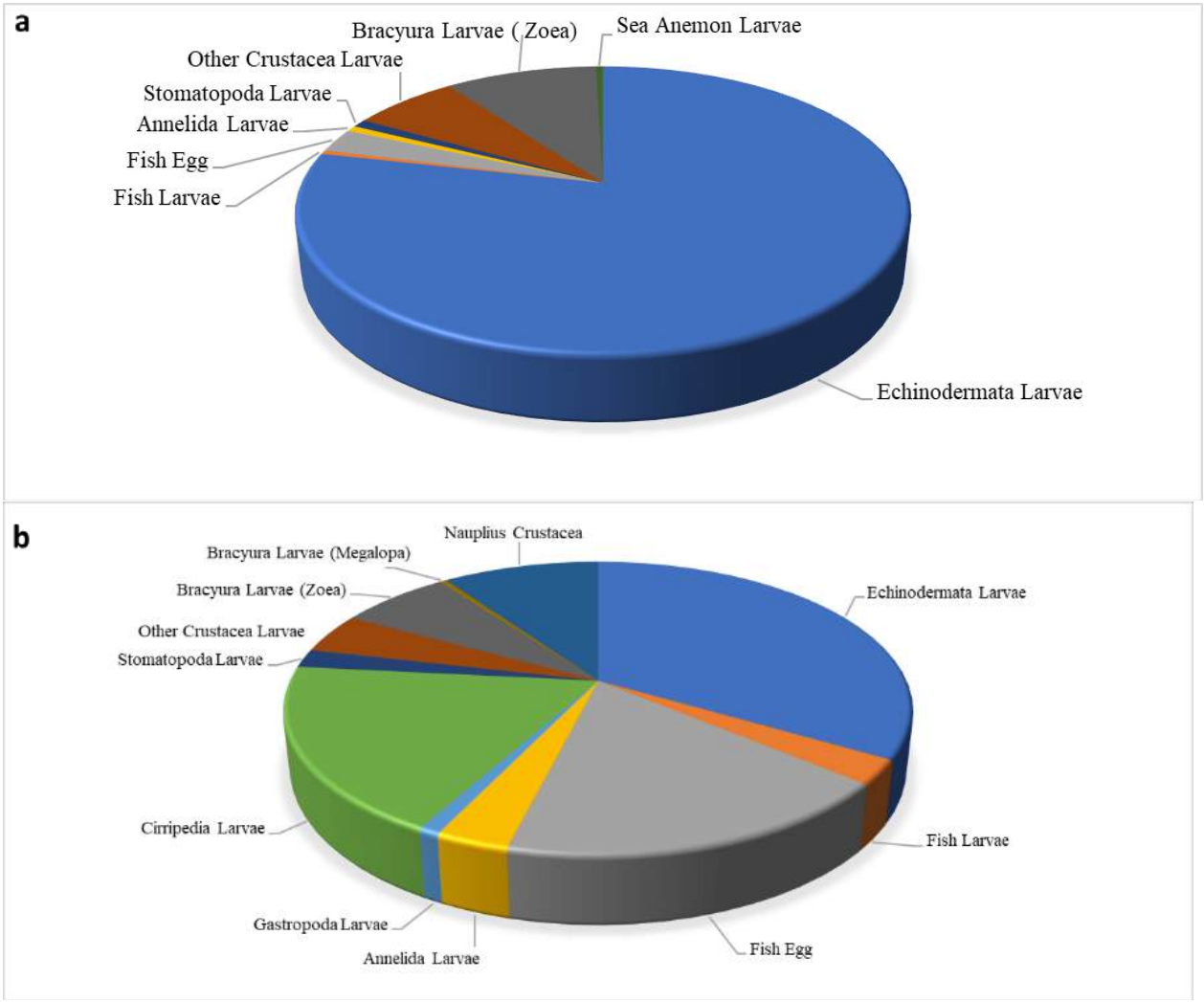


Figure 4. The percentage of meroplankton abundance of in OAB (a) and IAB (b).

Based on Figure 4, there was a difference between the abundance of meroplankton in the inner and outer Ambon Bays ($p < 0.05$). SIMPER results show that the difference in the value of these two locations is 67.11%. Echinodermata, Fish Eggs, and Cirripedia Larvae were the species with highest percentage of contribution to dissimilarity between groups. This has also been reported by [20], who also conducted research on meroplankton in Ambon Bay (May and June 2007), where meroplankton in IAB was higher than OAB. Furthermore, [21] also found that the abundance of zooplankton in March, April, and October 2016 in IAB was higher than OAB. This difference can be caused by the higher primary productivity in IAB compared to OAB [26]. Waters with high productivity cause abundant food sources for zooplankton including meroplankton.

4. Conclusion

This study shows that meroplankton's composition in Ambon Bay consists of 11 groups. The average abundance of meroplankton in IAB was 79.09 ind.m^{-3}, and OAB was 39.10 ind.m^{-3}. Echinodermata larvae were the most abundant of the meroplankton group. There was a significant difference between the meroplankton in IAB and OAB.

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