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Study of Plankton Communities in the Imessouane Bay

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Abstract

The plankton community was studied in the Atlantic waters of Imessouane Bay over a period of three months (May, June and July) at three stations (S1, S2 and S3); the aims of the study was to study the taxonomic composition of the plankton (Zooplancton and phytoplankton). The systematic study of the samples revealed the presence of 32 species of zooplankton with a predominance of the copepods which represented 14 species dominated by the species of *oithona nana* and 31 species of phytoplankton. The evolution of the species diversity of plankton, estimated by the index of Shannon-Weaver (H ') and Margalef (Dmg) were recorded a maximum values on June and minimum on May 19th, June 30th and July 21st. The similarity index of Sorensen (Qs) between the three stations taken in pairs is relatively large with 0.72 between S1 and S3, 0.60 between S1 and S2 and 0.62 between S2 and S3.

Keywords: Copepods; Tintinnids; Bay of Imessouane; Zooplankton; Phytoplankton; Oithona.

1. Introduction

The bay of Imessouane is an area that presents an important biological richness and the great ecological and economic value [1].

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This bay was the object of several scientific researches which regarded this zone as the heart of the upwelling [2]. This phenomenon therefore ensures the development of the entire food web [3]. The comprehension of the marine ecosystem is not quite simple due to its complexity, both functionally and constitutionally. Plankton plays an important role in the understanding of this ecosystem. Phytoplankton and zooplankton occupy the trophic levels 1, 2, 3, and 4 which are important parts of the biological production [4-5]. Considering the importance of plankton communities in the marine ecosystem, our present work aims to evaluation of the biodiversity and the richness of plankton communities in the Imessouane Bay.

2. Materials and methods

The study was done on samples taken at the Imessouane bay at three stations: S1 (9°49 ‘’58’W, 30°50 ‘’20N), S2 (09°49 ‘’30’W, 30°49 ‘’22’N) and S3 (9°49 ‘83’’W, 30° 49’71’’N) (Figure1), during May, June and July. For each station, vertical samplings were made at a depth of 10 m for 10 minutes using standard plankton nets of different mesh (100µm, 200µm and 500µm). The samples were fixed in formaldehyde (5%), and the identification of plankton species were made on an inverted microscope (Olympus ULWCD0.30). The plankton identification based on morphological criteria provided by various determination keys collections.

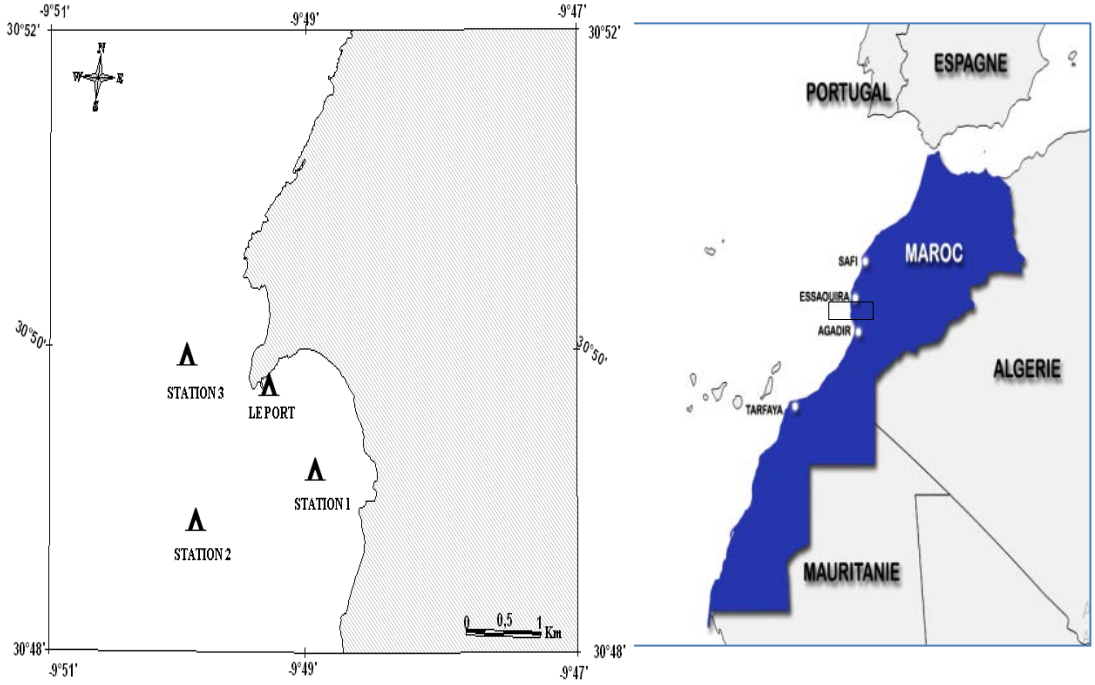


Figure 1: Location of sampling stations (Imessouane) (MapInfo)

1.1 Statistial treatment

The statistical processing we used to treat our results is based on two indices of species richness: Shannon index and Margalef [6, 7].

Species diversity is estimated by the index of Shannon-Weaver (H '). The index is calculated using the following formula [6]:

$$H' = -\sum_{i=1}^{S} (Pi * log2(Pi))$$

With Pi is the ratio of the number of species i in the sample and the total number in the sample.

The Margalef index (Dmg) is calculated using the following formula [7]:

$$Dmg = \frac{(S-1)}{Log2(N)}$$

N = total number of individuals in the sample;

S = total number of species.

The similarity index Sorensen (Qs) enables a comparison between the three stations taken two by two. This index is calculated by the following formula [8]:

$$Qs = 2j / a+b$$

j = number of species common between the two stations;

a = total number of species at station A;

b = total number of species at station B.

3. Results and Discussion

3.1. Specific richness

The study of the species composition of plankton communities Which lives in Imessouane bay shiws the presence of 32 species of zooplankton including 14 species of copepods, and a 31 species of phytoplankton (Table 1).The analysis of the specific composition of our samples, the settlement of various scales established by Giron [9] and adopted by Ehrhard, Soenen and Seguin, allowed us to notice that the Imessouane's plankton community of the bay is quite varied.

Our results show a quite difference in the number of copepod species compared to the Agadir's bay (with 22 species of the Copepod) [10], and the Moroccan South Atlantic coast (with more than 40 species of the Copepod) [11].

Table 1: List of the plankton species from the Imessouane bay during the study period.

		7-may		19-may			12-june			30-june			21-july			31-july		
		ST1	ST2	ST1	ST2	ST3	ST1	ST2	ST3	ST1	ST2	ST3	ST1	ST2	ST3	ST1	ST2	ST3
Zooplankton																		
Copepods	*Acartia clausi*	+	+	-	+	+	+	+	+	+	+	+	+	-	+	+	+	+
	Centropages typicus	-	-	-	-	-	-	-	-	-	+	+	-	+	+	-	-	-
	Centropages chierchiae	+	+	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-
	Calanus helgolondicus	+	-	-	-	+	+	+	+	-	+	+	-	-	-	+	+	+
	Calocalanus sp	-	-	+	-	+	+	+	+	+	+	+	-	-	-	+	+	-
	Euterpina acutifrons	-	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+
	Labdidocera wollastoni	+	+	+	-	-	+	+	+	+	+	+	-	-	-	+	+	-
	Macrosetella gracilis	+	-	-	-	-	-	-	+	-	+	-	-	-	-	+	+	+
	Oithona nana	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Oncaea venusta	-	-	-	-	-	-	-	-	+	+	+	+	-	-	+	+	+
	Oithona similis	-	+	+	+	+	-	+	+	+	+	+	-	+	-	+	+	+
	Paracalanus parvus	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	+	+
	Temora stylifera	-	-	-	-	+	+	-	+	-	-	-	-	-	-	+	+	+
Other zooplankton groups	*Evadne SP*	+	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-
	Jellyfish	+	-	-	-	+	+	+	+	-	+	+	-	-	-	+	+	+
	Siphonophore	-	-	-	-	+	+	-	+	-	-	-	-	-	-	+	+	+
	Ostracoda	-	-	+	-	+	+	+	+	+	+	+	-	-	-	+	+	-
	Sagitta sp	+	-	-	-	-	-	-	+	-	+	-	-	-	-	+	+	+
	Oikopleura	+	+	+	-	-	+	+	+	+	+	+	-	-	-	+	+	-
	Larvae of polychaete	-	-	-	-	+	+	-	-	+	+	+	-	-	-	+	+	+
	Echinoderm larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+
	Larvae of gasteropod	-	+	+	+	+	-	+	+	+	+	+	-	+	-	+	+	+
	Strombidium sp	+	+	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-
	Tintinnopsis campanula	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
	Helicostomella kiliensis	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+
	Favella ehrenbergii	+	+	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-
	Favella serrata	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
	Favella adriatica	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-
	Favella sp	-	-	-	-	-	+	-	+	-	-	-	+	-	-	-	-	-
	Stenostomella sp	-	+	+	+	+	-	-	-	-	+	-	-	-	-	+	-	+
Phytoplankton																		
Diatoms	*Actinocyclus sp*	-	-	-	-	-	-	-	+	-	-	-	+	+	+	-	-	-
	Bacillaria paradoxa	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
	Coscinodiscus wailesii	-	-	-	-	-	+	-	+	-	-	-	-	-	-	+	-	-
	Chaetoceros tortissimus	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
	Cerataulina pelagica	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-

	Coscinodiscus granii	-	-	-	+	-	+	-	+	+	-	-	-	-	-	-	+	-
	Diploneis bombus	-	-	-	+	+	-	-	+	-	-	-	+	-	-	+	+	+
	Lauderia borealis	-	-	-	+	+	-	-	+	-	-	-	-	-	-	+	-	-
	Licmophora	-	-	-	-	-	+	+	+	-	+	-	-	-	-	-	-	-
	nitzschia seriata	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
	Pleurosigma sp	-	-	+	+	+	+	-	+	-	-	-	+	+	-	-	-	-
Dinoflagellates	*Alexandrium catenella*	+	+	-	-	-	+	-	+	-	-	-	-	-	-	-	+	-
	Alexandrium tamarense	-	-	-	-	-	+	-	+	+	-	-	-	-	-	-	-	-
	Ceratium fusus	-	+	-	-	-	+	-	+	+	+	+	-	-	-	+	+	-
	Ceratium furca	-	-	+	-	+	+	-	+	+	+	+	-	-	-	-	-	+
	Ceratium macroceros	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
	Ceratium pantagumus	+	+	+	-	-	+	-	-	+	+	+	-	-	-	+	+	+
	Ceratium pentagonum	-	+	-	-	+	+	+	+	+	+	+	+	-	+	+	+	+
	Ceratium candelabrum	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-
	Dinophysis acumunata	+	+	-	+	+	+	+	+	+	+	+	+	-	-	+	+	+
	Dinophysis caudata	+	+	-	-	-	+	-	+	-	+	-	-	-	-	+	+	+
	Heterodinium detonii rampi	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-
	Peridinium diabolus	+	+	-	+	-	+	-	+	+	+	+	+	-	-	+	+	+
	Prorocentrum micans	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+
	Protoperidinium caudatum	+	+	-	+	-	+	+	+	+	+	+	-	-	-	+	+	+
	Peridinium grani	-	-	-	-	-	+	-	+	-	+	+	+	+	+	-	+	+
Other	*Pediastrum*	-	-	-	-	-	+	-	+	-	-	-	-	-	-	+	-	+
	Halosphaera sp	+	-	-	-	-	-	-	+	+	+	+	-	-	-	-	+	-
	Dictyocha fibula	-	+	+	-	-	-	-	+	+	+	+	+	-	-	+	+	+

3.2. species diversity

In ecology, a diversity index is a statistics parameter, which is applied to measure the species biodiversity in an ecosystem. The specific richness of zooplankton communities of the Imessouane bay was analyzed using two indices: Shannon index and Margalef index. The calculation of these biodiversity indices, allowed us to trace the evolution curves of each index during the study period (Figure 2). The indices recorded maximum values on June and minimum on May 19 th, June 30 th and July 21st.

According to [12,13,14,15] the strong upwelling are characterized by low values of zooplankton diversity index. Medina-Gaertnea [16] also found that the upwelling corresponds to low values of species richness. During our study the values of zooplankton diversity index which were recorded during on May 19th, June 30th and on July 21st, are low. The evolution of these biodiversity indices for the phytoplankton show important values during the beginning of the summer period. Also most of the great values recorded during the period of study are in the station 2 and 3 (figure 2).

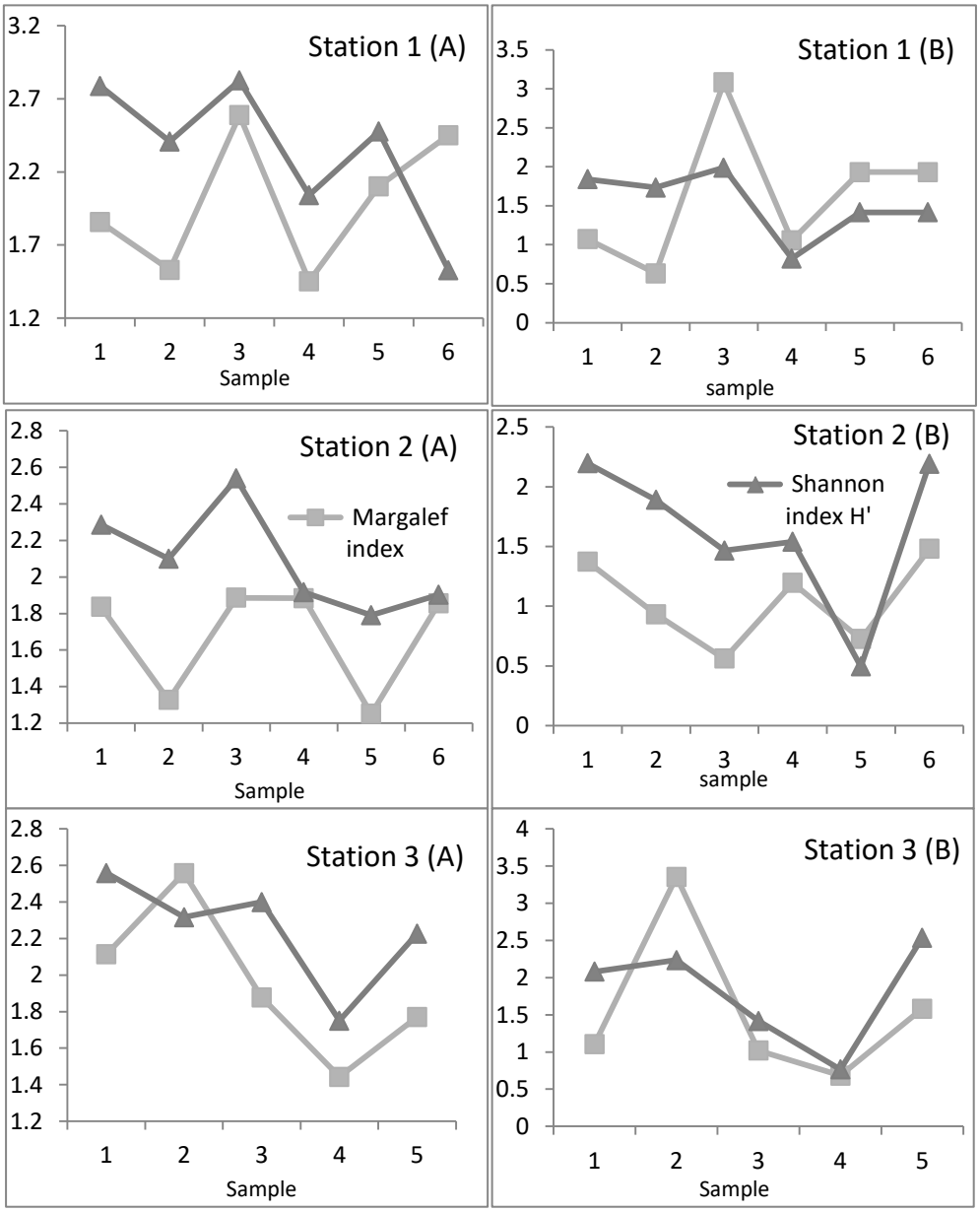


Figure 2: Evolution of the species richness of zooplankton (A) and phytoplankton (B) communities of Imessouane Bay, during the study period.

A comparison in total numbers of phytoplankton species between Imessouane bay and different coastal waters of Morocco is given in the table 2. A stressed environment typically has a lower number of species (those adapted to the stress) having many more individuals than the other species [17].

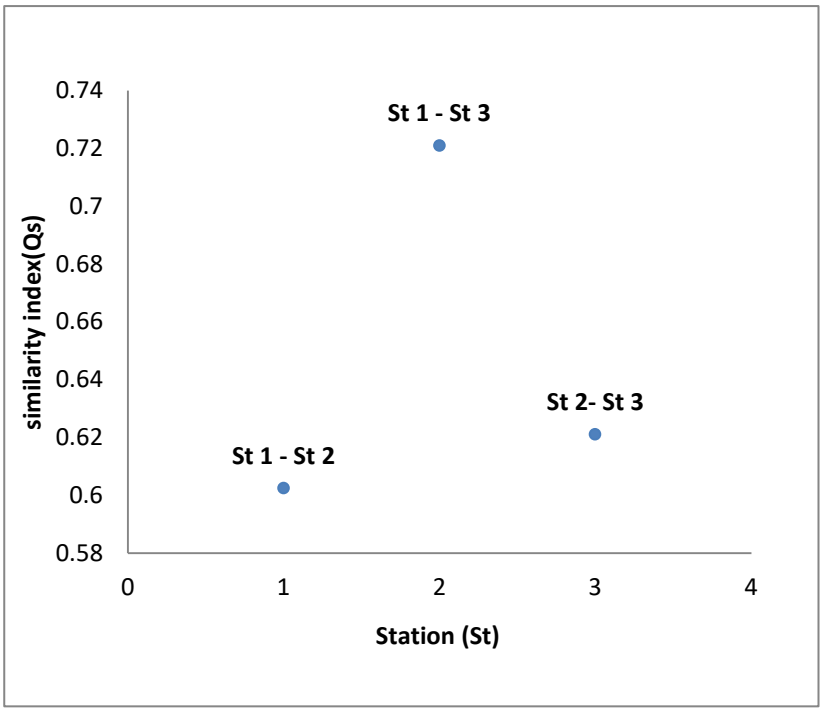


Figure 3: Variation of the Similarity index for every station

Table 2: The total numbers of phytoplankton species observed in the different coastal waters of Morocco

Sites	Number of species	Periods	References
Bay of Imssouane	31	May 2009-july 2009	This study
BouRegreg estuary	307	Mar 1999-Mar 2001	Benabdellouahad, 2006 [18]
Bay of Agadir	210	Sept 2002-Sept 2003	Fraikech and his colleagues 2005 [19]
Moulay bousselham lagoon	35	Oct 2003-Sep 2004	Loumrhari and his colleagues 2009 [20]
Nador lagoon	311	Nov 2007-Aug 2008	El Madani and his colleagues 2011 [21]
Massa estuary	105	Mar 2009-Mar 2010	Badsi and his colleagues 2012 [22]
Oualidia lagoon	127	June 2011-May2012	Natij and his colleagues 2014 [23]
Maritime area of Aglou	83	April 2013-June2013	Gallouli and his colleagues 2014 [24]

Sorensen similarity indices calculated to compare the specific composition of plankton in the three stations are presented in Figure 3. The values show, firstly a relatively large similarity between the station 1 and 3 (Q>70%). On the other hand, and a bit less similarities were found between the station 1 and 2 and between the station 2 and 3.

3.3. zooplankton communities

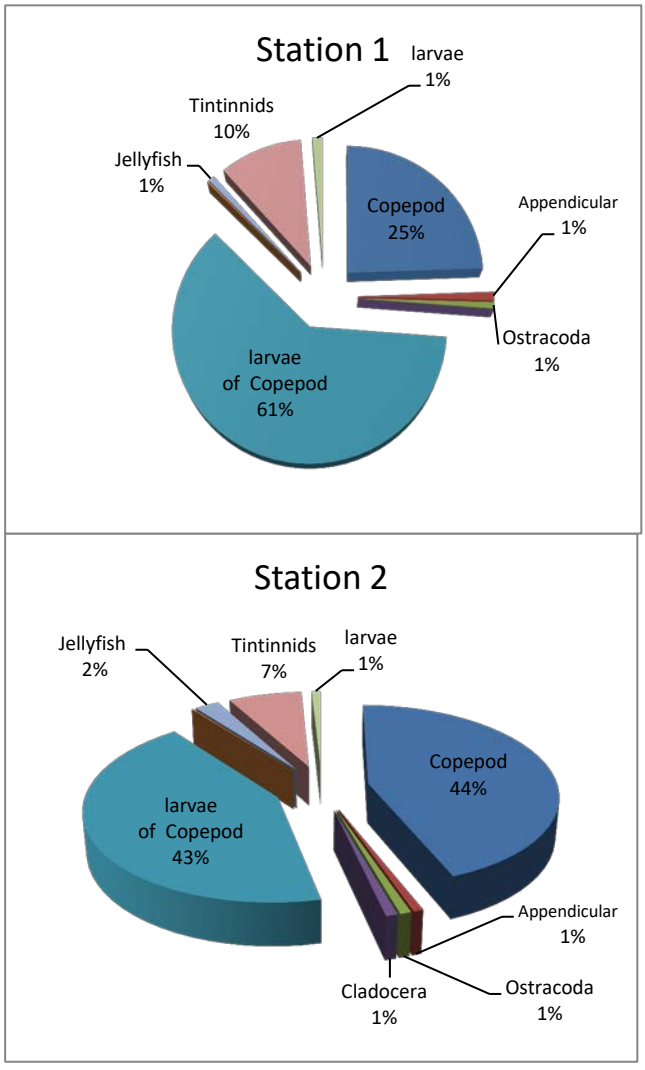
Analysis of the different groups of zooplankton shows the dominance of copepod species and larval stages. This group has reciprocity between the adult stages and larval stages.

This appears very clear at the all stations (Figure 4). The tintinnids groups present the progressive reductions at the end of spring at the first station. However, it records low percentages in the season of summer. Our results agree with those found by [25] at the Aglou's coast which has noted that tintinnids recorded low abundance at the beginning of summer.

The dominance of copepods in our results is confirmed by the other work carried out on the Moroccan coast that have recorded the same result [26, 27,28,29,30,31].

Copepods communities are dominated by the species of *Oithona nana* throughout the study period.

This species has the ability to adapt to different food sources, because it has a food range than other copepods. Also it is very important in many neritic areas which are exposed to eutrophication [32].



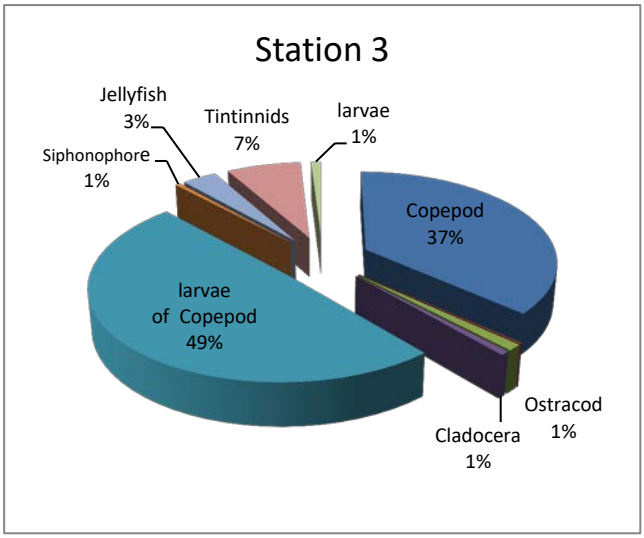


Figure 4: Relative abundance of the different groups in Imessouane Bay

4. Conclusion

The analysis of species richness of planktonic communities of our site has allowed noting that the population of our zone of interest is very varied. We identified 32 species of zooplankton including 14 copepod species and 31 species of phytoplankton. The copepods are the most dominant in the zooplankton population. The species *Oithona nana* has an absolute dominance during the study period in the three stations. During our study period we recorded a low index value of diversity that characterizes the upwelling. Also the number of phytoplankton species found is low, which characterizes stressed ecosystems.

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