Copepod fauna of the Northern Levantine Basin shelf waters

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Abstract- The species composition and temporal changes in abundance and biomass of copepods in relation to ambient factors in the northern Levantine basin shelf waters was studied over a period of one year. Among the 185 copepod species recorded only 151 of them were identified at species level. 36 species are mentioned for the first time for this region. Three copepod species new to science were also recorded. Species new to science included *Scaphocalanus emine, Calanopia metu* and *Calanopia levantina.* Most of the observed copepod species are common for the Mediterranean Sea while some other species are introduced from the Red Sea, where they also in time became common in the plankton. Introduction of the Indo-Pacific species into the Levant Sea confirms by biological data the fact that the Red Sea waters may occasionally extend outmost to the north eastern parts of the Mediterranean Sea. Sharing similar species of Indo-Pacific origin give the copepod fauna of the Levantine basin a subtropical affinity. Copepods were most abundant towards the end of March and in the beginning of September reaching about 2221 individuals/m^3 and 1790 individuals/m^3, respectively. To the lowest level was reached in early March as 215 individuals/m^3. Significant fluctuations both in numbers and biomass of copepods were observed throughout the year. Copepod biomass reached to maximal levels during mid February (22 mg/m^3) and in the beginning of June (16 mg/m^3) and dropped to its lowest level in mid January (4 mg/m^3). Copepod fauna of the basin was found most species rich during whole summer (species richness **d** = 10.1, 10.7 and 9.8 for June, July and August, respectively) and during early winter in December (**d** = 9.5) and January (**d** = 10.8). It was found low during spring and autumn with lowest levels during the strong stratification period in September and in October (**d** = 6). Diversity (Shannon-Wiener Index) was found highest in February (**H'** = 2.9) and lowest in March (**H'** = 2.1). Multivariate analyses (two-dimensional non-metric Multi-Dimensional Scaling) have shown formation of distinct seasonal zooplankton assemblages throughout the year. Temperature rather than salinity was the main factor determining copepod assemblages. Dominant copepod species during late winter and spring were *Oithona nana*, *Oithona* sp, *Oncaea media*, *Oncaea* sp, *Calocalanus elegans*, *Euterpina acutifrons* and *Oncaea zernovi*, respectively. *Calocalanus* sp, *C. elegans*, *Oncaea dentipes*, *Oncaea* sp, *Oithona nana*, *Clausocalanus furcatus*, and *Temora stylifera* were the dominant species during summer and *Oncaea* sp, *Calocalanus* sp, *Oithona nana*, *Clausocalanus paululus*, *C. furcatus*, *Parvocalanus* sp and *Calocalanus elegans* were dominating species during autumn and early winter.

Keywords- Copepod, diversity, abundance, biomass, Levantine basin.

Introduction

In the Mediterranean, long-term time series on zooplankters, especially on copepods, are few and concern mainly the northwest regions (for references see Uysal *et al.*, 2002). Only few studies concerned with the dynamics and composition of zooplankton from the northern Levantine basin (see Uysal *et al.*, 2002). Gucu (1987) studied the time series (biweekly) species composition and dynamics of zooplankton over a period of one year in the region. In the eastern Mediterranean, certain regions have been studied in more detail (see Uysal *et* al., 2002). The coastal ecosystem of the far eastern Mediterranean has altered greatly with major changes in the drainage systems, such as the construction of the Asuan Dam in the upper Nile. Following construction, terrestrial nutrient input to the receiving Mediterranean waters was greatly blocked and resulted in a non-fertile, oligotrophic water system. Shortage of vital nutrients first diminished phytoplankton growth, and hence the zooplankton as the second step in the marine food chain. Recent studies indicate that changes still do occur in the northern Levantine basin at different trophic levels (Gucu et al., 1992, 1994; Gucu & Bingel, 1995; Uysal & Mutlu, 1993). Introduction of alien species through Lessepsian migration from the Red Sea also represents a notable example of anthropogenic effects into this region. On the other hand, the natural variables are frequently of the same magnitude as anthropogenic effects, which makes diagnosis difficult. Due to low surface nutrients, upwelling at fronts and nutrient supply in the river mouths and coasts appear significant. Dramatic increase in human population, intense marine traffic, pollutants of industrial and domestic origin, and agricultural and atmospheric loads make the ecosystem of the coastal regions extremely vulnerable to the imposed environmental burdens. The most predominant anthropogenic impact is the severe eutrophication experienced in Iskenderun and Mersin Bays. Eutrophication is considered to play a key role in the ecosystem by leading to substantial alterations in the structure and function of marine flora and fauna both qualitatively and quantitatively. Recent studies have shown alarming expansion of the threat in all dimensions. Compared to the Black Sea, the region may be regarded as one of the least studied extreme environments.

Materials and Methods

Zooplankton samples for this study were collected from a single station (34°22'E, 36°30'N), about 10 km offshore of the Institute of Marine Sciences of

Middle East Technical University, located in the northeastern coast of the Mediterranean Sea. This station, with a total depth of 150m, was visited at weekly intervals with R/V Erdemli. Zooplankton samples were collected by a Nansen net with a mouth opening of 0.385 m^2 and 112 micron mesh size by vertical hauls from 100m to the surface. On board, the samples were preserved in 4% borax buffered formaldehyde solution in seawater. In the laboratory, large and rare species were identified and counted for the whole sample. Mass species were sorted by taking duplicate sub-samples of one or two millilitres using the stempel pipette.

Results

Weekly zooplankton survey over a period of one year yield the presence of 185 copepod species in the study area. Among these, 36 species are recognised for the first time, including three new species. At present, the total list of copepod species from the Levantine basin includes 233 species. Significant fluctuations in abundance (number of individuals/m^3) and biomass (mg/m^3) of copepods were observed throughout the year in the basin (see Fig.s 1a,b). Copepods were most abundant towards the end of March and in the beginning of September reaching about 2221 individuals/m^3 and 1790 individuals/m^3, respectively. Lowest level was attained in early March as 215 individuals/m^3. Copepod biomass peaked in mid February (22 mg/m^3) and early June (16 mg/m^3) and was lowest in mid January (4 mg/m^3).

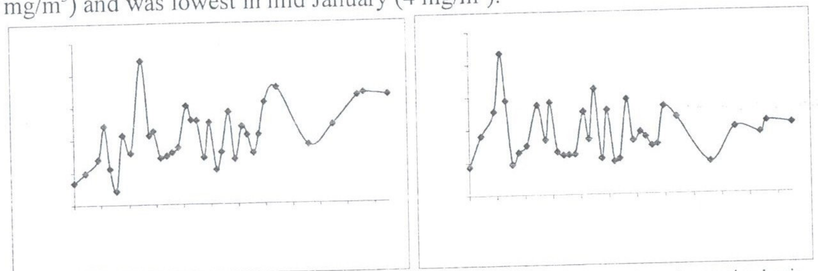

Fig. 1. Weekly changes in abundance (a) and biomass (b) of copepods in northern Levantine basin.

Fig. 3a show two-dimensional non-metric MDS plots of weekly zooplankton populations having six distinct clusters at an arbitrary similarity level (based on Bray-Curtis similarity) of 60% (Fig. 2). The largest group **1** contain mainly the winter and spring populations and the second largest group **5** contain mainly the summer population. Dominant copepod species during late winter and spring were *Oithona nana*, *Oithona* sp, *Oncaea media*, *Oncaea* sp, *Calocalanus elegans*, *Euterpina acutifrons* and *Oncaea zernovi*, respectively. *Calocalanus* sp, *C. elegans*, *Oncaea dentipes*, *Oncaea* sp, *Oithona nana*, *Clausocalanus furcatus*, and *Temora stylifera* were the dominant copepod species during summer. Group **6** represent the autumn and early winter populations. *Oncaea* sp, *Calocalanus* sp, *Oithona nana*, *Clausocalanus*

paululus, *C. furcatus*, *Parvocalanus* sp and *Calocalanus elegans* were dominating species during autumn and early winter.

Among the ambient factors, temperature rather than salinity was considered to be the main factor controlling such copepod assemblages (Fig. 3b). Surface temperature ranged between 16.01-29.91°C, being lowest on 31 March and highest on 25 August 1998. Throughout the study period, the surface salinity varied between 38.52 - 39.43 ppt, being lowest on 21 May and highest on 24 September 1998. MDS plots of superimposed values of copepod abundance and total number of species are given in Fig.s 3c,d. Copepod fauna of the basin was found most species rich during whole summer (species richness **d** = 10.1, 10.7 and 9.8 for June, July and August, respectively) and during early winter in December (**d** = 9.5) and January (**d** = 10.8). It was found low during spring and autumn with lowest levels during the strong stratification period in September and in October (**d** = 6). Diversity (Shannon-Wiener Index) was found highest in February (**H'** = 2.9) and lowest in March (**H'** = 2.1).

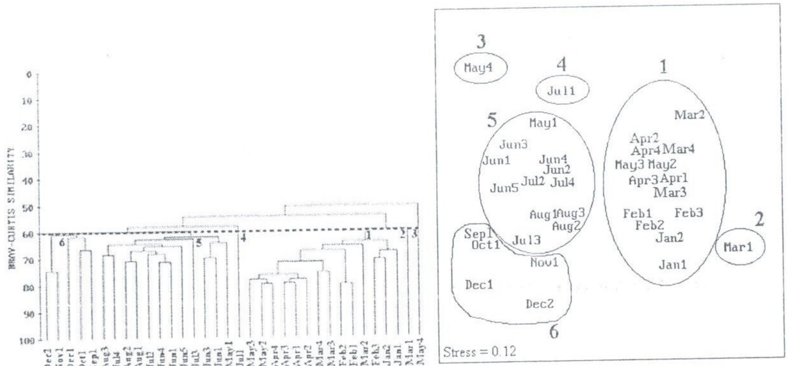

Fig. 2. Dendogram showing 6 groups distinguished at an arbitrary similarity level of 60%.

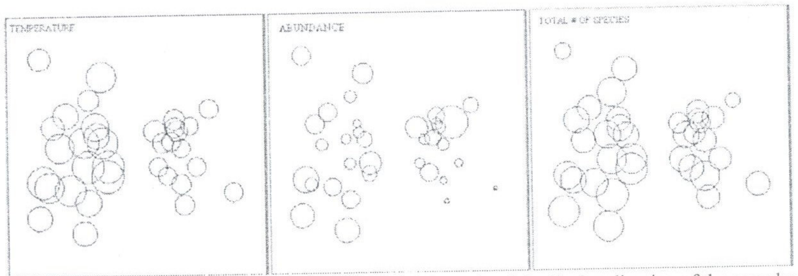

Fig. 3. Two-dimensional non-metric MDS (Multi-Dimensional Scaling) ordination of the samples and MDS plots of superimposed values of temperature, abundance and total number of species.

Table 1 . Variation in copepod species diversity throughout the year.

Month	Total # of indvs.	Total # of species	Richness d	Shannon H'	Evenness J'
January	31822	113	10.80	2.66	0.56
February	31600	79	7.53	2.99	0.68
March	41455	79	7.34	2.10	0.48
April	35188	76	7.16	2.35	0.54
May	43110	95	8.81	2.35	0.52
June	35299	107	10.12	2.46	0.53
July	41903	115	10.71	2.51	0.53
August	43616	106	9.83	2.65	0.57
September	68871	68	6.01	2.31	0.55
October	34805	64	6.02	2.45	0.59
November	46369	80	7.35	2.45	0.56
December	64307	107	9.57	2.56	0.55

Conclusion

Research on zooplankters from the northern Levantine basin shelf waters during the period 1998 – 1999 revealed the presence of about 151 copepod species of which 36 are reported for the first time in the region. With the addition of new species and new records the total number of copepod species reached 233 species in the Levantine basin. The copepod species inhabiting the region are interesting in their faunal composition, and in their distribution, which is related to the existing current regime. Observation of Indo-Pacific species in the Levantine Sea confirms the fact that the Red Sea waters penetrate into eastern regions of the Mediterranean. The distribution of these species may indicate possible boundaries of this penetration. The presence of new species being introduced into the Levantine Sea points out that their invasion and acclimatisation in this region is intensive at present which therefore necessitates further studies.

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Meroplankton and pelagic polychaetes of the Northern Levantine Basin shelf waters

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Abstract- Taxonomic composition of the meroplankton and holoplankton of the northern Levantine basin shelf waters has been investigated for the first time. Qualitative and quantitative analysis of total 12 samples taken in monthly intervals from a fixed station have shown that meroplankton of the region is represented under 5 phyla, 9 classes and 28 families. Pelagic nectochaete larvae of the Spionidae family (Polychaeta) and zoeas of Grapsidae family (Decapoda) were the dominating meroplanktonic groups throughout the year. Total 12 pelagic Polychaete larvae, 3 Gastropod larvae, 5 Decapod species and 6 adult pelagic Polychaete species were identified during the study period. There is considerable seasonal difference in the taxonomic composition and quantitative distribution of meroplankton and pelagic polychaetes. Presence of trochophora, metatrochophora, nectochaeta, rostraria larvae of Polychaeta; ophiopluteus, echinopluteus, auricularia, doliolaria, pentactula, bipinnaria, brachiolaria larvae of Echinodermata; zoea, mysis, megalopa larvae of Decapoda; nauplius, cypris larvae of Cirripedia; tornaria of Enteropneusta; actinotrocha larvae of Phoronidea make the region remarkably species diverse. Typical stenohaline taxa formed by classes of Enteropneusta, Ophiuroidea, Asteroidea, Echinoidea, Holothuroidea have been also revealed. Winter meroplankton taxa composed of 4 phyla, 4 classes and 17 families. Highest meroplankton diversity was observed in January with 15 families. The predominance of the decapod larvae was a distinguishing feature of the winter. Maximal meroplankton abundance totalling 176 specimens within the 0-100 m layer was recorded during the February. Holoplanktonic polychaete species identified in winter are *Tomopteris elegans*, *Vanadis studeri*, *Travisiopsis lobifera*, *Pelagobia serrata* and *Maupasia caeca*. Highly diverse meroplankton composition including 5 phyla, 9 classes and 19 families is observed during spring. During this period holoplanktonic polychaetes also composed of 4 families, 5 genera and 3 species. Overall, meroplankton and holoplankton diversity was highest during the spring (Margalef's Index **d** = 4.3, 5.4 and 5.6 for March, April and May, respectively) and lowest during August (**d** = 1.9) and November (**d** = 2.3). Predominance of the polychaete larvae in April and May was a distinguishing feature. A remarkable increase in numbers (60 specimens) of nectochaetes of family Spionidae (especially of genus *Prionospis*) was observed in May. Holoplanktonic polychaetes identified during spring were *Travisiopsis lobifera*, *Pelagobia serrata* and *Maupasia caeca*. Summer meroplankton composed of 4