# Comparison of zooplankton biodiversity between Levantine Basin and Black Sea with reference to the alien species

S. Lakkis[1], A. E. Kıdeyş[2] , A. A. Shmeleva[3], Kovalev[3], E. Ünal[2], R. Zeidane[1]

*slakkis@inco.com.lb; slakkis@ul.edu.lb; kideys@ims.metu.edu.tr; plankton@ibss.iuf.net*
[1] *Marine Ecology & Plankton, Lib. Univ. & NCMS/LNCSR, Batroun, P.O.box 138, Byblos, Lebanon*
[2] *Institute of Marine Sciences, METU, Erdemli, Icel,Turkey*
[3] *Institute of Biology of Southern Seas,Nakhimov Ave, 2 Sevastopol/Ukraine*

**Abstract-** Levantine Basin although oligotrophic water body, the taxonomic diversity is very high as compared with Black Sea. Most of the planktonic species inhabiting Levantine waters are of Atlanto-Mediterranean type with subtropical affinity. About 45% of the occurring species in the Levantine Basin, are also present in the Red Sea, and 65% are common with the western Mediterranean. Several Lessepsian species of Indo-Pacific origin inhabit the Levantine Basin where the copepods count 70-90% of the total zooplankton abundance. In Black Sea zooplankton diversity is low where gelatinous organisms are the dominant group. Few Mediterranean species may reach the Black Sea through the narrow and shallow Dardanelles and Bosphorus. The "neritization" of plankton community in the Black Sea is a typical phenomenon due to the anthropogenic activities and the reduction of water exchange between the two basins. The invasion of alien species from the Mediterranean into the Black Sea has create an ecological instability within the planktonic community; that may affect the biodiversity of the Black Sea. The invasion of *Mnemiopsis leidyi* is a striking example of alien species in the Black Sea ,whereas jellyfish *Rhopilema nomadica* is a typical alien in the Levantine Basin.

**Key-words-** Levantine Basin.Aegean, Black Sea. Biodiversity. Alien species

## Introduction

Levantine Basin (LB) in the Eastern Mediterranean (EMED) and Black Sea (BS) are considered as isolated basins, their connection with world's ocean is very limited to narrow straits of Gibraltar, Bosphorus and Dardanelles. However the pelagic environment, namely planktonic system, share some common features between the two basins; zooplankton structure and biological diversity remain quite different in the two adjacent seas (Kovalev et al, 1999) . Aegean Sea and the Cilician sub-basin are considered as a prolongation of the LB, showing the same hydrographic properties.; whereas the Sea of Marmara shows the same hydrological properties than the BS. Hydroclimatological and hydrological characteristics are different from each other; the LB is situated in a warm temperate region,whereas BS is a cold temperate basin with cold temperate affinity. 65% of the zooplankton in LB belong to Atlanto-Mediterranean fauna and 35% of encountered species are of Indo-Pacific origin. Many of those are Lessepsian migrants (Kimor and Wood,1975; Lakkis,1980) LB is a concentration

basin, with high salinity (S> 39.50‰) and oligotrophic water, displaying poor phytoplankton production and low zooplankton biomass. On the contrary, the BS is highly eutrophicated, namely in the NW region with a brackish water of low salinity (S< 20‰) due to huge amount of outflowing freshwater from rivers carrying nutrients and organic matter. This eutrophication has been increasing during the last decades, due to heavy anthropogenic impact (Kideys and Niermann,1994). This heavy eutrophication has leaded to the "neritization" of the Black Sea fauna and changes in the characteristics of zooplankton community were observged. Certain changes in the hydrology of the Levantine Basin have occurred fter the construction of Aswan High Dam and the deepening and enlargement of the Suez Canal, showing increase of salinity and temperature; these changes have contributed to increasing immigration process from Red Sea into Mediterranean . Zooplankton of the Black Sea is characterized by poor meso and bathyplankton because of the deep anoxic water layers and restricted connection with EMED; only surface and neritic Mediterranean species can enter into the BS. For instance, 3 out of 7 Cladoceran species and 3 out of 15 of Pontellid copepods living in the EMED have migrated into the BS (Kovalev et al.,2001). The zooplankton community structure and abundance of South Aegean and Cilician sub-basin are similar to that of the EMED, whereas zooplanton community of Marmara is close to that of the BS (Unal et al.,2000). Most of the invading zooplaktonic species into BS are tolerant euryaline and eurytherme animals, able to adapt themselves in a different environment of low salinity (18‰) and big range of temperature between 0° and 27°C.

In this synoptic study, we compare the biodiversity of zooplankton community in the LB with that of adjacent seas: NE Levantine, Aegean,Sea of Marmara and BS, with particular reference to alien species.

## Material and Methods

This study is based on plankton samples collected from neritic and deep sea Lebanese waters since 1970 ( Lakkis,2001;Lakkis et al.,1996). Other zooplankton data reported from the Eastern Mediterranean were used in this survey (Mazzocchi et al.,1997; NE Levantine (Uysal et al.,2000), Aegean Sea (Siokou-Frangou et al.,1997),Sea of Marmara (Unal et al.,2000) and Black Sea (Kideys,1994;Kovalev et al.,2001 ). Sampling methods and zooplankton analysis carried out in different regions and Institutes are different from each other; this make difficult the quantitative comparison. However, qualitative and vertical samples hauled mainly with 200 microns mesh size plankton net, allow to do comparison of taxonomic diversity and zooplankton composition between different areas.

## Results

***Zooplankton diversity of East Levantine:*** Zooplankton of the EMED belongs to the temperate Atlanto-Mediterranean fauna with certain tropical affinity. Most of the groups are represented in the zooplankton of the neritic waters of the



LB, from the pelagic protozoans up to the prochordates, including big variety of meroplankton larvae. In addition to the *Microzoplankton* groups, we have: *Cnidaria, Ctenaria, Polychaeta, Crustacea, Chaetognatha, Mollusca, Tunicata, Meroplankton larvae* and *Ichtyoplankton* (Eggs and *Fish larvae*). The number of species so far recorded in the Lebanese waters amounts to 850 species. Taxonomic list of micro and mesozooplankton was reported in previous studies (Lakkis et al.,1996).

Microzooplankton including all planktonic protozoans,is highly diversified.We identified the *Foraminifera* (15 species), *Actinopoda* (90), *Radiolaria* (66), *Tintinnidae* (140). Among those 40 species are considered as thermophile species and probably Lessepsian migrants of Indo-pacific (Lakkis and Novel-Lakkis,1985) *Hydromedusae* include five orders counting 67 species are represented in the Lebanese waters. Among those,11 are considered as tropical forms of Indo-Pacific origin and 19 species are new to the Mediterranean (Goy *et al.*,1991). Fifteen psychrophile species are common during winter and 20 thermophile abundant in summer. *Scyphomedusae* comprise 6 jellyfish species, from which two are Lessepsian: immigrants: *Cassiopia andromeda* and *Rhopilema nomadica*. This last Lessepsian immigrant is a stinging species, it competed with the non offensive *Rhizostoma pulmo* to overcame it and became dominant jellyfish in the LB. During its swarming period (June-July), this alien species creates damages to the nets fishermen and stinging injuries to swimmers on the beach. *Ctenophora* are represented by three species:*Eucharis multicornis*, *Beroe ovata* and *Pleurobrachia rhodopis*. It is important to notice the absence of *Mnemiopsis leidyi* in Lebanese waters, whereas it was recorded along the Mediterranean Turkish coast (Kideys et Niermann,1994). Copepoda count between 70% and 90% of the total zooplankton in the LB. Out of 175 species found in the Lebanese waters from which 110 are Calanoids, 55 are tropical forms and 15 are Lessepsian immigrants. They have settled permanent populations in the LB (Lakkis,1984;Malt *et al.*,1989;Uysal et al.,2001 ). Most of these species inhabit the Aegean Sea where similar copepod assemblages were defined (Siokou-Frangou et al.1997). *Cladocera* are very abundant in summer, forming patches on surface water between May and August. Three genera with 6 species are common, the most abundant are *Evadne spinifera* and *E. tergestina. Planktonic Ostracoda* are very rare,they are more frequent in the water column of deep oceanic water of Lebanese sector, where 6 species are reported Out of 28 taxa of Siphonophora are represented by 28 species, of which 23 Calycophores and 5 Physonectes. From those 18 species inhabit the Red (Halim,1969;Lakkis,1980). Hyperid *Amphipoda* count 25 species belonging to 21 genera in the LB; they are more frequent in the water column 300-0m. Out of 13 species of *Euphausiacea* known in the whole Mediterranean ,5 species were identified from the Lebanese waters, the Indo-Pacific species *Stylocheiron abbreviatum* being the most common Adult *Decapoda* are mostly benthic organisms,they live on rocky beds from littoral to the deepest bottom. The pelagic larval stages constitute a big fraction of the meroplankton The only holoplanktonic genus decapods found in LB is the Sergestid *Lucifer*, represented by two species:

*L. typus* and *L.hanseni*. Out of 189 adult species occurring on the Levantine coast (Holthuis & Gotlieb,1958), 110 were found at different larval stages; many of them are of tropical affinity. Pelagic molluscs contribute to 4% of the total zooplankton abundance in the EL. In addition to the Prosobranch and Lamellibranch larvae, two groups of molluscs are holoplanktonic : *Heteropoda* (4 species) and *Pteropoda* (9). Amongt this latter group, 4 species are probably Lessepsian immigrants in the LB: *Creseis acicula, C. virgula* and *Limacina inflata, L .trochiformis*. From 30 *Chaetognatha* species known in the world ocean, 10 are present in the East Mediterranean , nine of which belong to the genus *Sagitta*:The two most common species are: *S.friderici* and *S.eflata* which account 90% of this group.Five thermophile species are circumtropical : *Krohnitta subtilis, S. bipunctata, S. enflata, S.hexaptera* and *S.serrato-dentata. Appendicularia* group is represented by 15 species belonging to 5 genera, *Oikopleura* being the most important including 7 species. *Thaliacea* include the *Pyrosomida (Pyrosoma)* the *Salpida (Salpa* and *Thalia)* and *Doliolida* (*Doliolum, Doliolina, Dolioletta*). *Ichtyoplankton* representing with Eggs and Fish larvae constitute an important fraction of the meroplankton. Among 354 species of fish present in the Lebanese waters from which 55 are Lessepsian immigrants, 95 eggs and fish larva belonging to 52 families,were found in the plankton samples (Lakkis & Zeidane,1993).

***Zooplankton diversity of the Black Sea:*** About 150 species are reported for the Black Sea including numerous brackish-water and freshwater organisms, mostly restricted to NW and coastal areas..This number is about 6 times less than that found in the EMED (Kovalev, 1991). Only 50% of the BS species occur in the East Mediterranean, whereas few Mediterranean species have penetrated and acclimatized in the BS. This is due mainly to the difference in the hydrological structure of the two marine environments. Taxonomic composition of zooplankton in the BS and EL shows remarkable differences. Typical stenohaline species common in the EL such as Radiolarians, Siphonophores, Pteropodes and Salps are absent from the BS. Other abundant Mediterranean groups are present in reduced number in the BS; such as Copepods, Chaetognaths, Medusae (Table1).On the contrary of the Mediterranean, the BS is poor in mesopelagic bathypelagic species. Only neritic and coastal species can enter from the North Aegean into the Marmara and BS. From six Cladoceran species, 5 can penetrate into the Marmara and thus into the BS. Three *Pontellidae* Out of 15 Pontellidae, only 3 Mediterranean species are reported from the BS: *Pontella mediterranea, Anomalocera patersoni, Labidocera brunescens* (Kovalev et al.,,2001).The intruding species are mostly eurytherme and euryhaline organisms, able to adapt themselves in quite different marine environment with low salinity (18‰) and big range of temperature (0-27°C). Most of these Mediterranean species are of coastal and neritic affinity; whereas in the BS they are distributed in the entire basin. This phenomenon is called "neritization".of the BS fauna (Kovalev,1991) as well as in the Sea of Maramara (Unal et al.,2001).



Table 1. Number of species of some zooplankton groups in the EMED and Black Sea.(Kovalev et al.,2001)

| Zooplankton groups | EMED | Black Sea |
|---|---|---|
| Copepoda | 313 | 12 |
| Cladocera | 6 | 5 |
| Siphonophora | 25 | 0 |
| Appendicularia | 15 | 1 |
| Chaetognatha | 10 | 1 |
| Hydrozoa | 70 | 7 |

Zooplankton of the BS communities differs from that of the LB. If the copepods in the LB account for 70-96% of total zooplankton number; they represent between 60 and 80% in the BS. Other groups such as the Cladocerans, Appendicularians, Ctenophora (*Mnemiopsis leideyi*, *Pleurobrachia rhodopis)* and *Noctiluca scintillans* occur with higher relative abundance. Zooplankton biomass is about 10 times more abundant in the BS than in the EMED (Kovalev et al., 2001). During the last decades, a remarkable increase in the anthropogenic impact on the ecosystem of the BS has noticeably affected the species composition of zooplankton assemblages (Kideys et al., 2000).This change was more pronounced after the invasion of the BS with *Mnemiopsis leidyi* by the mean of ship ballast waters in 1988 from Atlantic. This alien species has created serious ecological damages and changes in the structure and the dynamics of pelagic communities in the BS. As a predator, it feeds on eggs and larvae of *Engraulis encrasicolus* , so that the annual catch of anchovy in the BS decreased 4 times between 1988 and 1991 (Kideys,1994). In Romanian coast, the catch of *Sprattus* and other fish have dropped drastically to a very low level during last years.The previous dominant cyclopoid *Oithona nana* and calanoid *Labidocera brunescens* no longer occur in zooplankton samples. In the NW Black Sea and between 1960 and 1980,several *Pontellidae* species decreased by 35 fold during 1960-80. In the same region and for the same period,*Paracalanus parvus*, *Centropages ponticus* ,*Pseudocalanus elongatus,Calanus euxinus (C. helgolandicus),Sagitta setosa, Penilia avirostris* and *Evadne spinifera* decreased by 4 to 50 fold for the same period .All these drastic ecological changes recently observed in the pelagic system of the BS seem to be due not only to heavy predation by *Mnemiopsis leidyi* on zooplankters ,but also to the toxic impact of pollution and heavy eutrophication (Kideys,1994 )

Significant long-term changes in zooplankton assemblages occurred in the BS between 1950-2000. The number of some groups and species such as *Copepoda*, *Oikopleura* and *Pleurobrachia* decreased considerably. The opposite trend was observed for *Noctiluca* scintillans which increased up to 62% during 1960-69. Over the past decades, gelatinous component (mainly *Mnemiopsis leidyi*, *Aurelia aurita*) accounted for 99.5% of zooplankton biomass (Kovalev et al., 2001).

## Conclusion

Although some zooplankton species inhabit equally the BS and the LB, there are big differences as regard the group composition and abundance of zooplankton community of the two basins. This dissimilarity is mainly due to the geographical

isolation of the BS and restricted connection with the Aegean and EMED. Moreover, the hydrological properties of the two marine environments are quite different. This difference in zooplankton composition has been aggravated in recent years due to sensitivity of the BS ecosystem because of anthropogenic impact. The "neritization of the plankton community is due partly to the heavy eutrophication and the increasing anoxia. During last three decades, we noticed in the LB a certain "tropicalization" of the plankton system due to the increasing temperature ($\Delta T=0.5°C$) and salinity ($\Delta S=0.40‰$) and to the continuous immigration through Suez Canal. This phenomenon has increased the tropical species in the EMED where they acclimatized and settled permanent populations. The impact of these man-made changes which occurred to EMED and tributaries is very important on the composition and ecology of plankton and thus on the biodiversity. Furthermore, the "neritization" of the BS and "tropicalization" of the EMED can reduce the exchange facilities of water masses between the two basins and thus the limited migration of species through the connecting Dardanelles and Bosphorus. As consequences to these phenomena, the biodiversity in the BS is going decreasing whereas it continue increasing in the LB Moreover, the alien species which invaded, naturally or artificially, the two basins display negative effect on the ecology of pelagic ecosystem. A big number of benthic organisms have penetrated in the Black Sea (Zaitsev and Ozturk, 2001). If all these species have acclimatized, their larval stages can affect the composition and structure of plankton. A continuous survey is necessary to be undertaken in order to study the evolution of these exotic species in the BS.and in the LB. The negative impact of the alien jellyfish *Rhopilema nomadica* is noticed in the damage of fihermen nets and touristic swimming activity .The effect of *Mnemiopsis leidyi* in the Black sea is more serious since the damage includes the pelagic ecology and fisheries production.

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