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FULL LENGTH ARTICLE

Abundance, distribution, diversity and zoogeography of epipelagic copepods off the Egyptian Coast (Mediterranean Sea)

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KEYWORDS

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Abstract The abundance, distribution and diversity of epipelagic copepods were studied along the Egyptian Mediterranean Coast during April, August, 2008, February, 2009 and 2010. The geographical distribution and ecological affinities of the recorded species are presented in order to follow up the migrant species that recently entered in the study area. Copepoda was the most dominant zooplankton group, representing 74.14% of the total zooplankton counts. The annual averages of copepod abundance in the coastal, shelf and offshore zones were 699.3, 609.7 and 555.7 ind.m^{-3}, respectively. Spring was the most productive and diversified season. 118 copepod species were identified in the study area; among them twelve species are recorded in the Mediterranean Sea for the first time and 41 species are new records in the Egyptian Mediterranean waters. The community was dominated by *Oithona nana*, *Calocalanus pavo*, *Nannocalanus minor*, *Clausocalanus arcuicornis* and *Paracalanus parvus*. The study area could be considered as a crossroad for migration process from Atlantic Ocean in the west and Indian Ocean via Red Sea and Suez Canal from the south. In addition, the maritime activities in the Mediterranean Sea may have contributed into the change of copepod diversity in the study area where some species could have come to the Egyptian Coast from other water systems via ballast water.

Introduction

The Mediterranean Sea is one of the most oligotrophic semi-enclosed basins and its marine life is heavily threatened by habitat degradation mostly due to human activities (Lancelot et al., 2002). Por (1978) declared that the Suez Canal is considered as a link and barrier in plankton migration between the Red Sea and the Mediterranean. The Suez Canal's being a nar-

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row and shallow water course, turbidity and temperature are higher than those of the adjacent seas. In addition, the Bitter Lakes, which are hyper saline natural lakes that form part of the Canal, south, and the Nile fresh water dilution, north, acted as two selective salinity barriers that blocked the migration of the Red Sea species into the Mediterranean for many decades, but as the salinity of the lakes gradually equalized with that of the Red Sea, the barrier to migration was removed, and plants and animals of the Red Sea have begun to colonize the Eastern Mediterranean. The construction of Aswan High Dam across the Nile River in 1965 reduced the inflow of fresh water and nutrient-rich silt from the Nile into the Eastern Mediterranean, making conditions there even more like the Red Sea. Evidently, plankton migration through Suez Canal is a continuous process and it is increasing from south toward the north of the Canal particularly after the disappearance of hydrological barriers and the increasing salinity in the Levantine Basin after the construction of High Dam (Abd El-Rahman, 2005; Zakaria, 2015).

In the Egyptian Mediterranean waters, the distribution of zooplankton abundance in coastal waters was studied by Dowidar and El-Maghraby (1971, 1973), El-Maghraby and Dowidar (1973), Samaan et al. (1983), Aboul-Ezz (1994), Hussein (1997a,b) and Abdel-Aziz (2002, 2004). Some studies included information on the seasonal variability of community composition (Dowidar and El-Maghraby, 1970; Dowidar et al., 1983; Abdel-Aziz, 1997, 2001; El-Tohamy, 2005; Zakaria 2006a, 2007a,b; Zakaria, 2014; Zakaria et al., 2007; Aboul Ezz et al., 2014; Abou Zaid et al., 2014). The offshore waters have received little attention (Hussein, 1977; Nour El-Din, 1987; Abdel Aziz and Aboul-Ezz, 2003; Zakaria, 1992, 2004, 2006b). Few of them concern copepods despite their ecological importance in the marine food web. The main objective of the present study is to investigate the copepod distribution and diversity in coastal and offshore waters of western part of the Egyptian Mediterranean Coast with special focus on the zoogeography of the recorded alien species.

Material and methods

The study area covered the western part of the Egyptian Mediterranean coast and lies between longitudes 25° 30′ E and 29° 30′ E and extends northward to latitude 32° N (Fig. 1). The Egyptian Mediterranean waters are characterized by the presence of different water masses which converge and mix: the surface water mass of minimum salinity (38.6–38.8 ppt) and maximum oxygen concentration (> 5.2 ml/l) which is of Atlantic origin and extends 50–150 m in depth; the intermediate water mass of maximum salinity (38.9–39.1 ppt) which extends below 150 m to about 300–400 m depth; and the deep waters which are of eastern Mediterranean origin (Said and Eid, 1994). The water circulation along the Egyptian Mediterranean Coast is dominated by the Atlantic water inflow along the North African Coast and by the Mersa Matruh and El-Arish gyres. The Mersa Matruh gyre exhibits a strong winter to summer variability, reversing from anticyclonic to cyclonic (Said and Rajkovic, 1996). The salinity values ranged between 39 and 39.2 (Said and Rajkovic, 1996; Zakaria, 2006b). The pH values ranged between 7.98 and 8.44 during winter and between 8.07 and 8.6 in summer. The dissolved oxygen concentrations varied between 4.13 $ml.l^{-1}$

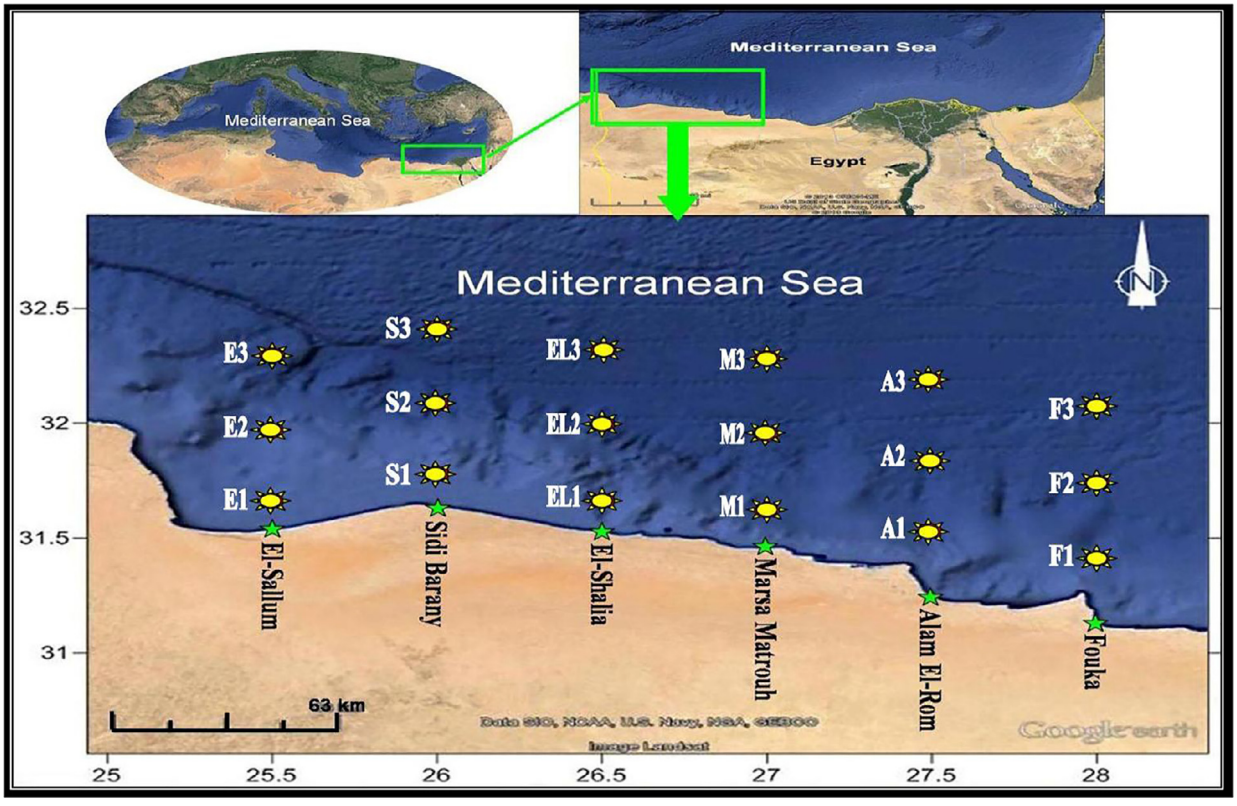

Figure 1 Area of investigation and the locations of the sampling stations.