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FULL LENGTH ARTICLE

Vertical distribution of zooplankton in Lake Nasser

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Abstract The composition and distribution of zooplankton communities in three depths (surface, 10–5 m and 20–15 m depths) along main channel of Lake Nasser were studied in 2013. The density of total zooplankton was increased to maximum during winter and autumn at surface water (39,362 and 63,100 Ind. m^{-3}, respectively) and gradually decreased with depth until attaining the lowest average density at 20–15 m (12,460 and 8976 Ind. m^{-3}). During spring and summer, zooplankton was irregularly distributed through the water profile, where the highest average density was recorded at 10–5 m depth (66,007 and 66,734 Ind. m^{-3}). Copepoda was the dominant zooplankton group at all depths, it represented about 70–76.2% of the total zooplankton count. Cladocera formed about 13.4%, 14.5% and 11% of total zooplankton density for surface, 10–5 m and 20–15 m depth. It was decreased with increasing depth during winter and autumn; however it attained its maximum density at 10–5 m depth during spring and summer. Rotifera average density decreased with increasing depth. The dominant zooplankton species inhabiting Lake Nasser were strongly temperature-dependent. The study recommends the introduction of some pelagic fish species to consume the high persistence of zooplankton community at the upper 10 meters of water column.

Introduction

The construction of the Aswan High Dam in southern Egypt resulted in the creation of the longest man-made lake in the world. The major portion of this lake is extending in Egypt for about 300 km and is known as Lake Nasser and for 180 km further south in Sudan as Lake Nubia. Lake Nasser extends between 22° 31́to 23° 45́N and 31° 30́ to 33° 15́ E and filled during late 1970s (El-Shabrawy, 2009).

The role of zooplankton not only regulates the aquatic productivity by occupying intermediate position in the food chain, but also by indicating environmental status in a given time (Xie et al., 2008). Many studies dealt with the seasonal variation and surface distribution of zooplankton in Lake Nasser (Gaber, 1982; Zaghloul, 1985; Iskaros, 1993; Mohamed, 1993; Taha and Mageed, 2002; Mokhtar, 2003; El-Shabrawy and Dumont, 2003; Mageed and Heikal, 2005; Ali et al., 2007; El-Enany, 2009; El-Serafy et al., 2009). While the vertical distribution of zooplankton was concerned by Samaan (1971) who estimated the standing crop in the upper 10 meters during March 1970 from three localities. Samaan and Gaber (1976) studied the plankton population of Lake Nasser at ten meter water depth during March and August. Mageed (1995),

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El-Shabrawy (2000), Abdel Mola (2012) compared between the distributions of zooplankton at different water levels of the upper ten meters of the lake. The concentration of zooplankters in the water column (0–20 m) was variable throughout the year at six sampling sites from El-Ramla in the north to Abu Simbel in the south along the main channel of Lake Nasser (Habib, 2000).

The vertical position of different zooplankton groups was explained by specific combinations of biotic and abiotic factors. Even though the vertical position of individual zooplankton groups was quite variable, the study of Wissel and Ramacharan (2003) found consistent patterns among lakes, sampling dates, and zooplankton groups. Also, the relative vertical positions of groups of different body size suggested that avoiding predation by planktivorous fish was the major constraint that shaped this behavior.

The objective of the present study is to investigate the temporal and spatial distribution patterns of zooplankton organisms at different water levels in Lake Nasser.

Material and methods

Sampling program

Seasonal samples were collected at nine sites in Lake Nasser (Fig. 1) from February 2013 to November 2013. Surface water samples were collected to estimate temperature, pH, transparency and dissolved oxygen by using the standard methods of APHA (1995).

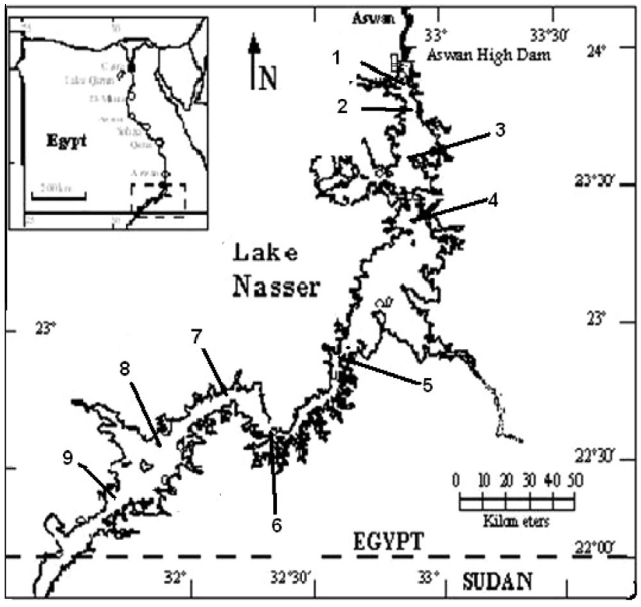

Figure 1 Lake Nasser map showing the selected study sites.

Zooplankton analysis

For zooplankton quantitative analysis, three zooplankton samples were collected from each site, one from the surface and the second from 10 to 5 m depth, while a third sample from 20 to 15 m depth. Thirty liters were taken from surface water at each sampling site by filtering through a zooplankton net of 55 μm mesh diameter and vertical samples were collected by vertical tows. Collected samples were kept in plastic bottles with some lake water to which 4% formalin was added as a preservative. Samples were studied under the compound microscope and specimens identified at the species level when possible. Zooplankton numbers were expressed as number of organisms per cubic meter. Many publications and taxonomic references were used for zooplankton identification (Edmondson, 1963; Bick, 1972; Ruttner-Kolisko, 1974; Koste, 1978; Pontin, 1978; Dodson and Frey, 1991; Hussein et al., 1991; Einsle, 1996; Foissner and Berger, 1996).

Data analysis

Shannon-Wiener diversity, species richness, evenness, Simpson diversity and similarity index were calculated using the Primer 5 program. The correlation coefficient was done using the SPSS program version 16 between species of zooplankton and the different environmental variables. A two-way analysis of variance was calculated to find out the significance of the differences in density of the zooplankton groups among different sites at the three studied depths of the main channel.

Results

The ranges and averages of physico-chemical characteristics of the lake water at different seasons are shown in Table 1.

Zooplankton in Lake Nasser comprised Copepoda, Cladocera and Rotifera and Protozoa, while meroplanktonic organisms were rarely recorded. Four copepods, seven cladocerans, thirty rotifers and five protozoans were detected from the three depths (Table 2).

The seasonal average density of zooplankton was nearly equal at both surface and 10–5 m depth (50,789 and 49,114 Ind. m^{-3}) and dropped to the least value of 14,527 Ind. m^{-3} at 20–15 m depth. During winter and autumn, zooplankton density decreased with depth and maximum averages of 39,362 and 63,100 Ind. m^{-3} at surface water, and decreased to the least averages densities of 12,460 and 8976 Ind. m^{-3} at 20–15 m depth. During spring and summer, the highest average density of zooplankton was detected at 10–5 m depth (66,007 and 66,734 Ind. m^{-3}), and it decreased to the lowest density of 23,651 and 13,021 Ind. m^{-3} at 20–15 m depth, respectively (Fig. 2).

Table 1 Ranges and averages of physico-chemical parameters in Lake Nasser.

		Winter	Spring	Summer	Autumn
Temperature (°C)	Range (average)	18.1–21.5 (19.6)	23.7–33.9 (28.3)	27–32.4 (29.6)	22.7–26.8 (24.4)
pH	Range (average)	8.2–9.01 (8.6)	7.9–8.6 (8.4)	7.1–8.8 (8.1)	7.1–8.5 (8.1)
Trans. (cm)	Range (average)	180–430 (320)	190–300 (230)	150–525 (271)	150–500 (350)
DO (mg/l)	Range (average)	5–8.1 (6.5)	3.5–7.6 (5.7)	2.9–6.9 (4.7)	5.2–6.8 (6.6)