# Vertical distribution of zooplankton in relation to thermocline at the main channel of Lake Nasser, Egypt.

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#### ABSTRACT



Temperature plays an important role in vertical distribution of zooplankton especially in summer. Zooplankton samples were collected vertically at different depths in the main channel of Lake Nasser in front of Khor Kalabsh during July, 2007. The highest density of zooplankton (63779 Organisms/m<sup>3</sup>) and the highest number of species (10) was recorded between 2-5 m with an average temperature of  $30.21^{\circ}$ C. The surface water layer recorded the second most abundant zooplankton (47222 Organisms/m<sup>3</sup>) with temperature ( $34.8 \, ^{\circ}$ C). This is due to the highest abundance of *Brachionus calciflorus* ( $14444 \,$ Organisms/m<sup>3</sup>). Also, *B. calcifloris* recorded high number from 0-2 m ( $10508 \,$ Organisms/m<sup>3</sup>) and not recorded at any other water layer (up to 20 m depth). This indicates that this species is thermophilic which is supported by the highest positive correlation (0.79) with temperature. *Keratella tropica* was recorded only between 15-20 m with an average temperature of  $21.88 \, ^{\circ}$ C.

Keywords: Zooplankton, Vertical distribution, Thermocline, Lake Nasser.

#### INTRODUCTION

Seasonal thermocline is a temperature gradient in a water body that's not affected by the diurnal changes in surface forcing; in general. It is established each year by heating at the surface water in the summer, and is broken by cooling of the surface and wind-driven mixing in winter. Pandey and Shukla (2005) mentioned that thermal stratification is the separation of water into distinct warm and cold layers and it divided into three layers: the upper most warm layer (epilimnion), the lower cooler layer (hypolimnion) and the layer in between (thermocline). Rapid changes in temperature take place in thermocline layer. Mohamed (1993) reported the thermocline takes place in many stations of the main channel of Lake Nasser during summer (June, July and August) months. El-Serafy et al. (2009) stated that temperature is an important factor which affects the distribution of zooplankton. Zooplankton is one of the most interesting groups of freshwater animals. They occupy intermediate position in the food chain of most aquatic ecosystems. Zooplankton is a food for juvenile and adult fish and large invertebrates (Pandey and Shukla, 2005). Because of their central role in the food web, they are a key ecosystem component from the standpoint of the food web. Zooplankton in most temperate lakes comprises three main groups; Rotifera, Cladocera, and Copepoda, in addition to the meroplanktonic form (El-Serafy et al., 2009). Rotifers mostly inhabit the littoral zone, sessile in nature and associated with substrate. Cladocera are larger than rotifers, they are mostly littoral species. Copepoda are considered good swimmers compared to the other groups (Ali et al., 2007). Studies by all investigators showed that zooplankton in Lake Nasser consists of Copepoda, Rotifera and Cladocera with Copepoda as the most dominant group. Zooplankton in Khors of Lake Nasser was studied by many investigators. Mohamed (1993),

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Shehata *et al.*, (1998b) and El-Shabrawy (2000) studied the vertical distribution of zooplankton in the main channel of Lake Nasser. However, little information is known about the effect of thermocline on the vertical distribution of zooplankton in Lake Nasser.

This work aims to focus on the vertical distribution of different zooplankton species in euphotic zone (from surface to 20 m) of the main channel of the lake and its relation with thermocline which takes place in the lake, mainly during summer season only.

#### MATERIALS AND METHODS

Lake Nasser (Fig. 1) has an area of about 5248 km<sup>2</sup>, a mean depth of 21.5 - 25.5 m (maximum 90 m) and a width of 8.9 to 18.0 km at 160 and 180 m above mean sea level, respectively. It lies between latitudes 22° 00'-23°58' N and longitudes 31° 19' - 33° 19' E. Lake Nasser is unique in its performance because it is situated in pure desert surroundings. The site of sampling was located at the middle of the main channel in front of khor Kalabsh (44 Km from Aswan High Dam). It lies at latitudes 23° 33' N and longitudes 32° 42' E. with 81 m depth and 36.8 °C air temperature. Thermocline was conducted by Japanese Measuring Transducers model Megatron. Zooplankton samples were collected from surface water by filtration of 30 liters and vertically from different depths at 0-2 m, 2-5 m, 5-10 m, 10-15 m and 15-20m with a closed plankton net 55 µm, 25 cm diameter and 80 cm length. The samples were immediately fixed with 4 % formalin.

In the laboratory, the samples were examined, counted and identified according to description and keys constructed by Edmondson (1966); Ruttner-Kolisko (1974); Pontin (1978) and Shehata *et al.* (1998 a & b). The correlation coefficient was carried out on data of thermocline and the most abundant zooplankton species at the selected station during July, 2007.



Figure (1): Map of Lake Nasser showing Kalabsha site of sampling during July, 2007.

### **RESULTS AND DISCUSSION**

At the surface layer, the second highest density of zooplankton was recorded (47222 Organisms/m<sup>3</sup>) which can be related to high temperature being 34.8 °C and also, the highest abundance of nauplius larvae and copepodite stages which formed collectively (49 %) and *B. calciflorus* (14444 Organisms/m<sup>3</sup>). High number of *B. calcifloris* was recorded from 0-2 m (10508 Organisms /m<sup>3</sup>). Moreover, it was not recorded at any other water layer which indicates that this species are thermophilic and can tolerate high temperature.

This is supported by the highest positive correlation (0.79) with temperature. Rotifers were the second dominant group forming 45 % of the total zooplankton. Although, Cladocera formed the lowest dominant group (6 %) of the total zooplankton were recorded its highest density at the surface (2778 Organisms/m<sup>3</sup>). This is due to the increasing of Bosmina longirostris (2222 Organisms/m<sup>3</sup>) and *Diaphanosoma excisum* (556) Organisms/m<sup>3</sup>) and this Cladocerans species recorded high positive correlation with temperature. This observations agree with Shehata et al. (1998b) who mentioned that Cladocera attain their maximum abundance in summer due to the flourishing of some species e.g D. excisum which prefer the warm water. The percentage of groups at the different depths and the profiles for temperature and the dominant zooplankton species are graphically represented in Figures 2 and 3. The highest density of zooplankton (63779 Organisms/m<sup>3</sup>) and the highest number of species (10) was recorded between 2-5 m with average temperature 30.21 °C. This layer recorded the highest number of Copepoda (93 %) which are considered the most dominant zooplankton groups of Lake Nasser. They may be sinking to escape from high water temperature in the upper layer, because, they are good swimmers compared to the other groups (Ali et al., 2007). Also, it may be due to the increasing of phytoplankton in the upper layers. Taha and Mageed (2002) stated that the increasing of zooplankton at the main channel of Lake Nasser always accompanied by increasing of phytoplankton and recorded high positive correlation. Habib (1995) found that the highest values of Chlorophyll *a* concentrations were recorded at the upper layers because of photosynthetic activity of phytoplankton which inhabit high light intensity of solar radiation. The present finding agrees with Mohamed (1993) who found that zooplankton were abundant in August 1993 due to the high increase of nauplius larvae and copepodite stages. Rotifera at 0-2 m formed 72 % which may be due to the abundance of rotifers like, B. calcifloris, Keratella cochlearis and Platyias patulus which can tolerate the warm water in this layer and the present data recorded high positive correlation for these species with temperature. This indicates that these species are thermophilic. The abundance of Rotifera in present study may also be related to increasing of oxygen

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Figure (2): Percentage of occurrence for zooplankton groups at the surface water and at different layers of euphotic zone in the main channel of Lake Nasser during July, 2007.

in this layer. This agrees with Mola (2011) who found high positive correlation between *Brachionus* and water temperature, transparency and dissolved oxygen. At 2-5 m the percentage of Rotifera, recorded sharp decrease (5%) while an increase in Copepoda to 93%. It is probable that the predation effect of most copepods on Rotifera (Pandy *et al.*, 2004).

At 5-10 m, the density of zooplankton decreased (2441 Organisms/m<sup>3</sup>) with decreasing temperature (29.58 °C) and number of species (6). Rotifera recorded the lowest abundant group (7 %) while copepoda and Cladocera recorded the highest percentage being 47 % and 46 %, respectively. This may be related to the dominance of nauplius larvae and copepodite stages and three species of Cladocera (*B. longirostris, Ceriodaphnia cornuta* and *D. excisum*) recorded at this layer. *B. longirostris* was recorded as the most dominant zooplankton species in this water layer (978 Organisms/m<sup>3</sup>) and the most dominant cladocern species in the study site.

At 10-15 m the density of zooplankton showed remarkable decrease (1262 Organisms/m<sup>3</sup>). Copepoda were missing and Cladocera (58 %) and Rotifera (42 %)

were the only recorded groups. They were represented by two species for each group; the rotifers *K. tropica* and *Filina opoliensis* and the Cladocerans *B. longirostris* and *Daphnia longispina*. *D. longispina* was recorded only in this layer being 41 Organisms/m<sup>3</sup>. This may be attributed to this species preference for the low water temperature. This is confirmed with El-Shabrawy (2000) who finding that there is a general decrease in daphnid species observed during high temperature. At 15-20 m the temperature and the density of zooplankton reached to the lowest. *K. tropica* was recorded only (408 Organisms/m<sup>3</sup>) with average temper-ature 21.88 °C.

The presence of this species in surface water as well as in deep water indicates that this species can live in wide range of temperature and in different depths. *K. tropica* recorded a high positive correlation (0.75) with *T. longiseta* due to the presence of the two species in the surface layer and the both species recording a positive correlation with temperature while *K. tropica* showed a negative correlation (-0.37) with *C. cornuta* due to the increasing of this species with depth while *C. cornuta* decreasing with depth.



**Figure (3)**: Thermocline profile, profile for total zooplankton and the dominant species (organisimis/m<sup>3</sup>) in the main channel of Lake Nasser during July, 2007.

The data of correlation coefficient matrix (Table 1) showed that temperature showed a high positive correlation with all the recorded species except M.

ogunnus and C. cornuta which recorded low positive correlation of 0.11 and 0.10 respectively. The highest positive correlation between species (0.99) was recorded

between two rotifers species (K. cochlearis and T. longiseta) and between the copepod T. galebi and the cladocern C. cornuta being 0.97. This is due to the fact that these species follows the same trend of their vertical distribution. While the two abundant copepod species M. ogunnus and T.galebi recorded negative correlation with the rotifer species B. longirostris, T. longiseta, K. tropica and the cladocern B. calyciflorus. This is due to the fact that this copepod species was not recorded in the

Surface water to escape from high temperature in the upper layer and recorded it in maximum occurrence from 2-5 m under surface showing different behaviour. This is in conformity with the findings of El-Shabrawy (2000) who studied the vertical distribution of zooplankton in the main channel during spring 1997. He mentioned that the upper 5 meters recorded the highest abundance, it gradually decreased until reached to minimum density at a depth from 15 -20 m.

<b>I abit</b> (1). Conclation coefficient matrix between temperature and the most dominant zooprankton species during
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Zooplankton * Temp.	Temerature	D. excisum	C. cornuta	B. longirostris	T. longiseta	P. patulus	K. tropica	K. cochlearis	B. calyciflorus
Total zoo.	0.60	0.97	0.72	0.28	0.63	0.91	0.25	0.71	0.37
M. ogunnus	0.11	0.56	0.99	-0.26	-0.04	0.44	-0.36	0.07	-0.29
T. galebi	0.18	0.57	0.97	-0.32	-0.02	0.58	-0.42	0.07	-0.23
B. calyciflorus	0.79	0.59	-0.35	0.53	0.93	0.58	0.64	0.86	
K. cochlearis	0.76	0.86	0.03	0.71	0.99	0.91	0.77		
K. tropica	0.30	0.43	-0.37	0.86	0.75	0.63			
P. Patulus	0.64	0.96	0.41	0.62	0.83				
T. longiseta	0.79	0.81	-0.09	0.67					
B. longirostris	0.50	0.42	-0.22						
C. cornuta	0.10	0.51							
D. Excisum	0.72								

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Received: October 18, 2012 Accepted: November 21, 2012 التوزيع العمودي للهائمات الحيوانية وعلاقتها بمنحني التدرج الحراري في المجري الرئيسي لبحيرة ناصر ـ مصر

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تلعب درجات حرارة المياة دوراً هاماً في التوزيع العمودي للهائمات الحيوانية خصوصاً في فصل الصيف تم تجميع عينات الهائمات الحيوانية رأسياً من أعماق مختلفة في المجري الرئيسي لبحيرة ناصر أمام خور كلابشة أثناء شهر يوليو ٢٠٠٧. سجلت الهائمات الحيوانية أعلي كثافة (٢٣٧٧ كائن/م) وكذلك أكبر عدد من الأنواع (١٠ أنواع) في ما بين ٢-٥ متر مع متوسط حرارة للمائمات الحيوانية منوية.

بينما سُجلت طبقة المياة السطحية ثاني أكثر الطبقات كثافة (٤٧٢٢٦ كائن/م<sup>7</sup>) مع حرارة سجلت ٣٤,٨ درجة مئوية ويرجع ذلك لوفرة نوع البراكيونس كالسيفلورس (١٤٤٤٤ كائن/م<sup>7</sup>). كما سجل هذا النوع بكثافة عالية في ما بين ٢٠-٢ متر (١٠٥٠٨ كائن/م<sup>7</sup>) ولم يسجل في أي طبقة من عمود الماء بعد ذلك (حتي ٢٠ متر) وهذا يدل علي أن هذا النوع من الهائمات الحيوانية محب للحرارة ومما يؤكد ذلك درجة الأرتباط القوية (٢٩,٠) مع درجة حرارة المياة. سجل نوع كيراتيلا تروبكا تواجده فقط ما بين ١٠-٢ ٢٠ متر مع متوسط حرارة درجة مئوية ٨٩.