Gamal EL-SHABRAWY, Mohamed GOHAR, Mousa GERMOUSH, Elena ANUFRIIEVA and Nickolai SHADRIN, 2014. Long-term Changes in the Saline Lake Qarun (Egypt). *Acta Geologica Sinica* (English Edition), 88(supp. 1): 180-182.

Long-term Changes in the Saline Lake Qarun (Egypt)

Gamal EL-SHABRAWY[1], Mohamed GOHAR[1], Mousa GERMOUSH[2], Elena ANUFRIIEVA[3,4] and Nickolai SHADRIN[3,4]

1 National Institute of Oceanography and Fisheries, Fish Research Station, El-Khanater, El-Khairia, Cairo, Egypt;
2 Biology Department, College of Science, Al Jouf University, Sakaka, Saudi Arabia;
3 Institute of Biology of the Southern Seas, Department of Physiology of Marine Animal and Biochemistry, Sevastopol, 299011, Russia;
4 MLR Key Laboratory of Saline Lake Resources and Environments, Institute of Mineral Resources, Beijing, 100037, China

1 Introduction

There is now ample evidence of the impacts of the recent climate change and anthropogenic activities on different saline lake ecosystems. All over the world salt lakes are threatened by climate change, water diversions upstream for agricultural purposes, watershed changes, introduction of aliens, etc. that result in catastrophic changes of the lakes. Among the examples of this there are the largest saline lakes including Great Salt Lake, Owens Lake, Mono Lake (N. America), Laguna Mar Chicuita (S. America), the Dead and Aral Seas, Ebinur Lake, Urmia Lake (Asia), St. Lucia Estuary (Africa), etc. A lot of negative consequences for human communities are resulted from that. In our World of Change some changes are a natural result of the global climate system variability, but the responsibility for other changes falls squarely on humanity's shoulders. We need to know how to divide these two groups of the causes of the salt lake changes to predict and mitigate the negative results.

Lake Qarun (Moeris) is a terminal saline lake in the northern part of El-Fayum Depression (Middle Egypt, ~80 km southwest of Cairo, at the margin of the Nile Valley). It lays on 29°30'N and 30°40'E. The lake's surface area is 43 m below sea-level, and covers about 202 sq km. It is the third largest lake in Egypt and supports human culture during about 7,000 years (Hassan, 1986). This means that climate fluctuations and anthropogenic activities interact as the causes of the lake changes during that long time. In 2300 BC, the waterway from the Nile to the natural lake was widened and deepened to make a canal which is now known as the Bahr Yussef. Figure 1 shows long-term changes of the lake from prehistoric time.

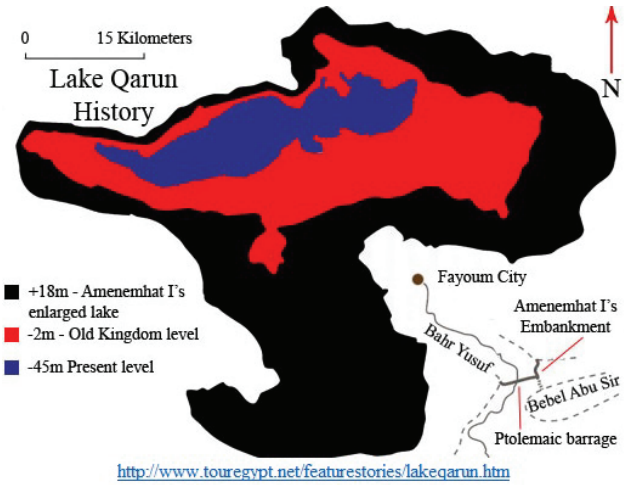

Fig. 1. Long-term changes of Lake Qarun area.

2 Material and methods

In summer 2011 we made a survey of zooplankton and 21 physico-chemical parameters on 10 stations in the lake using standard methods. Taking these data and results of different previous studies of the lake we analyzed long-term changes in the lake.

3 Results and discussion

Salinity fluctuated between 31.4 ‰ and 39.5 ‰ on all stations, excluding stations 1 and 7, where it was 21.31 ‰

* Corresponding author. E-mail: lena.anufriieva@gmail.com

and 26.4 ‰. Highest concentrations of nutrients were also detected on stations 1 and 7. We concluded that stations 1 and 7 were different from all other stations. They are most eutrophic and less saline stations in the lake; this is caused by the discharges from El Bats and El Wadi drainage systems. A total of 15 species of holozooplankton were identified; they are belonging to Protozoa–7 species, Rotifera–5, Copepoda–3. Meroplankton includes 6 groups (Cirripedia larvae, Nematoda, Polychaete larvae, Ostracoda, mollusk larvae, fish larvae) (Figure 2).

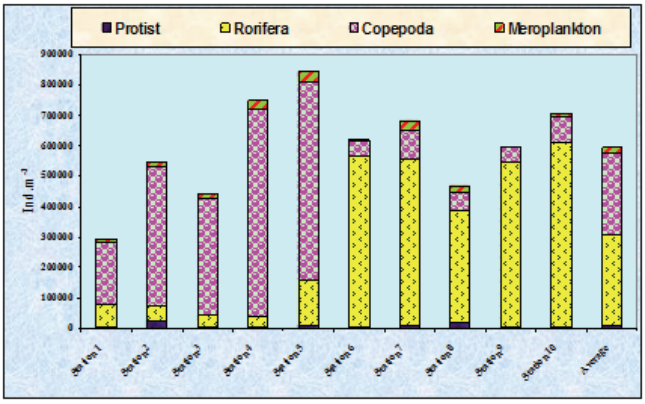

Fig. 2. Species composition of zooplankton of different stations in Lake Qarun (summer 2011).

Salinity increased and fluctuated since 1901: 8.5 ‰ in 1905; 12.0 ‰ in 1922; 38.0 ‰ in 1980; 30.0 ‰ in 1985; 42.0 ‰ in 1994 (Payne, 1986; Baioumy et al., 2011). Salt composition in water also fluctuated: SO_4/Cl was 0.557 in 1999-2000, 0.458 in 2006, and 0.75 in 2011. K/Na fluctuated between 0.029 and 0.113. Averages concentration of SiO_4 gradually decreased: 17.71 mg L^{-1} (1989), 6.70 mg L^{-1} (1995), 6.16 mg L^{-1} (2003), 3.59 mg L^{-1} (2006), 2.07 mg L^{-1} (2011). Zooplankton density and composition also fluctuated (Figure 3). Before 1930 zooplankton in the oligohaline Lake Qarun consisted mainly of brackishwater species; *Arctodiaptomus salinus* (Daday, 1885) (Copepoda) and *Moina salina* Daday, 1888 (Cladocera) dominated (Wimpenny and Titterington, 1936). Twenty years after there was no more evidence of *A. salinus* and *M. salina,* while the marine copepod *Paracartia latisetosa* (Kritchagin, 1873), which was recorded at first in 1930, had high abundance (Naguib, 1985). To maintain fishery in the lake, mullet, eels and sole have been periodically introduced from the Mediterranean since 1928 (Naguib, 1961). Different plankton and benthic animals, including *P. latisetosa*, were occasionally transported in the lake during these fish introductions. There are considerable seasonal and inter-annual variations of zooplankton structure and physico-chemical parameters in the lake. Spatial variability of all studied parameters, including zooplankton ones, in summer 2011 was essentially less than seasonal and inter-year temporal variability of these parameters.

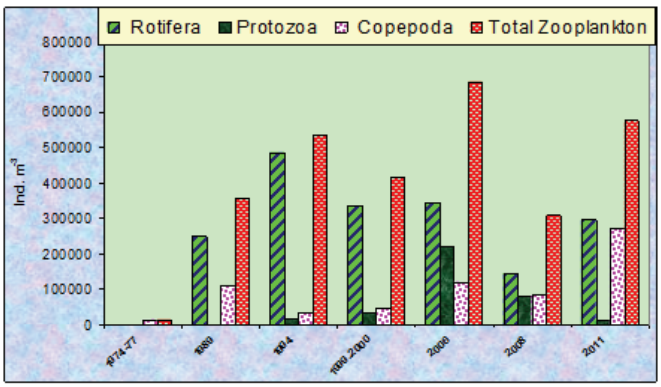

Fig. 3. Long-term changes of zooplankton in Lake Qarun

We concluded that there is no single abiotic parameter, which determine composition and density of zooplankton in Lake Qarun. Salinity changes did not directly impact on composition and abundance of zooplankton in the lake. We agree with Williams (1998) that salinity is not a major determinant of species occurrence: major determinants probably included stochasticity, predation, food availability, competition, other biotic interactions, and complex of particular physical and chemical factors. Disappearance of *A. salinus* and *M. salina* in plankton of Lake Qarun could not be due to observed salinity increase, because halotolerance of these species is very high (Shadrin and Anufriieva, 2013 a,b). Alien *P. latisetosa* pressed on *A. salinus* and *M. salina* to come out from plankton.

Increase salinity in water bodies of arid and semi-arid zones would continue because there is a trend of global warming. The forecasted salinity in the next 75 years might be over 60 ‰ (Meshal, 1977); this may lead to a reappearance of *M. salina* and *A. salinus* in plankton of Lake Qarun.

More integrated studies are needed to separate anthropogenic and natural causes of the lake ecosystem changes and predict the possible scenarios of future Lake Qarun change.

Key words: saline lake, long-term changes, zooplankton, abiotic parameters.

References

Baioumy, H., Kayanne, H. and Tada, R., 2011. Record of Holocene aridification (6000–7000 BP) in Egypt (NE Africa): authigenic carbonate minerals from laminated sediments in Lake Qarun. *Quaternary International*, 245: 170–177.

Hassan, F.A., 1986. Holocene lakes and prehistoric settlements of the western Fayum. *Journal of Archaeological Science*, 13:

483–501.

Meshal, A.H., 1977. The problem of the salinity increase in Lake Qarun (Egypt) and a proposed solution. *Journal du Conseil*, 37: 137-143.

Naguib, M., 1958. Studies on the ecology of Lake Qarun (Fayum, Egypt). Part I. *Kieler Meeresforschungen*, 14: 187-222.

Naguib, M., 1961. Studies on the ecology of Lake Qarun (Fayum, Egypt). Part II. *Kieler Meeresforschungen*, 17: 94-131.

Payne, A.T., 1986. *The ecology of tropical lakes and rivers*. Chichester: John Wiely and Sons, 300.

Shadrin, N. and Anufriieva, E., 2013a. Dependence of *Arctodiaptomus salinus* (Calanoida, Copepoda) halotolerance on exoosmolytes: new data and a hypothesis. *Journal of Mediterranean Ecology*, 12: 21-26.

Shadrin, N. and Anufriieva, E., 2013b. Climate change impact on the marine lakes and their Crustaceans: The case of marine hypersaline Lake Bakalskoye (Ukraine). *Turkish Journal of Fisheries and Aquatic Sciences*, 13: 603-611.

Williams, W.D., 1998. Salinity as a determinant of the structure of biological communities in salt lakes. *Hydrobiologia*, 381: 191-201.

Wimpenny, R. and Titterington, E.T., 1936. The tow net-plankton of Lake Qarun, Egypt. Dec., 1930 to Dec., 1931. *Notes and Memoirs, Fisheries Research Directorate,* 14: 00-57.