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State of Fisheries in Lake Qarun, Egypt: Review Article

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Abstract

This article aims to review the available studies concerning fisheries status of Lake Qarun to suggest an effective strategy for improving its annual total fish catch. Data were collected from the available Publications from GAFRD (General Authority for Fish Resources Development), Central Agency for Public Mobilization and Statistics (CAPMAS), and data collected from reports funded by World Fish Center and FAO were used as data sources of this article. In addition to published papers and reports. Also, from extended visits to Lake Qarun. This article introduces information about study area, environment of Lake Qarun, fishing boats and methods, total fish production, species composition and different biological studies that carried out on Lake Qarun from 1935 till 2019. Recommendations for proper management of this selected sector were recorded in the present study.

Keywords: Lake Qarun, Fisheries, fishing boats, environment, management.

Introduction

Lake Qarun is the only enclosed saline lake in Egypt and it represents one of the important sectors in the Egyptian fisheries, for both significant total catch and a large number of economically important species (Shehata *et al.,* 2017). It has unique ecosystem that attracts attention of several authors to study, beside it has historic and scientific importance.

Since the beginning of 20th century, several investigations have been done concerning Lake Qarun fisheries including those of Wimpenny and Faouzi (1935), Faouzi (1936), Wimpenny (1936), El-Zarka (1963), El-Zarka and El-Sadafy (1967), Boraey (1974), Abdel-Malek (1980; 1982), Ishak *et al*. (1982), Sweilum (1989), Mosaad (1990), Gabr (1998), El-Shabrawy and Fishar (1999) and El-Serafy *et al*. (2014). However, these studies are still scarce and fragmentary (Konsowa, 2006). Therefore this study aims to review the available studies concerning fisheries status of this lake to help in suggesting an effective strategy to improve its total fish production.

Data sources

The author used publications from GAFRD (General Authority for Fish Resources Development), Central Agency for Public Mobilization and Statistics (CAPMAS), and data collected from reports funded by World Fish Center and FAO. In addition to published papers and reports. Also, there have been extended visits to Lake Qarun.

Review

Study Area:

Lake Qarun is located in the western desert part of Fayoum depression Lake and it is centered around 29°30°N, 30°40°E (Fig.1). Its length is about 40 km from east to west, and the

breadth at its widest point is about 6.7 km. Its surface area is about 243 km2 and its water volume is about 924 million m3 at 43 m below sea level (Anonymous, 1995). The deepest point (~8.3 m) is located northwest of the island. The lake has no connection to the sea, being located 320 km south of the Mediterranean coast of Egypt, and is sustained directly by the Nile River through the Bahr Yussef canal. The lake and surrounding area is a protected area and has been designated as a Ramsar site since 2012. It is bordered from its northern side by the desert and by cultivated land from its south and southeastern side (Abdel-Satar *et al*., 2010).

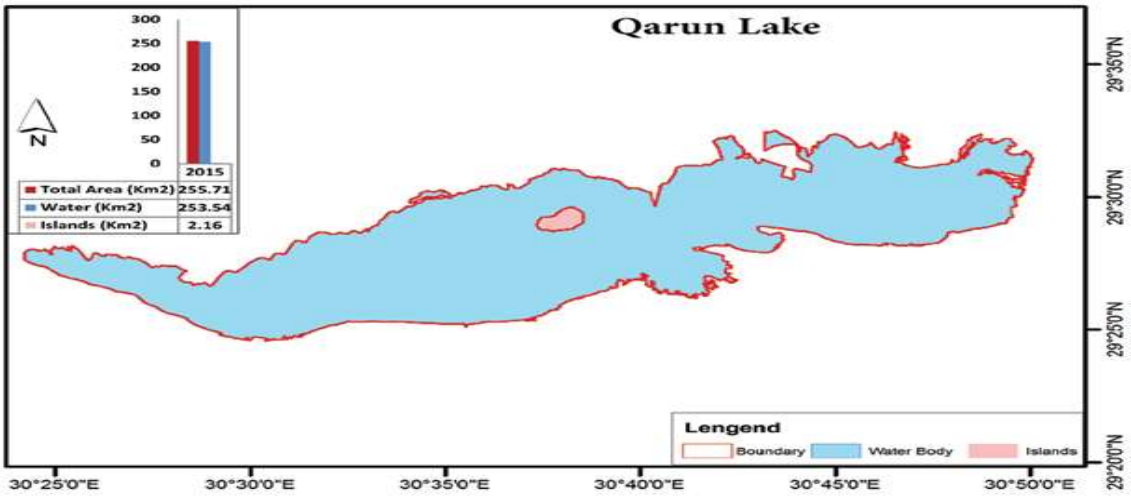

Fig. 1: Map show Qarun Lake; location, total area and water surface (After GAFRD, 2015).

Environment of Lake Qarun:

Lake Qarun is immense freshwater palaeo-lake, occupies part of the basin of ancient Lake Mories that persisted until the mid Holocene (Hassan, 1986). Lake Qarun now has the salinity of seawater (Aleem, 1985). Gradual increasing salinity has accelerated since ~1900s (Ball, 1939), reached 32–36 g/L in 1975/76 (Boraey, 1980), and caused a profound effect on lake fauna and flora.

Lake Qarun still suffers nowadays from several environmental problems. The progressive increase of its salinity was considered as the most serious problem which affects the different life aspects in the lake. Also, the aggravation of eutrophication of the lake's water, that caused by the nutrient carriage from the agricultural drainage water (Sabae and Ali, 2004). These conditions led to change in the biodiversity of the different biota (Mageed, 2005).

Several drains (El-Bats, El-Wadi and El-Berkah Drains) of El-Fayoum irrigation systems terminate and pour highly amounts of fresh or brackish water into Lake Qarun. Such water is loaded with wastes, salts and nutrients that may accumulate and contaminate the aquatic environment (Hassan, 2002; Ghanem, 2006 & 2011 and Khalaf-Allah, 2014).

Al-Afify *et al*. (2019) reported that, municipal and agricultural sewage wastes discharged into Lake Qarun causes serious problem of its water quality. They added that the water quality index (WQI) values indicated that the lake water is poor for irrigation and aquatic life guidelines.

As a result of increasing land reclamation in Fayoum Province over the past decade, it was necessary to find another reservoir to receive quantities of agricultural wastewater drainage

exceeding the capacity of the lake. This was achieved by transferring the surplus drainage to Wadi El -Rayan Depression, where two man-made lakes were created at two different levels. The first lake has nearly half the area of the second lake, and they are joined by a connecting shallow channel (Zahran, 1973; El-Shabrawy, 1999). The first lake of Wadi El-Rayan receives frequent effluent of wastewater from the Wadi Drain.

Concerning salinity of Lake Qrun, it was increased throughout the 20th century (Fig. 2), being around 14‰ in the early 1900s (Ball, 1939). Mean salinity reached an average ~38 ‰ in the 1980s but, since then, has stabilized. Seasonally, soluble salts in the lake increase during summer and this is can be attributed to evaporation and changes in the inflow regime. Being located in an arid area with intensive evaporation (~7 mm h^{-1}), freshwater input does not compensate for seasonal evaporation and salinity increases. The salinity of the lake is not homogenous, being lower near the mouth of the inflows that drain the lakes southern landscape (Fathi and Flower, 2005).

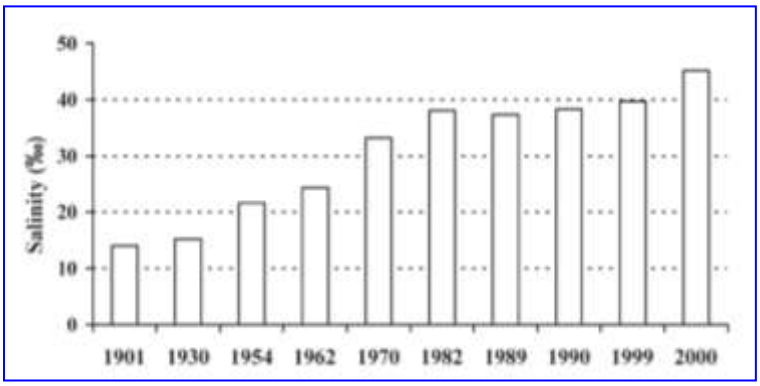

Fig. 2. Changes in salinity in Lake Qarun during the period 1901-2000 (Soliman, 1990; Anonymous, 1995; El-Sayed and Guindy, 1999; Fathi and Flower, 2005).

Fishing boats and methods:

About 615 woody non-motorized fishing boats (Fig. 3) were operated in the lake during 2010- 2011. Four fishermen were working on each boat. The fishing gears used in the lake namely; 1-Trammel nets with four types differed in their dimensions, mesh sizes and mainly targeting *Mugil cephalus*, *Tilapia zillii*, *Solea spp.* and *Liza spp.* 2- Seine nets with three types and targeting *M. cephalus*, anchovy and shrimp. 3- Others fishing methods (Fishing aggregation system, traps and hooks) targeting mainly *T. zillii* (El- Serafy *et al.*, 2014).

Fig. (3): Photos showing Lake Qarun fishing boats.

Krzebietke *et al*., (2016) reported that, the main fishing equipment used in the lake was trammel nets, beach seines, hand lines and traps. There were four types of trammel nets which differed in their design, characters, dimensions and mesh sizes according to their target species. The first trammel net (Ghazl Bolti) mainly targeted tilapians, particularly *Tilapia zillii*. This worked effectively in the East and Middle sub-areas of the lake. The second trammel net (Ghazl Bory), which targeted *Mugil cephalus* worked mainly in the northern part of the lake and deeper water. The third trammel net (Ghazl Mossa) was set mainly on the bottom to catch sole fish, e.g. *Solea solea* and *S. aegyptiaca*. It operated mainly in the middle and western parts of the lake. The fourth trammel net (Ghazl Fahhar) targeted mullet fish species other than *M. cephalus*, such as *Liza ramada, L. aurata* and *L. saliens*. It was mainly active in the Middle sub-area. Beach seines with two main types, Gorafet Bory and Gorafet Zardina, were also set in the lake. Gorafet Bory was targeted mainly by *M. cephalus* and it operated in the northern beach of the lake, while Gorafet Zardina was present mostly in the southern beach and targeted anchovy. Other fishing gears, handlines and traps were mostly targeted by *T. zillii* in the eastern and middle sub-areas

Total fish production of Lake Qarun:

The commercial total annual catch decreased from 4000 tonnes during 1920 to an average of 1- 2 thousand tonnes in subsequent years (El-Serafy *et al*., 2014).

To compensate the drop in fish production, some marine fishes were introduced and transplanted to the lake including *Mugil spp. , Solea spp.,Sparus aurata, Dicentrarchus labrax* and shrimps. *Liza saliens, Solea spp.* and shrimps were succeeded to acclimatize and spawn in the lake (El-Serafy *et al*., 2014). On the other hand, some species like, Atherina spp. were accidentally introduced as fry mixed together with mullet fry (Anonymous, 2007).

For the period 2002-2011, the average annual total fish catch was about 3000 tonnes (GAFRD, 2012), represented mainly by four fish groups; tilapias, mullets, soles and shrimps. According to GAFRD fish statistics (2002-2011), catch per unit effort (CPUE) has an average of 29.286 kg/boat/day. The total annual fish landing for different species from Lake Qarun during this period is shown in Figure (3).

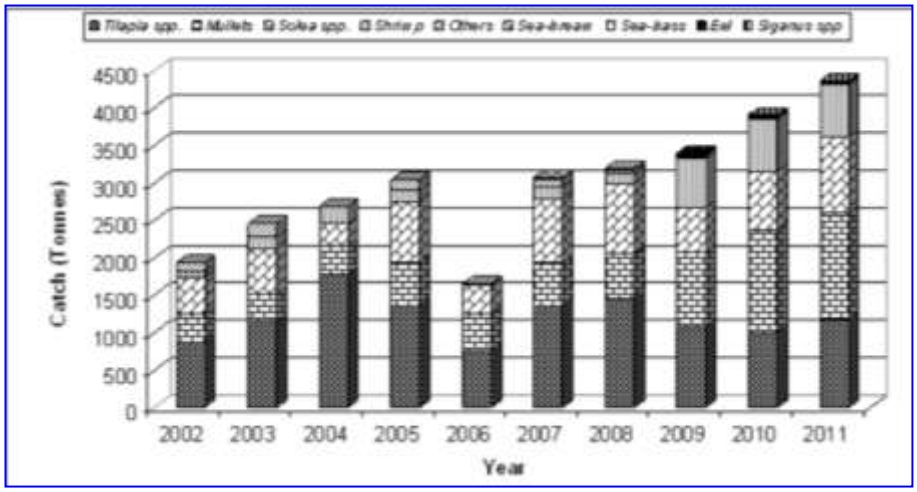

Fig. 3. Total annual fish landings for different species from Lake Qarun according to GAFRD for the period (2002-2011) (After El-Serafy *et al*., 2014).

The commercial catch in Qarun Lake dropped from around 4000 tons per year during last 5 years to be about less than 1000 tons in 2016 (GAFRD, 2017) (Fig.4).

Recently, Qarun Lake undergo parasitic infection (Isopoda), on its fishery production which has a bad impact on the lake production, fish quality and fishermen community.

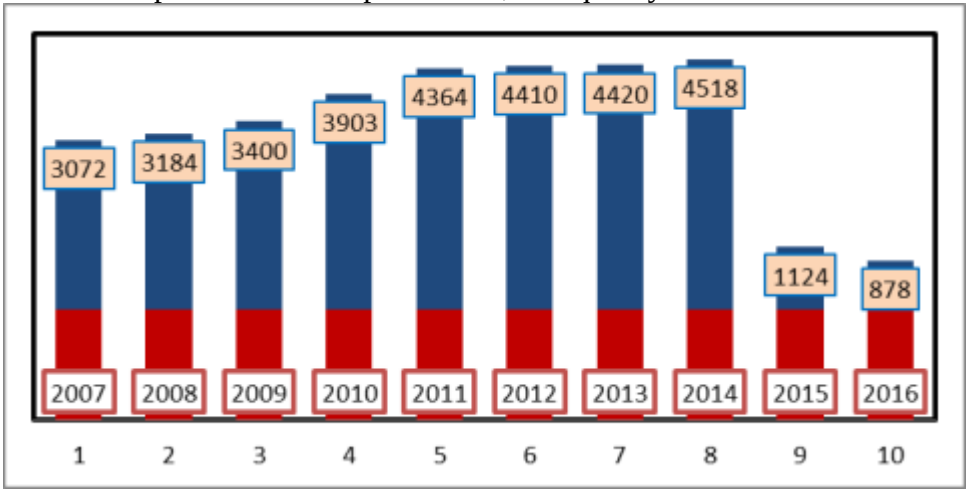

Fig. (4): Development of Qarun Lake fisheries during the period from 2007 to 2016 (GAFRD, 2017).

Poor fish production in Lake Qarun is a direct result for implementation of irrational and unevaluated policies such as introducing of some species to the lake (El-Far, 2014). Moreover, some invasive species like isopods (*Nerocila orbigyni*) and jelly-fishes are affected the fish production and fish quality in the recent three years (Anonymous, 2015 and El-Shabrawy & Dumont, 2016).

All fresh-water species with the exception of *Tilapia* spp. and *Anguilla* spp. gradually disappeared from the lake depending on their tolerance to salinity (El-Zarka, 1961&1963).

Abdel- Malek *et al.* (1990) revealed that the main factors accounted for the decline of fisheries in Lake Qarun is related to dryness of the coastal area (area of spawning to most fishes) due to lowering of water level, during the period 1970–1977. Also, this decline was due to introducing of some predatory marine fish species and increasing natural mortality due to pollution and to increased water salinity.

Species Composition:

El-Zarka (1961) mentioned that *Tilapia zillii* and *Solea vulgaris* were considered as the main fishes in Qarun Lake as they compose more than 65% of the annual total catch of the lake, beside they spawn in it. On the other hand, *Mugi*l species, *Angulla vulgaris, Sparus auratus* and shrimp are transported as fries from their spawning regions in the Mediterranean Sea to the lake. El- Zarka (1963 a &b) studied the acclimatization of both *Solea vulgaris* (Linn.) and *Mugil saliens* (Larr.) in Lake Qarun. El- Zarka and El- Sedfy (1970) studied the biology and fishery of *Mugil saliens* (the catch, age & growth composition, size distribution and reproduction) in Lake Qarun. Al-Kholy and Abdel-Malek (1971) studied food and feeding habits of some Egyptian fishes in Lake Qarun. The later authors studied *T. zillii* (Gerv.) at different localities. Abdel-Malek (1972 a &b) studied food and feeding habits of *T. zillii* (Gerv.) in relation to different length group and sex. Ezzat *et al.* (1979) studied biometric variation in *Solea vulgaris* acclimatized in Lake Qarun, Upper Egypt. They investigate the morphology of these fishes and

made measurements and compare with those of fish caught in the Mediterranean. Ishak *et al.* (1982) studied length and age composition of mullets in Lake Qarun, they found that the growth in length and weight of *Mugil cephalus* were better in the lake than in other coastal area of Egypt. They recommended that studies should continue to improve survival of transplanted mullet fry into the lake.

Mosaad (1990) studied the length- weight and condition factor (K) of the most common fishes in Lake Qarun (*Mugil capito*, *Mugil cephalus*, *Mugil saliens*, *Solea vulgaris* and *Tilapia zillii*). Ibrahim (1993) studied the length-weight relationship, age- length Kay, age composition, Gonado- somatic index, fecundity, length frequency distribution and food items of *Metapenaeus* spp. *Solea* spp, *Liza* spp. and *Tilapia* spp. in the lake. Falts (1995) studied the population dynamics of *Tilapia zillii* in Lake Qarun during 1991 to samples taken from the trammel net catch. Saleh *et al.* (1995) computed the annual total catch, annual catch of *Tilapia zillii* (as pelagic fish) and *Solea vulgaris* (as bottom fish).

Shalloof (2009) studied fisheries biology of *T. zillii* and *Solea vulgaris* in Lake Qarun. She concluded that decline in the value of condition factor (K) and disappearances of older age groups of both two studied species reflect the drastic condition of Lake Qarun which had a profound effect on its fauna and flora.

El-Serafy *et al*., (2014) studied Qarun Lake fisheries; Fishing gears, Species composition and Catch per unit effort. They concluded that the species composition for the mostly used gear in Lake Qarun as follow *Mugil cephalus* , *Liza ramada* and *Liza saliens,Solea spp., Tilapia zillii, Gobius niger, Dicentrarchus labrax* and *Engraulis encrasicolus* and shrimps.

Table (1): Scientific and local names of different species in Lake Qarun , Egypt

Scientific name	Local name
***Mugil cephalus* (Linnaeus,1758)**	**Bouri**
***Liza ramada*(Risso, 1826)**	**Tobara**
***Solea spp*.**	**Moussa**
***Dicentrarchus labrax* (Linnaeus,1758)**	**Qarous**
***Anguilla Anguilla*(Linnaeus,1758)**	**Hannash**
***Engraulis encrasicolus*(Linnaeus,1758)**	**Anshouga**
***Tilapia zillii*(Gervais, 1848)**	**Bolti akhdar**
***Oreochromis niloticus* (Linnaeus,1758)**	**Bolti sultani(nily)**
***Sarotherodon galilaeus*(Linnaeus,1758)**	**Bolti Ain Salem**
***Metapenaeus stebbingi* (Nobili, 1904)**	**Gambari abiad)**
Bagrus *spp* .	**Shamoth**
***Lates niloticus*(Linnaeus,1758)**	**Keshr Bayad**

Conclusion:

From the previous survey of literatures, it is possible to conclude that Qarun Lake fish production face many problems like the environmental challenges due to rising the salinity, and polluted water drains (without treatment), and uncontrolled fishing practice. Recently, Qarun Lake undergo parasitic infection (Isopoda), on its fishery production which has a bad impact on the lake production, fish quality and fishermen community.

Recommendations:

1- Treatment of sewage before discharged into the lake (since the commercial catch in Qarun Lake dropped to be about less than 1000 tons in 2016.
2- Supply depression with large quantities of healthy fry especially from El- Bardawil Lake, since different studies recorded that this lake less polluted comparing with other Egyptian lakes.
3- Using of legal fishing methods.
4- Reduce the salinity of the lake by supplying the lake with a larger amount of water.
5- Use of biological control against isopod parasite after further research by specialists.
6- More research into biological and environmental studies of Isopoda parasite to learn how to resist it.
7- The establishment of fish ponds where fish fry is placed for a specific period of time before being transferred to Lake Qarun and Wadi Al Rayyan to ensure that they are free from any parasites or unwanted fish species.
8- Pay attention to the fishermen community and find ways to compensate them for staying in the lake.
9- The competent authorities shall work together to develop solutions for the development of the lake.

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