Qarun Lake fisheries; Fishing gears, Species composition and Catch per unit effort

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ABSTRACT

Qarun Lake is a closed salty basin located about 90km southern Cairo Egypt, cover an area of 230km^2 with annual production of about 3000 tonnes. The present study assessed the lake fishery for better management purpose. Data, information and samples were collected through 42 field trips and 311 fishermen interviews during fishing season (2010-2011). The lake was divided into three sub-areas, east, middle and west. It was found that the fishing gears used in the lake were; 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 that were targeting *M. cephalus,* anchovy and shrimp. 3- Others fishing methods (Fishing aggregation system, traps and hooks) targeting mainly *T. zillii*. For each gear and methods used, the species composition (target and by-catch) and catch per unit effort were estimated according to sub-area and season. It is realized that middle area was more productive with higher species diversity. The present study recommends prohibiting traps in spring and all seine nets except *Gahzl Zardina* during summer in west and improving the fish catch and effort statistics for sustainable management of this valuable resource.

Keywords: Qarun Lake, Fishing gear, species composition, CPUE.

INTRODUCTION

Lake Qarun is considered the oldest natural lakes in Egypt, located in about 90km southern Cairo (Fig., 1). It has about 230 Km^2 of water surface with a rich biological diversity including birds, plants and fishes (Fouda, 2012). Lake Qarun became a saline lake in the early 1900s due to decreased freshwater inflow coupled with high evaporation rate. Since the lake was fresh water, its fisheries production contained most of Nile fishes (Faouzi, 1936&1983). By the time, the lake water has undergone drastic changes as its salinity has increased progressively. 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). The commercial catch dropped from 4000 tonnes during 1920 to an average of 1 to 2 thousand tonnes in subsequent years. To compensate the decline in fish production, some marine fishes, like *Mugil spp.* and *Solea spp.* followed by *Sparus aurata*, *Dicentrarchus labrax* and shrimps, were introduced and transplanted to the lake. Some species like, *Atherina spp.* were accidentally introduced as fry mixed together with mullet fry (Anonymous, 2007). *Liza saliens, Solea spp.* and shrimps were succeeded to acclimatize and spawn in the lake.

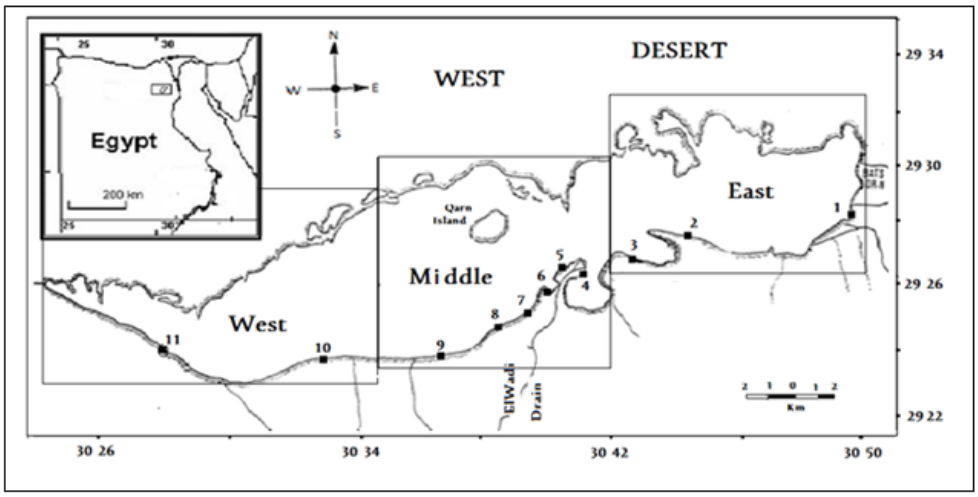

Fig. 1: Map showing Lake Qarun, sub-areas (East, Middle and West) and main Landing sites during the period of study (2010-2011).1) Senoris, 2) Abu-Neema, 3) Shakshouk, 4) Abu-Soliman, 5) Abu-Shanab, 6) Kahk, 7) El-Lokanda, 8) El-Rawashdia, 9) El-Saaida, 10) Ayuob and 11) Qarun.

During 70's, their production ranks at the top of other species, where it contributed more than 50% of lake fisheries production till 1978 (Bishai and Kirollus, 1987). For last 10 years (2002-2011), the average annual catch was about 3000 tonnes (GAFRD, 2012), represented mainly by four fish groups; tilapias, mullets, soles and shrimps (Fig. 2).

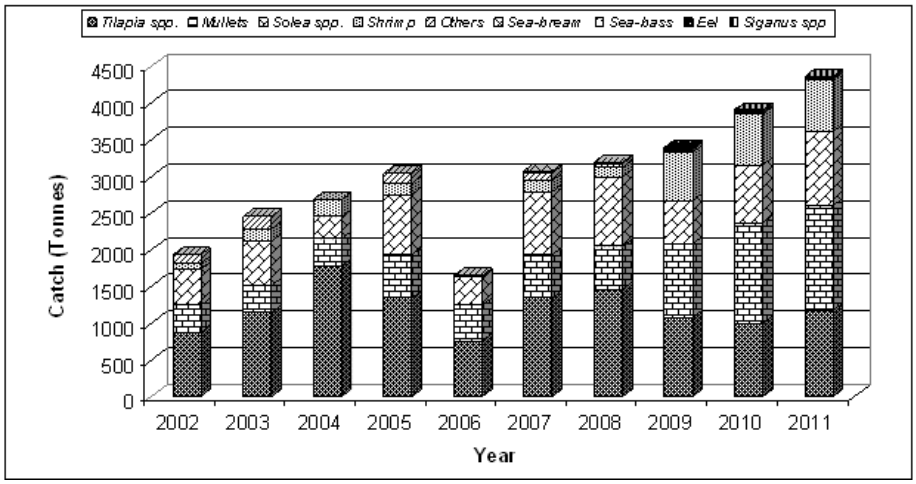

Fig. 2: Fish landing by species from Lake Qarun during the period from 2002 to 2011 according to GAFRD (2002-2011).

The present study aims to describe the general features of Lake Qarun fisheries and to assess the fishing activities in this important water body.

MATERIAL AND METHODS

Fishing activities in Lake Qarun were investigated during the period from July 2010 to April 2011 while May, June and January were closed time for fishing. The lake was divided into three sub-areas; the east, middle and west. Forty two field trips were conducted in the three sub-areas at the early morning and 311 fishermen were

interviewed during the period of study. Information about fishing gears and methods; mesh sizes, height and length of nets were recorded. Moreover, information about boats; their length, and number of fishermen per boat as well as the fishing grounds were collected. The catch and species compositions of each boat in each sub-area were investigated. Fishes from different types of fishing gears and methods were collected and identified to species level (according to Whitehead, 1986 and Fish Base, 2012). Fish total length in cm (distance from the tip of snout to the end of the caudal fin) and total weight to nearest milligram were measured.

Catches from at least three boats used the same fishing gear were averaged, and the total catches were standardized to daily catch per unit effort defined as weight of fish in Kg per 100 meter net length (kg/100m net/day) or Kilogram per haul (kg/haul) for beach seine. On the other hand, to estimate the catch per unit effort according to fishing boat, the total fish landed was divided by the number of actually fishing days to get the average total catch per day and then the result divided by number of active fishing boat to estimate catch per unit effort as kilogram per boat per day (Kg/boat/day).

RESULTS AND DISCUSSION

Fishing boats and fishermen: About 615 woody non-motorized fishing boats were operated in the lake during the period of study. Most of them (525 boats) operating in the middle part of the lake. Four fishermen were working on each boat, with an age ranged from 13 years to 60 years old most of them (65%) in middle age (15-35 years), this could consider as socio-economic indicator in the fishing community around the lake (healthy and promising sector).

Fishing gear and methods used in Qarun Lake were classified into three categories (Table 1).

Table 1: The main fishing gears and methods used in Qarun Lake, target species and their mean length between brackets during the period of study (2010 to 2011).

Fishing gear type		Local name	Filament	Dimensions		Mesh size (mm)	Target species (mean length/cm)
				Length (m)	Height (m)		
Trammel Nets	Flathead Mullet Trammel net.	*GhazlBory*	Monofilament	600 - 1000	6.0- 10.0	Inn.: 25- 41.7 Out.: 63- 100	*M. cephalus* (38.37)
	Tilapia Trammel net.	*GhazlBolti*	Monofilament	200- 1000	1.2-4.0	Inn.: 22-29.4 Out.: 62.5-90.9	*T. zillii* (14.33)
	Soles Trammel net.	*GhazlMossa*	Monofilament	600-3000	0.65-1.5	Inn.: 20.8- 29.4 Out.: 62.5- 85.2	*Solea spp.* (17.06)
	Leaping mullet Trammel net.	*GhazlFahhar*	Monofilament	150-750	2.0-3.5	Inn.: 19.2-25 Out.: 65.8-83.3	*Liza spp.* (20.09)
Seine Nets	Beach seine (1)	*Gorafat Zardina*	Knotted-twisted multifilament	150 - 300	1.5 - 3.0	8.3	*E. encrasicolus* (7.28)
	Beach seine (2)	*GorafatBory*	Braided knotless multifilament	200-500	10-35	23.8 - 31.3	*M. cephalus* (36.50)
	Boat seine	*Hattata*	Knotted twisted multifilament	150 - 300	1.5 - 3.0	8.3	*T. zillii* (9.67) *Solea spp.* (12.33)
Others fishing methods	Fish aggregating system (FAS)	*Heml*	Multifilament	8	4	25	*T. zillii* *Anguilla* spp.
	Traps	*Goaby*	Mono or multifilament	0.5 diameters.	1.0 m height	21-28	*T. zillii*
	Hooks	*Sennar*	Line with 3 to 5 hooks.	J-shape	15-16 in size.	---	*T. zillii*

1-Trammel net: The main gear used which composed of three nylon monofilament panels joint together by the upper and lower rope; the outer two panels have larger mesh size and the wider inner panel with smaller mesh size. The upper rope has floats

and the lower one has leads. This net was classified into four types according to their target species and specifications:

a) Flathead grey mullet Trammel net, *Ghazl Bory*. It is used in fishing ground deeper than 5 meters and set over night in the water. It is targeting *Mugil cephalus* while *Solea spp., Tilapia zillii, Dicentrarchus labrax* and *Engraulis encrasicolus* are considered by-catch.

b) Tilapia Trammel net, *Ghazl Bolti*. It is used in fishing ground ranged from 3 to 4 meters depth. It set in the water over night or spread in day. It is working mostly in east and middle of the lake and targeting *Tilapia zillii* while *E. encrasicolus*, *Solea spp., Liza ramada* and *Liza saliens*, are caught as by-catch.

c) Soles Trammel net, *Ghazl Mossa*, It set in the water mostly over night. This net is working mostly in middle and west of the lake and targeting sole fishes while *E. encrasicolus*, *T. zillii, M. cephalus*and *Liza spp*. are caught as by-catch. This type had similar characters and mesh size of that noted by Ferretti& Froglia (1975) and Vallisneri *et al.* (2000) in Adriatic Sea.

d) Leaping mullet Trammel net, *Ghazl Fahhar*. This net present only in the middle of the lake at depth up to 5 meters and targeting *Liza* spp. while *E. encrasicolus, T. zillii* and *Solea spp.* are consider as by-catch. The gear design is matched to its target species, therefore the target species contributed for at least 47% of the gear total catch.

2- Seine Nets (*Ghazl Ahmar*): A seine is fishing net consists of a net panel with two wings; the wings end with a bag (bunt) and connected to a hauling rope ended with woody rods. Wings and the bunt are always multifilament (usually had small mesh size) hanged vertically in the water. In Qarun Lake such nets can be categorized into three types:

a) Beach Seine (1), *Gorafat Zardina*. It is a seine net operating from the shore line, the net bunt in the center and drag lines are towed simultaneously from the beach. It is mainly targeting Anchovy fish and usually using in the south beach of the lake.

b) Beach Seine (2), *Gorafat Bory*. The bag is located in the net side and the net has no hauling rope, fixed directly by a woody rod in the beach from the bag net side. The net mesh size mostly 29.4mm, it is targeting *Mugil cephalus* and by-catch *Sparus auratus* and *T. zillii*.

c) Boat Seine, *Hattata*. Its design is typically that of *Grafat Zardina*, except the net is dragged completely on in the water by an anchored boat, it is caching small soles and tilapia (<15 cm), and shrimps (Fig. 3).

3- Others Fishing Methods; these methods include:

a) Fish Aggregating System (FAS), *Heml*. This method is depending on an artificial substrate (bands of tree branches) set by a weight in muddy shallow water for three months. Then the aggregated fishes caught by small seine-like net every three days. It is mainly using to catch tilapia and eels.

b) Traps (*Goaby*). Cylinder basket of mono or multifilament or wire with one meter height, 0.5m diameters and 21mm mesh size. They are set in shallow water and occasionally use in early spring to catch tilapia species.

c) Hooks (*Sennar*). Fishers setting on a boat or a floating plate in deep water depth (3 - 7m) using 3 or 5 J-shape hooks joint to monofilament line. Hooks are using mainly in summer targeting tilapia species, using shrimp as bites catching about 0.5kg fish per day for fisherman.

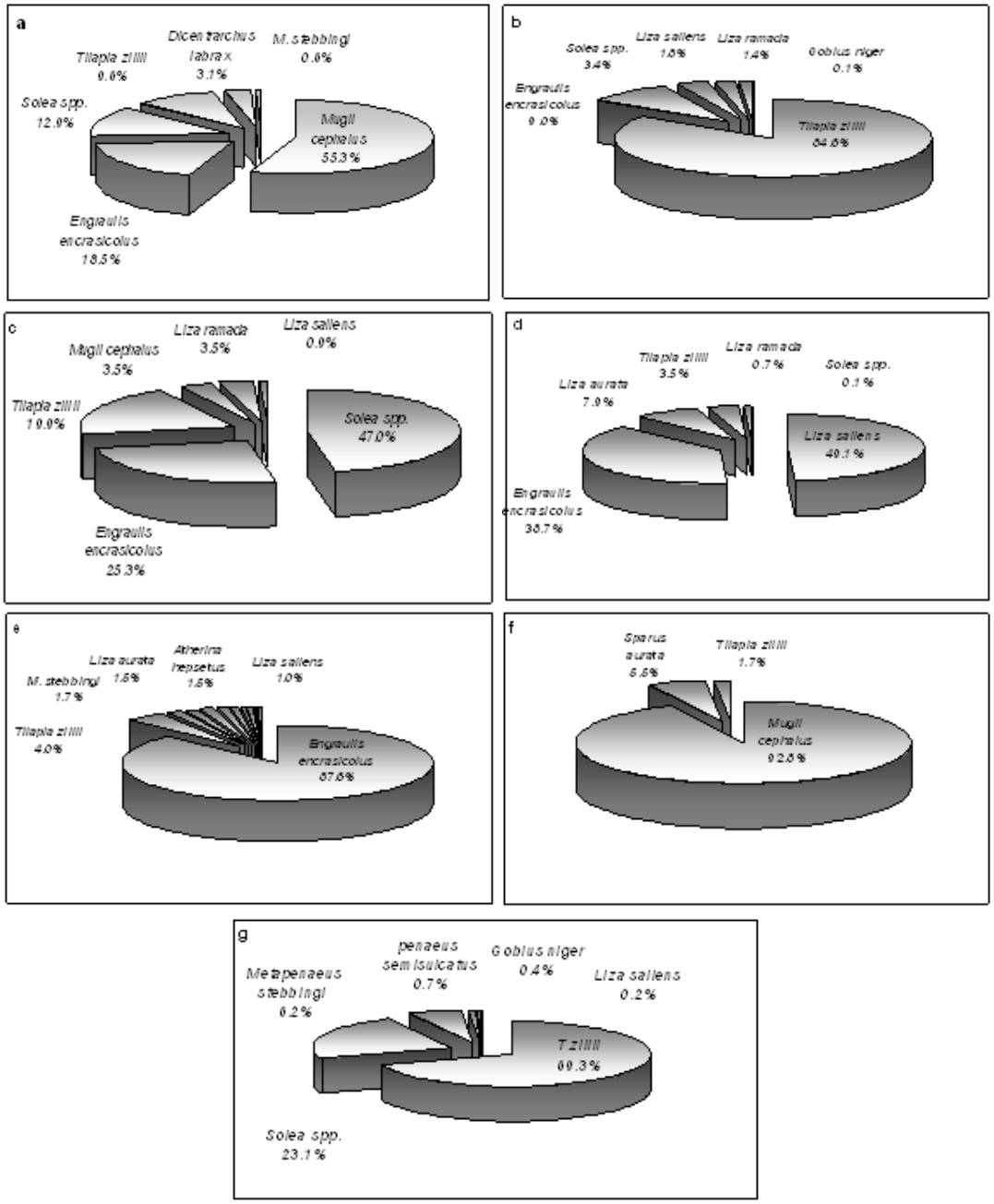

Fig. 3: Species composition of trammel net in Qarun Lake during the period of study; a) *Ghazl Bory*, b) *Ghazl Bolti*, c) *Ghazl Mossa*, *d) Ghazl Fahhar* e) *Gorafet Zardina*, f) *Gorafet Bory* and g) *Hattata.*

Species composition according to lake area: in the present study, Qarun Lake was divided into three sub-areas. The species composition for the mostly used gear was recorded for each sub-area {East (E), Middle (M) and West (W)} during summer and winter as following:

a) In East sub-area: *Mugil cephalus* contributed about 81.1% and 38.1% of the catch of *Ghazl Bory*, while *Tilapia zillii* contributed about 100% and 84.4% of *Ghazl Bolti* catch during summer and winter respectively. *Ghazl Mossa* caught *Solea* spp. (25.9%) and *T. Zillii* (74.1) in summer and *Solea* spp. (21.5%) and *E. encrasicolus*

(76.1%) during winter. *Gorafat Zardina* caught *E. encrasicolus* (65.6% & 99.0%) and *Atherina hepsetus* (19.7 & 0.5%) during winter and summer respectively. The others species caught by these gears contain *M. Stebbingi, P. semisulcatus, Gobius niger* and *Liza saliens. Ghazl Fahaar, Grafat Bory* and *Hattata* are rarely used in this sub-area. Although, East is the most productive of phytoplankton and zooplankton (Konsowa, 2007 and Fathi& flower, 2005), it is poor in fish variety and production due to the waste water of El-Buts drain that loaded with great amount of clay, very fine particles of sand and sewage (Hussein *et al.,* 2008).

b) In Middle sub-area: *M. cephalus* (10.7 %), *T. zillii* (22.7%) and *Solea spp.* (66.7 %) caught by *Ghazl Bory* in summer and *M. cephalus* (32.3%), *T. zillii* (1.9%) and *E. encrasicolus* (55.7 %) in winter. During summer, *Ghazl Bolti* caught *T. zillii (89.9 %), L. saliens* (9.0 %) and *T. zillii* (61.2 %), while during winter; it caught *E. encrasicolus* (25.5 %) *Solea spp*. (6.5 %), and *L. ramada* (6.8 %). *Ghazl Mossa* caught *Solea spp*. during summer, while it caught *Solea spp*. (45.5 %), *E. encrasicolus* (22.7 %), *L. ramada* (18.2 %), *T. zillii* (9.1 %) and *L. saliens* (4.5 %) during winter. *Ghazl Fahhar* caught during summer *L. aurata* (80.0 %) and *L. saliens* (20.0 %) while *E. encrasicolus* (42.6 %), *L. saliens* (30.2 %) and *L. ramada* (24.8 %) caught during winter. *Gorafat Zardina* caught *E. encrasicolus*, *T. Zillii* and *Sorthedon galileous* during summer, while it caught *E. encrasicolus*, *T. zillii,* and *L. saliens* during winter. *Grafat Bory* in this area was used only during summer. Other species like *Gobius niger*, *M. stebbingi*, *A. hepsetus*, and *P. semisulcatus* was recorded.

c) In West sub-area: *M. cephalus* (68.1 %), *M. stebbingi* (10.8 %) were caught by *Ghazl Bory* during summer and only *M. cephalus* during winter. *Ghazl Bolti* caught *T. zillii* (84.4 %) and *Solea spp*. (9.4 %) during summer and it rarely used during winter. *Ghazl Mossa* caught only *Solea spp*. during summer, while *Solea spp*. (77.8 %) and *T. zillii* (22.2 %) during winter. *Gorafat Zardina* caught *E. encrasicolus*, *M. stebbingi*, and *P. semisulcatus* during summer, and *E. encrasicolus*, *L. aurata* during winter. *Grafat Bory* is widely used and it caught *M. cephalus*, *Sparus auratus* and *T. zillii.* Also *Hatatta* widely used in this area. Others species like crabs, sea-horse were recorded in this sub-area (Table 2).

Length frequency of target species: Fig. (4) shows the length frequency percentages of dominant fish species in the lake catch. The peaks of the distribution of these species were 12, 15, 35, 18 and 8cm for *T. zillii, Solea spp., M. cephalus, L. saliens* and *E. encrasicolus* respectively. High frequency percentages of important fishes were under size (relatively small fishes). This possibly due to the use of seine net with small mesh sizes. The stocks of many species were undergoing an overexploitation in Qarun Lake (Anonymous, 2007). The relationship between fishing pressure and the shift in growth rates condition, ages, sizes of reproduction and maturity is widely known (Holman *et al.*, 2009). Using of gears like beach seines and boat seine that catch many small fishes, reduce the catch of other gear types that select larger and more species-specific targets (McClanahan, 2005).

Catch per unit effort (CPUE): According to fishing gears CPUE shows a higher values in winter for gears operated far from coasts *Ghazl Bory* (2100 g/100m/day), *Ghazl Bolti* (5000 g/100m/day) and *Ghazl Mossa* (1448 g/100m/day), while higher values of CPUE were recorded during summer in gears that operated close to the coast like *Grafat Zardina* (470 kg/haul), *Grafat Bory* (16.42 kg/haul) and *Ghazl Fahhar* (3333 g/100m/day) (Table 3). These results may be attributed to the active movement of anchovy, in the water surface layer during its spawning season in low temperature (around 14 Cº) (Lluch- Belda *et al.* (1991), Bellier *et al.* (2007) and Zarrad *et al.*

(2012). For *Goaby*, each trap caught about 0.350 kg, while for hooks CPUE was calculated as 5.0 kg/fisherman/day.

Table 2: Species composition of deferent fishing gears used in Qarun Lake according to area and season during the period study (2010-2011).

Gear	Species	East		Middle		West	
		summer	winter	summer	winter	summer	winter
Trammel net (1) *GhazlBory*	***Mugil cephalus***	81.1%	38.1%	10.7%	32.3%	68.1%	100.0%
	Tilapia zillii	10.8%	47.6%	22.7%	1.9%	---	---
	Solea spp.	8.1%	---	66.7%	---	29.8%	---
	Engraulis encrasicolus	---	14.3%	---	55.7%	---	---
	Metapenaeusstebbingi	---	---	---	---	2.1%	---
	Dicentrarchus labrax	---	---	---	10.2%	---	---
Trammel net (2) *GhazlBolti*	***Tilapia zillii***	100.0%	84.4%	89.9%	61.2%	81.1%	---
	Solea spp.	---	9.4%	1.1%	6.5%	1.0%	---
	Engraulis encrasicolus	---	5.7%	---	25.5%	16.9%	---
	Liza ramada	---	---	---	6.8%	1.0%	---
	Liza saliens	---	---	9.0%	---	---	---
	Gobius niger	---	0.5%	---	---	---	---
Trammel net (3) *GhazlMossa*	***Solea spp.***	25.9%	21.5%	100.0%	45.5%	100.0%	77.8%
	Engraulis encrasicolus	---	76.0%	---	22.7%	---	---
	Tilapia zillii	74.1%	2.4%	---	9.1%	---	---
	Mugil cephalus	---	---	---	---	---	22.2%
	Liza ramada	---	---	---	18.2%	---	---
	Liza saliens	---	---	---	4.5%	---	---
Trammel net (4) *GhazlFahhar*	***Engraulis encrasicolus***	---	---	---	42.6%	---	---
	Liza saliens	---	---	20.0%	30.2%	---	---
	Liza ramada	---	---	---	24.8%	---	---
	Tilapia zillii	---	---	---	2.2%	---	---
	Soleaspp	---	---	---	0.1%	---	---
	Liza aurata	---	---	80.0%	0.2%	---	---
Beach seine (*GorafatBo*	***Tilapia zillii***	---	---	---	---	1.5%	6.7%
	Mugil cephalus	---	---	---	100.0%	90.9%	93.3%
	Sparus aurata	---	---	---	---	7.6%	---
Beach seine (2) *GorafatZardina*	***Engraulis encrasicolus***	65.6%	99.0%	45.2%	94.0%	52.2%	71.8%
	Tilapia zillii	5.8%	---	29.8%	2.6%	3.2%	---
	Liza saliens	---	0.5%	---	1.4%	---	---
	Atherina hepsetus	19.7%	0.5%	1.9%	0.9%	---	---
	Mugil cephalus	---	---	---	0.7%	---	---
	T. Puta	---	---	---	0.3%	---	---
	Gobius niger	1.1%	---	3.4%	---	0.4%	---
	crab	---	---	---	---	0.8%	---
	Sarotherodon galilaeus	---	---	10.7%	---	---	---
	Solea spp.	---	---	6.0%	---	10.1%	---
	Metapenaeusstebbingi	7.2%	---	2.7%	---	29.3%	---
	Penaeussemisulcatus	0.6%	---	0.2%	---	4.0%	---
	Liza aurata	---	---	---	---	---	27.5%
	Sea horse	---	---	---	---	---	0.1%

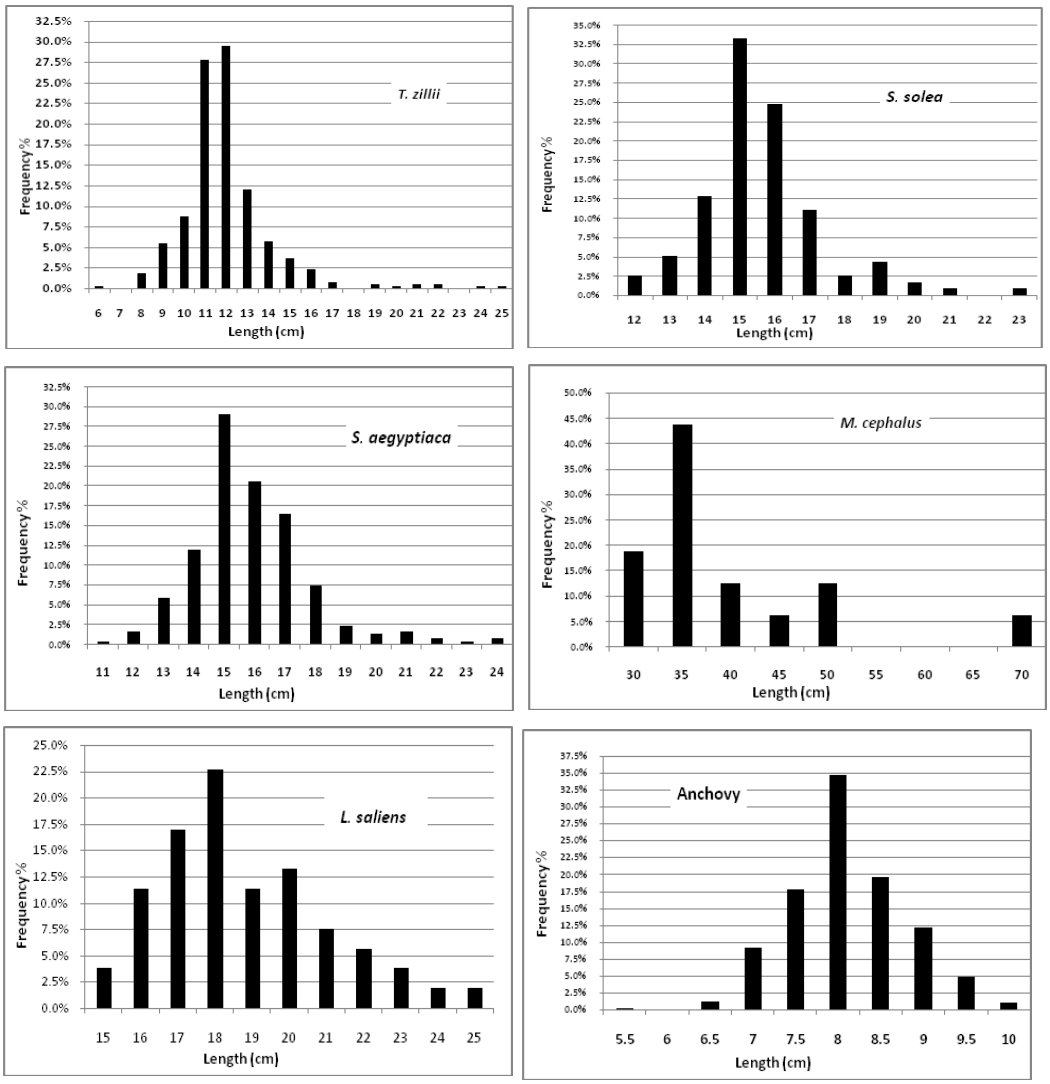

Fig. 4: size composition of target species occurring in fish landing ofQarun Lake during the period of study (2010-2011).

Table 3: Catch per unit effort (CPUE) for deferent fishing gears and methods used in Qarun Lake during the period study (2010-2011).

Sub-area	CPUE (g/100m net/day)					
	East		Middle		West	
Season / Fishing gea	summer	winter	summe	winter	summe	winter
Trammel net (1) *GhazlBory*	714.3	2100.0	966.3	752.9	1413.5	1756.9
Trammel net (2) *GhazlBolti*	990.9	5000.0	1151.3	1675.0	415.0	2411.5
Trammel net (3) *GhazlMossa*	187.5	450.0	266.7	667.0	1350.0	1448.0
Trammel net (4) *GhazlFahhar*	-	-	3333.3	3010.2	-	-
	CPUE (kg/haul)					
Beach seine (1) *GorafatZardino*	200.0	350.0	143.0	300.0	470.0	450.0
Beach seine (2) *GorafatBory*	-	-	-	8.500	16.417	3.750

According to GAFRD fish statistics (2002-2011), CPUE has an average of 29.286 kg/boat/day and this value is higher than that recorded as 15-20kg by Shalloof

(2009) in the lake. Although Qarun Lake considered as a highly eutrophic (Mageed, 2009), its catch per unit area showed that, the lake fish landing per acre (53.36 kg/acre/year) is poor comparing with some other Egyptian lakes, e.g. like Borullus (480.35 kg/acre/year), Edku (455.24 kg/acre/year) and Maruit (3465.06 kg/acre/year) lakes for the last ten years (2002 to 2011). Fig. (5) shows the catch per unit area (CPUA) for most of Egyptian lakes as well as their landings recorded by GAFRD (2002-2011) and lakes area according EEAA (2005). The environmental parameters, physic-chemical and blooming phenomenon may have an impact in fish production potential (Abou El-Gheit *et al.,* 2012).

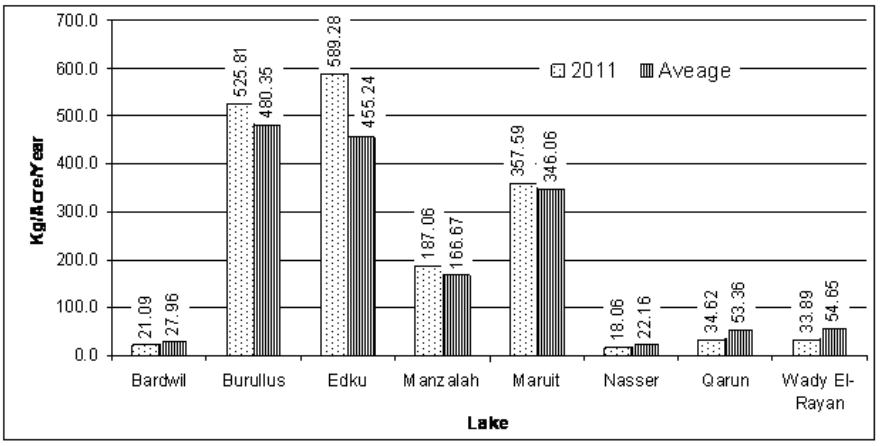

Fig. 5: Catch per unit area (CPUA) for some Egyptian lakes, during 2011 and average during the last ten years (2002-2011).

CONCLUSION

Poor fish production in Qarun Lake is a direct result of implementation of irrational and unevaluated policies to the lake. To maintain and develop the lake fisheries, the following steps should be considered: a) Improve the water quality of the lake particularly treatment of discharged water of El-Bats drain .b) Encourage fish transformation specially, *Mugil cephalus, Sparus auratus* (Sea-bream) and *Dicentrarchus labrax* (Sea-bass). c) Prohibit seine nets, especially *Hattata and Heml* while *Goaby* should be banned during summer (tilapias spawning season). d) Allow using *Ghazl Zardina* with only 150m drag rope and 150m net length in the western part during summer. e) Improve the catch statistical methods by GFARD.

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ARABIC SUMMRY

مصايد بحيرة قارون؛ طرق ومعدات الصيد، التركيب النوعي والمصيد لكل وحدة جهد

صبري الصيرفي[١]، علاء الدين الحويط[٢]، عزة الجانيني[٣] وعلاء الفار[٣]

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تعد بحيرة قارون (منطقة الدراسة) حوض مغلق من المياه المالحة، تقع على بعد حوالي ٩٠ كم جنوب القاهرة وتغطي مساحة ٢٣٠كم^{٢}. يبلغ متوسط الإنتاج السمكي في البحيرة حوالي ٣٠٠٠ طن سنوياً. وتهدف هذه الدراسة إلى تقييم مصايد هذه البحيرة وتقديم مقترحات لإدارة أفضل لتلك المصايد. وقد تم تجميع البيانات، المعلومات والعينات من خلال ٤٢ رحلة ميدانية و٣١١ مقابلة للصيادين في البحيرة خلال موسم الصيد (٢٠١٠-٢٠١١) . تم تقسيم البحيرة إلى ثلاث مناطق فرعية وهي: الشرق والوسط والغرب. وقد وجد أن طرق الصيد المستخدمة هي؛ ١ – شباك المحير (الكنار) ويجود منها أربعة أنواع تختلف في المواصفات تبعاً لأنواع الاسماك المستهدفة. وتستهدف هذه الشباك أسماك البوري والبلطي الاخضر وموسى والفحار. ٢ –شباك الجرافة (غزل أحمر) ومنها ثلاثة أنواع تستهدف أسماك البوري والأنشوجة والجمبري. ٣ – طرق اخرى للصيد (نظام الصيد بالتجميع ،الفخاخ والسنار). وقد تم تحديد التركيب النوعي (المستهدف والمصيد الجانبي) لكل الطرق وأساليب الصيد المستخدمة وأيضاً المصيد لكل وحدة جهد تبعاً للمنطقة الفرعية والموسم. وقد تبين أن المنطقة الوسطى كانت أعلى إنتاجية وأكثر تنوعاً. وتوصي الدراسة بحظّر استخدام الفخاخ في الربيع وجميع أنواع الجرافات باستثناء جرافة الزردينة خلال فصل الصيف في الغرب وتحسين طرق الإحصاء السمكي للتنمية المستدامة لهذا المورد الثمين.