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Biological observations on the introduced prawns in Lake Quarun (Egypt)

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Lake Quarun (a closed inland lake) is considered as the best site for grownig and reproducing shrimps, after five years of transplantation with post larvae (PL 30).

Penaeus kerathurus *FORSKAL*, Metapenaeus monoceros *FABRICIUS and* Metapenaeus stabbingi *NOBILI are considered the most adapted species.*

The shrimp production of Lade Quarun in 1987 was about 44% of the total fish production. The rich benthic fauna and abundance of plankton as well as the suitable topography and environmental conditions play important roles in the reproduction behaviour of these species. Growth in weight and length of samples from lake Quarun for M. stebbingi *was higher than those collected from their natural habitats (in the Mediterranean Sea). This was not noticed in the other two species. The continous decrease in abundance of* M. monoceros *and* P. kerathurus *in lake catch is expected to be due to many reasons, as the lack of migration behaviour, temperature effect on early stages mortality, and the intraspecific and interspecific competition for food and space. More studies are needed to increase the efficiency of producing shrimps from lake Quarun.*

INTRODUCTION

Lake Quarun is a saline land locked lake, located in the lowest part of the Fayoum depression in the western desert. It extends for about 40 km from east to west and has its maximum breadth 9.25 km in the western part west of El-Karn Island (Fig.1). Physical studies done in lake Quarun reveal that the mean depth of the lake is about 4.2 m.

The western area is relatively deeper then the eastern part, the maximum depth is 8.5 m. More then 76% of the lake area has a depth range between 5.0 and 8.0 meters (ISHAK and ABDEL MALEK, 1980). The bottom of the lake is sandy, silty sand, sand silt, clayish silts and silty clay as reported by EL WAKEEL, 1963).

Water salinty in this lake have increased progressively since its formation. Recently salinity in the lake varies between 26-29% in winter and 33-34% in summer. For this reason, transplantation of marine fishes was organized by authorities as a means of increasing the production of fishes in the lake. Fishes of family Mugilidae were successfully introduced into this lake since 1923 (EL ZARKA, 1963).

Stocking of the lake with prawns was started in winter of 1977. The first batch was about three milion of post larvae which were mainly of penaeid species *Penaeus japonicus* BATE, 1888; *Penaeus kerathurus* FORSKAL, 1775); *Metapenaeus monoceros* FABRICIUS, 1798) and *Metapenaeus stebbingi* NOBILI, 1904.

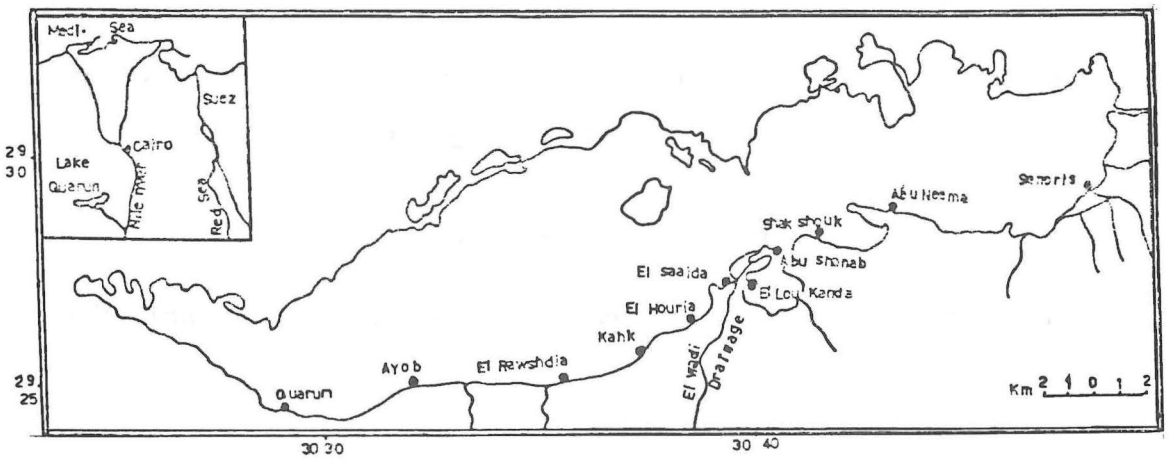

Figure 1. The fishing centers on the South coast of lake Quarun

The post larvae (mainly of PL 30) were collected from the Mediterranean coast near the Damietta branch. Another batch of shrimps post larvae were collected from Gulf which consisted mainly of *M. stebbingi.*

The annual stocking program with prawns into lake Quarun was stopped thereafter. However, prawns succeeded to integrate into their habitat.

The bionomics of *P. kerathurus,* the predominant prawn species transplanted into lake Quarun after one year of stocking was studied by ISHAK *et al.,* 1980.

The present investigation deals with the biological observations on the introduced prawns in lake Quarun after five years of transplantation and the prospects for the production of the transplanted prawns in the lake.

MATERIALS AND METHODS

Monthly prawn samples were taken from the commercial catch at various landing centers on the lake during different periods 1978-1979 (one year after transplantation) and 1983-1984 (five years after transplantation). A comparison was done with marine samples of the same species which were collected from different fishing centers during the period (1970-1976) along the Mediterranean coast. Samples of the same species were also collected from lake Borollos (a northern Delta Lake) at about 2 km for the lake sea connection during the period 1987-1988.

Individuals belonging to each species in the different habitats were sexually differentiated. Total length measurement were recorded to the nearest milimeter from the tip of the rostrum to the extremity of the telson and tail fin with the abdomen fully extended. The total weight was recorede as the weight of body to the nearest 0.1 g.

In order to determine the maturity of prawns, the nature, color, size and texture of ovaries were recorded. Length-weight relationship was calculated using the equation $W=aL^b$, where "W" is the weight in grams, "L" is total langth in cm, and "a", "b" are constants.

SHRIMPS PRODUCTION IN LAKE QUARUN

The trend of the annual shrimp production (Table 1) can be considered more or less descriptive of the condition of the prawn fishery in the lake.

Table 1. Prawn production of lake Quarun in tons*

Year	Prawn production	Total lake production	% of prawn to the total
1984	18	747	2.4%
1985	227	803	28.3%
1986	232	1351	17.2%
1987	499	1145	44%
1989	315	883	36%
* report of the Accademy of Science (1990)			

EL KERYONY *et al.*, (1991) reported that, the present shrimp populations in lake Quarun are characterized by the general trend "increasing to the infinity" and about 30% of the changes in shrimp production are to be expected due to the ecological factors prevailing in the lake. Table 2. describes the species composition of prawns in lake Quarun during the period of acclimatization (1978-1989).

Table 2. Species compositon of prawns in lake Quarun during the period of acclimatization (1978-1989)

Year	Percentage abundadnce of different species			With respect to shrimp total catch
	M. stebbingi	*M. monoceros*	*P. kerathurus*	
1978–1979	1.8%	2.6%	95.6%	ISHAK *et al.*, (1980) present observation unpublished data.
1983–1984	30%	22%	48%	
1984–1989	100%	–	–	

RESULTS

1) *Length-weight relationships in the lake Quarun as compared with other habitats*

The three studies species *P. kerathurus, M. monoceros and M. stebbingi* are present in the catch of the Mediterranean, Red Sea, Delta lakes (Borollos and Manzalh) as well as in lake Quarun. Figure 1a,b,c describes the size distribution and size range of the three studied species in Mediterranean and Quarun lake. The graphs show that the modes of population sizes in *M. stebbingi* and *M. monoceros* are nearly similar in both habitats (8.0-11.0 cm, 9.0-11.0 cm) and (12.0-15.0 cm, 12.0-14.0 cm) respectively. In case of *P. kerathurus,* the mode of the population size in the Mediterranean is higher in lake Quarun (15.0-17.0), (11.0-14.0 cm) respectively.

Fig. 2. shows the length frequency distribution of these species in lake Borollos, one of northern Delta lakes.

The size mode 5.5-6.5 cm comprised *M. stebbingi,* while *M. monoceros* has a mode of 6.5-7.5 cm and *P. kerathurus* 5.5-6.5 cm.

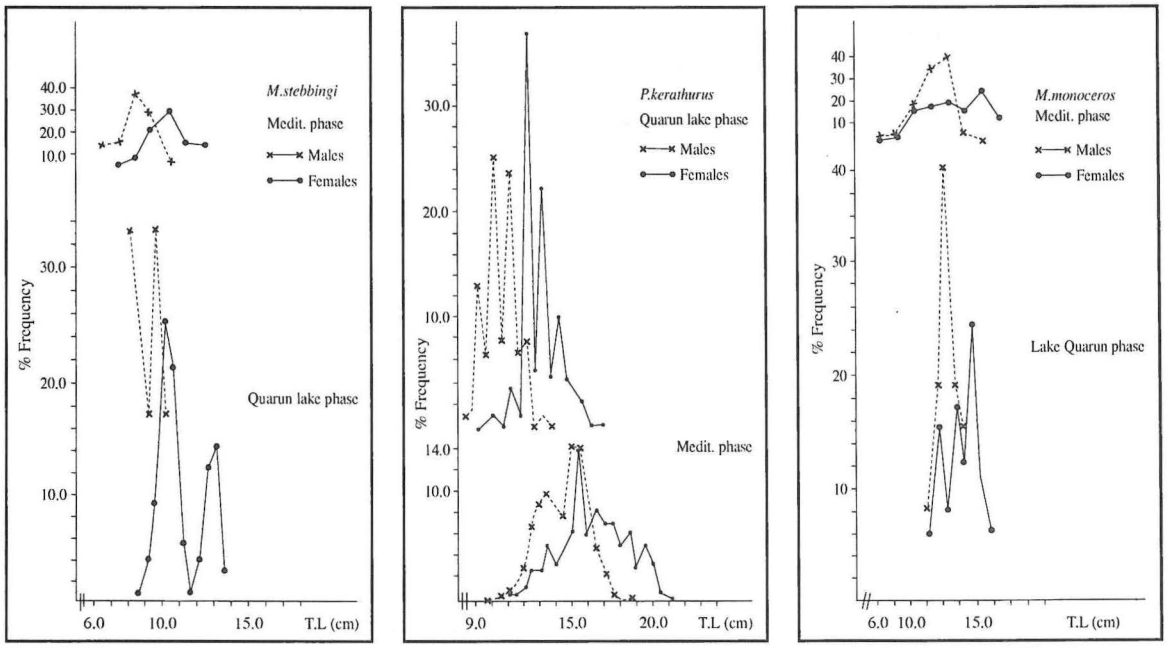

Fig. 1a,b,c The percentage sizes frequency distribution of *M. stebbingi, P. kerathurus* and *M. monoceros* respectively inhabiting lake Quarun and the Mediterranean Sea.

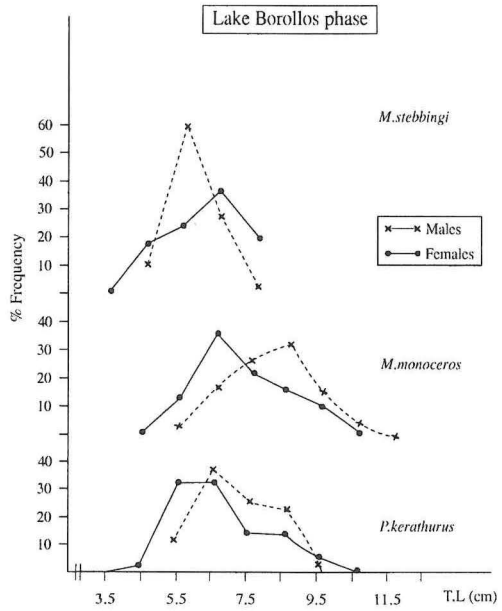

Fig. 2. Differential in growth rate of three studied species in lake Borollos.

Because of the migratory behavior of these species between sea and northern Delta lakes, the bigger specimens of these species move to the sea to begin their maturation process and spawning.

Thus, the shrimp populations present in lake catch are always of small sizes (ABDEL RAZEK, 1988).

The graph of the length-weight of the two populations (lake Quarun and Mediterranean sea) for the three studied species (Fig. 3a, b) are such that weight of shrimp of the same length can be easily compared. *M. monoceros* and *P. kerathurus* of the sea population were consistently heavier at all lengths.

The lake Quarun shrimp *M. stebbingi* is heavier at all sizes than in the sea population (Fig. 3a). This indicates that lake Quarun provided a highly favourable habitat for *M. stebbingi* then the other two species. Table 3 provides the comparison between the constant of the three studied species in lake Quarun and Mediterranean sea.

2) *Differential growth of sexes:*

The study of length frequency patterns of the two sexes are set for each species at different habitat as in Fig.1a, b, c and Fig. 2. The first figure shows that there is a differential growth in the sexes for sea populations with the females having a higher growth rate than males. The larges male and female measured were 19.2 cm and 22.7 cm for *P. kerathurus,* 14.5 cm and 15.5 cm for *M. monoceros* and 10.5 cm, 12.5 cm for *M. stebbingi* respectively.

In case of lake Quarun, the largest male and female measured were 14.5, 17.5 cm for *P. kerathurus,* 13.2, 14.7 cm for *M. monoceros* and 10.2, 13.7 cm for *M. stebbingi* respectively.

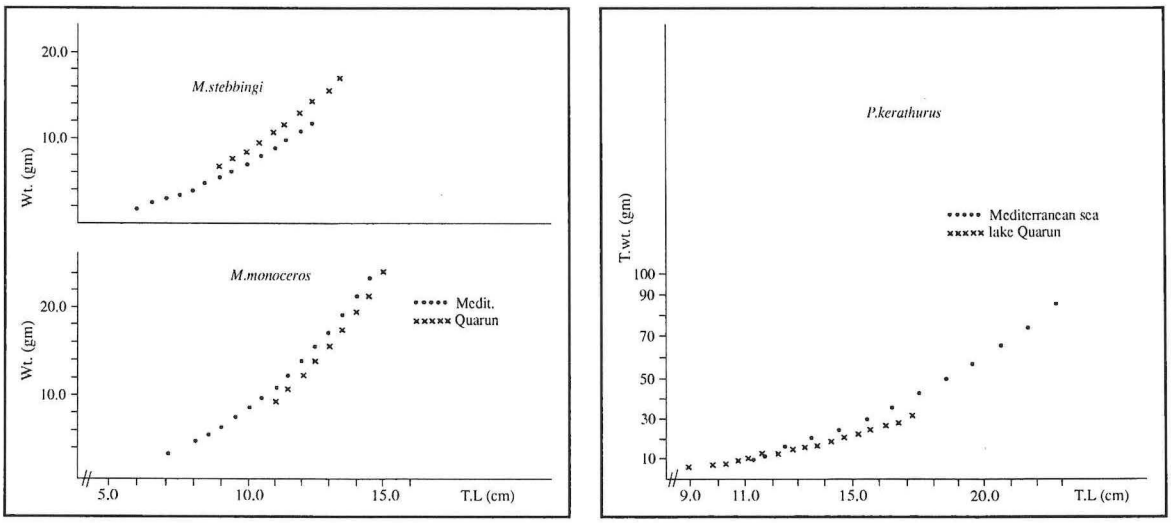

Fig. 3a, b. The relationship between total length (cm) and total weight (g) of *M. stebbingi, M. monoceros* and *P. kerathurus.*

Table 3. The constant of *a* and *b* with the correlation coefficient and the standard error for each species in both habitats (Lake Quarun and Mediterranean Sea)

Species	Area	Log a Intercept	Slope b	Correlation coefficient r	Standard error	Student's test at P<0.001
M. stebbingi	Medit.	–1.730837	2.54192	0.980612	0.146636	7.065236
	Quarun	–1.480249	2.38239	0.97948	0.1733027	Highly significant
M. monoceros	Medit.	–2.020477	2.90067	0.990004	0.1104387	6.042333
	Quarun	–2.292702	3.10599	0.992426	0.154725	Highly significant
P. kerathurus	Medit.	–1.922126	2.84715	0.985501	0.147792	8.16404
	Quarun	–1.98763	2.80171	0.984531	0.128737	Highly significant

In the early stages of these species such as the populations living in Delta lakes as in Fig. 2, such differenteal growth is not apparent, since the size frequency distribution of both sexes were nearly the same for the same species (ABDEL RAZEK, 1988).

3) *Maturation and spawning:*

Table 4. shows that higher percentage occurrence of spawners of *P. kerathurus* and *M. monoceros* were found at a size beginning from 11.0 cm total length, while in *M. stebbingi* most of the spawners were found with sizes beginning from 9.0 cm.

It is worth mentioning that the minimum biological size of these species recorded in the Mediterranean Sea were 11.5 cm, 10.5 cm and 9.3 cm respectively (ABDEL RAZEK, 1985).

This means that maturation process of the three studied species take place normally in lake Quarun as well as in their natural habitat. Spent stage individuals were observed for *P. kerathurus* and *M. stebbingi* but not recorded for *M. monoceros* in the lake catch.

CONCLUSION

Lake Quarun is considered the area for cultivation and producing shrimps now, especially

Table 4. Distribution of spawning and non spawning individuals of different studied species according to their sizes

Size classes (cm)	*P. kerathurus*			*M. monoceros*			*M. stebbingi*		
	Non Spawn.	Spaw.	Spent	Non Spawn.	Spaw.	Spent	Non Spawn.	Spaw.	Spent
9.0-9.5	–	–	–	–	–	–	23%	67%	–
9.5-10.0	100%	–	–	–	–	–	20%	70%	10%
10.0-10.5	100%	–	–	–	–	–	38%	54%	8%
10.5-11.0	100%	–	–	–	–	–	27%	55%	18%
11.0-11.5	–	100%	–	67%	33%	–	40%	60%	–
11.5-12.0	77%	23%	–	100%	–	–	–	–	–
12.0-12.5	27%	67%	6%	100%	–	–	100%	–	–
12.5-13.0	64%	27%	9%	91%	9%	–	36%	64%	–
13.0-13.5	50%	50%	–	89%	11%	–	54%	46%	–
13.5-14.0	100%	–	–	76%	24%	–	23%	67%	–
14.0-14.5	50%	25%	25%	75%	25%	–	–	–	–
15.0-15.5	60%	20%	20%	67%	33%	–	–	–	–
15.5-16.0	50%	–	50%	–	–	–	–	–	–
16.0-16.5	75%	25%	–	–	–	–	–	–	–
16.5-17.0	–	50%	50%	–	–	–	–	–	–
17.0-17.5	–	100%							–

with the three important penaeid species, *(Penaeus kerathurus, Metapenaeus monoceros* and *Metapenaeus stebbingi)* (ISHAK *et al.*, 1980).

The results of the comparative analysis between lenght and weight of the three introduced penaeid species with those collected from the Mediterranean fishing centers, indicates that these animals adapted themselves to their new habitat and succeded to reproduce in it. Lake Quarun seems to give a highly favorable habitat for them.

Lake Quarun is a saline water lake and this affects its fauna and flora as well as its total productivity. The increase of salinity is a result of the increase of soloble solid materials, found in the drainage water coupled with evaporation (GORGY, 1959; ISHAK and ABDEL MALEK, 1980). The most important diatoms which are abundant in the lake are *Nitzshia* spp., *Chaetoceros* spp., *Navicula* spp., and *Amphora* spp., other diatom species are also abundant.

Blue-green, brown and green algae are also flourishing. The benthic and planktonic fauna of the lake comprise the larvae of bivalve and gastropod mollusks, nereids, rotifers, cirripeds and copepods as well as *Daphnia* (KHALIL, 1978).

These types of fauna and flora are considered as the best food for shrimp larvae (DALL, 1968). It is worth mentioning that minimal temperature in winter is 17-18°C and maximal 30-33°C in summer.

The analysis of the yearly shrimp production of lake Quarun as well as the continuous observation of its gonadal maturation, proves that *M. stebbingi* is constituting the main shrimp species of the lake catch.

On the other hand, the presence of late maturing and spent stage of the gonads as well as the abundance of different larval stages of *M. stebbingi* in the plankton collections (unpublished data, 1991). All these data indicate that this species reproduce in the lake successfully and that the environmental conditions of the lake are favorable for reproduction and growth all the year.

The presence of *M. monoceros* in less amount than *M stebbingi* and complete disappearance from lake catch, is expected to be due to the interspecific competition between them on food and space. So, further observation and analysis are needed.

On the other hand, the presence of different maturity stages of *P. kerathurus* in the collected lake samples gives some indications that this specise spewns in the lake. But the low abundance of the adult stages of this species in lake catch in the 1984-1985 and the disappearance thereupon is expected to be due to many reasons such as the lack of migration affecting its normal balance.

In addition, the temperature factor plays a role in early mortality of larvae as well as the interspecific competition for food. Much observation on *P. kerathurus* are needed to explain its scarcity in the catch.

Finally, production of *M. stebbingi* can be increased in lake Quarun through a continuous control on the fishing of the spawners and the optimum mash size used in the trewling operations. While the other two species *P. kerathurus* and *M. monoceros* can be increased through a program of releasing the postlarvae into the lake.

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Biološka opažanja rakova uvedenih u jezero Quarun (Egipat)

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KRATKI SADRŽAJ

Jezero Quarun (zatvoreno kopneno jezero) smatraju najboljim za uzgoj i razmnožavanje kozica pet godina nakon nasađivanja postlarvama (PL 30).

Penaeus kerathurus FORSKAL, *Metapenaeus monoceros* FABRICIUS and *Metapenaeus stebbingi* NOBILI smatraju se najprikladnijima.

Proizvodnja kozica u jezeru Quarun iznosila je 1987. oko 44% ukupne proizvodnje ribe. Bogata bentoska fauna i obilje planktona uz odgovarajuću topografiju i povoljne uvjete okoliša igraju važnu ulogu kod razmnožavanju ove vrste. Rast u dužinu i dobitak na težini uzoraka *M. stebbingi* iz jezera Quarun bio je bolji nego kod primjeraka iz njihovog prirodnog staništa (u Sredozemnom moru). Ovo nismo utvrdili za druge dvije vrste. Razlozi neprestanog pada količine *M. monoceros* i *P. kerathurus* u lovinama iz jezera mogu biti raznovrsni, od izostanka migracije, utjecaja temperature na smrtnost ranih stadije kao i interspecifična i intraspecifična kompeticija za hranu i prostor. Potrebno je daljnje izučavanje učinkovitosti proizvodnje kozica u jezeru Quarun.