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SOME BIOLOGICAL STUDIES OF *PARAPENAEUS LONGIROSTRIS* (LUCAS, 1846) (CRUSTACEA, DECAPODA) IN THE MEDITERRANEAN COAST OF EGYPT

ABDEL RAZEK F.A.[*]; EL-SHERIEF, S.S.[**]; TAHA S.M[*] AND MUHAMAD, E.G.[*]

[*]*National Institute of Oceanography and Fisheries, Alexandria, Egypt*
*** Faculty of Science, zoology Dep. Alex. University*
**E-mail: fatma_abdelrazek@gawab.com*

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ABSTRACT

Parapenaeus longirostries (Lucas, 1846) is known by the deep marine water rose shrimp and it constitutes with the shrimps *Trachypenaeus curvirostries* and *Metapenaeus stebbingi* about 40-50% of total shrimp catch in Egypt. Bimonthly samples of *P. longirostris* were collected from Abu-Kir Bay area near Alexandria city during the year (2005), sex ratio showed monthly variations with the dominance of females in the catch. The sizes of the females varied from 4.0 cm to 14.5 cm with high abundance of size group 9.0-9.5 cm and for males from 5.0 to 11.0 cm with dominance of length groups from 7.0 to 8.5 cm. computations of total length-carapace length and total length total weight and tail weight relationships were done. The recovery rate for males is higher than females 64.8% and 58.5% respectively. Size at first sexual maturity was found to be 5.6 cm total length while the smallest observed ripe female was 7.0 cm., total length. Spawning takes place throughout the year, with higher occurrence during November. Immature individuals were found from January to September. Spawning is expected to be in deeper waters.

1. INTRODUCTION

There are 7 penaeid shrimp species in the eastern Egyptian coastal waters. These are *Penaeus japonicus, Penaeus semisulcatus, Penaeus kerathurus; Metapenaeus monoceros; Metapenaeus stebbingi; Parapenaeus longirostris* and *Trachypenaeus curvirostris.* The total shrimp catch during the period from 1995 to 2004 constitutes about 8% of the total yield from the Mediterranean fisheries sector of Egypt (GAFRD, 2004).

After the regulation of the Nile flow following the erection of the Aswan high Dam, small sized shrimp species dominated the landed catch. The three species; *M. stebbingi, Trachypenaeus curvirostris* and *Parapenaeus longirostris*, contribute the main bulk of shrimp yield (about 40-50% of total shrimp catch from the Mediterranean, (Wagdi and Abdel Razek, 1985).

Parapenaeus longirostris (Lucas, 1846) commonly called deep water rose shrimp according to FAO, usually inhabits the mud and muddy sand bottom and is found between 50 and 400 meters depth in the continental shelf and upper slope, related to sandy bottoms as reported by Maria and Pedro (2001) in Angola.

P. longirostris has a very wide geographical distribution as in East Atlantic: from Portugal to Angola, also in the entire Mediterranean. West Atlantic: from Massachusetts, U.S.A. to French Guiana Perez Farfante, (1982). It is considered the most important commercial species of the Mediterranean coasts of Spain, France and Italy. Also in Algeria, Tunisia, Greece and

Turkey the species is of a commercial value, although on a lesser scale.

In the southern part of the Gulf of Guinea the fishery for the species at depths between 200 and 325 m is very productive, (Holthius, 1980). The total catch reported for this species to FAO for 1999 was 19056mt. The countries with the largest catch were Italy (4631 mt.) and Spain (4237 mt.).

Bayhan *et al.* (2005) reported some biological aspects of *P. longirostris* inhabiting the sea of Marmora, Turkey. In Algeria Nouar & Maurin (2001) studied the nature of the sea bottom and the characteristic facies of *P. longirostris*. Geostatistical techniques was applied to investigate the spatial distribution of *P. longirostris* in Tyrrhenian Sea in Italian waters.

In the Mediterranean basin, the distribution of *P. longirostris* is reported between 20 and 700 m, though it is more common between 70 and 400 m (Holthuis, 1987).

Nevertheless the biology of *P. longirostris* in Egypt is poorly known, the present work constitutes a contribution to the knowledge of the biological parameters of *P. longirostris* and the aspects related to its reproduction.

2. MATERIALS AND METHODS

Bi-Monthly shrimp samples were collected from January to December (2005) from Abu-Kir fishing center near Alexandria city see Fig. (1). About 1142 specimens were sexed and measured. Total length (TL, to nearest 0.1 cm) measured from the tip of the rostrum to the end of the telson; carapace length (CL to nearest 0.1 cm), from the tip of the rostrum to the posterior margin of the carapace; total weight, gonad weight and tails weight (Tw, G.W, tail wt.) to nearest 0.01 g as wet weight using a direct reading electric balance (Sartorius GMBH).

The maturity of the ovary was determined visually and the degree of maturity was divided into the following five categories after (Abdel Razek 1985): (I) immature: ovary transparent; (II) Early mature: ovary cream or pale yellow; (III) Maturing: ovary dark yellow or pale green; (IV) late mature: ovary green or dark green and (V) spent ovary empty and colourless. Monthly and size distribution of different maturity stages were done.

Size at sexual maturity was determined by the percentage distribution of late mature stage (IV) plotted against the corresponding length group. A straight line was then fitted between the points, extension of this line is supposed to meet the x-axis at the size of sexual maturity. Gonadosomatic index was calculated monthly for females to determine spawning periods according to the following formula:

$$G.S.I. = \frac{weight \text{ of gonad (g)}}{total \text{ body weight}} x100$$

For each sex, the total length-carapace length relationship was estimated from the linear equation of y = a+bx, where y in the total length; x is its carapace length and a & b are constants.

The total length-total weight; carapace length-total weight and total length-tail weight relationships were calculated, following a logarithmic transformation for the exponential regression formula $W = aL^b$.

Where W is the total or tail weight in (g), and L is the total or carapace length in (cm).

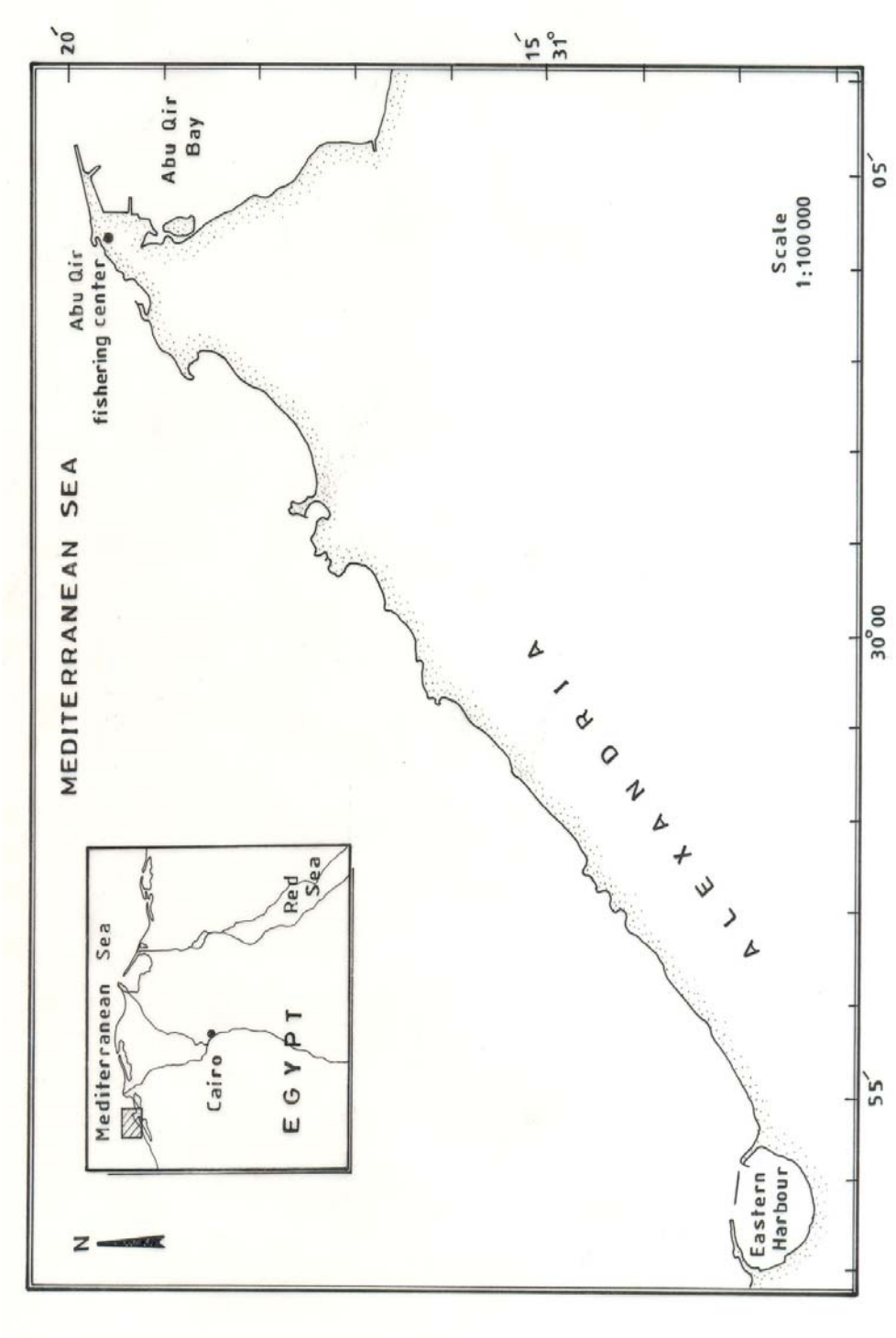

Fig. (1): Study area showing the site of sampling.

3. RESULTS

3.1. Size frequency distribution

A total of 1142 individuals composed of 877 females and 265 males of *P. longirostris* were analyzed throughout the research period. The length frequency distribution diagrams for females, male and for overall specimens are given in Fig. (2).

As clearly illustrated in Fig. (2A), the size of the female individuals range between 4.0 and 14.5 cm with size groups from 9.0 to 9.5 cm dominating the catch. Length frequency distribution of males Fig. (2B), reveal that the size range of males between extends from 5.0 to 11.0 cm with size groups 7.0 to 8.5 cm dominating the catch.

It appears that the abundance of females was always higher than that of males specially in sizes larger than 8.0 cm total length. Males larger than 11.0 cm total length, were absent.

The length frequency distribution of the pooled data Fig. (2C) clearly demonstrates the presence of a normal length distribution within the community with the dominant size group varying from 8.0 to 9.5 cm.

3.2. Morphometric characteristics

In order to determine the size at which shrimp species can be profitably exploited, the relation between increase in mass weight of a shrimp population through growth and recruitment as well as decrease through natural and fishing mortality must be known. Also, to make quantitative comparison between shrimps of different species, origin or sexes, for fisheries management or aquaculture purposes, some different measurements including carapace length, total length, total weight and tail weight with available mathematical expressions which define each relationship.

Smaller size less than 4.0 cm total length of *P. longirostris* were poorly represented in this study as they were not frequent in the investigated catch.

a- Total length-carapace length relationship

The total length (T.L) of *P. longirostris* varies from 4.0 cm to 14.0 cm and carapace length (C.L) from 1.3 cm to 5.8 cm. The relationships between the two variables for both sexes are given in Fig. (3) and presented by the following equation

Females T.L. = -0.68666 + 0.428283 C.L.
$r^2 = 0.99378$

Males T.L.= -0.49394 + 0.39091 C.L
$r^2 = 0.99525$

b- Length-weight relationship

The relationship between the total length (T.L) and total weight (W) (ranges from 0.7 g to 11.7 gm in females and from 0.96 g to 5.0 gm for males) are given in Fig. (4) and represented by the following equation:

Female $W = 0.008366\ T.L^{2.81925}$
$r^2 = 0.9988$

Male $W = 0.01275\ T.L^{2.58367}$
$r^2 = 0.9972$

The relationship between the carapace length and total weight for both sexes are given in Fig. (5) and the equations as follows:

Female $W = 0.45434\ C.L^{1.78011}$
$r^2 = 0.9966$

Male $W = 0.04054\ C.L^{2.08649}$
$r^2 = 0.9719$

The relationship between the total length and tail weight (headless weight) for both sexes are given in Fig. (6) and the equations as follows

Female W (tail weight) $= 0.01028\ T.L^{2.47286}$
$r^2 = 0.9934$

Male W(tail weight) $= 0.01162\ T.L^{2.41281}$
$r^2 = 0.9976$

C. Recovery rate:

The edible part of the prawn is normally the abdominal musculature while the carapace is the portion which has no food value. Therefore the greater the abdominal musculature of a shrimp for any particular total length, the greater is the value of that shrimp as food. The recovery rate of *P. longirostris* was calculated for females and

males as shown in Table (1). Both sexes have more or less irregular recovery rate with a tendency for a higher rate at smaller lengths. It is noticed a higher recovery rate for males than females. The average recovery rate for females is 58.5% and for males 64.8%.

The equations, using data for each sex satisfactorily describe the relation between whole and headless weight for *P. longirostris* in the Mediterranean waters and can be used to count values of each.

Females Tail.wt. = $0.01028\ L^{2.47286}$
$r^2 = 0.9934$

Males Tail.wt. = $0.01162\ L^{2.41281}$
$r^2 = 0.9976$

3.3. Maturation and spawning

a- Total length at first maturity

The percent frequency of late mature stage (IV) of *P. longirostris* as a result of measurements performed over 668 females was plotted against the corresponding length group as in Fig. (7). A straight line was then fitted, extention of this line is supposed to meet the x-axis at the size of sexual maturity, according to Abdel Razek (1985) the equation representing this relationship is a follows T.L= -53 – 5714 + 9.71429

$r^2 = 0.8448$.

The initial size at first maturity for female individuals of this species was calculated to be 5.6 cm while the smallest observed ripe one was 7.0 cm.

b- Distribution of different maturity stages

Fig. (8) illustrates the monthly distribution of different maturity stages of 649 females of *P. longirostris* collected during the present study. Samples during February and October were absent completely from the catch, while in May all the observed samples were in immature stage only. The abundance of maturing (III) & late mature (IV) stage was found during all other months of the year from June – January and March – April with a maximum abundance of ripe individuals during November. On the other hand, the spent individuals (V) were highly abundant during December.

Table (2) describes the distribution of the female maturity stages according to its size during the present study. The stages maturing (III) and late mature (IV) were observed with shrimps of total lengths that start from 7.0-7.5 cm up to 13.5 – 14.0 cm and the percentage of abundance of late mature (IV) stage increase with increasing size. Immature individuals were observed in sizes varying from 6.0 cm to 10.0 cm with a maximum occurrence from 6.5 cm to 7.0 cm total length.

The previous distribution indicates that the occurrence of ripening and mature gonads always starts from June to September and November with larger size individuals.

c- Gonado somatic index and spawning (G.S.I)

Fig. (9) shows the monthly distribution of G.S.I. of females *P. longirostris*. Increase in G.S.I females was observed during March – April, from June to September and in November. This observation proves the previous results which indicates that maturation and spawning activity of *P. longirostris* coinsided with spring, summer and autumn months in the Egyptian water.

Table (1): Total weight and tail weight (g) of *P. longirostris* and recovery rate in relation to the total length

Mean T.L. (cm)	Females			Males		
	Av. body wt. g	Av. tail wt. g	Recovery rate %	Av. body wt. g	Av. tail wt. g	Recovery rate %
4.5	0.58	0.42	72%	-	-	-
5.5	1.02	0.70	69%	1.04	0.71	68%
6.5	1.64	1.05	64%	1.61	1.06	66%
7.5	2.50	1.50	60%	2.32	1.50	65%
8.5	3.50	2.0	57%	3.21	2.03	63%
9.5	4.80	2.69	56%	4.30	2.66	62%
10.5	6.30	3.40	54%	-	-	-
11.5	8.20	4.30	52%	-	-	-
12.5	10.4	5.30	51%	-	-	-
13.5	12.9	6.40	50%	-	-	-
	Average recovery rate for females 58.5%			Average recovery rate for males 64.8%		

Table (2): Percentage frequency distribution of maturity stages of females *P. longirostris* according to size (2005).

Monthly stages	%					
Av. T.L. (cm)	Immature I	Early mature II	Maturing III	Late mature IV	Spent V	Total no.
4.5	-	-	-	-	-	-
5.5	-	-	-	-	-	-
6.5	100	-	-	-	-	10
7.5	59	-	23	18	-	34
8.5	16	20	34	30	-	128
9.5	5	15	27	50	3	223
10.5	-	1	35	44	19	167
11.5	-	-	8	48	44	64
12.5	-	-	-	59	41	32
13.5	-	-	-	90	10	10

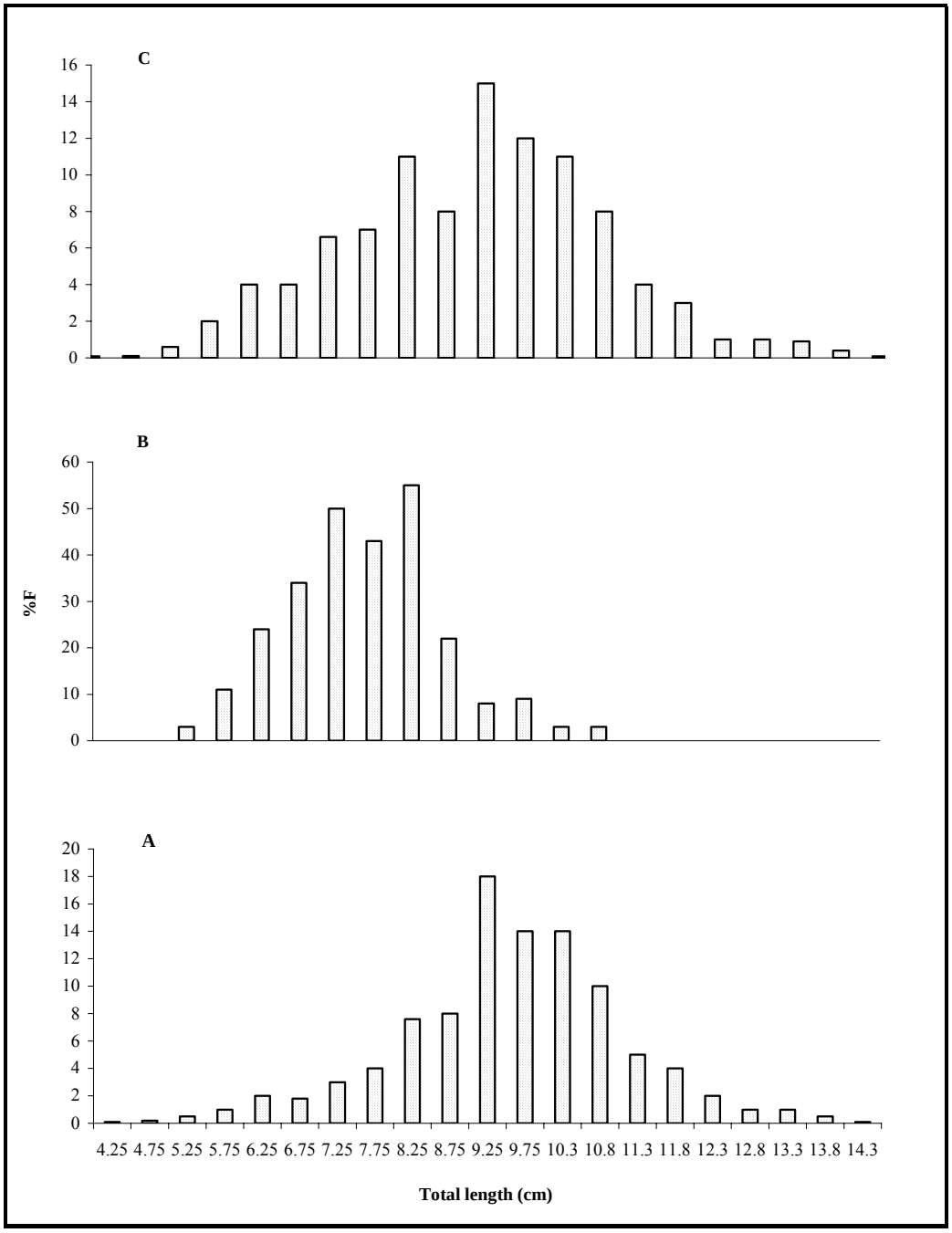

Fig. (2): A: Total length distribution of females (n= 877), B: total length distribution of males (265) and C: total length distribution of pooled data (n= 1142).

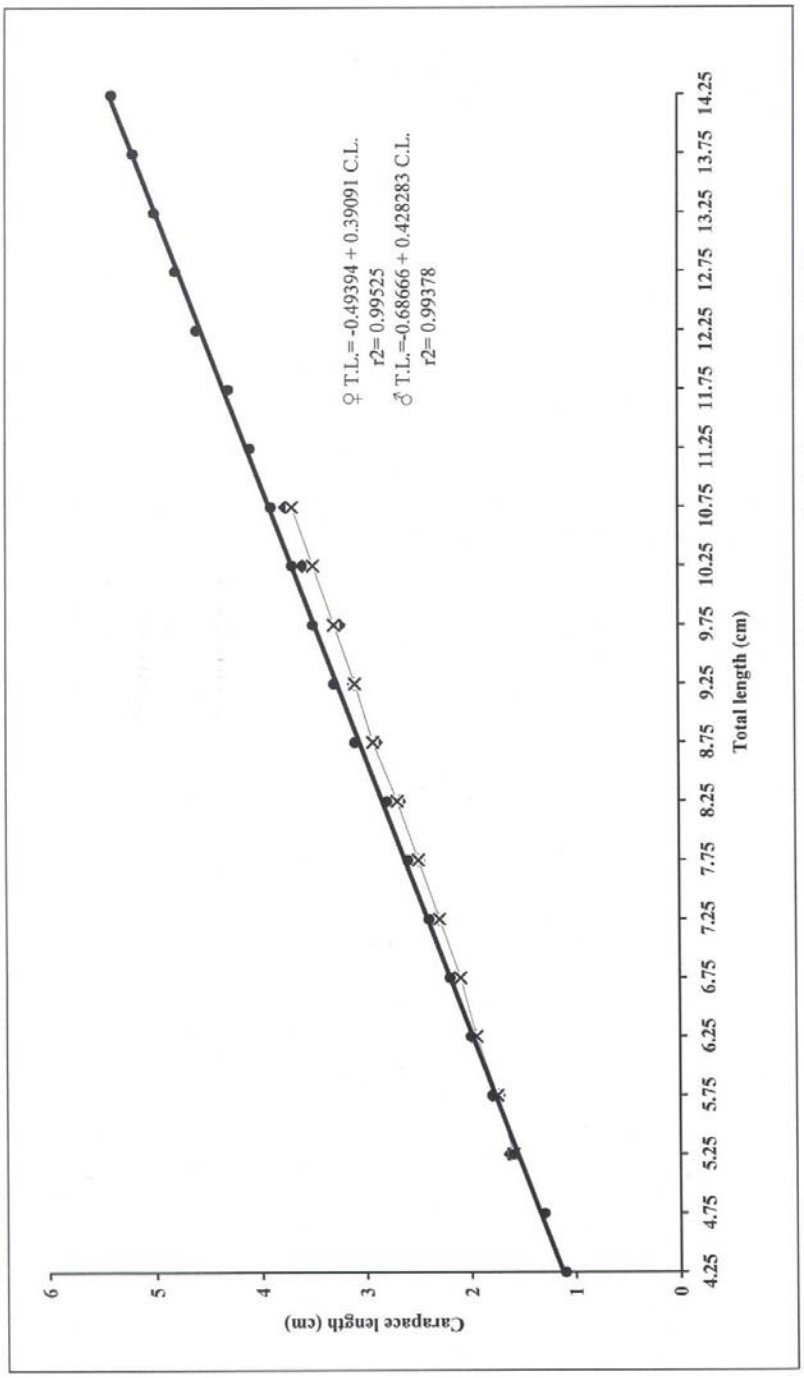

Fig. (3): Total length-carapace length relationship of *P. longirostris* of both sexes during (2005).

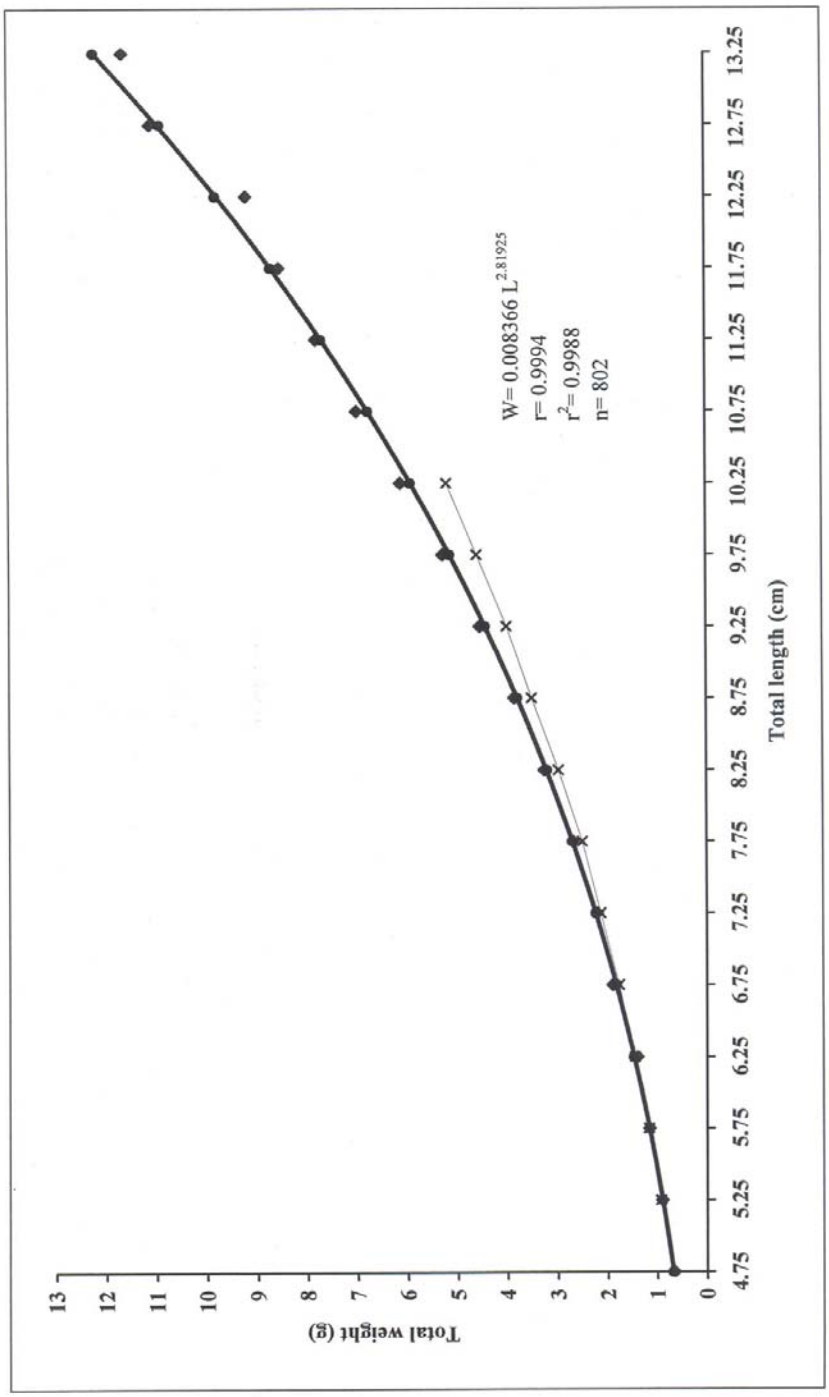

Fig. (4): Total length-total weight relationships of both sexes *P. longirostris* during (2005)

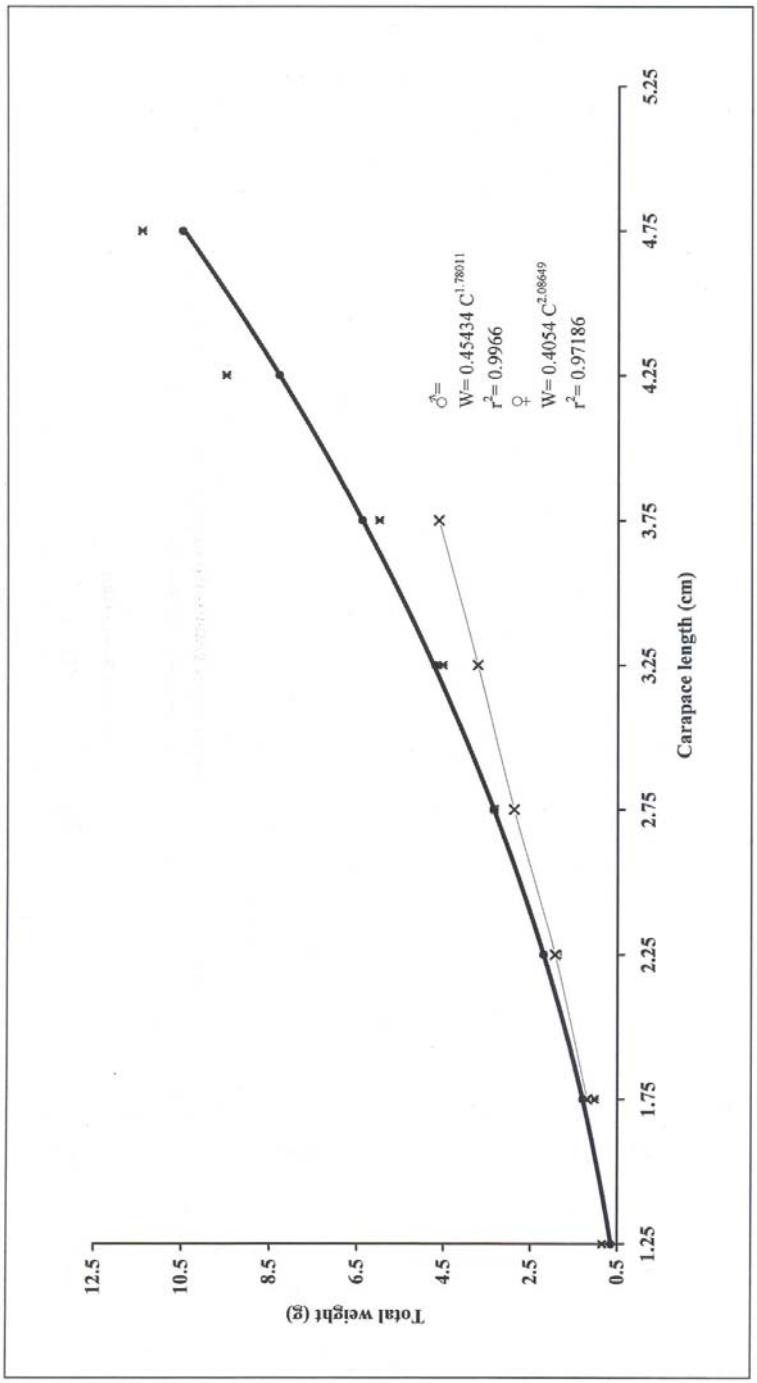

Fig. (5): Carapace length & Total weight of *Parapenaeus longirostris* of both sexes during (2005)

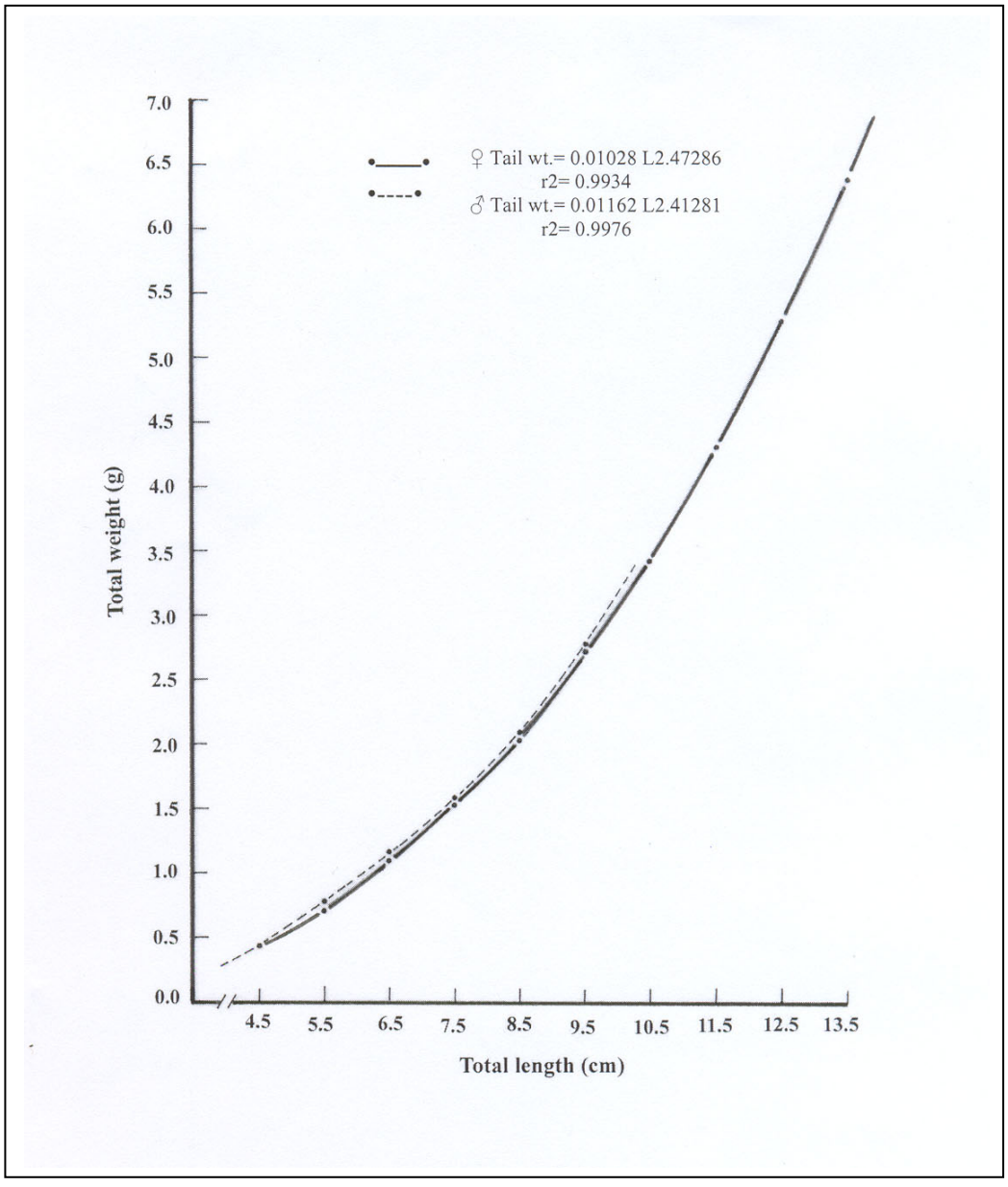

Fig. (6): Total length-total weight of both sexes *P. longirostris* during (2005).

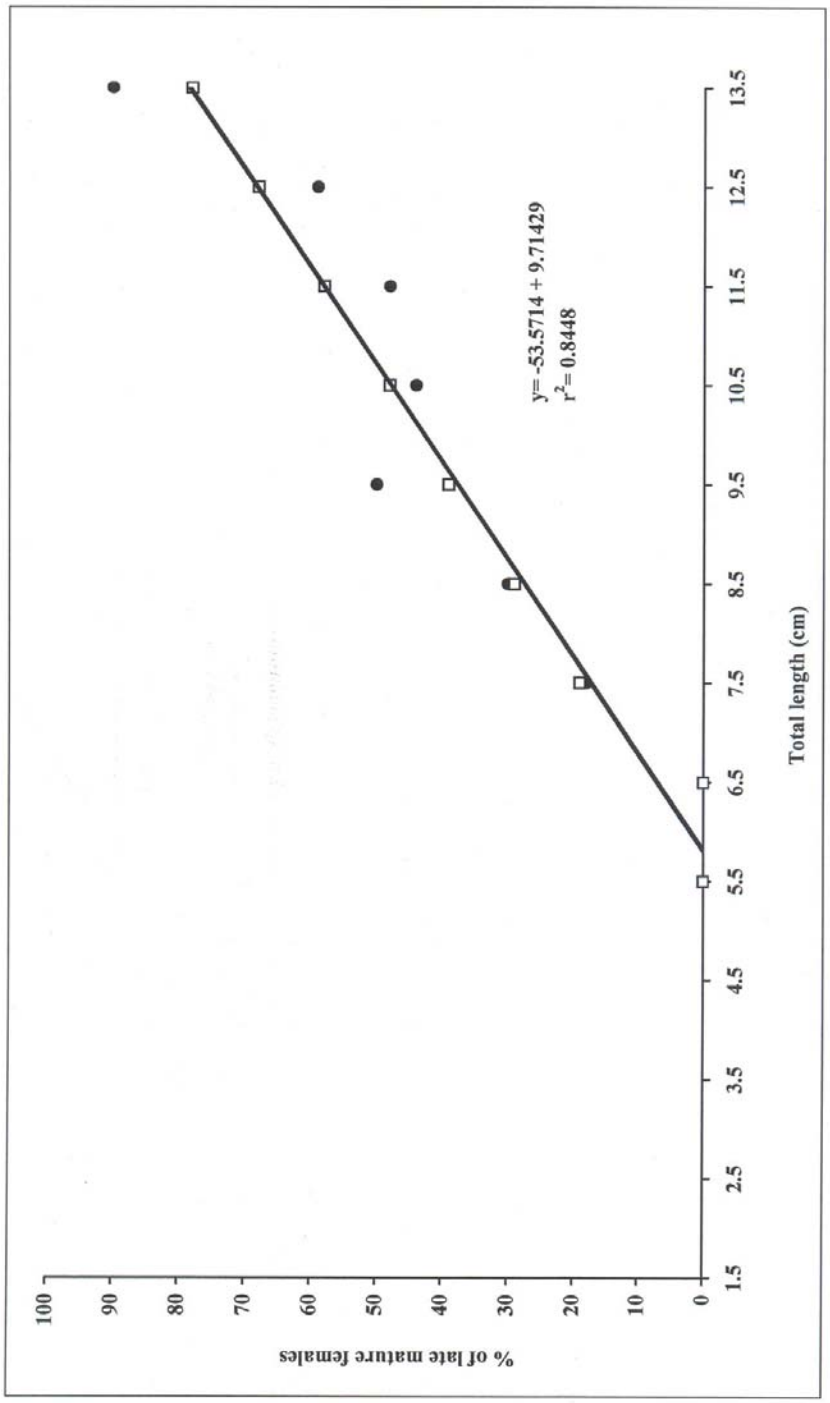

Fig. (7): Size at first sexual maturity of *P. longirostris* females during the period of (2005)

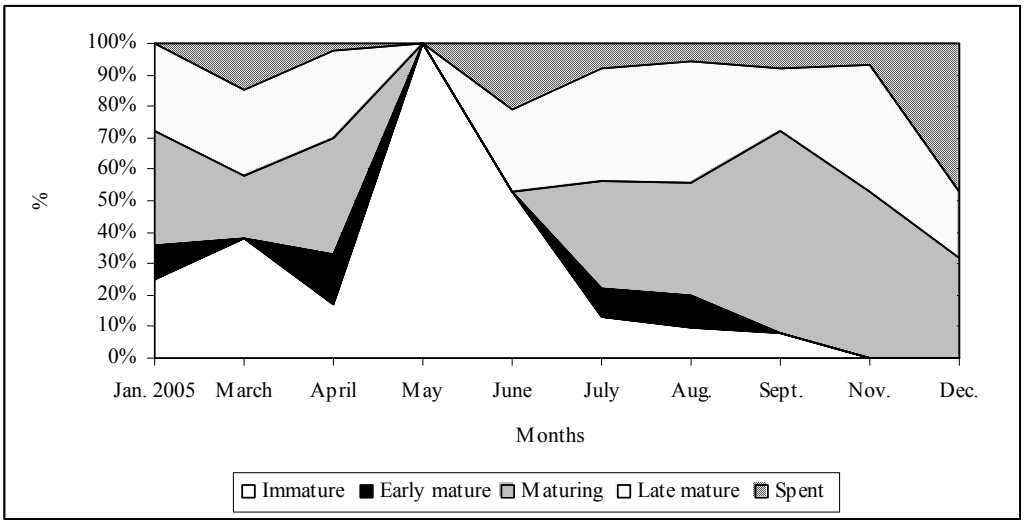

Fig. (8): Monthly distribution of different maturity stages *P. longirostris* (2005).

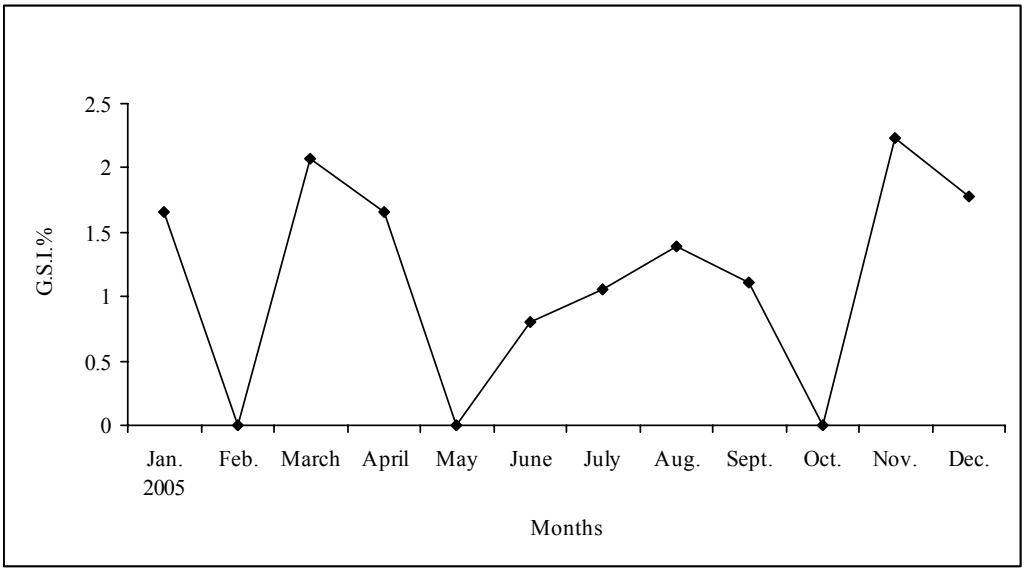

Fig. (9): Monthly distribution of G.S.I of females *P. longirostris* during (2005).

4- DISCUSSION

P. longirostris is caught mainly by the offshore fishery, it is generally regarded as a deep marine water species, not recorded in the northern Delta lakes as the other panaeid species Abdel Razek (1974). Abu Kir fishing area is considered the most important area for its fisheries. Sex-ratio showed monthly variations with the females prevailing in the catch. Female of this species are larger than males, however, this could be partly due to selectivity of the fishing gear. The dominance of females in *P. longirostris* was also found in Angolan water as reported by Maria and Pedro (2001) they also mentioned that the sex ratio is significantly higher at the deeper strata.

In sea of Marmora (Turkey) as recorded by Bayhan *et al.* (2005), females of *P. longirostris* reach a much greater size and weight more than males and the maximum sizes given for males and females more or less lie in the same order of magnitude for each sex.

In the present study the female size ranges varied from 4.0 to 14.5 cm with a dominant size groups from 9.0 cm to 9.5 cm, while in males size range was 5.0 cm to 11.0 cm total length with higher frequency in sizes from 7.0 to 8.5 cm. Bayhan *et al.* (2004) found that the sizes of males and females *P. longirostris* inhabiting the sea of Marmora were 1.0-14.0 and 1.0-16.0 cm respectively, while Bayhan *et al.* (2003) reported that the maximum size for this species as 14 cm. Another study by Kocatas *et al.* (1991) mentioned that 16 and 19 cm are the maximum sizes for males and females, respectively. The average size for males and females were 10-11 cm and 12-13 cm, respectively in the sea of Marmara according to the study of Balkis (1998-99).

According to FAO identification sheet, this species inhabit the depth from 20 to 700 m, but usually 150 and 400 m with a maximum total length 16.0 cm for males and 18.6 cm for females, Holthius (1980).

In Angolan waters the catch rates show an increase of abundance of *P. longirostris* in a north south direrction and the average abundance at the southern areas is significantly higher than in more northern areas. Also, there is a decrease in mean lengths with latitude for both males and females (North-south), the carapace length increases with depth for both sexes, as reported by Maria and Pedro (2001).

In the present study, the recovery rate of males was found to be higher than females as 64.8% and 58.5%, respectively.

According to the present study females of *P. longirostris* mature for the first time at 5.6 cm total length while the smallest observed ripe one was 7.0 cm. This species was reported to mature at 22 mm carapace length (6.75 cm total length according to the present results) in Angolans waters. Bayhan *et al.* (2004) found the initial size at first maturity for females of the same species at 9.7 cm total length. This size is in agreement with the 9.2 cm size which has been reported earlier by Bayhan *et al.* (2003).

Although the highest G.S.I values were obtained in March – April and from June to September and in November, late mature (IV) females were present throughout the year, with the exception of May where only immature individuals were present. November was characterized with highest abundance of ripe individuals and highest G.S.I. This conclusion is closely related to the results obtained by Bayhan *et al.* (2003) and (2004). Smallest size groups for both sexes were found from January to September. It could be concluded that the most intensive spawning of *P. longirostris* takes place from June to December with maximum activity during November in Egyptian Mediterranean waters. This conclusion is nearly similar for the same species in the sea of Marmara, Bayham *et al.* (2005).

On the other hand in Angolan waters, spawning of this species takes place in deeper water. The percentage of ripe females

increases with depth, and they dominate below 350 m, while immature individuals were formed in all depths with the highest percentage at depths shallower than 50m, Maria and Pedro (2001).

The correlations between the ripe females of *P. longirostris* and the large sizes (in their total length) in the population under study, could show according to the previous conclusion that spawning of this species takes place at deeper waters in Egyptian waters.

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REFERENCES

Abdel Razek, F.A.: 1974, Biological studies on some migrating species of the penaenidae from the Mediterranean and Delta lakes of Egypt M.Sc. Thesis, Alexandria Univesity.

Abdel-Razek, F.A.: 1985, Contribution to the biology of panaeid prawns of the Mediterranean coast of Egypt. 1- Maturation and spawning J. Egypt Vet. Med. Ass., **5** (2): 17-28.

Balkis, H.: 1998-99, Shrimp in the sea of Marmara. University of Istanbul, Journal of Biology, **61:** 121-145.

Bayhan, K.; ünlüer, T.; and Akkaya, M.: 2005, Some biological aspects of *Parapenaeus longirostries* (Lucas, 1846) (Crustacea, Decopoda) inhabiting the sea of Marmara. Turk. J. Vet. Anim. Sci. **29:** 853-856.

Bayhan, K.; Ünlüer, T.; Özdöl M.: 2003, An investigation on determination of reproduction season of Economically important penaeid shrimps Northeastern Mediterranean XII. National Fisheries symposium, Elazig, 2-5 September 2003.

GAFRD: 2004, Report of Gernal Authority for fish Resources Development on Fishery Egyptian.

Holthius, L.B.: 1980, FAO species catalogue Vol. 1. Shrimps and prawns of the world. An annotated catalogue of species of interest to fisheries. FAO fish synop., (125). Vol. 1: 261p. The "Interest to fisheries" section has been updated according to recent FAO fishery statistics.

Holthius, L.B.: 1987, Crevettes. In: W. Fischer, M.SCHNEIDER & M.L. BAuchOT (eds.), Fiches FAO d'identification des especes pour les besoins lela péche (Revision 1). Méditerranéan et Mer Noire. Zone de Pêche 37, 1, Végétaux et invertébrés: 271-272.

Kocatas, A.; Katagan, T., Ucal, O.,H.A.: 1991, Shrimp of Turkey and shrimp culture. Ministry of Agriculture and Rural Affairs No. 4 Bodrum, 24-85.

Maria de Lourdes Sardinha and Pedro de Barros: 2001, Association between bottom depth and some biological characteristics of *Parapenaeus longirostries* (Lucas, 1846) in Angolan waters. Instituto de Investigacea Marinha, CP 2601, Luando Angola.

Nouar, A. and C. Maurin: 2001, Nature of and typical populations on the characteristic facies of substratum of *Parapenaeus longirostries* (Lucas, 1846) Along the Algerian coast. Crustaceana **74** (2): 129-135.

Perez Farfante II,: 1982, The geminate shrimps species *Parapenaeus longirostries* and *Parapenaeus politus* lab. Tecnol Pesca, **3** (2-5): 187-205.

Wagdi, W.F. and Abdel Razek, F.A.: 1985, The effect of Damming on the shrimp population in the south eastern part of the Mediterranean Sea. Fish. Research **3:** 325-335.