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4FISHERIES OF THE SHRIMPS PENAEUS JAPONICUS AND PENAEUS LATISULCATUS IN THE GULF OF SUEZ

BY

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Key Words: *Penaeus japonicus*, *Penaeus latisulcatus*, bottom trawl surveys, Gulf of Suez.

ABSTRACT

Large shrimps, Penaeus japonicus and Penaeus latisulcatus are of the most economically important species caught from the Gulf of Suez. According to the present data, Penaeus japonicus was found in 42% of the trawling area. Penaeus latisulcatus was caught from 21% of the trawled area. The wide domain and productive for fishing the shrimps were El-Sokhnna Bay and its opposite eastern side for Penaeus japonicus and from Za' afrana to false Ras Gharib and its opposite eastern side for both shrimps and El-Fayrouze south of the Gulf for Penaeus latisulcatus. Penaeus japonicus was caught mainly from sandy bottoms while Penaeus latisulcatus was mainly from sandy and grassed bottoms. Depth had a nonlinear relation with the catch per hour and mean length of the tow catch of Penaeus japonicus. A significant difference was estimated for the diurnal variation of catch per hour for Penaeus japonicus. Penaeus latisulcatus did not appear in the catch during the day. Catches per hour of the full moon, spring tide, were significantly lower than that of neap tide for both shrimps. On the contrary, the mean length of the catch during the full moon was significantly larger than that of the first quarter for Penaeus japonicus.

INTRODUCTION

The catchability coefficient has been shown to be quite variable for shrimp so that it may have created large enough errors in prior indices of shrimp stock and recruitment as to obscure an underlying relationship between these two variables (Hannah, 1995 & 1999). A thorough understanding of the fish natural behaviour, such as feeding activity, geographical distribution, migration, against the trawl set, is an essential basic in analyzing data of the scientific surveys to have more precise unbiased fish biomass indices (Godø, 1994). Vertical migration seems to be a common behaviour among the shrimp species (Matthews *et al.*, 1991; Lee *et al.*, 1996). The majority of the penaeid prawns are nocturnal, spend most of the day buried in sediment and emerge to forage at night (Dall, 1958; Racek, 1959; Duronslet *et al.*, 1972; Fuss & Ogren, 1966; Al-Kholy & El-Hawary, 1970). Their nocturnal activity may protect them from predators (Matthews *et al.*, 1991) or a high daytime temperature (Hindley, 1975).

Penaeid shrimps ***Penaeus japonicus*** and ***P. latisulcatus***, are of the most economic large shrimp landings from the trawl fishery in the Gulf of Suez. Together with the other penaeid shrimp, ***P. semisulcatus***, they are considered as one catch category, large shrimps, in the Gulf trawl landings (Yassien *et al.*, 1993). Seasonal catch of the large shrimps constitutes the third category in the trawi catch hierarchy. Some authors studied some biological aspects for the shrimp from the Gulf of Suez. Al-Kholy and El-Hawary (1970) studied the spawning and metamorphosis of ***P. japonicus*** and ***P. latisulcatus***. Yassien (1992) investigated some biological parameters of ***P. latisulcatus***. Zaghloul (1995) studied the reproductive biology of ***P. japonicus***.

Landings of the large shrimps from the Gulf of Suez and adjacent area suffer deep fluctuations and continuous regression (Fig., 1). Therefore, the ground fishery of the large shrimps in the Gulf needs routine scientific surveys to assess and monitor the shrimp stock to give the appropriate scientific management tools. The present study aims to shed light on some behaviour characters of ***P. japonicus*** and ***P. latisulcatus*** to bottom trawling. Using such information, during the data analysis of the bottom trawl survey, is necessary to have precise and accurate results.

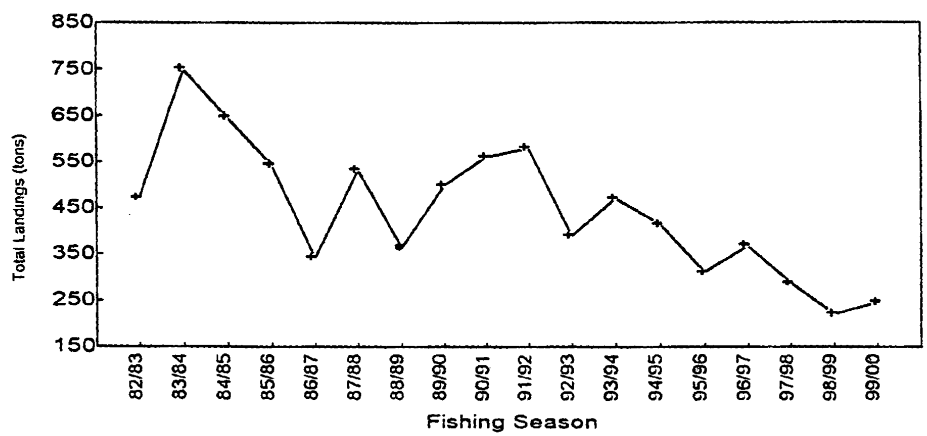

Fig. 1: Seasonal variation of the large shrimp landings from the Gulf of Suez. Data from the General Authority of Fish Resources.

MATERIALS AND METHODS

The present data were collected during a scientific trawling survey during the period 25 November – 4 December 1998 conducted by the National Institute of Oceanography and Fisheries, NIOF, in the north-west Red Sea, in the Gulf of Suez and its adjacent area (Fig. 2). The surveyed area was randomly covered by 84 trawl tows. Planning of the survey and sampling on deck followed the standard procedures (FAO/UNDP, 1975; Gulland, 1975 and Sparre and Venema, 1992).

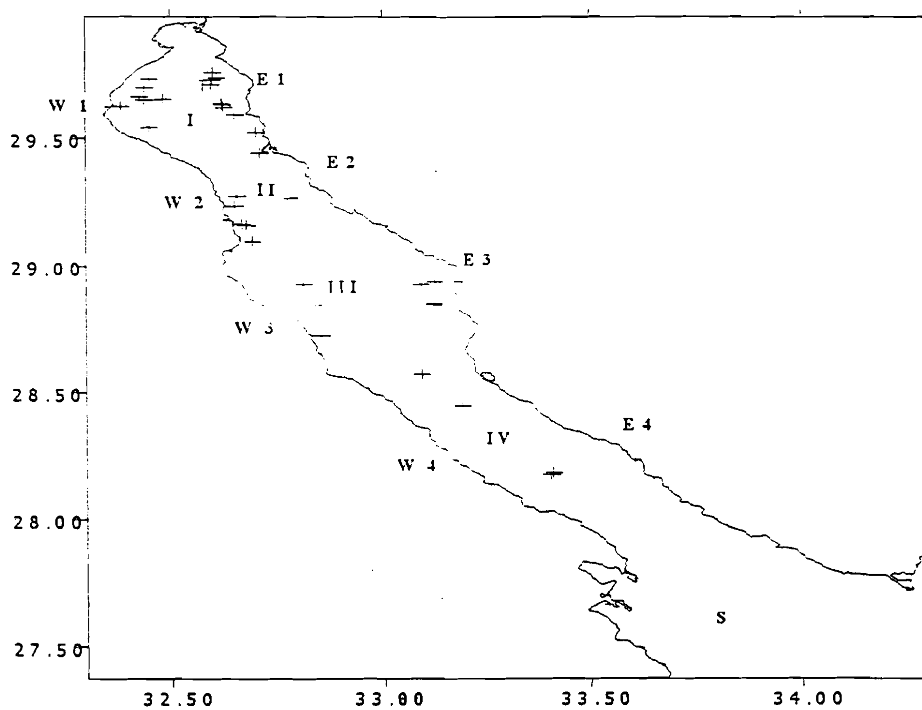

Fig. 2: Geographical distribution of tows with ***P. japonicus*** from the Gulf of Suez during the autumn survey, 1998.

Boat Specifications:

Length of the boat was 23.75 m. Its width was 6.5 m. It was powered with 450 hp main engine. The boat was equipped with motorized winch, echosounder for depth determination and an electronic device for navigation to record the rout and the speed.

The trawl net, used the present investigation, was of the Mediterranean type. The net length was 27 m. It ends with a 5.5 m unselective covered codend (unselective net). The headline was 2.2 m while the ground rope was 2.4 m. The headline has 16 floats. The ground rope was supported by 11 chains. Each chain was 1.5 kg.

The otter board was made of steel. It weighed 115 kg. The otter boards were attaching to the two sides of the net by two sweep lines. Each sweep line was 200 m in length and 200 kg in weight. The sweep line ended at 9.0 m very thick part (El-Lappan) at the vicinity of the net.

Description of the surveyed area (Fig., 2 & 3):

Considering the manpower, and the geographic locations along the Gulf axis, the surveyed area was divided into 5 sectors. The Gulf was of longitudinally 4 sectors (I, II, III & IV) and the fifth sector, S, was the adjacent area. The eastern and western sides of the Gulf were trawled, in addition to the main channel, which lies in the middle.

* Latitudes of the proposed sectors for the Gulf of Suez.

Sector	East Latitude	West Latitude
I	$29^{0}\ 50'$ (Ras Misalla)	$29^{0}\ 49.5'$ (Ras Adabiya)
	$29^{0}\ 27'$	$29^{0}\ 23'$ (Ras Abu Daraq)
II	$29^{0}\ 27'$	$29^{0}\ 23'$ (Ras Abu Daraq)
	$29^{0}\ 13'$	$29^{0}\ 07'$ (Ras Zaafarana)
III	$29^{0}\ 13'$	$29^{0}\ 07'$ (Ras Zaafarana)
	$28^{0}\ 34'$	$28^{0}\ 30'$ (Fals Ras Gharib)
IV	$28^{0}\ 34'$	$28^{0}\ 30'$ (Fals Ras Gharib)
	$27^{0}\ 56'$ (Ras Kenisa)	$27^{0}\ 49.5'$ (Umm El Kiman)

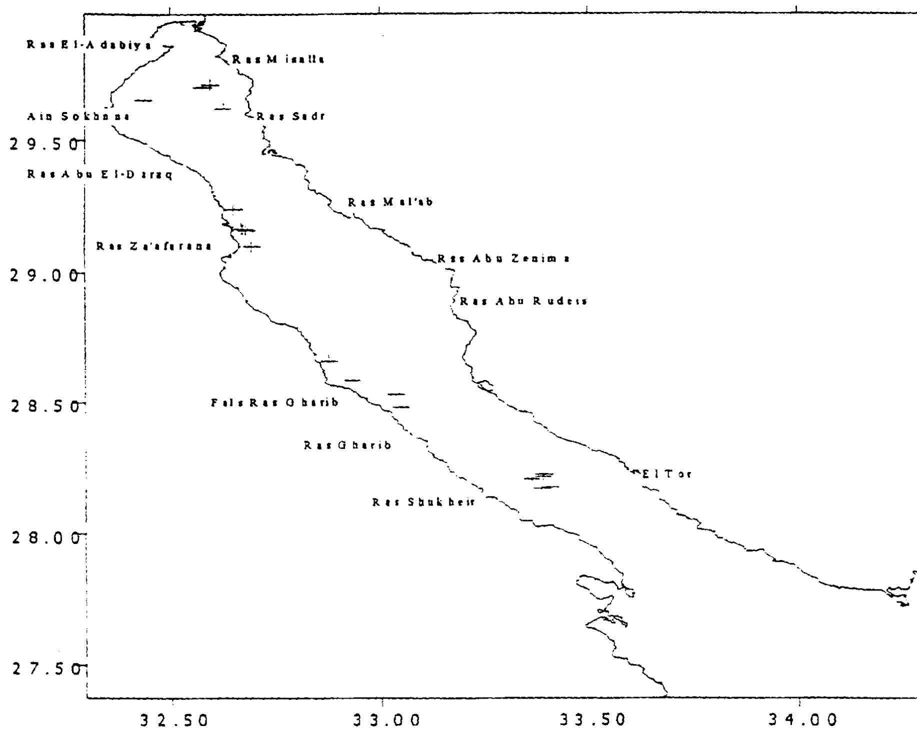

Fig. 3: Geographical distribution of tows with *P. latisulcatus* from the Gulf of Suez during the autumn survey, 1998.

Data analysis:

To deduce the relationships of the different variables, the nonlinear module, with Quasi-Newton method was used. The comparison between groups was performed using the non-parametric Kruskal-Wallis ANOVA method, in the STATISTCA Package V5.0. Using such method was to ensure the results and avoid the critical assumptions of the parametric methods. The significant p value ($p<0.05$) is bolded and underlined in the tables of the results.

The following terms were used:

Length (cm.): It is the total length measured from the tip of the specimen rostrum to the posterior end of the telson, to the nearest 1 cm.

Catch per hour, CPH (kg/hr): It is the weight of the tow catch of *P. japonicus* or *P. latisulcatus*, in kilograms, divided by the time of the tow duration, in hours.

RESULTS

I. Geographical distribution of large shrimps.

Regarding *Penaeus japonicus*, it was caught from 35 stations, about 42% of the total trawled stations (Fig. 2). Eastern and western sides of the Gulf and the main channel for navigation all yielded *P. japonicus*.

In case of *P. latisulcatus*, only 18 stations scattered mainly along the western side of the Gulf yielded the species. They formed more than 21% of the total number of tows (Fig., 3). The adjacent area of the Gulf gave no catch for both shrimps.

II. Distribution of catch per hour and length.

1- Catch per hour, CPH:

A. The Gulf sectors, I, II, III & V. (Table, 1):

Table 1: Distribution of the catch per hour of *P. japonicus* and *P. latisulcatus* in the Gulf of Suez sectors, autumn trawl survey, 1998.

Reg.	Sp.	N	Mean	Range	St. d.	Sp.	N	Mean	Range	St. d.
I	*P. japonicus*	17	0.6	0.1-1.2	0.330	*P. latisulcatus*	4	0.1	0.05-0.4	0.162
II		5	0.6	0.05-1.7	0.626		3	1.1	1.0-1.3	0.184
III		10	0.8	0.1-1.9	0.595		6	1.4	0.3-3.1	1.039
IV		3	0.4	0.1-0.8	0.395		5	1.4	0.9-2.2	0.510
P<		0.8305					**0.0204**			

Reg.: Region, Sp: Species, N: Number of Tows, St. d.: Standard deviation.

Penaeus japonicus:

The maximum CPH was shown in the third sector (III). The first and second sectors had the same CPH. The minimum CPH was from the fourth (IV) sector. The catches per hour from the longitudinal areas of the Gulf were not significantly different.

P. latisulcatus:

The mean CPH increased southerly. The maximum CPH, was shown in the third (III) and fourth (IV) sectors. The minimum CPH was from the first (I) sector. The catches per hour from the longitudinal areas of the Gulf were significantly different ($p<0.0204$).

B. Both sides of the Gulf.

P. japonicus (Table, 2):

Eastern Side of the Gulf: Catch per hour increased southerly to attain its maximum in the third region (E3) and then dropped to the minimum in the fourth region (E4). Means of catches per hour for the eastern four regions were significantly different ($p<0.0359$). The percentage of tow number, of the total trawled number of tows in the region, yielding the shrimp *P. japonicus* decreased southerly. The percentages were 75%, 66.7%, 50% and 0.08% for the first, second, third and fourth regions (E1, E2, E3 & E4) respectively.

Table 2: Distribution of the catch per hour of ***P. japonicus*** on both sides of the Gulf of Suez, autumn trawl survey, 1998.

Reg.	N	Mean	Range	St. d.	Reg.	N	Mean	Range	St. d.	P<
E1	9	0.7	0.1-1.2	0.342	**W1**	8	0.5	0.1-0.9	0.294	0.2520
E2	2	1.0	0.3-1.7	0.969	**W2**	3	0.4	0.05-0.6	0.300	0.8467
E3	5	1.2	0.8-1.9	0.487	**W3**	5	0.3	0.1-0.8	0.326	0.0618
E4	1	0.4	-	-	**W4**	2	0.4	0.1-0.8	0.491	-
P<	**0.0359**				**P<**	0.7864				
E	17	0.8	0.1-1.9	0.466	**W**	18	0.4	0.05-0.9	0.310	**0.0075**

E: Eastern side, W: Western side.

Western Side of the Gulf: Catch per hour slightly decreased southerly to reach the minimum in the third region (W3) and then increased to in the fourth region (W4). Means of catches per hour for the western four regions were not significantly different. As in the eastern side, the percentage of tow number giving the large shrimp, ***P. japonicus***, decreased southerly. The first, second, third and fourth regions (W1, W2, W3 & W4) possessed numbers of tows of percentages about 73%, 43%, 42% and 29% respectively.

The means of catches per hour of the three couples of eastern and paralleled western regions (E1&W1, E3&W3 and E4&W4) were not significantly different. Both eastern and western sides of the Gulf showed significantly different means of catches per hour ($p<0.0075$).

P. latisulcatus (Table, 3):

Eastern Side of the Gulf: Only, the first (E1) and fourth (E4) regions yielded the large shrimp *P. latisulcatus*. Two tows in E1 gave the same CPH. In E4, 5 tows gave the maximum mean CPH. Means of CPHs for the eastern two regions were not significantly different.

Table 3: Distribution of the catch per hour of *P. latisulcatus* on both sides of the Gulf of Suez, autumn trawl survey, 1998.

Reg.	N	Mean	Range	St. d.	Reg.	N	Mean	Range	St. d.	P<
E1	2	0.05	0.05-0.05	0.001	W1	2	0.2	0.1-0.4	0.225	-
E2	-	-	-	-	W2	3	1.1	1.0-1.3	1.836	-
E3	-	-	-	-	W3	6	1.4	0.3-3.1	1.039	-
E4	5	1.4	0.9-2.2	0.510	W4	-	-	-	-	-
P<	0.1188				P<	0.1223				
E	7	1.0	0.05-2.2	0.791	W	11	1.1	0.1-3.1	0.869	0.8767

Western Side of the Gulf: The means of CPHs increased southward. The first region (W1) possessed 2 tows giving *P. latisulcatus* with the minimum mean of CPH. The maximum mean of CPHs was achieved by the third region (W3), from 6 tows. The fourth region (W4) gave no catches of *P. latisulcatus*. Means of CPHs for the western three regions were not significantly different.

Both eastern and western sides of the Gulf showed insignificantly different means of catches per hour.

2- Length distribution:

A. The Gulf sectors, I, II, III & V. (Table, 4):

***P. japonicus*:**

The first sector (I) of the Gulf showed a relatively large mean length. The mean length dropped in the second sector (II) to the smallest. Then it increased southward to attain its largest measurement from one tow in the fourth sector (IV). The means of the specimens lengths per tow in the four sectors of the Gulf were significantly different (p<0.0001).

Table 4: Distribution of the mean length of *P. japonicus* and *P. latisulcatus* in the Gulf of Suez sectors, autumn trawl survey, 1998.

Reg.	Sp.	NS	Mean	Range	St. d.	Sp.	NS	Mean	Range	St. d.
I	*P. japonicus*	114	18.7	15.0-22.0	1.516	*P. latisulcatus*	15	16.6	12.0-19.0	1.882
II		30	16.7	12.021.0	2.229		67	14.8	11.0-19.0	1.817
III		135	17.9	14.0-24.0	1.894		27	15.1	12.0-18.0	1.424
IV		3	19.3	18.0-20.0	1.155		24	13.8	13.0-16.0	0.833
P<		0.0001					0.0001			

NS: Number of specimens.

P. latisulcatus:

The mean length nearly decreased southward. Two tows were sampled in the first sector (I). They gave the largest mean length. The smallest mean length was from one tow in the fourth sector (IV). The four sectors of the Gulf possessed significantly different means of the specimens lengths (p<0.0001).

B. Both sides of the Gulf,

P. japonicus (Table, 5):

Table 5: Distribution of the mean length of *P. japonicus* on both sides of the Gulf of Suez, autumn trawl survey, 1998.

Reg.	NS	Mean	Range	St. d.	Reg.	NS	Mean	Range	St. d.	P<
E1	73	18.9	15.0-21.0	1.478	W1	41	18.5	16.0-22.0	1.569	0.1044
E2	15	16.7	15.0-18.0	1.034	W2	15	16.6	12.0-21.0	3.044	0.6752
E3	72	17.5	14.0-24.0	1.731	W3	62	18.3	14.0-23.0	1.882	**0.0039**
E4	-	-	-	-	W4	3	19.3	18.0-20.0	1.155	-
P<			**0.0001**		P<			0.1007		
E	160	18.0	14.0-24	1.758	W	121	18.2	12.0-23.0	2.057	0.3435

Eastern Side of the Gulf: The maximum mean length was achieved by the first region (E1). The minimum mean length was in the second region (E2) from one sampled tow. The third region (E3) possessed the highest variability of specimens' total lengths, including the smallest and the largest total length (Fig., 4). The fourth region (E4) was not sampled due to the bad sea conditions. Mean lengths of eastern regions were significantly different, p<0.0001.

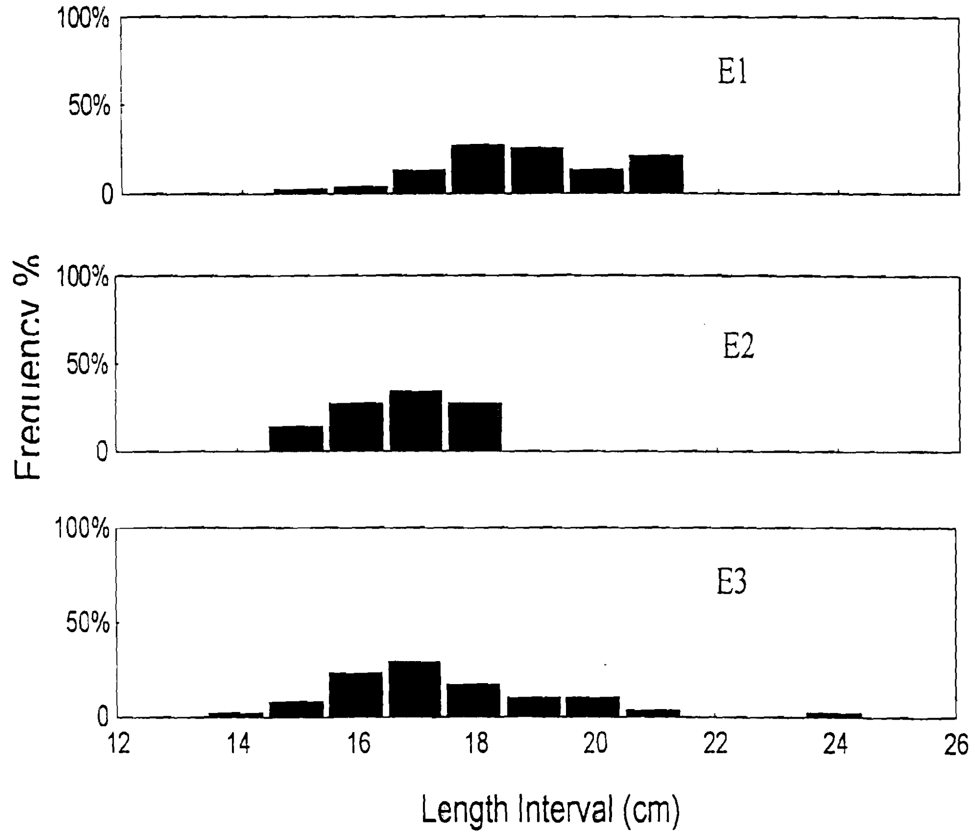

Fig. 4: Length frequency distribution of tows with *P. japonicus* (Eastern Side, E) from the Gulf of Suez during the autumn survey, 1998.

Western Side of the Gulf: The mean length dropped in the second region (W2) to the smallest mean. Subsequently the mean length increased southward to attain its largest in the fourth region (W4), from one sampled tow. The second and third region (W2, W3) yielded the highest variability of specimens' total lengths, including the smallest total length in W2 and the largest total length in W3 (Fig. 5). The western regions produced shrimp of mean lengths that were not significantly different ($p<0.1007$).

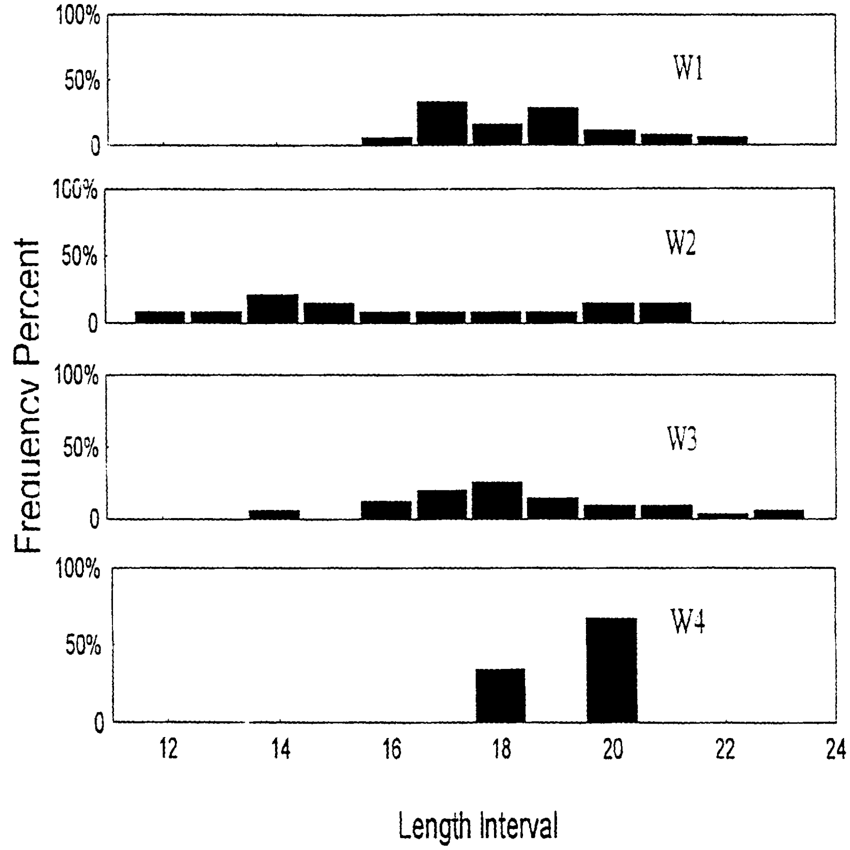

Fig. 5: Length frequency distribution of tows with *P. japonicus* (Western Side, W) from the Gulf of Suez during the autumn survey, 1998.

M n lengths of each one of the couples of the two eastern and parallel western regions (E1&W1 a _&W2) were not significantly different but for (E3&W3) mean lengths were significantly different ($p<0.0039$). Both eastern and western sides of the Gulf showed insignificantly different mean lengths ($p<0.3435$).

P. latisulcatus (Table, 6):

Eastern Side of the Gulf: One tow was sampled per each region, the first (E1) and the fourth (E4). E1 produced two specimens included the smallest and the largest total length. However, E4 yielded higher variation of specimens' total lengths (Fig. 6). They were not significantly different (p<1.0000).

Western Side of the Gulf: For the first (W1) and the second (W2), one tow was sampled per each region. The mean length in W1 was the largest and in W2 was the smallest. The third region (W3) provided a relatively large mean length from two sampled tows. The second region (W2) possessed the highest variability of specimens' total lengths, including the smallest and the largest total length (Fig., 7).The means of the three regions were significantly different (p<0.0015).

Both eastern and western sides of the Gulf showed significantly different mean lengths (p<0.0002).

Table 6: Distribution of the mean length of ***P. latisulcatus*** on both sides of the Gulf of Suez, autumn trawl survey, 1998.

Reg.	**NS**	**Mean**	**Range**	**St. d.**	**Reg.**	**NS**	**Mean**	**Range**	**St. d.**	**P<**
E1	2	15.5	12.0-19.0	4.050	**W1**	13	16.8	15.0-19.0	1.363	0.3945
E2	-	-	-	-	**W2**	67	14.8	11.0-19.0	1.817	-
E3	-	-	-	-	**W3**	27	15.1	12.0-18.0	1.424	-
E4	24	13.8	13.0-16.0	0.833	**W4**	-	-	-	-	-
P<	1.0000				**P<**	**0.0015**				
E	26	13.9	12.0-19.0	1.356	**W**	107	15.1	11.0-19	1.769	**0.0002**

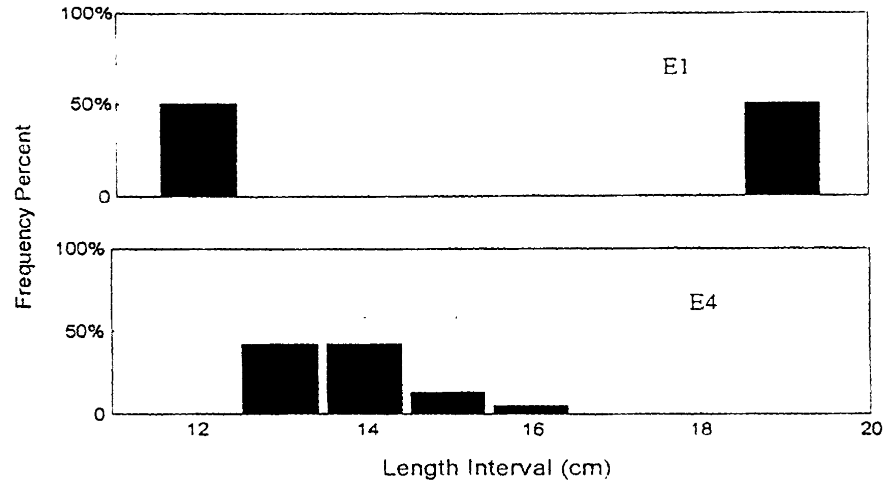

Fig. 6: Length frequency distribution of tows with *P. Latisulcatus* (Eastern Side, E) from the Gulf of Suez during the autumn survey, 1998.

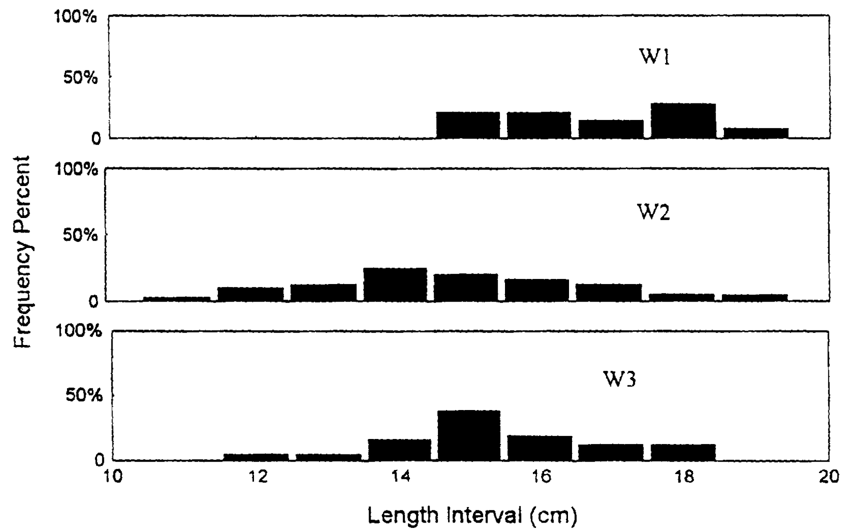

Fig. 7: Length frequency distribution of tows with *P. Latisulcatus* (Western Side, W) from the Gulf of Suez during the autumn survey, 1998.

III. Effect of environmental physical characters:

The length variability of *P. latisulcatus* due to the effect of the physical factors was not investigated owing to the small number associated with the different categories of the factors.

1- Nature of the sea bottom.

P. japonicus was found in sandy bottoms accompanying cleaned shots. *P. latisulcatus* was found in soft sandy bottoms and mostly was accompanying shots from areas of sea grasses.

2- Depth.

Most of the trawled depths yielded *P. japonicus*. For *P. japonicus* the 35 tows provided the large shrimp were of depth range, 13.9-75.0m with a mean of 37.6 ±13.137m. The 18 tows provided the large shrimp *P. latisulcatus* were of depth range, 16.8-51.8m, with a mean of 34.2 ±9.616m.

Catch per hour CPH:

P. japonicus:

Removing the arrow-marked outlier point, a relatively good relation between the CPH and depth was revealed (Fig., 8). The relation was expressed by the polynomial model:

$$CPH= a + b1 * Dep + b2 * Dep^2 + b3 * Dep^3 + b4 * Dep^4$$

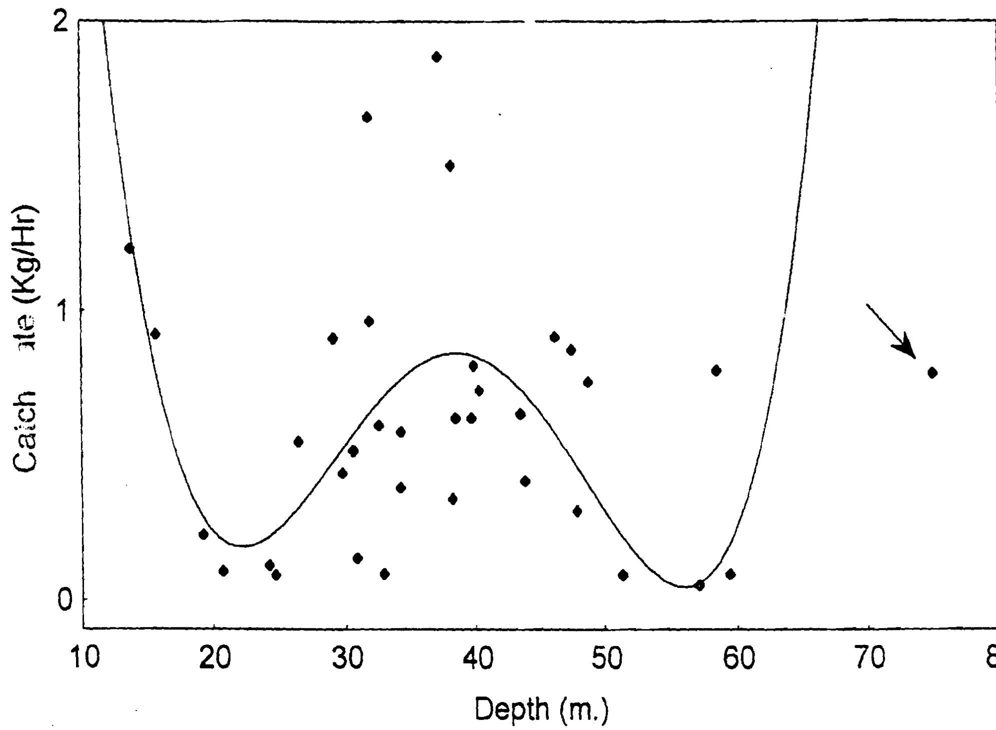

Fig. 8: Catch per hour against depth, and its fitted curve, for *P. japonicus* caught from the Gulf of Suez, during autumn bottom trawl survey, 1998.

Where Dep was the depth (in meter). The constants were, a = 13.847, b1 = - 1.7246, b2 = 0.07663, b3 = - 0.00140 and b4 =0.00001. The correlation coefficient r = 0.55 and the explained proportion of the data by the model was more than 30%.

P. latisulcatus:

The CPH exhibited no clear systematic change with changing depth for *P. latisulcatus* (Fig., 9).

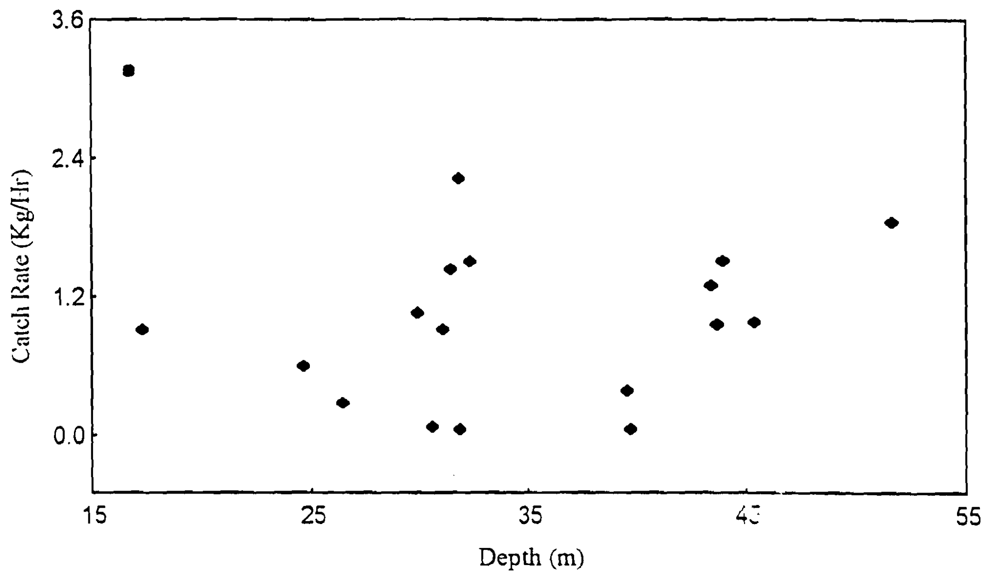

Fig. 9: Catch per hour against depth for *P. latisulcatus* caught from the Gulf of Suez, during autumn bottom trawl survey, 1998.

Mean length:

P. japonicus:

By removing the outlier point, a reasonable nonlinear model (Fig., 10) was revealed relating the mean length of the specimens of tow catch and depth of the tow:

$$ML = a + b1 * Dep + b2 * Dep^2 + b3 * Dep^3$$

Where ML was the mean length. The parameter estimates were a= -15.2, b1= 2.7185, b2= -0.0708 and b3= 0.0006. The regression coefficient r= 0.56 and the explained proportion of data was more than 31.7%.

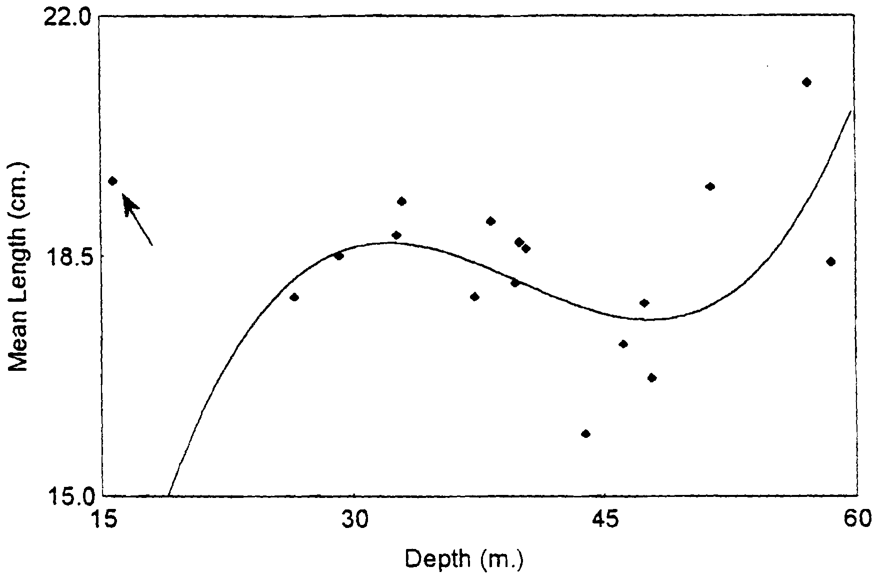

Fig. 10: Mean length of tow catch against depth and the fitted curve for *P. japonicus* caught from the Gulf of Suez, during autumn bottom trawl survey, 1998. Arrowed point is extreme.

3- Diurnal variation

Catch per hour, CPH:

P. japonicus:

Catches per hour of the night tows had higher variability than daytime tows (Fig., 11). The mean CPH at night (22 stations) was 0.713 ±0.4807 kg/hr and during the day (14 stations) was 0.378 ±0.3328 kg/hr. Day and night means of CPH were significantly different ($p<0.0322$).

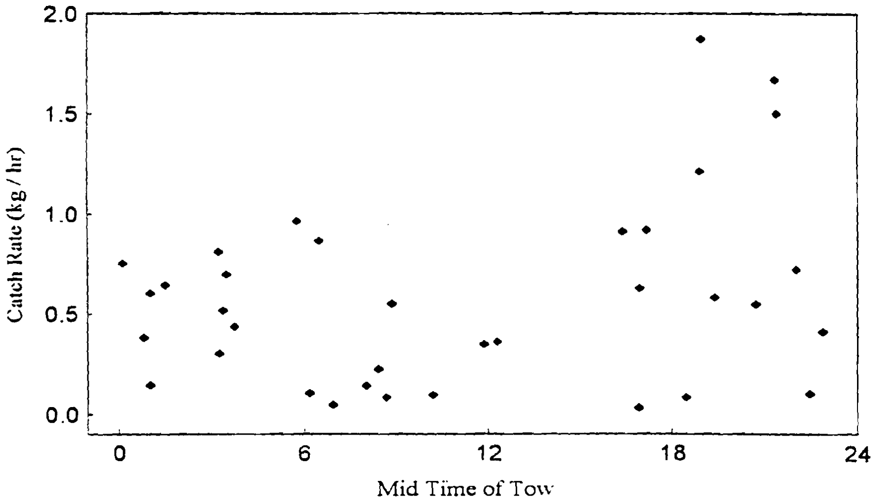

Fig. 11: Catch per hour against the mid time of tow for ***P. japonicus*** caught from the Gulf of Suez, during autumn bottom trawl survey, 1998.

***P. latisulcatus*:**

Nearly all tows yielded the shrimp were at night (Fig., 12).

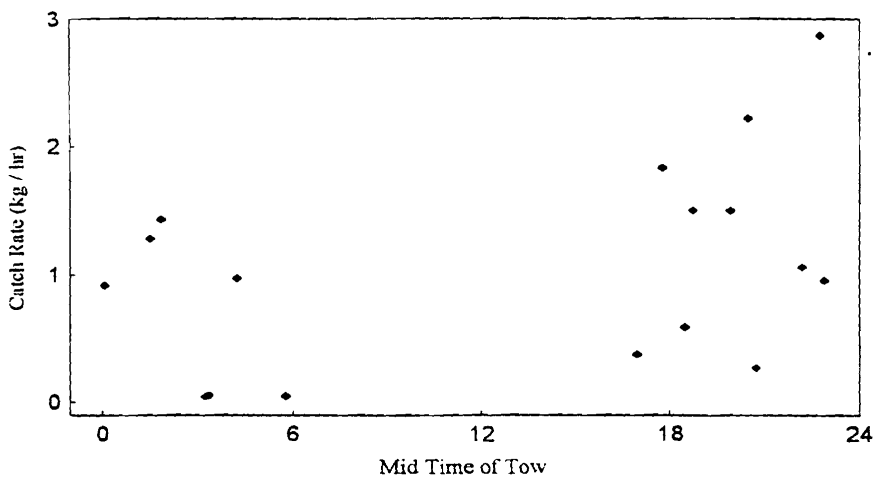

Fig. 12: Catch per hour against mid time of tow for ***P. latisulcatus*** caught from the Gulf of Suez, during autumn bottom trawl survey, 1998.

Mean length:

P. japonicus:

Mean length did not exhibit a clear systematic behaviour with changing time of towing (Fig., 13). Also, There was no significant day night variation for the mean length of the shrimp (p<0.3778).

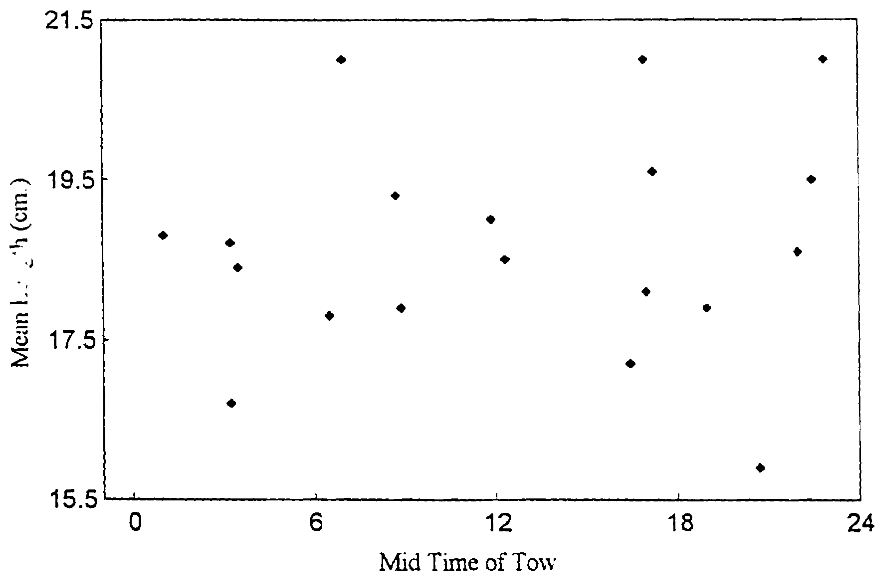

Fig. 13: Mean length of tow catch against mid time of tow for ***P. japonicus*** caught from the Gulf of Suez, during autumn bottom trawl survey, 1998.

4- Lunar Cycle

Catch per hour, CPH:

P. japonicus:

Moon dates (the 5th to the 8th) of the first quarter of the moon and dates of the neap tides were characterised by higher CPHs (Fig., 14). CPHs of the full moon, of the spring tide time were of lower values. The mean catch per hour of the first quarter, neap tide was 1.0 ±0.531 kg/hr (11 tows). The mean catch per hour of the full moon, spring tide was 0.5 ±0.304 kg/hr (24 tows). They were significantly different ($p<0.0019$).

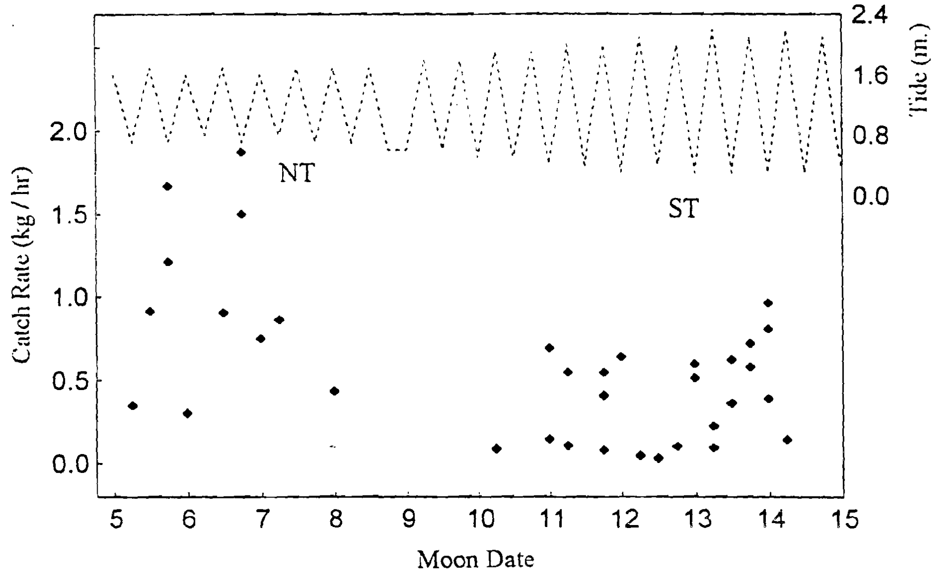

Fig. 14: Catch per hour against moon date (including the four tide times per day) for ***P. japonicus*** caught from the Gulf of Suez, during autumn bottom trawl survey, 1998. NT, ST: Neap & Spring Tides.

P. latisulcatus:

Due to the relatively low tide of the 10th moon day and the continuity of the high availability of the shrimp, the 10th moon day was considered as the end of the neap tide time (Fig., 15). Moon dates (the 7th to the 10th) of the first quarter of the moon and dates of the neap tides, were characterized by higher mean CPH than that of the full moon, of the spring tide time (Fig., 11). The mean catch per hour of the first quarter, neap tide was 1.7 ±0.636 kg/hr (8 tows). The mean catch per hour of the full moon, spring tide was 0.5 ±0.462 kg/hr (9 tows). They were significantly different ($p<0.0021$).

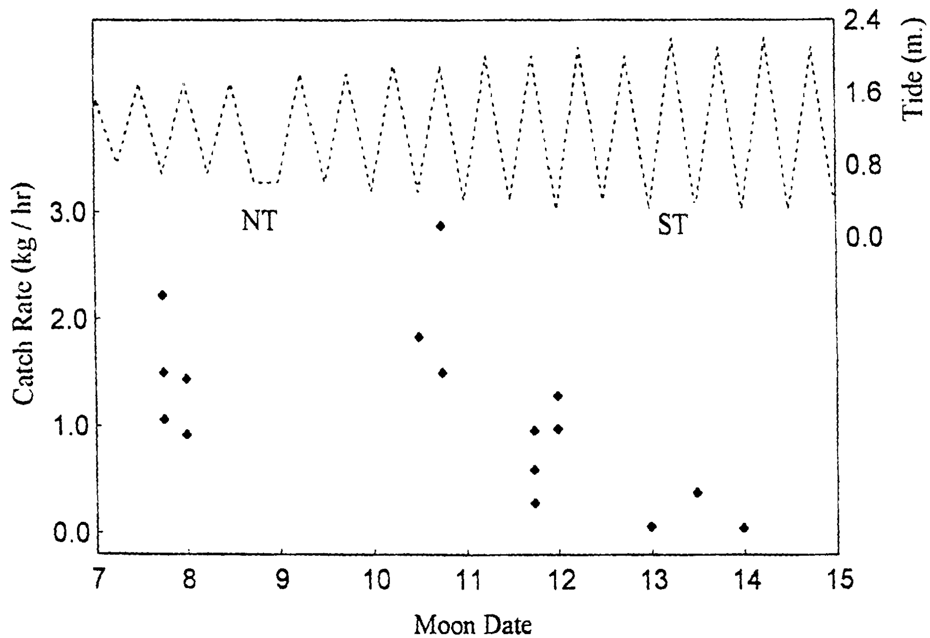

Fig. 15: Catch per hour against moon date (including the four tide times per day) for ***P. latisulcatus*** caught from the Gulf of Suez, during autumn bottom trawl survey, 1998.

Mean Length:

Mean length exhibited larger measurements, during the spring tide time, than that of the neap tide time for *P. japonicus* (Fig., 16). The mean length of the specimens caught during the first quarter, neap tide was 17.7 ±0.429 cm, from 6 sampled tows and 104 specimens. The mean length of the specimens caught during the full moon, spring tide was 18.4 ±0.478 cm, from 11 sampled tows and 178 specimens. These two means were significantly different ($p<0.0007$).

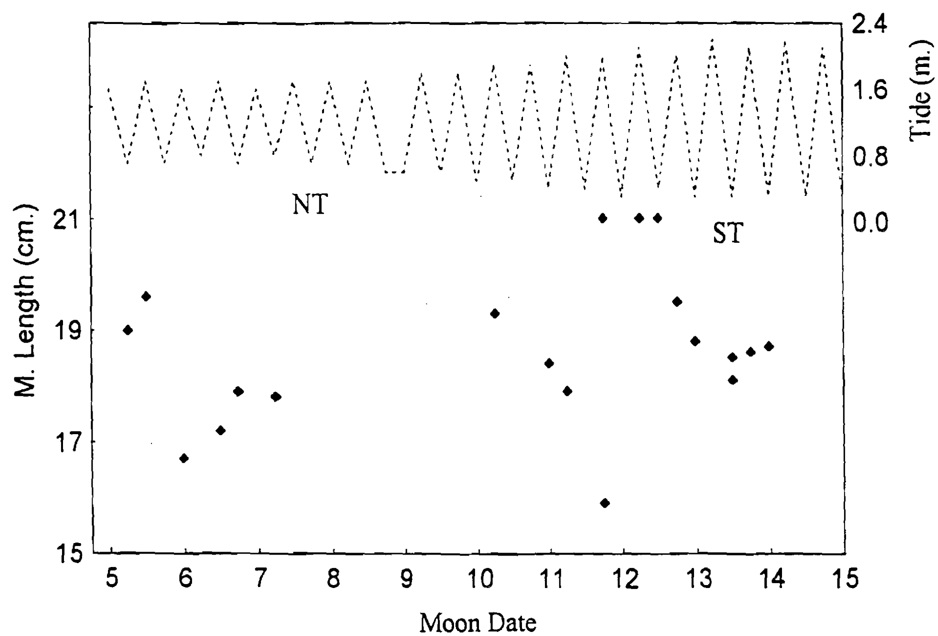

Fig. 16: Mean length of tow catch against moon date (including the four tide times per day) for *P. japonicus* caught from the Gulf of Suez, during autumn bottom trawl survey, 1998.

DISCUSSION

Large shrimps *P. japonicus and P. latisulcatus* are distributed mainly along the both sides and the navigation channel of first and second sectors of the Gulf, from Ras El-Adabaya, latitude 29^0 49.5' to Ras Za' afrana, latitude 29^0 07' on the western side and the latitude range 29^0 50' - 29^0 13' on the eastern side. On both sides, there is an area from latitude 28^0 56' to 28^0 29'. In addition, a very small area called El-Fayrouze around the line longitude 33^0 23.3', latitude 28^0 10.5' and longitude 33^0 23.5', latitude 28^0 13.7' is relatively productive for large shrimps. In the present study, the adjacent area has no catches for both shrimps.

Considering that large shrimps are of night catch and due to 34 tows of a total of 36 night tows giving large shrimps, it may be concluded that more than 94% of the Gulf area produces large shrimps. About 61% of the area may give *P. japonicus* and about 36% may yield *P. latisulcatus*.

The first area of the Gulf, eastern latitude range of 29^0 27'-29^0 49.5' and western range of 29^0 23'- 29^0 49.5' (El-Sokhnna Bay), may possess the widest domain to be trawled for *P. japonicus*. In addition, the third area, eastern latitude range of 29^0 13'-28^0 34' and western range of 29^0 07'-28^0 30', holds a relatively wide fishing area for the shrimp. Regarding the catch per hour, the third western region and the very small area El-Fayrouze are the most productive in the Gulf for *P. latisulcatus*. The third eastern is the most productive for *P. japonicus*.

El-Sokhnna Bay (the western side of the first area of the Gulf) is the most rich region in benthos such as polychaete worms, mussels, snails and crustaceans (EIMP, 1999 and Emara, 1999), chlorophyll-a, an indicator of phytoplankton (EIMP, 2000), phytoplankton, especially diatoms (Nassar, 2000). Abdel-Rahman (1999) reported a high abundance of copepoda during autumn offshore El-Sokhnna, twice times the abundance offshore the western side of the south Gulf. Additionally, El-Sokhnna and Abu Zenema (on the eastern side) possess relatively high levels of the nutrient, reactive phosphate, PO_4-P. Moreover, El-Sokhnna Bay and off Ras Sadr (on the eastern side) have relatively high levels of the nutrient silicate, SiO_4-Si, an indicator of the potential for diatom blooms (EIMP, 2000).

In the eastern side of the third region, offshore Abu Rudeis possesses a relative abundance of benthos (EIMP, 1999). Offshore Ras Badran contains the highest level of silicate and relatively high level of reactive phosphate (EIMP, 2000). Offshore El Tur (the eastern side of El-Fayrouze) has relatively high levels of benthos (EIMP, 1999), chlorophyll-a and reactive phosphate (EIMP, 2000). Offshore Shukeir (the western side of El-Fayrouze) contains relative abundance of copepoda during autumn (Abdel-Rahman, 1999) and relatively high levels of chlorophyll-a and silicate (EIMP, 2000).

Such above environment save the shrimp food requirements as; small crustaceans as copepods, small bivalves, fish fry, small cephalopods, diatoms and small benthic fauna (Al-Kholy & El-Hawary, 1970; Abdel-Razek, 1974 and Yassien, 2004). Consequently, it secures proper habitats in the above areas of the Gulf for both shrimps.

The western side of the second area exhibits high variability of length distribution including the small lengths for both shrimps. All the specimens of *P. japonicus* from the eastern side of the second area of the Gulf are relatively small. The third sector of the Gulf possesses the highest variability of the length distribution including relatively small specimens of *P. japonicus*. El-Fayrouze yields *P. latisulcatus* of small length and narrow length interval.

The length at 50% of specimens attained maturity (of maturity stages higher than II) is 16.5 cm (Zaghloul, 1995) for *P. japonicus*. Thus, in the present study, more than 40% of the collected specimens from the eastern side and more than 53% from the western side of the second area of the Gulf may be of maturity stage II and less. For *P. latisulcatus*, the length at 50% is 14.6 cm. Hence, more than 46% of the specimens from the western side of the second area of the Gulf and more than 83% from El-Fayrouze may be of maturity stage II and less.

Consequently, and from all the above data and of the regional length frequency distribution, it may be concluded that the second area of the Gulf (especially off Za' afarana in the west and Abu Zeinema to Matamer in the east), the third area and El-Fayrouz may act as nursery grounds for *P. japonicus* and *P. latisulcatus*. Otherwise, such nursery grounds may be found inshore of these areas where the intertidal zones are very wide, particularly on the eastern side of the Gulf.

P. japonicus is caught from sandy bottoms. *P. latisulcatus* is found in soft sandy bottoms and mostly accompanies tows from sea grass grounds. Al-Kholy and El-Hawary (1970) reported the main three large Penaeid shrimps, caught by otter trawl in the Gulf of Suez, from sandy and sandy muddy bottoms.

Considering the number of tows yielding shrimps, the depth ranges 30-50m and 30-45m are the most productive for *P. japonicus* and *P. latisulcatus* respectively. Al-Kholy and El-Hawary (1970) stated a depth range of 18-45 fathoms for the main three large Penaeid shrimps from the Gulf of Suez. High rates of catches of *P. japonicus* come from depth range 35-45m. All depths, within the range yielding *P. latisulcatus*, may be equally likely to give the same catch per hour. The total length of *P. japonicus* may exhibit a nonlinear relation against depth. Large lengths of *P. japonicus* are mostly from depths deeper than 50 m.

Catches per hour of *P. japonicus* during the night are about twice as high as during daytime. In addition, catches per hour at night have higher variability. Furthermore, the number of night tows yielding the species is more than 1.5 that of the daytime. *P. latisulcatus* is caught only at night. Consequently, in terms of economy, for shrimp species, night trawling may be more profitable.

At the time of the shrimp activity, it is being available to bottom trawlers. Al-Kholy and El-Hawary (1970) reported nocturnal activity for five recorded Penaeid shrimps from the Gulf of Suez, spending the day hidden the whole body in the sediment, except the eyes, end of rostrum and antennae and forage at night. They observed more catch by night for the main three large Penaeid shrimps from the Gulf of Suez. During an experiment, Zaghloul (1995) observed that *P. japonicus* from the Gulf of Suez, is active during darkened times of the day as well as during night time. The same behaviour was reported for ***Metapenaeus bennettae*** (Dall, 1958 and Racek, 1959), for *P. duorarum* (Fuss and Ogren 1966), for *P. azetecus* (Duronslet *et. al.*, 1972 and Matthews *et. al.*, 1991) and *P. merguiensis* (Hindley, 1975). Lee *et al*, (1996) reported diurnal vertical migration, upward migration for feeding in the night and downward in the day occurred for three species of commercially important sergestid shrimps in the coastal waters of Taiwan. Dall (1958) stated that many of the penaeid prawns are nocturnal, spend most of the day buried in sediment and emerged to forage at night. The penaeid nocturnal activity may be to avoid their predators (Matthews *et. al.*, 1991) or a high daytime temperature (Hindley, 1975).

Day-night times may have no significant influence on the length catchability variation of the *P. japonicus*.

Regarding the lunar cycle, it may be concluded that the first quarter moon phase time, the neap tide time is significantly more productive in catch per hour, about two times, than the full moon phase, the spring tide time for the shrimp *P. japonicus*. The available data for *P. latisulcatus* shows a significant higher mean of catch per hour, for the first quarter of the moon time, than during the full moon phase time, more than 3.5 times. Nearly the same was reported for the catches per hour of *P. semisulcatus* and *P. escalentus* from the Gulf of Carpentaria, which exhibit significant peak during the neap tide but of the third quarter of the moon (Salini *et. al.*, 2001).

During the semidark light, penaeids behave the same nocturnal food searching activity (Dall, 1958; Racek, 1959; Fuss and Ogren, 1966, Duronslet *et. al.*, 1972; Matthews *et. al.*, 1991; Zaghloul, 1995). Thus, shrimps *P. japonicus* and *P. latisulcatus* may behave a significant vertical migration during the full moon days to forage. They may use the spring high tidal currents to move away out of the fishing area to the inter-tidal zones where the earthworms and other food organisms may be distributed and nocturnal active. Such movement may significantly decrease the availability of the shrimps to the industrial bottom trawlers during the spring tides.

The higher activity of the vertical migration of *P. japonicus* during the spring tide time and drifting of the shrimp, especially the smaller individuals to the inter-tidal zones by the high tide may decrease their catchability and increasing the mean length of the tow catch. Inversely, during the neap tide time, all the specimens' lengths may be available.

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