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CATCHABILITY OF RED MULLETS (UPENEUS SPP.) FROM NORTH WEST RED SEA DURING AUTUMN

ALY YOUSIF[*1] AND MANAL M. SABRAH
National Institute of Oceanography and Fisheries, Suez

Key words: Upeneus spp., Upeneus japonicus, red mullets, bottom trawl survey; Gulf of Suez.

ABSTRACT

Catch of red mullets, *Upeneus spp.,* occupies the fifth order among the commercially important species in the trawl fishery of the Gulf of Suez and its adjacent area. Red mullets were found in about 61% of the trawled stations, spreading over most of the Gulf and the adjacent area. They were found in sandy and sandy muddy bottoms. CPH of *Upeneus spp.* increases southward to reach its maximum in the adjacent area. Mean length of *U. japonicus* increases southward but decreases in the adjacent area. El-Sokhnna Bay, the eastern side of the south of Gulf and the adjacent area may act as nursery grounds for *U. japonicus*. Depth had a significant effect on the catch per hour (CPH) of *Upeneus spp.* and on the mean length per trawling operation of *U. japonicus* Daytime 12:00-18:00 hr showed significantly higher mean CPH of *Upeneus spp.* with a smaller mean length of *U. japonicus*. Semidiurnal tidal current has no significant effect on CPH of *Upeneus spp.*, while it significantly affects mean length of *U. japonicus*. Full moon phase exhibited significantly higher mean CPH of *Upeneus spp.* and larger mean length of *U. japonicus*.

* Corresponding author: PO Box 371, Suez, Egypt.

INTRODUCTION

Rational management of commercially important fish stocks requires monitoring changes of their abundances. Scientific bottom trawl surveys are the most reliable to estimate the abundances of the ground fishes, overcoming the uncertainties inherent in using commercial catch data. Natural behaviour of the fish stocks may influence the reliability of the bottom trawl surveys (Godø, 1994). Diurnal, feeding habit, bottom depth or fish density induced horizontal or vertical migration alter the availability of the fish stocks and hence their catchability (Beamish, 1966; Engås & Soldal, 1992). Modeling the dynamics of the fish vertical migration and distribution using the involved environmental and biological parameters is essential to have adjusted abundance indices (Godø, 1994).

Mamuris *et. al.,* (1999) studied the genetic differences among four mullid species and found some of them are genetically close. Goatfishes feed on small benthic crustaceans, worms, mollusks and small fish (Hureau, 1986; Vassilopoulou & Papaconstantinou, 1992; Labropoulou *et. al.,* 1997; Platell *et. al.,* 1998). They are reef dwellers. They have long chin barbels with which they probe the reef surface or sandy bottoms around it. Once a goatfish locates a prey with its barbels, it sucks it up with its flexible, slightly subterminal mouth. Goatfishes could be either nocturnal or diurnal, depending on the species (Moyle & Cech, 1989).

Fishermen usually have difficulties to separate goatfishes (Mullidae) into different species. Therefore, they are considered in the commercial catch statistics as one catch category. Annual catch of the mullids

1. Corresponding author

constitutes the fifth category in the trawl catch hierarchy (Yousif, 1991).

Landings of goatfishes from the Gulf of Suez and adjacent area suffer deep fluctuations (Fig., 1). No doubt, the ground fishery of mullids in the Gulf needs routine scientific surveys in order to find out the appropriate scientific management tools. The present study is to shed light on some behaviour features of mullids to bottom trawling. Using such information is essential during the data analysis of the bottom trawl survey for good precision and accuracy of the results.

MATERIALS AND METHODS

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

Boat Specifications:

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

Fishing set specifications:

The trawl net was of the Italian, Mediterranean type, length 27 m., ending with a 5.5 m covered codend. The headline was 2.2m while the ground rope was 2.4 m. The headline was furnished with 16 floats. The ground rope was supported by 11 chains, each chain was 1.5 kg.

The otter board was made of steel, weighing 115 kg. The otter boards were attached to the two sides of the net by two sweep lines; each 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:

This survey covers the area between latitude 29^{0} $49.5^{\backslash}$ N of the Gulf down to 27^{0} $56^{\backslash}$ at the south of the Gulf. The area between latitude 27^{0} $56^{\backslash}$ and 27^{0} $30^{\backslash}$ is what we call the adjacent area. The Gulf was of longitudinally 4 sectors (I, II, III & IV) and the fifth sector, S, was the adjacent area (Fig., 2). Using the main navigation channel as a geographical separator, the eastern and western sides of the Gulf were considered separately, in addition to the main channel.

- Latitudes of the proposed sectors and regions for the Gulf of Suez.

Data analysis:

On deck, no segregation according to species was done. All species are collected and aggregated into one catch category. Therefore, CPH was investigated for the whole catch category of the red mullet species. However, samples taken for further study were separated into species. ***Upeneus japonicus*** was the most dominant species in the most collected samples and constituted about 70% of these samples. Thus, length frequency analysis was only done for that species.

To find out the relationships of the different variables, the multiple regression module and the nonlinear module with Quasi-Newton method were used. The comparison between groups was performed using the non-parametric Kruskal-Wallis ANOVA method (Bhattacharyya and Johnson, 1977), 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 snout to the posterior end of the upper fork of the tail (to the nearest 1 cm).

CPH (kg/hr): It is the catch weight of the trawling operation of ***Upeneus spp***., in kilograms, divided by the duration of the trawling operation, in hours.

RESULTS

Catch of the red mullets was found to comprise the following species; ***Upeneus japonicus***, ***U. tragula***, ***U. vittatus*** and ***U. sulphureus***. It was found that ***Upeneus japonicus*** constituted more than 70% of the samples collected on deck of family Mullidae from the bottom trawl fishery in the Gulf of Suez.

i. Geographical Distribution.

Red mullets were fished from 51 stations (Fig., 2), constituting about 61% of the total trawled stations (84 stations). Eastern and western sides of the Gulf, the main channel for navigation and the adjacent area, all yielded red mullets.

ii. Regional distribution:

1. CPH of *Upeneus spp*.

a) Both sides of the Gulf, (Table, 1):

<u>Eastern Side</u>: The percentage of the number of the trawling operation that yielded mullids, with respect to the total number of the trawling operations in the region, were 36%, 0%, 90% and 75% for the first, second, third and fourth regions (E1, E2, E3 & E4) respectively. In the second region (E2) no red mullets were detected in the catch. The smallest CPH was noted in the first region (E1), 1.5 kg/hr. The highest CPH, 6.0 kg/hr, was caught from the fourth region (E4). Mean catch rates for the eastern three regions, E1, E3 and E4 were not significantly different, $p<0.3983$.

<u>Western Side</u>: The percentage of the number of the trawling operations that yielded mullids, with respect to the total number of the trawling operations in the region, were 33%, 28%, 66% and 100% for the first, second, third and fourth regions (W1, W2, W3 & W4) respectively. The second region (W2) produced the smallest CPH, 0.5 kg/hr, as compared to the other regions of the same side. CPH increased southerly, as in the eastern side, to attain its maximum, 12.9 kg/hr in the fourth region (W4. Means of catch rates from the western four regions were not significantly different ($p<0.1227$).

The mean catch rate of each of the three eastern regions (E1, E3 and E4) was compared with that of the paralleled western regions (W1, W3 and W4). They were not significantly different (Table, 1). Both the entire eastern (E) and western (W) sides of the Gulf showed insignificantly different means of catch rates ($p<0.9113$).

b) Along the Gulf and Adjacent Area, (Table, 3):

In general, CPH increased southward. The second region (II) produced the smallest CPH 0.5 kg/hr. The adjacent area showed the maximum value of CPH, 11.2 kg/hr, with the widest range.

The mean values of CPH from the areas (I, II, III & V) in the Gulf were not significantly different ($p<0.0582$). By adding the adjacent area, we noticed that the mean values of CPH of the different sectors were significantly different ($p<0.0323$).

2. Length Distribution of *U. japonicus*:

a) Both sides of the Gulf:

<u>Eastern Side</u>: As was cited before, the trawling operations in the second region (E2) did not yield any of *U. spp*. In general, the mean length of ***U. japonicus***, fished from the eastern side, increased southwards (Table, 2) attaining a maximum size of 13.0 cm, in the fourth region (E4). The first region (E1) exhibited the smallest mean length, 12.3 cm. The mean lengths of fish from the eastern regions E1, E3 and E4 were significantly different, $p<0.0001$.

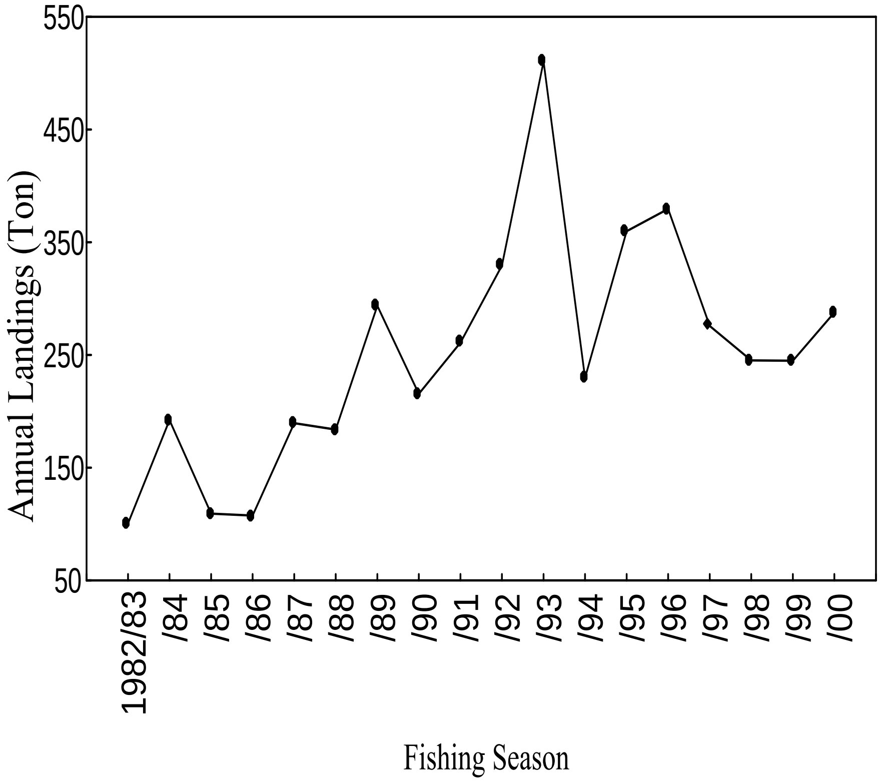

Fig. (1). Seasonal Landings of *Upeneus spp.* from the commercial trawl fishery of the Gulf of Suez and the adjacent area. Data from the General Authority for Development of Fish Resources.

Sector	**Western Side**		**Eastern Side**	
	Region	**Latitudes**	**Region**	**Latitudes**
I	**W1**	$29^{0}\ 49.5^{\prime}$ (Ras Adabiya)	**E1**	$29^{0}\ 50^{\prime}$ (Ras Misalla)
		$29^{0}\ 23^{\prime}$ (Ras Abu Daraq)		$29^{0}\ 27^{\prime}$
II	**W2**	$29^{0}\ 23^{\prime}$ (Ras Abu Daraq)	**E2**	$29^{0}\ 27^{\prime}$
		$29^{0}\ 07^{\prime}$ (Ras Zaafarana)		$29^{0}\ 13^{\prime}$
III	**W3**	$29^{0}\ 07^{\prime}$ (Ras Zaafarana)	**E3**	$29^{0}\ 13^{\prime}$
		$28^{0}\ 30^{\prime}$ (Fals Ras Gharib)		$28^{0}\ 34^{\prime}$
IV	**W4**	$28^{0}\ 30^{\prime}$ (Fals Ras Gharib)	**E4**	$28^{0}\ 34^{\prime}$
		$27^{0}\ 49.5^{\prime}$ (Umm El Kiman)		$27^{0}\ 56^{\prime}$ (Ras Kenisa)

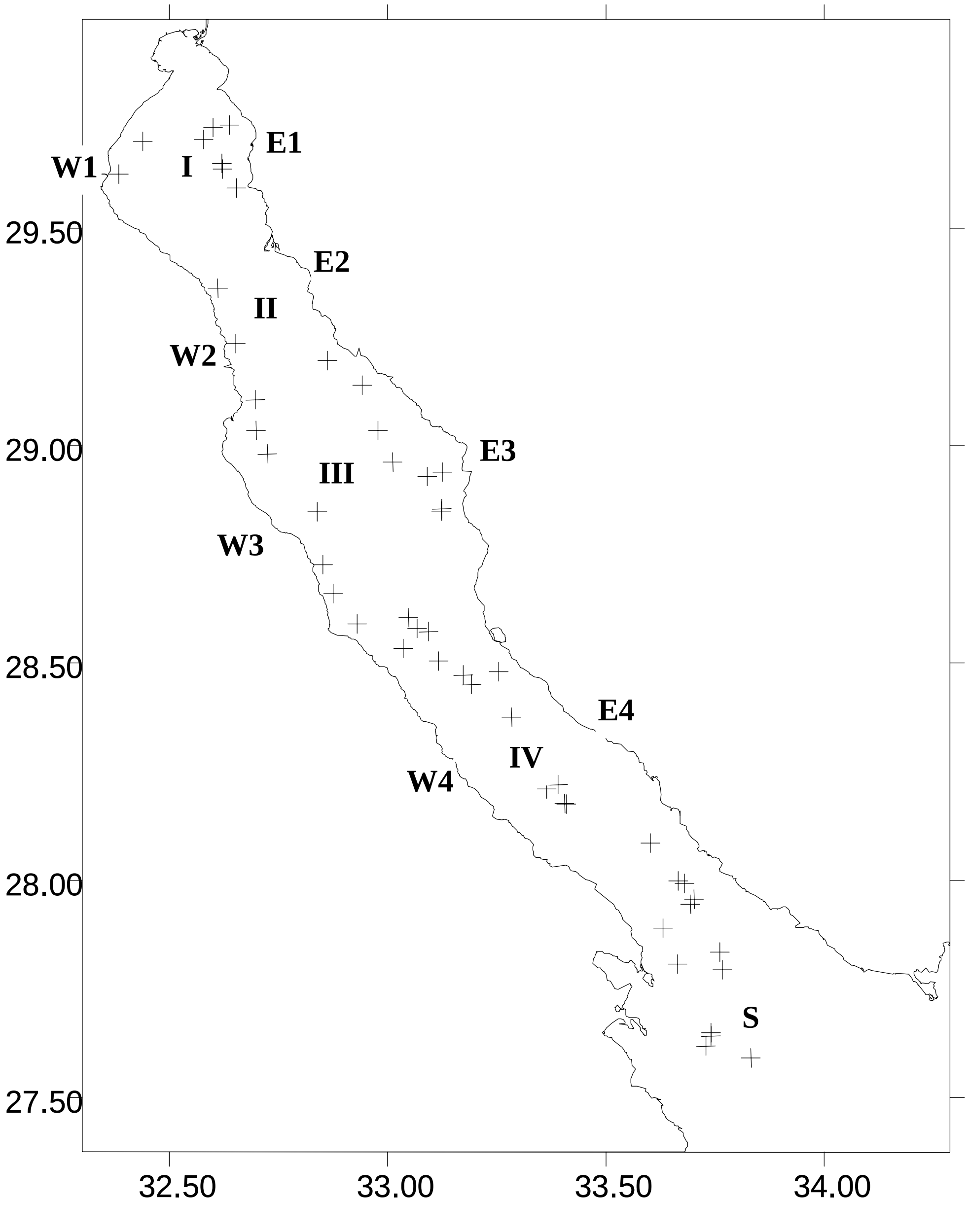

Fig. (2). Geographical distribution of trawling operations with *Upeneus spp.* from the Gulf of Suez during the autumn survey, 1998.

Table (1). Regional distribution of CPH of ***Upeneus spp***. in the Gulf of Suez, autumn survey, 1998.

Reg.	TN	N	Mean	Range	±SE	Reg.	TN	N	Mean	Range	±SE	P<
W1	9	3	1.4	1.1-2.1	0.309	E1	14	5	1.5	0.6-2.5	0.396	0.8808
W2	7	2	0.5	0.4-0.6	0.138	E2	3	-	-	-	-	-
W3	12	8	5.9	0.3-23.0	2.625	E3	10	9	2.9	1.1-6.1	0.579	0.6304
W4	2	2	12.9	4.7-21.2	8.241	E4	20	15	6.0	0.4-19.5	1.652	0.2330
P<	0.1227					P<	0.3983					
W	30	15	5.2	0.3-23.0	1.868	E	47	29	4.3	0.4-19.5	0.928	0.9113

Reg.: Region, TN: Total number of tows N: Number of tows yielded *U. spp*, SE: Standard error

In addition, the mid length of the peak of the length frequency distribution of ***U. japonicus*** increased southwards (Fig., 3). The trash fish in the fourth region (E4) comprised discarded small lengths of ***U. japonicus*** which had a peak at mid length of 8.0 cm (Fig., 4).

Western Side. The first region (W1) possessed the smallest mean length, 11.8 cm (Table, 2). The third and the fourth regions (W3 & W4) showed means of 12.6 cm and 12.5 cm respectively. The fish mean lengths of the three western regions (W1, W3 and W4) were significantly different (p<0.0001).

The modal length of ***U. japonicus*** also increased southwards (Fig., 5). The trash fish of the first region (W1) comprised discarded small lengths of ***U. japonicus*** with a peak at mid length of 9.0 cm (Fig., 6).

Upon comparing the mean length of ***U. japonicus*** from each region on the eastern side with that corresponding to it on the western side, it appeared that they were significantly different, p<0.0001 for each couple, with the exception of (E3 &W3). Regarding the mean length of the entire eastern side (E) and that of the western side (W) of the Gulf, they were significantly different (p<0.0001). b) Along the Gulf and Adjacent Area:

The mean length of ***U. japonicus***, in the different sectors, increased southwards (Table, 3) to attain its maximum (12.9 cm) in the fourth region (IV), accompanied by the widest range in lengths. However, the mean length dropped to be 12.1 cm in the adjacent area.

The means of fish lengths in the three areas of the Gulf (I, III & IV) and its adjacent area were significantly different (p<0.0001).

Table (2). Regional distribution of the mean length of *Upeneus japonicus* in the Gulf of Suez, autumn survey, 1998.

Reg.	NS	Mean	Range	±SE	Reg.	NS	Mean	Range	±SE	P<
W1	47	11.8	9-18	0.222	E1	124	12.3	8-19	0.152	0.0100
W2	-	-	-	-	E2	-	-	-	-	-
W3	291	12.6	10-18	0.078	E3	206	12.6	8-17	0.101	0.6771
W4	241	12.5	7-17	0.084	E4	801	13.0	6-20	0.074	0.0001
P<	0.0001				P<	0.0001				
W	579	12.5	7-18	0.056	E	1131	12.9	6-20	0.058	0.0001

NS: Number of specimens

Table (3). Distribution of CPH of Upeneus spp. and mean length of U. japonicus along the Gulf of Suez and the adjacent area (S) , autumn survey, 1998.

Sector	Catch Rate				Fish Length			
	N	**Mean**	**Range**	**±SE**	**NS**	**Mean**	**Range**	**±SE**
I	8	1.5	0.6-2.5	0.258	171	12.2	8-19	0.127
II	2	0.5	0.4-0.6	0.138	-	-	-	-
III	17	4.3	0.3-23.0	1.285	497	12.6	8-18	0.062
IV	17	6.8	0.4-21.2	1.7089	1042	12.9	6-20	0.060
S	7	11.2	0.9-39.6	5.079	412	12.1	9-18	0.079
P<	**0.0323**				**0.0001**			

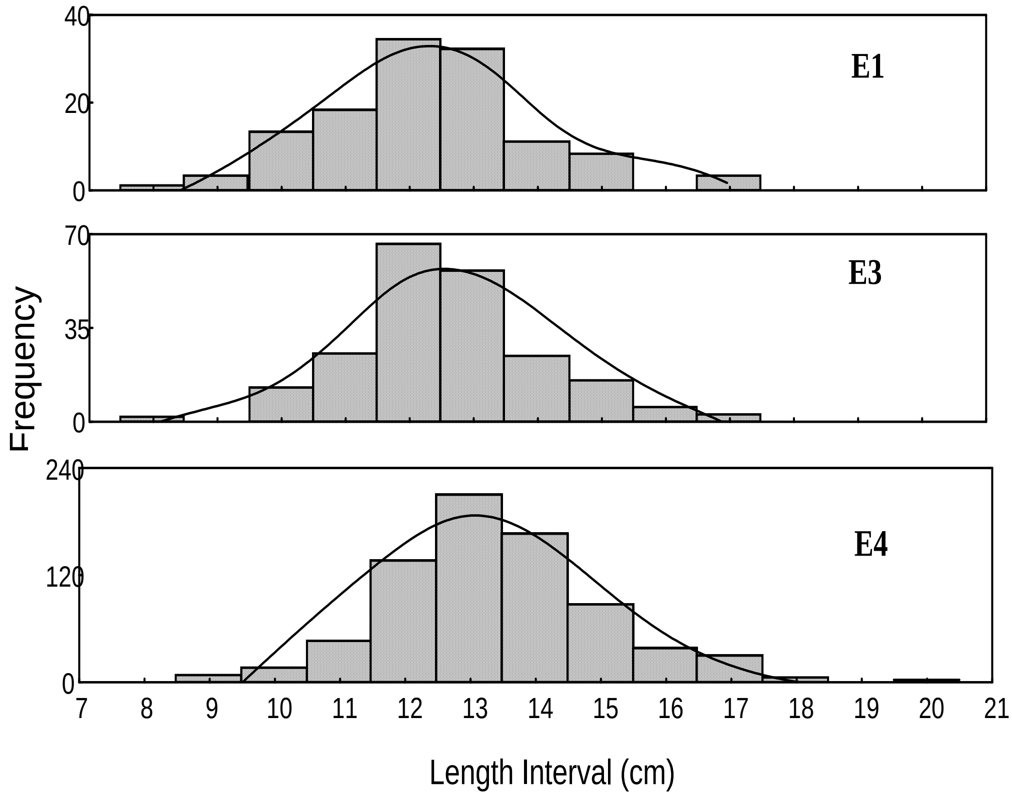

Fig. (3). Length frequency distributions of U. japonicus in the different eastern side regions of the Gulf of Suez, autumn survey, 1998.

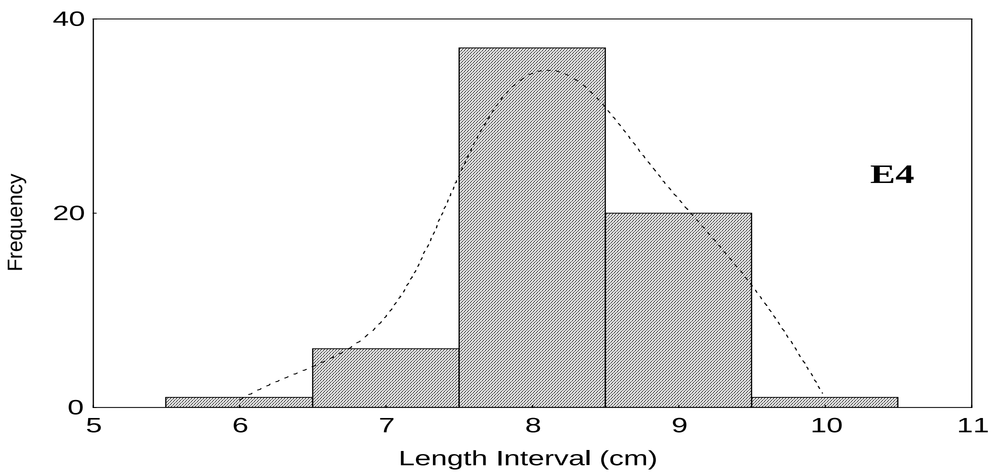

Fig. (4). Length frequency distribution of the small discarded specimens of ***U. japonicus*** from the fourth eastern region (E4) of the Gulf of Suez, autumn survey, 1998.

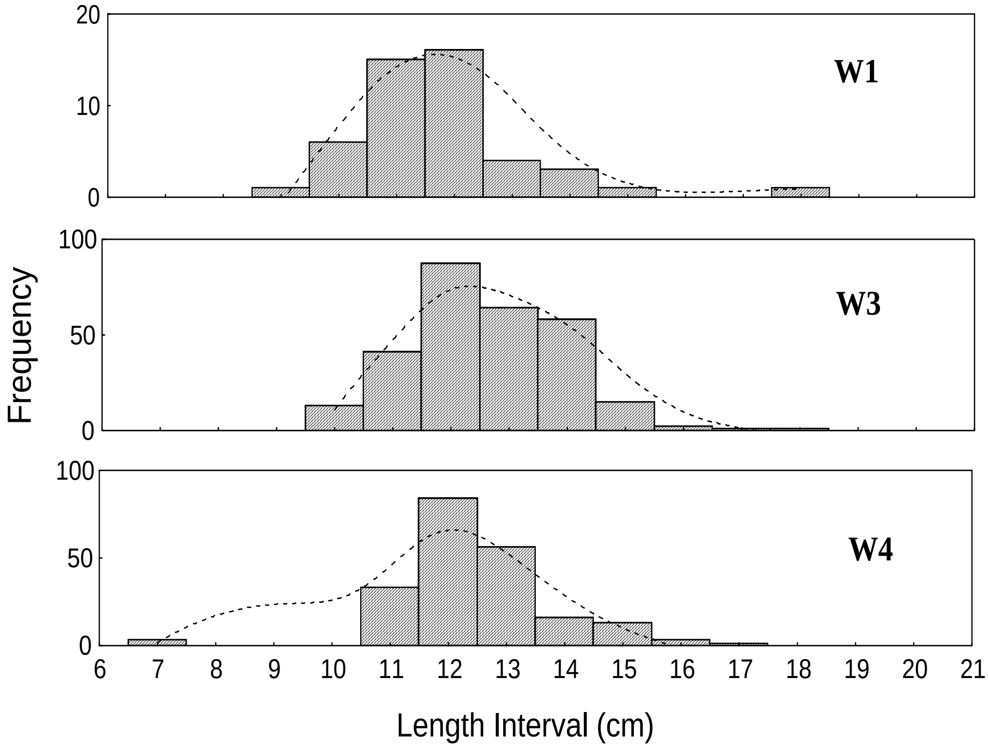

Fig. (5). Length frequency distributions of ***U. japonicus*** in the different western side regions of the Gulf of Suez, autumn survey, 1998.

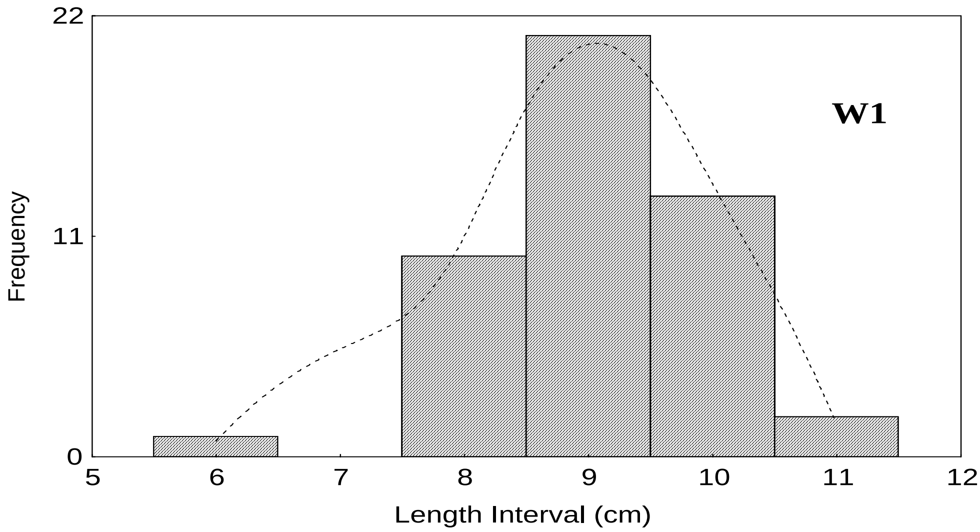

Fig. (6). Length frequency distribution of the small discarded specimens of ***U. japonicus*** from the first western region (W1) of the Gulf of Suez, autumn survey, 1998.

iii. Effect of Some Physical Factors

1. Nature of the sea bottom.

Red mullets were found in sandy and sandy muddy bottoms. In addition, red mullets were represented in the shots carried out in the sea-grass stations. They were not found in the muddy bottoms.

2. Depth.

a) Effect of depth variation on CPH:

Nearly, all the trawled depths yielded ***Upeneus spp***. The 51 trawled stations provided ***Upeneus spp***. varied in depth between 15.8 and 77.0m, with a mean of 48.3 ± 17.673m. CPH exhibited no clear systematic change with changing depth (Fig. 7). Mean CPH of the two depth categories ≤ 50m (26 trawling operations) and >50m (25 trawling operations) were 2.5 ±0.433 kg/hr and 8.6 ±1.914 kg/hr respectively. They were significantly different (p<0.0110).

a) Effect of depth variation on mean length of *U. japonicus*:

The length distribution of ***Upeneus japonicus*** was studied in 33 stations. The mean of fish total length (ML), per trawling operation catch, against the station depth (Dep) showed the following significant linear relation (Fig., 8):

$$ML=11.8 + 0.021\ Dep.$$

The correlation coefficient r of the regression analysis was 0.510 (p<0.0081).

3. Diurnal variation.

a) Diurnal variation of CPH:

There was no clear relation between CPH and mid time of trawling operation (Fig., 9). Mean CPH caught during daytime was 6.9 ±1.577 kg/hr (32 stations) and at night was 3.1 ±0.664 kg/hr (19 stations). However, these were not significantly different (p<0.1387).

The means of CPHs carried out in the afternoon, 12:00-18:00 hr (18 trawling operations) and those of the other times (33 trawling operations) were 10.1 ± 2.538 kg/hr and 3.0 ± 0.470 kg/hr respectively. They were significantly different (p<0.0065).

b) Diurnal variation of mean length of *U. japonicus*:

The catches of trawling operations performed during the time interval 12:00-18:00 hr showed smaller means of lengths of ***U. japonicus*** (Fig., 10). Mean length caught during the time interval 12:00-18:00 hr (16 stations, 1472 specimens) was 12.4 ±0.023cm and at the other times (17 stations, 588 specimens) was 13.1 ±0.028. They were significantly different (p<0.0001).

4. Semidiurnal tidal current.

a) Effect of tidal current on CPH:

The mean CPH of the low tide (26 stations) was 6.7 ±1.810 kg/hr and that of the high tide (25 stations) was 4.3 ±0.990 kg/hr. They were not significantly different (p<0.6376).

b) Effect of tidal current on mean length of *U. japonicus*:

The mean length of the low tide (1239 specimens, 17 stations) was 12.2 ±0.020 cm and that of the high tide (821 specimens, 16 stations) was 13.2 ±0.026 cm. They were significantly different (p<0.0001).

5. Lunar cycle.

a) Effect of lunar cycle on CPH:

Moon dates (8^{th}, 9^{th} and 10^{th}), the first three days of the spring tide, showed higher catch rates (Fig., 11). The mean CPH of these three moon dates (22 stations) was 10.0 ±2.043 kg/hr. The mean CPH of the remaining moon dates (29 stations) was 2.1 ±0.340 kg/hr. These two means of catch rates were significantly different (p<0.0001).

b) Effect of lunar cycle on mean length of *U. japonicus*:

Moon dates (7^{th} and 8^{th}) showed larger means of fish lengths of trawling operations catches (Fig., 12). The mean length of the specimens caught during these moon dates (8 stations, 428 specimens) was 13.7 ±0.021 cm. The mean length of the specimens caught during the remaining moon dates (25 stations, 16.32 specimens) was 12.3 ±0.018 cm. These two means were significantly different (p<0.0001).

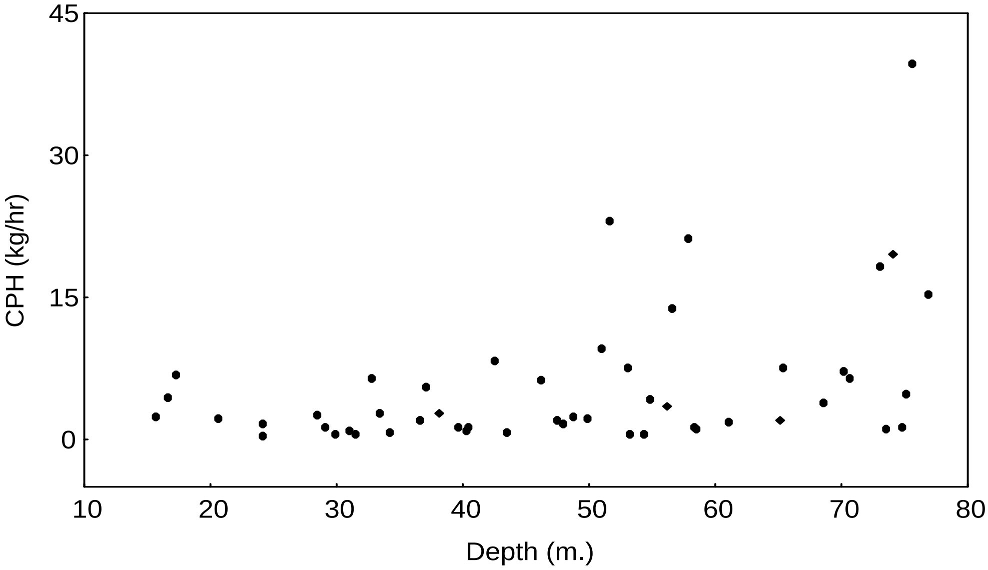

Fig. (7). CPH against depth for ***U. spp.*** caught from the Gulf of Suez and adjacent area, during autumn survey, 1998.

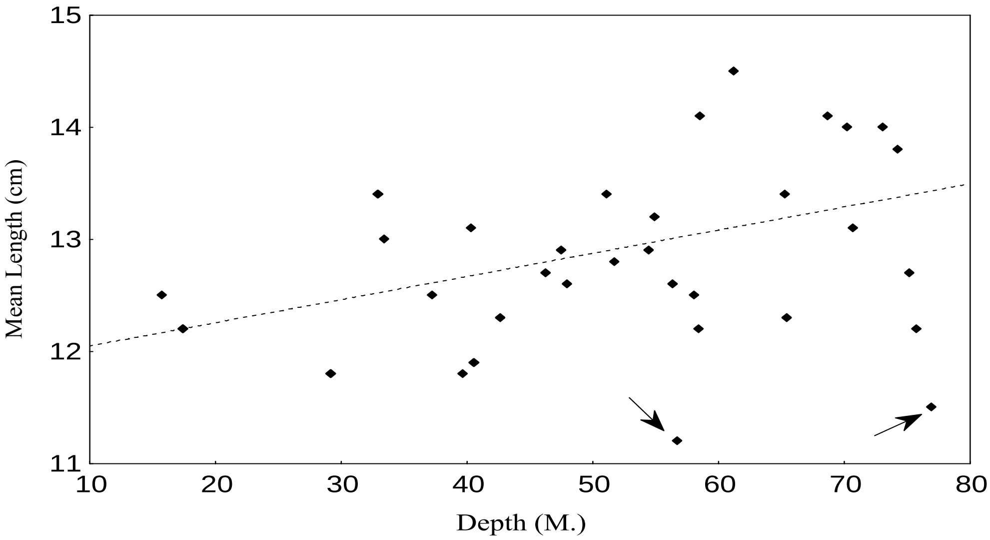

Fig. (8). Mean length against depth for *U. japonicus*, and the fitted line, caught from the Gulf of Suez and adjacent area, during autumn survey, 1998. (The arrowed points are outliers).

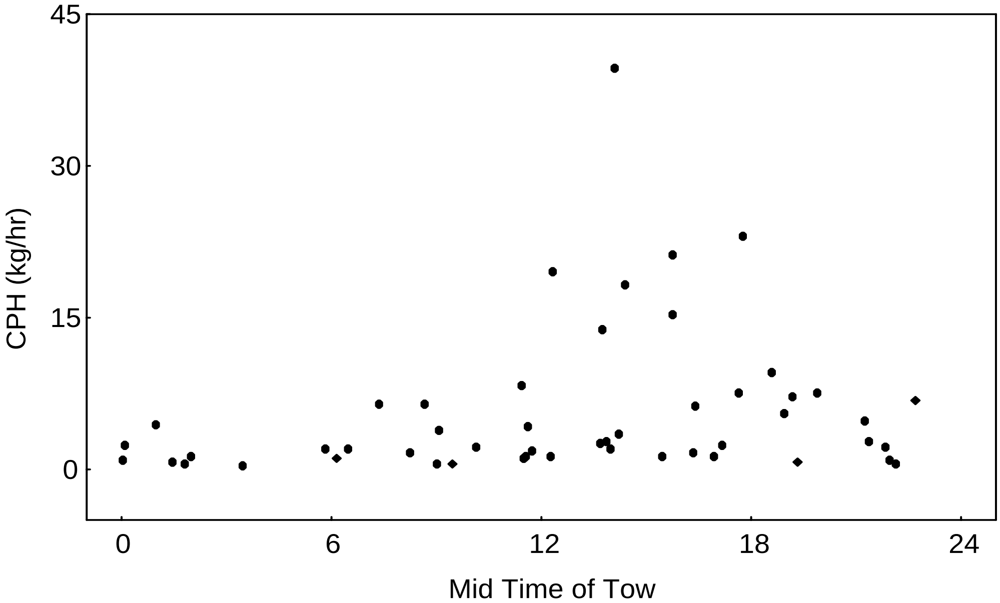

Fig. (9). CPH against mid time trawling operation for ***U. spp***. caught from the Gulf of Suez and adjacent area, during autumn survey, 1998.

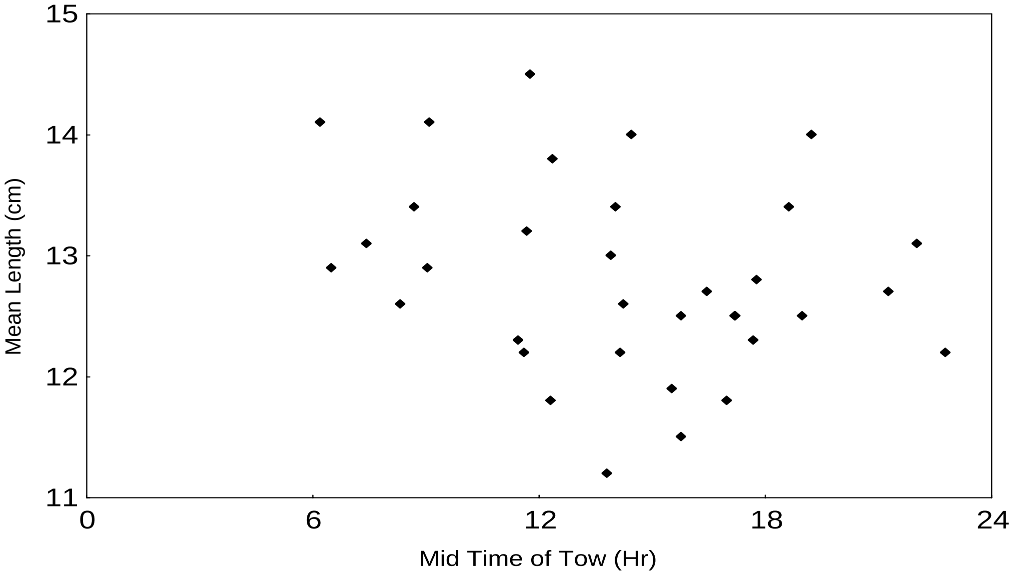

Fig. (10). Mean length against mid time trawling operation for *U. japonicus* caught from the Gulf of Suez and adjacent area, during autumn survey, 1998.

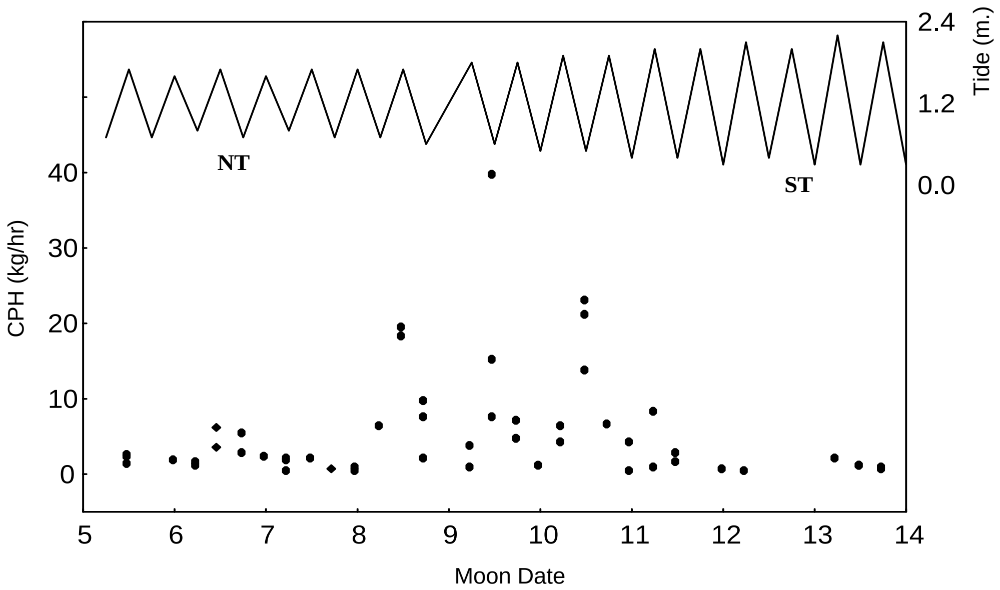

Fig. (11). CPH against moon date (including the semidiurnal tide) for *U. spp.* caught from the Gulf of Suez and adjacent area, during autumn bottom trawl survey, 1998.
NT: Neap Tide, ST: Spring Tide.

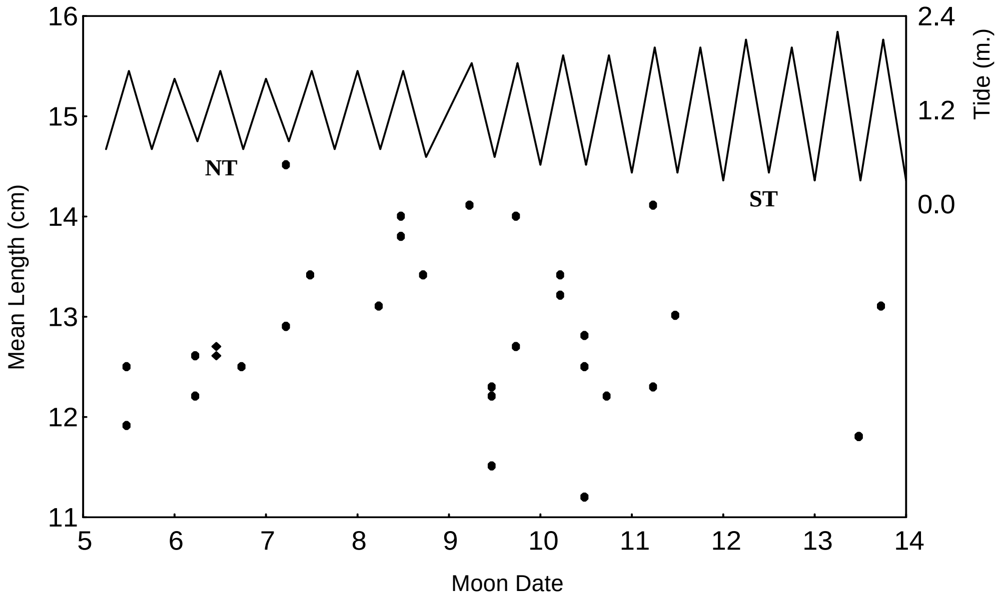

Fig. (12). Mean length against moon date (including the semidiurnal tide) for U. japonicus caught from the Gulf of Suez and adjacent area, during autumn bottom trawl survey, 1998.

DISCUSSION

The bottom trawl survey of the present study showed that fishing grounds of *Upeneus spp.* constitutes more than 61% of the total trawlable area in the Gulf of Suez. Generally, the percentage of the fishing grounds for *Upeneus spp* to the trawlable area increases as we go southward, on both sides of the Gulf. It attains a maximum value in the adjacent area. All the trawling operations in the adjacent area yielded *Upeneus spp*.

Concerning CPH of *Upeneus spp.*, on both sides of the Gulf, eastern and western of each area may form one unit. As in the case of the fishing grounds, the CPH increases southwards along both sides of the Gulf and attain its maximum in the adjacent area. It may be concluded that the most productive area is on the south of the Gulf and the adjacent area. The distribution of the coral reefs increase southward along the Gulf to attain the highest distribution in the adjacent area. Such environment saves a proper habitat for *Upeneus spp.* Moyle and Cech (1988) reported that goatfishes are reef dwellers, they use their barbells to probe the reef surface or sandy bottoms around a reef for benthic invertebrates or small fish.

According to the present results, it has been found that the mean length of *Upeneus japonicus*, increases as we go southwards on both sides of the Gulf. The west side of the first area, El-Sokhnna Bay, (W1) and the east side of the fourth area (E4) are characterized by the small fishes, including juveniles. El-Sukhnna Bay yields relatively high catch rates and small lengths of *U. japonicus*. It is a shallow wide Bay bordered by much of inshore distributed coral reefs. El-Sokhnna Bay is the richest region along the Gulf in zoobenthos (EIMP, 1999 and Emara, 1999) that can be considered as the main food items for adults and juveniles of this species (Moyle and Cech, 1988; Sommer *et al.*, 1996). Such environment saves the proper context for living of *U. japonicus*. Accordingly, El-Sukhnna Bay may act as a nursery ground for *U. japonicus*. Likewise, the presence of the small fishes including juveniles in the trash fishes of the fourth eastern region (E4) may reveal that it is a nursery ground for this species also. Similarly, the adjacent area has the smallest commercial mean length of *U. japonicus*. In addition, it is characterized by the distribution of many coral reef batches offering an appropriate environment for the living of the goatfishes. Therefore, the coastal waters of the adjacent area might act as a nursery ground for *U. japonicus*, as well.

From the present results, it appears that the fishery grounds of the red mullets are of sandy and sandy muddy types. Some fishing areas comprise sea grasses. Sommer *et. al.,* (1996) reported sand and mud bottoms for *Upeneus tragula* off Somalia. Boraey and Soliman (1987) found *U. sulphureus* in soft bottom off Safaga. Randall *et. al.,* (1993) stated *U. japonicus* from sandy bottoms.

In the present study, red mullets are found at a depth range of 15.8-77.0m. Kumaran and Randall (1984) reported a depth range of 10-40 for *U. sulphureus*. Randall *et. al.,* (1993) recorded *U. japonicus* from depth range of 20-200m. Although, CPH may not show a systematic change with changing depth, depth greater than 50m may significantly yields higher CPH more than 3.4 times that is yielded from depth shallower than 50m. Mean length per trawling operation for *U. japonicus* significantly increases with increasing depth in a rate of 0.021 after the length of 11.8 cm. Yousif (2004) reported such phenomenon of increasing length with increasing depth for *Pomadasys stridens* from the Gulf of Suez.

Daytime is more productive and shows higher mean CPH for red mullets than trawling operations at night. Mean CPH caught during the daytime interval 12:00-18:00 is significantly about 3.4 times that of the other times. In addition, mean length of

U. japonicus caught during daytime 12:00-18:00 was significantly smaller than that caught in another time. Accordingly, red mullets from the Gulf of Suez, may behave active foraging during that time. Moyle and Cech (1988) stated that depending on the species, goatfishes can be either nocturnal or diurnal. Mazzola *et. al.,* (1999) investigated the diel feeding habits of juveniles of *Mullus surmuletus* and derived a unimodal trend in the daily rhythm of food consumption, with a peak in feeding between 12:00 and 20:00h.

Considering the semidiurnal tidal current, the mean CPH of *Upeneus spp.* during the low tide is more than 1.5 times that of the high tide. Mean length of *U. japonicus* of the high tidal current is significantly larger than that of the low current. The small fishes may not tolerate the high tide, staying in the reef batches avoiding the high tidal current and consequently being unavailable for trawlers. While, large lengths may bear the high tidal current and being available for trawlers more than the smaller goatfish sizes. On the other hand, during low tide, all lengths are active and being available causing higher catch rates. Michalsen et al., (1996) attributed the variation in catches of cod and haddock in the Barents Sea and Svalbard area, reprted by Engås and Soldal (1992), to a semidiurnal rhythm set by changes in the tidal currents.

The mean CPH of *Upeneus spp.* during the first three days of the spring tide (full moon phase) was significantly about five times the mean rate of the other moon dates. The mean length of *U. japonicus* of the beginning of the spring tide (full moon phase) was significantly larger than the mean rate of the other dates. It seems that the relation is to tide not to the moon phase. *Upeneus spp.* may use the relatively high tide of the beginning of the spring tide to reach the feeding area that is the fishing ground around the corals, increasing their availability to bottom trawlers. During the neap low tide and the spring vigorous tide, some of the goatfishes may prefer to probe food in the coral reefs decreasing their availability to trawlers.

REFERENCE

Beamish, F.W.H., 1966. Vertical Migration by Demersal Fish in the Northwest Atlantic. J. Fish. Res. Bd. Can., 23 (1), 109-139.

Bhattacharyya, G. K. and R. A. Johnson, 1977. Statistical Concepts and Methods. John Wiley & Sons, New York, 639p.

Boraey, F.A. and F.M. Soliman, 1987. Length-weight relationship, relative condition, and food and feeding habits of the goatfish *Upeneus sulphureus* Cuv. & Val. in Safaga Bay of the Red Sea. J. Inland Fish. Soc. India 19(2):47-52.

EIMP, 1999. Annual Report of Environmental Data from Coastal Areas of the Gulf of Suez, Red Sea proper and Gulf of Aqaba, Cairo, Egypt.

Emara, A. M., 1999. Surveillance and biological studies of the intertidal molluscs along the western coast of the Gulf of Suez, Egypt. Ph. D. thesis, Tanta Univ., Egypt.

Engås, A. and A. V. Soldal, 1992. Diurnal variation in bottom trawl catches of cod and haddock and their influence on abundance indices. ICES J. Mar. Sci. 49, 89-95.

FAO/UNDP, 1975. FAO regional fishery survey and development project, Doha (Qatar). Report of the Ad hoc working group on survey technique and strategy. Rome, FAO, (278): 45p.

Godø, O. R. (1994): Factors Affecting the Reliability of Groundfish Abundance Estimates from Bottom Trawl Surveys. In: Fernö, A., Olsen, S., (Eds.), Marine Fish Behaviour in Capture and Abundance Estimation. Fishing News Books, Oxford, England, pp. 166-199.

Gulland, J. A., 1975. Manual of methods for fisheries resources survey and Appraisal. Part5. Objectives and basic methods. FAO Fish. Tech. Pap., (145): 29p.

Hureau, J. C., 1986. Mullidae. P. 877-882. In P. J. P. Whitehead, M. L. Bauchot, J. C. Hureau, J. Nielsen and E. Tortonese (eds.) Fishes of the north-eastern Atlantic and the Mediterranean. UNESCO. Paris, Vol. 2.

Kumaran, M. and J.E. Randall, 1984. Mullidae. In W. Fischer and G. Bianchi (eds.) FAO species identification sheets for fishery purposes. Western Indian Ocean fishing area 51. Vol. 3.

Labropoulou M., A. Machias, N. Tsimenides and A. Eleftheriou, 1997. Feeding habits and ontogenetic diet shift of the striped red mullet, *Mullus surmuletus* Linnaeus, 1758. Fisheries Research Vol. 31 (3) pp. 257-267.

Mamuris, Z., C. Stamatis, M. Bani and C. Triantaphyllidis, 1999. Taxonomic relationships between four species of the Mullidae family revealed by three genetic methods: allozymes, random amplified polymorpic DNA and mitochondrial DNA Journal of Fish Biology. Vol. 55, No. 3, pp. 572-587.

Mazzola, A., L. Lopiano, T. La Rosa and G. Sarà, 1999. Diel feeding habits of juveniles of *Mullus surmuletus* (Linneo 1758) in the lagoon of the Stagnone di Marsala (Western Sicily, Italy). Journal of Applied Ichthyology, Volume 15 (3), 143-151.

Michalsen, K., Godø, O. R., Fernö, A., 1996. Diel variation in the catchability of gadoids and its influence on the reliability of abundance. ICES J. Mar. Sci. 53, 389-395.

Moyle, P. B. and J. J., Cech, 1988. FISHES: An Introduction to Ichthyology. 2nd ed. Prentice Hall, Englewood Cliffs, New Jersey, 559 p.

Platell, M. E., I. C. Potter and K. R. Clarke, 1998. Do the habitats, mouth morphology and diets of the mullids *Upeneichthys stotti* and *U. lineatus* in coastal waters of south-western Australia differ? Journal of Fish Biology, Vol. 52, No. 2, pp. 398-418.

Randall, J.E., M.L. Bauchot and P. Guézé, 1993. *Upeneus japonicus* (Houttuyn), a senior synonym of the Japanese goatfish *U. japonicus* (Temminck et Schlegel). Jap. J. Ichthyol. 40(3):301-305.

Sommer, C., W. Schneider and J. M. Poutiers, 1996. FAO species identification field guide for fishery purposes. The living marine resources of Somalia. FAO, Rome. 376 p.

Sparre, P and Venema, S. C. (1992): Introduction to tropical fish stock assement. Part 1. Manual. FAO Fish. Tech. Pap., (306): 376p.

Vassilopoulou, V. and C. Papaconstantinou, 1992. Feeding habits of red mullet (*Mullus barbatus*) in a gulf in western Greece. Fisheries Research Vol. 16 (1) pp. 69-83.

Yousif A. 1991. Biological and Fisheries Sudies on *Pomadasys stridens* in the Gulf of Suez. M. Sc., Suez Canal Univ. Egypt.

Yousif, A. 2004. Abundance of the striped piggy (*Pomadasys stridens*) in the NW Red Sea, Egypt. Egypt. J. Aquat. Biol. & Fish. Vol. 8, No. 3: 139-158.