

**STOCK ASSESSMENT AND MANAGEMENT OF LETHRINUS NEBULOSUS
(FAMILY LETHRINIDAE) OF QATAR WATERS, ARABIAN GULF.**

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ABSTRACT

Samples of *Lethrinus nebulosus* from the trawl catch of Qatar waters were analyzed Bi-monthly during May, 1987 to April, 1988. Age was determined by both scale examination and length frequency distribution.

The VBGR parameters were estimated as:

$K = 0.145$, $t_0 = 0.47$ years, $L_{\infty} = 85.8$ cm

The fish reaches its first maturity at 37 cm in total length. The age classes 5-7 were relatively rare in the trawling grounds, while abundant in the shallow and reef areas.

The trawl fishery studied is based almost entirely on 3-4 years old fish. This trawl fishery discards, overboard, all fish of less than 20 cm in total length.

The exploitation ratio of the mentioned species being around 0.5. The fishery will be aiming at overfishing condition unless some measures would be taken into consideration,

The total yield could be increased by about 30% if regulating both the minimum size in the catch and the trap mesh size operating in the spawning grounds.

INTRODUCTION

The drop in the shrimp landings of the 1980's in the Gulf countries, apparently associated with overfishing, caused a significant concern for the fisheries welfare of the region. It drew attention to the need for assessment and fisheries management. At the same time, interest was expressed in the possibility of expanding Qatar fish landing to confirm food supply safety, as well as exporting the surplus for diversification of the national income.

The objectives of the present study are to assess the current condition of one of the commercially important fish species in Qatar waters and to create a sufficient degree of awareness about the status of the fisheries in Qatar for management recommendations to be implemented in the future if so needed.

Family Lethrinidae was selected in this regard due to its important role

in Qatar fish landing. The family is represented in the total landing of the country by about 26%, and by about 54% of Qatar National Fishing Company (QNFC) landing of 1987. The family is represented in Qatar waters by four species namely, *Lethrinus nebulosus*, *L. lentjan*, *L. miniatus* and *L. kallopteurs*. In terms of abundance; they were represented in QNFC landing by : 45, 45, 6 and 4% respectively, while by 50, 30, 5 and 25% respectively in the artisanal fisheries of the country.

Lethrinus nebulosus was so selected among the other mentioned species of the family due to the fact that it is the most abundant, the largest in maximum size and it fetches higher prices. Besides, some biological studies on the fish are being published by the present authors elsewhere.

MATERIALS AND METHODS

The landings of the bottom trawler "Gazelle" of QNFA, during her regular fishing trips in Qatar waters, were sampled bi-monthly during the period from May, 1987 to April, 1988. Sampling included, among other things, length frequency distribution to the nearest mm landing, effort, species composition and scale samples.

Each sample was based on three fish baskets (ca. 40 kg each) of any one of the fishing trips picked at random twice a month. On some occasions of pooling the catch of the three bottom trawlers, owned by QNFC, prior to analysis, and/or when landing was categorized into marketable-size before sampling; one basket of each category was picked at random for analysis and the results were adjusted accordingly.

The fishing ground is located on the eastern side of Qatar with the most frequent area between 25°20' - 25°55' N and 52°25' - 52°50' E. The salinity varies around 39‰, the temperature of the near bottom waters varies between 18-22°C, while at the surface it varies between 16-32°C between January and August. The depth is confined to 15-20 fathom isobath and the predominant type of bottom is muddy-sand.

The type of the trawl net being used by the vessel is an Engle's Balloon Bottom Trawl 527 meshes circ. by 200 mm stretched mesh designed for a stern trawler with 600 HP main engine. The meshes of the net were: Wings 200 mm, Belly 200 mm, 160, 120, 80, 40 and codend 40 mm. Each fishing trip lasted between 3-4 days, and the landing of the three trawlers were, some times, pooled together to be shipped via one of the vessels to their land base.

Length at age data, as estimated from the mean of both the body scales and the length frequency distribution utilizing the integrated method as described by Pualy, 1983 were used to estimate the Von Bertalanffy Growth Formula (VBGF).

The total mortality rate (Z) was estimated from the mean length in the

by means of Beverton and Holt formula, (1956) as follows:

$$Z = K (\bar{L} - L_{\infty}) / (\bar{L} - L)$$

where: K and L_{∞} are the VBGF parameters,

\bar{L} is the mean length in the catch,

L is smallest fish length in the catch.

The natural mortality rate (M) was calculated from both the mean environmental temperature in which the fish lives which is between 18-30°C with a mean of 25°C and the value of L according to the derivation of Pauly (1980).

The fishing mortality (F) was calculated as:

$$E = Z - M$$

where parameters are as above.

The exploitation ratio (E) was estimated according to Gulland (1971) as:

$$E = F / (F + M)$$

The population parameters derived from these analysis were used in conjunction with the length-weight relationship and the length at age data in a yield/recruitment analysis utilizing Ricker's integrative method, 1975.

The population parameters derived from these analyses were used in conjunction with the length-weight relationship and the length at age data in a yield/recruitment analysis utilizing Ricker's integrative method (1975).

Based on both the scale examination and the integrated method of the length frequency distribution as described by Pauly (1981) (Ibrahim, et al., in press) gave the mean growth parameters of the VBGF of *Lethrinus nebulosus* from Qatar waters during the same period of this study as:

$$K = 0.145, \quad t_0 = 0.47 \text{ years}, \quad L = 85.8 \text{ cm}$$

They also estimated the following relationships:

$$\text{Length - weight relations as: } W = 0.02 * L^{2.89}$$

$$\text{Length - Depth relationship as: } D = 0.564 + 0.322 (L)$$

$$\text{Scale radius - Body length as: } L = 0.88 (S) - 3.52$$

(NB: L and D are in cm and S is in micrometer).

Table 1 represents the monthly percent of the length frequency distribution of *L. nebulosus* during the period of the study together with the numbers of fish encountered in the fishing trips. The total body lengths are arranged into two cm length intervals.

TABLE 1
Percentage length frequency distribution of
Lethrinus nebulosus in the trawling grounds of Qatar
waters during the months May 1987 to April 1988, and
the average number of fish/fishing trip/month/trawler.

L E C M L G A T S H S Cm.	Year And Month											
	1987						1988					
	5	6	7	8	9	10	11	12	1	2	3	4
22	-	-	0.8	-	-	0.5	-	-	-	-	-	0.4
24	1.1	4.2	1.6	-	1.7	10.9	13.2	5.2	-	0.8	-	3.1
26	14.7	14.6	4.1	6.4	3.5	9.3	23.1	19.6	3.9	4.1	8.7	5.8
28	22.5	7.3	4.1	13.6	8.0	0.1	-	7.8	17.3	3.3	17.6	4.3
30	17.4	8.3	8.2	10.7	17.7	9.2	3.1	6.0	12.0	21.8	25.2	4.6
32	14.6	13.5	17.7	24.6	18.5	10.7	8.7	5.5	19.8	22.3	15.4	10.6
34	13.1	15.1	18.5	27.6	24.7	9.6	5.2	16.8	21.5	13.8	6.9	25.0
36	3.4	14.5	10.1	6.9	12.8	4.3	6.4	10.8	6.1	6.4	7.8	25.0
38	4.4	7.2	6.7	3.0	4.6	0.6	11.7	8.4	3.7	2.1	9.8	8.3
40	1.2	9.3	10.1	-	0.9	0.4	9.0	7.6	5.6	2.1	1.4	-
42	1.0	-	1.9	-	-	-	4.8	3.0	1.7	-	0.7	-
44	1.0	-	-	-	0.4	-	4.0	4.4	-	-	1.0	-
46	0.7	-	0.9	0.4	-	1.1	0.6	1.6	0.5	-	0.7	-
48	1.0	-	0.9	0.7	-	0.5	0.6	1.0	-	1.6	0.7	-
50	0.3	-	-	0.7	1.9	2.2	-	0.6	0.5	-	1.0	1.6
52	0.7	0.4	2.9	0.8	0.4	0.5	0.6	-	1.9	-	0.3	-
54	0.7	0.4	3.9	1.1	1.5	3.2	3.8	1.0	0.5	-	1.4	0.8
56	0.7	-	1.9	0.7	0.4	-	1.9	-	1.9	6.2	0.3	2.4
58	0.7	0.4	0.9	1.8	1.6	1.6	1.3	0.3	1.4	1.6	0.3	1.6
60	0.3	0.4	0.9	0.4	0.4	1.1	1.3	-	1.4	6.2	-	2.4
62	-	2.0	0.9	0.4	0.4	-	0.6	-	-	4.7	0.7	1.6
64	0.3	0.4	2.9	-	0.8	-	-	0.3	0.5	3.1	-	2.4
66	-	-	-	-	-	0.5	-	-	-	-	-	-
68	-	-	-	-	-	0.5	-	-	-	-	-	-
F	5	3	1	2	2	2	4	3	3	2	2	1
M 1	1	3	6	3	2	4	5	3	1	4	5	6
O 5	5	1	7	5	3	0	9	6	0	0	0	0
N	2	6	8	1	7	2	0	6	7	7	8	1

Utilizing the previously mentioned parameters values of Ibrahim et al., (in press) and the data of Table 1; the length at age data is represented as monthly percent age-class frequency distribution in Table 2. Then, utilizing the length-weight relationship, mentioned above, to the mid of each length class of Table 1 to calculate the monthly percent weight distribution pertaining to each age-class during the study period, together with the actual mean landing per fishing trip. The results are presented in Table 3.

TABLE 2
Percentage length at distribution of
Lethrinus nebulosus in the trawling grounds of Qatar
waters during the months of May, 1987 to April 1988.
The average for the whole period is shown.

A G E C A T G O R Y	1987												1988				A V E R A G E																		
	M O N T H S												M O N T H S																						
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8																			
2	17.1	0.0	0.0	0.8	0.0	0.0	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.8	2	17.1	0.0	0.0	0.8	0.0	0.0	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.8	
3	26.3	63.0	41.2	26.8	43.2	40.2	45.9	43.8	41.4	42.1	41.2	39.5	32.2	63.8	40.2			3	26.3	63.0	41.2	26.8	43.2	40.2	45.9	43.8	41.4	42.1	41.2	39.5	32.2	63.8	40.2		
4	34.4	28.2	44.0	44.2	49.8	51.4	27.9	27.7	38.8	41.2	39.5	32.2	63.8	40.2				4	34.4	28.2	44.0	44.2	49.8	51.4	27.9	27.7	38.8	41.2	39.5	32.2	63.8	40.2			
5	41.3	3.6	9.3	12.5	0.2	1.3	7.0	18.1	15.8	7.6	4.2	3.5	0.0	6.9				5	41.3	3.6	9.3	12.5	0.2	1.3	7.0	18.1	15.8	7.6	4.2	3.5	0.0	6.9			
6	47.3	1.7	0.0	1.4	1.6	1.9	3.3	0.9	2.4	0.8	1.6	2.1	1.6	1.6				6	47.3	1.7	0.0	1.4	1.6	1.9	3.3	0.9	2.4	0.8	1.6	2.1	1.6	1.6			
7	52.5	1.8	0.8	7.8	2.3	2.1	3.7	5.3	1.0	3.3	3.1	1.8	2.0	2.9				7	52.5	1.8	0.8	7.8	2.3	2.1	3.7	5.3	1.0	3.3	3.1	1.8	2.0	2.9			
8	57.0	1.2	0.6	2.3	2.4	2.1	2.2	2.9	0.3	3.1	7.5	0.5	4.0	2.4				8	57.0	1.2	0.6	2.3	2.4	2.1	2.2	2.9	0.3	3.1	7.5	0.5	4.0	2.4			
9	60.9	0.3	2.4	2.8	0.6	1.0	0.6	1.2	0.2	1.0	9.4	0.7	4.0	2.0				9	60.9	0.3	2.4	2.8	0.6	1.0	0.6	1.2	0.2	1.0	9.4	0.7	4.0	2.0			
10	64.3	0.2	1.8	1.5	0.0	0.4	0.6	0.0	0.2	0.3	0.6	0.0	1.2	0.6				10	64.3	0.2	1.8	1.5	0.0	0.4	0.6	0.0	0.2	0.3	0.6	0.0	1.2	0.6			
11	67.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				11	67.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100				TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100			

TABLE 3
Percentage weight-at-age distribution of
Lethrinus nebulosus in the trawling grounds of Qatar waters during
the months of May, 1987 to April 1988.
The average for the whole period is shown.

A G E C A T G O R Y	1987												1988				A V E R A G E																		
	M O N T H S												M O N T H S																						
	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8																			
2	73	0.0	0.0	0.1	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2			2	73	0.0	0.0	0.1	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2		
3	254	36.0	17.8	8.9	21.1	18.5	21.4	16.9	19.1	16.7	12.2	39.4	8.3	19.4				3	254	36.0	17.8	8.9	21.1	18.5	21.4	16.9	19.1	16.7	12.2	39.4	8.3	19.4			
4	852	34.4	40.8	31.2	52.3	51.0	27.9	22.8	38.6	38.2	21.0	38.8	48.8	37.2				4	852	34.4	40.8	31.2	52.3	51.0	27.9	22.8	38.6	38.2	21.0	38.8	48.8	37.2			
5	936	7.5	14.7	15.1	0.4	2.1	11.9	25.5	29.2	12.0	4.5	7.2	0.0	10.8				5	936	7.5	14.7	15.1	0.4	2.1	11.9	25.5	29.2	12.0	4.5	7.2	0.0	10.8			
6	1385	5.3	0.0	2.5	4.2	4.8	8.3	1.9	6.1	1.8	2.5	5.3	3.0	3.9				6	1385	5.3	0.0	2.5	4.2	4.8	8.3	1.9	6.1	1.8	2.5	5.3	3.0	3.9			
7	1872	7.5	2.5	10.5	8.1	7.0	12.4	14.7	9.4	10.4	5.6	7.4	5.1	8.6				7	1872	7.5	2.5	10.5	8.1	7.0	12.4	14.7	9.4	10.4	5.6	7.4	5.1	8.6			
8	2374	6.1	2.3	7.0	10.8	0.0	9.4	10.2	1.3	12.4	20.1	2.6	13.1	8.7				8	2374	6.1	2.3	7.0	10.8	0.0	9.4	10.2	1.3	12.4	20.1	2.6	13.1	8.7			
9	2875	2.0	11.4	10.3	3.2	5.2	3.1	5.2	1.1	4.8	30.7	4.3	16.0	8.1				9	2875	2.0	11.4	10.3	3.2	5.2	3.1	5.2	1.1	4.8	30.7	4.3	16.0	8.1			
10	33.63	1.5	10.2	6.5	0.0	3.5	3.1	0.0	1.2	1.7	2.3	8.0	1.7	2.9				10	33.63	1.5	10.2	6.5	0.0	3.5	3.1	0.0	1.2	1.7	2.3	8.0	1.7	2.9			
11	3820	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0				11	3820	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0			
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100				TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100			
Ave. Landing (Kg/trip)	2370	1990	1124	1246	1253	1396	3075	1885	1844	2027	1317	1169	1726					Ave. Landing (Kg/trip)	2370	1990	1124	1246	1253	1396	3075	1885	1844	2027	1317	1169	1726				

Figures 1A and 1B represent the monthly contributions, both in numbers and weights, of each age-class to any particular fishing trip. Figure 2 represents the overall average of the yearly contributions mentioned.

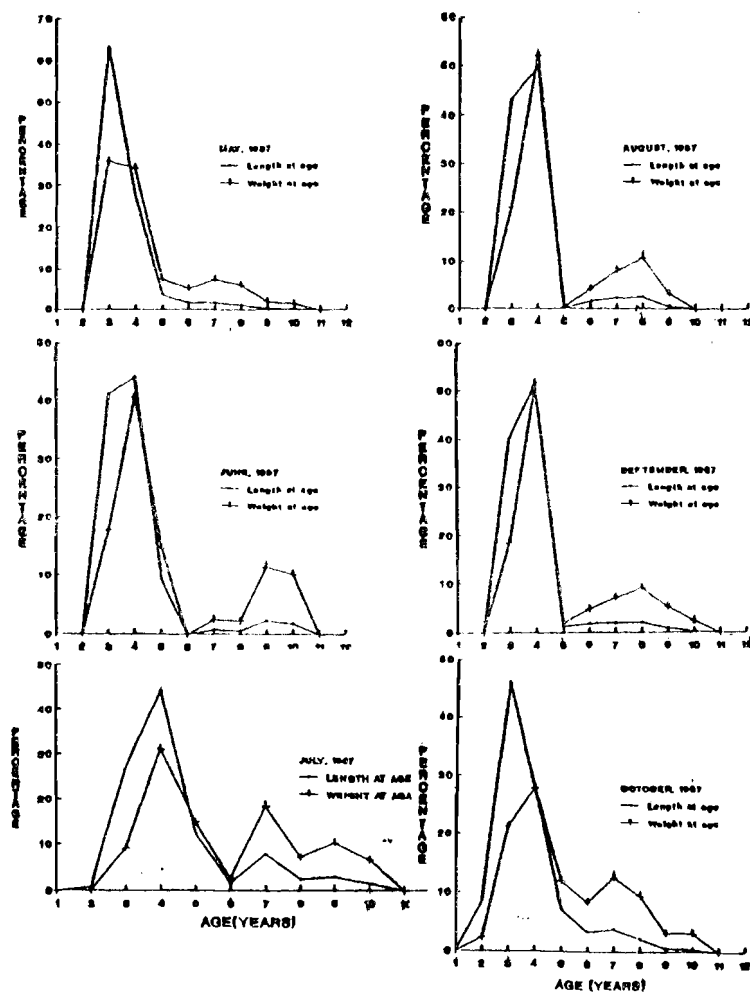


FIG. 1A
Percentage frequency distribution of
Lethrinus nebulosus in the trawling grounds of Qatar waters
during the months May, 1987- October, 1988.

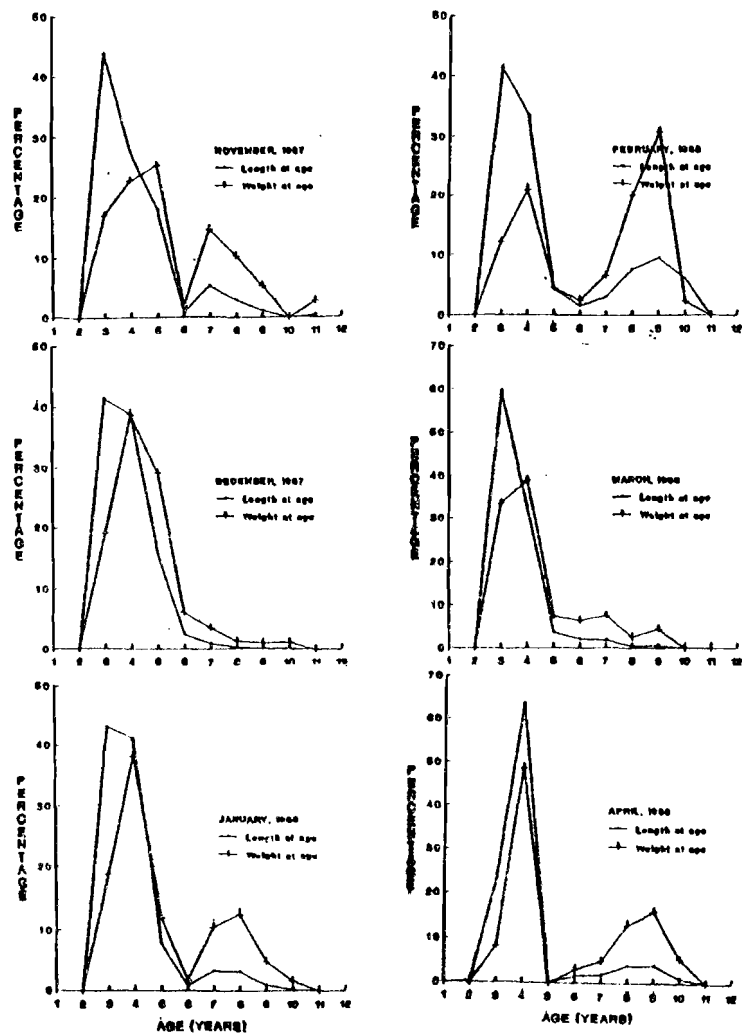


FIG. 1B
 Percentage frequency distribution of
Lethrinus nebulosus in the trawling grounds of Qatar waters
 during the months November, 1987-April, 1988.

Table 1 shows an unprecedented phenomenon among *Lethrinus nebulosus* in Qatar waters. It is mainly that, the size range 40-52 cm, in total length, is either lacking or is represented by relatively small percentage than expected within the bottom trawl landings. This size range represents the age-classes 5-7. Ibrahim et al. (in press) postulated that this species moves to the shallow waters and coral reef areas for spawning migration, since this species reaches the first spawning age at 3-4 years.

When grouping the data of Table 1 into length at age as presented in Table 2; it became evident that age class 6 shows the minimum percentage frequency distribution. Plotting the results on Figure 1, it became clear that classes 3 and 4 represent the maximum percentage contribution to the bottom trawl landings, while age class 6 represents the minimum contribution. This indicates that, with respect to *Lethrinus nebulosus*, the trawl fishery of QNEC is based almost entirely on 3 and 4 years old with some 5 years old fish entering the fishery in lower numbers, a minimum number of 6 years old, then the number increases again through ages 7-9 and very few numbers of 10 years old.

With respect to percentage weight contribution, even though both age classes 3 and 4 contribute almost the same percentage in numbers, age class 4 contributes almost twice as age class 3. Age class 4 contributes almost the same percentage as in number as in weight. At age 5 and older; the percentage contribution exceeds that of the number. This could be seen from the overall average of the study period as represented in Figure 2.

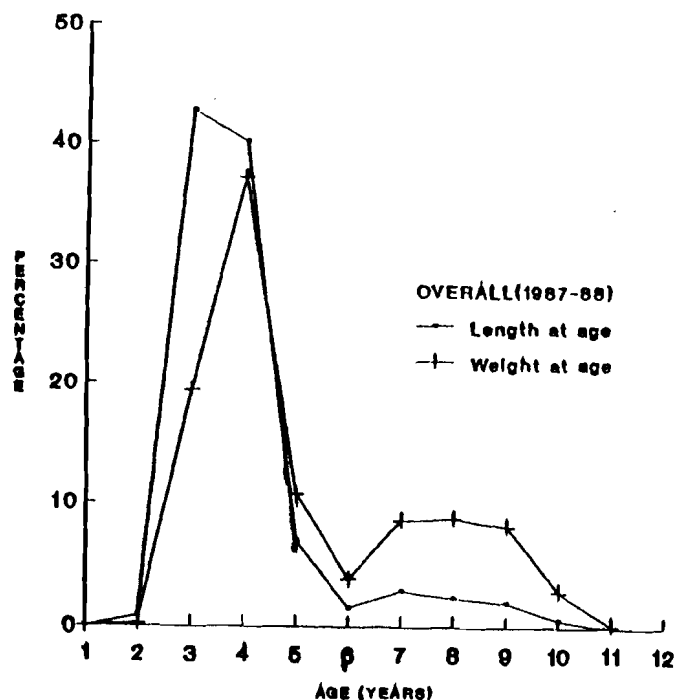


FIG. 2
Overall percentage frequency distribution of
Lethrinus nebulosus from Qatar waters during May, 1987, to April, 1988.

The maximum, the minimum and the average lengths of the extensive data pertinent to each month, in addition to the estimated VBGF parameters were used to calculate the total mortality-rate (Z) as described by Beverton and Holt (1956). The results are presented in Table 4. The calculated (Z) values pertaining to each month did not show any particular trend under a constant natural mortality rate of 0.36. These variations in the (Z) values may be attributed to the fact that each fishing trip was working on a

TABLE 4
VBGF parameters, Length; maximum, minimum and average in cm, the annual; natural (M), fishing (F) and total (Z) mortality rates of *Lethrinus nebulosus* from Qatar waters during the period from May, 1987 to April, 1988.

	K = 0.145			$t_0 = 0.47$ years				$L_{\infty} = 85.8$ cm				A V E R A G E	
	1987				YEARS				1988				
	M O N T H S												
	5	6	7	8	9	10	11	12	1	2	3		4
Max. Length	63.0	66.0	64.0	61.0	64.0	66.0	62.0	63.0	64.0	64.0	62.0	64.0	63.6
Min. Length	24.0	24.0	22.0	25.0	23.0	21.0	23.0	24.0	26.0	24.0	26.0	22.0	23.7
Ave. Length	31.5	33.6	37.3	33.0	33.6	32.0	34.3	33.3	34.3	37.8	32.3	36.0	34.1
(Z)	1.05	0.79	0.46	0.96	0.71	0.71	0.66	0.82	0.90	0.50	1.23	0.52	0.78
Mean Temp.	Annual Mean Temperature = 25C°												25C°
(M)	Annual Natural Mortality Rate = 0.36												0.36
(F)	0.69	0.43	0.10	0.60	0.35	0.35	0.30	0.46	0.54	0.14	0.87	0.16	0.42
(E)	0.66	0.54	0.22	0.63	0.49	0.49	0.45	0.56	0.60	0.28	0.71	0.31	0.50

commission basis depending on the amount of landing. So, the fishing vessel keeps on fishing or searching for fish no matter what species are being caught as long as it fetches good commission. It happened, sometimes, that more than 70% of the catch was thrown overboard as by-catch. Also the fishing operations are depending entirely on the experience of the master fisher-man and a lot on good luck to encounter a good fish population.

Since the monthly fishing mortality rates were calculated by the equation:

$$F = Z - M$$

where M is assumed to be constant at 0.36; then it is expected that fishing mortality rates show no particular monthly trend. The annual mean of (F) was estimated as 0.42.

The monthly exploration ratio (E), as presented in Table 3, did not show any particular trend either. It ranges between 0.22-0.71 with an average

of 0.50. Based on the assumption that sustainable yield according to Gulland (1971) is optimal when $F = M$; so one can roughly assess if a stock is overfished or not. The average value of (F) obtained in this study is 0.50. It indicates that the stock of *Lethrinus nebulosus* in the fishing grounds of QNFC vessels is close enough to reach the condition of overfishing unless some measures are implemented.

The length-weight relationship was incorporated into the length at age data to perform the yield per recruitment analysis as suggested by Ricker (1975) and the results are shown in Table 5. The mentioned table is based on the assumption that the initial weight of the stock is 1000 kg, the annual natural mortality rate is 0.36 and the annual fishing mortality rate is constant at 0.42. It is also assumed that the stock is at equilibrium due to the fact that during the past few years fish production in Qatar has been at an almost

TABLE 5
Computation of survivors and annual yield from a theoretical recruit of 1000 fish of *Lethrinus nebulosus* from Qatar waters at the start of age 2 and under equilibrium conditions: The instantaneous rate of natural mortality (M) is 0.36 and of fishing mortality (F) is 0.42. (A = age in years, B = mean length in cm, C = mean weight in gm, D = instantaneous rate of growth, E = (growth-total mortality), F = weight-change factor, G = weight of stock, H = average weight in gm and I = yield in kg).

A	B	C	D	E	F	G	H	I
2	17.1	73				1000		
3			1.25	0.42	1.6		1298	545
3	26.3	254				1595		
4			0.78	-0.01	1.0		1592	669
4	34.4	552				1589		
5			0.52	-0.25	0.78		1412	593
5	41.3	936				1235		
6			0.39	-0.39	0.68		1036	435
6	47.3	1365				838		
7			0.30	-0.48	0.62		678	285
7	52.5	1872				519		
8			0.24	-0.54	0.58		410	172
8	57.0	2374				302		
9			0.19	-0.59	0.56		234	99
9	60.9	2875				167		
10			0.16	-0.62	0.54		129	54
10	64.3	3363				90		
11			0.13	-0.65	0.52		68	29
11	67.2	3820						47
TOTAL								2881

steady level. The total fish landing was 2171, 1860, 2060, 3068, 2394 and 1883 metric tons for the years 1981 to 1986 respectively. The resultant yield per recruitment was calculated as 2881 kg. This means that, on a theoretical basis and under the prevailing environmental conditions of the Qatari waters; the stock of *Lethrinus nebulosus* can yield about two more times the initial weight of the stock.

In order to estimate an actual yield, it is necessary to estimate the spawning and/or the standing stock and their resultant year by year. This matter is not simple, especially in the absence of detailed catch records reinforced by a sampling and aging program and the absence of basic data about Qatar fisheries for the past few years. Even then, changes in the fishing patterns and/or availability of the particular species would make accurate real time estimation difficult.

Concerning the expected overfishing problem of the species under investigation, it is known that an increase in fishing mortality or a decrease in size at first capture always results in high yield. Similarly, a decrease in fishing mortality or an increase in size at first capture always results in lower yield in the short term, although in the long term higher yield may be reached. The duration of the transition period can be several years in fish which have a high longevity - such as this species under consideration and are subject to exploration over a number of years.

As mentioned earlier and shown in Figure 2; the trawl fishery is based almost entirely on age classes 3 and 4 years old. Each contributes to the annual landing 42.7% and 40.2% by numbers and 19.4% and 37.2% by weight respectively. With minor contribution from age class 2 which donates to the landing 0.8% by numbers and 0.2% by weight. It is known also that fish size is one of the factors categorizing its marketable value, where fish of less than 20 cm in total length are not marketable in Qatar. This indicates that an appreciable amount of the mentioned yield presented in Table 5 should not be considered among the total yield. On the other hand, Ibrahim et al. (in press) indicated that about 11% of the landing of family *Lethrinidae* from Qatar waters was discarded overboard as by-catch during 1987. They related that to the small mesh size net being used by QNFC fleet. This situation represents an unharvested resource and a lost opportunity for the first to contribute to the yield in the years to come.

If it could be assumed that only half of the discarded fish would be left in the sea, by for example controlling the mesh size to let the fish escape capture, then recalculating the yield in Table 5 on a new assumption that the initial weight of stock is 1300 kg, with $(M) = 0.36$ and $(F) = 0.42$, it would appear that the new yield per recruit would reach 3745 kg. This represents an increase of about 30% relative to that of Table 5. The results of this increase would be seen after few years following the implementation of the said measure.

An other measure could be taken into consideration to improve the exploitation ratio (E). It is mainly through protecting the spawners in the

shallow waters, since the fish of size range 40-52 cm are dominant in the shallow waters and coral reef areas for commencement of spawning during the months of April-May. It is advisable to protect the spawners in time and place. This could be achieved through controlling the trap's mesh size, which are the main fishing gears for this species, during the spawning season. It could also be achieved by slackening the trawlers fishing effort during the mentioned period through performing the annual maintenance of some of the trawlers then.

CONCLUSION

Family Lethrinidae contributes about 26% of Qatar fishery as a whole, and about 54% of QNFC landing. The family is represented in Qatar waters by four species with *Lethrinus nebulosus* ranked as number one both in abundance and maximum size attained. This fish species showed an unprecedented phenomenon which is the relatively very low abundance of the size range 40-52 cm in total length in the trawling grounds, while abundant in the shallow and coral reef areas. This size range represents the age class 5-7 years. The fish reaches its first maturity at about 37 cm in total length corresponding to the age of 4 years.

The VBGF parameters were estimated for this fish as:

$$K = 0.145 \quad t_0 = 0.47 \text{ years} \quad L_{\infty} = 85.8 \text{ cm}$$

With respect to QNFC trawlers, their fishery is being based almost entirely on the 3 years old (19%) and the 4 years old (37%). The rest of the percentage is distributed among the age groups 5 and 7 to 10 years with the minimum contribution from age group 6.

The annual mortality rates were estimated as:

$$Z = 0.78 \quad F = 0.42 \quad M = 0.36$$

The exploitation ratio (E) was estimated as 0.5. This indicates that the fishing grounds of QNFC are close to reach an overfishing condition with respect to this species. This was attributed to the catchability of the net in use, which can catch fish of less than 20 cm in total length in large quantities, then these fish are discarded overboard as by-catch.

Under the prevailing environmental conditions in Qatar waters; a hypothetical initial stock weight yields a total of as twice as much its original weight. Yet, the total yield could be increased by about 30% if only half of the by-catch would have the chance to escape capture by the trawl net.

The exploitation ratio (E) could also be improved by controlling the fish traps mesh size in the shallow and reef areas and also by slackening the trawls fishing effort during April-May through conducting the annual maintenance of some of the trawlers during this period.

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