ISSN 1110-0354
Bull. Nat. Inst. of Oceanogr. & Fish., A.R.E., Vol. (29) 2003: 15 - 29

RESOURCE ASSESSMENT AND MANAGEMENT PROSPECTIVE OF TWO NEMIPTERID SPECIES (NEMIPTERUS JAPONICUS AND N. ZYSRON) IN THE GULF OF SUEZ

BY

AZZA A. EL-GANAINY AND SAHAR F. MEHANA
National Institute Of Oceanography And Fisheries, Suez Branch, P.O. Box 182, Suez, Egypt.
E-Mail: Azzaelgan@Yahoo.Com

Keywords: *Nemipterus japonicus*; *Nemipterus zysron;* Relative abundance; Growth; Mortality rates; Exploitation; Yield per recruit.

ABSTRACT

The population parameters of two commercially important nemipterid species (Nemipterus japonicus and Nemipterus zysron) were estimated from length frequency composition. Samples were collected from the Gulf of Suez during the fishing season 2000/2001. The von Bertalanffy growth function (VBGF) estimates were: L_∞= 28.35 cm. total length, K= 0.63 year^{-1} and t_o= -0.435 years for N. japonicus. The corresponding estimates for N. zysron were L_∞=28.1 cm, K=0.58 yr^{-1}, and t_o= -0.475 year. The total mortality coefficient (Z) was computed as 3.18 yr^{-1}, the natural mortality coefficient (M) estimated as 0.967 yr^{-1} with fishing mortality calculated as F= 2.213 yr^{-1} and the exploitation ratio (E=F/Z) for N. japonicus was 0.696. The mortality estimates for N. zysron were Z= 2.33 yr^{-1}, M= 0.946 yr^{-1} and F= 1.384 yr^{-1} and exploitation ratio (E) calculated as 0.594. The Beverton and Holt yield per recruit model was used to explain the present status of the nemipterid fishery, which shows that N. japonicus stock in the Gulf of Suez is overexploited.

INTRODUCTION

Fishes of family nemipteridae represent one of the most commercially important fish groups in the trawl fishery of the Gulf of Suez, Red Sea. They are caught at depths range from 30 to 70 m. and found in sandy, muddy substrates. Six nemipterid species, belonging to two genera were recorded in the Gulf of Suez (Breikaa, 1996). These are *Nemipterus japonicus*, *N. bipunctatus*, *N. zysron*, *Scolopsis vosmeri*, *S. ghanan* and *S. taeniatus*. The threadfin bream, *Nemipterus japonicus* is the most abundant fish species in the demersal nemipterid catch. It contributes about 90% of the nemipterid landings, followed by the slender threadfin bream *N. zysron* that contributes about 7% of the landings, while the other four species appear occasionally in the catch.

Despite of the economic importance of fishes of family nemipteridae in the Gulf of Suez, information on the population parameters and dynamics of these species are scarce. Where, Breikaa (1992 and 1996) studied the stock assessment of *N. japonicus* in the Gulf of Suez. On the other hand, the biology and population dynamics of the species were the subject of intensive investigations in Indo-Pacific region (Ingles & Pauly 1984; Edward, Bakhader & Shaher 1985; Vivekanandan & James 1986; Murty 1987; Devaraj & Gulati 1988; Khan & Mustafa 1989; Iqbal 1991; Mostafa 1994; Lavapie-Gonzales, Gonaden & Gayanilo 1997 and Al-Sakaff & Esseen 1999). Studies on the slender threadfin bream *N. zysron* are rare, only Letourneur, Kulbicki & Labrosse (1998) recorded the length weight constants of the species in New Calidonia.

The objective of this study is to provide information on growth, mortality rates, exploitation rates and effect of fishing on the stocks of *N. japonicus* and *N. zysron* in the Gulf of Suez for the proper management of these resources.

MATERIALS AND METHODS

Random samples of unsorted nemipterid catch landed by bottom trawlers at the Attaka harbor during the fishing season 2000/2001 were collected monthly. The monthly catch and effort statistics were also recorded.

Samples were sorted to detect species composition; length measures were to the nearest 0.1 cm. and weighed to the nearest 0.1 gm. The length frequency distributions were determined at 1.0 cm. length intervals. To establish the length weight relationship, the commonly used relationship $W = a\ L^b$ (Ricker 1975) was applied, where W is the weight (gm), L is the total length (cm) and a and b are the equation constants.

The monthly length frequency distributions were analyzed by using the appropriate routines and subroutines of the FiSAT program (Gayanilo, Sparre & Pauly 1995). For the separation of the length frequency composition into its component distributions, the maximum likelihood concept applied by Hasselblad (1966) method was used.

A prime estimate of the asymptotic length (L_∞) and the growth coefficient (K) were obtained by applying the method of Wetherall (1986). The estimated (K) was ascertained by the equation of Pauly, Moreau & Gayanilo (1998). The resultant growth estimates were then used as seed values in ELEFAN I program (Pauly, 1984) for estimation of the best combination of (L_∞ and K). The empirical equation of Pauly (1979) was used to estimate the hypothetical age (t_o) of fish, which would have at zero length. The reliability of these growth parameters was tested using the Munro's phi prime index (Φ) computed from the equation derived by Pauly & Munro (1984):

$$\Phi = \log_{10} K + 2 \log_{10} L_{\infty}$$

The instantaneous rate of total mortality (Z) was estimated by the length converted catch curve method described by Pauly (1983). The instantaneous rate of natural mortality (M) was computed from the longevity of the fish: $M = -\ln (0.01)/ t_{max}$ Where t_{max} is the maximum age of fish.

The instantaneous rate of fishing mortality (F) was extracted as F = Z-M. The exploitation ratio (E) was calculated as equal to the fraction of death caused by fishing E = F/Z. The effect of fishing was explained using the Beverton & Holt (1957 and 1966) relative yield per recruit model.

RESULTS

Catch statistics and relative abundance

The fishery in the Gulf of Suez is seasonal. The fishing season is commenced during September and is continued through to the end of May. In recent years (from 2000/2001), the commencement of the fishing season has been delayed to October through mid June.

The mean annual catch of the nemipterid group of fishes fluctuated between 74.3 to 431.9 tons during the period from 1994/1995 to 2000/2001. The monthly catches of nemipterids during this period (Fig. 1) show that the most productive months were those at the beginning of each fishing season, thus about 60% of the annual nemipterid catches were landed from October to the end of December, and then the landings progressively decrease toward the end of the season in May. The fishing effort described as number of landings expanded through the same period reflects a trend of progressive increase, particularly within the last season. Figure (2) shows that fishing effort at the beginning of the fishing season is very high, and then it decreases in the following months. The annual catch per unit effort (Fig. 3) is fluctuating, detecting a high relative abundance during the fishing seasons 1997/98 to 1999/2000, and then it sharply dropped in 2000/2001.

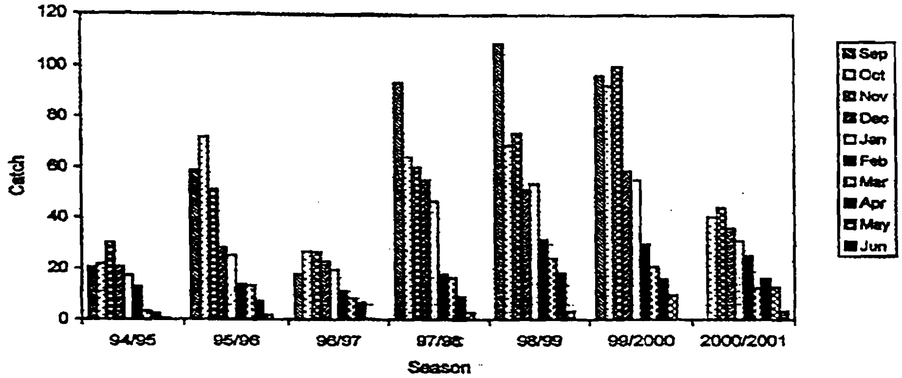

Fig. (1) Monthly catch of nemipterid group of fishes in the Gulf of Suez during the fishing seasons 1994/95 to 2000/2001.

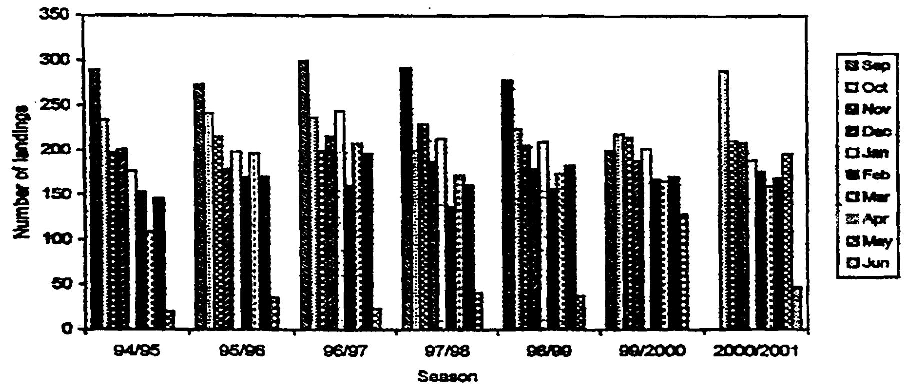

Fig. (2) Monthly fishing effort (No.of landings) exerted in the Gulf of Suez during the fishing seasons 1994/95 to 2000/2001.

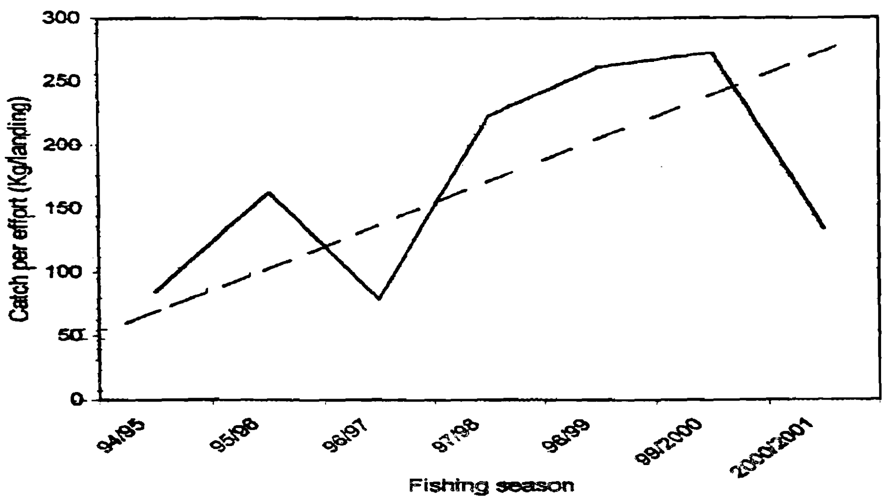

Fig. (3) Annual catch per unit effort of nemipterid group of fishes in the Gulf of Suez.

Length-weight relationship:

The total length measurements of *N.japonicus* specimens ranged from 9.0 cm. to 23.5 cm. with an average of 16.5 cm. while the total weight measurements varied from 8.6 to 162.2 gm. with an average of 65.08 gm. In case of *N. zysron* the total length measurements ranged from 17.0 cm. to 23.0 cm. with an average of 20.5 cm. and the total weight ranged from 65 to 148 gm. with an average of 86.14gm. (Table 1). The length weight relationships were computed and the obtained equations were in the form of $W=0.01176\ L^{2.99108}$ for *N. japonicus* with a correlation coefficient of 0.99074 and $W=0.01131\ L^{3.11023}$ for *N. zysron* with a correlation coefficient of 0.99365.

Table 1: Distribution of length and weight of two nemipterid species in the Gulf of Suez

	N. japonicus		*N. zysron*	
	L	Wt	L	Wt
Number	1097		246	
Range	9.0 - 23.5	8.6 – 162.2	17.0 – 23.5	65 – 130
Mean	16.5	65.08	20.5	86.14
S.E	1.1902	12.272	0.54	16.231
Median	16.5	52.885	20.5	78.4

S.E Standard Error

Age and Growth

Figure (4) shows an output of the Hasselblad (1966) method, for the pooled length frequency distributions of the two studied species. Four components could be identified for *N. japonicus,* which were considered as distinct age groups with mean lengths of 12.106, 16.773, 20.0 and 23.50 cm (Fig. 4). The length composition of *N. zysron* was separated into three components with mean lengths of 18.868, 20.512 and 22.215 cm (Fig.4), the first component could be considered as age group two due to the missing of the small length classes. The mean assigned lengths, their standard deviation and separation indices are given in Table (2).

Table 2: Mean assigned lengthes, standard deviation and separation index for *N. japonicus* and *N. zysron* estimated from Bhattacharya method.

Age group	*N. japonicus*			*N. zysron*		
	Mean L	S.I	S.d	Mean L	S.I	S.d
I	12.106		1.491	18.868		0.837
II	16.773	5.563	2.151	20.512	2.182	0.679
III	20.000	2.762	1.512	22.215	2.049	0.983
IV	23.500	3.432	0.528			

S.I Separation index
S.d Standard deviation

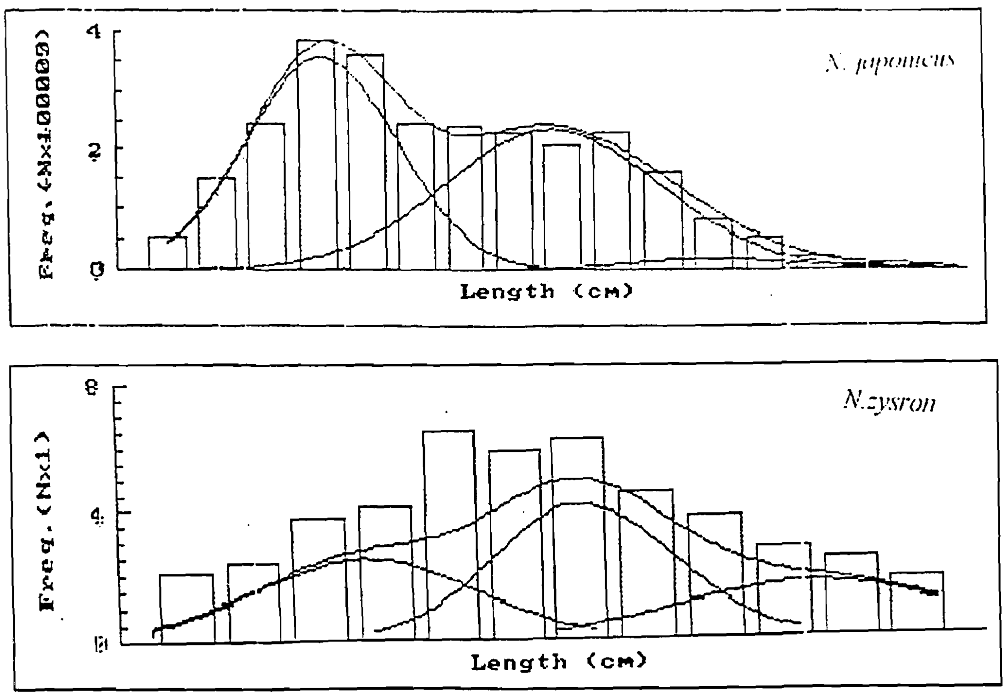

Fig. 4: Length frequencies of *N. japonicus* and *N. zysron* showing the composite distributions identified by Hasselbad method.

A summary of the estimated von Bertalanffy growth parameters that describe growth in length and weight (L_∞, K, W_∞ and t_o) and the derived growth performance index (Φ) are presented in Table (3). The estimated growth performance index (Φ) was relatively higher for *N. japonicus* than that for *N. zysron* of similar sizes.

Table 3: Estimated population parameters of two nemipterid species from the Gulf of Suez.

Parameters	*N. japonicus*	*N. zysron*
L_∞	28.350	28.100
K (yr^{-1})	0.630	0.580
t_o (yr)	-0.435	-0.475
W_∞	267.14	362.47
T_{max} (yr)	4.762	5.172
Φ	2.704	2.661
M (yr^{-1})	0.967	0.946
M/K	1.535	1.631
F (yr^{-1})	2.213	1.384
Z (yr^{-1})	3.180	2.330
A	0.958	0.903
E (F/Z)	0.696	0.594

The longevity ($t_{max} = 3/K$) was estimated using the value of the corrected growth coefficient, K, and it was found to be about five years (Table, 3). The von Bertalanffy growth equations for the growth in length and weight for the two studied species were described as:

$L_t = 28.35\ (1 - e^{-0.63\ (t + 0.435)})$

$W_t = 267.14\ (1 - e^{-0.63\ (t + 0.435)})^{2.99108}$

For *N. japonicus*

$L_t = 28.10\ (1 - e^{-0.58\ (t + 0.475)})$

$W_t = 362.47\ (1 - e^{-0.58\ (t + 0.475)})^{3.11023}$

For *N. zysron*

Mortality rates

Figure (5) shows the FiSAT output of the length converted catch curve for *N. japonicus* and *N. zysron* respectively. The computed values of the instantaneous mortality rates and the annual rate of mortality $A = 1 - e^{-Z}$ are given in Table (3). The obtained results of Z and A of *N. japonicus* are relatively higher than those of *N. zysron*. The reliability of the estimated natural mortality rate was ascertained using the M/K ratios, as Beverton & Holt (1957) reported that the M/K value for most of the fishes lies in the range 1.12-2.5. The values of M/K ratio were 1.535 and 1.631 for *N. japonicus* and *N. zysron* respectively. The corresponding estimates of the fishing mortality rates were 2.213 and 1.384 for both species respectively.

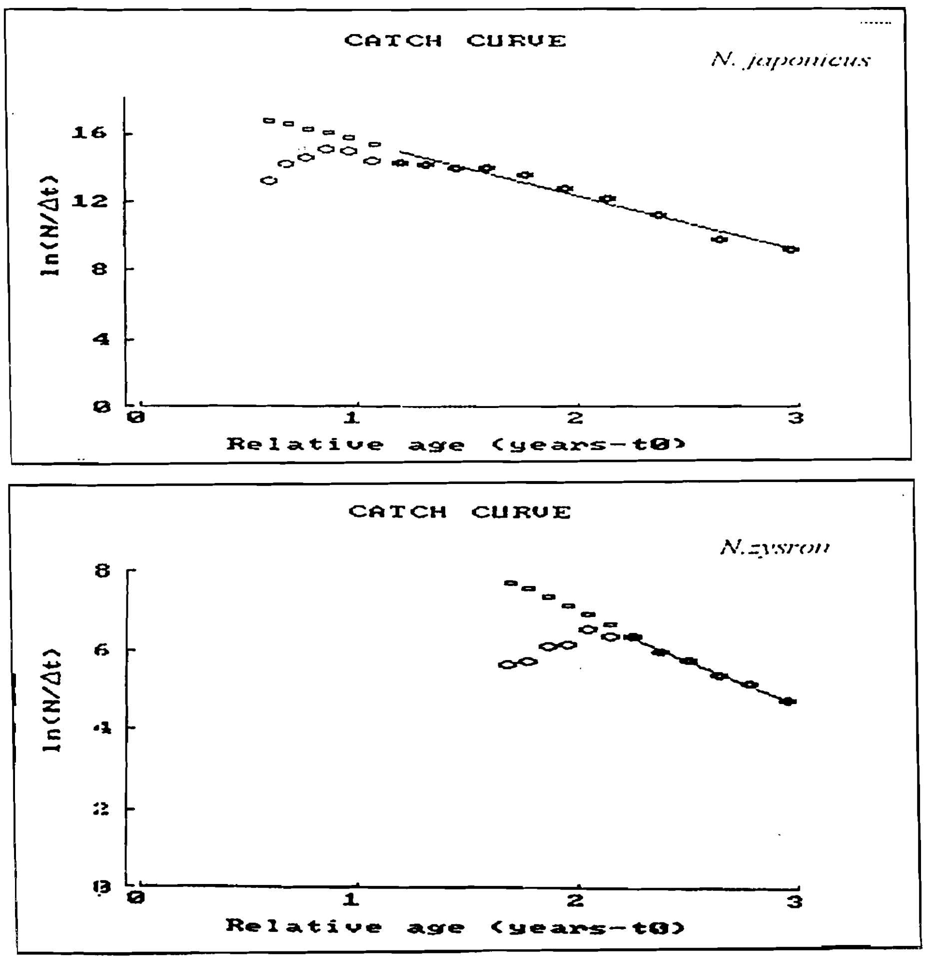

Fig. 5: Length converted catch curve of *N. japonicus* and *N. zysron* collected from The Gulf of Suez.

The exploitation ratio (E=F/Z) was calculated as E = 0.696for *N. japonicus* and E = 0.594 for *N. zysron.* According to Gulland (1971) the optimum exploitation ratio E_{opt} = 0.5, this implies that the stocks of *N.japonicus* and *N. zysron* in the Gulf of Suez are overexploited.

Relative Yield per Recruit

As the threadfin bream *N.japonicus* is the dominant species in the nemipterid catch, the relative yield per recruit (Y'/R) analysis was undertaken for *N.japonicus* only. The length at first capture (L_c) was estimated from the left ascending part of length-converted catch curve, the method derived by Pauly (1984) has been found to provide reasonable estimates of mean size at first capture. Thus, Fig (6) illustrates the probabilities of capture for *N.japonicus* and the estimated L_c was found to be 11.688 cm. Breikaa (1996) calculated the L_c for *N.japonicus* from the Gulf of Suez as 12.663 cm.

PROBABILITY OF CAPTURE ANALYSIS

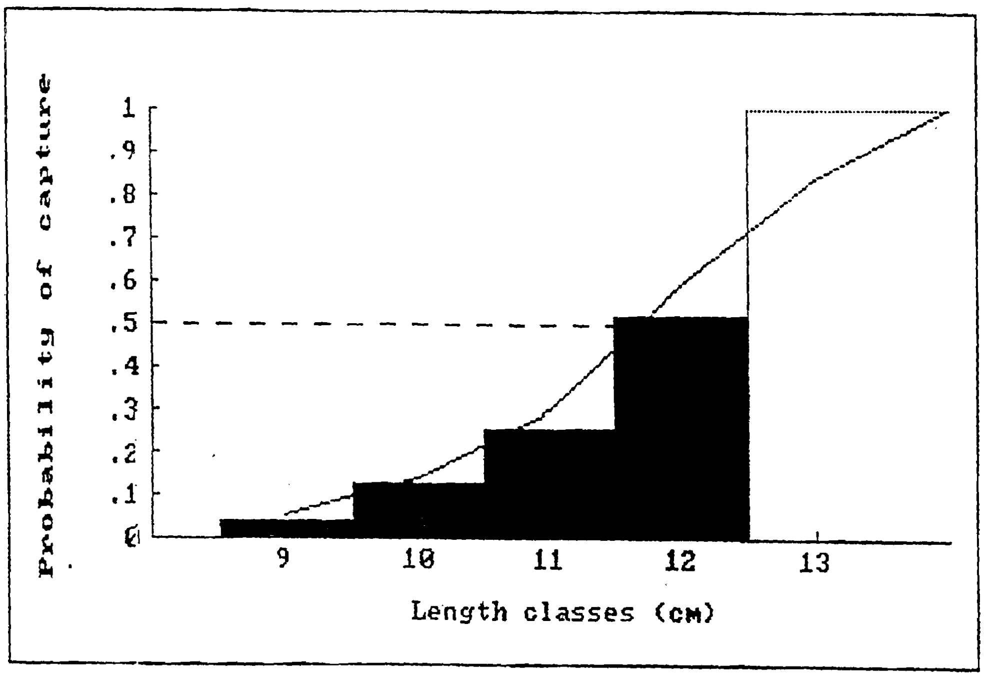

Fig. 6 : Length at first capture of *N. japonicus* collected from The Gulf of Suez.

The effect of fishing on the stock of *N.japonicus* was examined by changing the L_c value. The Y'/R was computed as a function of different values of exploitation ratio (E) and length at first capture L_c. The results (Fig.7) indicate that the estimated Y'/R increase continuously with increase in the exploitation ratio over the range of investigated values. At the present value of length at first capture (L_c = 11.688) and the current natural mortality (M = 0.967), the present value of the fishing mortality F = 2.213 is higher than that associated with the maximum relative yield per recruit (F_{max} = 1.429) by about 35.8%. This means that the fishing pressure exerted in the Gulf of Suez must be reduced by about 35.8% of its current value.

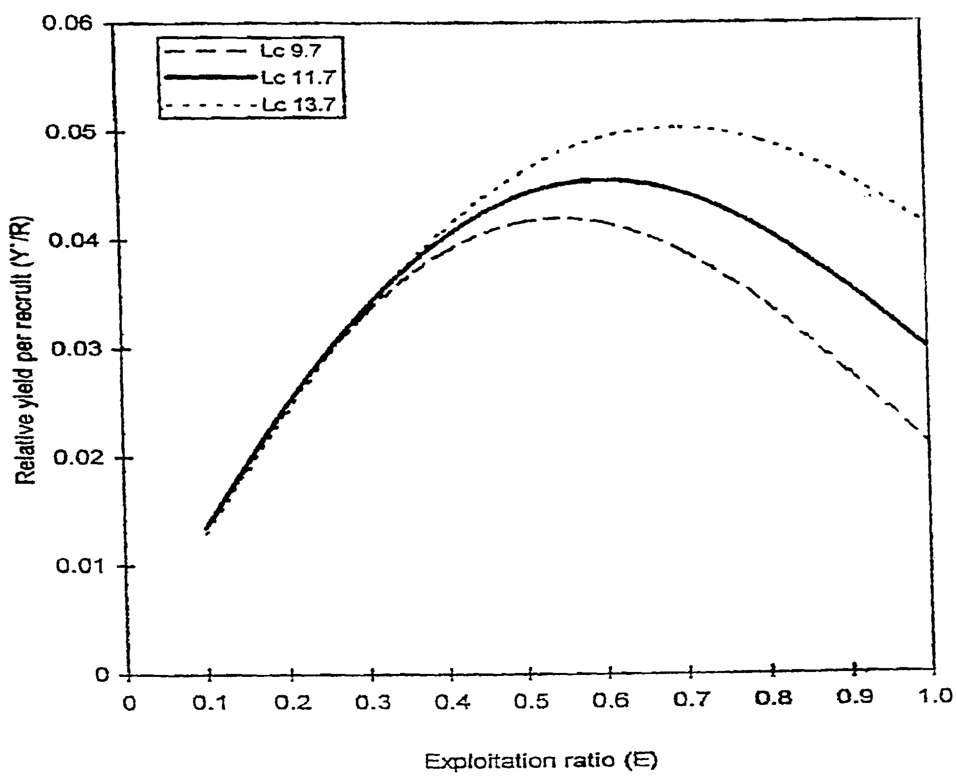

Fig. 7 : Relative yield per recruit as a function of legth at first capture and exploitation ratio for *N. japonicus* collected from The Gulf of Suez.

The results also show that the Y'/R for L_c = 13.7 cm. are generally higher than that for L_c = 11.7 and 9.7 cm.

DISCUSSION

The nemipterid group of fishes supports an important commercial fishery in the Gulf of Suez. The present results showed that the fishing effort at the onset of the fishing season is very high then progressively decrease in the following months. It was found that about 42.5% of the total fishing effort is expanded in the first three months of the season producing about 60% of the annual nemipterid catch; this may reflect the higher abundance of fish stocks at the beginning of each fishing season. The analysis of the catch per unit effort as a true and accurate index of abundance of fish stocks showed that the relative abundance of nemipterids fluctuated during the investigated period with a sharp decline in the fishing season 2000/2001, in spite of the progressive increase in the fishing effort. This is an obvious indication of a cumulative over-fishing on the nemipterid stock.

Species composition of nemipterids consisted of six species, of which *N.japonicus* and *N. zysron* are the most abundant. The maximum recorded length of the two species was about 24 cm. total length, and the estimated asymptotic length L_∞ was 28.35 and 28.1 cm for *N.japonicus* and *N. zysron* respectively which is realistic, although the length range of *N. zysron* is not fully represented in the younger ages and this may have influenced the estimation of the growth parameters for this species. No other studies dealing with age and growth of *N. zysron* were found to compare it with the present results. On the other hand, the estimated growth parameters of *N.japonicus* compared with those recorded in other indo-pacific areas are given in Table (4). A good agreement between most of the estimates is obvious.

The calculated longevity (t_{max}) of the studied species is about 5 years indicating that they are short-lived. However, the age composition showed that the fish caught were mostly less than two years of age, implying that they are normally caught before they grow large enough to contribute substantially to the stock biomass; this is an indicative of growth over-fishing.

The exploitation ratio of *N.japonicus* and *N. zysron* was beyond the expected optimal exploitation level, $E_{opt} = 0.5$, indicating over-exploitation by the trawl fishery in the Gulf of Suez. This was confirmed by the analysis of the yield per recruit for *N.japonicus*, which postulate that the fishing effort exerted in the Gulf of Suez must be reduced by about 35.8% of its current level. These results suggest an economic justification for reducing the size of the trawl fleet or decreasing the number of fishing days. Choosing the most appropriate number of vessels will depend on the management objectives of the fishery. Awadallah (1983) stated that the annual catches and profitability of the trawl fishery would be maintained if the vessel number were fixed. Additional vessels would result in slightly more catch but reduced profitability, while fewer vessels would result in slightly less catch and increased profitability. Briekaa (1996) estimated the maximum sustainable yield (MSY) for nemipterid catch in the Gulf of Suez and found that the operating fishing effort during the fishing season 1993/94 exceeded that realizing MSY by about 44% of the nemipterid catch, which in concurrence with our results.

The assessment also indicates that the size at which the fish are first liable to capture must be increased. This could be achieved by increasing the cod end mesh size and develop the used gear to caught larger fish.

Table 4: Summary of the estimated growth parameters of *N. japonicus* in different Indo-Pacific areas.

Locality	L_∞	W_∞	K	t_o	Φ	Source
Philippine Manila Bay	30.00	348	0.700		2.800	Ingles & Pauly (1984)
Gulf of Aden	29.10	397	0.310	0.048	2.420	Edward *et al* (1985)
India/Madras	30.50		1.004	0.226	2.970	Vivekanandan & James (1986)
India	33.90		0.520	-0.160	2.776	Murty (1987)
India	29.80	341	0.821		2.860	Devaraj & Gulati (1989)
Bangladesh	24.16		1.060		2.791	Khan & Mustafa (1989)
Pakistan Arabian Sea	28.80	307	0.460		2.580	Iqbal (1991)
Gulf of Suez	28.64	286	0.495	-0.122	2.609	Breikaa (1992)
Bangladesh	24.50	189	0.940		2.750	Mustafa (1994)
Gulf of Suez	29.27	283	0.462	-0.198	2.597	Breikaa (1996)
Philippine	28.30					Lavapie-Gonzales *et al* (1997)
Bay of Bengal	25.60	216	94.000		2.790	Mustafa (1999)
Gulf of Suez	28.35	267	0.630	-0.435	2.704	Present study

REFERENCES

Al Sakaff, H. and Esseen, M., 1999. Length-weight relationship of fishes from Yemen waters (Gulf of Aden and Red Sea). Naga, ICLARM Q. 22(1): 41-42.

Awadallah, M. W., 1983. An incomes and costs study of the Egyptian trawl fishery operated in the Gulf of Suez and off the southern Red Sea coast during 1980/81.Suez. Egypt. FAO/37 p.

Beverton, R. J. H. and Holt, S.J., 1957. On the dynamics of exploited fish populations. Fish. Invest. Minist. Agric. Fish. Food G. B., series II, Vol. 19: 533 p.

Beverton, R. J. H. and Holt, S. J., 1966. Manual of methods for fish stock assessment. Part 2.Tables of yield functions. FAO Fish. Tech. Pap. (38) Rev. 1 : 67 p.

Breikaa, M.I.M., 1992. A study of population dynamics of the threadfin bream *Nemipterus japonicus* in the Gulf of Suez. M. SC. Thesis, Faculty of Science, Cairo University. 260p.

Breikaa, M.I.M., 1996. Dynamics and fisheries management of the threadfin bream *Nemipterus japonicus* (Pisces: Nemipteridae) in the Gulf of Suez. Ph.D. Thesis, Faculty of Science, Cairo University. 318p.

Devaraj, M. and Gulati, D., 1988. Assessment of the stock of threadfin bream *Nemipterus japonicus* in the north-west continental shelf of India.. In M. Mohan Joseph (ed). The first Indian Fisheries Forum Proceeding. Asian Fisheries Society, Indian Branch, Mangalore. p. 159-164.

Edwards, R.R.C., Bakhader, A. and Shaher., S., 1985. Growth, mortality, age composition and fishery yield of fish from the Gulf of Aden. J. Fish. Biol. 27:13-21.

Gayanilo, F. C. Jr.; Sparre, P. and Pauly., D., 1995. The FiSAT user's guide. FAO computerized information series fisheries. 99, ICLARM, DIFMAR, Rome.

Gulland, J.A., 1971. The fish resources of the ocean. FAO Fish Tech. Pap. (97): 425p.

Hasselblad, V., 1966. Estimation of parameters for a mixture of normal distributions. Technometrice, 8: 431-44.

Ingles, J. and Pauly, D., 1984. An Atlas of the growth, mortality and recruitment of Philippines fishes. ICLARM Tech. Rep. 13. 127p.

Iqbal, M., 1991. Population dynamics of *Nemipterus japonicus* from the Northern Arabian Sea, Pakistan. Fishbyte 9 (1): 16-22.

Khan, M.D.G. and Mustafa, M.D.G., 1989. Length-frequency based population analysis of the threadfin bream *Nemipterus japonicus* of the Bangladesh coast. Indian J. Fish. Vol. 36, no. 2, 163-166.

Lavapie-Gonzales, F.; Ganaden, S.R. and Gayanilo,Jr. F.C., 1997. Some population parameters of commercially important fishes in Philippines. Bureau of Fisheries and Aquatic resources, Philippines. 114p.

Letourneur,Y.; Kulbicki, M. and Labross, 1998. Length-weight relationship of fish from coral reefs and lagoons of New Calidonia, southwestern Pacific Ocean: an update. Naga, ICLARM Q. 21(4): 39-46.

Murty, V.S., 1987. Further studies on the growth and yield per recruit of *Nemipterus japonicus* (Bloch) from the trawling grounds off Kakinada. Indian J. Fish. Vol. 34, no. 3, 265-276.

Mustafa, M.G., 1994. Length-based estimates of vital statistics in threadfin bream *Nemipterus japonicus* from Bay of Bengal, Bangladesh. Naga, ICLARM Q. 17 (1): 34-37.

Pauly, D., 1979. Theory and management of tropical multispecies stocks: a review with emphasis on the Southeast Asian demersal fisheries. ICLARM Stud. Rev., (1): 35p.

Pauly, D., 1983. Some simple methods for the assessment of tropical fish stocks. FAO Fish. Tech. Pap. (234): 52p.

Pauly, D., 1984. Fish population dynamics in tropical waters: a manual for use with programmable calculators. ICLARM Stud. Rev. (8): 325p.

Pauly, D. and Munro, J.L., 1984. Once more on the comparison of growth in fish and invertebrates. ICLARM Fishbyte, 2(1): 21.

Pauly, D., Moreau, J. and Gayanilo, Jr.F.C., 1998. Auximetric analyses. P. 130-134 In R. Froese and D.Pauly (eds) FishBase 1998: concepts, design and data sources. ICLARM, Manila, Philippines. 293p.

Ricker, W.E., 1975. Computation and interpretation of biological statistics of fish population. Bull. Fish. Res. Bd. Can., No. (191) 382p.

Vivekanandan, E. and James, D.B., 1986. Population dynamics of *Nemipterus japonicus* (Bloch) in the trawling grounds of Madras. Indian J. Fish. Vol. 33, No. 2, 145-154,

Wetherall, J. A., 1986. A new method for estimating growth and mortality parameters for length frequency data. Fishbyte 4 (1): 12-14.