Turkish Journal of Fisheries and Aquatic Sciences 9: 59-66 (2009)

Some Biological Aspects of Atlantic Stargazer *Uranoscopus scaber* Linnaeus, 1758 (Family: Uranoscopidae) in The Egyptian Mediterranean Water

Samir I. Rizkalla[1], Shnoudy A. Bakhoum[1,*]
[1] National Institute of Oceanography and Fisheries, Alexandria, Egypt.

* Corresponding Author: Tel.: +203.4807138; Fax: +203.4801174;
E-mail: shnoudybakhoum@yahoo.com

Received 23 June 2008
Accepted 05 January 2009

Abstract

Atlantic stargazer (*Uranoscopus scaber* Linnaeus, 1758) fish samples were monthly collected during 2001-2002 from landing of bottom trawlers operating off Alexandria, Egypt. The results revealed that this species did not exceed five years of age and females were larger than males, reaching 30.0 cm and 26.0 cm, respectively. The study of length-weight relationship showed that no significant difference between males and females (P>0.05). Growth performance in length (Φ/) and weight (Φ) were found to be 2.62 and 1.05, respectively. The von Bertalanffy growth parameters were found to be L_∞ =35.02 cm, K=0.3424 yr^{-1} and to=- 1.011 yr. The rates of total mortality (Z), natural mortality (M) and fishing mortality (F) were 0.901 yr^{-1}, 0.554 yr^{-1} and 0.347 yr^{-1}, respectively. This population is characterized by low exploitation rate (E= 0.229).

Keywords: age, growth, mortality, *Uranoscopus scaber*, South Eastern Mediterranean.

Introduction

The Atlantic stargazer (*Uranoscopus scaber* Linnaeus, 1758) is a benthic species occurring in the littoral waters and on the continental shelf and upper slope of the sea, usually found burrowing in sandy or muddy bottoms and distributed along Atlantic coast of Europe and Africa, Mediterranean and Black Sea (Hureau, 1986). This species is the only one of the 49 Species of the family Uranoscopidae, which inhabits Mediterranean and Black Sea (Demestre *et al.*, 2000). Pietch (1989) showed that Atlantic stargazer buried in the sand almost to its eyes attracting its prey by means of proctile appendix attached to its mandible and waved like a lure. Moharrem (2003) declared that the spawning period of Atlantic stargazer extends from April to September in the Egyptian Mediterranean coastal waters.

The Atlantic stargazer is rarely found in the commercial catches from the eastern part of the Egyptian Mediterranean coast, whereas it constitutes 2.6% of the total trawl catch from the western part of Egyptian Mediterranean coast (Sidi Barani-El Allamen) (El-Sayes *et al.*, 2001). Despite that, the present work is aimed to estimate the biological and population parameters of *U. scaber* in the Egyptian Mediterranean coastal waters, which required for proposing a future plan to sustain and manage this valuable fish resource.

The present study aims to contribute in the biology of *U. scaber* in the Egyptian Mediterranean coastal waters, around Alexandria.

Material and Methods

A total of 506 stargazer specimens were collected on a monthly basis during 2001-2002 from the commercial catches of trawlers landed at Alexandria port, Egypt. For each fish, total length (TL) was measured to the nearest cm, total and gutted weight to the nearest 0.01 g and sex was recorded. Out of 506 fish only 459 were aged since the rest its otoliths were highly calcified and can't be read for age determination, using a binocular microscope with a 25x magnification. The opaque zone was used for ageing, the distance from the otolith nucleus to the rostrum (maximum radius) and the radius (distance from the otolith nucleus to the opaque zone edge, in the same direction of maximum radius) of each ring was measured with an optical micrometer.

The relation between otolith radius and total length was computed using the formula: L=a±bR (Lagler, 1956), where L is the body length in cm, R is the otolith radius, a and b are constants.

Back-calculated lengths at age of individual fish were estimated using the formula given by Lee (1920).

$$L_n = r_n / R\ (L-C) \pm C,$$

where L_n is the total length of fish at the time of annulus formation (n) in cm, r_n is from the otolith focus to the n ring, R is from the focus to the posterior margin of otolith, L is the total length of fish (cm) at the time of capture, and C is the value of intercept in the regression equation between otoliths radius and total length.

The commonly used length-weight relationship ($W=a\ L^b$) was applied, where L is total length (cm), W is weight (g), a and b are constants. The gutted weight was used in order to exclude the effect of stomach contents and weight of gonads (Ricker,

1975). The Fulton's Condition Factor (K) was calculated from the equation given by Fulton (1902):

$$K=100\ W/L^3$$

where W: gutted weight in grams, L: total length in cm.

In order to exclude the effect of gonad weight and intestinal contents, the condition factor was calculated from gutted weight as suggested by Clark (1928). Data of length-weight relationship and condition factor was statistically analyzed using covariance and ANOVA respectively.

Growth in length was computed using the von Bertalanffy equation (VBGF)

$$L_t = L_\infty \{1- e^{-K(t- to)}\},$$

where L_t is the total length at age t, L_∞ is asymptotic length (cm), K is the growth rate (yr^{-1}), t is the age (yr), t_o is the hypothetical age at zero length (yr).

Growth parameters (L_∞, k and t_o) were calculated by using the method of Gulland (1964).

Growth performance in length (Φ') and weight (Φ) were estimated according to the following equations given by Moreau *et al*. (1986):

$$\Phi' = \text{Log } K + 2 \text{ Log } L_\infty \text{ and}$$
$$\Phi = \text{Log } K + 2/3 \text{ Log } W_\infty.$$

The instantaneous total mortality coefficient (Z) was obtained using the catch curve given by Ricker (1975), by taking the slope of the descending portion of the curve, whereas total mortality was obtained from the slope of descending limb of catch curve.

Natural mortality (M) was calculated according to the empiric equation suggested by Pauly (1983).

$$\text{Log } M = -0.0066 - 0.279 \log L_\infty + 0.6543 \text{ Log } K + \text{Log}T,$$

where T is the water temperature (°C).

Fishing mortality (F) was deduced from the formula F = Z – M (Gulland, 1971). The rate of exploitation ratios (E) was estimated according to Cushing (1968), where

$$E = F (1- e^{-Z}) / Z.$$

The calculated length at first capture (Lc) was estimated using the following equation given by Beverton and Holt (1957):

$$L_c = L^- K (L_\infty - L^-) /Z$$

Yield per recruit (Y/R) was computed according to the following model developed by Beverton and Holt (1957).

$$Y/R=F*e\{-M (t_c-t_r)\}*W_\infty*\Sigma^3_{n=0}U_n\, e^{\{-nk(tc-to)\}}/F+M+nk,$$

where Y is the annual yield in weight, R is the annual recruitment, F is the fishing mortality coefficient (yr^{-1}), M is the natural mortality coefficient (yr^{-1}), t_c is the age at first capture (yr), t_r is the age at recruitment (yr).

U_n = Summation variable taking the values 1, -3, ±3, 1 for n= 0, 1, 2, 3, respectively.

W_∞, K and t_o are von Bertalanffy's growth in length parameters.

The biomass (B) is confined as the weight of a stock or some defined portion of it. This is derived by dividing the yield per recruit by the corresponding fishing mortality (Ricker, 1975).

Results

Size Composition

Concerning the differences in length between males and females, the results indicated that females exhibit higher total length than males reaching 30 cm, while the maximum male total length is 26 cm. The mean total length of males is 17.29±2.450 cm, while in females tends to be larger (20.504±4.17 cm). Males reached the maximum body proportions (80%) at the length class of 12 cm, while females at the length class of 24 cm represent 96% to reach 100% in length range from 25-30 cm. Seasonal and annual variations in the number of males and females with total length of *U. scaber* captured from the Mediterranean Sea are shown in Figure 1. It is clear that the minimum length range of males (12-20 cm) was found in spring, while the maximum one (12-26 cm) was in winter, whereas females had the same length range (12-28 cm) in winter and autumn. The maximum length range of females were found in (13-30 cm) summer.

The seasonal size composition of stargazer captured by trawler is given in Figure 2. The sizes of the sampled *Uranoscopus scaber* ranged between 6.0 and 30.0 cm. About 65.18% of the total catches ranged between 15.0 cm and 21 cm. The smallest fish size groups (6.0-10.0 cm) forming 3.64% are mainly observed in spring, while larger individuals are markedly observed in spring and summer. The seasonal variations in the mean total length of *U. scaber* varied from 17.3±3.677 cm in winter to 19.96±3.646 cm in summer.

Age and Growth

The relationship between otolith radius and total length was expressed by the following equation:

$$L=0.4191\pm0.2358\ R\ (r^2 = 0.9524)$$

The Age-Length relationship of *Uranoscopus scaber* captured from the Egyptian Mediterranean water off Alexandria were shown in Figure 3. The mean length estimated for the zero to fifth age groups which confirmed from the otolith readings was: 7.00,

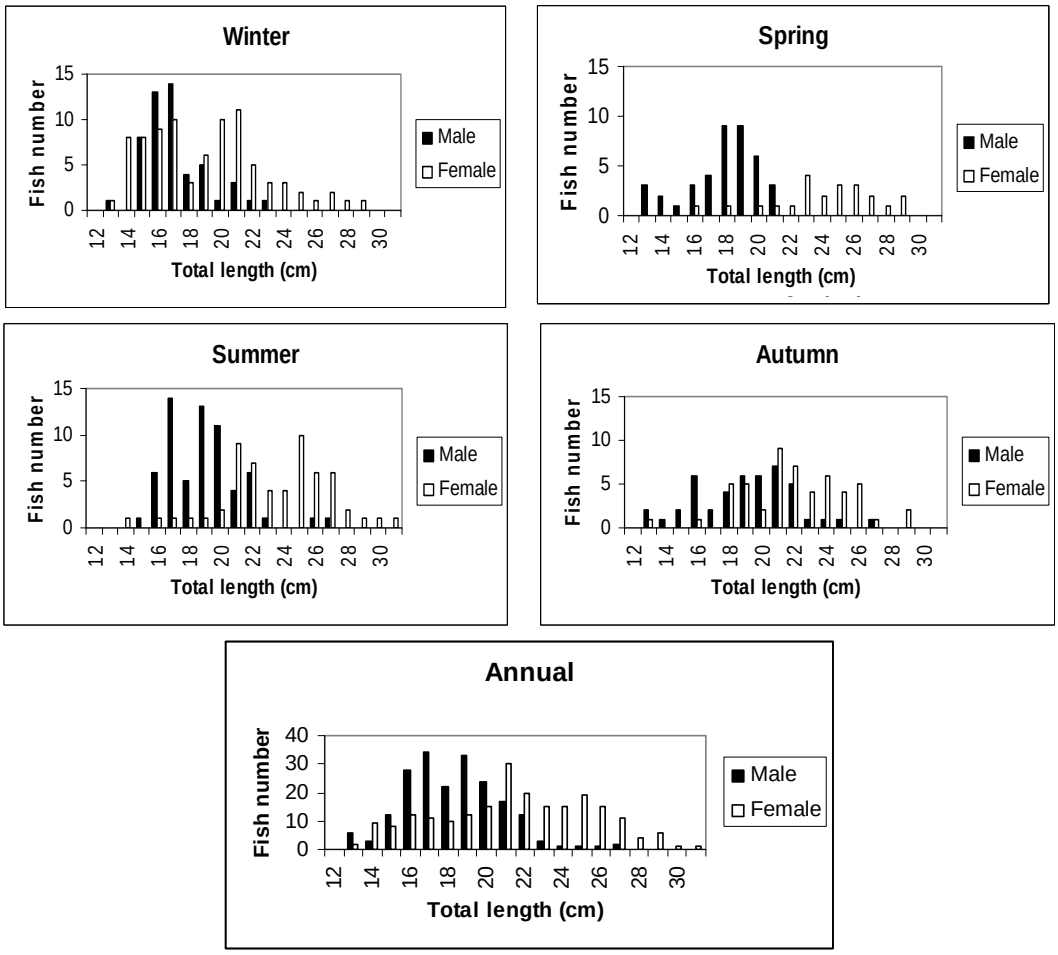

Figure 1. Seasonal and annual variations in the numbers of males and females with total length of *Uranoscopus scaber* captured from the Egyptian Mediterranean water off Alexandria.

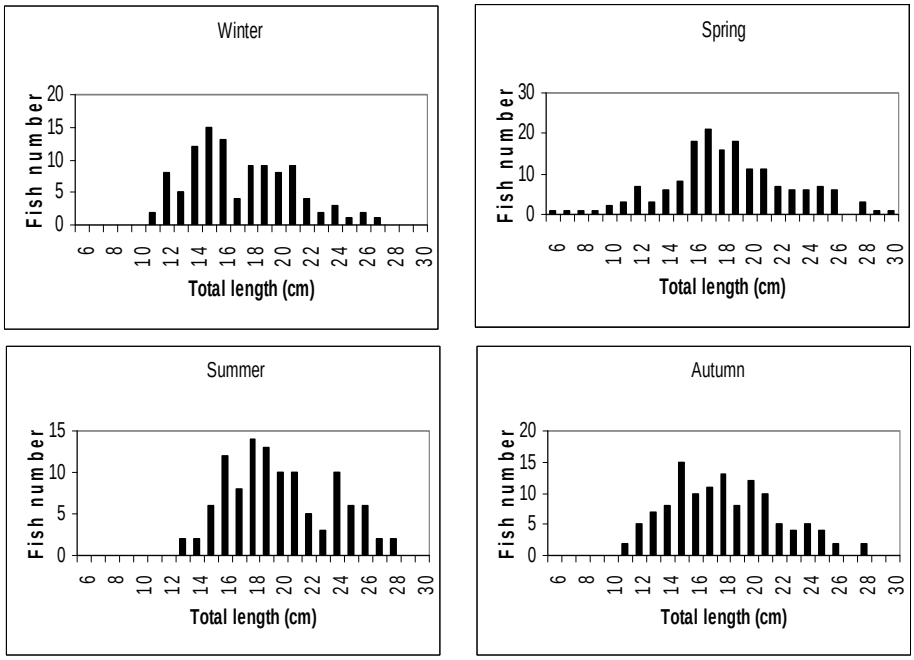

Figure 2. The seasonal size composition of *U. scaber* captured by trawler off Alexandria.

11.76, 15.11, 17.48, 19.82 and 22.11 cm respectively. The higher increment was noticed in group less than first year (4.76 cm), and then the increment tends to decrease (Table 1).

The weights estimated for *U. scaber* from weight and age analyses were 6.0, 22.8, 48.2, 74.5, 108.5 and 150.3 grams for the zero to the fifth age groups, respectively. The minimum fish weight gain was observed in the first year of life (16.80 g) and this rate increased sharply to reach the maximum value (41.80 g) in the fifth year of life (Table 1).

Length-weight Relationship

The relationship between total length (L, cm) and total weight (W, g) was found to represente by the equations:

For male: $W=0.0207\ L^{2.8659}$ ($r^2 = 0.8434$)

For female: $W=0.0095\ L^{3.1216}$ ($r^2 = 0.9024$)

The computed length-weight relationships of males and females of *U. scaber* showed no significant differences in the regressions between sexes according to analysis of covariance (P>0.05). The equation given for combined sexes was as following:

$W = 0.0142\ L^{2.9944}$ ($r^2 = 0.9147$) (Figure 4).

The Coefficient of Condition

The mean values of Fulton's condition factor (K) at different lengths for *U. scaber* in the Egyptian Mediterranean waters are shown in Table 2. The mean values of condition factors were found to be 1.439 for males and 1.400 for females. The analysis of variance indicates that there is not a significant difference in the mean values of condition factor between the two sexes of this species (P>0.05).

Seasonal variation of Fulton's condition factors (Figure 5) indicating higher feeding activity of this species showed higher value during autumn (1.45±0.102). Then decreased in winter (1.42±0.156) and spring (1.40±0.156) to reach the lowest value in summer (1.38±0.065).

Theoretical Growth and Growth Performance

The equations of theoretical growth in length and weight obtained were as follows:

$L_t = 35.02\ [\ 1- \exp - 0.342\ (\ t\pm1.01)]$

$W_t = 188.40\ [\ 1- \exp - 0.342\ (\ t\pm1.01)]^{2.9944}$

Back calculation of theoretical growth in length (L_t) and weight (W_t) at different years of life for *U. scaber* from von Bertalanffy parameters is shown in Table 1. It revealed very small differences between the back calculated lengths and weights and those calculated for the above equations.

Growth performance in length (Φ') and weight (Φ) for *U. scaber* were found to be 2.62 and 1.05, respectively.

Mortalities and Rate of Exploitation

Instantaneous total mortality coefficient (Z) for *U. scaber* was found to be 0.9011 $yr^{-1,}$ as given in Figure 6. According to Pauly (1983), the natural mortality (M) was computed using the calculated L_∞=35.02 cm and K = 0.342 yr^{-1}, the water temperature (T) used in the calculation was 22.5°C (Kamel, 1993). The obtained value of M was 0.5537

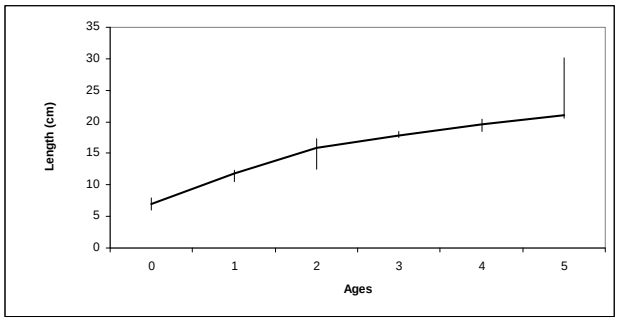

Figure 3. Age- Length relationship of *Uranoscopus scaber* captured from the Egyptian Mediterranean water off Alexandria.

Table 1. Back-calculation lengths (cm) and weights (g) at different ages and those predicted from the von Bertalanffy equation for *U. scaber* in Egyptian Mediterranean waters off Alexandria

Parameter	Age group (year)					
	0	1	2	3	4	5
Number of fish	41	98	138	115	58	9
Empirical length (cm)	7±1.789	11.76±0.467	15.11±1.324	17.48±0.289	19.82±0.537	22.11±2.217
Increment of length (cm)		4.76	3.35	2.37	2.34	2.29
Length predicted from v.B	7.70	12.38	16.02	18.61	20.45	21.76
Empirical weight (g)	6.00	22.80	48.20	74.50	108.50	150.30
Increment of weight (g)		16.80	25.40	26.30	34.00	41.80
Weight predicted from v.B	4.66	22.95	49.66	77.78	103.21	124.33

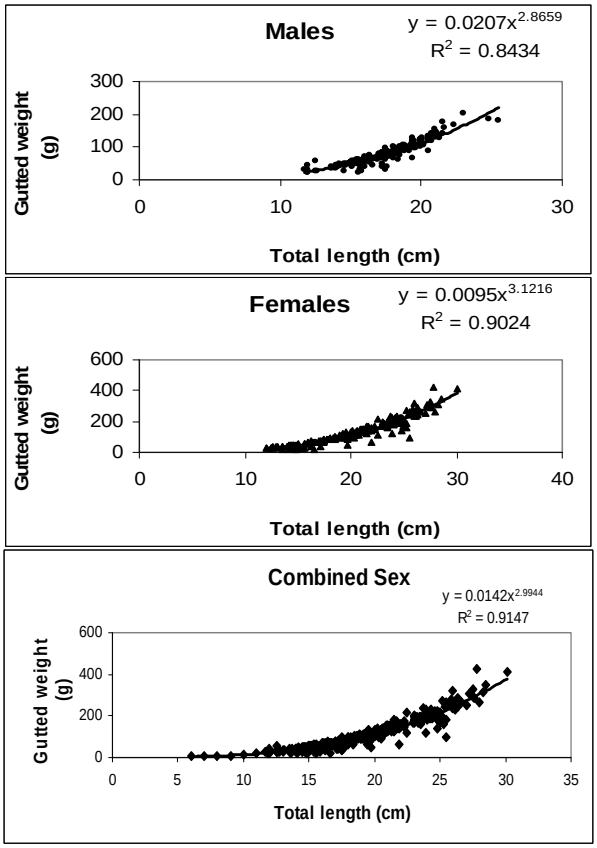

Figure 4. Length-weight relationship of *Uranoscopus scaber* captured from the Egyptian Mediterranean water off Alexandria.

Table 2. Fulton's condition factor (K) of *Uranoscopus scaber* captured from the Egyptian Mediterranean water off Alexandria

Total length (cm)	Fulton's condition factor (K)		
	Male	Female	combined
6	--	--	1.620 (1)*
7	--	--	1.458 (1) *
8	--	--	1.370 (1) *
9	--	--	1.100 (1)*
10	--	--	1.300 (2) *
11	--	--	1.340 (7) *
12	1.702 (16)	1.476 (4)	1.589 (20)
13	1.355 (5)	1.504 (12)	1.430 (17)
14	1.488 (16)	1.332 (12)	1.410 (28)
15	1.452 (31)	1.198 (13)	1.325 (44)
16	1.393 (42)	1.270 (11)	1.332 (53)
17	1.378 (29)	1.293 (15)	1.336 (44)
18	1.399 (41)	1.522 (11)	1.461 (52)
19	1.436 (31)	1.472 (17)	1.454 (48)
20	1.425 (20)	1.407 (21)	1.416 (41)
21	1.45 (17)	1.466 (23)	1.458 (40)
22	1.517 (5)	1.406 (16)	1.462 (21)
23	1.596 (2)	1.451 (13)	1.524 (15)
24	1.451 (1)	1.422 (23)	1.437 (24)
25	1.226 (1)	1.308 (17)	1.267 (18)
26	1.392 (1)	1.419 (15)	1.406 (16)
27	--	1.414 (3)	1.414 (3)
28	--	1.477 (7)	1.477 (7)
29	--	1.503 (1)	1.503 (1)
30	--	1.503 (1)	1.503 (1)

* Unidentified sex

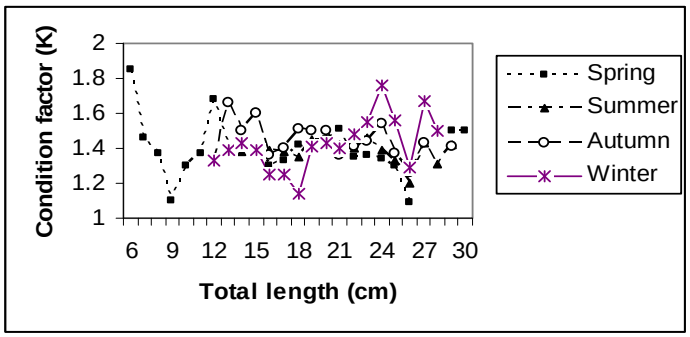

Figure 5. Seasonal variations in Fulton's condition coefficient (K) of *Uranoscopus scaber* captured from the Egyptian Mediterranean water off Alexandria.

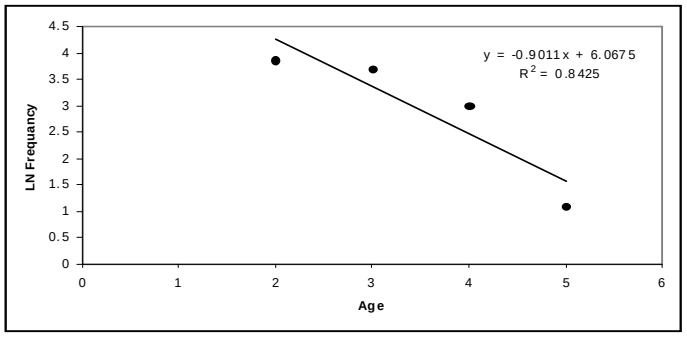

Figure 6. Catch curve of *Uranoscopus scaber* captured from the Egyptian Mediterranean water off Alexandria.

yr^{-1} whereas the calculated fishing mortality (F) was 0.3474 yr^{-1}.

Exploitation ratio (E) gives an indication of whether a stock is over-fished or not on the assumption that the optimal value of E is about or equal to 0.5 (Gulland, 1971). Its value in the present study (0.229) was less than optimal value.

Length and Age at First Capture

The calculated length at first capture (L_c) was calculated, where L- the mean length (cm) of the total catch which was set to 18.37 cm. The calculated length **(**L_c**)** was 14.06 cm. By using von Bertalanffy's growth constants, the corresponding age of L_c was 2.51 yr.

Length and Age at Recruitment

The calculated length at recruitment (L_r) was estimated using the previous equation and minimum length of fish in the catch (6.0 cm). The obtained value was 7.50 cm corresponding to 0.31 year.

Yield Per Recruit (Y/R)

The plot of relative yield per recruit Y'/R and relative biomass-per- recruit (B'/R) of *U. scaber* captured from the Egyptian Mediterranean water off Alexandria, against the exploitation rate E (Figure 7). It gives a maximum (Y'/R) at E_{MSY}= 0.611 and $E_{0.5}$= 0.333. This results revealed that, the present level of exploitation rate (E= 0.229) is lower than the exploitation rate ($E_{0.5}$= 0.333), which maintain 50% of the stock biomass.

Separate estimates of yield per recruit were calculated for different fishing mortalities (0.01- 1.2). The results show that the estimated yield per recruit increases continuously with the increase in fishing mortality coefficient, reaching its climax at Maximum Sustainable yield point (MSY). Thereafter, it remained more or less constant. According to Beverton and Holt (1957) The Maximum Sustainable yield is not preferable target in fisheries management, but the profitable one is the optimum yield or maximum economic yield (MEY). The Maximum Sustainable Yield was attained at fishing mortality F = 0.06 yr^{-1} reaching Y/R = 2.63 g and B/R= 4.38. While, the current levels of Y/R and B/R were 2.07 and 5.97 g respectively, with F = 0.35 yr^{-1}. The maximum economic yield estimated from fishing mortality at the optimal value of E is about or equal to 0.51, which was found to be 2.70 at fishing mortality 0.65 yr^{-1}.

Discussion

The present study showed that the size of males is lower than that of females. This agrees with Sanz (1985) from his study on the same species in Spanish waters, which identified that females tend to be larger than males. The Atlantic stargazers are rarely found in

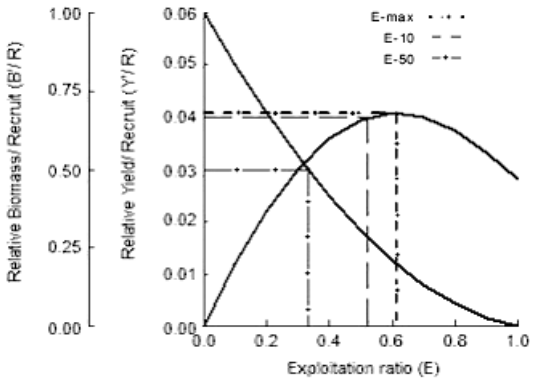

Figure 7. Yield per recruit analysis of *Uranoscopus scaber* from the Egyptian Mediterranean water.

the eastern part of the Egyptian Mediterranean coastal waters, while it is present in the western part. According to el-Sayes *et al.* (2001), in the western part its has a total length range between 8.0-29.0 cm. This was less than that we found (6.0-32.0 cm) for this species in the eastern part.

In the present study, the maximum age of *U. scaber*, which is based on samples collected from a fleet using Italian otter trawls was five years. During an earlier study, the maximum age was found to be six years in the western part of the Egyptian Mediterranean coastline from a fleet using Japanese design trawls (El-Sayes *et al.*, 2001). This difference might be attributed to the difference in the design of the two nets as the first has cod end with mesh size of 24 mm, while the other has mesh size of 40 mm.

The study of length- weight relationship of this species showed non significant differences between males and females. This result agrees with those given by Sanz (1985) for the same species in Spanish water, moreover comparing the Fulton's condition factor given by this author with that in the present work revealed that *U. scaber* in Spanish water is heavier (K= 1.603) than those in the Egyptian Mediterranean water (K= 1.413). It can be attributed to the fact that the environmental conditions in South Eastern Mediterranean water are deteriorated for living this species than those of Western Mediterranean coast.

The asymptotic length and weight (L_∞ =35.02 cm & W_∞ =188.40 g) of the present study were generally close to the maximum length and weight observed in this study (30 cm & 410 g). Moreover, the asymptotic length was equal to observed total length (30 cm) for this species in Eastern Adriatic (Dulcic and Kraljevic, 1996). This is in agreement with Pauly (1979) who stated that asymptotic length and weight in small fishes are generally close to the maximum length and weight of oldest fish.

The parameters representing the population dynamic of this species in the present results: total mortality (Z = 0.901 yr^{-1}), natural mortality (M = 0.5537 yr^{-1}), fishing mortality (F = 0.347 yr^{-1}) and exploitation rate (E = 0.229) indicated that this species is not subjected to over fishing in the Egyptian Mediterranean waters. This is in agrees with fishing mortality (F = 0.145 yr^{-1}) and exploitation rate (E = 0.117) and higher than total (Z = 0.445 yr^{-1}) and natural (M = 0.301 yr^{-1}) mortalities reported by El-Sayes *et al*. (2001). In addition to, this authors declared that this species in the western area of the Egyptian Mediterranean waters is characterized by low exploitation rate (E= 0.172) as compared with other demersal fishes caught from the same area, as their exploitation rate were: *Serranus cabrilla* (E = 0.306), *Bothus podas* (E = 0.286), *Spicara smaris* (E = 0.241) and *Diplodus vulgaris* (E = 0.212).

References

Beverton, R.J.H. and Holt, S.J. 1957. On the dynamics of exploited fish populations. Fish. Invest., London, Ser., 2(19): 533.

Clark, F. 1928. The weight-length relationship of the California Sardine (*Sardina caerulea*) at San Pedro. Fish. Bulletin, 12. California.

Cushing, D.H. 1968. Fisheries biology. A study of population dynamic.Univ. Wisconsin Press, Madison, 200 pp.

Demestre, M., Sanchez, P. and Abello, P. 2000. Demersal fish assemblages and habitat characteristics on the continental shelf and upper slope of the north-western Mediterranean. J. Mar. Biol. Assoc., 80(6): 981- 988.

Dulcic, J. and Kraljevic, M. 1996. Weight-length relationship for 40 fish species in the eastern Adriatic (Croatian waters). Fish. Res., 28(3): 243-251.

El-Sayes, A., Abd El- Hameed, K., Faltas, S.N., Rizkalla, S.I. and Abdallah, A. 2001. Demmersal fish resources along the Mediterranean coast of Egypt. Technical report on demersal fisheries survey.Conf.of Nat. Inst. Oceanogr. & Fish. UAR March, Egypt, 62 pp.

Fulton, T. 1902. Rate of growth of sea fishes. Fish. Scotl. Sci. Invest. Rep., Scotland, 20 pp.

Gulland, J.A. 1964. Manual of methods of fish population analysis, FAO Fish. Techno. Pap., Rome, 40 pp.

Gulland, J.A. 1971. Science and fishery management. J. Cons. CIEM, 33(3): 471- 477.

Hureau, J. 1986. Fishes of the North - eastern Atlantic and the Mediterranean, 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, 2: 955-956.

Kamel, M.S. 1993. Wind driven water movement of the upper layer of the eastern and western Mediterranean Sea. MSc. thesis, Alexandria: Alex., Univ., Fac. Sci., Egypt, 109 pp.

Lagler, K.F. 1956. Fresh Water Fishery Biology In: W.M.C. Brown (Eds.), Comp., Dubuque, Iowa, 421 pp.

Lee, R.M. 1920. A review of the methods of age and growth determination in fishes by means of scales. Fishery Invest., 4 (2): 1-32.

Moharrem, S.G. 2003. Reproductive biology of *Uranoscopus scaber* (Linnaeus, 1758), Family: Uranoscopidae in the Egyptian Mediterranean waters. Egypt. J. Aquat. Biol. & Fish., 7(2): 175-208.

Moreau, J., Bambino, C. and Pauly, D. 1986. Indices of overall growth performance of 100 Tilapia (Cichlidae) population. In: J.L. Maclean, L.B. Dizon and L.V. Hosillos (Eds.), The first Asian Fish, Fourum Manila Philippines, Asian Fish. Soc., 201-206.

Pauly, D. 1979. Gill size and temperature as governing factor. *IN*: Fish Growth: a Generalization of von Bertalanffy' s Theory of Growth. Ber. Inst. Meeresked Christian- Albrechts Univ. Kiel., 156 pp.

Pauly, D. 1983. Some simple methods for the assessment of tropical Fish stocks, FAO Fish., Tech. Pap., Rome: 52-234.

Pietch, T.W. 1989. Phylogenetic relationships of trachinoid fishes of family Uranoscopidae. Capeia: 253-303.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish.Res. Bd. Can., 191: 382-391.

Sanz, A. 1985. Contribucion al estudio de la bilogia de *Uranoscopus scaber* Linnaeus, 1758 (Osteichthyes, Uranoscopidae) del Mediterraneo occidental. Inv. Pesq., 49 (1): 35-46.