International Journal of Fisheries and Aquatic Studies 2015; 3(1): 75-80

ISSN: 2347-5129
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.352
IJFAS 2015; 3(1): 75-80

www.fisheriesjournal.com
Received: 11-06-2015
Accepted: 13-07-2015

Sabry S El-Serafy
Zoology Department, Faculty of Science, Benha University.

Fahmy I El-Gammal
Fisheries Department, National Institute of Oceanography and Fisheries.

Sahar F Mehanna
Fisheries Department, National Institute of Oceanography and Fisheries.

Nasr-Allah H Abdel-Hameid
Zoology Department, Faculty of Science, Benha University.

Elsayed FE Farrag
Fisheries Department, National Institute of Oceanography and Fisheries.

Correspondence
Elsayed FE Farrag
Fisheries Department, National Institute of Oceanography and Fisheries.

Age, growth and mortality of Streaked Gurnard (*Trigloporus lastoviza*, Bonnaterre, 1788) in the Egyptian Mediterranean waters off Alexandria

Sabry S El-Serafy, Fahmy I El-Gammal, Sahar F Mehanna, Nasr-Allah H Abdel- Hameid, Elsayed FE Farrag

Abstract
Age, growth and mortality of Streaked Gurnard *Trigloporus lastoviza* from the Egyptian Mediterranean waters off Alexandria were investigated between the period from July 2009 and August 2010. The observed maximum age was 4 years for both sexes based on otolith readings. The length-weight relationship was estimated as *W=0.0088L3.0694 (r=0.9854); W=0.0085L3.0836 (r=0.9803)* and *W=0.0106L3.0058 (r=0.9853)* for males, females and combined sexes respectively. The von Bertalanffy growth equations for length were: *Lt=27.17 (1-e-0.3466 (t+1.01), Lt = 27.0 (1 - e -0.3703 (t + 0.93)* and *Lt = 26.92 (1 - e -0.3699 (t + 0.92)* for males, females and combined sexes respectively. The growth performance index value *(Φ)* was calculated as 2.41, 2.43 and 2.43 for males, females and combined sexes respectively. The back calculated data indicated that the growth in length of *T. lastoviza* was highest at the end of the first year of life, followed by a gradual continuous decrease throughout the fish life. Total, natural and fishing mortalities were estimated for combined sexes as 1.51, 0.43 and 1.08 $year^{-1}$ respectively. The results indicate that population is overexploited (*E = 0.72*) and suffering from high fishing pressure.

Keywords: Gurnard, *T. lastoviza*, Alexandria, Growth, Mortality.

1. Introduction
The Streaked Gurnard (*Trigloporus lastoviza*) is a demersal marine fish, distributed in the Mediterranean Sea and the Eastern Atlantic from England to Canary and Azores Island Akalin and Ilhan [3]. The ecology of gurnards was investigated by Papaconstantinou [29] along the Greek Seas, Tsimenidis *et al*. [40] along the Cretean shelf (Greece), Colloca *et al*., [11] in the Central Mediterranean Sea. The growth and reproduction were investigated in different localities; Baron [4, 5] in France, Faltas and Abdallah [16] in Egypt, Abdallah and Faltas [2] in Egypt, Uçkun [41] in North Aegean Sea, Olim and Borges [28] in Portugal, Sangun *et al*. [36] in Turkey, Boudaya *et al.* [8] in Tunisia, Akalin and Ilhan [3] in Izmir Bay.
The aim of this study is to provide some information on age, growth and mortality of *T. lastoviza* in the Egyptian Mediterranean waters off Alexandria.

2. Materials and Methods
Streaked gurnard specimens were collected from eastern harbor of Alexandria, Egypt by bottom trawl during the period from July 2009 to August 2010. After collection, samples were freshly examined in the laboratory and the following data were recorded for each specimen: date of capture, total length to nearst 0.1cm, total weight nearest to 0.1g, sex and stage of maturity also taken. To study age, fishes were dissected, otolith were carefully removed, cleaned, dried and examined under the binocular microscope at magnification of x25 after being immersed in glycerol. The age estimates were obtained by reading each otolith at least twice, if the readings did not coincide, the otolith was rejected.
The total length otolith radius relationship was derived by plotting the total otolith radius and the total fish length. The intercept value of the regression equation was used to back-calculated fish length at the end of each year of life according to the equation by Lee, 1920 [22]: $Ln = (Lt - a)\, Sn/S + a$ where Ln is the length at the end of n years (cm), Lt is the total length at capture (cm), Sn is the otolith radius to the nth annulus, S is the total otolith radius and (a) is the intercept with Y-axis from the relationship of length and radius. Growth was expressed in

terms of the von Bertalanffy [6] equation; $Lt=L\infty$ *(1-e-k (t-to))* where *Lt* is the fish length at age *t*; $L\infty$ represent the asymptotic length; *k* is a relative growth coefficient and *to* theoretical age when fish length is zero. Growth parameter ($L\infty$ and *K*) were estimated using the *a* and *b* constants of the linear relationship between *Lt* and *L t+1* after Ford [17]-Walford [43] formula, $L_{t+1} = L_\infty (1-e^{-K})+e^{-K} Lt$ Where, $L_\infty = a/1-b$ and $K = -Ln (b)$. The initial condition parameter (to) was calculated by applying the inverse von Bertalanffy growth equation: $T_o= t+ [(1/k) (L_n (L_\infty - Lt)/L_\infty$.

The length-weight relationship was described by the equation; $W=aLb$ where *W* is the total weight (g), *L* is the total length (cm), *a* and *b* are the regression constants. Le Cren [21]. The growth type was identified by Students *t-test* which was applied to determine the significance of differences between the isometric growth (b=3) and allometric growth (b#3) according to the equation $ts= (b-3)/Sb$, where *Sb* is the standard error of the slope. Morey *et al.* [26].

Growth performance index ($\Phi L=logk+2 \log L\infty$) were estimated by Moreau *et al.* [25], where *k* is a growth coefficient and $L\infty$ is a maximum length. Total mortality rate (Z) was estimated by two methods, the first is linearized catch curve Ricker [35] and the second from length-converted catch curve Pauly [32]. Natural mortality coefficient (M) was calculated from different methods; Djabalia *et al.* [12], Ursin [42] and Taylor [38]. The Fishing mortality coefficient (F) and the exploitation ratio (E) were calculated by the equation F=Z-M and E=F/Z Pauly [31]

3. Results

3.1. Age determination and growth in length

The relation between the total body length and the otolith radius of *T. lastoviza* was establishing for the reliability of otolith for age determination. The age estimates were obtained by reading 388 male and 454 females ranging from 11.3 to 24.4cm in total length. The constants *a* and *b* were calculated using the least square method, and the relationship can be expressed by the following equations: $L = -1.972 + 0.447 x$ and $L = -1.505 + 0.435x$ for males and females respectively.

The back-calculated lengths for males and females of *T. lastoviza* at the end of the different years of life are given in tables (1 and 2). Thus, it's clear that, the mean calculated length at the end of each year of life for males were 13.63, 17.57, 20.44 and 22.38 cm for 1st, 2nd, 3rd and 4th year of life respectively, while the back-calculated lengths at the end of each year of life of females were 13.77, 17.84, 20.73 and 22.64 cm for1st, 2nd, 3rd and 4th years of life respectively. It is also evident that both males and females of *T. lastoviza* attain their highest growth in length at the end of the first year of life, after which the annual increment in length decreases gradually with further increase in age until reaches its minimum value at the end of the last year of life.

Table 1: Back-calculated lengths at the different years of life of *T. lastoviza* (males) from the Egyptian Mediterranean water, off Alexandria.

Age (year)	No.	Observed length (cm)	Back calculated length			
			I	II	III	IV
I	102	15.05	14.02			
II	185	18.12	13.87	17.92		
III	89	21.01	13.76	17.71	20.52	
IV	12	22.79	12.87	17.09	20.36	22.38
Average calculated length			13.63	17.57	20.44	22.38
Increment			13.63	3.94	2.87	1.94
% of increment			60.90	17.62	12.81	8.67

Table 2: Back-calculated lengths at the different years of life of *T. lastoviza* (females) from the Egyptian Mediterranean water, off Alexandria.

Age (year)	No.	Observed length (cm)	Back calculated length			
			I	II	III	IV
I	113	15.01	14.06			
II	223	18.44	13.84	17.96		
III	108	21.08	13.66	17.82	20.84	
IV	10	22.93	13.52	17.75	20.62	22.64
Average calculated length			13.77	17.84	20.73	22.64
Increment			13.77	4.07	2.89	1.91
% of increment			60.82	17.99	12.75	8.44

3.2. Length-Weight relationship

The total length measurements of male specimens ranged from 12 to 23cm, while the total weight measurements varied from 19.3 to 134.9gm. In case of females the total length and total weight measurements ranged from 11 to 24cm and from 14.2 to 154.2gm respectively. The length-weight relationship parameters were estimated as in Table [3]. According to the student t-test, isometric growths were observed for both male and female. Also for all fish, weight increased isometrically with length.

Table 3: Length-weight relationship parameters of *T. lastoviza* from the Egyptian Mediterranean water off Alexandria.

Sex	N	a	b	r	t-test
male	397	0.0088	3.0694	0.9854	0.5891 [a]
females	490	0.0085	3.0836	0.9803	0.8236 [b]
All	910	0.0106	3.0058	0.9853	0.0064

[a](t-test, t<t 0.05, t=1.66), b(t-test, t<t 0.05, t=1.65)

3.3. Back-calculated weight

The estimation of growth in weight for each year of life for *T.lastoviza* was obtained by applying the calculated total length to the length -weight equation as seen in Table (4 and 5). The mean weight for each age group of males was estimated to be 26.80, 58.34, 92.66 and 122.39 g. during the 1st, 2nd, 3rd and 4th years of life respectively, while for females the mean calculated weights at the end of each year of life were 27.65, 61.45, 97.57 and 128.03 gm. during the 1st, 2nd, 3rd and 4th years of life respectively. The results indicated that, the highest increment in weight takes place at the end of the third year of life for both males and females 92.66g (34.32%) and 36.12gm (28.22) respectively, while the lowest input in weight was recorded at the end of the first year of life being; 26.80g (21.90%) for males and 27.65g (21.60%) for females.

Table 4: Back-calculated weight at the different years of life of *T. lastoviza* (males) from the Egyptian Mediterranean water, off Alexandria.

Age (year)	No.	Observed weight (g)	Back calculated weight			
			I	II	III	IV
I	102	36.21	29.13			
II	185	64.01	28.18	61.87		
III	89	100.82	27.50	59.67	93.77	
IV	12	129.40	22.40	53.49	91.55	122.39
Average calculated weight			26.80	58.34	92.66	122.39
Increment			26.80	31.54	34.32	29.73
% of increment			21.90	25.77	28.04	24.29

Table 5: Back-calculated weight at the different years of life of *T.lastoviza* (females) from the Egyptian Mediterranean water, off Alexandria.

Age (year)	No.	Observed weight (g)	Back calculated weight			
			I	II	III	IV
I	113	36.05	29.47			
II	223	68.0	28.07	62.69		
III	108	102.73	26.96	61.20	99.17	
IV	10	133.16	26.12	60.46	95.98	128.03
Average calculated weight			27.65	61.45	97.57	128.03
Increment			27.65	33.79	36.12	30.46
% of increment			21.60	26.40	28.22	23.79

3.4. Theoretical growth in length and weight

The von Bertalanffy growth parameters were estimated and the obtained equations were as follows: Lt = 27.17 (1-e -0.3466 (t + 1.01); Lt = 27.0 (1- e-0.3703 (t + 0.93)) and Lt = 26.92 (1- e-0.3699 (t + 0.92)) for males, females and combined sexes respectively. On the other hand the obtained theoretical growth in weight equations of males, females and combined sexes of *T. lastoviza* can be represented as follow: Wt = 222.01 [1–e -0.3466 (t + 1.01)] 3.0694; Wt = 220.45 [1– e-0.3703 (t + 0.93)] 3.0836 and Wt = 210.78 [1–e -0.3699 (t + 0.92)] 3.0058 respectively. The calculated von Bertalanffy growth parameters and growth performance index values were given in Table 6.

Table 6: Parameters of the von Bertalanffy growth and growth performance (Φ) values of *lastoviza* from the Egyptian Mediterranean water off Alexandria.

Sex	Parameters	Methods	
		Ford-Walford	Gulland
Male	L∞	27.17	27.18
	K	0.3466	0.3430
	to	-1.01	-1.05
	W∞	222.01	222.11
	Φ	2.41	
Female	L∞	27.0	27.0
	K	0.3703	0.3661
	to	-0.93	-0.97
	W∞	220.45	220.41
	Φ	2.43	
Combined	L∞	26.92	26.91
	K	0.3699	0.3659
	to	-0.92	-0.96
	W∞	210.48	210.65
	Φ	2.43	

3.5. Mortality

The annual instantaneous rate of total mortality (Z) derived from two different methods, and the mean values of total mortality were 1.37, 1.61 and 1.51 year for males, females and combined sexes respectively. In the present study, three methods were adopted to estimate of the natural mortality and the average values of the natural mortality (M) were 0.43, 0.44 and 0.43 year for males, females and combined sexes respectively. The fishing mortality coefficient (F) of males, females and combined sex of *T. lastoviza* were 0.95, 1.18, 1.07years respectively.
The obtained results indicated that, the fishing mortality coefficient of females is higher than that of males. This is may be due to that females are more vulnerable to the fishery than males or may be due to the differences in behaviors between females and males. The exploitation rate (E) of males, females and combined sexes of *T. lastoviza* was estimated to be as follows E=0.69, 0.73 and E=0.71/year respectively.

4. Discussion

The Total length of Streaked gurnard *T.lastoviza* specimens ranged from 11.0 to 24.0 cm in the research area. This range was compared with the results given by different studies (Table 7). The range values in our sample somewhat differ from those given below probably due to their sampling method, net used, growth, mortality relating to difference in fishing intensity, and fishing characteristics in different geographical areas.

Table 7: Maximum size (cm) of *T.lastoviza* as given by various authors in different localities.

Authors	Locality	Maximum size
Lozano & Rey [23]	Spanish Mediterranean	32 cm TL
Bini [7]	Italian Mediterranean	40 cm TL
Papaconstantinou [29]	Greek Sea	30 cm TL
Baron [4]	Dournenez Bay, France	45 cm TL
Faltas & Abdallah [16]	Egyptian Mediterranean	25 cmTL
Boudaya *et al.* [8]	Tunisian water	22 cm TL
Akalin & Ilhan [3]	IzmirBay	24.4 cm FL
Present study	Alexandria (Egypt)	24 cm TL

The lengths at the end of the different years of life for males, females and combined sexes of *T. lastoviza* collected from the Egyptian Mediterranean waters were back-calculated using Lee's equation. Data showed that, the mean back-calculated length at the end of each year of life of males and females were: 13.63, 17.57, 20.44 and 22.38cm; 13.77, 17.84, 20.73 and 22.64cm for 1st, 2nd, 3rd and 4th years of life respectively.
It is also evident that both males and females of *T. lastoviza* attain their highest growth in length at the end of the first year of life (13.63cm for males and 13.77cm for females). Similar result was obtained by Kartaz [19]; Baron [4]; Faltas & Abdallah [16] and Akalin & Ilhan [3]. After which the annual increment in length decreases gradually with further increase in age until reaches its minimum value at the end of the last year of life (1.94 and 1.91cm at the end of 4th year of life for males and females respectively). Kartaz [19] in Catalan Sea and Baron [4] in Douarnenez Bay found that the age groups of *T. lastoviza* up to five years. Faltas & Abdallah [16] are estimating the mean length for three age groups were 9.0, 16.98 and 22.48cm for combined sexes of *T. lastoviza* in the Egyptian Mediterranean water, off Alexandria by using length frequency data. Boudaya *et al*. [8] in Tunisian water are giving up to five years for males and Four years for females. Akalin and Ilhan [3] in Izmir Bay recorded five and six age groups for males and females respectively. There must be some differences between growth characteristics from one area to another because of differences in the quantity of food and quality of food, prey-predator interactions and fishing pressure as well as climatic and hydrographic conditions.
The length-weight relationship has its important applications in the field of the fisheries management. Equations of the length-weight relationship revealed no differences between sexes, with the coefficient *b* no different from value 3, indicating isometric growth. Similar results were found in the Bay of Biscay and East and West Channel by Dorel [13] in the Adriatic Sea; Dulcic and Kraljevic [14]: on the Mediterranean coast of Egypt Abdallah [1]; in the Aegean Sea Moutopoulos and Stergiou [27]; Edremit Bay Uçkun [41]; Northern Aegean Sea Karakulak *et al.* [18]; South coast of Portugal Olim and Borge [28] and North-eastern Mediterranean Sangun *et al.* [36] (Table 8).

Table 8: Length-weight relationships of *T. lastoviza* in different locations.

Authors	Localities	Sex	A	b	r^2
Dorel[13]	Bay of Biscay	F+M	0.0128	2.963	0.994
Petrakis&Stergiou[34]	Greek waters	F+M	0.000017	2.951	0.98
Dulcic&Kraljevic[14]	Eastern Adriatic	F+M	0.0000396	3.037	0.872
Merella *et al.*[24]	Balearic Island	F+M	0.0185	2.74	0.991
Abdallah, 2002	Alexandria (Egypt)	F+M	0.023	2.951	0.984
Santos *et al.,*[37]	Southern Portugal	F+M	0.0101	3.03	0.972
Olim & Porges[28]	South coast of Portugal	F	0.004	3.3	0.97
		M	0.008	3.1	0.99
		F+M	0.007	3.12	0.98
Sangun *et al*.,[36]	North-eastern Mediterranean	F+M	0.0085	3.079	0.99
Akalin & Ilhan[3]	Coast of Turkey (Izmir Bay)	F	0.0116	3.032	0.971
		M	0.0136	2.971	0.959
		F+M	0.0117	3.03	0.969
Present study	Egyptian Mediterranean off Alexandria	F	0.0085	3.084	0.99
		M	0.0088	3.069	0.99
		F+M	0.0106	3.006	0.99

The von Bertalanffy growth parameters of *T. lastoviza* in different studies were represented in Table 9. In the table, it is clear that there must be some differences between the growth characteristics from one area to another for reasons of quantity and quality of food and hydrographical and climatic conditions. Methodological differences in the age determinations and the number of fish studied may also have an effect in this situation. When we compare the growth performance index (Φ) values of the present study with other studies (Table 9), our data were considerably lower than the data reported by Papaconstantinou [30]; Campillo [10] and Uçkun [41] for Saronikos, Mediterranean and Edremit Bay, respectively. Nevertheless, our values are higher than the corresponding values determined by Baron [4]; Faltas and Abdallah [16]; Boudaya *et al.* [8] and Akalin&Ilhan [3] for Douarnenez Bay, the Egyptian Mediterranean waters, Tunisian waters and Izmir Bay respectively. The differences of values between regions can be attributed to the difference in the size of the largest individual as well as the number of species sampled in each area.

Pauly, 1980 [31] in the review of the natural mortality of 174 fish stocks noted an overall model mortality of M=0.2-0.3 year-1. The natural mortality of *T.lastoviza* in our study area was considerable slightly high (0.43). The annual instantaneous rate of fishing mortality of combined sexes (F=1.07 y-1 was considerably greater than the target (Fopt=0.22) and limit (Flimit=0.29) biological reference point, suggesting that the stock is heavily over-exploited. The exploitation ratio (E=0.71) showed that it was overexploited. This result similar to results recorded by Faltas & Abdallah [16]. Papaconstantinou [30] estimated that E=0.83, which was very high and showed that the stock of *T.lastoviza* was overfished for saronikos Bay. Akalin & Ilhan [3] in Izmir Bay reported that the stock of *T.lastoviza* is rationally exploited (E=0.51). Table (10).

Table 9: The von Bertalanffy growth parameters and growth performance of *T.lastoviza* in different areas.

Authors	Localities	Sex	L∞	K	to	Ø
Kartaz [19]	Gulf of Lion	All	38.2	-	-	-
Baron [4]	Douarnenez Bay	F	35.9	0.58	0.04	2.96
		M	36.9	0.65	0.15	2.95
		All	35.6	0.133	1.12	2.23
Papaconstantinou [30]	Saronikos Gulf	All	38.2	0.254	0.37	2.57
Campillo [10]	Mediterranean waters	All	34.7	0.372	-	2.65
Faltas & Abdallah [16]	Mediterranean waters (Egypt)	F	26.3	0.19	1.55	2.12
		M	26.9	0.184	1.59	2.13
		All	26.4	0.186	1.61	2.11
Uckun [41]	Edremit bay	M	33	0.13	-2.94	2.06
Boudaya *et al*, [8]	Tunisian water	All	29.84	0.13	-3.73	2.15
Akalin & Ilhan [3]	Izmir Bay	F	19.59	0.36	1.37	2.14
		M	26.8	0.152	2.28	2.04
		All	23.28	0.235	1.89	2.11
Present study	Egyptian Mediterranean-	F	27	0.34	-0.95	2.43
		M	27.18	0.37	-1.03	2.41
		All	26.92	0.37	-0.95	2.43

Table 10: Natural and Fishing mortality and exploitation ratio of *T.lastovza* in different areas.

Authors	Localities	M	F	E
Papaconstantinou[30]	Saronikos Gulf	0.18 y-1	0.86 y-1	0.83y-1
Faltas & Abdallah[16]	Alexandria (Egypt)	0.81y-1	2.01 y-1	0.75 y-1
Akalin & Ilhan[3]	Izmir Bay	0.62 y-1	0.63 y-1	0.51 y-1
Present study	Alexandria (Egypt)	0.43 y-1	1.07 y-1	0.71 y-1

5. Conclusion

It can be concluded that the *T. lastoviza stock* off the Egyptian Mediterranean waters, off Alexandria is in a situation of overexploitation and not at sustainable rate, indicating a tendency for catching immature and maturing fishes together. To ensure sustainability of this species, optimum size is required to maximize yield per recruit and allow the stock to recovery through applying management measures including reduction of the present level of fishing effort by about 73% and an increase in the length at first capture. Where reducing of fishing effort seems difficult for socio-economic reasons, it is recommended a closed season with regulate the mesh sizes of the trawl to reducing the by-catch. A new monitoring and control system based on annual data which implements realistic measures with further stock assessment study is urgently needed.

6. References

1. Abdallah M. Length-weight relationship of fishes caught by trawl off Alexandria, Egypt. The ICLARM Quart 2002; 25:1.
2. Abdallah M, Faltas SN. Reproductive Biology of *Trigla lucerna* and *Trigloporus lastoviza* in the Egyptian Mediterranean Waters. Bull. Nat. Inst. of Ocean. & Fish. A.R.E 1998; 24:285-304.
3. Akalin S, Ilhan D. Age, growth and mortality of Rock Gurnard (*Trigloporus lastoviza*) Bonnaterre, 1788 (Osteichthys: Triglidae) in Izmir Bay. The Black Sea J of Sc. 2013; 3(9):47-56.
4. Baron J. Les Triglides (Teleosteens, Scorpaeniformes) De La Baie De Douarnenez. 1-La croissance de *Eutrigla gurnardus, Trigla lucerna, Trigloporus lastoviza* et *Aspitrigla cuculus*. *Cybium* 1985a; 9(2):127-144.
5. Baron J. Les Triglides (Teleosteens, Scorpaeniformes) De La Baie De Douarnenez. 1- La Reproduction de *Eutrigla gurnardus, Trigla lucerna, Trigloporus lastoviza* et *Aspitrigla cuculus*. *Cybium* 1985b; 9(3):255-281.
6. Bertalanffy LV. A quantitative theory of organic growth. Hum. Biol 1938; 10:181-213.
7. Bini G. Atlante dei pesci della coste italiane. Mondo Sommerso 1969; 7:200.
8. Boudaya L, Neifar L, Rizzo P, Badalucco C, Bouain A, Fiorentino F. Growth of *Chelidonichthys lastoviza* (Bonnaterre, 1978) in Tunisia. Rapp. Comm. int. Mer Médit., 2010, 39.
9. Boudaya L, Neifar L, Taktak A, Ghorbel M, Bouain A. Diet of *Chelidonichthys obscurus* and *Chelidonichthys lastoviza* (Pisces: Triglidae) from the Gulf of Gabes (Tunisia). J Appl. Ichthyol. 2007; 23:646-653.
10. Campillo A. Les pêcheries françaises de Méditeranée: synthèse des connaissances. Institut Francais de Recherche pour Exploitation de la Mer, France, 1992.
11. Colloca F, Ardizone GD, Gravina MF. Trophic ecology of gurnards (Pisces: Triglidae) in the Central Mediterranean Sea. Marine Life 1994; 4(2):45-57.
12. Djabalia F, Mehailia A, Koudil M, Brahmi B. Empirical equations for the estimate of natural mortality in Mediterranean Teleosts. Naga, ICLARM. Q 1994; 16(1):35- 37.
13. Dorel D. Poissons de Atlantique nord-est relations taille-poids. Institut Francais de Recherche pour Exploitation de la Mer. Nantes, France, 1986.
14. Dulcıc J, Kraljevic M. Weight-length relationships for 40 fish species in the Eastern Adriatic (Croatian waters). Fisheries Research. 1996; 28:243-251.
15. Faltas SN. Food and feeding habits of gurnards: *Trigla lucerna* L. 1758 and *Trigloporus lastoviza* B. 1768 in the Egyptian Mediterranean waters. Bull. Natl. Inst. Oceanogr. Fish (Egypt) 1996; 22:167-179.
16. Faltas SN, Abdallah M. Growth, Mortality and Relative Yield Per Recruit of Two Triglid Species from The Egyptian Mediterranean, off Alexandria. Bull. Nat. Inst. of Oceanogr. and Fish. A.R.E 1997; 23:473-484.
17. Ford E, An account of the herring investigations conducted and plymouth during the years from 1924 to J Mar. Biol. Assoc. U.K. 1933; 19:305-384.
18. Karakulak FS, Erk H, Bilgin B. Length-weight relationships for 47 coastal fish species from the northern Aegean Sea, Turkey. J of Appl. Ichthyol. 2006; 22:274-278.
19. Kartaz F, Les Triglidae de la mer Catalane. Distribution, croissance et reproduction. Ph.D. Univ. Paris, France. Labropoulou, M. and Machias. A. 1998. Effects of habitat selection on the dietary patterns of two triglid species. Mar. Ecol. Prog. Ser 1971; 173:275-288.
20. Labropoulou M, Machias A. Effect of habitat selection on the dietary patterns of two triglid species.Mar. Ecol. Prog. Ser 1998; 173:275-288.
21. Le Cren ED. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviattilis*). J Anim. Ecol. 1951; 20:201-219.
22. Lee RM. A review of the methods of age and growth determination in fishes by means of scale. Fish. Invest. Min. Agr. Fish. Ser.2&4 1920; (2):1-32.
23. Lozano Y, Rey L. Pesces fisoclistos, Subserie toracisos. Mems. R. Acad. Cienc. Exact. Fis. Nat. Madrid, 1952; 14(1): 378.
24. Merella P, Quetglas A, Alemany F, Carbonell A. Length-weight relationship of fishes and cephalopods from the Balearic Islands (Western Mediterranean). Naga, ICLARM Q 1997; 20(3-4):66- 68.
25. Moreau J, Bambino G, Pauly D. Indices of overall growth performance of Tilapia (Cichlidae) populations. J. Mar. Biol. Ass U.K. In J.L Maclean, l.B Dizon and L.V. Hossillos (eds). The first Asian Fisheries Forun. Asian Fisheries Society, Manilla, Philippines 1986; 3(2):201-206.
26. Morey G, Moranta J, Massuti E, Grau A, Linde M, Riera F *et al.* Weight-length relationships of littoral to lower slope fishes from the western Mediterranean. Fish. Res 2003; 62:89-96.
27. Moutopoulos DK, Stergiou KI. Length-weight and length-length relationship of fishes species from the Aegean Sea (Greece). J of Appl. Ichthyol. 2002; 18:200-203.
28. Olim S, Borges TC. Weight-length relationships for eight species of the family Triglidae discarded on the south coast of Portugal. J of Appl. Ichthyol. 2006; 22:257-259.
29. Papaconstantinou C. Observations on the ecology of gurnards (Pisces: Triglidae) of the Greek Seas. *Cybium,* 1983; 7(4):71-88.
30. Papaconstantinou C. The life history of rock gurnard (*Trigloporus lastoviza,* Brünn. 1768) in the Saronikos Gulf. Sonderdruck aus. J of Appl. Ichthyol. Bd. 1986; 2:75-86.
31. Pauly D. On the Relationships between Natural Mortality, Growth Parameters and mean Environmental Temperature in 175 Fish Stocks. J Cons. Int. Explor. Mer. 1980; 39(2):175-192.

32. Pauly D. Length-converted catch curves: a powerful tool for fisheries research in the tropics. Part I. Fishbyte 1983; 2:9-13.
33. Pauly D, David N. ELEFAN 1. Basic program for the objective extraction of growth parameters from length frequency data. *Berichte der deutschen Wissenschaftlichen Kommission fur Meeresforschung* 1981; 28(4):205-211.
34. Petrakis G, Stergiou K. Weight-length relationships for 33 fish species in Greek Waters. Fisheries Research 1995; 21:465-469.
35. Ricker WE. Computation and interpretation of biological statistics of fish population. Bull. Fish. Res. Bd. Can 1975; 191:382.
36. Sangun L, Akamca E, Akar M. Weight-length relationships for 39 fish species from the North-Eastern Mediterranean coast of Turkey. Turk. J Fish. Aquat. Sci. 2007; 7:37-40.
37. Santos MN, Gaspar MB, Vasconcelos P, Monteiro CC. Weight- length relationships for 50 selected fish species of the Algarve Coast (Southern Portugal). Fish. Res 2002; 59:289-295.
38. Taylor CC. Temperature, growth and mortality – the pacific cockle. J Cons. CIEM. 1960; 26:117-124.
39. Tetrats A, Petrakis G, Papaconstantinou C. Feeding habits of *A. cuculus* (L., 1758) (red gurnard), *L. cavillone* (Lac., 1802) (large scale gurnard) and *T. lastoviza* (Brunn., 1768) (rock gurnard) around Cyclades and Dodecanese Islands (E. Mediterranean). Mediterranean Marine Science 2000; 1:1.
40. Tsimenidis N, Machias A, Kallianiotis A. Distribution patterns of triglids (Pisces: Triglidae) on the shelf (Greece), and their interspecific associations. Fisheries Research. 1992; 15:83-103.
41. Uçkun D. Investigation of the age and growth characteristics of the species belonging to the family Triglidae in Edremit Bay. *Ege University* Journal of Fisheries and Aquatic Sciences 2005; 22(3-4):363-369.
42. Ursin E. A mathematical model of some aspects of fish growth, respiration and mortality. J Fish. Res Bd Can. 1967; 24:2355-2453.
43. Walford LA. A new graphic method of describing the growth of animals. Biol. Bull. Mar. Biol 1946; 90(2):141-147.