

Age, Growth and Mortality of Rock Gurnard (*Trigloporus lastoviza* (Bonnaterre, 1788)) (Osteichthyes:Triglidae) in İzmir Bay

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Geliş Tarihi: 28.09.2012

Kabul Tarihi: 23.03.2013

Abstract

In this study, age, growth and mortality of the rock gurnard (*Trigloporus lastoviza*) was investigated in İzmir Bay (Aegean Sea) between January and December 2005. The fork lengths of females were ranged from 11.9 cm to 19.8 cm, and that of males from 8.2 cm to 18.2 cm. Sex ratio was 1:1.07 (female: male). The observed maximum age was 6 for females and 5 for males by otolith readings. The length-weight relationships were estimated as $W=0.0116*FL^{3.032}$ ($r=0.985$); $W=0.0136*FL^{2.971}$ ($r=0.979$) and $W=0.0117*FL^{3.030}$ ($r=0.984$) and the von Bertalanffy growth equations for length were found as; $L_t=26.80(1-e^{-0.152(t-2.822)})$, $L_t=19.59(1-e^{-0.361(t-1.370)})$, $L_t=23.28(1-e^{-0.235(t-1.887)})$ for females, males and sex combined, respectively. The growth performance index value (Φ) was calculated as 2.105 for all specimens. Total, natural and fisheries mortalities were estimated as 1.25, 0.62 and 0.63 year⁻¹ respectively.

Keywords: Age, Growth, Mortality, *Trigloporus lastoviza*, İzmir Bay, Aegean Sea

İzmir Körfezi'nde Kırlangıç Balığının (*Trigloporus lastoviza* (Bonnaterre, 1788)) (Osteichthyes: Triglidae) Yaş, Büyüme ve Ölüm Oranları

Özet

Bu çalışmada, Ocak-Aralık 2005 tarihleri arasında İzmir Körfezi'nde (Ege Denizi) Kırlangıç balığının (*Trigloporus lastoviza*) yaş, büyüme ve ölüm oranları tespit edilmiştir. Örneklerin çatal boyları dişi bireylerde 11.9 cm ile 19.8 cm, erkek bireylerde ise 8.2 cm ile 18.2 cm arasında dağılım göstermiştir. Cinsiyet oranı 1:1.07 (dişi: erkek) dir. Otolitlerden yapılan yaş tayini ile maksimum yaş dişilerde 6, erkeklerde 5 olarak tespit edilmiştir. Boy-ağırlık ilişkisi ile boya göre von Bertalanffy büyüme denklemleri dişi, erkek ve tüm bireyler için sırasıyla; $W=0.0116*FL^{3.032}$ ($r=0.985$); $W=0.0136*FL^{2.971}$ ($r=0.979$), $W=0.0117*FL^{3.030}$ ($r=0.984$) ve $L_t=26.80(1-e^{-0.152(t-2.822)})$, $L_t=19.59(1-e^{-0.361(t-1.370)})$, $L_t=23.28(1-e^{-0.235(t-1.887)})$ olarak bulunmuştur. Tüm bireyler için büyüme performans indeksi değeri (Φ) 2.105 olarak saptanmıştır. Toplam, doğal ve balıkçılık ölüm oranları sırasıyla, 1.25, 0.62 ve 0.63 yıl⁻¹ olarak hesaplanmıştır.

Anahtar kelimeler: Yaş, Büyüme, Ölüm Oranları, *Trigloporus lastoviza*, İzmir Körfezi (Ege Denizi)

INTRODUCTION

The rock gurnard (*Trigloporus lastoviza*) is a demersal marine fish, distributed in the Mediterranean Sea and the Eastern Atlantic from England to Canary and Azores Island (Tortonese, 1975).

The ecology of gurnards was investigated by Papaconstantinou (1983) along the Greek Seas. Papaconstantinou (1986) examined the life history traits of the gurnards in the Saronikos Gulf (Greece). Its growth and reproduction were investigated in Douarnenez Bay (France) by Baron (1985a,b). Faltas and Abdallah (1997) and Abdallah and Faltas (1998) reported its growth, mortality and relative yield per recruit, and reproductive biology in the Egyptian Waters of the Mediterranean, respectively. Tsimenidis et al. (1992) determined the distribution pattern of Triglids along the Cretean shelf (Greece). Colloca et al. (1994) presented the tropic ecology of gurnards in the Central Mediterranean Sea. Effects of habitat selection on the dietary patterns of the species reported by Labropoulou and Machias (1998). Tetrats et al. (2000) examined its feeding habits in the Eastern Mediterranean, while Uçkun (2005) studied some biological characteristics of the species in Edremit Bay (North Aegean Sea). In addition, Olim and Borges (2006); Karakulak et al. (2006) and Sangun et al. (2007) reported its length-weight relationships with other fish species on the coast of Portugal, the Northern Aegean Sea and the North-Eastern Mediterranean coast of Turkey, respectively.

The aim of this study is to provide information on age, growth and mortality of *T. lastoviza* from İzmir Bay.

MATERIALS and METHODS

Rock gurnard specimens were collected by bottom trawl from İzmir Bay (Central Aegean Sea) from January 2005 to December 2005 by trawl surveys.

A traditional, 600 meshes around mouth, commercially used bottom trawl was operated by R/V EGESÜF to obtain the study. The towing duration was 30 minutes for all hauls and the average towing speed was 2.4 knots (ranging between 2.0 and 2.8). A nominal 400 mm diamond mesh cod-end about 5 m in stretched length was used. The

samples obtained were measured to the nearest 0.1 cm (fork length, FL), and weighted to the nearest 0.01 g (total weight, W) and dissected in the laboratory.

Age determination was based on sagittal otoliths. Otolith pairs were removed and stored in paper envelopes. Age was read from whole otoliths immersed in glycerin (25%) and alcohol (75%) mixture and viewed with a low-power binocular microscope, under reflected light against a black background. The age estimates were obtained by reading each otolith at least twice by two readers. If the readings did not coincide, the otolith was rejected.

Growth was expressed in terms of the von Bertalanffy equation; $L_t=L_{\infty}(1-e^{-k(t-t_0)})$ where L_t is the fish length at age t ; L_{∞} represent the asymptotic length; k is a relative growth coefficient and t_0 theoretical age when fish length is zero (Sparre et al., 1989).

The length-weight relationship was described by the equation; $W=aL^b$

Where W is the total weight (g), L is the fork length (cm), a and b are the regression constants (Ricker, 1979). Growth performance index ($\Phi=\log(k)+2\log(L_{\infty})$) were computed in FISAT 1.01.

Total mortality rate (Z) was estimated from length-converted catch curve (Pauly, 1983) using FISAT (Gayanilo et al., 1994). Natural mortality coefficient (M) was calculated from the empirical equation of Pauly (1980):

$$\log_{10} M=0.0066-0.279 \log_{10} L_{\infty}+0.6543 \log_{10} K+0.4634 \log_{10} T.$$

Where L_{∞} and k are parameters of von Bertalanffy's growth equation and T is the mean annual water temperature. Fishing mortality coefficient (F) and the exploitation ratio (E) were calculated by the equation $F=Z-M$ and $E=F/Z$ (Pauly, 1980).

RESULTS

The fork length of females ranged from 11.9 to 19.8 cm and the weight from 22.04 to 102.14 g. Males also ranged from 8.2 to 18.2 cm in length and from 6.31 to 74.67 g in weight. It has been observed that most of the specimens were distributed between 13.0 cm and 14.9 cm for both sexes (Figure 1).

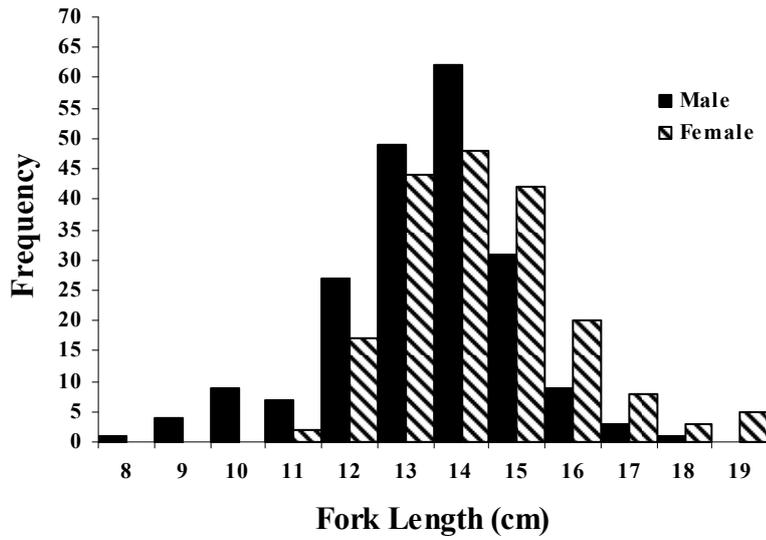


Figure 1. Length distribution of *T. lastoviza* in İzmir Bay

The length-weight relationship parameters were estimated as in Table 1. According to the student t-test, isometric growths were observed for both female and male. Also for all fish, weight increased isometrically with length.

Table 1. Length-weight relationship parameters of *T. lastoviza* in İzmir Bay

Sex	n	a	b	se(b)	r	t-test
F	189	0.0116	3.032	0.0494	0.971	0.648 ^a
M	203	0.0136	2.971	0.0666	0.959	0.435 ^b
All	392	0.0117	3.030	0.0369	0.969	0.813

^a(t-test, $t < t_{0.05, n=80=1.66}$), ^b(t-test, $t < t_{0.05, n=200=1.65}$)

The age estimates were obtained by reading 309 otolith and the age-length key was given in Table 2. Age classes covered in this study by otolith sample analysis ranged from I to VI years. Year-class II was found to be as the most observed age in the total sample for both sexes. Among all specimens, year-class II represented by 53.72 %.

Table 2. Age-length key for *T. lastoviza* in İzmir Bay

FL(cm)	Age Groups						Total
	I	II	III	IV	V	VI	
8.0	1						
9.0	4						
10.0	9						
11.0	9						
12.0	23	9					
13.0		65					
14.0		70	14				
15.0		22	38	1			
16.0			15	10			
17.0			2	7	2		
18.0				1	3		
19.0					2	2	
Total (N)	46	166	69	19	7	2	309
% N	14.89	53.72	22.33	6.15	2.26	0.65	100
FL	11.47±0.36	14.05±0.11	15.47±0.17	16.91±0.28	18.26±0.72	19.8	14.04±0.20
Female	3	3	0	5	0	0	0
Males	8	74	39	13	5	2	141
F:M	1:4.75	1:1.24	1:0.77	1:0.46	1:0.4	-	1:1.20

The calculated von Bertalanffy growth parameters and growth performance index values were given in Table 3. The values of L_{∞} are higher than the maximum observed lengths.

Table 3. Parameters of the von Bertalanffy growth equation and Φ values of *T. lastoviza*

Sex	N	L_{∞}	k	t_0	Φ
F	189	19.59	0.361	- 1.370	2.14
M	203	26.80	0.152	- 2.822	2.04
All	392	23.28	0.235	- 1.887	2.11

N, number of specimens; **L_{∞}** , the asymptotic length(cm); **k**, a relative growth coefficient; **t_0** , theoretical age; **Φ** , growth performance index

The length-converted catch curve is shown in Figure 2. The rates of total mortality for all fish samples were $Z=1.25 \text{ year}^{-1}$, $M=0.62 \text{ year}^{-1}$ and $F=0.63 \text{ year}^{-1}$. The exploitation ratio was calculated as $E=0.51 \text{ year}^{-1}$.

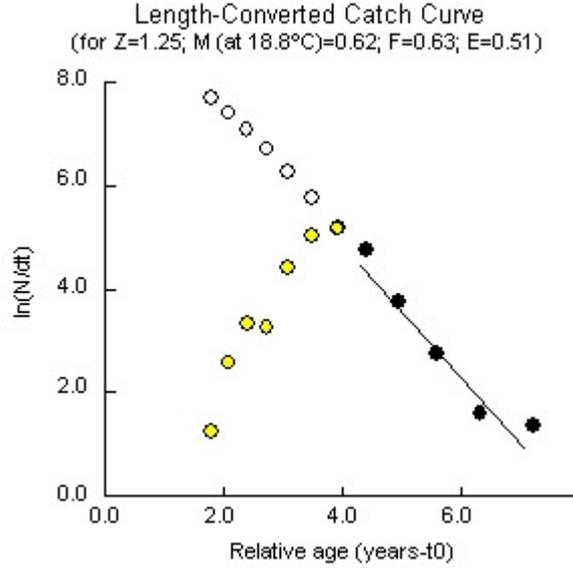


Figure 2. Length converted catch curve for *T. lastoviza* in İzmir Bay

DISCUSSION

The fork length of rock gurnard specimens ranged from 8.2 to 19.8 cm in the research area. This range was compared with the results given by different studies (Table 4). The range values in our sample somewhat differ from those given above probably due to their sampling method, net used, growth, mortality relating to difference in fishing intensity, and fishing characteristics in different geographical areas.

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 (Dorel, 1986) in the Adriatic Sea (Dulcic and Kraljevic, 1996), on the Mediterranean coast of Egypt (Abdallah, 2002), in the Aegean Sea (Moutopoulos and Stergiou, 2002), Edremit Bay (Uçkun, 2005) Northern Aegean Sea (Karakulak et al., 2006), South coast of Portugal (Olim and Borge, 2006) and North-eastern Mediterranean (Sangun et al., 2007) (Table 4).

Table 4. Length-weight relationship comparisons of *T. lastoviza* between this study and other studies

References	Sex	N	Min.(cm)	Max.(cm)	a	b	r	Locality
This study	F	189	11.9	19.8	0.0136	2.973	0.969	İzmir Bay (Aegean Sea)
	M	203	8.2	18.2	0.0123	3.006	0.974	
	All	392	8.2	19.8	0.0124	3.007	0.974	
Papaconstantinou (1986)	All	753	4.5	29.3	-	-	0.985	Saronikos Gulf
Dorel (1986)	All	192	11.0	42.0	0.0128	2.963	0.994	Bay of Biscay East & West Channel
	All	156	6.0	37.0	0.0049	3.039	0.998	
Dulcic and Kraljevic (1996)	All	52	7.4	35.0	0.00002	3.003	0.980	Eastern Adriatic
Merella et al. (1997)	All	50	6.3	14.6	0.0185	2.740	0.991	Balearic Island
Moutopoulos and Stergiou (2002)	All	24	11.5	25.1	0.0145	2.892	0.985	Aegean Sea
Abdallah (2002)	All	15	12.1	23.9	0.0152	2.951	0.989	Evvoikos, Greece
Uçkun (2005)	All	220	5.2	14.4	0.023	2.79	0.984	Alexandria (Egypt)
	F	348	10.1	22.1	0.0114	3.033	0.970	Edremit Bay (Aegean Sea)
	M	224	10.2	19.7	0.0166	2.885	0.963	
Karakulak et al. (2006)	All	572	10.1	22.1	0.0122	3.004	0.969	Northern Aegean Sea
	All	7	15.2	19.5	0.0043	3.325	0.919	
Olim and Borge (2006)	F	16	11.3	22.4	0.004	3.30	0.985	South coast of Portugal
	M	15	10.6	27.4	0.008	3.10	0.995	
	All	45	9.4	27.4	0.007	3.12	0.990	
Sangun et al. (2007)	All	75	6.5	19.3	0.0085	3.079	0.995	North-eastern Mediterranean

The maximum observed life span for rock gurnard in İzmir Bay was six years for females and 5 years for males. The maximum observed life spans were five years for both sexes from Lion Bay (Kartas, 1971); Catalane Sea and Douarnenez Bay (Baron, 1985a). Uçkun (2005) reported five (for females) and six (for males) age groups from Edremit Bay (Aegean Sea). Papaconstantinou (1986) noted eight age groups for females and six year classes for males in Saronikos Bay. There must be some differences between growth characteristics from one area to another because of differences in the quantity and quality of food, prey-predator interactions and fishing pressure as well as climatic and hydrographic conditions.

The rock gurnard population was composed of 48.21% female and 51.79% male individuals from İzmir Bay. Papaconstantinou (1986) and Abdallah and Faltas (1998) reported that the overall sex ratios were 1:1 and 1:1.01 in the Saronikos Bay and the Egyptian Mediterranean waters, respectively. The overall sex ratio is close to 1:1 in

many species, but may vary from species to species, even from population to population of the same species, and may change from year to year in the same population (Nikolsky 1963).

Table 5. The von Bertalanffy growth parameters of *T. lastoviza* in different areas.

References	Sex	N	L_{∞} (cm)	k	t_0	Φ	Locality
This study	F	189	19.59	0.361	1.370	2.14	İzmir Bay (Aegean Sea)
	M	203	26.80	0.152	2.822	2.04	
	All	392	23.28	0.235	1.887	2.11	
Kartas (1971)	All	-	38.2	-	-	-	Gulf of Lion
Seret and Opic (1981)	All	-	35.0	-	-	-	West African Tropical Sea
Baron (1985a)	F	38	39.5	0.58	0.04	2.96	Douarnenez Bay
	M	24	36.9	0.65	0.15	2.95	
Papaconstantinou (1986)	All	638	35.6	0.133	1.12	2.23	Saronikos Gulf
Campillo (1992)	All	-	38.2	0.254	0.639	2.57	Mediterranean waters
Faltas and Abdallah (1997)	All	-	34.68	0.372	-	2.65	Alexandria (Egypt)
Uçkun (2003)	F	348	26.3	0.190	1.554	2.12	Edremit Bay (Aegean Sea)
	M	224	26.9	0.184	1.586	2.13	
	All	572	26.4	0.186	1.613	2.11	

The von Bertalanffy growth parameters of rock gurnard in different studies were represented in Table 5. 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 5), our data were similar ($p>0.05$) to those reported by Papaconstantinou (1986) and Uçkun (2005) for Saronikos and Edremit Bay, respectively. Nevertheless, our values are considerably lower than the corresponding values determined by Baron (1985a), Campillo (1992) and, Faltas and Abdallah (1997) for Douarnenez Bay, Mediterranean and the Egyptian Mediterranean waters, 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) in the review of the natural mortality of 174 fish stocks noted an overall modal mortality of $M=0.2-0.3 \text{ year}^{-1}$. The natural mortality of rock gurnard in our study area was considerable high (0.62 year^{-1}) and the exploitation ratio ($E=0.51 \text{ year}^{-1}$) showed that it was rationally exploited. Papaconstantinou (1986) estimated that $M=0.18 \text{ year}^{-1}$, $F=0.86 \text{ year}^{-1}$, $Z=1.04$ and $E=0.83 \text{ year}^{-1}$, which was very high and showed that the stock was overfished for the Saronikos Bay. Faltas and Abdallah (1997) reported that rock gurnards was exposed to high fishing mortality ($F=2.01 \text{ year}^{-1}$) and over-exploited ($E=0.71 \text{ year}^{-1}$) in the Egyptian Waters of Mediterranean.

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