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Age, Growth and Mortality of *Upeneus pori* Ben-Tuvia and Golani, 1989 off the Karatas Coasts of Iskenderun Bay

[1]Erdogan Cicek and [2]Dursun Avsar
[1]Department of Biology, Faculty of Art and Sciences, Nevsehir University, 50300 Nevsehir, Turkey
[2]Faculty of Fisheries, Cukurova University, 01330 Adana, Turkey

Abstract: This study was carried out from September 2002-April 2003 in the Karatas Coasts (Iskenderun Bay). A total of 274 specimens were trawled by monthly sampling. The age of *Upeneus pori* was estimated by examining sagittal otoliths and it was found out that the age composition varied from 0+ to IV+ age classes. The mean total length and total weight values were calculated as 9.83±1.56 cm to 9.74±5.03 g and the calculated length-weight relationship was $W = 0.0107*L^{2.9487}$. The von Bertalanffy growth parameters were L_∞: 21.98 cm, K: 0.194 year^{-1} and t_0: -1.168 year. The instantaneous rate of total mortality (Z) was 5.24, the natural Mortality (M) was 0.46 and the Fishing mortality (F) was estimated to be 4.78. The Exploitation rate (E) was calculated as 0.91 using value of M and F. Therefore, the population of *U. pori* off Karatas coast of Iskenderun Bay was under the threat of overfishing.

Key words: *Upeneus pori*, Iskenderun Bay, lessepsian fish, age, growth, mortality, Turkey

INTRODUCTION

Upeneus pori is a lessepsian fish species that came into the Mediterranean sea via the Suez canal. Its habitat is the Western Indian ocean: the Red sea to Southern Oman. The species was firstly reported from the Mediterranean sea (Iskenderun Bay) by Kosswig, namely *Upenoides* (*Upeneus*) *tragula* and was successively established in the eastern Mediterranean. The species were reported as some synonyms *U. asymmetricus*, *U. tragula* and *U. vittatus* (Golani *et al*., 2002). The species feed on hypobenthic invertebrates, mainly crustaceans and to a lesser extent, polychaetes which they detect with their barbells.

The species are distributed on sandy and muddy substrate to 50 m and caught in large quantities by trawl in shallow waters of 10-40 m (Whitehead *et al*., 1986; Golani, 1994; Froese and Pauly, 2009; Ismen, 2006). *U. pori* is a commercial species and recent years, they were one of the ten species caught during bottom trawl fishery in the shallow areas of the Northeastern Mediterranean coasts of Turkey (Cicek *et al*., 2006). Most of the previous studies have been conducted on the occurrence and distribution of *U. pori* (Gucu *et al*., 1994; Gucu and Bingel, 1994; Torcu and Mater, 2000). In recent years, some studies have been done on the length-weight relationship (Taskavak and Bilecenoglu, 2001) and growth and reproduction of the species (Cicek *et al*., 2002, 2006; Ismen, 2006). In This study, it is aimed to determine the age, growth rate, length, weight and age composition of *U. pori* with von Bertalanffy growth models. Additionally, the natural and fishing mortality and the level of exploitation of this species off Karatas coast of Iskenderun Bay were also estimated.

MATERIALS AND METHODS

Commercial bottom trawl vessels registered in Karatas Port generally fish in an area between 34°50′ and 36°00′ E. This study was carried out between September 2002 to April 2003 off Karatas Coasts of Iskenderun Bay during the fishing season 2002-2003. The specimens were obtained by monthly sampling using commercial bottom trawl vessels (Coskun Reis, 22 m length and 285 HP) in depths from 0-100 m from the stations shown in Fig. 1. Trawl operations were done during the day time with 1 h haul duration using Mediterranean Type Bottom Trawl 22 mm mesh size (knot-to-knot). All of the catch were transferred from field to the laboratory in ice and stored at -18°C in the refrigerator. Then the samples were defrosted and sorted by species and weighted to determine Catch Per Unit Effort (CPUE) in the laboratory for each depths ranges. In order to determine population parameters, the sub sampling procedure was applied as recommended by Holden and Raitt (1974). The total length and the total weight were measured and weighted to the nearest 1 mm and 0.01 g, respectively. The sagittal otoliths were examined under the stereo binocular microscope forage

Corresponding Author: Erdogan Cicek, Department of Biology, Faculty of Art and Sciences, Nevsehir University, 50300 Nevsehir, Turkey

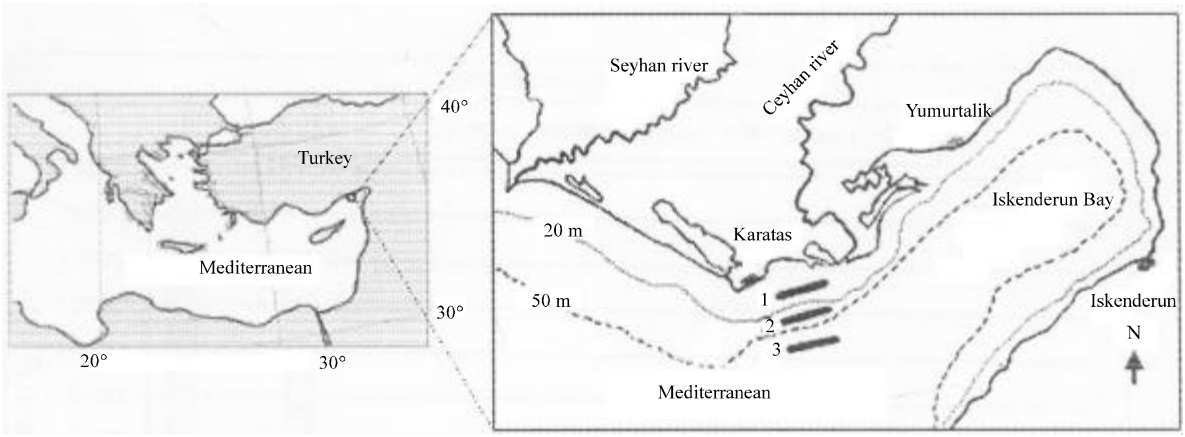

Fig. 1: Study area and sampling stations

determination. The length-weight relationships were determined according to the allometric equation given by Sparre *et al.* (1989) as $W = a*L^b$. In this equation, W is total weight, a and b are regression constants and L is total length. Growth in length and weight were expressed in terms of the von Bertalanffy equation; $L_t = L_\infty [1-e^{-K(t-to)}]$. The growth parameters K, L_∞ and t_0 were estimated using the Least squares method recommended by Sparre *et al.* (1989). Correspondence between empirical data and an expected distribution was tested by χ^2-test. The b value was tested by t-test to verify that it was significantly different from the isometric growth (b: 3). Total mortality rate (Z) was estimated based on the length at first capture methods evaluated by Beverton and Holt (1957):

$$Z = K*(\frac{L_\infty - L_m}{L_m - L_c})$$

Where:

L_m = The average total length of the entire catch
L_c = The length at which 50% of the fish entering the gear are retained (Sparre *et al.*, 1989)

Instantaneous natural mortality rates (M) were estimated using the equation derived by Ursin (1967) based on the mean total length where $M = W^{-(1/b)}$ (W: mean total length; b: constant of length-weight relationship). Fishing mortality rates (F) were calculated as the difference between Z and M (Z = F+M). The value of the average annual exploitation rate (E) was obtained by E = F/Z (Sparre *et al.*, 1989).

RESULTS

Monthly distribution of CPUE value of *U. pori* was shown in Fig. 2. As can be shown the Fig. 2, the highest

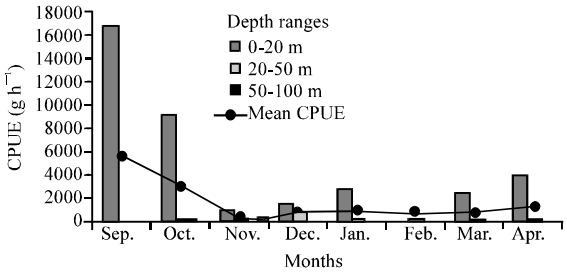

Fig. 2: Monthly distribution of CPUE value for *U. pori* off the Karatas coast of Iskenderun Bay

CPUE value was obtained in September at 5524.5 g h^{-1}. CPUE value decreased in the months that followed and the lowest value was obtained in November (338.7 g h^{-1}) then the value fluctuated in the following months. Overall mean CPUE value was calculated as 1645.8±1771.1 g h^{-1}. Nearly half of the total catch (43.75%) obtained in September and 23.80% of the total catch was obtained in October. Taking into consideration the CPUE distribution in each depth range, nearly all of the catch (96.99%) was obtained in depths of 0-20 m and on the contrary no individual caught in the depths of 50-100 m.

A total of 247 individuals were collected, ranging in size from 6.30-15.50 cm TL. The length-frequency distribution is shown in Fig. 3. As can be shown in the Fig. 3, the 9 cm length group was the most common one. Length-frequency distribution, minimum, maximum and mean length and weight values of *U. pori* for each age class were shown in Table 1. As can be shown in the Table 1, the age of *U. pori* ranged from 0+ to IV+ age classes and the most dominant age class was I+ with the value of 71.2%. Total weight of the sampled individuals ranged from 2.23-38.13 g. Overall mean total length and weight were calculated as 9.83±1.56 cm and 9.74±503 g,

Table 1: Length-frequency distribution, minimum, maximum and mean length and weight values for each age class for *Upeneus pori* off the Karatas coast of Iskenderun Bay

		Total length (cm)		Total weight (g)	
Age	Frequency	Min-Max	Mean	Min-Max	Mean
0+	21 (8.5%)	6.30-8.700	7.56±0.78	2.23-7.12	4.26±1.45
I+	176 (71.2%)	8.00-12.40	9.46±0.95	4.70-16.01	8.26±2.46
II+	37 (15.0%)	10.50-13.20	11.56±0.65	10.84-20.64	14.87±2.51
III+	12 (4.8%)	11.50-15.50	13.02±1.33	14.40-38.13	22.05±7.04
IV+	1 (0.5%)	14.05	14.05	27.80	27.80
Total	247	6.30-15.50	9.83±1.56	2.23-38.13	9.74±5.03

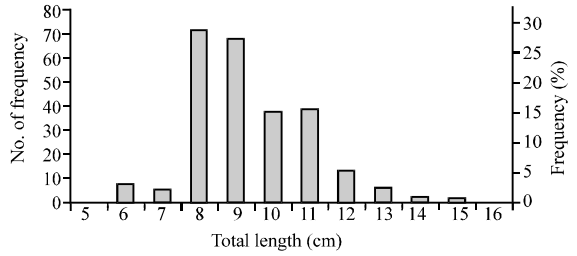

Fig. 3: Length-frequency distribution for *Upeneus pori* off the Karatas coast of Iskenderun Bay (10 mm length classes)

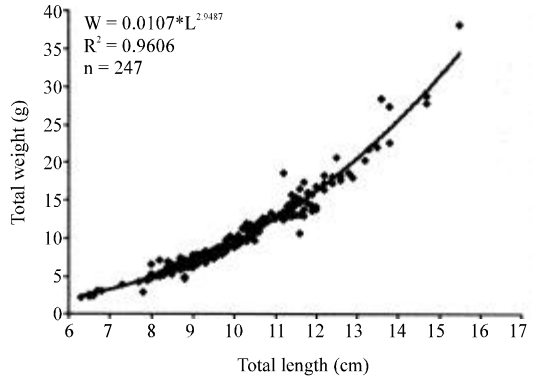

Fig. 4: Length-weight relationship for *Upeneus pori* off the Karatas coast of Iskenderun Bay

respectively. The relationship between TW and TL is shown in Fig. 4. As can be shown in the Fig. 4, the parameters of length-weight relationships a and b were estimated at 0.0107 and 2.9487, respectively. The growth parameters calculated on the basis of von Bertalanffy were L_∞: 21.98 cm, K: 0.194 year^{-1} and t_0: -1.168 year. The back-calculated lengths were determined using von Bertalanffy growth parameters and the observed and calculated growths in total length were shown in Table 2. The growth curves were not significantly different between the observed and calculated length ($p>0.05$). The von Bertalanffy growth curve was fitted to lengths at age for *U. pori* (Fig. 5). Growth is fast until the 2 age classes

Table 2: Observed and calculated total length of *Upeneus pori* using von Bertalanffy growth equations off the Karatas coast of Iskenderun Bay

	Total length (cm)		Total weight (g)	
Age	Observed	Calculated	Observed	Calculated
0+	7.56	7.33	4.26	3.80
I+	9.46	9.51	8.26	8.21
II+	11.56	11.30	14.87	13.64
III+	13.02	12.76	22.05	19.53
IV+	14.05	13.96	27.80	25.44

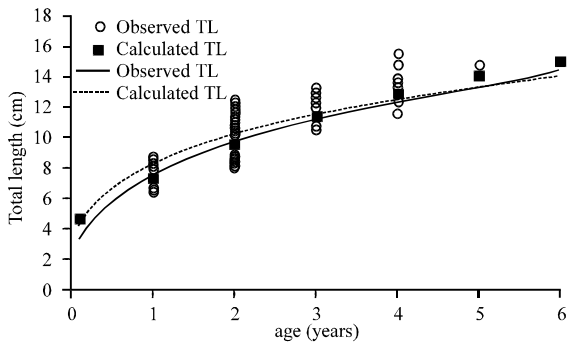

Fig. 5: Von Bertalanffy length-at-age growth curve for *Upeneus pori* off the Karatas coast of Iskenderun Bay

and with growth in length slightly reduced beyond the age class 2. The annual instantaneous rate of natural Mortality (M) was estimated at 0.46 year^{-1} and instantaneous total mortality rate was estimated at 5.24. Using the estimate of Z from the mean total length and the estimate of M obtained using the based on the length at first capture methods, an estimate of fishing mortality was obtained at 4.78. The exploitation rate was estimated at 0.91 using the value of Z and the estimated F.

DISCUSSION

The highest CPUE value was obtained in September as 5524.5 g h^{-1} and nearly half of the total catch (43.75%) was obtained in September and 23.80% of the total catch was obtained in October. In other words, most of the yield was exploited in the 2 months after the opening of the fishing season. The same trend was reported for yield of the other trawlable species and total catch in the studied area (Cicek *et al*., 2006). The majority of the catch (96.99%) was obtained in a depth range of between 0 and 20 m. At the same time, *U. pori* was the most abundant fish species in weight in trawl catch in depths from 0-20 m. Similarly, Gucu and Bingel (1994) reported that *U. pori* was the top 20 species in the coastal area of Iskenderun and Mersin Bays. Similar result was reported in Babadillimani Bight (Mersin Bay) by Cicek *et al*. (2002). In view of the circumstances, it could be claimed the settlement process of *U. pori* is a lessepsian immigrant

species which has been still continues. On the other hand, stock size fluctuations size of *U. pori* came into being during the last 3 decades (Gucu and Bingel, 1994). Indeed, Ben-Yami and Glaser (1974) reported long-term fluctuations in stock size for *U. moluccensis* which is another lessepsian fish species belonging to the Mullidae family. The fish stock can fluctuate due to factors such as fisheries, disease, lack of food or habitat, competitions for available food and space among the other species, water quality, temperature anomalies, poor breeding success, etc.

Additionally, the major driving force in population fluctuations is recruitment variability year by year (Sætre *et al*., 2002). In previous studies, LW relationship was reported as $W = 0.0051*L^{3.256}$ by Taskavak and Bilecenoglu (2001), $W = 0.0087*L^{3.047}$ by Cicek *et al.* (2002) and $W = 0.0102*L^{3.01}$ by Ismen (2006). In previous studies, the results indicated that the type of growth showed was either isometric or positive allometric growth. The growth type found in this study was isometric (b: 2.948, SE: 0.035; 95% confidence intervals of b: 2.80-3.017).

The von Bertalanffy growth parameters were estimated using sagittal otoliths (L_∞: 21.98 cm, K: 0.194 $year^{-1}$ and t_0: -1.168 year). The value of the parameters are more similarly reported as L_∞: 22.54 cm, K: 0.190 $year^{-1}$, t_0: -1.69 year by Cicek *et al.* (2002) for Mersin Bay and L_∞: 19.1 cm, K: 0.360 $year^{-1}$, t_0: -0.812 year by Ismen (2006) for Iskenderun Bay. Growth of *U. pori* is slow (K: 0.194). The K observed in this study is similar to that derived by Cicek *et al.* (2002). On the other hand, K is lower than that estimated by Ismen (2006). The estimated parameters may vary as a function of a variety of factors such as region, year and methodology (Goncalves *et al*., 2003). The estimated total and fishing mortality rates along with the exploitation rates were very high.

These results indicate that the fisheries had a heavily negative effect on the fish populations and the resource was being heavily exploited by trawl-based fisheries in the studied area. In fact in the previous bottom trawl selectivity studies (22 mm cod end mesh size, knot-to-knot) showed high fishing pressure in Iskenderun Bay (Gucu and Bingel, 1994; Cicek *et al*., 2006). On the other hand when the lengths at first maturity of these species 10 cm were taken into consideration (Cicek *et al*., 2002; Ismen, 2006), 79.7% of the total catch consisted of immature or nearly matured individuals and only 20.3% of the catch consisted of mature one.

CONCLUSION

These results indicated the growth of overfishing of the stock. The protection of juveniles and their habitats are probably key factors for the sustainability of these resources (Ehrhardt and Ault, 1992).

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