

Age and Growth of the Bluemouth Rockfish, *Helicolenus dactylopterus* (Delaroche 1809) from the North-Eastern Mediterranean Sea, Turkey

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Abstract.- In the recent study, age, growth and length-weight relationship of *Helicolenus dactylopterus* (Delaroche, 1809) were investigated. A total of 525 specimens were collected from bottom-trawl research surveys and commercial trawl fishery along the southern continental slope of the Iskenderun Bay between June 2012 and May 2014. Age was determined by reading whole sagittal otoliths. Fish ranged from 9.3 to 20.9 cm in total length, which corresponded to fish between 1 to 8 years old. Growth parameters were estimated using the standard Von Bertalanffy growth model ($k=0.064$, $L_{\infty}=35.419$ cm and $t_0=-4.797$ for combined sexes). Length-weight relationships were estimated for females ($W=0.0385L^{2.6645}$) and males ($W=0.0345L^{2.7089}$). The low level of maximum length registered in this study could be related to high pressure level of trawl fishery during the last two decades in Iskenderun Bay.

Key words: *Helicolenus dactylopterus*, bluemouth rockfish, length-weight relationship, otoliths, Von Bertalanffy growth model.

INTRODUCTION

The bluemouth rockfish, *Helicolenus dactylopterus*, is a medium sized deep-sea scorpionfish widely distributed in the Atlantic Ocean, Southern Indian Ocean and Mediterranean basin, where it plays an important ecological role in deep-sea fish communities on the coarse and mud-sandy bottoms of the continental shelf and mostly on the slope as deep as 1000 m (Eschmeyer, 1969).

The depth distribution for this species was recorded as ranging from 3 m (in the Humber estuary) to 1134 m (off the Canary islands) (Kelly *et al.*, 1999). Wheeler (1969) described its contemporary distribution in the North-Eastern Atlantic to be from Norway to Morocco, the Azores, Madeira, the Canaries, and the Mediterranean in depths of 200–1000 m. Pirrera *et al.* (2009) defined that the species is mainly located around 150–300 m depth, whereas the adult specimens were spread over a wider depth range from 200 m to as deep as 1000 m. Merrett and Marshall (1981) reported greatest abundance of bluemouth rockfish at 279–500 m off the coast of North Africa. Cardador and Pestana (1995) indicated that greatest abundance of this species off the Portuguese south-west coast to occur at 200–500 m. In several Italian fisheries, this

species was denoted to be more than a negligible fraction of the commercial catch by Pirrera *et al.* (2009). This species was found throughout Southern shelves of the Iskenderun bay at 100–400 m depth (Basusta and Erdem, 2000). The depauperation of this large-size sedentary and slow-growing fish can be an index of overexploitation in the region (Pirrera *et al.*, 2009). In particular, this species is exploited as a bycatch in deep-sea trawl fisheries targeted at deep-water crustaceans and fishes in the study area (Can *et al.*, 2004; Cicek *et al.*, 2014). It was the aim of the present study to determine age and growth of the *H. dactylopterus* using the sagittal otoliths and to compare the results with the previously published findings for this species. This is the first and only study on age and growth of the *H. dactylopterus* in the North-East Mediterranean.

MATERIALS AND METHODS

Samples were collected by bottom trawl surveys and commercial trawl fisheries with 44 mm codend mesh size at depths of 180–250 m in the North-Eastern Mediterranean Sea (southern continental shelves of Iskenderun Bay) coordinates between 36° 12' 00" - 36° 02' 30" N and 35° 41' 30" - 35° 33' 30" E from June 2012 to May 2014. Total length (TL to the nearest 0.1 cm), total weight (to the nearest 0.1 g), and sex based on macroscopic examination of the gonads were recorded for each fish, and the otoliths (sagittae) were extracted,

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cleaned and stored dry (Turkmen *et al.*, 2005).

A total of 982 whole otoliths were examined without the knowledge of the fish length. Otoliths were examined in glycerine with reflected light and a dark background under and analysed with a dissecting microscope that was equipped with a video camera and monitor (Demirhan *et al.*, 2007). Annual growth increments were counted with the antisulcal face up, and from the nucleus towards the post-rostrum edge. Otolith increments were counted independently by two readers. If no agreement could be reached, the otolith was rejected (Demirhan and Can, 2009). The von Bertalanffy growth formula was fitted to length-at-age data obtained from whole otolith readings for males and females separately, using FISAT computer software (Gayanilo *et al.*, 2005). Data were pooled and a new VBGF $L_t = L_\infty [1 - e^{-k(t-t_0)}]$ was fitted. The coefficient of determination (r^2) was also determined (Ricker, 1973). All total lengths and weights were fitted to the length-weight equation: $W = aL^b$, by using least square methods with Statistica software. In the length-weight equation “a” and “b” are intercept and the slope of the length-weight curve, respectively (Basusta *et al.*, 2013; Ricker, 1973).

RESULTS

A total of 525 specimens were sampled; 238 were females with TL ranging from 9.3 to 19.3 cm, and 287 were males with TL ranging from 9.5 to 21.9 cm (Fig. 1). The ratio did not depart significantly ($p < 0.05$) from unity, with 45% females and 55% males. Of the 1050 otoliths processed for age estimation, only 6.5% were considered to be unreadable and excluded from subsequent analysis. Ages of 465 specimens were counted and found out to be ranging from 1 to 8 years (Fig. 2). The length-weight relationships were calculated by using the lengths and weights as follows; $W = 0.0141 \times L^{3.088}$ ($n = 110$, $r^2 = 0.97$) for males, $W = 0.0135 \times L^{3.084}$ ($n = 225$, $r^2 = 0.98$) for females, and $W = 0.0145 \times L^{3.06}$ ($n = 345$, $r^2 = 0.98$) for sexes combined respectively (Fig. 3). The VBGFs estimated for length at age data were $L_t = 35.648 [1 - e^{-0.058(t - (-5.816))}]$ for females, $L_t = 37.583 [1 - e^{-0.061(t - (-4.623))}]$ for males and $L_t = 35.419 [1 - e^{-0.064(t - (-4.797))}]$ for sexes combined (Fig. 4).

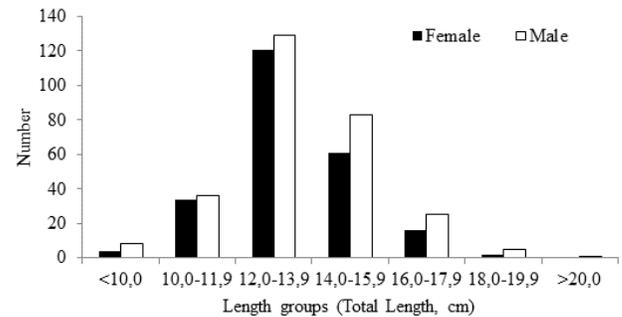


Fig 1. Length frequency distribution of *Helicolenus dactylopterus* grouped by sex for the Southern shelves of Iskenderun Bay.

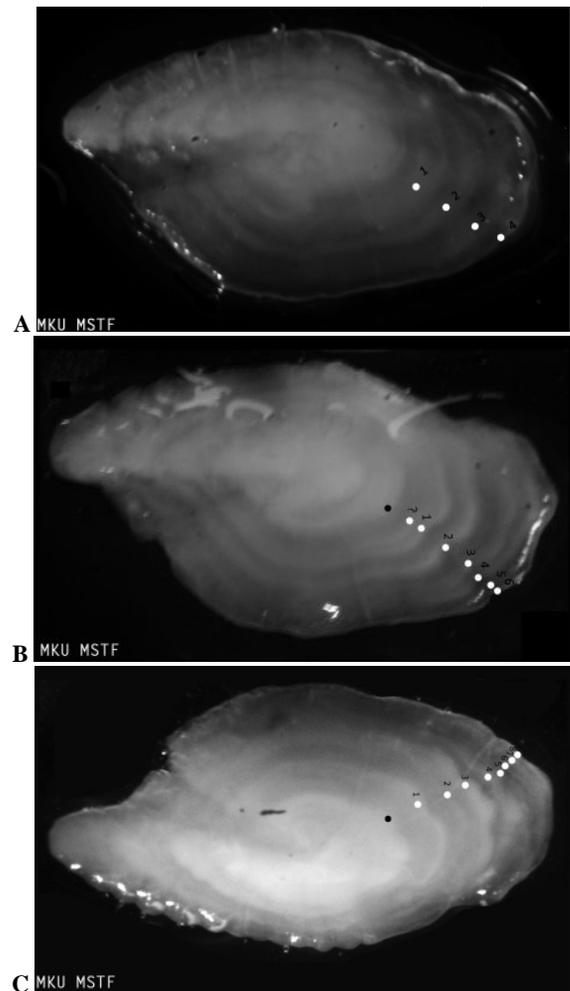


Fig 2. Sample of sagittal otolith of *Helicolenus dactylopterus* (A) 12.5 cm TL female, (B) 18.3 cm TL male (C) 20.9 cm TL male.

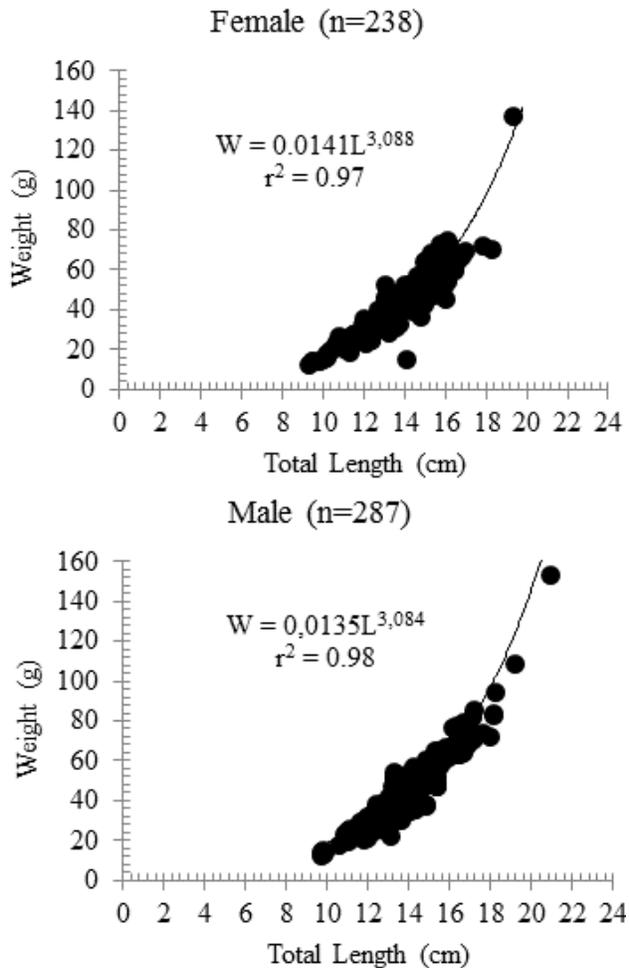


Fig. 3. *Helicolenus dactylopterus* total length-weight relationships data from Southern continental shelves of Iskenderun Bay.

DISCUSSION

The bluemouth rockfish is a long-lived species that can attain more than 30 years of age (Pirrer *et al.*, 2009). Age and length values ranged from 0-43 years and 3-47 cm respectively in the previous studies. Measured maximum length (21.9 cm) and age (8+) values in this study were lower than all other previously studies. The von Bertalanffy growth rates (k) estimated in the present study were lower than almost all other studies which predict a slightly faster growth rate than the present study except one studies from Continental Portuguese slope. Regarding the estimate of von

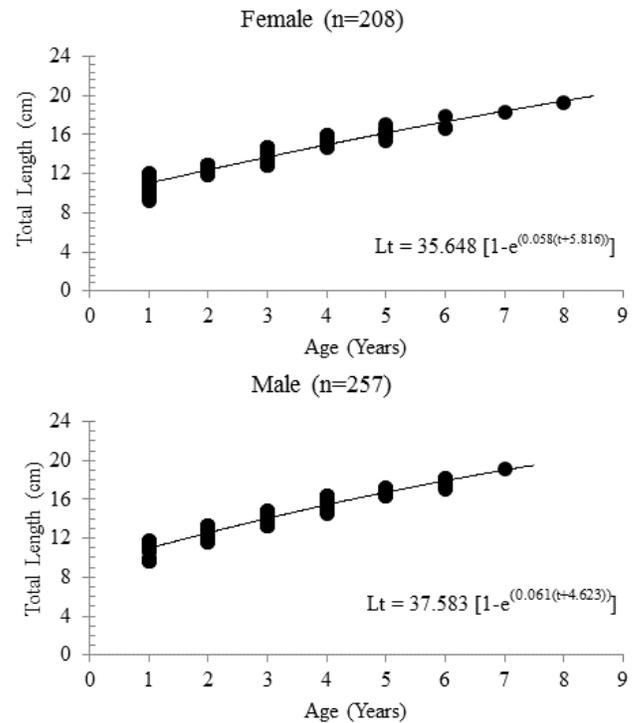


Fig. 4. *Helicolenus dactylopterus* total age-at-length data from Southern continental shelves of Iskenderun Bay, and the fitted von Bertalanffy growth model.

Bertalanffy growth parameters, a low estimate of “ k ” from all the studies cited here indicates that this species to be relatively slow growing and long-lived. Furthermore, estimated asymptotic lengths were lower than studies in Azores, greater than studies in western Mediterranean and Northern Atlantic in this study (Table I).

The results obtained in this study are in agreement with the available Mediterranean and Atlantic literature, that the population sampled by trawl nets is mainly composed of recruits and juveniles. Probably, the older population prefers rocky bottoms not accessible to trawl fishery (Pirrer *et al.*, 2009; Sequeira *et al.*, 2009). Therefore, to correctly evaluate the true exploitation of the species, data coming from trawl surveys should be integrated with those coming from studies using different sampling gear.

When comparing our results with those published from other areas, differences among all the estimated parameters are obvious and are also

Table I.- The von Bertalanffy growth parameters estimated, obtained for *Helicolenus dactylopterus*.

		L_{∞}	K	t_0	Length range	Age range
Isidro (1987) (Azores/Atlantic)*	f	38.69	0.18	0.42	16-38	3-16
	m	44.80	0.11	1.83	16-41	3-12
Esteves <i>et al.</i> (1997) (Azores/Atlantic)	f	54.70	0.10	-1.16	14-46	3-12
	m	50.20	0.16	0.05	15-47	3-14
Krug <i>et al.</i> (1998) (Azores/Atlantic)*	f+m	50.50	0.14	-1.23	14-47	1-16
Kelly <i>et al.</i> (1999) (Rockall Trough/Atlantic)	f	31.00	0.09	-3.00	10-38	1-37
	m	37.20	0.06	-4.00	10-38	1-43
Abecasis <i>et al.</i> (2006) (Azores/Atlantic)*	f	56.52	0.06	-1.13	13-41	2-15
	m	59.06	0.07	-0.21	14-46	3-16
Sequeira <i>et al.</i> (2009) (Continental Portuguese slope/Atlantic)	f+m	45.50	0.05	-4.01	5-37	0-27
	f	45.29	0.05	-4.17	6-37	0-27
	m	43.30	0.05	-3.68	6-35	0-26
Allain and Lorange (2000) NE Atlantic*	f+m	29.00	0.10	-2.79	6-32	1-43
Mamie <i>et al.</i> (2007) (North Sea)*	f+m	28.20	0.12	2.10		2-32
Ragonese and Reale (1995) (Strait of Sicily)*	f+m	39.20	0.13	1.46	8-33	0-10
Massuti <i>et al.</i> (2000a) (Iberian coast)*	f+m	25.50	0.25	-0.53	3-36	0-19
Massuti <i>et al.</i> (2000b) (Alborean Sea)*	f	27.10	0.12	-2.65	28	0-26
	m	32.30	0.09	-3.31	29	0-30
	f+m	30.00	0.10	-2.86		
Massuti <i>et al.</i> (2000b) (Balearic Sea)*	f	27.00	0.16	-1.62	7-28	1-22
	m	32.50	0.10	-2.62	8-30	1-21
	f+m	29.90	0.13	-1.75		
Pirrerera <i>et al.</i> (2009) (Tyrrhenian Sea)	f+m	30.00	0.16	-0.02	2.5-24.5	0-4
Recent study (Southern shelves of Iskenderun Bay)	f	35.65	0.058	-5.82	9-19	0-8
	m	37.58	0.061	-4.62	10-21	0-8
	f+m	35.42	0.064	-4.80	9-21	0-8

*indicates citation from Sequeira *et al.*, 2009.

reflected in the different values for von Bertalanffy growth parameters. These differences could be a consequence of several factors: (1) the different ageing method used (whole and sectioned otoliths, length frequency analysis, back calculation), (2) different sampling method (trawl, longline and trammel nets), (3) different latitudes and environmental conditions and (4) different fishing pressures (Sequeira *et al.*, 2009).

Deep-water species like the bluemouth rockfish are particularly vulnerable to overfishing because of their biological characteristics (long life, large size, late maturity, slow growth and low

mortality rate) and are strongly exploited by trawling fishing (Pirrerera *et al.*, 2009).

Our study suggested that, beside mention factors, the reason for noted low level maximum length values in the current study, might be related to the high pressure level of trawl fishery during the last two decades in 150-400 m depths fishing ground in Iskenderun Bay.

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