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Age and growth of the Curled Picarel *Centracanthus cirrus* RAFINESQUE, 1810 (Osteichthyes: Centracanthidae) in Northern Cyprus, Eastern Mediterranean Sea

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*Age and growth of the curled picarel (*Centracanthus cirrus *RAFINESQUE, 1810) in the Northern Cyprus waters were studied. Otoliths from 251 specimens were read for age determination. Total length ranged between 7.2 and 15.9 cm, while weight varied from 2.2 g to 31.2 g. The von BERTALANFFY growth constants were calculated as* W_∞*=32.3 (g),* L_∞*=16.8 (cm), k=0.47 (year* $^{-1}$*) and* t_o*= -1.14 (year). Weight increased allometrically and the length-weight relationship estimated for all fish was* W_∞*=0.0052* $L^{3.097}$ *(r=0.946). The curled picarel is a short-life and fast growing species, the oldest specimen was estimated to be 5 years old. Growth of* C. cirrus *in length is rapid, which attains 61.2% of the asymptotic length during the first year of life.*

Key words: Centracanthidae, *Centracanthus cirrus*, age, growth, northern Cyprus

INTRODUCTION

The curled picarel, *Centracanthus cirrus* RAFINESQUE, 1810, is a relatively common fish of Mediterranean inshore waters, which inhabits rocky and gravel bottoms to a depth of at least 200 m (TORTONESE, 1986). It occurs in the eastern Atlantic, Portugal, Morocco (off south coast), Azores, Madeira, Canary Islands and the Mediterranean (HEEMSTRA, 1990). The presence of eggs of species in the Black Sea was mentioned by TSOKUR (1988) based on material collected off Varna. Curled picarel is generally found in large schools in the littoral zone and forms a significant component of the bottom trawl catch in Sicilian and Cypriot fishery, but frequently discarded due to its relatively low commercial value (BAUCHOT, 1987).

Published information on the biology of curled picarel, when compared to other Centracanthids, is scarce. Majority of the works included zoogeographical distribution of the species (BEN-TUVIA, 1962; TORTONESE, 1975, 1986; BAUCHOT and PRAS, 1980; BAUCHOT, 1987). MAGNÚSSON and MAGNÚSSON (1987) and MERELLA *et al.* (1997) presented data on the length-weight relationship of the species, but no information is currently available on the age and growth of curled picarel in the Mediterranean Sea.

Our main objective is to obtain appropriate data for gaining a better knowledge of the growth of the species in the eastern Mediterranean Sea. In this context, we have presented the new information on age composition, growth and length-weight relationship of *C. cirrus* in Magosa Bay, northern Cyprus waters.

MATERIAL AND METHODS

The study was based on data collected in northern Cyprus waters during an experimental fishing cruise conducted between 2nd and 26th July 1998. Curled picarel specimens were collected off Magosa Bay (35°13'6"N; 33°56'0"E) by the R/V K. PIRI REIS, equipped with a bottom trawl of 22 mm mesh size net (knot-to-knot) at the cod-end. Twelve trawling hauls were carried out by a cruise speed of 2.5 miles h^{-1} at depths ranging from 150 to 180 m in the daytime. Each hauling period was restricted to 30 minutes.

Total lengths and weights of 343 individuals were measured on board to the nearest 0.1 cm and 0.1 g, respectively. Age determination was based on sagittal otoliths. Otoliths were removed from all individuals and studied after being placed in a concave black dish under the reflected light of a stereomicroscope at a magnification of × 20. Two types of rings were observed; opaque rings appeared white, while translucent rings appeared dark. Translucent rings that continued around the entire circumference of the otoliths were considered as annuli. Cloudy surfaced thick otoliths were read after processing with sandpaper. The 92 otoliths were difficult to interpret as they bear indistinct annuli, so they could not be aged.

No macroscopic differences in the external appearance of the gonads of males and females could be observed. Consequently, their data have been combined and all specimens were treated as unsexed.

The length-weight relationship was described by the equation: $W=aL^b$, where W is the weight, L is the total length, b is the growth exponent and a is a constant (SPARRE and VENEMA, 1992). For the estimation of individual growth rate, von BERTALANFFY growth equations for length and weight were used: $L_t=L_\infty\,[1-e^{-k(t-to)}]$ and $W_t=W_\infty\,[1-e^{-k(t-to)}]^b$, where L_t is the total length at age t, L_∞ the asymptotic total length, W_∞ the asymptotic total weight, k the growth curvature parameter and t_o the theoretical age when fish would have been at zero total length (SPARRE and VENEMA, 1992). The chi-square (χ^2) test was used to detect differences between the observed and calculated length-at-age data.

RESULTS

The total length-frequency distribution of curled picarel is shown in Fig. 1. The total length of all individuals (n=343) ranged from 7.2 cm to 15.9 cm and weight varied from 2.2 g to 31.2 g. The bulk of the specimens presented distinctive peaks at 12.0 -12.9 cm and 13.0 -13.9 cm, respectively. Mean total length (±95% confidence intervals) and weight of all individuals were 11.58 cm (± 0.22) and 11.34 g (± 0.63).

According to the results of otolith readings, the age of *C. cirrus* varied between 0+ and V. The age group II (39.84%) was dominant, followed by I (26.69%), 0+ (17.53%), III (13.15%), IV (1.99%) and V (0.80%) age groups. The age-length key for curled picarel is presented in Table 1, which shows a considerable range in length for each age group and relative overlap between adjacent age groups.

The total length-weight relationship was evaluated for all fish (n=343) and allometric growth was observed within the growth characteristics of curled picarel. The relationship was estimated as $W = 0.0052\ L^{3.097}$ (S.E. of b=0.051; r=0.946) and presented in Fig.2.

The von BERTALANFFY growth constants for *C. cirrus* were calculated as follows: L_∞=16.8 (cm), W_∞= 32.3 (g), k = 0.47 (year-1) and t_o= -1.14 (year). The calculated and theoretically estimated mean lengths and weights for each age group are given in Table 2. There were no differences between the observed and calculated mean data of length (χ^2 = 0.027, p>0.05, d.f.= 4) and weight (χ^2 =0.700, p>0.05, d.f.= 4). The von BERTALANNFY growth curve fitted by length-at-age as given in Fig.3.

The greatest growth in length occurred in the first year of life (Table 2), which attains 61.2% of the asymptotic length.

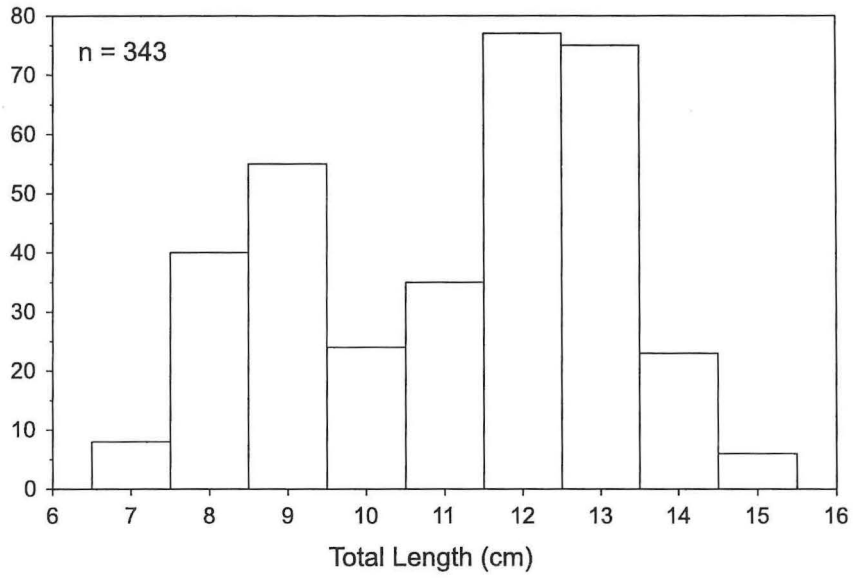

Fig. 1. Total length-frequency distribution for the curled picarel in Magosa Bay, northern Cyprus

Table 1. Age-length data for the curled picarel

Length Group (cm)	Age (years)						Total
	0+	I	II	III	IV	V	
7.0-7.9	5	1					6
8.0-8.9	23	9					32
9.0-9.9	15	25					40
10.0-10.9	1	13	2				16
11.0-11.9		8	12	1			21
12.0-12.9		11	41				52
13.0-13.9			40	15			55
14.0-14.9			5	16	2		23
15.0-15.9				1	3	2	6
Total	44	67	100	33	5	2	251
%	17.53	26.69	39.84	13.15	1.99	0.80	100

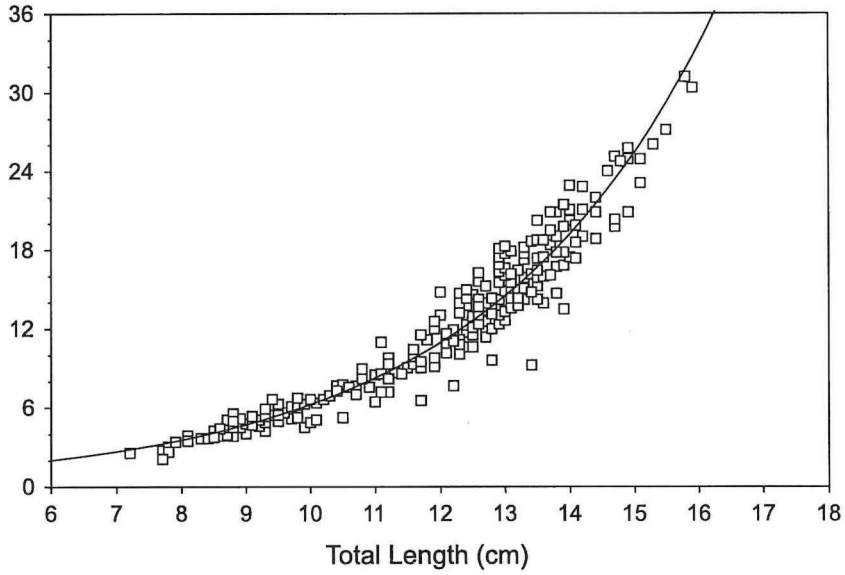

Fig. 2. Length-weight relationship for the curled picarel (n=343)

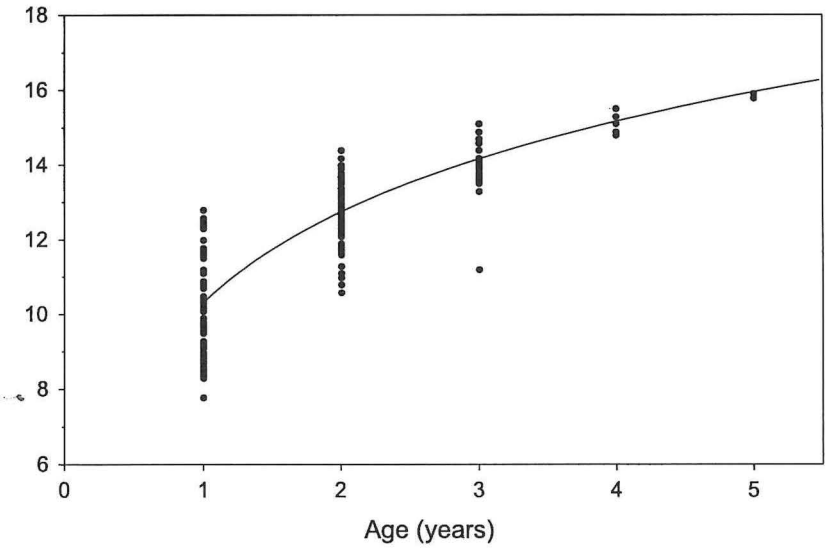

Fig. 3. The von BERTALANFFY growth curve fitted by length-at-age data for the curled picarel

DISCUSSION

The curled picarel, *C. cirrus*, is a short-life species. The oldest specimen was estimated to be 5 years old. Since there are no available data on age and growth of curled picarel, it was not possible to make any comparisons. The theoretical maximal length (16.8 cm) and weight (32.3 g) seem to be valid since the largest specimen sampled during the surveys was 15.9 cm long and 31.2 g weight. Based on the collection of fishes from Cyprus, BEN-TUVIA (1962) observed lengths ranging form 10.1 cm to 15.1 cm for *C. cirrus*. According to HEEMSTRA (1990), the species can reach to a maximum total length of 34 cm, whereas TORTONESE (1975) and BAUCHOT and PRAS (1980) recorded a maximum of 20 cm. However, the noted differences may be attributed to the sampling strategy of this study, i.e. restricted depth

Table 2. Observed and calculated mean total lengths and weights of curled picarel for each age group

Age Groups	Mean Length (cm)		Mean Weight (g)	
	Observed	Calculated	Observed	Calculated
I	10.26	10.64	7.49	7.94
II	12.84	12.94	14.92	14.51
III	13.98	14.38	19.18	20.06
IV	15.12	15.28	25.72	24.19
V	15.85	15.84	30.8	27.03

Table 3. Parameters of the length-weight relationship (a, b) in this study and in studies by other authors (n = number of species; N/A: not available)

Locality	n	Range	*a*	*b*	r
Cape Verde Islands[1]	360	16.0-34.0	0.0235	2.9	N/A
Balearic Islands[2]	57	14.4-21.0	0.0063	3.04	0.99
Northern Cyprus[3]	343	7.2-15.9	0.0052	3.097	0.946

[1] *MAGNÚSSON and MAGNÚSSON, 1987;* [2] *MERELLA* et al., *1997;* [3] *Present study*

Table 4. Comparison of parameters of the growth (L_∞, k, t_0) of Mediterranean Centracanthids (TL: total length; FL: fork length).

Species	Locality	Sex	Length Type (cm)	Age (years)	L_∞ (cm)	k (year^{-1})	t_o (year)
Spicara smaris[1]	Black Sea	female	TL	6	33.5	0.12	-2.85
		male	TL	6	27.4	0.19	-2.40
Spicara smaris[2]	Crete	female	FL	5	19.2	0.15	-3.52
		male	FL	7	12.8	0.92	-0.22
Spicara flexuosa[3]	Patraikos	female	FL	5	17.3	0.23	-3.41
	Gulf	male	FL	5	17.1	0.24	-3.95
Centracanthus cirrus[4]	N. Cyprus	combined	TL	5	16.8	0.47	-1.14

[1] *SAHIN and GENC, 1999;* [2] *VIDALIS and TSIMENIDIS, 1996;* [3] *MYTILINEOU and PAPACONSTANTINOU, 1991;* [4] *Present study*

range (150 – 180 m) and sampling period, as well as to variations in temperature and probable differences of tropic potential in various localities. The slower growth of the species can be explained with the poverty of nutrients and plankton abundance of northern Cyprus waters (ANONYMOUS, 1999).

The length-weight relationship of curled picarel in the eastern Mediterranean displayed positive allometry similar to those inhabiting the Balearic Islands (MERELLA *et al.*, 1997), but departing from the population at Cape Verde Islands that exhibit a negative allometry (MAGNÚSSON and MAGNÚSSON, 1987) (Table 3). These differences of allometric growth between the values of *b* may arose from several ecological factors such as the characteristics of the biotope, temperature, spawning conditions, feeding etc. as defined by RICKER (1975).

The growth coefficient of *C. cirrus* (k = 0.47) indicates a fast attainment of maximum size and is higher than those reported for other Mediterranean Centracanthids (Table 4). The only exception is for the female *Spicara smaris* (k = 0.92) collected off Crete (VIDALIS and TSIMENIDIS, 1996). Our findings are in accordance with the descriptions of SPARRE and VENEMA (1992) who indicated that a short-lived species should have a steep growth curve with a high value of k.

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Starost i rast ribe *Centracanthus cirrus* RAFINESQUE, 1810 (Osteichthyes: Centracanthidae) u obalnom moru sjeverno od Cipra, istočni Mediteran

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SAŽETAK

Istraživani su starost i rast ribe *Centracanthus cirrus* RAFINESQUE, 1810 u obalnom moru sjeverno od Cipra. Starost ribe je određivana očitovanjem na 251 primjerku otolita. Totalna dužina svih jedinki kretala se između 7.2 i 15.9 cm, dok je težina varirala od 2.2 g do 31.2 g. Parametri rasta prema von BERTALANFFY-u iznosili su: L_∞=16.8 (cm), W_∞= 32.3 (g), k = 0.47 (god.$^{-1}$) i t_o= -1.14 (god.). Težina se povećavala alometrijski te je dužinsko - težinski odnos za sve ribe iznosio $W=0.0052\ L^{3.097}$ $(r=0.946)$. Rast ove ribe je brz, a životni ciklus kratak. Najstariji primjerak imao je 5 godina. Dužinski rast ove vrste ribe je brz i doseže 61.2% asimptotičke dužine tijekom prve godine života.