

BIOMETRY ANALYSIS OF JUVENILE ATLANTIC BLUEFIN TUNA (*THUNNUS THYNNUS* L., 1758) IN THE EASTERN MEDITERRANEAN SEA

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Abstract

This paper presents some biological features of juvenile specimens of Atlantic bluefin tuna, *T. thynnus* Linnaeus, 1758, in the eastern Mediterranean Sea. A total of 369 specimens were analysed. Juvenile individuals ranged from 12.2 to 46.5 cm. In order to analyse biometry, 11 morphometric characters were analysed. Length-weight relationships of juveniles was $W = 0.0087 \times FL^{3.246}$.

Keywords: *Fishes, Pelagic, Biometrics, North-Eastern Mediterranean*

Atlantic bluefin tuna is highly migratory and pelagic species. This species is distributed in the Atlantic Ocean including the Mediterranean and Black Sea [1]. *T. thynnus* is important species for the Turkish fishery. Juvenile *T. thynnus* was collected from commercial hand line fisheries of Turkish waters (Eastern Mediterranean Sea) between July and October, 2011-2013. This area is considered an important spawning and feeding ground for tuna species [2] and this species was captured during the feeding phase. According to the growth parameters for bluefin tuna stock of eastern Atlantic and Mediterranean [3], the age of specimens correspond to 0 to 1 years old and they were fully immature [4]. Juvenile *T. thynnus* (smaller than the minimum landing size, i.e. 115 cm FL) were collected under the provision of the ICCAT Atlantic Wide Research Program for Bluefin Tuna (GBYP).

A total of 11 morphometric parameters were used for analyses. Measurements were obtained from inter-landmark distances (as a straight line in cm) following anatomical landmarks [5]. Inter-landmark refer to: fork length (FL), head length (LH), first predorsal length (LD1), length of pectoral fin (LP), preanal length (LA), second dorsal fin height (HD2), caudal fin width (CC), maximum body height (H), snout length (SL), eye diameter (ED), and postorbital length (PO). All measurements were taken a caliper to nearest 0.05 millimeter and a digital balance to the nearest 0.01 g. Length-length and length-weight relationships were determined by the least squares method to fit a simple linear regression model.

A total of 369 specimens were collected during the study period. The fork length ranged 12.2 to 46.5 cm with a mean of 24.95 ± 3.61 cm. Total weight varied from 0.025 to 2.300 kg. The mean values and standard deviations (SD) of total weight were 0.324 ± 0.21 kg.

The morphology of the sampled fish is described as relative body proportions of the LH, LD₁, LA, LP, HD₂, CC and H related to the FL, and SL, ED and PO related to the HL (Table 1). The coefficients of variation (CV) indicated the highest variability in the CC/FL ratio (CV=13.11%) while the lowest variability was noted in the LH/FL ratio (CV=2.55%).

Tab. 1. Morphometric characteristics of *T. thynnus* caught in the eastern Mediterranean Sea.

Parameter	N	Min.	Max.	Mean±SD	CV (%)
FL	369	12.20	46.50	24.95±3.61	6.50
%FL					
LH	369	24.22	29.74	28.23±0.72	2.55
LD ₁	369	28.30	36.22	31.99±0.93	2.91
LA	363	46.62	71.99	61.29±2.40	3.92
LP	369	10.84	18.83	15.39±1.06	6.89
HD ₂	369	5.58	10.05	7.51±0.62	8.26
CC	358	13.80	30.81	23.04±3.02	13.11
H	369	11.21	29.43	23.99±1.68	7.00
%LH					
SL	369	21.16	35.59	27.67±1.64	5.93
ED	369	15.97	29.27	20.02±1.45	7.24
PO	369	42.69	61.78	52.33±1.89	3.61

Overall data of relative morphometric relationships of measured body proportions for *T. thynnus* are presented in Table 2. Morphometric characters were strongly positively correlated except for LD₁/FL and LA/FL ($p < 0.05$). The best fit for length-length relationships was recorded between pectoral fin length (LP) and fork length (FL) ($r=0.699$). The lowest value of correlation coefficient was found between the head length (HL) and the fork length (FL) ($r=0.116$). The length-weight relationship is described $W = 0.0087 \times FL^{3.246}$ ($r=0.988$).

Genovese [6] found significant differences in morphometric characteristics among *T. thynnus* caught from the Tyrrhenian Sea and off the coast of Tunis,

mainly related to FL, LH, LD₁, and LP. According to Ticina et al. [5], for western Mediterranean *T. thynnus* samples, the LH, LA, LD₁, LP and ED were relatively greater than in the eastern Atlantic specimens. Comparing the biometric characteristics of *T. thynnus* caught in the eastern Mediterranean Sea with the fish caught in the Adriatic Sea, the LH, LA, LD₁, and PO were similar to each other (close together), but LP, HD₂, CC, H, and SL were shorter than in Adriatic Sea specimens. However, the ED was relatively greater than in Adriatic Sea specimens. The differences of the biometric characteristics of *T. thynnus* caught in the different areas could be originated by the regional differences, the case of different stock or variation of the sample sizes.

Tab. 2. Linear regression analyses describing changes in body proportions of *T. thynnus* related to increment of fork length (FL) and head length (HL).

X variable	Y variable	r	intercept	slope	95%CI slope	F
ln FL	ln (LH/FLx10 ²)	0.116	24.992	0.022	0.012 to 0.032	5.002*
ln FL	ln (LD ₁ /FLx10 ²)	0.007	32.238	-0.001	-0.012 to -0.01	0.017
ln FL	ln (LA/FLx10 ²)	0.067	55.079	0.019	0.004 to 0.034	1.640
ln FL	ln (LP/FLx10 ²)	0.699	2.139	0.358	0.339 to 0.377	351.147*
ln FL	ln (HD ₂ /FLx10 ²)	0.310	2.669	0.187	0.157 to 0.217	39.030*
ln FL	ln (CC/FLx10 ²)	0.176	8.593	0.177	0.124 to 0.230	11.346*
ln FL	ln (H/FLx10 ²)	0.221	12.165	0.123	0.095 to 0.151	18.842*
ln LH	ln (SL/LHx10 ²)	0.262	17.329	0.110	0.089 to 0.131	27.101*
ln LH	ln (EE/LHx10 ²)	0.522	60.316	-0.260	-0.282 to -0.238	137.235*
ln LH	ln (PO/LHx10 ²)	0.264	39.237	0.068	0.055 to 0.081	27.468*

References

- Collette, B.B., 1986. Scombridae (including Thunnidae, Scomberomoridae, Gasterochismatidae and Sardidae). p. 981-997. In P.J.P. Whitehead, M.-L. Bauchot, J.-C. Hureau, J. Nielsen and E. Tortonese (eds.) Fishes of the north-eastern Atlantic and the Mediterranean, Volume 2. Unesco, Paris.
- Karakulak, S., Oray, I., Corriero, A., Deflorio, M., Santamaria, N., Desantis, S., De Metrio, G. 2004. Evidence of a spawning area for the bluefin tuna (*Thunnus thynnus* L.) in the eastern Mediterranean. *J. Appl. Ichthyol.* 20, 318-320.
- Cort, J. L., Deguara, S., Galaz, T., Mèlich, B., Artetxe, I., Arregi, I., Neilson, J., Andrushchenko, I., Hanke, A., Dos Santos, M. N., Estruch, V., Lutcavage, M., Knapp, J., Compeán-Jiménez, G., Solana-Sansores, R., Belmonte, A., Martínez, D., Piccinetti, C., Kimoto, A., Addis, P., Velasco, M., De la Serna, J. M., Godoy, D., Ceyhan, T., Oray, I. K., Karakulak, S., Nøttestad, L., López, A., Ribalta, O., Abid, N., Idrissi, M., 2013. Determination of Lmax for Atlantic Bluefin Tuna, *Thunnus thynnus* (L.), from Meta-Analysis of Published and Available Biometric Data. *Rev. Fish. Sci.* 21 (2), 181-212.
- Corriero, A., Karakulak, S., Santamarina, N., Deflorio, M., Spedicato, D., Addis, P., Desantis, S., Cirillo, F., Fenech-Farrugia, A., Vasallo-Aguis, R., De La Serna, J. M., Oray, I. K., Cau, A., Megalofonou, P., De Metrio, G., 2005. Size and age at sexual maturity of female bluefin tuna (*Thunnus thynnus* L. 1758) from Mediterranean Sea. *J. Appl. Ichthyol.* 21, 483-486.
- Ticina, V., Grubišić, L., Šegvić Bubic, T., Katavic, I., 2011. Biometric characteristics of small Atlantic bluefin tuna (*Thunnus thynnus*, Linnaeus, 1758) of Mediterranean Sea origin. *J. Appl. Ichthyol.* 27, 971-976.
- Genovese, S., 1958. Dati biometrici sul tonno (*Thunnus thynnus* L.) Tirenico. *Rapp. Comm. Int. Mer. Médit.* 14, 327-328.