BIOMETRIC MEASUREMENTS OF HORSE MACKEREL, (*TRACHURUS MEDITERRANEUS PONTICUS*) FROM THE BULGARIAN BLACK SEA COAST

Maria YANKOVA[1]

[1]Institute of Oceanology, BAS, Varna, Bulgaria, Asparuhovo quarter 40, First of May str.
Corresponding author Maria Yankova, e-mail: maria_y@abv.bg

Abstract-2050 samples of Trachurus mediterraneus ponticus ranged 9.0-18.9 cm length with mean 15.60±1.74 and 10.14-44.87g weight with mean 24.75±2.47 from the Bulgarian Black Sea coast were analyzed to investigate length-weight relationships (LWR) of fish in relation to condition factor (K). Standard length (SL), fork length (FL), head length (HL) head width (HW), body girth (BG), dorsal fin length (DFL), dorsal fin base (DFB), pectoral fin length (PcFL), pelvic fin length (PvFL) and anal fin length (AFL) are found to be highly correlated with increasing total length and wet body weight (r > 0.500). Wet body weight has positive (r=0.540) and total length has no correlation (r=0.344) with calculated Condition factor (K). The slope "b" in the relationship is 3.56 and intercepts -2.2361.

Keywords: Trachurus mediterraneus ponticus, morphology, Body weight, Black Sea

I. INTRODUCTION

In fishery sciences, length weight relationships provide statistics which is cornerstone in research and management and are major tools for precise estimation of biomass and calculation of length frequency samples to total catch (Pauly and Gayanilo, 1996). This data is also an essential component of morphological and statistical analysis of fish growth, length and age ecological patterns and such other population structures (Kolher *et al.*, 1995). Length weight relationships help in conversion of growth in length equations to growth in weight equations particularly in fishes which is a useful parameter for ichthyologists and fish farmers in assessment, culture and stocking of fish (Morato *et al.*, 2001; Özaydin and Taskavak, 2007). Length weight relationships are good indicators of fatness and fish condition (Le Cren, 1951), sexual development potential and comparative study of specific fishes in historical alike regions (Wooton, 1990). The concise relationship between body weight and length is always a unique, different among species of fishes and even fish of same species and this reflects innate, specific, robustness of fish and inherited body shape configuration (Bayley, 1991). Analysis of length weight data has directed toward mathematically described length- weight correlations that are changed to other predictive variable factors from expected weight for length of fish as indications of various morphological and physiological processes (Le Cren, 1951). The main focus of this study is to analyze some biometric characteristics of *Trachurus mediterraneus ponticus* from the Bulgarian Black Sea coast.

II. MATERIALS AND METHODS

2050 samples of *Trachurus mediterraneus ponticus* were collected from the Bulgarian Black Sea coast, during the season (May and December 2012).

Body weights of these fish were measured with the help of an electric balance to the nearest 0.1 g after removing the debris from the surface of body. Total length (TL) and Standard length (SL) were measured from the terminal part of the snout to the tip of the caudal fin. Head width (HW) was taken as a straight distance between the eyes. Fin length and Fin base values are measured as Dorsal (DFL), pectoral (PcFL), pelvic (PvFL), anal (AFL) and these were measured as distance from anterior point of junction with body to the most anterior tip of the fin. Dorsal (DFB), pectoral (PtFB), pelvic (PvFB) and anal fin base (AFB) were measured in the same way systematically. The length-weight relationship (LWR) of this data was analyzed and estimated by: $W = aL^b$, where W= weight (g), L= total length (cm), a = constant, b= growth exponent. These parameters are then converted to logarithmic form that resulted in linear relationship as: $\log W = \log a + b \log L$. Condition factor, K is determined by specific formula from obtained morphometric values. The formula is as under: $K = W \times 100/L^3$, where K=condition factor, W=total body weight (g), L= total length (cm). Comparative determinants resulting from comparison of the slopes of length-weight regressions and 3 by using student's t-test for each fish (Sokal and Rohlf, 1987) and these were used to estimate whether fish grew isometrically or in other pattern. This t-test is important in ascertaining seasonal changes correlations in condition factor for the fish and to verify whether the decline in regression ("b value") showed a significant difference of 3.0. This shows the isometric type of growth, where (b=3.0).

Table 1. Central tendency values including mean ±S.D and range of various body measurements of *Trachurus mediterraneus ponticus*.

Body Measurements	Mean ± S.D	Range
Total length (TL)	15.60±1.74	9.0-18.9
Wet weight (WW)	24.75±2.47	10.14-44.87
Standard length (SL)	13.50±2.42	7.2-17.0
Fork length (FL)	11.91±1.75	9.5-16.2
Head length (HL)	3.23±.34	1.3-3.4
Body depth (BD)	3.77±0.86	1.2-4.0
Head width (HW)	3.12±0.56	2.2-3.9
Body girth (BG)	3.80 ± 1.72	2.4-4.2
Dorsal fin length (DFL)	2.8±0.52	1.7-3.4
Dorsal fin base (DFB)	2.43±0.46	1.7-2.5
Pectoral fin length (PtFL)	2.24±0.57	1.3-3.3
Pelvic fin length (PvFL)	2.11±0.42	1.3-3.1
Anal fin length (AFL)	2.04±0.37	1.3-2.9
Tail width (TW)	3.71±0.93	1.9-6.2
Caudal fin width (CFW)	0.60 - 0.72	0.7-1.1

SD = Standard Deviation

III.   RESULTS AND DISCUSSION

In regression analyzed results, central tendency values of measured morphometric values such as mean values (±S.D), ranges and index of morphometry of external body parts of *Trachurus mediterraneus ponticus* are given in Table 1, which shows ranged from 9.0-18.9 cm total length with 15.60 mean value and 10.14-44.87g body weight with 24.75 mean value.

When total length was kept on x-axis and other morphometric on y-axis then Length-weight relationship (LWR) is found to be highly significant correlated ($r = 0.896$; $P < 0.001$) with slope value 3.27 (95% CI of 3.13-3.40) in *Tr. m. ponticus*. And other significant correlations exist in Standard length- Total length (SL-TL), Fin length-Total length (FL-TL), Head length- Total length (HL-TL), Head width- Total length (HWTL), Body girth- Total length (BG-TL), Dorsal fin length- Total length (DFL-TL), Dorsal fin base- Total length (DFBTL), Pectoral fin length- Total length (PcFL-TL), Pelvic fin length- Total length (PvFL-TL) and Anal fin length- Total length (AFL-TL) ($r>0.875$). Maximum correlation observed in Fin length- Total length (FL-TL) ($r= 0.971$) while minimum in Standard length- Total length (SL-TL) ($r= 0.759$) (Table 2). By keeping wet body weight on x-axis and other morphometric values on y-axis results come approximately same with slightly different r values as compared to first one. Fin length- Weight (FL-W), Head length-Weight (HL-W), Head width- Weight (HW-W), Body girth- Weight (BG-W), Dorsal fin length- Weight (DFL-W), Dorsal fin base- Weight (DFB-W), Pectoral fin length-Weight (PcFL-W) Pelvic fin length-Weight (PvFL-W) and Anal fin length-Weight (AFLW) have significant correlation ($r>0.862$). Coefficient of determination (r^2) is also very high length weight relationships except correlation of length or weight with condition factor ($r^2 >0.652$). Length-weight relationships were also studied by Yankova *et al.,* 2010; Yankova *et al.,* 2011; Yankova *et al*., 2013; Yankova, 2013.

Table 2. Descriptive statistics and regression parameters of total length (TL, cm) with different morphometrics for *Trachurus mediterraneus ponticus*.

Equation	Relationship Parameters		95% CI of a	95% CI of b	r	r^2
	a	b				
W = a + b TL	-2.2361	3.56	-2.3582 to -2.0669	3.43-3.12	0.896***	0.856
K = a + b TL	-0.4435	0.74	-0.3351 to -0.0779	0.53- 0.40	0.224[ns]	0.219
SL = a + b TL	0.0125	0.80	-0.1445 to 0.1417	0.65- 2.04	0.759***	0.492
FL = a + b TL	0.0645	0.82	-0.022 to 0.0559	0.70- 0.96	0.971***	0.859
HL = a + b TL	-0.3841	0.698	-0.6077 to -0.4511	0.87– 0.90	0.891***	0.527
HW = a + b TL	-0.6103	0.84	-0.6601 to -0.4186	0.33- 2.05	0.756***	0.833
BG = a + b TL	- 0.5632	1.63	-0.2301 to -0.27824	1.72– 1.40	0.913***	0.872
DFL = a + b TL	-0.9014	1.56	-0.7997 to -0.9091	1.19 –1.25	0.825***	0.942
DFB = a + b TL	-0.8041	1.91	-0.2248 to -0.4613	1.08- 1.25	0.946***	0.967
PtFL = a + b TL	-0.7054	1.06	-0.8240 to -0.2007	0.29– 1.68	0.805***	0.920
PvFL = a + b TL	-0.2468	1.29	-0.6766 to -0.7390	0.58– 1.40	0.979***	0.973
AFL = a + b TL	-0.3710	0.92	-0.3270 to -0.5679	0.71– 1.45	0.922***	0.788

correlation coefficient (r), r^2: coefficient of determination, intercept (a), regression coefficient (b), Cl: confidence intervals, standard error (S.E.), *** $p < 0.001$, [n.s] $p > 0.05$

Table 3. Descriptive statistics and regression parameters of total length (TL, cm) with different morphometrics for *Trachurus mediterraneus ponticus***.**

Equation	Relationship Parameters		95% CI of a	95% CI of b	r	r²
	a	b				
K = a + b W	-0.0921	0.12	-0.1346 to -0.0397	0.08 - 0.17	0.560**	0.392
SL = a + b W	0.5431	0.29	0.5475 to 0.6782	0.22 - 0.32	0.769***	0.466
FL= a + b W	0.7139	0.24	0.6513 to 0.7826	0.26 - 0.29	0.974***	0.858
HL = a + b W	0.0531	0.23	0.0301 to 0.2094	0.19 - 0.27	0.785***	0.716
HW = a + b W	0.1729	0.24	0.0931 to 0.3645	0.25 - 0.33	0.862***	0.641
BG = a + b W	0.2723	0.38	0.3320 to 0.3449	0.32 - 0.42	0.828***	0.488
BD = a + b W	0.0561	0.39	0.0191 to 0.3286	0.34 - 0.42	0.842***	0.511
DFL = a + b W	-0.0247	0.31	-0.0542 to 0.0608	0.32 - 0.36	0.933***	0.773
DFB = a + b W	-0.0192	0.31	-0.0442 to 0.0374	0.30 - 0.33	0.952***	0.305
PtFL = a + b W	-0.0632	0.34	-0.2162 to -0.0588	0.30 - 0.32	0.923***	0.651
PvFL = a + b W	-0.1356	0.35	-0.2527 to -0.0728	0.30 - 0.36	0.896***	0.706
AFL = a + b W	-0.0214	0.26	-0.2046 to -0.0219	0.24 - 0.31	0.826***	0.584

The estimated value of b in total length-weight relationship is 3.27 (p<0.05) showing positive allometric growth for horse mackerel as estimated by other studies.

Change of *b* values does not depend only on the shape and fatness of the species, but there are many other various factors which influence the differences in parameters of the LWR among seasons and years, such as temperature, salinity, food (quantity, quality and size), sex, time of year and stage of maturity and "b" value is variable with season, habitats and even with daily changes as compared to "a" value which is more constant as described by Gonçalves *et al.,*1997 and Özaydin *et al.,* 2007, so in the present work the length-weight relationship in fish are considered not to be influenced by none of environmental factors. Significant correlation is there in condition factor and wet body weight (r = 0.510) and condition factor remains constant with increase in total length (r = 0.224) (Table 2 and 3). Variation of condition factor is possible in special cases described by Charlander *et al.,*1952. Sexual reproductive behavior and condition factor are closely related with reference to specific habitat of fishes reported by Ugwumba 1990, Aboaba 1993 and Saliu 1997.

REFERENCES

[1] Aboaba, M.A. 1993. Reproduction, larval rearing and the influence of dietary protein on the growth of the catfish (*Chrysichthys nigrodigitatus*). Ph.D. Thesis, University of Ibadan, Ibadan, Nigeria.

[2] Bayley, P.B. 1991. Personal communication to Paul Seelbach with unpublished length-weight equations for many fish species in Illinois waters.

[3] Carlander, K.D., Lewis, W.M., Ruhr, C.E, Cleary, R.E. 1952. Abundance, growth and condition of yellow bass *Morone interrupta* Gill, in Clear Lake, Iowa, 1941 to 1951. Trans. Am. Fish. Soc., 82: 91-103.

[4] Gonçalves, J. M., Bentes, L., Lino, P.G., Ribeiro, J., Canario A.V., Erzini, K. 1997. Weight-length relationships for selected fish species of the small-scale demersal fisheries of the south and south-west coast of Portugal, Fisheries Research, 30: 253-256.

[5] Kolher N., Casey J., Turner, P. 1995. Length- weight relationships for 13 species of sharks from the western North Atlantic, Fishery Bulletin, 93: 412-418.

[6] Le Cren, E. D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca flavescens*), J. Anim. Ecol., 20: 201–219.

[7] Morato, T. P., Afonso, P., Lourinho, P., Barreiros, J. P., Santos, R. S., Nash, R.D. 2001. Length-weight relationships for 21 coastal fish species of the Azores, north-eastern Atlantic, Fish. Res., 50: 297-302.

[8] Özaydin, O., Taskavak, E. 2007. Length-weight relationships for 47 fish species from Izmir Bay (eastern Agean Sea, Turkey), Acta Adriatica, 47(2): 211-216.

[9] Pauly, D., Gayanilo, F.C. 1996. Estimating the parameter of lengthweight relationships from length frequency samples and bulk weights, p. 136. In: Baseline studies of biodiversity: the fish resources of western Indonesia, (Eds.) D. Pauly and P. Martosubroto. ICLARM Stud. Rev. vol. 23, p. 321.

[10] Sokal R.R., Rohlf, F.J. 1987. Introduction to Biostatistics. W.H. Freeman, New York, USA, 1987.

[11] Saliu, J.K.O. 1997. Age, growth, feeding and reproductive ecology of the Characid: Brycinus nurse (Paugy) in Asa reservoir, Ilorin, Nigeria, Ph.D. Thesis, University of Ibadan, Nigeria.

[12] Ugwumba, A.A. 1990. Food and feeding ecology of *Oreochromis niloticus*, *Sarotherodon melanotheron* and *Heterotis niloticus* (Pisces: Osteichthyes) in Awba reservoir Ibadan, PhD Thesis, University of Ibadan, Ibadan, Nigeria.

[13] Wooton, J.R. 1990. Ecology of teleost fishes. Chapman & Hall, London, England.

[14] Yankova, M., Raykov, V., Gerdzhikov, D., Bogomilova, P. 2010. Growth and Length-Weight Relationships of the Horse Mackerel, *Trachurus mediterraneus ponticus* (Aleev, 1956), in the Bulgarian Black Sea Coast. Turkish Journal of Zoology, 34(1): 85-92.

[15] Yankova, M., Pavlov, D., Raykov, V., Michneva, V., Radu, Gh. 2011. Length-Weight Relationships of Ten Fish Species from the Bulgarian Black Sea waters. Turkish Journal of Zoology, 35(2): 265-270.

[16] Yankova, M., Pavlov, D., Mihneva, V., 2013. Length-Weight Relationships of Eight Fish Species from the Bulgarian Black Sea waters. In: Animal Diversity, Natural History and Conservation, (Eds.) V. K.Gupta and Anil K. Verma. Daya Publishing House, New Delhi, Vol.3, p. 189-195.

[17] Yankova, M. 2013. An overview on the biology of horse mackerel, *Trachurus mediterraneus*, off the Bulgarian Black Sea coast. In: Animal Diversity, Natural History and Conservation, (Eds.) V.K.Gupta and Anil K. Verma. Daya Publishing House, New Delhi, Vol.2, p.165-179.