A C T A I C H T H Y O L O G I C A E T P I S C A T O R I A

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Fish biology

LENGTH-WEIGHT RELATIONSHIP IN DAMSELFISH (*CHROMIS CHROMIS* L. 1758) FROM THE EASTERN ADRIATIC DURING SPAWNING

ANALIZA STOSUNKU DŁUGOŚCI DO MASY CIAŁA CHROMISA KASZTANOWEGO (*CHROMIS CHROMIS* L. 1758) WE WSCHODNIEJ CZĘŚCI ADRIATYKU W CZASIE TARŁA

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Length-weight relationship in adult damselfish from the samples collected from the northern and central Adriatic during spring-summer 1992 fishing season was analysed. Length-weight relationship factors were 2.637 and 3.071 respectively with significant difference between them. Empirical and cubic condition factors were calculated and they were significantly differed for both areas.

INTRODUCTION

The evaluation of population size of a commercially important fish species for the purpose of its rational exploitation, requires an essential knowledge of individual body length-weight relationship in the respective population.

The problem of proportionality of fish weight increment in relation to growth in length is usually analysed from two different viewpoints: the observed species is either accepted to be „ideal", what means that the species is forming and growing harmoniously and homothetically or empirical length-weight relationship is held to be better suitable.

Two methods resulted from this approach and two types of conditions factors are obtained, each with peculiar significance. By the first method, using fixed length-weight relationship, a comparison of the same species populations may be carried out as well as a comparison of variations in body shape of this species individuals. However, the method based on empirical length-weight relationship is used for the study of short-term variations, either individuals or collective, within a population.

Length-weight relationship in damselfish (*Chromis chromis*) was studied only once. Duka and Shevchenko (1980) studied the Black Sea and Mediterranean damselfish.

In this paper, length-weight relationship and condition in damselfish population from the eastern Adriatic coast were analysed during spawning. Damselfish were divided in two groups, one group containing fish from northern Adriatic and the other from the central Adriatic. These two Adriatic zones are principal fishing grounds of the Croatian coastal sea.

MATERIAL AND METHODS

Length and weight data of a total of 892 damselfishes from the northern Adriatic (the Rijeka Bay) (A) and 1110 damselfishes from the central Adriatic (central Adriatic channels, Vis and Biševo Islands) (B) were analysed (Fig. 1).

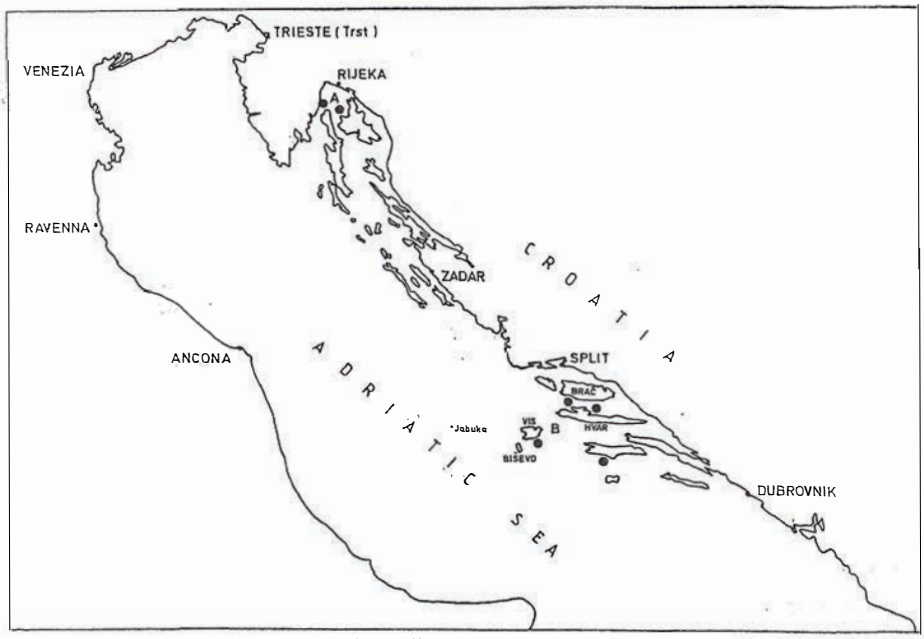

Fig. 1. Locations of sampling stations (A - Rijeka Bay, B - central Adriatic channels, Vis and Biševo Islands

Commercial catches of spring-summer season (May-August, 1992) were sampled. Damselfish spawn in this period and thus physiological condition of all fishes were similar.

Total length was measured in milimetres and fish grouped in length classes to the nearest 1 mm, each sex separately as well as both sexes together. Weight was measured with the precision of 0.01 g and mean weight was calculated for each respective length class.

Allometric length-weight relationship was described by the equation:

$$W = a L^b \qquad (1)$$

or in logarithmic form

$$\log W = \log a + b \log L$$

where W = weight, L = total length, b = allometric factor or length-weight factor and a = constant.

Two condition factors were calculated, the empirical and cubic ones

The function of the form:

$$C = WL\text{-}b \qquad (2)$$

was used for the empirical condition factor (C) calculation, and the function of the form:

$$K = WL\text{-}3 \qquad (3)$$

for the cubic condition factor (K) calculation for every length class.

RESULTS

Length-weight relationships in damselfish from the northern and central Adriatic were calculated on the basis of the data on length and weight obtained by measurements of individuals sampled (Tab. 1). These relationships were expressed by the following functions:

Northern Adriatic			Central Adriatic		
males	$W = 0.03 \times L^{2.793}$	$r = 0.997$	males	$W = 0.02 \times L^{2.901}$	$r = 0.990$
or log	$W = 2.793 \log L - 1.523$		or log	$W = 2.901 \log L - 1.700$	
females	$W = 0.04 \times L^{2.671}$	$r = 0.995$	females	$W = 0.02 \times L^{3.070}$	$r = 0.983$
or log	$W = 2.671 \log L - 1.398$		or log	$W = 3.070 \log L - 1.700$	
total	$W = 0.04 \times L^{2.637}$	$r = 0.992$	total	$W = 0.02 \times L^{3.071}$	$r = 0.992$
or log	$W = 2.637 \log L - 1.364$		or log	$W = 3.071 \log L - 1.796$	

Table 1

Distribution of weight by length classes of male and female damselfish from the spring-summer season 1992

Total length (cm)	Mean weight (g)					
	Northern Adriatic			Central Adriatic		
	males	females	total	males	females	total
5-5.9	3.80	3.69	3.76	-	3.44	3.44
6-6.9	5.20	5.60	5.40	4.61	4.52	4.57
7-7.9	7.52	8.12	7.82	7.12	8.09	7.61
8-8.9	10.35	10.69	10.52	10.07	11.98	11.03
9-9.9	16.29	17.40	16.85	15.46	15.47	15.47
10-10.9	21.56	22.09	21.83	19.79	20.81	20.30
11-11.9	25.27	26.30	25.80	23.37	25.13	24.25
12-12.9	31.45	32.13	31.80	31.26	33.36	32.31
13-13.9	40.15	41.00	40.58	39.42	41.10	40.26

Theoretical weigths of fish of different lengths (Fig. 2, 3 and 4) were calculated by mean of these equations

Greater empirical weights were recorded in females then in males for same length classes what can be explained by greater looses of weight in males in reason of greater metabolic processes during intensive spawning, caused by greater movements of males and greater activity in the begining of maturing on the localities were this species spawn, but maybe also in reason of earlier maturing of males then females of damselfish.

Calculation of the empirical condition factor (C) gave the following results:

Northern Adriatic		Central Adriatic	
males	$C \times 10^2 = 2.799$	males	$C \times 10^2 = 1.059$
females	$C \times 10^2 = 3.755$	females	$C \times 10^2 = 1.499$
total	$C \times 10^2 = 2.834$	total	$C \times 10^2 = 1.425$

The analysis of variance shows that the difference between empirical condition factor in damselfish from the northern Adriatic and that in damselfish from the central Adriatic is statistically significant ($F > F_{.001,1,16} = 16.10$) (Tab. 2)

Table 2

The analysis of variance of empirical condition factors in damselfish from the northern and central Adriatic in spring-summer 1992

Source of variation	Degree of freedom	SS	MS	F_S	P
Between groups	1	0.000897	0.000897	342.50	0.001
Within groups	16	0.000042	0.000003		
Total	17	0.000939			

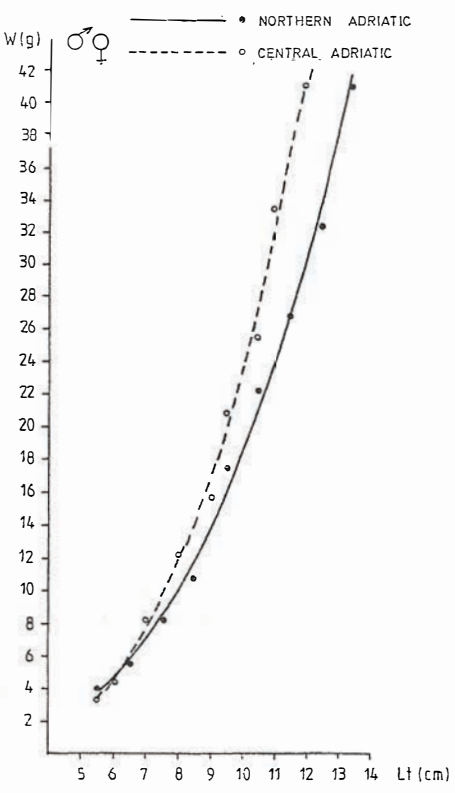

Fig. 2. Length-weight relationship in damselfish from northern and central Adriatic

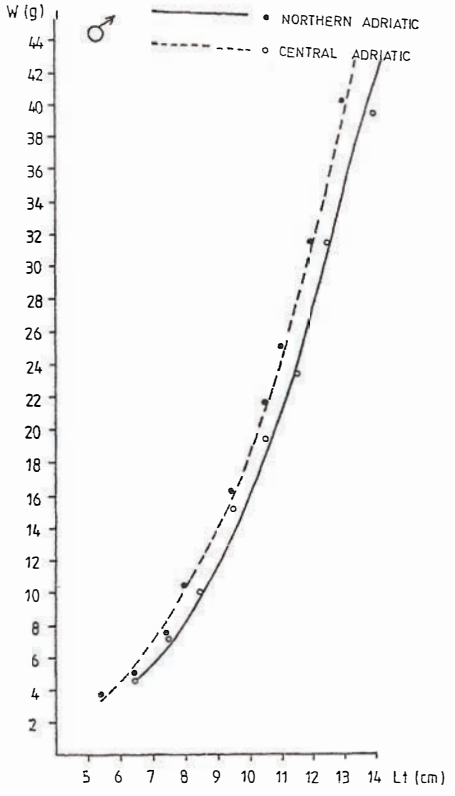

Fig. 3. Length-weight relationship in male damselfish from northern and central Adriatic

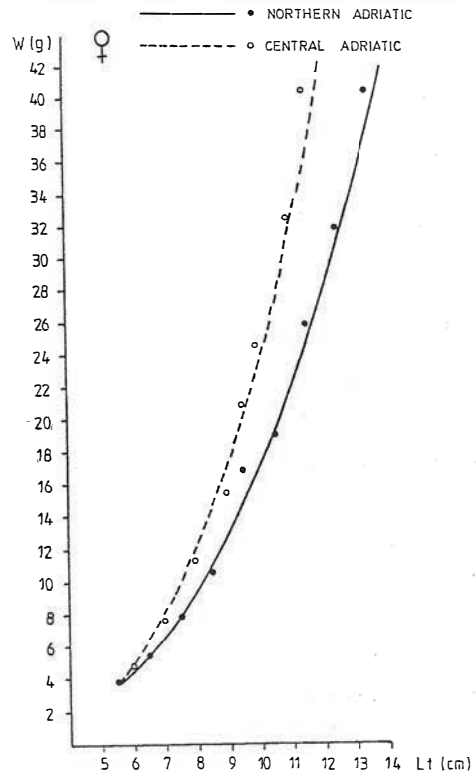

Fig. 4. Length-weight relationship in female damselfish from northern and central Adriatic

Cubic condition factor (K) was calculated for each length class (Tab. 3). Results show better female condition in both areas. The correlation coefficient between fish length and condition was also examined (Tab. 3).

Significance of condition factor variation in damselfish from the northern and central Adriatic was tested by the analysis of variance. It was proved that the analysed groups did not show the same parametric variation ($F > F_{25,1,16} = 1.42$) (Tab. 4).

Table 3

Fluctuaction in cubic condition factors (K) in function of total length of damselfish from the northern and central Adriatic in 1992

Total length (cm)	$K \times 10^2$					
	Northern Adriatic			Central Adriatic		
	males	females	total	males	females	total
5-5.9	0.023	0.022	0.023	-	0.021	0.021
6-6.9	0.019	0.020	0.020	0.017	0.017	0.017
7-7.9	0.018	0.019	0.019	0.017	0.019	0.018
8-8.9	0.017	0.017	0.017	0.016	0.020	0.018
9-9.9	0.019	0.020	0.020	0.018	0.018	0.018
10-10.9	0.019	0.019	0.019	0.017	0.018	0.018
11-11.9	0.017	0.017	0.017	0.015	0.017	0.016
12-12.9	0.016	0.017	0.016	0.016	0.017	0.017
13-13.9	0.016	0.017	0.017	0.016	0.017	0.018
Mean	0.018	0.019	0.019	0.017	0.018	0.018
±SD	0.0021	0.0021	0.0020	0.0008	0.0015	0.0013
r	-0.726	-0.633	-0.696	-0.592	-0.273	-0.423

Table 4

The analysis of variance of cubic condition factors in damselfish from the northern and central Adriatic in spring-summer 1992

Source of variation	Degree of freedom	SS	MS	F_S	P
Between groups	1	0.00035	0.00035	2.07	0.25
Within groups	16	0.00268	0.00017		
Total	17	0.00303			

DISCUSSION

Data included in this paper refer to the samples of commercial catches from spring-summer season, May-August 1992. This is the spawning season of adult damselfish which show the most advanced maturity stages (Contini and Donato 1973; Grubišić 1982). We used the samples from this period since all the available individuals were in similar physiological condition and therefore seasonal variation in gonad development and trophic activities will not affect the shape and condition of fish.

Length-weight factor of the relationship between body length and weight in adult damselfish from the northewrn Adriatic is 2.637 and that of damselfish from the central Adriatic is 3.071. First values is lower than 3, that is express the negative allometry and second value is greater than 3 what means positive allometry. Duka and Shevchenko (1980) established the value of the length-weight factor b = 2.945 for damselfish from Mediterranean Sea (Island Lampedusa) and b = 2.867 for damselfish from Black Sea on the basis of data from period May-June 1976. The value of b exponent show that damselfish from the central Adriatic exceed in weight those from the northern Adriatic within the same length classes. In addition, the results of calculations of length-weight factors for the samples grouped by sexes show differentiation as shown by the obtained equations. Accordingly males show better growth in relation to weight increment than females in northern Adriatic and vice versa. Even though damselfish from the central Adriatic show greater tendency to isometry. The difference between length-weight factors was statistically significant. This fact may be an indicator of no mixing of different damselfish groups during spawning. The length-weight factor was found to differ in different areas, sexes and vital stages and thus may be character for the differentiation of groups or a subpopulation within the same population, like for any other morphometric relationship (Le Cren 1951).

The values of empiric condition factor in damselfish slightly vary in relation to length. Accordingly, a change in fish length does not affect individual fish condition. Individual variations of empirical condition factor may be understood as a consequence of the different degree of fattening and stomach fulness, as much this factor affects the variation in short-term changes of fish shape. Taking into account the established stability of C factor, it may

be used for an intraspecies comparies of observed group. It was found taht the obtained C values belonged to different statistical populations ($F_S = 342.50$, $P < 0.001$).

Theoretically, if the length-weight factor is lower than b = 3, cubic condition factor evolves to the direction opposite to that of the length. Thus larger individuals will have poorer condition and in turn smaller individuals will have more improved condition. This analysis of damselfish population of the eastern Adriatic coast show the values of allometric factor to be lower in the northern part of Adriatic. Cubic condition factor is based on an ideal length-weight relationship. Thus it may be held as a measure of fish deviation from the hypothetical ideal fish. If the deviations of populations from different environments are considerable the differences between them may be of genetic origin due to racial differences (Le Cren 1951). The analysis of variance showed that the difference between both (K) factors was significant ($P < 0.25$). Accordingly, it may be assumed that the damselfish population from the northern Adriatic differ in some physiological respect from that from the central Adriatic. This differentiation is probably due to the different degrees of food requirements and food supply.

CONCLUSIONS

The paper reports the analysis of length-weight relationship in adult damselfish populations from the northern and central Adriatic caught durind spring-sumer, that is the spawning season.

Length-weight factor is 2 637 for damselfish from the northern Adriatic and 3 071 for those from the central Adriatic. The values b expotent show that damselfish from the cental Adriatic weight more than these from the northern Adriatic. Significant differences between factors of both areas was established.

Empirical condition factor is 2.834×10^{-2} for damselfish from the northern Adriatic and 1.425×10^{-2} for those from the central Adriatic.

Mean value of cubic condition factor is 1.9×10^{-2} (northern Adriatic) and 1.8×10^{-2} (central Adriatic). This is indicative of the poorer condition of damselfish from the central Adriatic during spawning.

The analysis of variance of obtained data shows that the difference between found condition factors in damselfish from both areas is significant.

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ANALIZA STOSUNKU DŁUGOŚCI DO MASY CIAŁA CHROMISA KASZTANOWEGO (*CHROMIS CHROMIS* L. 1758) WE WSCHODNIEJ CZĘŚCI ADRIATYKU W CZASIE TARŁA

STRESZCZENIE

W niniejszej pracy analizowano stosunek długości do masy ciała dojrzałego stada chromisa kasztanowego w północnej i środkowej części Adriatyku w okresie wiosenno-letnich połowów roku 1992 (okres tarła tego gatunku).

Współczynnik długości do masy ciała chromisa kasztanowego w północnej części Adriatyku wynosił 2.637, a w środkowej części 3.071. Wartość eksponenta allometrii b wskazuje, że chromis kasztanowy Adriatyku środkowego charakteryzuje się wyższą masą niż chromis kasztanowy z Adriatyku Północnego. Stwierdzono statystycznie charakterystyczną różnicę współczynników pomiędzy długością a masą chromisa kasztanowego występującego w obydwu rejonach Adriatyku. Empiryczny współczynnik kondycji chromisa kasztanowego z Adriatyku Północnego wynosił 2.834×10^{-2}, a dla Adriatyku Środkowego 1.425×10^{-2}.

Średnia wartość faktoru sześciennego chromisa kasztanowego z Adriatyku Północnego była równa 1.9×10^{-2}, a z Adriatyku Środkowego 1.8×10^{-2}.

W okresie tarła kondycja chromisa kasztanowego z Adriatyku Środkowego była słabsza niż kondycja chromisa kasztanowego z Adriatyku Północnego.

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