

## CONDITION OF FISH, SEA BREAM (*SPARUS AURATA*) AND SEA BASS (*DICENTRARCHUS LABRAX*) FROM FISH FARM IN BOKAKOTORSKA BAY (SOUTH-EAST ADRIATIC)

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### KONDIKIONO STANJE RIBA, ORADA (*SPARUS AURATA*) I BRANCIN (*DICENTRARCHUS LABRAX*), SA FARME U BOKOKOTORSKOM ZALIVU (JUGOISTOČNI JADRAN)

#### *Apstrakt*

U ovom istraživanju obrađeno je 210 jedinki orade (*Sparus aurata* Linnaeus, 1758) i 210 jedinki brancina (*Dicentrarchus labrax* Linnaeus, 1758) sa uzgajališta COGIMAR koje se nalazi na lokaciji Ljuta u Bokokotorskom zalivu. Istraživanja su započeta u decembru mesecu 2014. godine i u ovom radu biće predstavljeni preliminarni podaci o dužinsko-težinskom odnosu i kondicionom faktoru ovih vrsta.

Totalna dužina (TL) jedinki orade u uzorku kretala se od 19,9 do 31,1 cm, sa prosečnom vrednošću od  $28,1 \pm 1,8$  cm (prosečna dužina  $\pm$  standardna devijacija, SD), dok se raspon ukupnih težina kretao od 130 do 485 g, sa prosečnom vrednošću od  $337,56 \pm 55,75$  g (prosečna dužina  $\pm$  SD). Kod brancina totalna dužina jedinki u uzorku kretala se od 20,8 do 54 cm, sa prosečnom vrednošću od  $33,7 \pm 3,8$  cm (prosečna dužina  $\pm$  SD), dok se raspon težina kretao od 150 do 1945 g, sa prosečnom vrednošću od  $397,84 \pm 171,85$  g.

Analiza dužinsko-težinskog odnosa kod obe vrste pokazala je da se vrednost parametra b razlikuje od idealne izometrijske vrednosti 3. Kod orade vrednost parametra b iznosi 2,4851, dok je kod brancina vrednost parametra b iznosi 3,0591. Studentov t-test pokazao je da se parametar b dužinsko-težinskog odnosa kod ukupnog uzorka orade i brancina nije statistički značajno razlikovao od idealne izometrijske vrednosti 3.

Koeficijent kondicije kod obe vrste određen je pomoću Le Cren-ove i Fulton-ove formule po mesecima istraživanja i prema dužinskim klasama. Prosečan koeficijent kondicije orade (Slika 3.) iznosi  $K_a=0,9467 \pm 0,099$  (Le Cren, 1951), odnosno  $K_a=1,4607 \pm 0,1875$  (Fulton, 1904), a od istraživanih meseci najniža vrednost zabeležena je u februaru,  $K_a=0,947$  (Le Cren), odnosno  $K_a=1,4196$  (Fulton). Kod brancina prosečan koeficijent kondicije (Slika 4.)

za ceo ispitivani uzorak iznosi  $K_a=1,0164\pm 0,0627$  (Le Cren), odnosno  $K_a=1,0041\pm 0,0721$  (Fulton), a od istraživanih meseci najniža vrednost zabeležena je u februaru mesecu  $K_a=0,9656$  (Le Cren), odnosno  $K_a=0,9512$  (Fulton).

*Ključne reči: orada, brancin, odnos dužina-širina, faktor kondicije, bokakotorski zaliv*  
*Keywords: Gilthead sea bream, European sea bass, length-weight relationship, condition factor, Bokakotorska Bay*

## INTRODUCTION

Gilthead sea bream (*Sparus aurata*, Linnaeus 1758) and European sea bass (*Dicentrarchus labrax*, Linnaeus 1758) are demersal species distributed in Eastern Atlantic, entire Mediterranean and Adriatic Sea. Due to its euryhaline and eurythermal habits, both species are found in both marine and brackish water environments, such as coastal lagoons and estuarine areas, in particular during the initial stages of its life cycle (Jardas, 1996). *S. aurata* is protandric hermaphrodite species, maturing first as male (during the first or second year of age, at length 20-30 cm) and after the second or third year of age, at length 33-40 cm, as female. Spawning of this species happens generally from October to December, with sequenced spawning during the whole period (Bauchot et al., 1981; Buxton and Garratt, 1990). *D. labrax* reaches sexual maturity at 23-30 cm at males (second year of life), and 31-40 cm at females (third year of life). Spawning of *D. labrax* happens between November and March (Jardas, 1996).

Gilthead sea bream and European sea bass are the most cultivated species in aquaculture at Mediterranean, and only two fish species cultivated in marine aquaculture in Montenegro. At this moment there are two marine fish farms in Montenegro, both located inside Bokakotorska Bay, and both of them Gilthead sea bream and European sea bass are cultured.

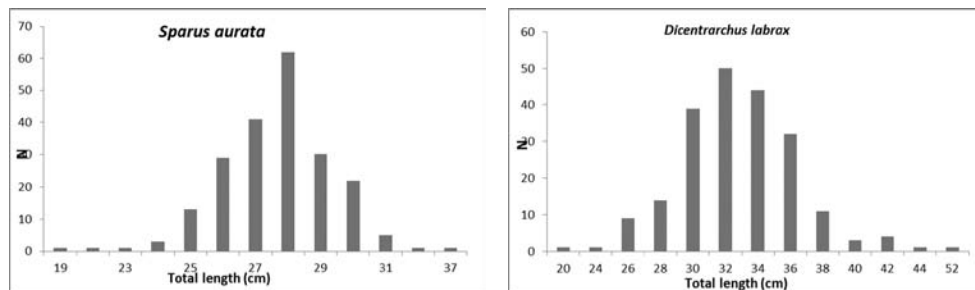
## MATERIALS AND METHODS

Sampling of Gilthead sea bream (*Sparus aurata*, Linnaeus 1758) and European sea bass (*Dicentrarchus labrax*, Linnaeus 1758) from fish farm COGIMAR started in December 2014, and continued until May 2015. Each month 50 individuals of both species were sampled. The length was measured to the nearest mm, and the total body weight (using a electronic balance) to the nearest 1 g. Length-weight relationship was determined for the entire sample, according to the formula  $W = a \cdot L^b$ . Parameters  $a$  and  $b$  were estimated using ordinary least-square regression after transforming the data in natural logarithms ( $\ln W = \ln a + b \cdot \ln TL$ ). Modified Student's  $t$ -test was used to test whether there was a statistically significant difference between the value of slope (parameter  $b$ ) of the length-weight relationship and the ideal, isometric value of 3.

The allometric condition index was determined according to the formula:  $K_a = W/aL^b$  (Le Cren, 1951) where  $a$  and  $b$  are the coefficient and exponent of the length-weight relationship, respectively. Additionally, Fulton's condition factor,  $K_a$ , was calculated according to the formula  $K_a = 100(W/L^3)$ , where  $W$  is the whole body wet weight in grams and  $L$  is the length in centimeters; the factor 100 is used to bring  $K$  close to a value of one.

## RESULTS AND DISCUSSION

A total of 210 individuals of Gilthead sea bream (*S. aurata*) and 210 individuals of European sea bass (*D. labrax*) were processed. Total length of *S. aurata* ranged from 19.9 to 31.1 cm, with mean value  $28.1 \pm 1.8$  cm (Figure 1), while weight ranged from 130 to 485 g, with mean value  $337.56 \pm 55.75$  g. For sampled individuals of *D. labrax*, total length ranged from 20.8 to 54 cm, with mean value  $33.7 \pm 3.8$  cm (Figure 1, while total weight ranged from 150 to 1945 g, with mean value  $397.84 \pm 171.85$  g.



**Figure 1.** Total length frequency distribution of *S. aurata* and *D. labrax*

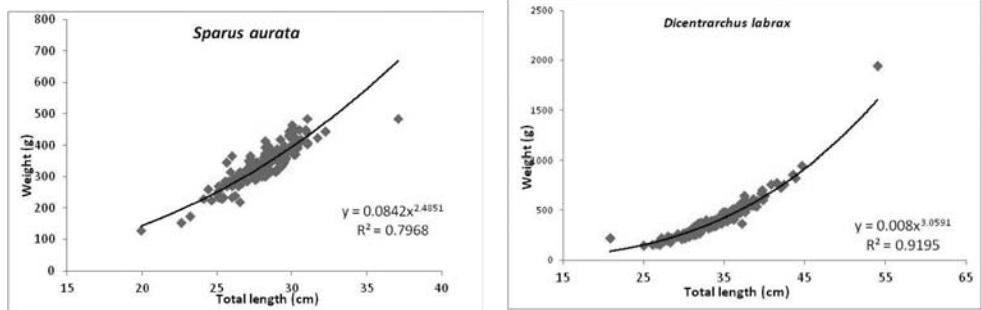
The length-weight relationship parameters for the total sample of *S. aurata* show that the parameter  $b$  (slope) has a value lower than the ideal, isometric value of 3, implying a faster growth in length compared to the gain in weight, or, alternatively, the body assuming a more elongated shape with growth. On the contrary, at *D. labrax* parameter  $b$  (slope) has a value higher than the ideal, isometric value of 3 (Table 1). Student's  $t$ -test showed that there is no statistically significant difference between the estimated value of coefficient  $b$  and the isometric value of 3 at both examined species.

**Table 1.** Length-weight relationship parameters of *S. aurata* and *D. labrax* total sample ( $a$  – intercept,  $b$  – slope,  $R^2$  – coefficient of determination,  $t$  – t-statistic)

Species	Number	$a$	$b$	$R^2$	$t$
<i>S. aurata</i>	210	0.0842	2.4851	0.7968	0.524*
<i>D. labrax</i>	210	0.008	3.0591	0.9195	0.0665*

\* No statistically significant difference for  $p \geq 0.05$

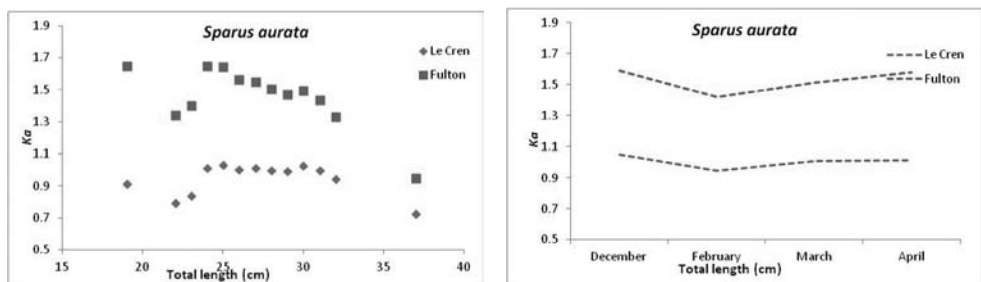
Length-weight relationships of *S. aurata* and *D. labrax* are presented in Figure 2. The highest value of parameter  $b$  for *S. aurata* is recorded in December,  $b = 2.8209$ , and the lowest in March,  $b = 2.3286$ . For *D. labrax* highest value of parameter  $b$  is recorded in March,  $b = 3.4172$ , and the lowest in December,  $b = 2.5653$ .



**Figure 2.** Length-weight relationship of *S. aurata* and *D. Labrax*

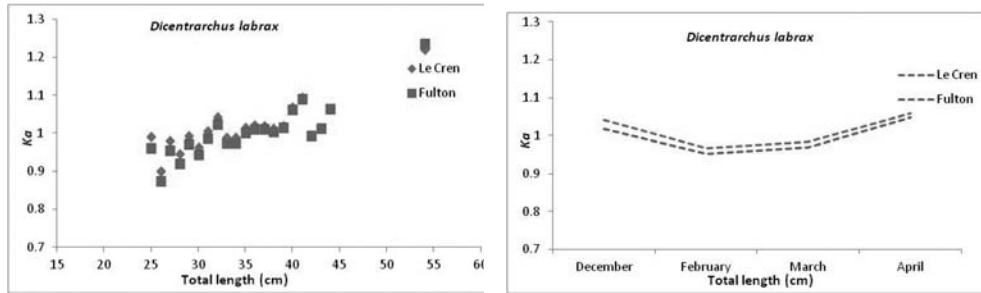
Similar results for parameter  $b$  of length-weight relationship for Gilthead sea bream was reported for some other parts of Mediterranean:  $b = 2.736$  (Ceyhan et al., 2009),  $b = 2.835$  (Sangun et al., 2007),  $b = 2.985$  (Cicek et al., 2006), while for Adriatic Sea reported value is  $b = 3.052$  (Kraljevic and Dulcic, 1997). For Adriatic area reported value of  $b$  parameters for European sea bass are  $b = 3.065$  (Dulcic and Glamuzina, 2006) and  $b = 3.146$  (Dulcic and Kraljevic, 1996), while for North – West Aegean Sea are reported values  $b = 3.158$  and  $b = 3.200$  (Koutrakis and Tsikliras, 2003).

Condition factor of Gilthead sea bream by length and by month is presented in Figure 3. Highest value of condition factor is reported in December,  $Ka = 1.0504$  and  $Ka = 1.5868$  (Le Cren and Fulton respectively), while the lowest value is recorded in February,  $Ka = 0.947$  and  $Ka = 1.4196$  (Le Cren and Fulton respectively). Lowest values of condition factor are recorded at lengths of 22 and 37 cm, which coincides with length of first maturity (20-30 cm for males, and 33-40 cm for females), when reserves are used for the development and maturation of the gonads, rather than to the growth and development of individuals, for what would normally be used.



**Figure 3.** Condition factor of *S. aurata* (Le Cren and Fulton) by length and by month

Condition factor of European sea bass (Figure 4) shows lowest value in February  $Ka = 0.9655$  and  $Ka = 0.9512$  (Le Cren and Fulton respectively), while the highest values are recorded in April,  $Ka = 1.0579$  and  $Ka = 1.0466$  (Le Cren and Fulton respectively). Similar to Gilthead sea bream, value of  $Ka$  is decreasing at the length of reaching sexual maturity.



**Figure 4.** Condition factor of *D. labrax* (Le Cren and Fulton) by length and by month

Earlier reported results of condition factor for *S. aurata* shows similar values:  $Ka = 1.29 - 1.49$  (Deguara et al., 1999), or much higher values  $Ka = 1.72 - 2.59$  (Faggio et al., 2014). For *D. labrax* reported values for  $Ka$  are  $Ka = 1.0713 - 1.5862$  (Erguden and Turan, 2005). Condition factor is a measure of the condition of fish. If  $Ka < 1$  fish is in a poor condition, if  $Ka > 1.4$  a fish is in good to excellent conditions. Our results showed that, even if in some months  $Ka$  values are next to 1, this factor is mostly  $>1$ .

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