SOME BIOLOGICAL PARAMETERS OF SARDINE, *SARDINA PILCHARDUS* WALB. 1792, IN MONTENEGRIN WATERS

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NEKI BIOLOŠKI PARAMETRI SRDELE, *SARDINA PILCHARDUS* Walb. 1792, U CRNOGORSKIM VODAMA

Abstrakt

Srdela, Sardina pilchardus, je jedna od najrasprostranjenijih i komercijalno najvažnijih vrsta riba u Jadranskom moru (FishStat Plus, FAO). Industrijski ribolov srdele i inćuna u Crnoj Gori je još uvek nerazvijen, pa se ove vrste uglavnom love alatima malog obalnog ribolova, tj. mrežama potegačama male veličine oka (5-6 mm) u Bokokotorskom zalivu. Podaci predstavljeni u ovom radu rezultat su istraživanja sprovedenog u okviru Pilot studije AdriaMed projekta u periodu septembar 2007. – septembar 2008. godine. Tokom Pilot studije putem intervjua sa ribarima prikupljane su informacije o ulovu i ribolovnom naporu svih aktivnih tipova brodova, a takođe su uzimani i biološki uzorci komercijalno važnih vrsta kako bi se proučavale njihove biološke karakteristike. Uzorci srdele prikupljeni su u području Bokokotorskog zaliva (koji predstavlja jedno od najproduktivnijih područja na crnogorskom primorju, pa je mrestilište i hranilište mnogih ribljih vrsta. Uzorci su prikupljani mesečnom dinamikom. Prikupljeni su sledeći podaci: totalna dužina tela sa preciznošću 0.1 cm, totalna težina sa preciznošću 0.01 g, pol i stadijum zrelosti gonada (upotrebljena je skala sa četiri stadijuma zrelosti, 1 – nezrele, 2 – sazrevanje, 3 – zrele i 4 – izmrešćene jedinke). Na osnovu ovih podataka određen je dužinski raspon, distribucija dužinskih frekvenci, odnos polova, dužina dostizanja polne zrelosti ($L_{50\%}$ dužina pri kojoj je 50% populacije polno zrelo, kao i $L_{25\%}$ $L_{75\%}$), kao i dužinsko-težinski odnos prema formuli $\log W = \log a + b \log L_T$. Srdela je bila najzastupljenija u ulovu u periodu april – jul. Dužinski raspon iznosio je od 7.3 do 16.6 cm, sa srednjom vrednošću od 13.1 cm. Kod oba pola prisutne su dve grupe individua (Sl. 2). Kod ženki prvu grupu čine individue dužinskog rapona 7.5 – 12 cm, a druga grupa obuhvata adultne jedinke dužine 12.5 – 16.5 cm. Kod mužjaka prvu grupu čine mlade jedinke dužine manje od 12.5 am, dok drugu, mnogoizraženiju grupu, čine jedin-

ke dužinskog raspona 13 – 16 cm. Od ukupnog broja jedinki (613) ženke čine 51.4% a mužjaci 48.6% (Tab. 1). U većim dužinskim klasama (>15 cm) ženke su zastupljenije od mužjaka (78%) (Sl. 3, 4). Zrele jedinke srdele obuhvataju dužinu 7.3 – 15 cm kod mužjaka, a kod ženki 8 – 16.6 cm. Nezrele jedinke čine oko 21% ukupnog uzorka, dok je izmrešćenih jedinki pronađeno 26 tokom čitavog istraživanja. Najveći broj uzorkovanih jedinki bio je u drugom stadijumu zrelosti. Jedinke u fazi mresta najzastupljenije su bile u periodu februar – mart. Procenjeno je da je dužina pri kojoj 50% populacije srdele dostigne polnu zrelost 12. 29 cm, dok su $L_{25\%}$ i $L_{75\%}$ procenjeni na 11.59 i 12.98 cm (Sl. 5). Koeficijent b dužinsko-težinskog odnosa kod mužjaka iznosio je 3.138, a kod ženki 2.973.

***Ključne reči**: srdela, biološke karakteristike, Bokokotorski zaliv*

INTRODUCTION

The FAO AdriaMed Project provides support to the Adriatic countries in developing the necessary expertise and tools for the appraisal of the fisheries resources and of the main socio economic aspects related to the fisheries. The Montenegro joined AdriaMed in 2004 and since then the Project assisted the country in the establishment of a system for the fisheries resources evaluation and management. A Pilot study on biological and socio-economic fishery data collection was scheduled and implemented in Montenegro by the Institute of Marine Biology of Kotor with the support of the AdriaMed Project in the period September 2007 - September 2008. The information on catch and effort of all the active fleet segments in the sampling ports were gathered by interviewing the fisherman, also the biological samples of the main target species were taken to study their biological characteristics.

MATERIAL AND METHODS

Sardine samples were collected in the Boka Kotorska Bay (Fig. 1), a closed marine bay with many freshwater springs and runoffs, and is prone to rather great temperature and salinity variations. It is one of the most productive areas of the Montenegrin coast and it seems to be a nursery ground for sardine and other small pelagic fish species.

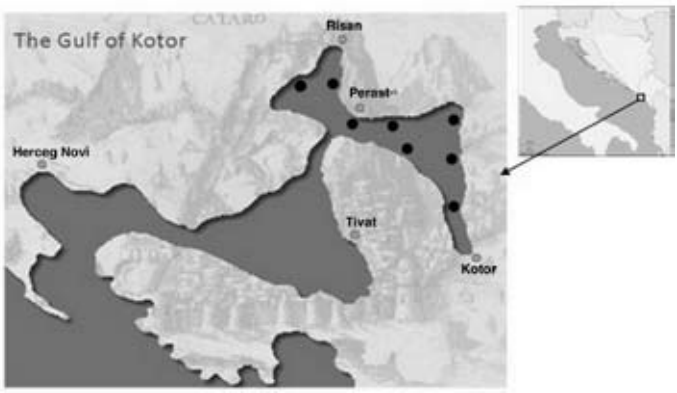

Figure 1. Map of the study area

The beach seine samples were collected monthly from September 2007 to September 2008, except in January when there were no catch due to a bad weather conditions. The following data was collected: total length to the nearest 0.1 cm, total weight to the nearest 0.01 g, sex and sexual maturity. For fishes a four maturity stages scale was considered (immature, maturing, mature and spent – resting; respectively, stages 1, 2, 3 and 4).

These data allowed to estimate the size range and length frequency distribution, the sex-ratio as proportion of males over the combined number of males and females, the size at first maturity (size at 50 percent of maturity, $L_{50\%}$) and size at 25 and 75 percent of maturity ($L_{25\%}$ and $L_{75\%}$) according to the classical logistic model and the length-weight relationship parameters using a power function. The length–weight relationship was determined according to the logarithmic form of the original exponential equation: $\log W = \log a + b \log L_T$, where a is the proportionality constant, b the allometry coefficient, W is fish weight in grams, and L_T is total length in centimetres.

RESULTS AND DISSCUSSION

Sardine, *Sardina pilchardus*, was more abundant in the catch in April-July period. Size range of the collected specimens was from 7.3 to 16.6 cm, with an overall average length of 13.1 cm. The LFD by sex showed a continuous pattern between 8 and 16.5 cm TL, even if two groups of individuals were apparent in both sexes (Figure 2). In females there was a first group of individuals included between 7.5 and 12.0 cm TL, and a second group describing the adults with size included between 12.5 and 16.5 cm TL. In males the first group comprised specimens < 12.5 cm TL, while the second, more evident, group was included between 13 and 16.0 cm TL (mode about 13.5 cm TL).

On the whole sample (613 individuals), females and males components were 51.4 and 48.6 percent respectively and no unsexed individuals were recorded (Tab. 1). The sex ratio value of the whole data set was close to 0.5 (0.48). More females than males (78%) in the higher TL classes (from 15 cm) were recorded (Fig. 3, 4). Similar results are reported for the same area for the period 2006-07 (Pesic *et. al.*, 2010). Mature specimens of *S. pilchardus* were found at wide size range, TL varying between 7.3 and 15.7 cm in males and 8.0 and 16.6 cm TL in females. According to Sinovcic *et. al.* (2008) sardine at the end of the first year of life, the smallest mature female are at 7.1 cm and male at 7.3 cm. A large fraction of immature individuals (more than 21%) was found, but only 26 post-spawning specimens were sampled during the whole study period. The largest fraction of the sampled specimens was in the 2 maturation stage. Period of highest occurrence of spawning specimens was during February and March. Spawning of this species is mainly during the October – April period (Muzinic, 1954; Regner *et. al.*, 1981, 1983, Nejedli *et. al.*, 2004, Pesic *et. al.*, 2010). The peak of spawning based on the investigations of GSI and oocyte composition in sardine ovaries in Bokaotorska Bay is in February (Pesic *et. al.*, 2010).

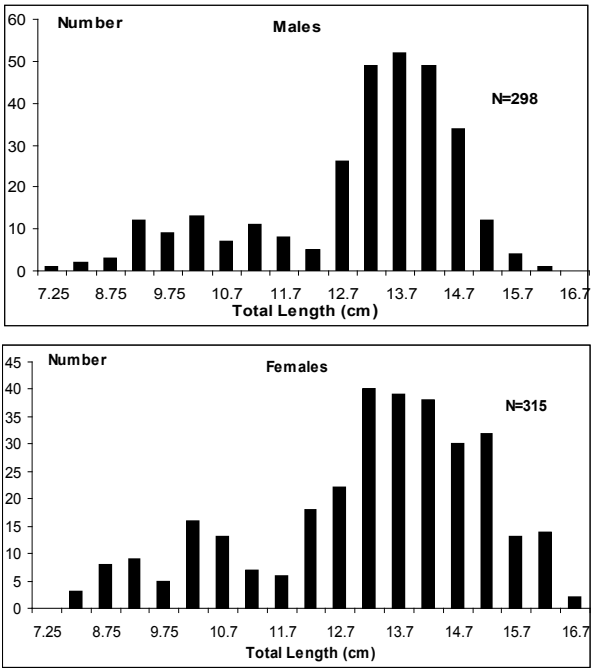

Figure 2. Length frequency distribution of *Sardina pilchardus* caught in national waters of Montenegro during 2007/2008 by sex. N = number of specimens

Table 1. Sex and gonad maturity stages of *Sardina pilchardus*. F = female; M = male; TL = total length in cm; 1-4 = gonad maturity stages

Sardina pilchardus	M				F			
Maturity stage	No	%	TL min	TL max	No	%	TL min	TL max
1	68	22.82	8.7	14.2	63	20.00	8.3	16
2	200	67.11	7.3	16.2	174	55.24	8.1	16.3
3	23	7.72	13.1	15.2	59	18.73	12.1	16.6
4	7	2.35	13.8	15.2	19	6.03	12	15.2
Total	298	100.00			315	100.00		

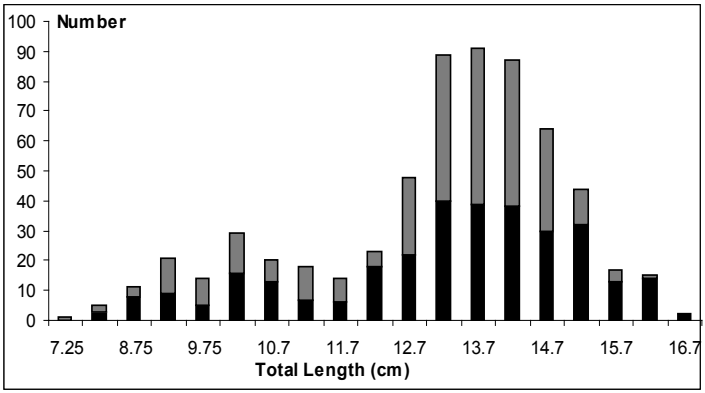

Figure 3. Length frequency distribution by sex. Black bars = females; stripped bars = males.

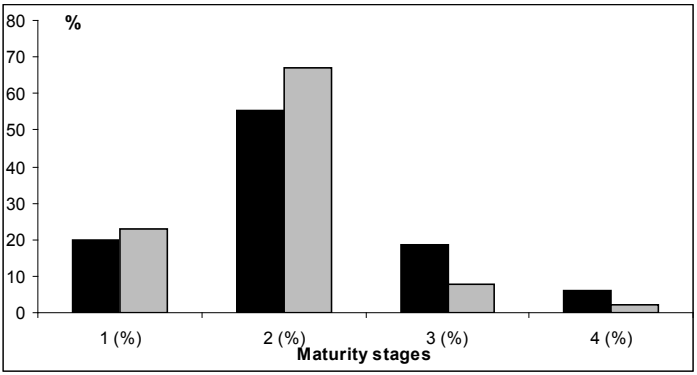

Figure 4. Sex and gonad maturity stages proportion. Black bars = females; stripped bars = males.

The proportion of mature specimens as a function of size (TL) fitted the logistic model and the computation of the ogive parameters provided an estimate of $L_{50\%}$ of 12.29 cm (Fig. 5); the value of $L_{25\%}$ was 11.59 cm, whereas that of $L_{75\%}$ was 12.98 cm. The power coefficient (*b*) of the LW relationship was 3.138 for males and 2.973 for females. For the same area in the period 2006-07 Pesic *et. al.* (2010) reported the power coefficient *b* for male 3.113 and for females *b*=3.077.

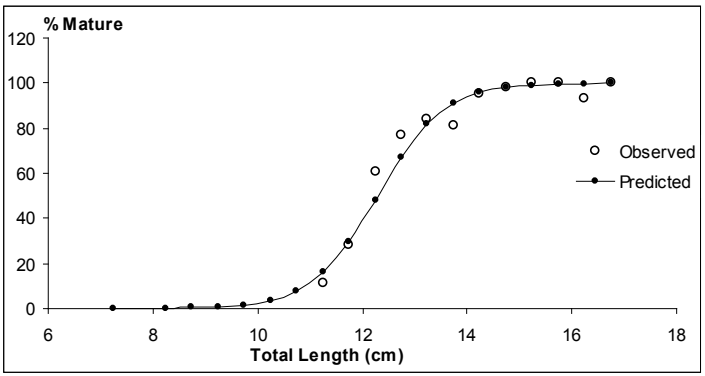

Figure 5. Proportion of mature specimens by size compared with estimated logistic curve.

CONCLUSIONS

The results of this study pointed out that a large fraction of immature individuals, more than 21%, are caught through small-scale fishery in the Boka Kotorska Bay. Some important management decisions need to be recommended for this area. On the other side, this type of fishery has a long tradition in Boka Kotorska Bay and must be preserved.

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