POPULATION STRUCTURE AND GROWTH PARAMETERS OF *ALOSA IMMACULATA* SPECIES, BENNETT, 1835 (PONTIC SHAD) ON THE DANUBE SECTOR KM 169 - KM 197 IN 2020

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Abstract

Pontic shad is one of the most important species for industrial fishing and one of the most appreciated fish given its organoleptic qualities, having a particularly fine meat taste and a high percentage of fat. The purpose of this paper is to assess the condition of Pontic shad flocks that arrived in the breeding areas in 2020. The morphometric characteristics, the sex ratio, the age and the growth parameters for the Pontic shad from the Smârdan - Gropeni area, Brăila county were studied. A number of 50 specimens of Pontic shad were examined during April-May 2020. The sex ratio in the analysed group was 56% females and 44% males. The smallest males were 2 years old, measured 26 cm and weighed 150 g, while the largest specimens were 3 years old with a total length of 33 cm and a weight of 275 g. The average length of the males was 30.214 ± 1.608 cm and the average weight was 215.952 ± 35.410 g. The smallest females measured 30 cm, weighed 220 g and were 2 years old and the largest specimens were 5 years old, they had 37 cm and 450 g. The average length of the female specimens was 33.357 ± 1.870 cm and the average mass was 328.571 ± 64.792 g. Analysing the population structure and the Fulton coefficient, we appreciate that in 2020, in the studied breeding areas, the Pontic shad flocks, in which females over 3 years of age predominated, had a good state of maintenance.

Key words: Pontic shad, sex structure, Danube River

INTRODUCTION

Alosa immaculata, Bennett, 1835 (Pontic Shad), belongs to the family *Clupeidae* being an important species in ecological system Lower Danube-Danube Delta-Black Sea with a high economic value [11].

It is a migratory euryhaline pelagic marine species, which lives in the sea, climbing in the breeding season on rivers for reproduction at distances of hundreds of kilometres. It winters in the Black Sea at a distance up to 90 meters from the shore.

The sexual maturity of the Pontic shad is reached at 2-3 years with a body length of 20-30 cm. Its prolificacy is between 14,000 - 140,000 eggs per female, depending on the weight and size of the specimens, but the absolute prolificacy is recorded in 5-year-old specimens [15].

In the Danube River, the migration of breeds starts in February-March at water temperatures of 3-5°C with a maximum intensity in April-May at temperatures of 9-17°C and ends at the end of June when water temperatures reach 22-26°C [11,12]. It has also been observed that the first cohorts who migrates to the river for breeding are made up exclusively of males. After [14], the structure of the population was 62.4% of 3-year-old specimens with lengths between 27-30 cm that reach the first reproduction. The next in weight of 32.6% were the 4-year-old with a length of 27-37 cm.

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Pontic shad has a great ecological and economic importance, being appreciated fish given its organoleptic qualities. Unfortunately, according to IUCN the species is listed as Vulnerable VU [6] and in Romania the status is unfavourable inadequate in Danube River and Black Sea.

In this context, the aim of this paper was to analyse the structure of the Pontic Shad population *Alosa immaculata* (Bennett, 1835) in the year 2020 on the Danube sector of Brăila (km 169-197).

MATERIALS AND METHODS

Samples were collected in the year 2020 during April- May 2020. The Danube area of Brăila falls between the villages Smârdan and Gropeni (km 169-197). This area make part from sector two of Danube River km 155 (confluence of Siret River) – km 227 (Călmăţui River) including the Vâlciu Arm (Figure 1). The studied area is of interest due to the places suitable for Pontic shad reproduction.

The fishing has been made through gill nets with mesh size 30×30 mm, height 4.20 m, length 190 m (2 pieces). The fishing area is 1000 m long. There were 8 day launches with a total capture of 90 fish.

Water temperature and level data at Brăila were taken from Danube River Administration of the Lower Danube which records such data daily in all Romanian Danube stations. In April water temperature varied between 8,5-15°C and water level 101-240 cm. In May water temperature varied between 16-20°C and water level 110-138 cm.

Only a number of 50 Pontic shad were examined (measured and weighed). Fish were measured with an ichtiometer at a precision of 1 mm (total length = L), weighed to an accuracy of 1 g scale (weight = W). For age determination we collect 10-20 scales from the body between lateral line and dorsal fin. Determination of age was made by reading the annual growth rings on scales using binocular microscope with a magnification of 1×10 according to [8]

The statistical analysis like mean value, standard deviation (SD) of collected data was done with MS Excel 2016.

Fig. 1 Sampling locations during spawning migrations of 2020

RESULTS AND DISCUSSIONS

The majority of the Pontic shad individuals caught during the year 2020 are four years old and three years old (34 %), followed by five years (18 %) and two years (12 %), while only 2% of the population was six years old (Figure 2).

Regarding the sex structure population from this year dominated was females aging five years old (58.57 %), followed by four years (42.85 %) and three years (21.42 %). Only a percent of 2.58 was recorded in the case of female of two years old. The male population was represented mostly by fish of three years old (50%), followed by four and two years (22.73 %) and only a small percentage of five years old (4.54%) (Figure 2).

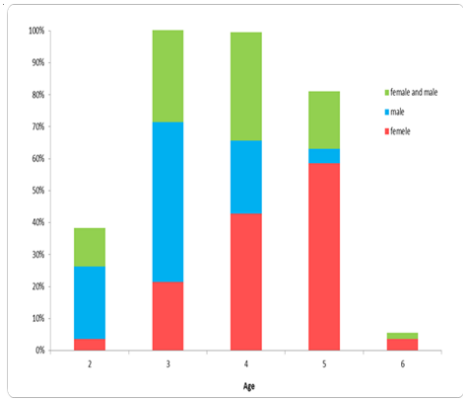

Fig. 2 Age and sex structure of Pontic shad during the year 2020

The sex ratio in 2020 migration was M / F = 0.78. This value was similar with those registered by others authors for previous years [10, 19].

In table 1 is presented the main descriptive parameters of length and weight of the Pontic shad population of migration from the year 2020.

The smallest male was 2 years old, measured 26 cm and weighed 150 g, while the largest specimens were 3 years old with a total length of 33 cm and a weight of 275 g. The average length of the males was 30.214 ± 1.608 cm and the average weight was 215.952 ± 35.410 g. The smallest females measured 30 cm, weighed 220 g and were 2 years old and the largest specimens were 5 years old, they had 37 cm and 450 g. The average length of the female specimens was 33.357 ± 1.870 cm and the average mass was 328.571 ± 64.792 g.

Table 1. The main descriptive parameters of length and weight of the Pontic shad population of migration from the year 2020 from the Smârdan - Gropeni area.

	Total length (cm)		Total weight (g)	
	Female	Male	Female	Male
Mean ± Sdev	33.357 ± 1.870	30.214 ± 1.608	328.571 ± 64.792	215.952 ± 35.410
Min	30	26	220	150
Max	37	33	450	275

From the histogram of length and weight (Figure 3 and Figure 4) it can be observed that in the case of female the captured specimens belong to eight classes of length and eleven classes of weight, the majority being in the classes of 32,50 and 35 cm length, respectively 320-380 g and 250-280 g weight.

In the case of male there were dived in seven classes of length and six classes of weight, the majority of fish having the total length near 30 cm and the total weight around 200-220 g.

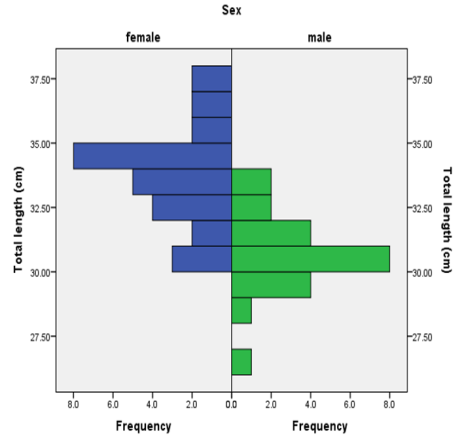

Fig. 3 Total length distributions of Pontic shad female and male in the 2020 migration from the Smârdan - Gropeni area

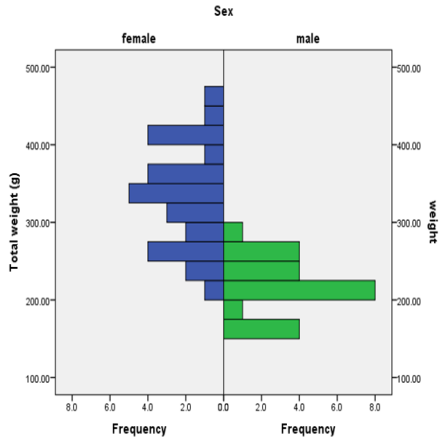

Fig. 4 Total weight distributions of Pontic shad female and male in the 2020 migration from the Smârdan - Gropeni area

Our results are similar with those found by [9], during the period of migration from 2009 (April - June). At the same fishing area, the total lengths of the fish were between 24 and 39 cm, with an average value of 31.11 cm, while the fish weight varies between 100 g and 400 g with a mean value of 276.72 g.

In order to evaluate the environmental living conditions of fish we calculate the length (L)-weight (W) relationship. Also, this L-W relationship can offer information about gonadal development, feeding rate and maturity condition [2].

The formula is $W = a \times L^b$. where W is the weight of the fish (g), L is the total length (cm), "a" is the constant and b is the slope. The values of "b" coefficient is between 2 and 4 [1], and the ideal values is "3" representing an isometric growth [17]. The value of "b" can differ in fish according to the species, age, sex, season or feeding [18]

In table 2 are given the values of the "a" and "b" growth coefficients and in the figure 5, 6 and 7 are presented graphical relationships between length and weight for female, male and the whole Pontic shads fish from migration of the year 2020.

Table 2 Values of the length-weight relationship a and b coefficients in Pontic shad migration of 2020

Sex	a	b	R^2
Female	0.015	2.843	0.627
Male	0.014	2.820	0.821
Female + Male	0.018	3.435	0.830

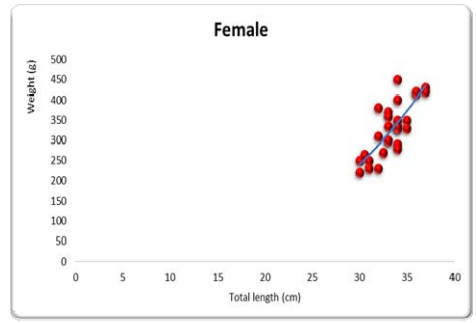

Fig. 5 The length-weight relation for female of Pontic shad

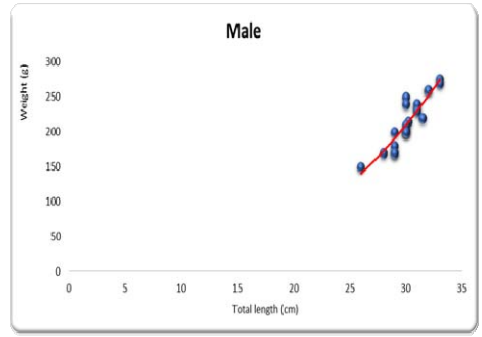

Fig. 6 The length-weight relation for male of Pontic shad

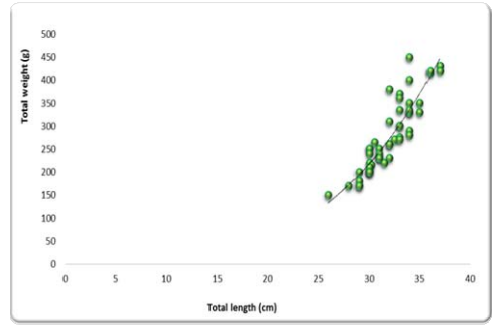

Fig. 7 The length-weight relation for Pontic shad migration in 2020 from the Smârdan - Gropeni area

During the migration of 2020 from the Smârdan - Gropeni area, the values of coefficient „b" for female and male was near 2,8, indicating an allometric growth, the weight increase being slower than the length increase. However, analyzing the „b" values for the entire population, the determination coefficient (R^2) resulting from the regression was equal to 0,83, and the value of „b" coefficient reflecting optimum conditions for growth of fish (3,435), fish growing being better in weight rather length.

The value of "b" for the whole population obtained for 2020 migration is better than those obtained by [9] (b=2,487) for Pontic shad migration from 2009 in the same catch area. Also, for Pontic shad [11] reported a value of "b" coefficient near 2,457.

Also, we evaluate the status of "well-being" of Pontic shad population, by calculating the Fulton coefficient, $K = (W / L^3) \times 100$ where: K = coefficient of Fulton; W = weight of fish body mass; L = length of fish body, measured from the tip of the snout to the tail base [18] . In our study the Fulton coefficient of females was 0.789±0.112 and of the males 0.778±0.057, and 0.834±0.105 for the both sexes combined.

The values obtained by us are lower than those published by [13], which analyse the Fulton coefficient during migration from 1988-2014 (K= 1.42), respectively for the period 1988-2014 (K=1.2÷1.7). Generally, the values of K greater than 1 or very close to 1 indicate a "well-being" state of the fish population [7], but according to [11] the Fulton coefficient for shads decreases with migration distance to the Danube River and reproduction, due to biomass loss for the energy consumed for migration and spawning.

CONCLUSIONS

From the specimens of Pontic shad captured in 2020 on km 169 - km 197 of Danube sector can be concluded:

- migration on the sector was dominated by individuals of 4 and 3 years, the percentage of male and female on the reproduction age being quite high (male - 3 years, 50% and 22.73% 2 years; female 3 years 21.42%);
- in the case of female the captured specimens belong to eight classes of length and eleven classes of weight, the majority being in the classes of 32.50 and 35 cm length, respectively 320-380 g and 250-280 g weight, while in the case of male there were dived in seven classes of length and six classes of weight, the majority of fish having the total length near 30 cm and the total weight around 200-220 g;
- regarding the welfare status of Pontic shad population, the values of coefficient „b" for female and male was near 2,8, indicating that fish growing was better in weight rather length.

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