STUDY ON THE MAINTENANCE STATUS AND BIOCHEMISTRY OF PONTIC SHAD *ALOSA IMMACULATA* (BENNET, 1835) DURING MIGRATION

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Abstract

In Romania, Pontic shad (Alosa immaculata) is a fish with a high commercial value, with an average annual catch of 200-500 tons, according to ANPA statistics. The shad meat is appreciated for its fine taste, but also for its fat, which is made up of polyunsaturated fatty acids.

The aim of this study is to bring new data on biological parameters, maintenance status and biochemical composition of Pontic shad (A. immaculata), during the period of maximum migration (April), on the Danube section the river mouth, where it flows into the Black Sea, and the point km 197, in Braila county. The samples were taken from 3 different points: St. Gheorghe arm (station 1), Isaccea village, Tulcea county at km 103 of the Danube (station 2) and Chiscani village, Braila county at km 197 of the Danube's mouth (station 3). The age of fish ranged from 3 to 5 years. The most abundant specimens are groups aged 3 years (40%) and 4 years (36%). The gender structure of catches is represented by 53% females and 47% males. The Fulton condition factor had values between 1.13 and 1.28, with the highest value at the beginning of the migration, in the area of the St. Gheorghe arm (1.28) and the lowest value (1.13) at 197 km from the Danube's mouth, in the intermediate area, at km 103 the value being 1.15. The percentages of lipids in the meat of the Pontic shad taken from stations 2 and 3 were relatively equal, of 17.62%, respectively 17.65%, the highest value being registered in station 1, at St. Gheorghe, where the value was 18.60%. The percentage of proteins for the biological material from Station 1 – St. Gheorghe was 0.4% lower than that of the samples taken from Station 2 - Isaccea, km 130 and 0.85% lower than that from Station 3 - Chiscani, km 197, the differences being insignificant (P> 0.05).

Key words: Pontic shad, maintenance status, biochemical composition, migration

INTRODUCTION

Pontic shad (*Alosa immaculata*), a marine fish of the *Clupeidae* family, is an endemic species relict in the Black Sea, from where spring migrates to the Danube for breeding. It is a fish with great economic and sociocultural value for the communities in the Danube-Pontic area. In Romania, Pontic shad has a high commercial value, with annual catches averaging 200-500 tons in the period 2008-2017, according to ANPA statistics [4]. The shad meat is appreciated for its fine taste, but also for its fat, which is made up of polyunsaturated fatty acids.

The aim of this study is to bring new data on biological parameters, maintenance status and biochemical composition of Pontic shad *(A. immaculata*), on the Danube section between the river basin in the Black Sea and km 197, in the area of Braila County , during the maximum migration period (April), when the water temperature was between 8.1°C and 15°C.

MATERIAL AND METHODS

The study was conducted in April 2020. Sampling was done by scientific fishing. During the migration period, in 3 different stations, control captures were made, from which 15 samples were extracted in order to perform the analysis, as follows:

- station 1 - St. Gheorghe's arm

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The manuscript was received: 30.07.2020
Accepted for publication: 15.08.2020

- station 2 - place. Isaccea, Tulcea County at km 103 of the Danube
- station 3 - Chiscani place, Braila county at km 197 of the Danube

The time interval between sampling from the three stations was 3 days.

For the caught fishes were determined: body mass, using a scale with an accuracy of 1 g (W), total length = LT, standard length = L, using an ichthyometer with an accuracy of 1mm. The condition factor Fulton (K), was calculated as the ratio of the weight to the cube of the standard length of the fish.

$$K = (W / L\ 3) \times 100;$$

K = the condition factor Fulton;
W = total body weight (g);
L = standard body length, (cm).

The anatomoponderal analysis was performed as a percentage on anatomical sections: meat, head, internal organs (liver, spleen, heart, sexual organs), viscera / digestive tract and other inedible parts (fins, bones, skin, scales, blood).

The biochemical composition of the meat was analyzed using standard methods of analysis.

The protein content (%) was calculated by Kjeldahl method which meant determining the nitrogen content, which was converted into protein equivalent by multiplying by factor 6.25. (AOAC, 1990) [1], using an automatic Gerhardt system.

The lipid content (%) was determined by the Soxthlet method, using an automatic Soxtherm system.

The ash content (%) was determined by calcining the samples in the electric oven at 600°C for 4 hours. The sample crucibles were brought to room temperature and weighed.

Moisture was determined according to standard official analyzes (AOAC, 1990) [1], by drying the samples at 103 ± 2°C to constant mass.

Statistical analysis

All analyzes were conducted in duplicate. Statistical analysis was performed using Excel tools. The mean values are presented together with the respective standard deviation. Statistical interpretation of the data was performed according to a significance threshold of $P < 0.05$.

RESULTS AND DISCUSSIONS

The capture from the 3 sampling points indicated a ratio between males / females of 0.87, a ratio that was maintained in the samples studied (Fig. 1). This result was similar to that obtained by Nastase et al., 2018 [7] for the Pontic shad migration in 2016, when the M / F ratio was 0.51.

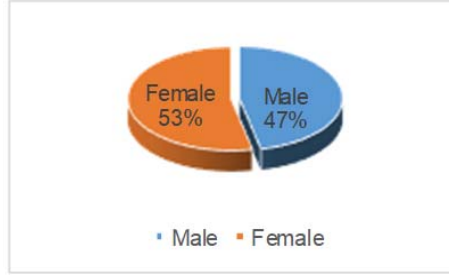

Fig. 1 The sex structure for *Alosa immaculata*

The structure of the sexes is influenced by the time and point of sampling, knowing that males predominate at the beginning of migration, and towards the end of it females predominate [9].

The age structure indicates the presence of 3 generations; 40% of the caught shad were 3 years old, 36% 4 years old and 24% 5 years old. The result of our study was analogous to that obtained by Navodaru, 2014 [10], but different from that of Rozdina et al., 2015 [12], who reported ages between 2 and 5 years, predominating ash trees with an age of 2 years (53.2%), as well as that of Ciolac and Patriche, 2004 [2].

The biometric data of the specimens from the 3 samples taken are shown in Table 1.

The average individual mass (W) was 200 g in the sample extracted from St. Gheorghe, 108 g in the area km 103 of the Danube, respectively 193.4 g in the sample extracted from the area of Braila County, at km 197. Regarding the standard length, its mean values ranged from 25.7 ± 3.0 cm to 27.5 ± 2.2 cm.

Table 1 The Biometric data and sex structure of Pontic shad samples analyzed

The growth parameter		*Station 1 – St. Gheorghe arm*	*Station 2 – Isaccea, km 103*	*Station 3 – Chiscani, km 197*
No. of specimens		*15*	*15*	*15*
Gender structure		*8 M / 7 F*	*7 M / 7 F*	*6 M / 9 F*
Individual mass (W)	W_{min} (g)	200.0	108.0	193.4
	$\overline{W} \pm S\overline{x}$ (g)	234.0±35.0	203.2±75.5	233.4±32.4
	W_{max} (g)	250.0	290.0	275.0
	CV** (%)	15.0	37.1	13.9
Total length (LT)	LT_{min} (cm)	28.0	25.4	27.7
	$\overline{LT} \pm S\overline{x}$ (cm)	29.9±1.5	29.6±3.3	30.8±2.3
	LT_{max} (cm)	32.0	33.5	33.5
	CV **(%)	5.1	11.0	7.5
Standard length (L)	L_{min} (cm)	25.0	22.0	24.7
	$\overline{L} \pm S\overline{x}$ (cm)	26.4±1.2	25.7±3.0	27.5±2.2
	L_{max} (cm)	28.0	30,2	30.0
	CV**(%)	4.7	11.6	7.9
Coefficient Fulton	$K=(W/L^3)x100$	1.28	1.15	1.13

** Standard deviation; ** Coefficient of variability*

The length of a fish is directly proportional to weight gain, being influenced by the breeding season [14]. The specimens analyzed in the study show an increase in length with the accumulation of biomass.

The Fulton condition factor, an indicator with a high degree of significance regarding the maintenance status of the fish, had values between 1.13 and 1.28, with the highest value at the beginning of the migration, in the St. Gheorghe arm area (1.28) and the lowest value (1.13) at km 197 on the Danube, in the intermediate area, at km 103 the value being 1.15. The values of the Fulton coefficient ≥ 1 indicate a very good state of maintenance of the analyzed sample. The value of the Fulton index decreased with the migration to the Danube, through the loss of biomass due to the effort made for migration and reproduction [8].

For the same species, but in other areas, the values of the Fulton index were: 1.12 for specimens caught in the middle of the Black Sea, in Turkey [13], and 1.08 for the shad from the Marmara Sea, Turkey [3].

Anatomoponderal analysis

The anatomoponderal distribution for the 3 samples, in percentages, is presented in fig. 2. The percentage of meat in station 1 - Sfantu Gheorghe is higher than in the other samples, the differences being insignificant (P> 0.05).

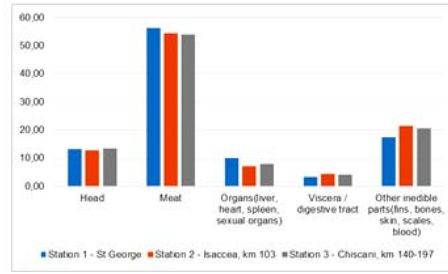

Fig. 2 Anatomoponderal distribution for *Alosa immaculata*

Biochemical analysis

The percentage of proteins for the biological material from the sample taken from station 1 – St. Gheorghe was 0.4% lower than that of the samples taken from station 2 - Isaccea, km 130 and 0.85% lower

than that from station 3 - Chiscani, km 197, the differences being insignificant (P> 0.05).

The specimens taken from station 1 (St. Gheorghe) showed the highest percentage of lipids (18.60%). The percentage of lipids in the specimens taken from stations 2 and 3 were relatively equal, of 17.62%, respectively 17.65%, being lower than that of station 1. The effort made for migration is found in a decrease in lipid content.

For the species Coreropus macrophthalmus, Luzzana et al. (1996) [5] showed that muscle fat is used as an energy source, which is consistent with our results, because the amount of lipids in Pontic shad meat decreased during migration from the beginning to the breeding area.

The results of the study are similar to those obtained by Misir G., 2014 [6], which identified an average percentage of lipids in shad muscles of 17.3 ± 2.50.

The biochemical profile for *Alosa immaculata* from the 3 analyzed samples is presented in table 2.

Table 2 Biochemical parameters of (*Alosa immaculata*) from 3 analyzed samples

	Number of the fish	Minimum	Maximum	Median±SD*	CV** (%)
Station 1 - St. George, Tulcea					
Moisture, (g %)	15	61.04	65.72	63.03±2.18	3.45
Proteins, (g %)	15	15.57	17.91	16.56±0.86	5.21
Lipids, (g %)	15	16.20	21.05	18.60±1.91	10.24
Ash (g %)	15	1.22	1.34	1.27±0.05	3.73
M/P***	15	3.44	4.18	3.82±0.28	7.38
Station 2 - Isaccea, km 103					
Moisture, (g %)	15	59.25	68.57	63.38±3.49	5.50
Proteins, (g %)	15	15.12	17.79	16.96±1.07	6.30
Lipids, (g %)	15	12.78	21.94	17.62±3.48	19.72
Ash (g %)	15	1.04	1.25	1.11±0.09	7.95
M/P***	15	3.39	4.54	3.76±0.45	11.88
Station 3 - Chiscani, km 197					
Moisture, (g %)	15	62.15	64.61	63.17+1.08	1.71
Proteins, (g %)	15	16.95	18.29	17.41+0.59	3.41
Lipids, (g %)	15	16.14	19.05	17.65+1.17	6.65
Ash (g %)	15	1.10	1.35	1.26+0.09	7.50
M/P***	15	3.49	3.80	3.63+0.13	3.62

** standard deviation; ** coefficient of variability; ***moisture/protein*

The weight loss of shad during migration, caused by a decrease in the percentage of fat, leads to a slight increase in the water content in its meat.

The ratio between moisture content and protein, which evaluates the protein quality of meat, was decreasing during migration (P>0.05), not being influenced by the variation of fat content.

The specimens with the lowest weight in the sample analyzed have a low nutritional value, therefore catching specimens below the allowed size is not justified. Fishing must be carried out in accordance with the legal regulations in force. The quality of fish and fishery products must be guaranteed by adopting legal standards and regulations [11].

CONCLUSION

In conclusion, the results of the study indicate a dominance of females (53%). In terms of age, the predominant generation was 3 years (40%), followed by 4 years (36%).

The maintenance status for the studied samples was slightly decreasing during migration, motivated by weight loss. The value of the Fulton Index decreased with the migration to the Danube, through the loss of biomass due to the effort made for migration and reproduction.

During migration, the percentage of protein in Pontic shad meat increased slightly, and the fat content in the muscles decreased, due to the transformation of fat into energy.

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