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17. Preliminary Data on the Studies of *Alosa immaculate* in Romanian marine waters

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Abstract: Danube shad is a fish with high economic and socio-cultural value for the human communities established in the Danubian-Pontic space. In Romania, shad fishery has a market value of about 1.5 million euro, with average annual catches of 200-500 tonnes. Biological material was collected during research surveys organized along the Black Sea coast, in 2012-2013, in spring season (March, April), summer (June, July) and autumn (September). Experimental fishing was done with fishing gillnets. Demographic structure of *Alosa immaculata* consists of generations of 2-5 years, dominated by generations of 3 to 4 years. The aim of this paper is to provide recent data regarding *Alosa immaculata* population along the Black Sea Coast consideribg that its biology is less known.

Keywords: Danube shad, experimental fishing, *Alosa immaculata*, Black Sea.

INTRODUCTION

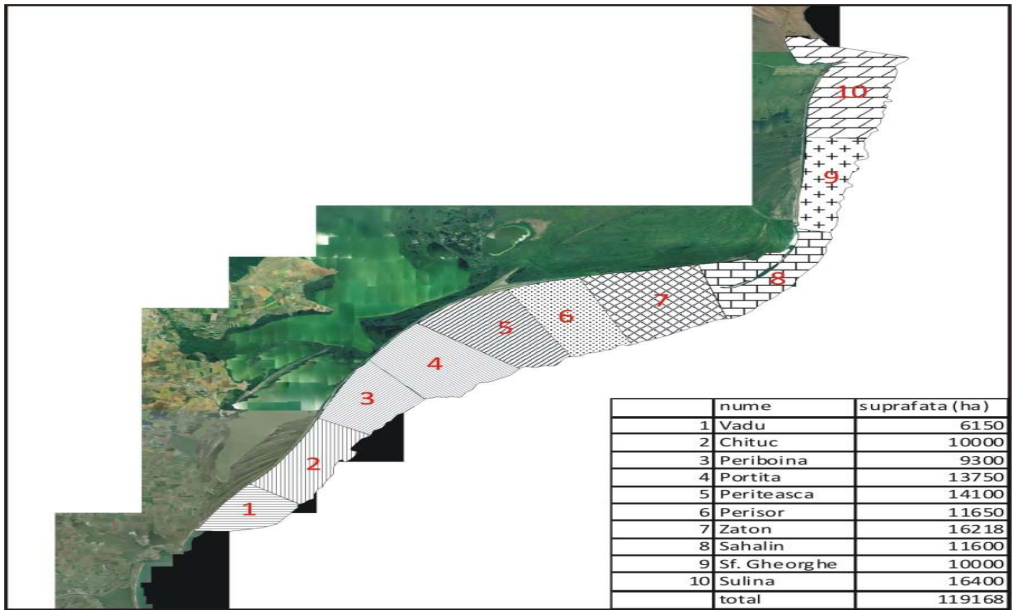
Genus *Alosa* is represented by several species, the most important being distributed in the Atlantic, Mediterranean, Black Sea and Caspian Sea. The best known are an American species, *Alosa sapidissima* (Wilson, 1811) and two European species, *Alosa alosa* (Linnaeus, 1758) and *Alosa fallax* (Lacepede, 1803), which are near the coasts of Scandinavia, southern England, Western Europe and the Mediterranean Basin. In our waters, Danube River and Black Sea, there are 3 other valuable species: *Alosa immaculata* (Bennett, 1835) - Pontic shad, *Alosa tanaica* (Grimm, 1901) – Azov shad, synonymous with subspecies *Alosa caspia nordmanni* (Antipa, 1906), *Alosa maeotica* (Grimm, 1901) - Black Sea shad (Năvodaru & Nastase, 2014).

Pontic shad is a fish with high economic and socio-cultural value for the human communities established in the Danubian-Pontic space. In Romania, shad fishery has a market value of about 1.5 million euro, with average annual catches of 370 tonnes in the last 25 years. But, since the interest for exploitation and marketing is high, also is maintaining the risk of decline of Pontic shad populations from Danube and Black sea. The main factors with negative impact on the shad stocks in the Black Sea and the Danube River are over-fishing, pollution and also, dam construction (Năvodaru, 1996). Therefore it is essential to know the aspects of eco-biology and exploitation conditions of the species, in order to ensure background information for the conservation and management of stocks.

The main goal of this research is to identify the current state of *Alosa immaculata* population along the Black Sea Coast. The paper presents the biological parameters, such as length and weight class structure, age, sex ratio and fattening degree of the *Alosa immaculata*, fish with high commercial value.

MATERIALS AND METHODS

Biological material was collected during research surveys organized along the Black Sea coast, in 2013, in spring season (March, April), summer (June, July) and autumn (September).
For fish sampling were chosen 10 areas that are representative for each type of habitat (**Fig. 1**).



	nume	suprafata (ha)
1	Vadu	6150
2	Chituc	10000
3	Periboina	9300
4	Portita	13750
5	Periteasca	14100
6	Perisor	11650
7	Zaton	16218
8	Sahalin	11600
9	Sf. Gheorghe	10000
10	Sulina	16400
	total	119168

Figure 1 Map and location of Pontic shad sampling in Romanian Black sea coast

Sampling activity was done with fishing gillnets, constructive characteristics of these tools were: length 75 meters (m), height 2.5-3.5 m, mesh size 30-36 millimetres (mm). Fixed gillnets used in fish sampling in marine waters, are gears that catch fish specimens, in tree way: wedged, gilled or tangled. This are highly productive during shad migration along sea coast towards Danube River.

Methodology and techniques that have been used for collection, verification, processing and analysis, as well as the assessment of fish stocks are generally accepted for the Black Sea and in accordance with international methodology (Zaharia, 2013). Research surveys during 2013, were carried out with research vessel "Steaua de Mare 1" belonging to the National Institute of Research and Development "Grigore Antipa", from which was launched the pneumatic boat to carry out a fish sampling with gillnets, in all ten areas taken in the study (**Photo 1; 2**).

Photo 1. Research vessel „*Steaua de Mare 1*”

Photo 2. Pneumatic boat „*Kingfisher*”

Survey of *Alosa immaculata* species consisted in an ichthyologic study of all samples from 2013. The fish were measured with a precision of ± 1 mm and weighed with a precision of ± 1 grams (g), in the study period 1010 specimens were examined. To determine age composition for the Pontic shad, scales were collected from 127 individuals, representing approximately 12% from the total sampled individuals, they were randomly selected in such a way to represent all age classes. Fattening status of Pontic shad was calculated by Fulton coefficient: F= Tw *100/Lst^3, in which F=coef. Fulton; Tw=total weight; Lst =standard length.

In the course of year 2013, at fish sampling for Pontic shad was done a total fishing effort of 36 days of fishing with an average Catch Per Unit Effort value (CPUE) of 0.157 kilograms/fishing hour/gillnet (**Table 1**).

Table 1 Fishing effort and CPUE resulted in experimental fishing in 2013

Year	Productive time (days)	Fishing effort/day (hours)	Effective time (hours/UP)	UP (number of boats)	Number of installations	Fishing effort/year (hours/gear)	Total catch (kg/year)	CPUE (kg/hour)
2013	36	12	432	1	36	432	271,60	0,157

RESULTS AND DISCUSSION

Catches were composed of shads with average size of 30.7 centimetres (cm) total length and 269 g total weight (**Table 2**) and maximal of 36.5 cm and 476 g.

Table 2 Size structure of *Alosa immaculata* in years 2013 (ind. = individuals)

			Total length (cm)		Total weight (g)	
	ind.	%	limits	average	limits	average
Samples for age determination (ind.)	127	12	25,2-31,2	28,2	163-442	248
TOTAL samples (ind.)	1010	100	17,5-36,5	30,7	62-476	269

Shads specimens sampled in the study were composed of 4 generations, respectively 2-5 years. Samples were dominated by generations of 3 to 4 years (**Fig.2**).

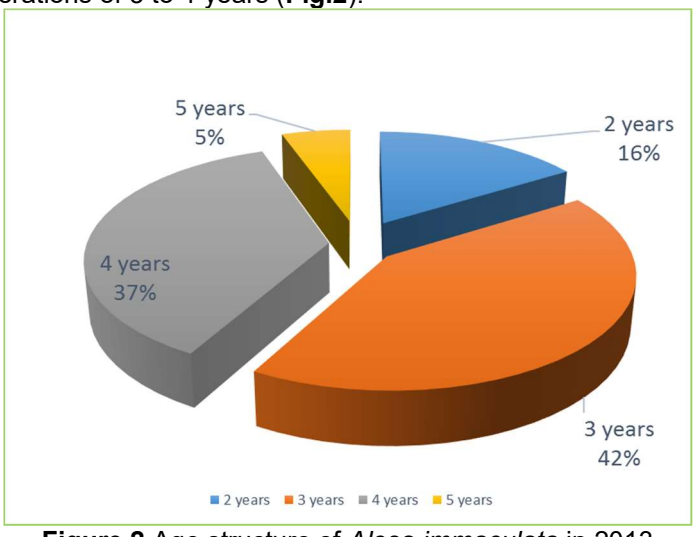


Figure 2 Age structure of *Alosa immaculata* in 2013

Sex ratio for 2013 was sub-unitary, expressing dominance of females (M/F = 0.62); within generations number of females increases with age, which means a higher survival of females after reproduction and decrease of males even after the first reproduction (**Fig. 3**).

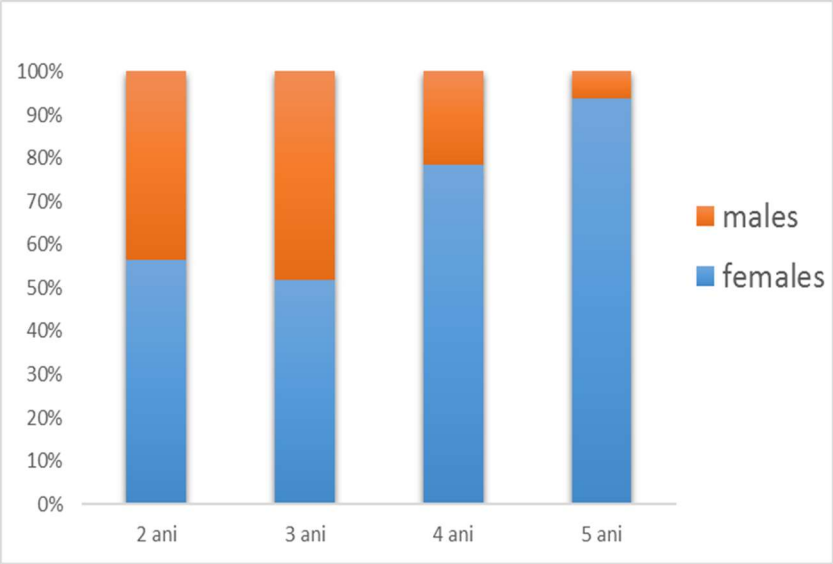


Figure 3 Sex ratio for *Alosa immaculata* - migrating in 2013

Shads sampled had an average degree of fattening, expressed as Fulton coefficient of 1.39, very close to the average of the years 1988 – 2004, which was of 1.38 (Năvodaru and Waldman, 2003). Fattening status of shads increases linearly with age for mean values of the Fulton coefficient (**Fig. 4**).

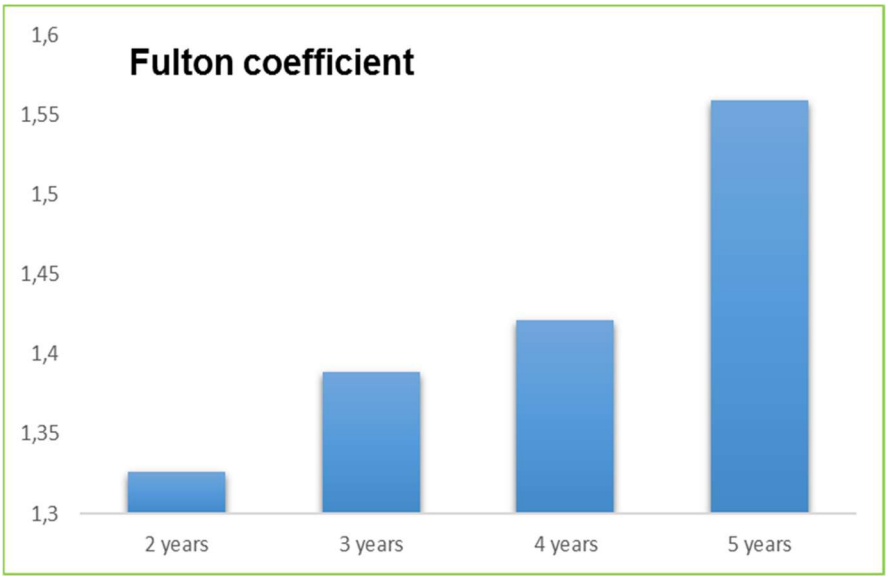


Figure 4 Fulton coefficient at *Alosa immaculata* in 2013

Spatial distribution is marked by the increasing of abundance number of shad catches from north – east, Periboina area till Danube River mouth, with highest abundance recorded in areas Zaton and Sakhalin perimeters (**Fig. 5**).

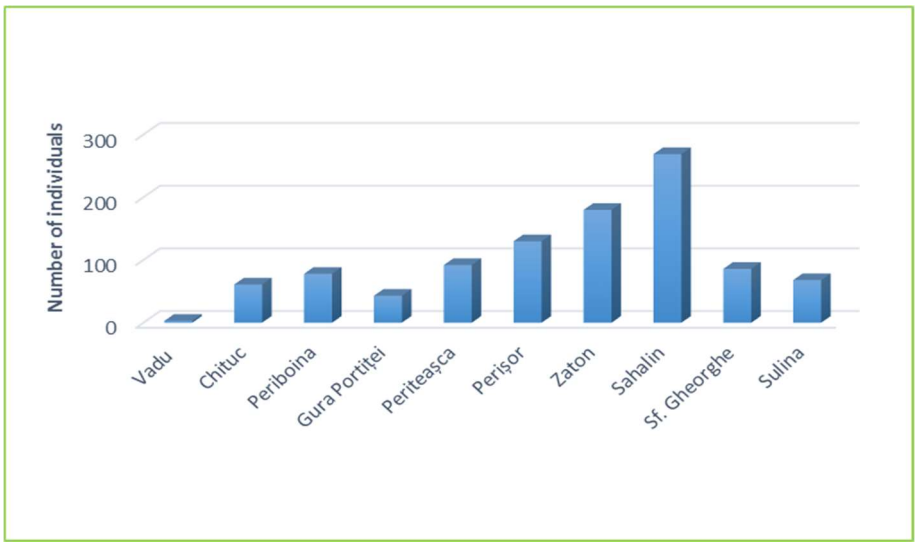


Figure 5 Spatial distribution of *Alosa immaculata* sampled in 2013

Shads specimens caught were grouped into 20 length classes ranging between 17.5 and 37.0 cm, with a class size of 1 cm, respectively 10 weight classes, ranging between 0 – 500 g.

The highest frequencies of catches were recorded in length classes between 30.0 - 34.0 cm, respectively body weight of 250 - 450 g. Average length of specimens was 30.7 cm and body weight was 269 g; values are related to age of 3 – 5 years (**Fig. 6, 7**).

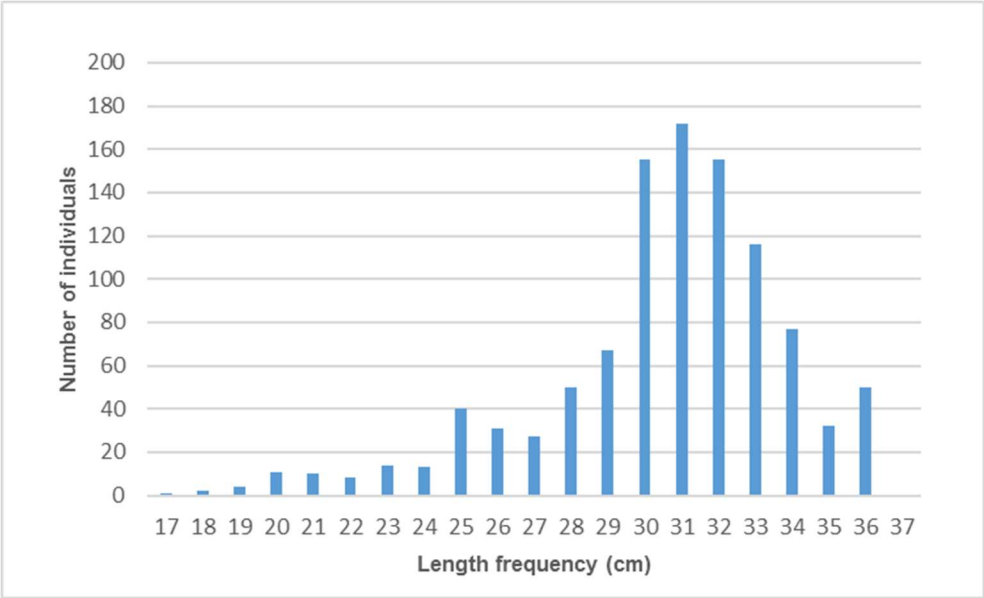


Figure 6 Lengths frequency of *Alosa immaculata* sampled in 2013

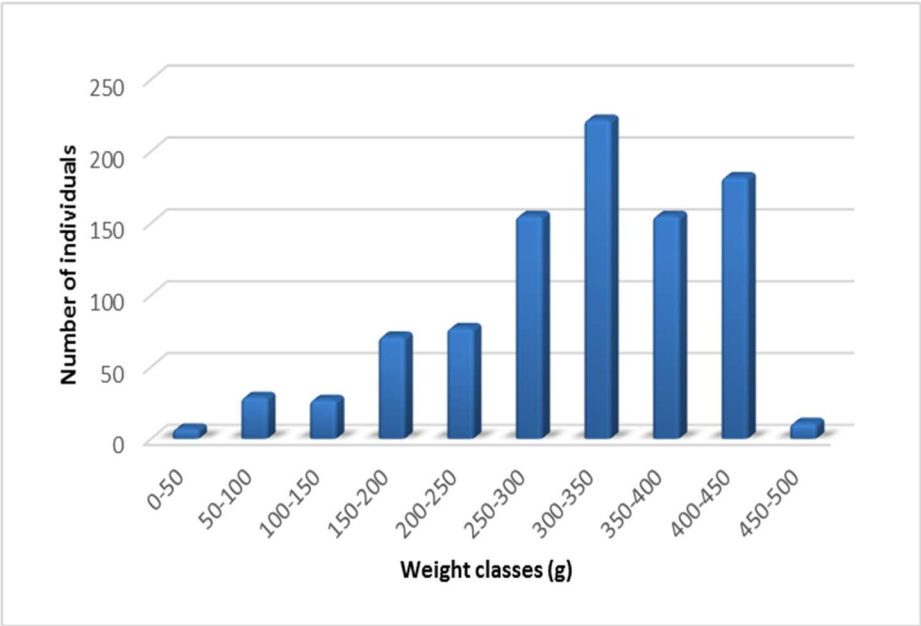


Figure 7 Weights frequency of *Alosa immaculata* sampled in 2013

Length and body weight parameters are used to analyse the fish growth according to total weight and total length.
Coefficient values *a, b* from the equation **W = a * TL^b,** were determined graphically for the shad population, using an exponential equation (**Figure 8**).

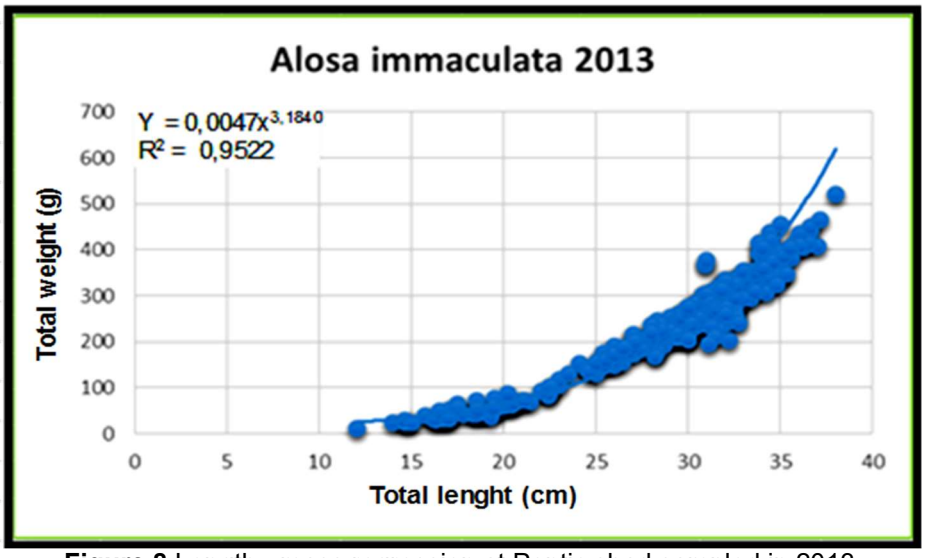


Figure 8 Length - mass regression at Pontic shad sampled in 2013

Values of index *b* expresses the growth character according to specialized literature, this are situated between 2 and 4 (Bagenal and Tesch, 1978; Weatherley, 1972), but often near 3 (Năvodaru, 1997); also this indicator is considered to be a measure of the living conditions that the environment provides to fish (Battes *et al*., 2003), being a generalization of Fulton coefficient (Pitcher, 1990; Moreau, 1979).

In the studied period, values of coefficient b are higher than 3 for Pontic shad, that means the body growth is realized more on body mass than the length, which implies the presence normal environmental factors for development and growth of the species. For the entire sample, the coefficient of determination (R^2)

resulted from regression is equal to 0,9522. Was obtained an average characteristic value of b = 3.1840, indicating and allometric growth for the sampled specimens, respectively a positive allometry (b > 3).

Value of coefficient b, on samples studied, is close to values reported other authors on this species, in the Black Sea: 3.124; 3.216; 3.067 (Kalayci, 2007), 3.285 (Savas, *et al*.,2011), 3.338 (Ozdaman, 1995), but higher than the values obtained in the Danube River: 2.,457 (Năvodaru, 1997), 2.487 (Ibănescu, *et al*.,2016), 2.731 (Rozdina, *et al*.,2013).

CONCLUSIONS

Demographic structure of *Alosa immaculata* consists of generations of 2-5 years, dominated by generations of 3 to 4 years.
Number of females increases with age, which indicates a higher survival of females after reproduction.
Environmental factors are in normal conditions for development and growth of the *Alosa immaculata* species.

ACKNOWLEDGEMENTS

The study was founded through the Sectorial Operational Programme Environment (POS Environment) founded by European Union structural found. Special thanks to Marian IANI, Lionte POPA, fishermen and vessel crew which contribute for fish sampling in the Black sea.

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Received 15 March 2017
Revised 29 March 2017