

STRUCTURE OF DANUBE SHAD (*Alosa pontica* Eichwald, 1838) SPAWNER FLOCKS MIGRATING FOR REPRODUCTION IN DANUBE RIVER (MIGRATION OF FISHES IN ROMANIAN DANUBE RIVER N^o 2)

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Abstract. The main purpose of this paper is to actualize last data on Danube shad (*Alosa pontica* Eichwald, 1838) migration process in Danube River. This species was widely studied last time in Danube River, but there are still some biological and ecological aspects to be revealed. Study of periodical changes in the total amount of capture and spawners structure could bring more and relevant information on presumed cyclic decrease and increase of stocks and also about the main causes of their interesting population dynamics. We try to examine some other aspects related to the spawning biology as well as to the biometry of different age-classes and also to link these issues to the last changes in environment conditions.

Keywords: *Danube shad, Migration, Captures, Stocks structure*

Introduction

Danube shad (*Alosa pontica* Eichwald, 1838) migration in Danube River is a yearly event quite impatiently expected by fishermen and biologists. First ones expect big captures of this species of fish which is highly appreciated by a certain number of customers regionally because it is a Christian custom of local people to eat Danube shad in the Lent. Second ones are trying to improve their database with new aspects regarding the interesting migration of this species.

The interest in this species is even more accentuated by its specific biology. Danube shad is a migratory species that is spread only in Black Sea and Low Danube River hydrologic basins. It could be considered as a species formed by only one population that use to live, eat and spend its winter season in the South-West part of Black Sea coming up into Danube just for spawning. This population is structured in one stock containing spawners of different ages and another one formed by the juveniles that migrate at a certain moment from Danube to feed and grow up in Black Sea.

From commercial aspects, Danube shad is a very important fish for fisheries in the Danube Delta, because in these places were registered some times 90% from the total amount of annual Danube shad capture on the whole Danube, and also for other upstream fisheries especially in the early spring season when other fish species are less available.

Materials and methods

We have a large amount of data for the study of Danube shad migration. We used samples collected from both experimental fishing campaign and commercial fishing on many different locations on Danube River.

Within experimental fishing period from 2000 to 2001 we used the same fishing technologies and similar fishing gears as commercial fishermen. We had been fishing on the same places during these years and we also collected samples from a few different locations known as preferred places for juveniles crowding. Fishing gears specialized for Danube shad were used: drift gillnets and appropriate boats operated by two fishermen.

We have collected biometric data from 1072 individuals randomly taken in different places on Danube starting from the Danube Delta to Bazias Town. The main biological parameters registered for each individual were: total length, standard length, individual mass, age and sex.

For age estimation 4 to 6 scales situated on the first half of the upper part of fish body have been collected and annual growing ring marks on the degreased scales were read in a laboratory. The sex of each individual has been established through dissection, where the gonads were sought.

We used also new and older statistic data regarding capture's level, data on water levels variability and water temperature dynamics in order to find any new relation between the intensity of migration and the fluctuation of main physical environment.

There have been considered also some information on ecological issues related to the local behavior of Danube shad such as best reproduction spots and preferred places of the offspring to crowd.

Results

Statistic data show that for a longer period of time the level of Danube shad captures could be very different in Romanian Danube River. If we look at the capture data taken in Danube Delta area (Sector No 1) and also captures upstream (Sector No 2) from 1991 to 2001, the total amount of yearly capture in Danube River had a very wide range. There

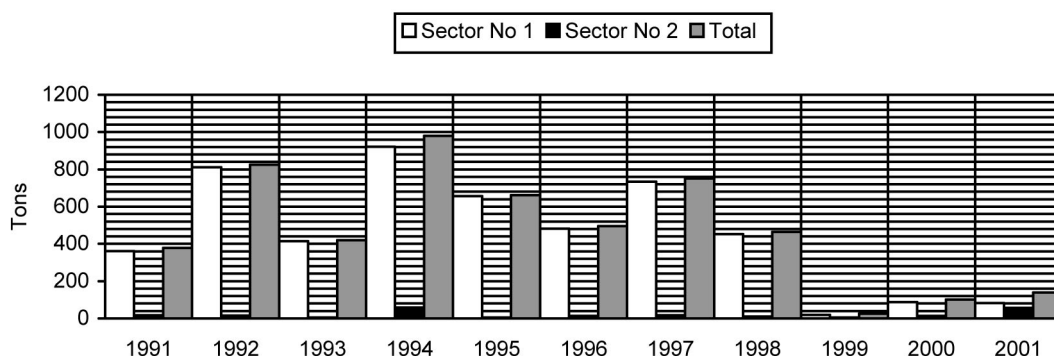


Figure 1. Danube shad capture dynamic in Romanian side on Danube River from 1999 to 2001.

is a maximum of 980 tons in 1994 and a minimum of only 24.6 tons in 1999 (Fig.1) We have to underline that even if there had been changes in fishing effort and even if some unfortunate errors happened or incomplete data registered, these factors could not bring a reasonable explanation of such a huge difference between the levels of annual amount of capture.

We do not consider the 1999 amount of capture in official statistics as real or credible because its unusual low value. It is easy to observe the big difference between annual data: from more than 980 tons in 1994 to less than a half of this amount (379 tons) in 1991. However in the next two years the capture dropped to about its third, if we compare the average yearly capture until 1999 with the values from 2000 and 2001.

In 2000 Danube shad started to migrate in March when water levels were increasing and water temperature stabilized at about 6°C, the maximum of migration intensity took place in April, and the migration ended in July.

The main capture of about 86% of total has been registered in Danube Delta area - especially on Saint George Branch.

Study of experimental fishing capture shows spawners belonging to 6 classes of age (Tab. 2), quantitatively dominated by those of 3 and 4 years old that represented together 83.5% of total annual amount of capture.

Table 1. *Danube shad percentage of sexes and classes of age estimated within 2000 and 2001 fishing campaigns (NA: not available).*

Year	Danube shad	Number of Fish	%	Class of age percentage (%)					
				2 years	3 years	4 years	5 years	6 years	7 years
2001	Males	402	53.5	87.8	4.2	34.0	29.8	18.8	14.5
	Females	350	46.5	12.2	45.8	66.0	70.2	81.2	85.5
	Total	752	100	5.2	50.2	33.3	5.0	3.2	1.2
2000	Males	148	46.25	72.2	51.2	18.4	11.2	5.3	NA
	Females	172	53.75	27.9	48.8	71.6	88.8	94.7	NA
	Total	320	100	21.5	41.2	30.3	4.1	2.9	NA

Males/females sex ratio (M/F) calculated on 752 individuals of about 1.15 is considered to be a normal one because the M/F of this species is usually around 1.0.

Average mass and length values (Tab. 3) show a normal condition of spawners in each class of age and a particularly good growing up and development of the younger, 2 years old individuals that explained a higher presence in the 2001 capture than usual.

Because of the relative high water temperature of 5°C to 7°C in February 2001, Danube shad migration started earlier than 2000 and lasted until the end of July with a peak of migration intensity in the second decade of April when the daily average water temperature was between 10-12°C.

Table 3. Biometric data of Danube shad spawners (TL: total length, ST: standard length, W: weight).

Age (Years)	Number of Fish	Biometric Data	Minimum Value	Maximum Value	Average Value
2	39	TL (cm)	20,4	31,6	27,2
		SL (cm)	19,2	17,4	23,0
		W (g)	98	238	175
3	378	TL (cm)	20,5	36,5	28,2
		SL (cm)	19,5	31,1	24,0
		W (g)	101	381	201
4	264	TL (cm)	23,4	37,4	30,1
		SL (cm)	19,9	32,1	25,6
		W (g)	124	418	236
5	38	TL (cm)	25,9	36,6	32,8
		SL (cm)	22,1	31,1	28,2
		W (g)	184	389	288
6	24	TL (cm)	33,4	38,5	35,2
		SL (cm)	26,0	32,8	30,1
		W (g)	268	434	348
7	9	TL (cm)	37,8	38,0	37,9
		SL (cm)	32,4	32,9	32,6
		W (g)	438	475	456

Similar to 2000, individuals of 3 and 4 years old are the most frequent representatives having together a percentage of 71.4%. We have noticed a bigger number of 2 years old spawners (21.5%) also in 2001, dominated by younger males as much as 72.1%. This time we did not find any individual of 7 years old. The possible reason for that could be the smaller number of individuals investigated and the reduced percentage of this class of age in total amount of capture (about 1%).

In 2001, sex ratio decreased under the value measured in 2000, showing a relative dominance of females. Calculated M/F for a number of 320 individuals was 0.86.

Discussion

Even there is not any reasonable explanation on this topic, some biologists [5] believe there is cyclic dynamism of Danube shad migration that includes a maximum every 10-11 years. This idea is based on the statistic analysis of yearly capture starting in 1920 [1], data which could not be considered very accurate for a certain period of time. This supposition considers year 1994 when the total amount of capture was more than 980 tons as the peak of the last cycle as well as 1999 being the year with the minimum value of this supposed cycle.

Probably there is another cycle: the intensity of migration changes every 3 to 4 years

[4]. The explanation of this fact could be the age structure of Danube shad flocks in which spawners of 2 (not so often) 3 and 4 years old are predominating as of more than 85%. That means a successful migration and reproduction, which will result in a large amount of offspring [2] and will form the core of flocks coming up for reproduction next time. In the capture dynamism it is easy to see that there is a peak of migration intensity every 2-3 years.

However, the graph of yearly captures (Fig. 1) shows an evidently decreasing tendency meaning a dramatic drop of the number of spawners migrating for reproduction and we do not have any reasons to suppose in a couple of years this situation will become better.

Causes of decline of migration could be multiple [6], including changes in evolution of seasonal temperature, hydrologic regime of Danube River, habitat and water quality degradation, all of them potentially affecting spawners status and offspring survival. Yet, the most important is the increasing fishing effort on almost all species of fish in Danube River and particularly on Danube shad.

Biometric data bring up some interesting information related to the average sex ratio and its distribution in the classes of age. Estimated M/F ratio as of 1.15 in 2000 and of 0.86 in 2001 are considered normal, their average value of about 1.0 being very close to the $M/F = 1.1$ ratio calculated within a wider period of time [3].

It is also very interesting to notice the very different values of M/F ratio for younger and older spawners. In the class of 2 years old individuals this value has an average of almost 2.6, for the individuals of 6 and 7 years old to be clearly represented almost just by females ($M/F=0.1-0.18$).

Conclusions

The recent dramatic fall in the number of Danube shad migrating for reproduction in Danube River is a real issue that evidently should concern interested persons and involved institutions, companies and organizations from both commercial and ecological point of view.

Last data on the quite low annual amount of capture does not bring up any hope concerning eventually further positive changes on Danube shad migration intensity, until environmental conditions will be more favorable.

Even if we consider the unfortunate changes of some ecological aspects related to the environmental factors such as lower water level, water temperature and pollution that could actually affect the success of the Danube shad reproduction, the most important cause of the decreasing of the stocks is the overfishing mainly in Danube Delta area, which provides about 90% of total amount of capture in Danube River.

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