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EVOLUTION OF FISH PRODUCTION ACHIEVED FROM COMMERCIAL FISHING IN THE DANUBE RIVER IN THE PERIOD 2015-2021

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Abstract

The paper presents the evolution of fish production from commercial fishing in the Danube River during 2015-2021 and is based on the analysis of statistical data collected by the National Agency for Fisheries and Aquaculture as part of the data collection program. Production data were collected annually by authorized commercial fishermen, quantitatively and by species. During the analysed period, there is a quantitative decrease in the production of wild carp and raptors, and significant increases in catches of Asian carp species. Catches of Danube record annual fluctuations with decreasing trends in the analysed period. At the end, the causes of the catches decrease of commercial fishing are analysed and the fisheries management measures that must be taken, based on ecosystem principles, to protect and restore the declining fish populations in the Danube River.

Key words*: biodiversity conservation, catches, fisheries management, sustainability.*

INTRODUCTION

According to Fish Base, 119 species of fish livein the Danube. As endemic species we mention the brook lamprey (*Eudontomyzonvladykovi,* Oliva & Zanandrea, 1959) and the European mudminnow (*Umbra krameri,* Walbaum, 1792). An emblematic specie in the Danube are the sturgeons, most of them almost extinct, excepting the sterlet (*Acipenser ruthenus*, Linnaeus, 1758). Also, sturgeon population depend, mostly, on repopulations.

Among the newly introduced speciescan be mentioned: the grasscarp, cosas (*Ctenopharyngodon idella*, Valenciennes 1848), silver carp, sanger (*Hypophthalmichythys molitrix,* Valenciennes, 1848) end big had carp, novac (*Aristichtys nobilis*, Richardson,1844).

The Danube supports both commercial and recreational fishing, depending on the country. In Germany, Austria and Slovakia an important role in the fishing catches is played by the recreational fishing. In contrast, Hungary, Romania, Bulgaria, Serbia and Ukraine, commercial fishing is more important, even though in this countries, large flood plains support both commercial and recreational fisheries (Schiemer et al., 2004). The largest fisheries in the Danube River area are in Serbia and Romania, but the construction of the Iron Gates Dams determined the decrease in the quotas of this type of fishing.

There are about 40 species are important for commercial and recreational fishing, among which we mention: the bream (*Abramis brama*), the pike-perch *(Sander lucioperca*), the barbel (*Barbus barbus*), the sterlet (*Acipenser ruthenus*), the crusian carp (*Carassius auratus gibelio*), the carp (*Cyprinus carpio*), the pike (*Esox lucius*), the asp (*Aspius aspius aspius*) and the tench (*Tinca tinca*) (Schiemer et al., 2004; Smederevac-Lalić et al., 2012). In Serbia and Hungary, 40% to 70% of commercial catches consist of bream, barbel and carp, while in Germany the recreational catches consist of whitefish (*Coregonus* spp.), perch, northern pike, and common carp (Smederevac-Lalić et al., 2012).

Since the 1970s, sturgeon fishing has decresed drastically, and the quality of catches has shown a continuous decline due to the poor connectivity between the river and its

floodplain and the blockade of the migration corridors (Schiemer et al., 2004).
A major importance for commercial fishing is hold by the Pontic shad (*Alosa pontica*), in Romania, being reported (according to ANPA statistical data) between 200-600 tons, annually.
The most complex and complete evaluation of the value of all the fishery components, from the point of view of stock diversity and quality and of the bioresources regeneration rate, is based on scientifically well-founded data. This represents the basis of an efficient and responsible management.
Depending on this, in fisheries management can take relevant decisions only through a good cooperation with all responsible factors; thus, the exploitation methods will be improved, the overexploitation risk will be reduced, the measures of protection and conservation of biodiversity will be observed, and a sustainable exploitation of all resources will be ensured (Călin et al., 2013, Maximov, 2006).
The purpose of the present work is to analyze the data of the reported catches but also of the data of the Total Allowable Catch (TAC), as well as the share of species of interest for commercial fishing in the Danube River.

MATERIALS AND METHODS

Fish data

The analysis of thefishcatches' dynamicsin 2015-2021 was made usingtheofficialrecords of the National Agency for Fisheriesand Aquaculture. It has also been compared to the annual ordersissued establishing the quotas and fishing effort (Common Order no. 368/391/2015, Common Order no. 284/613/2016, Common Order no. 13/142/2017, Common Order no. 546/352/2018, Comon Order no. 243/354/2019, Common Order no. 124/1159/2020, Common Order no. 99/814/2021).
Data processing was carried out using Microsoft Excel for Windows.

Study area

The studied fishing area includes the Romanian sector of the Danube from the entrance in the country at Baziaș to the border with the Danube Delta Biosphere Reserve. The Romanian sector of the Danube unfolds from Baziaș to the Black Sea is 1075 km long, representing 78% of the Danube (Figure 1).

Figure 1. Danube river in Romania - study area

The ecological structure of the Danube is determined by two major factors, conditioning the composition of the aquatic biocenosis: bottom of theriver, stony or silty, and the speed of the river current.
Based of the previous elements, for the Danube River were identified and established the following exploitation sectors:

Sector 1 - lenght 14 km - *Delimitation*: Mm 76 (Cotu Pisicii - up stream the RBDD limit) - km 155 (confluence with Siret river);
Sector 2 - lenght 75 km - *Delimitation*: km 155 (confluence with Siret river) - km 227 (Călmățui river), including The Valciu Branch;
Sector 3 - length 98 km - *Delimitation:* km 0 - km 98 Macin Branch (Vadu Oii);

Sector 4 - length 128 km - *Delimitation:* km 248 (Vadu Oii) - km 366 (lower from the Chiciu - Island);
Sector 5 - length 71 km - *Delimitation*: km 227 (Gura Călmăţui) - km 50 Borcea Branch;
Sector 6 - length 137 km -*Delimitation:* km 50 Borcea Branch - km 452 (Greaca);
Sector 7 - length 74 km - *Delimitation*: km 452 (Greaca) - km 526 (Vedea river);
Sector 8 - lenght 89 km - *Delimitation:* km 526 (Vedea river) - km 615 (Gârcov);
Sector 9 - lenght 50 km - *Delimitation:* km 615 (Gârcov) - km 665;
Sector 10 - length 152 km - *Delimitation:* km 665 - km 817 (upstream of the Citadel);
Sector 11 - lenght 46 km - *Delimitation:* km 817 (upstream of the Citadel) - km 863 (lower from the Iron Gates II Dam), including Gogoşu Branch;
Sector 12 - length 80 km - *Delimitation:* km 863 (Iron Gates II Dam) - km 943 (Iron Gates I Dam);
Sector 13 - lenght 69 km - *Delimitation:* km 943 (Iron Gates I Dam) - km 1012 (Cozla);
Sector 14 - lenght 63 km - *Delimitation:* km 1012 (Cozla) - km 1075 (Baziaş).

RESULTS AND DISCUSSIONS

The total annual catches (in tonnes) for most important fish species (cyprinids, clupeids, predatory fish, others species) from reported by commercial fishermen to the National Agency for Fisheries and Aquaculture in the period 2015-2021 are shown in Table 1. Also, in the table are shown the catch quotas which have been established by annual orders (TACs) and the fishing effort quantified by number of boats.
Also, in the table are shown the reported catch (tons), the catch quotas which have been established by annual orders (TACs) and the fishing effort quantified by number of boats.
The data in Table 1 indicate an increasing trend from year to year in both the fishing effort, the TAC, and the reported catches. But the reported catch quantities do not even reach 50% of the annual TAC.
Total allowable catches covered by annual orders varied between 764,80 tons in 2015 and 1122,50 tons in 2021, which indicates an allocated fishing quota/boat that varies between 1.18 tons/boat in 2015 and 1.37 tons/ boat in 2021.

Tabel 1. Evolution of reported catch and annual TACs values during 2015-2021

Year	The reported catch (t)	The quotas from annual TAC's	Fishing effort (Number of boats)
2015	179.28	764.80	646
2016	249.50	1086.50	696
2017	242.54	1087.50	696
2018	318.45	1087.50	696
2019	429.97	1084.60	800
2020	350.01	1105.80	810
2021	528.72	1122.50	814

The fishing effort (in number of boats) does not have large variations between 2015 and 2021, with a minimum of 646 boats (in 2015) and a maximum of 814 boats (in 2021).
The species structure in the Danube River (Figure 2) of the reported catches is dominated by cyprinids (carp, silver carp, grass carp, bighead carp, crucian carp, fresh water bream, barbel, etc.) 68%, then predatory fish (European catfish, pikeperch, pike) 20%, Pontic shad (8%), another species with low economic value (roach etc.). This structure of the reported catches was similar with Ibănescu, 2019, 2020, which analyzes the structure of fish species that are the object of commercial fishing in inland waters in Romania.

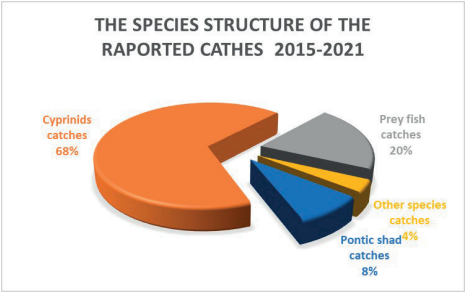

Figure 2. The species structure of the reported catches (2015-2021)

According to the Ibănescu (2020), the species structure of the catches only partially reflects the composition of the Danube rivers ichthyofauna because the type of gear conditions the report between the different species of fish caught.

If we analysed the evolution of cyprinid catches in the Danube (Figure 3), we can see that the maximum value reported was recorded in 2021 - 371.36 tons and the minimum value reported was 114.54 tons in 2015. It can also be observed that only in 2021 the value of the reported catch fishing.

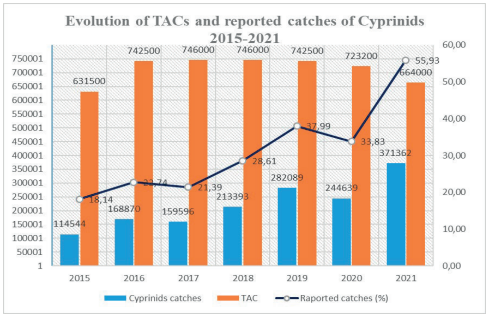

Figure 3. Evolution of TACs and reported quantities of Cyprinids (2015-2021)

The analysis of the evolution of predatory fish species in the Danube (Figure 4) indicates a maximum value of reported catches of 93.17 tons recorded in 2021 and a minimum value of 47.91 tons in 2015.

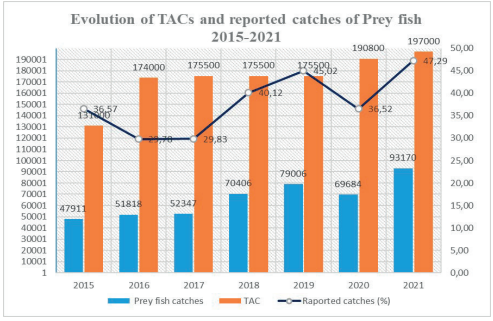

Figure 4. Evolution of TACs and reported quantities of predatory fish (2015-2021)

Radu (2012) and Chioveanu (2019) observed that in years or seasons with higher water levels and flow, peaceful species are advantaged, with more chances to escape the attack of predators, and years or seasons with low water levels favoring predatory fish species. According to the data reported by fishermen, it can be considered that the ratio between peaceful and predatory fish species indicates an ecosystem balance of the Danube River during the analyzed period.

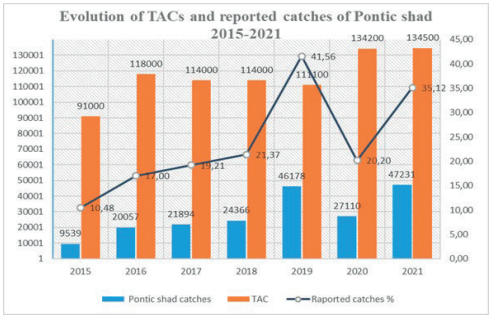

Figure 5. Evolution of TACs and reported quantities of Pontic shad (2015-2021)

Regarding the Pontic shad it can be said that despite the seasonality of fishing in the Danube (during the migration period), considerable quantities are reported, so the maximum value reported was 47.23 tons in 2021 and the minimum is 9.53 tons in 2015 according to Figure 5.

Other fish species with low economic value (roach, small silver bream etc) appear in accidental catches, but nevertheless their values varied between 7.28 tons in 2015 and 16,9 tons in 2021 (Figure 6).

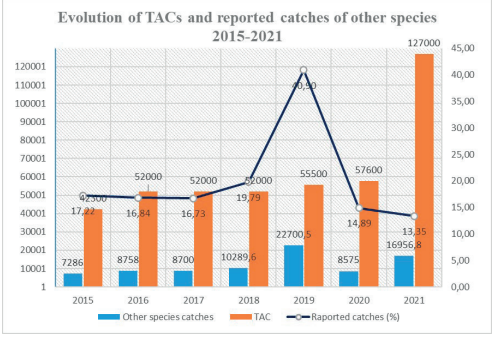

Figure 6. Evolution of TACs and reported quantities of other species (2015-2021)

Not even in the case of these species of fish with low economic value, the value of the total allowable catch is not even reached at 50%.

CONCLUSIONS

The species structure in the Danube River of the reported catches is dominated by cyprinids (grass carp, silver carp, bighead carp, common carp, crucian carp, fresh water bream, vimba bream, common barbel) 68%, then predatory fish (European catfish, pikeperch, pike) 20%,

Pontic shad (8%), and other species with low economic value (roach, small silver bream etc). Between 2015 and 2021, the total quantity of fish allocated by annual TACs was 7.470,20 tonnes and that reported by fishermen to the National Agency for Fisheries and Aquaculture was 2.298,47 tonnes.

Due to the fact that each year there are significant differences between allocated and reported quotas, it indicates that there are under reported in the case of all analyzed fish species. Catches reported in the period 2015-2021 represent on average 31% of the total allowable catch, which leads us to believe that fishermen reported only a small percentage of the actual catch.

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