26. Study of inland fisheries from Danube Delta - Romania

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ABSTRACT. The average commercial fish catch decreased from about 12000 tons (1967 year), in Danube Delta lakes to around 3000 tons in the last years. In this period piscivorous species like pike, wels catfish, european perch declined and the non-piscivorous species like gibel carp, bream, roach and white bream became dominant. According with the last years state of the fish stocks its estimated that in Danube Delta lakes a sustainable yield of about 6000 tons could be fished. The administration of the stocks on the durable principles and implementation of the correct strategy it decisively depends on the quality data concerning the catch size. The lack or unreliable records led to the underestimation or overestimation of some parameters with negative results about the current state and the exploitation of the stocks. The essential error source in stock estimation of lake Complexes is represented by the unrecorded catches of the legal family subsistence quota, black markets and poaching. The real data is very important for accurate assessment of the fish stock. Improvement of the quality of the catch statistics and monitoring of fishing effort are required for sustainable management of Danube delta fisheries.

KEY WORDS: inland fisheries, complex lakes, catch, Danube delta, fish stock, sustainable yield

INTRODUCTION

Removing of the wide surface from flooding Danube River, as well as practising of an intensive commercial fishing, lead to continually decrease of the fish's catches and to changes in the fish stocks structure, from this natural basin of the Danube Delta. The Danube Delta is one of the largest wetlands in Europe, situated in S-E Romania and N-W of the Black Sea, between North latitude $44^0$30' and $45^0$30' and East longitude $28^0$40' and $29^0$50'. The Romanian Government Law declared this territory the Danube Delta Biosphere Reserve (DDBR) in 1990, and in 1993 this status was recognised through a special law. The main objectives of this Reserve are biodiversity conservation and sustainable use of the natural resources. According to the DDBR objectives, sustainable use of fish stocks has to be implemented in its territory.

In 1960-1970 period, the average catches of the Danube delta lakes, were 8600 t (maximum in 1967 year – over 12.000 t) in which the dominant species were: *Rutilus rutilus* (34 %), *Esox lucius* (18 %), *Silurus glanis* (10 %), *Carassius carassius* (7,3%). In 1990-2004 period, the average catches has decreased for approximately 2,7 times (3146 to) with a dominance of the *Carassius gibelio* (41,5%), *Abramis* and *Blicca* (29,6%), *Rutilus* (14,5 %) and *Sander* (4,4 %) (Fig.1 and Fig.2).

The piscivorous species represented over 40% of the total catch in 1960 -1970 period but in 1990-2004 it reached around 7% average value. The sedentary species become dominant in the captures from the Danube delta lakes [9].

The ensemble of the negative factors of the deltas ichtyofauna, require elaboration a long time fishing strategy, to improve this catches composition qualitative and quantitative, establishing the minimum recruitment age without affect in time the exploitation of the stock fish. Fish stock assessment is required by the necessity of optimisation of the fishing activity for establishing of a optimum fishing level which to assure a maximum sustainable yield.

MATERIAL and METHODS

The Danube Delta Biosphere Reserve includes about 200 000 ha inland water areas, which produce an important fish resource. The implementation of sustainable use strategy as a part of fisheries management

means the knowledge of the population status and simulation of intermediate and long-term effects by improving of fish parameters. Due to the large diversity of ecological factors as well as in the fishing areas, the fish stock monitoring needs much work, requiring a software package. Using the existing knowledge in the world in this field, a research team from Danube Delta institute carried out his own "Fish Stock Assessment" (ESP) software package as a tool for sample processing in order to determine the growth parameters, gear selectivity, total mortality, stock size, biomass size, fishing features. This program has 8 mainly parts, using types of extension files: .LGR; .LGG; .PLG, some of them for analysis of various variants concerning mesh size or fishing effort improving [21] (Fig.3).

The main objective of fish stock assessment of exploited stocks is to predict what will happen in terms of future yields, biomass levels (sustainability) and value of the catch, if the level of fishing effort remains the same or if it is changed in one way or another. For elaboration the mathematical theory concerning on the fish stock assessment a considerable contribution had the studies effectuated by [1, 13, 15, 16, 17, 20].

Fishing strategy, based on the evaluation of the sustainable yield is applied in Hungary [2], Poland [3], Greece [10], France [12], Holland [14], and Russia [18].

For the assessment of the fish stock from Danube delta lakes, used analytical and holistic models. The analytical models, are "age-structured models" working with population's parameters. This approach assumes to know the length-frequency/specie. The processing and analysing of the collected samples made after FAO related publications [15, 19, 20]. Holistically models - Estimation of maximum sustainable yield using surplus production models - the Schaefer model. This is a global model applied about the multispecies fisheries, being recommended for the management of the inland waters [11]. It is based on the correlation between catch/effort (Y/f) and the fishing effort (f), from a time series data:
$Y/f = a + b \cdot f$; (if $f < - a / b$)
where: a, b - coefficients of the regression analysis;
Maximum Sustainable Yield: $MSY = - a^2 / 4b$
Fishing optimum effort for MSY: $f = -a /2b$

The primary data concerning fishing effort was collected from fisheries collection point.

RESULTS AND DISCUSSION

Danube Delta National Institute for Research and Development assess every year fisheries state, fish stock level and fundamenting fisheries regulations through the research programme financed by government and advised by Romanian Academy. For estimating of fish stocks state, every year since 1991 were sampled dominant species as giebel carp, bream, roach, pike and pike perch from the lakes of Danube delta. Average of a samples was around 1000 ex./specie/fishing area. In Razim-Sinoe Lake the samples were take only form seine net, and for the others lake from Danube delta sampling was made for active and passive nets. The growth and exploitation parameters (($L\infty$, K, to, F, M, Lc) was estimated based on the commercial samples using fish stock assessment methods.

As a result of the different characteristics of the seine net used in the lakes, the Lc from Razim-Sinoie lake is bigger than in the others lakes [4, 5].

In the optimum exploitation strategy, Lc is used for to establish the current exploitation point in the Beverton-Holt model and the selection factor is used for optimisation the mesh size of the fishing net.

Since 1984, the fisheries resources group from DDNI – Tulcea, has done research for fish stock assessment, using methods elaborated by FAO. It was estimated the growth and exploitation fish parameters, the average biomass and the sustainable yield in the Razim-Sinoie Lake, spreading it then in all lakes from Danube Delta. Fishing strategy, based on the evaluation of the sustainable yield is applied in Hungary, Poland, Greece, Holland, France [20]. The research and monitoring works on the fisheries from DDBR consisted in observations and sample taken from the commercial captures, in order to elaborate the following regulation:

Features and type of the nets. Analising the current exploitation state of the existing stocks from 1991-1993 period, it was found out that optimisation of the fishing intensity isn't a realisable measure on short term and nor economical efficient. Because the exploitation of the fish populations was earlier and monitoring of the fishing effort was lacking. So, in Danube delta lakes there were established the changes of the Lc increasing the mesh size of the seine net from a=26-28 mm to a=32mm (exception for gil nets where was recommended the minim mesh size a=40 mm). For Razim-Sinoie Lakes the mesh size of the seine net increased from a=40 to a=50 mm). These regulations were implemented starting with 1994.

Minimum allowable length for fishing. Since 1993 it has been proposed to add on the legal lenght list: for pike-40 cm (standard length), perch – 12 cm, asp – 30 cm, wels – 50 cm. These regulations were implemented starting with 1994.

Protection of the endangered species. Every year, there are doing proposals concerning protection of some species through fishing ban; so, in 1993, there were proposed for prohibition the following species: *Leuciscus idus, Vimba vimba, Tinca tinca*; regulation started in 1994. Since 1999, *Tinca tinca* has allowed again to be fished, due to partially rehabilitation of stocks.

Saving areas. Based on the research results, it was proposed and implemented saving areas on the old branch of Danube River, in order to protect the spawners of valuable species (wels, carp, pike-perch).

Prohibition on the overlapping sectors for the migratories species till spawning areas

Proposals for special, national, and international regulation for sturgeon protection.

Restocking. It was recommended yearly stocking of Razim-Sinoie Lakes, with 2000-3000 pike-perch embryon egg nests, and the Danube River branch with sturgeons fingerlings.

Fishing effort regulation. Beginning with 1994 it was settled the maximum admissible fishing effort in the Razim-Sinoie Lakes, and Rosu-Puiu Lakes, based on catch series data and the used fishing effort [6,7].

Fishing quota. Since 1991, it was established yearly fishing quota per zone and species, used by the DDBR Authority for fisheries resources management and nowadays for authorisation of this activity in the territory.

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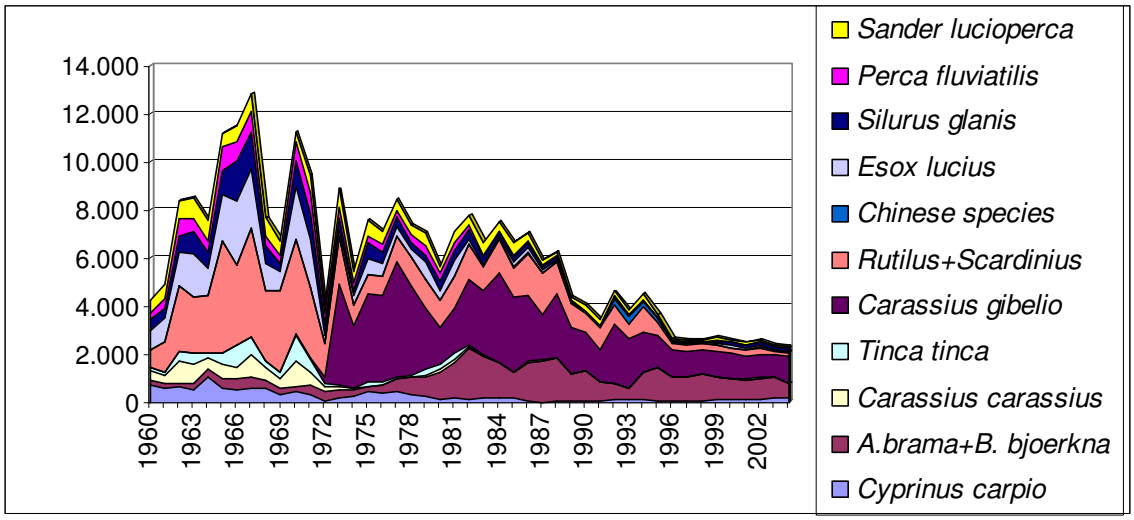

Fig. 1. Evolution of freshwater fish catches from Danube delta lakes

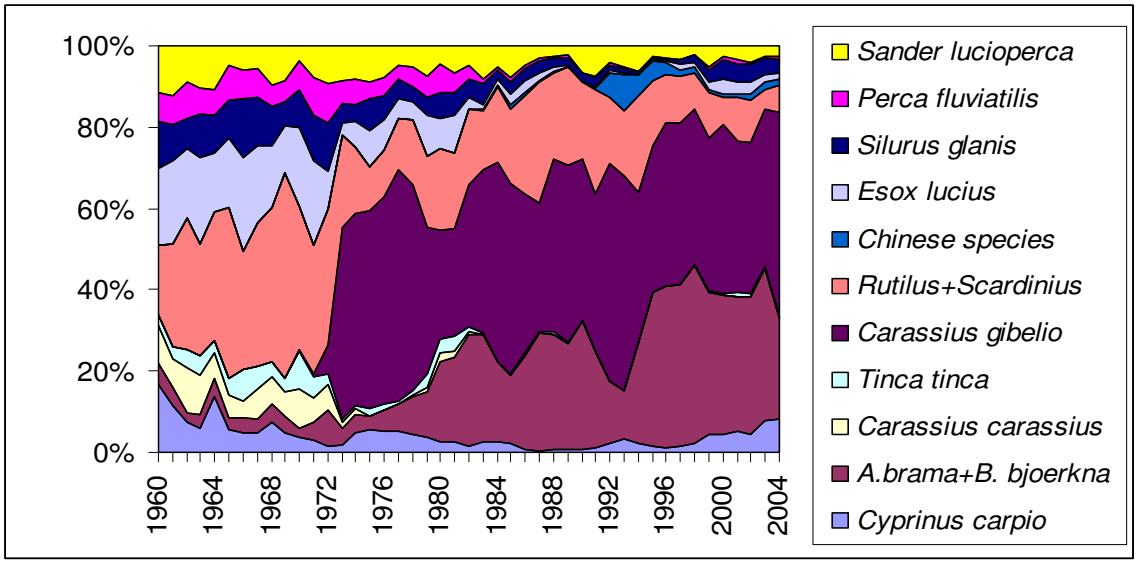

Fig. 2. Commercial freshwater species structure (%) in Danube Delta lakes

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