

ACTION PLAN
ON CONSERVATION OF STURGEONS
IN THE BULGARIAN AQUATORIES
OF THE DANUBE RIVER AND THE BLACK SEA

(SUMMARY)

Contract No. 2963-6884/19.11.2001
for realization of a small public commission financed by the Ministry of the Environment
and Water (MoEW)

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INTRODUCTION

The sturgeons are a group of vary ancient fishes, often described as “living fossils”. The fishes belonging to the order *Acipenseriformes* include approximately 25 species divided into two families *Polyodontidae* and *Acipenseridae*. All sturgeon fishes inhabit the Northern hemisphere, being freshwater and migrating. Since 1 April 1998 all the species from the families *Polyodontidae* and *Acipenseridae* are on the list of species under the Convention of International trade with endangered species of the wild flora and fauna (CITES Appendix II /Notification to the Parties No. 1998/13 *Conservation of Sturgeons*).

This necessitated the MoEW financing for the contract № 2963-6884/19.11.2001 “Action plan on conservation of sturgeons in the Bulgarian aquatories of the Danube River and the Black sea”.

“Action plan on conservation of sturgeons in the Bulgarian aquatories of the Danube River and the Black sea” is developed by institutes of the Bulgarian Academy of Sciences (Institute of Biology, Institute of Molecular Biology) and by the Biology faculty of the University of Sofia together with the Institute of fisheries and aquacultures in the town of Varna. It results from terrain studies and laboratory research work of the team; information gathered from local fishermen in meetings and RRA-method (Rapid Rural Appraisal); rationalization and generalization of the whole available information about those species.

On elaboration of the Plan the stages foreseen by the Working program are observed:

1. Supply of technical equipment, laboratory apparatuses and consumables;
2. Setting of points for gathering of ichthyologic materials;
3. Terrain work at points along the Danube River;
4. Supply of ichthyologic material from the farm in the village of Bolyartzi;
5. Laboratory processing bone material for fixing of the age make-up;
6. Molecular-genetic research;

7. Analysis and discussion of the obtained results;
8. Drafting the action plan;
9. Public discussion of the obtained results and recommendations for the plan;
10. Taking in mind expedient notes from the discussion;
11. Handing over to MoEW the final version of the Action plan.

The aim of the present Action plan is to determine the current state of the sturgeon fishes inhabiting the Bulgarian aquatories; development of recommendations for sustainable exploitation, stabilizing and increasing the number of populations of Beluga sturgeon (*Huso huso*), Russian sturgeon (*Acipenser gueldenstaedti*) and sterlet (*A. ruthenus*); as well as restoring the populations of *A. stellatus* and *A. nudiventris*.

DESCRIPTION AND EVALUATION OF THE STATE OF STURGEON POPULATIONS

In the International Red book from 1996 (IUCN, Red List of Threatened Animals) are included all species of sturgeons inhabiting Bulgarian waters. In the Red book of Bulgaria are included *Acipenser nudiventris*, which is too rare and *Acipenser sturio*, which is considered as already extinct. During the last ten and more years there is no registered catch of *Acipenser nudiventris* and *Acipenser sturio* in Bulgarian waters. The *Acipenser stellatus* is rather rare species for our catch in the last years and is also endangered of extinction, although it is not included in the Red book of Bulgaria.

German (Atlantic) sturgeon (*Acipenser sturio*)

Acipenser sturio has the status of **critically endangered species** in the IUCN, Red List of Threatened Animals /1996/. The area of the species includes the basins of the Black, Aegean, Adriatic and Mediterranean seas, the European coasts of the Atlantic Ocean and the Baltic Sea. Still *Berg* (1948) notes that in the greater part of Europe the population of this species is practically extinct and in the basin of the Black sea there is an annual catch of about 100 specimens. Till the beginning of the XX century the Atlantic sturgeon entered the delta of the Danube River up to the Bulgarian sector, and southward of the Aegean Sea along the Maritza River some specimen reached even to the city of Plovdiv (Drenski, 1951). In our country there is no catch recorded since 1963.

According to all the ichthyologists working on sturgeons , this species is already extinct along the upper and middle stream of the Danube River and most probably in the region of the Black sea as well. The maximum size of the species is: length up to 3,5 m and weight up to 320 kg. This species is migrating. The males reach sexual maturity at 7-9 years, females – at 8-14. The age limit is 17 years. This means that at the maximum age of living even the earliest sexually matured specimen would have spawned 4-5 times at the most.

Acipenser nudiventris

Acipenser nudiventris has the status of **endangered** species in IUCN, Red List of Threatened Animals /1996/. It is widely distributed in the basins of Caspian, Aral and Black seas and appertaining big rivers. The numerical strength of *Acipenser nudiventris* in the Black sea basin has never been great (*Berg*, 1948; *Drenski*, 1951; *Banarescu*, 1964). Until the beginning of the XX century singular specimens have been caught around Varna, while in the Danube River it has reached up to the Austrian sector (*Drenski*, 1951; *Hensel & Holcik*, 1997). No specimen has been recorded in the catches during the last years. According to some Danube fishermen it is a rare catch – 1-2 specimens in 2-3 years. Its presence needs scientific confirmation. The maximum length and weight which it reaches are 2 m and 130 kg. Migrating species. Propagates every 2-3 years.

Acipenser stellatus

Acipenser stellatus has the state of an **endangered** species in IUCN, Red List of Threatened Animals /1996/. The present area of propagation includes the Black, Azov and Caspian seas and their bigger rivers. In the past it was spread in the Aegean Sea wherefrom

some specimens had entered in the Maritza River up to the town of Dimitrovgrad (Drenski, 1951). In the Danube River earlier it reached up to Austrian waters (Hensel & Holcik, 1997). Now its area is limited to the lower stream of the river. The numerical strength of the population is strongly decreased. The species reaches length of 2 m, weight of 80 kg and limit age of 25 years. Migrating species. Males reach maturity at 5-8 years, females – at 8-12. Propagates every 2-4 years.

Acipenser gueldenstaedti

Acipenser gueldenstaedti has the status of an **endangered** species in IUCN, Red List of Threatened Animals /1996/. It inhabits the basins of the Black, Azov and Caspian seas and their appertaining big rivers. In the Danube River it penetrates during the whole year and in the past reached up to Regensburg (Germany). To our mind it should also be considered as critically endangered in the Danube basin. The limit size and age which this species reaches are respectively length of 1,5-2 m, weight of 40-70 kg and age of 50 years. In the past were caught specimens with length of 4 m and weighting 500-600 kg (Drenski, 1951). Migrating species. Males reach maturity at 7-12 years, females – at 12-15.

Beluga sturgeon (*Huso huso*)

Beluga sturgeon has the status of an endangered species in IUCN, Red List of Threatened Animals /1996/. It inhabits the basins of the Black, Azov and Caspian seas and their appertaining big rivers. It conducts the biggest breeding migrations compared to other sturgeon species. It is an anadromic species as well. The maximum length of the species is 4-5 m with weight of 400-500 kg. Beluga of such dimensions is at age of about 50 years. In the past were caught even bigger specimens. The biggest beluga in the Danube River had the weight of 882 kg (Karapetkova & Jivkov, 1995), yet the biggest ever known specimen was caught in 1827 in the Volga River. It had the length of 9 m and weight of 1500 kg (Berg, 1948). In 1924 again in that region was caught a beluga with a weight of 1228 kg, from which were taken out 246 kg caviar. Its age was determined at 112 years. This species reaches maturity last of all – males at 14-18 years, females – at 16-23. Propagates every 4-6 years.

Acipenser ruthenus

Acipenser ruthenus has a status of a **vulnerable** species in IUCN, Red List of Threatened Animals /1996/. It propagates in the rivers of Black sea-Azov, Caspian and Baltic basins, reaching Eastward up to the Enisey River. It is a local, non-migrant species with

comparatively biggest numerical strength, but even its population has strongly decreased. It is extinct almost along the whole upper stream of the Danube River. Single specimens being still met in the Austrian part of the river. Yet, in some parts of the middle stream during the last 15 years the *Acipenser ruthenus* has increased its numerical strength. The supposed reason for this is the improved quality of water. The maximum dimensions reached by this species are: length of 1 m and weight of 16 kg. Males reach maturity at 4-5 years of age, females –at 7-9 years.

No complex research studies on the biology and ecology of sturgeons (propagation, allocation, numerical strength, migrations, genetics, etc.) have been carried out until now in Bulgaria. A little exception are the partial research studies by Russet (1965) on the *Acipenser ruthenus* nutrition and by the Institute of Fish resources – Varna, in the years of 1980-1986 on the state of the sturgeons in Bulgaria (Dobrovlov, 1983; Kolarov, 1989).

EXISTING REGIME FOR USE OF STURGEON SPECIES

The Fishery and Aquacultures Law settles the license regime for use, mode and periods of fishing as well as preservation of fish resources (art. 17-20, art. 30) (An official gazette 41/24.04.2001). The use of surgeon resources is consistent with the Biological Diversity Law (An official gazette 77/09.08.2002).

National agency of fisheries and aquaculture (NAFA) survey of the year 2000 reports that the introduced license regime covers 100% on the fishermen along the Danube River. Between 98-179 are the sturgeons fishermen after the year of 1999. In the western regions (Vidin) it is typical to fish sturgeon with hook lines. The license regime has to be based on the catch data as well as on the scientific researches rendering an account of the dynamics in the state of sturgeon populations. This requests also a change and an annex to Regulation №43/26.11.2001 for the system of keeping of fishermen's diary and the system for constitution and delivery of declaration of origin with the following principal items: 1. The accounts for sturgeon catches to be given directly after they're done, not on receipt of a new fishing license. 2. On catch of sturgeon species **immediately** to inform the representatives of Commerce Law (CA) and NAFA and/or Regional inspectorate of environment and water (RIoEW) for registration and marking. 3. About the registered fishes – to register not only the requested up to now information (weight, length, place of catching and the type of fishing

device), but also the sex, quantity of caviar (if the fish is female), to take biological material from the fish for scientific research (the first ray of the pectoral fin, muscular tissue, 5 g caviar). 3. Only marked sturgeon fishes are subject to sale and buying. 4. The price of the issued licenses for sturgeon fishes has to correspond to the price of the seized resources.

The system of control over the catch of sturgeon fishes includes forbidden for catch periods and minimum allowed sizes defined by the Annex № 2 to art. 38, paragraph 1 of the Fishing and aquacultures law. The regimes for use of all sturgeon species , including the endangered species *Acipenser nudiventris* and *Acipenser sturio*, are regulated by the Biological Diversity Law.

The research on sturgeon fishes up to the middle of the 90-ies was realized on the basis of morphological and zoogeographical characteristics of the separate species. Nowadays, some molecular-biological methods are widely applied in the study of species diversity and intra-population structure.

The correct species identification is the first step in any conservation program (Avisé 1989, 1994), and in case the endangered species are subject to trade as well, the problem stands with even greater gravity (Cherfas 1989, Baker & Palumbi 1994, 1996).

The present work offers the first molecular-genetic research of sturgeon DNA in Bulgaria. As such it marks just the beginning and can give only limited circle of answers to the multitude of questions referring to the species identification, distribution and genetic diversity of sturgeons. An object of keen interest during the last years – especially for searching of intra-species and population mutability – are the macro-satellite zones of the nuclear DNA. Principal target area for search of specific species markers is cyto-chrome b gene of the mitochondrial DNA.

Molecular-genetic studies aim at lying the start of total check of how far the existing at the present moment methods are applicable to species identification of tissue material from sturgeon fishes inhabiting the Danube River for defining the genetic structure of their populations.

It is determined that the primary couple B3/B2a hybridises with a specific for the species *Huso huso* section of the mitochondrial cytochrome b gene and in result of that is obtained amplification product with a length of 260 nucleotide couples. The primary couple S1/S1a amplifies in a specific way a fragment with a length of 71 nucleotide couples only in

the genome of the *Acipenser stellatus*. The rest couples of primers do not show any specific species reactions – a particular primary couple either hybridises with parts of the genome of more than one species or the reaction does not take place at all.

To examine the population structure of *Huso huso* the amplification product obtained from hybridisation of the primary couple cytochrome-b1/S2A is subject to the action of several restrictase enzymes. Two of these enzymes disclose differences between the specimens of the species *Huso huso*.

The obtained results are as follows:

1. The method of PCR-reaction for DNA study of sturgeons is introduced.
2. It is determined that from the mentioned in the world literature specific primers for prove of species belonging of *A. stellatus*, *A. ruthenus* and *Huso huso* the primers B3/B2a are specific of the species *Huso huso*, the primers S1/S1an are specific for the *Acipenser stellatus*, while the rest primary couples /B2/B2a, cytb/S2A, Sturg5aF/Sturg5aR и het1/het2/ cannot be directly applied to determine a particular species of sturgeon fish.
3. Genetic polymorphism is found in specimens of *Huso huso*, which opens possibilities for further search of DNA markers for determining of intra-population diversity.

ANALYSIS OF THE STATE OF POPULATION AND CATCHES

NUMERICAL STRENGTH OF SPECIES IN THE BULGARIAN AQUATORIA

According to archaeological excavations the catch of sturgeon fishes dates back to more than 20 centuries (Sokolov & Tzepkin, 1996). It is considered that human influence on the numerical strength of these species starts to be noticed after 16-17 c. (Balon, 1968). The constant decrease of resources in worldwide scale begins since the end of 19 c. up to the present days. The most important catches, correspondingly the biggest production of caviar worldwide, is done in the basin of Caspian Sea – about 90% (Levin, 1981; Hodorevskaja & Novikova, 1995). Black –sea – Azov region is on second place. Some data of Russian and Ukrainian scientists show that the annual catch of sturgeon fishes in the Azov Sea in the period 1937-2000 decreased from 7270 t to 45 t, i.e. 162 times (Materials of the SSG work meeting, 2001). The official statistic data of FAO states that the sturgeon catches in the Azov

-Black Seas region for the period 1960-1993 have decreased about 14 times – from 458 t to 32 t (Prodanov, 2000). According to data by Navodaru et al. (1999) the tendency for considerable and constant decrease of the passage species of sturgeon fishes in the lower stream of the Danube River in the period 1931-1986 is well manifested (fig. 1).

After the construction of Dubosarska and Kahovska hydroelectric power stations, respectively on the rivers Dniester and Dnieper at the early 50-ies of the last century, the Danube River remained the main “sturgeon” river which offers opportunity for natural reproduction of sturgeon fishes in the Black sea region (Anbros, 1964, 1966; Salnikov, etc. 1975; Chepurnova & Dimitrova, 1981).

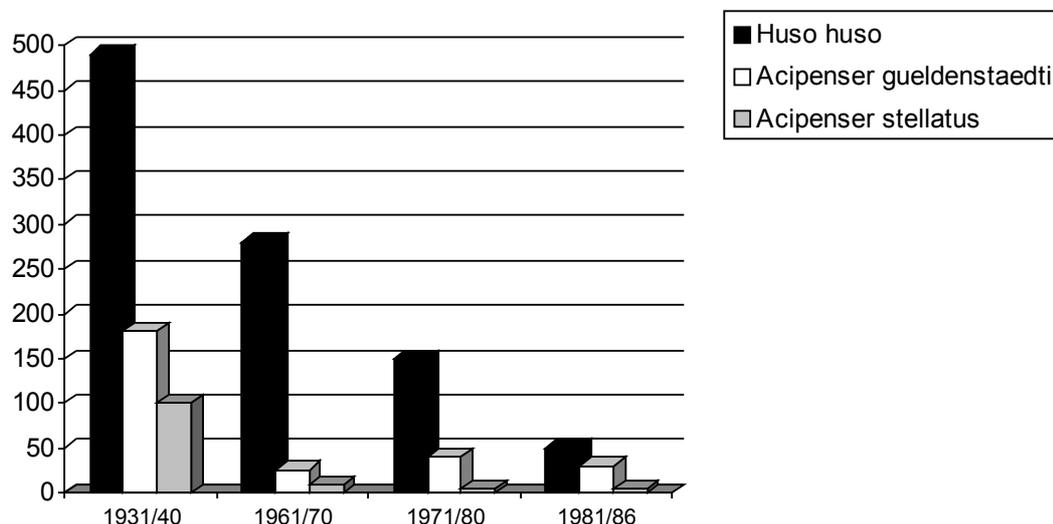


Fig. 1. Structure of sturgeon catches (t) by species in lower stream of the Danube River for the period 1931-1986 (acc. to Navodaru et al. 1999).

The methods of defining numerical strength and funds of each fish species subject to industrial fishing, such as sturgeon fishes, are rooted in their catches. Yet for this purpose is requested years-long information about the changes of the catches and their biological characteristics. This includes knowledge about age-size make up, recruitment (natural reproduction), natural, industrial and general mortality, rate/sex interrelation, growth speed et cetera parameters of catch population. Such research studies of sturgeons in the Danube River and the Black sea are not conducted up to this moment in our country and the fishery statistics

about those species is extremely inaccurate. There is a little, incomplete and – because of various reasons – quite subjective official data about the catches. All these render big impediments to establishing the present resources of sturgeon fishes. Statistics about fish catch started to be kept since the 20-ies of the last century (Drenski, 1928). Weight of landing *Huso huso*, *Acipenser sturio* and *Acipenser ruthenus* in the Bulgarian sector of the Danube River for the period 1920-1926 vary from 29,3 t to 72, 4 t. The average annual catch for that period is 45,1 t. During the year 1942 in the Bulgarian sector of the river are caught 64 t sturgeon fishes (Grozev, 1952). For the period 1945-1949 the catches include *Huso huso*, *Acipenser gueldenstaedti* and *Acipenser stellatus*. It is not clear why there is no registered data about *Acipenser ruthenus*, having in mind that according to Marinov (1978) it comprised 3.3-4.8% from the total catch in the Danube River during the period 1925-1974. During that period of greatest importance were *Acipenser gueldenstaedti* and *Acipenser stellatus*, which comprised 50,8% and 43,5% from the total catches. The total catches of sturgeons during that period is 162,7 t. Drenski (1951) remarks that the sturgeon stocks in the Danube River and the Black sea have decreased “minaciously” and the main reason for that is the “overexploitation” of sexually mature and especially juvenile specimens.

In the period 1960-1974 important changes occurred in the weight of catches concerning dominant sturgeon species. *Acipenser ruthenus* is the one which is mostly caught – 58,3%, followed by: *Acipenser gueldenstaedti* - 28,7%, *Acipenser stellatus* – 8,4% and *Huso huso* – 4,6%. The average total catch for each five years period varies from 150,5 to 196,5 t (average 168,2 t), i.e. there is no significant change in the total quantity of the catch. What matter in this case is namely the change of species domination in the draughts. During the last years an abrupt change in species domination in the Danube River catches is witnessed again (Table1).

Table 1. Sturgeon catches (t) in the Bulgarian section of the Danube River for the period 1995-2002 (acc. to data from the National Executive Agency for Fishing and aquacultures agency /NAFA/ at the Ministry of Agriculture and Forestry).

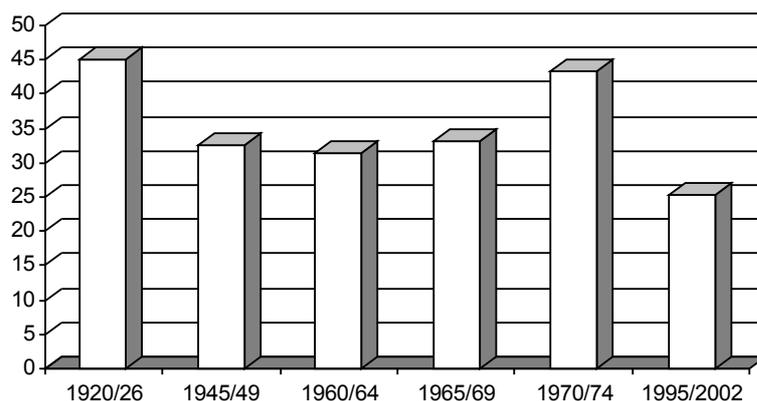
Species	1995	1996	1997	1998	1999	2000	2001	2002	average
<i>Huso huso</i>	10.8	23.5	30.7	31.2	27.0	18.4	6.6	9.9	19.8

Acipenser gueldenstaedti	3.8	1.7	3.6	5.3	4.0	0.9	0.6	1.2	2.6
Acipenser stellatus	0.03	0.5	0.2	3.7	6.0	1.1	0.7	1.7	1.7
Acipenser ruthenus	0.06	0.8	0.4	1.2	1.5	1.6	1.2	2.8	1.2
Total	14.7	26.5	34.9	41.4	38.5	22.0	9.1	15.6	25.3

From the average catches in table 1 can be calculated the following quantities of extracted caviar: **Huso huso 1782 kg, Acipenser gueldenstaedti 208 kg, Acipenser stellatus – 136 kg and Acipenser ruthenus – 96 kg.**

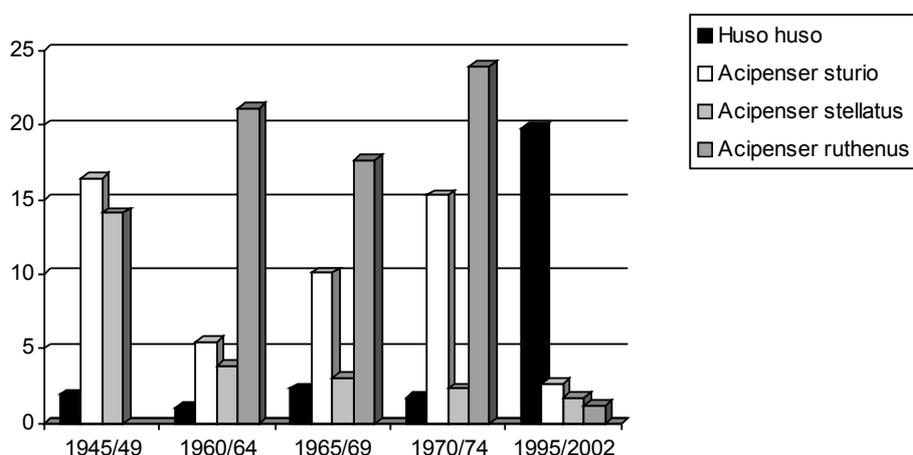
The average annual quantity of sturgeon catch in the Bulgarian section of the Danube River decreases from 45,1 t during the 20-ies to 25,3 t in the last 8 years (fig. 2). The importance of different sturgeon species in catches changes drastically. Until the 50-ies of the 20 c. most important in our Danubian catches were *Acipenser gueldenstaedti* and *Acipenser stellatus* – over 90%. During the 60-70-ies their draughts decrease about 3 times, and in the last years they are less than 20%. In the total catch until the 50-ies *Acipenser ruthenus* and *Huso huso* comprised 5% each. Essential increase of *Acipenser ruthenus* draughts is witnessed in the 60-70-ies when it comprised 58% of all sturgeon fishes. *Huso huso* preserves its 5%. During the last 7-8 years *Huso huso* takes the first place in sturgeon catches with about 79%.

Fig. 2. Average annual catches (t) of sturgeons in the Bulgarian section of the Danube River.



For a period of about 50 years (fig.3) *Acipenser stellatus* and *Acipenser gueldenstaedti* lost their leading role and now they have almost no importance for the quantity of the extracted caviar in our country. As far as *Acipenser ruthenus* is concerned, the fishing pressure increases especially in the 60-70-ies. The result does not loiter – nowadays *Acipenser ruthenus* has only about 4% of the catch. During the last years *Huso huso* is of greatest importance in sturgeon draughts and extraction of caviar in our country.

Fig. 3. Average annual catches (t) of sturgeons by species in the Bulgarian section of the Danube River in the period 1945-2002.



Sturgeon fishing in the Bulgarian black sea aquatory for the period 1995-2000 is shown in table 2. In the Black sea draughts *Huso huso* considerably prevails – 85,4%. *Acipenser gueldenstaedti* comprises 13,4%, while the *Acipenser stellatus* draughts are insignificant. The female sturgeon specimens caught in the Black sea are mostly without

spawn or it is in an early stage of maturity and consequently – of no trade value. In this way are exterminated fishes – future producers which could spawn at least one more time in the Danube River.

Table 2. Sturgeon catches (t) in the Bulgarian part of the Black sea for the period 1995-2000 (acc. to data from the NAFA/ at the Ministry of Agriculture and Forestry).

Species	1995	1996	1997	1998	1999	2000	Average
Huso huso	1.8	5.3	11.5	12.3	10.0	0.9	7.0
Acipenser gueldenstaedti	-	0.7	1.8	2.2	2.0	-	1.1
Acipenser stellatus	-	-	-	-	-	0.3	0.05
Total	1.8	6.0	13.3	14.5	12.0	1.2	8.2

In the last years more and more persistently is asked the question about the truthfulness of the catch quantities registered by the official statistics, as well as the question about illegal sturgeon catch. To the mind of a number of authors these statistics are not correct, mixed up and sometimes even curious. According to Bacalbasa-Dobrovici & Patrishe (1999) and Navodaru et al. (1999) the illegal sturgeon catch in Romania overcomes the legal one by 90%, i.e. more than twice. Following the method of quick evaluation (RRA), Navodaru et al. (1999), claims that in the period 1997-1998 the total sturgeon catch in the lower stream of the Danube River comprises 385 t, from which 180 t for Romania and 45 t for Bulgaria. Comparing this data to the draughts from the official statistics about that period, it becomes clear that in Romania the illegal catch exceed the official statistics almost 18 times (900%!). For Bulgaria this difference is 15,5%. According to our mind the data from the Bulgarian statistics for the period 1995-2000 are extended for *Huso huso* and lowered for *Acipenser ruthenus*.

NATURAL REPRODUCTION AND CHARACTERISTICS OF STURGEON POPULATIONS

Beluga sturgeon. From all which was presented up to now it is seen that the principal extraction of caviar is and will be from *Huso huso*. The numerical strength of *Huso huso* in the River Danube is due to natural reproduction only. Until now it was known that modern spawn sites of *Huso huso* begin down the stream at Iron Gates 2, but where do they reach It was not known (Bacalbasa-Dobrovici, 1997; Bacalbasa-Dobrovici & Patrishe, 1999; Reinartz, 2002). From the research studies carried out in spring (May) of 2002 were found out 13 spawn sites of *Huso huso* along the stream of the Danube River between the village of Vruv (840 pkm) and the island of Petrich (755 pkm) at a depth of 840 and 835 pkm (island of Gurla Mare); 829-826 pkm (village of Florentin); 824-823 pkm (village of Yassen); 820-819 pkm; 811-809 pkm (village of Koshava); 803-797 pkm (island of Kutovo); 793-788 pkm (island of Big Kalafat); 786-781 pkm (island of Bogdan); 778-777 pkm; 775-774 pkm Village of Botevo); 768-766 pkm (islands of Dessa and Dovlek); 764-763 pkm (island of Dobrina); 760-755 pkm (island of Petrich). About 85% from the *Huso huso* catches in the Bulgarian section of the Danube River are taken between 690 and 845 pkm. The total river length in which are situated the main *Huso huso* spawn sites down the stream from the Iron Gates 2 is 110 km, and approximately 85-90 km from which are between the Bulgarian and the Romanian coasts.

The numerical strength of the fertilized caviar in the spring of 2001 varied from 15-60 on sq. m. Strength of about 500 on sq. m is considered an optimal norm. (Novikova, 1993). On the basis of the available data it could be said that the use of natural spawn sites in the Danube River is far from the optimum. According to Bacalbasa-Dobrovici & Patrishe (1999) during the last years the strength of juvenile sturgeon fishes from the species *Huso huso*, *Acipenser gueldenstaedti* and *Acipenser stellatus* has significantly decreased in the Northwestern part of the Black sea. The authors give as example the fact that 30-40 years ago in occasional catches were caught between 20 and 50 juvenile specimen long 15-80 cm per night per net. Nowadays are caught not more than 5 specimens per net. The main reason for this is the insufficient quantity of producers reaching the spawn sites. The action which has to be inevitably taken is to establish *Huso huso* farms with the necessary capacity for artificial production of larvae and YOY for spawning of the Danube River. A good example can be the Caspian Sea region where 90% of the *Huso huso* resources are based on artificial reproduction (Vaisman & Raymakers, 2001).

On the basis of data from the years 2000-2002 concerning catches in the Danube River of *Huso huso* , mostly by Bulgarian and Romanian, partly Serbian and Ukrainian catches (Agreement on fishery in the Danube River Mixed Commission, 2002) in the last years, we

have summed up the link between weight, age and length. Most of all are caught *Huso huso* weighting 50-160 kg – total 64,3%, followed by the specimens between 161-250 kg – 30,9%. *Huso huso*, heavier over 250 to 400 kg are seldom caught – 4,8%. The average weight of female *Huso huso* in the catches is about 160 kg, and that of male – 65 kg. The average industrial weight of one *Huso huso* at a sex rate 1:1 is 112 kg. Under normal circumstances the male:female specimens rate in nature is about 3:1. For preservation of the natural rate it matters what kind of fishing devices are used. More male specimens are caught with net devices and more female – with hook lines. Gonade-somatic coefficient in female *Huso huso* varies between 12,9 and 24,8%. The average quantity of caviar is 18% of the fish's weight. According to the official statistics data for the *Huso huso* draughts in the Bulgarian region of the Danube River for the period 1995-2002 the average possible quantity of extracted caviar is about 1800 kg, varying between 700 and 2800 kg.

Of course, there is a connection between catches in the two sectors – our biggest catches coincide with the smallest Romanian ones and vice versa (table 3). According to Romanian scientists the real catch of *Huso huso* as well as of other sturgeon fishes is considerably greater because of poaching.

Russian sturgeon. Age, weight and linear parameters' data of the caught population of *Acipenser gueldenstaedti* in the Danube River are based on Bulgarian and Romanian catches (Agreement on fishery in the Danube River Mixed Commission, 2002). The principal sexually matured part of the population is between 7 and 29 years of age, weight up to 24 kg and length up to 1,5 m. There are separate reports for caught *Acipenser gueldenstaedti* weighting 30-45 kg, but obviously such specimens are very rare. According to Shlyahov and Akselev (1993) (acc. to Prodanov, Stoyanova, 2000) the *Acipenser gueldenstaedti* population in the Northwestern part of the Black Sea at the beginning of the 90-ies numbered about 3,8 million specimens, sexually mature being 317 000 (8,3%). Based on that data the catches in the Bulgarian section of the Danube River are extremely low and the tendency to their decrease is constant since the 40-ies of past century up to now. In the last 7 years the catches have decreased 5,5 times in comparison with those from before 30 years. Comparing the data about Bulgarian and Romanian draughts in the period 1995-2001 (table 3), it can be seen that for the period 1995-1999 catches are almost the same. Even the average annual catch in the Bulgarian section – 3,7 t, is a little bit higher than the Romanian – 3,3 t. Yet, for the period 2000-2001 the average catch in the Romanian section is 19,4 t and in the Bulgarian – 0,75 t.

Table 3. *Acipenser gueldenstaedti* catches(t) in Bulgarian and Romanian sections of the Danube River in the period 1995-2001.

Year	Bulgaria	Romania
1995	3.8	2.8
1996	1.7	3.3
1997	3.6	4.4
1998	5.3	1.7
1999	4.0	4.3
2000	0.9	17.8
2001	0.6	20.9
Average	2.8	7.9

It is obvious that the more *Acipenser gueldenstaedti* caught in the Romanian section, the less ones in the Bulgarian. Due to the geographic position of the both countries, this fact applies to the other passage anadromic fishes as well. In a long-term period the sturgeon fishes' catches in Romania have always been higher than those in Bulgaria. Yet the tendency to constant decrease of the catches is an undeniable fact for the both countries. The average industrial weight of female specimens of the caught Danubian population is about 16,6 kg, for male it is 10,4 kg, for both sexes together – 13,5 kg. Average gonade-somatic coefficient in females is 16% of the total weight. For the period 1995-2001 the average annual quantity of the extracted caviar is about 200-220 kg, and for the last two years it is about 60 kg. Practically, *Acipenser gueldenstaedti* has almost lost its industrial importance for our catches.

Stellate. The data for biological parameters of *Acipenser stellatus* population in the Danube River are based mainly on Romanian and partly on Bulgarian catches (Agreement on fishery in the Danube River Mixed Commission, 2002). The sexually mature part of the population consists of specimens between 4 and 13 years of age. The average weight of female *Acipenser stellatus* is 8 kg and that of male – 5,4 kg. The sex rate male/female is usually 2:1. Average gonade-somatic coefficient in females is 16% of the total weight. With such characteristics, according to the draughts' data during the last years, the quantity of caviar which could be extracted is about 60-70 kg per annum.

The industrial significance of the separate species of passage sturgeon fishes is different for Romanian and Bulgarian draughts. For Romania the three species have

approximately one and the same importance. For Bulgaria, during the last years, only one species dominates – *Huso huso*.

Acipenser ruthenus. Fishing the only non passage species of sturgeon in the Bulgarian section of the Danube River had been of substantial importance during the 60-70-ies years of the last century (58%). Now it is slightly important (3,7%). There are 8 age groups determined in the catches – from 2 to 9 years. Sex rate is near to 1:1 or there is a slight predominance of male specimens. Bigger specimens are seldom caught, respectively 1-2 years older. With that age structure, in the reproductive process take part 5-6 groups of male specimen and 2-3 groups of female ones. This indicates lowering of species resources. Such population is unstable and fishing has strongly negative influence on it. To our mind, the artificial reproduction and restocking of the river with *Acipenser ruthenus* as well is imperative, as the positive effect would be grater than that with other species.

ARTIFICIAL RECRUITMENT

Restocking with sturgeon fishes has been fulfilled in the Bulgarian section of the Danube River since 1998. For the period 1998-2001 (data from MoEW) in the river have been released in total 83820 numbers of *Acipenser gueldenstaedti* by weight of 20 grams to 1,8 kg; 3 650 numbers *Huso huso* by weight of 20 to 550 grams and 800 numbers *Acipenser ruthenus* - from 15 to 100 grams. In the year of 2002 in the Danube River are released 62 520 numbers *Acipenser gueldenstaedti* by weight of 12 to 300 grams; 2 125 numbers *Acipenser ruthenus* by weight 50 – 100 grams. Until the month of November 2003 in the river had been released 161 317 numbers *Acipenser gueldenstaedti* and 5 300 numbers of *Acipenser ruthenus*. For the year 2004 the number of released fingerlings is 211 126(table 4).

Table 4. Aquaculture produced sturgeon fingerlings released in Danube River for 1998-2003

Year	Total number	A.gulld.	Average weight (G)	H.huso	Average weight (G)	A.ruthenus	Average weight (G)
1	2	3	4	5	6	7	8
1998	1 500	1000	250	200	300	300	180
1999	30100	27 400	230	2 700	320	-	-

2000	21150	20 400	200	750	350	-	-
2001	28 100	28 100	200	-	-	-	-
2002	23 530	22 530	280	-	-	1 000	-
2003	166 617	161 317	82	5 300	5	-	-
Total	270 997	260 747		8 950		1 300	

As far as spawn material weight is concerned, the general practice in Kaspian basin countries is to spawn with multiple material (40-60 millions of specimen) weighting 1,5-3,5 g. During the last years in Iran there is a tendency of increasing the weight of the spawn to 5-7 g. For planting in Turkey are used small sturgeons weighting 5-6 g. Only in our country in the Danube River a considerably larger spawn material is released. Both ways have their advantages and shortcomings. In use of undersized restocking material the coefficient of natural death rate is bigger, which calls for breeding and releasing of bigger quantity small fishes. On the other side, time duration and expenses for breeding of undersized spawn material are less. In use of bigger breeding material the coefficient of natural death rate is smaller, yet correspondingly time duration and expenses (e.g. for artificial food) are bigger. In bigger fishes the coefficient of industrial death increases as well, i.e. the chances to catch the bigger fish increase. E.g. sturgeon weighting 100-150 g is easily bycaught in fishermen nets. Another factor restricting the use of bigger restocking material of passage species is the natural migration along the river stream towards the sea. In nature the greater part of anadromic sturgeons weighting over 15-20 g have already reached the sea and there their distribution and adaptation acquire quite another character. In this aspect we think that when restocking the Danube River, the sturgeon fishes have to be of 15-20 g weight as an optimum.

Using calculations recommended by Prof. Kolarov to MEW in 1999, it has to be spawned with 10 numbers of *Huso huso* and 30 numbers of *Acipenser gueldenstaedti* per 1 kg caviar of the quota (1720 kg). having in mind that up to sexual maturity reach 2% and that the sex ratio is 1:1, we shall get respectively 172 numbers *Huso huso* and 516 numbers *Acipenser gueldenstaedti*, from which will be extracted 1548 kg and 825 kg caviar. Draught's calculations made on the basis of spawn quantities could be used and applied only after 13-17 tears when the settled *Huso huso* and *Acipenser gueldenstaedti* would reach first sexual maturity. Besides, these calculations presuppose catch of spawned quantities before they have reproduced even once in natural environment, hence without any provision for make up for the natural populations of these artificially recruited specimens.

The above mentioned calculations show that restocking is necessary, but the process of recruitment for those fishes with a long life cycle is very slow and releasing them today does not guarantee preservation of population at the allowed simultaneous high rate of draughts. The catch rates should be slowed down and those of restocking – accelerated, so that to ensure preservation of sturgeon fishes' strength.

In order to allot more precisely the quantities for restocking, best releasing time and place, survival rate and demeanour of little fishes, it is necessary to mark and keep track of them and the best way to that is by use of radio-tracking.

2 CONCLUSIONS

1. *Acipenser sturio* is already considered an extinct species from the Danube-Black sea region. The presence of *Acipenser nudiventris* needs scientific confirmation. Replacement of these species could begin only by import of restocking material from outside.

2. The average annual catch of sturgeon fishes in the Bulgarian section of the Danube River have fallen from 45,1 t in the 20-ies of the last century to 26,8 t in the last 8 years.

3. During the whole period the part of separate species sturgeon fishes in the total catch is considerably changed. *Acipenser gueldenstaedti* and *Acipenser stellatus*, which had the biggest part of the catches (90%) now have almost lost their industrial significance. Similar is the situation of *Acipenser ruthenus*.

4. *Huso huso* is of the greatest importance for the Bulgarian sturgeon fishing and the extraction of caviar during the last years (79% of the catches).

5. *Huso huso*'s principal spawn sites in the Danube River are situated between 863 km (The Iron Gates 2) and 755 pkm (the island of Petrich). Because of the insufficient quantity producers reaching up to them, they are not optimally exploited.

6. The principal part of caught *Huso huso* specimens in the Danube River is aged between 15 and 36 years. The body length varies from 180 to 400 cm, the weight is between 50 -400 kg. Males reach sexual maturity at 15-16 years of aged, the females – at 18-20. Average industrial weight of *Huso huso caught* in the Bulgarian section is 112 kg. Average gonade-somatic coefficient for the females is 18%.

7. The principal sexually mature part of the caught *Acipenser gueldenstaedti* specimens is aged 7-29 years, the weight is 5-24 kg and the length – 1-1,5 m. Average industrial weight is 13,5 kg. Males reach sexual maturity at 7-8 years of age, females – at 12-13 years. Average gonade-somatic coefficient for the females is 16%.

8. The *Acipenser stellatus* caught in the Danube River is aged 4-13 years. Males reach sexual maturity at the age of 4-6 years, females – at 8-9 years. Average industrial weight is 6,7 kg. Average gonade-somatic coefficient for the females is 16%.

9. The part of *Acipenser ruthenus* population caught in the Danube River is aged 2-9 years, weight is from 150 g to 4 kg and length – 34-85 cm. males reach sexual maturity at the age of 4 years, females – at 7 years of age.

10. A total international ban for sturgeon fishing in the Black sea must be introduced. If total fishing ban in the Danube River is not possible, it should be for the maximum (60 days) period provided by the Fishery and Aquacultures Law (FAL).

11. Restocking with artificially propagated sturgeon fishes in the Danube River is imperative. The restocking material should be of weight about 15-20 g. The necessary restocking capacity which should be gradually reached is of about 500 000 to 1 million specimens per annum.

12. The research studies and the monitoring of sturgeon species in the Danube River should be stable. The necessary means can be taken from the companies exporting caviar, national and international projects.

13. The average annual quantity of the extracted *Huso huso* caviar in the years 2001-2002 is 1700-1800 kg. The one from *Acipenser gueldenstaedti* and *Acipenser stellatus* is about 120 kg.

SOCIOECONOMIC CHARACTERISTICS

Fishing is a common occupation for a great part of the inhabitants alongside the river valley of the Danube and the Black Sea coast. We are convinced that the issue of licenses has to be differentiated with regard to the fishing of different species. A limited number of

detached licenses should be issued and definitely to professional fishermen only. This step, of course requires certain changes in the operative Regulations and Rules to FAL.

RECOMMENDATIONS

The collected studies and literature obviously prove instability of the sturgeon populations in the aquatories of Bulgaria. WE RECOMMEND TO THE BULGARIAN COMPETENT OFFICIAL BODIES TO START INCONTINENTLY NEGOTIATIONS WITH THE RANGE COUNTRIES PARTIES TO THE DANUBE AGREEMENT AND SITES CONVENTION AIMING A DRASTIC DECREASE OF THE INDUSTRIAL STURGEON FISHING WITHIN 10 YEARS.

It is imperative for all countries in the region to use the considerable time required for the carrying out of the recommendation mentioned above, to provide an international control upon the fishing and to work out in agreement joint activities as follows in order to preserve the sturgeon.

- Optimisation of the period of fishing ban during reproduction.
- Protections of the areas, where spawn sites of sturgeon is found (for example – a tripartite agreement could be reached by Bulgaria, Serbia and Romania for a prohibition of fishing in the common frontier area).
- Regulation of use by gradual defining of lower quotas for both catch and export of caviar.
- Development of optimal conditions for organizing of sturgeon fishing farms (at least one of them should be public official industries) for breeding of *Huso huso* and other sturgeon species.
- Working out of separate plans of action for each sturgeon species.

The main aim which is to be reached is restoration of biodiversity and stability of the 6 sturgeon species populations.

The principal impediments and threats to achievement of the main aim are superfluous fishing and poaching mainly in the Romanian part (the delta) of the Danube River.

No matter how fast could be obtained an international agreement for restriction or defense of sturgeon species, it should not be waited for inactively. The following measures, which will restrain the negative consequences of the above mentioned restrictions, have to be taken:

- Tripartial (Bulgarian-Serbian-Romanian) fishing ban along the borders in regions which are registered as *Huso huso* spawn sites
- Prohibition of trawls fishing and their replacement with net devices
- The fishing ban during reproduction period should be of maximum legally provided extension – 60 days
- Fishing ban on sturgeons in the Black Sea
- Sturgeons on the internal market should have certificate of origin
- Sturgeon fishing license issue should be bound to gathering of data and ichthyologic material for scientific researches and monitoring
- Annual restocking with minimum 500 000 numbers of *Huso huso* and *Acipenser gueldenstaedti*, preferably in equal quantities
- Marking of the restocking material, if possible with radio tracking checks

OPERATIVE TASKS AND INSTRUCTIONS FOR PRESERVATION AND USE

The scientific research and the monitoring should be prioritized and continued in order to specify the populations of sturgeon species; administrative stimuli and financial elevations should be offered to the sturgeon farms, producing breeding material for these particular species; production of caviar from aquacultures should be stimulated.

Scientific programs are required to be worked out on:

1. Monitoring of the populations of the *Huso huso* and *Acipenser gueldenstaedti*, which are now seriously pressed by expanding fishing, as these species supply the quantity of caviar required for fulfilment of the Bulgarian quota;

2. Monitoring upon the spawning sites and the available conditions for development in them;

3. Specifying and founding of new spawning sites for *Huso huso* and the other sturgeon species;

4. Specifying of absolute and individual prolificacy and survival during the different phases of their individual development;

5. Determination of the nutritive spectrum of each species;

6. Watching the movement, survival and behaviour of the artificially propagated and released specimens *Huso huso* и *Acipenser gueldenstaedti* .

The official bodies should stimulate the breeding of sturgeon in the inner ponds of the region and so to reduce the fishing pressure upon the natural populations, which is due to the production of caviar they permanently supply. Two sturgeon fish farms with a capacity of over 250 tone have been founded in Bulgaria and successfully function nowadays.

The first quantities of caviar of *Huso huso* и *Acipenser gueldenstaedti* obtained from aquacultures were produced in 2004 and 2005. In the next years it is expected that the produced quantity of caviar obtained from aquaculture should reach up to 2,5 – 3 tons per annum.

The trade of sturgeon meat is expanding rapidly in Bulgaria. You can already find sturgeon meat obtained from aquaculture in nearly every shop or supermarket in the country.

ACTIVITIES PLAN

ACTIVITIES	AIM	EXPECTED RESULTS	DEAD LINES
Improvement of the existing legislation (for the recording and labelling the landed sturgeons before placing on the market, processing e.c.)	Optimising of the control on fishing and assistance to sturgeon scientific research.	Improvement of catch recording and statistics. Plotting of actual information about the catches throughout the year Decrease of the poaching and black market.	2004-2005
Terrain exploration.	Specifying of the recent status, biology and spawning sites of each sturgeon species	Clarification of the population status, their size and aging structure and the demands of population towards the spawning sites.	2004-2007
Promulgation of "Tripartite protected territory, providing natural reproduction of Huso huso and other sturgeons	Increase of possibilities for natural reproduction and recruitment.	Highest use of the spawning sites. Increasing the number of naturally reproduced sturgeon s.	2004-2007
Working out of scientifically based program for marking the artificial bred fishes in the farms, before planting them in the river.	Evaluation of the potential effect of the restocking	Clarification of the survival of the artificially bred material, its migration, use and risks from the restocking.	2004-2006
Working out of a program for reintroduction of A. nudiventris and Acipenser sturio according to articles 63-69 of Biological Diversity Act	Restoration of the biodiversity in the region.	Start of activities providing the formation of natural populations of the both species.	2004-2007
Foundation of sturgeon farms, including state owned farms	Production of appropriate quantity of artificially bred material for restocking	Commitment of local inhabitants to alternative employment. Increasing the number of sexually mature sturgeons.	2004-2009
Training of specialists in B CA of NAFA and RIoEW	Extension of qualification	Improved and strict recording on sturgeon landing and collecting materials for scientific research.	2004-2005

Working out database on the species	Monitoring	Actual information should be available for application of environmental protection activities, defining the export quotas of meat and caviar.	2004-2007
Laboratory elaboration on the genetic identification of species	Specifying and confirmation of the species belonging by DNA testing of the biological material (caviar and meat)	Clarification of the genetic structure of the populations and keeping artificial breeding for restocking under control. Restraining trade of species prohibited for commercial purposes.	2004-2009
Promoting and training activities	Publishing of brochures for public awareness.. Promoting of sturgeon breeding and farming.	Providing public support for the monitoring and prohibition measures. Stoppage of poaching. Commitment of the local inhabitants to foundation and exploitation of sturgeon breeding farms.	2004-2006
Monitoring			2004-2014