CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Twenty-fourth meeting of the Animals Committee
Geneva, (Switzerland), 20-24 April 2009

Sturgeons and paddlefish

SECRETARIAT'S REPORT

1. This document has been prepared by the Secretariat.

2. Resolution Conf. 12.7 (Rev. CoP14), on *Conservation of and trade in sturgeons and paddlefish*, directs the Secretariat to provide at each meeting of the Animals Committee a written report, including references to relevant documents, on its activities related to the conservation of and trade in sturgeons and paddlefish. The present document is the second such report and covers the period from April 2008 to January 2009. An oral update will be given of activities undertaken since 1 February 2009, when this document was prepared.

Export quotas

3. Concerning export quotas for the quota year 1 March 2008 to 28 February 2009 for the shared stocks in the Amur/Heilongjiang River, on 29 December 2007, the Secretariat received details of proposed catch quotas and meat and caviar export quotas made by China and the Russian Federation, together with the supporting scientific data used to establish these quotas.

4. After resolving a number of technical queries with the States concerned, the Secretariat published the quotas concerned on the CITES website on 22 May 2008, together with some voluntary export quotas established by China for caviar produced in aquaculture.

5. Concerning export quotas for the quota year 1 March 2008 to 28 February 2009 for the shared stocks in the Caspian Sea, at the request of the States concerned, the Secretariat published on 22 May 2008 on the CITES website, a clarification to the export quotas for Kazakhstan and the Russian Federation. This clarification specifies the volume of caviar that these two States export on behalf of Turkmenistan.

6. Having ascertained that there had been no agreement between the States concerned over the export quotas for sturgeon meat, the Secretariat published a zero export quota for meat for all these States on the CITES website on 23 July 2008.

7. At the time of writing this report (1 February 2009) the Secretariat had not received any proposals for sturgeon caviar and meat export quotas for the quota year 1 March 2009 to 28 February 2010 that met the requirements of Resolution Conf. 12.7 (Rev. CoP14).

Capacity building and the evaluation of the assessment and the monitoring methodologies used for shared stocks

8. In order to support range States in the development of a strategy including action plans for the conservation of Acipenseriformes, and to assist the Animals Committee in carrying out an evaluation of the assessment and the monitoring methodologies used for shared stocks of Acipenseriformes, the Secretariat developed contacts with the World Bank and Food and Agriculture Organization of the United Nations (FAO). FAO has a Technical Cooperation Programme project "Capacity building for the recovery and management of the sturgeon fisheries of the Caspian Sea" worth USD 380,000 and World Bank has established a project on "Caspian Fisheries Management" with a planned budget of USD 990,000.

9. The two organizations hosted an initial Caspian Fisheries Technical Workshop with range States in Rome from 28 to 30 April 2008. The Secretariat participated, in particular to promote the holding of a workshop to review existing sturgeon stock assessment/Total Allowable Catch determination methodology and to elaborate a scientific methodology that is internationally acceptable, using the FAO review on the Caspian Sea stock assessment methodology. Such a workshop had been proposed by the Animals Committee at its 23rd meeting (Geneva, April 2008).

10. At the Caspian Fisheries Technical Workshop, participants agreed on the *modus operandi* for the requested workshop on stock assessment and Total Allowable Catch determination methodologies. This event was held in Rome on 11-13 November 2008 with the participation of a representative of the Animals Committee and is reported on in document AC24 Doc. 12.2. Participants also agreed *inter alia* to hold further meetings focussing on hatchery operations, combating illegal fishing and illegal international trade, and support for the development of standards for genetic testing of sturgeon products that can be used to regulate international and domestic caviar trade and to identify biological units for fisheries management.

11. Concerning the Animals Committee's evaluation of the assessment and the monitoring methodologies used for shared stocks of Acipenseriformes other than in the Caspian Sea, the Secretariat has received information relating to the Azov Sea and Amur/Heilongjiang River shared stocks. For the Azov Sea, the Ukraine-Russian Commission concerning Fisheries in the Azov Sea (Berdiansk, Ukraine, 22-24 October 2008) agreed at its 20th session on a "Comprehensive technique of the stock assessment and TAC determination for sturgeon species in the Azov Sea" which is attached in the Annex to the present document in the language in which it was submitted. Regarding the Amur/Heilongjiang River, mandated by the 18th meeting of the China-Russia Fishery Mixed Committee (Moscow, Russian Federation, 15-19 September 2008), a meeting of specialists took place in Harbin (China, 18-20 November 2008) and they agreed that the evaluation approach presented in Annex 2 of document AC23 Doc. 13.2 (Rev. 1) still applied and that this methodology would be confirmed at a China-Russia fishery conference scheduled for March 2009. For the North-West Black Sea and Lower Danube shared stock, no additional information to that found in Annex 3 of document AC23 Doc. 13.2 (Rev. 1) has been received by the Secretariat.

12. At its 23rd meeting the Committee recommended that the evaluation of the assessment and the monitoring methodologies used for the shared stocks of Acipenseriformes mentioned in paragraph 10 above be reviewed in a manner similar to that performed for the Caspian Sea assessment (by FAO if possible), and that the Secretariat promote the holding of a workshop to review existing sturgeon stock assessment / Total Allowable Catch (TAC) determination methodology and elaborate a scientific methodology that is internationally acceptable. Whilst the Secretariat will endeavour to do this, it notes that the responsibility for this evaluation rests with the Animals Committee and that the Conference of the Parties has not foreseen the raising of external funds for this exercise.

Trade controls

13. The caviar trade database continues to be operated by UNEP-WCMC and the Secretariat is pleased to note that the submission of copies of permits and certificates appears to have improved in recent months. Timely submission of documents by Parties is essential for the database to be effective.

14. Aquaculture continues to be an increasing and major source of caviar in international markets and the Secretariat continues to encourage close monitoring of such operations by national authorities. It welcomed the opportunity, during a mission to Saudi Arabia in November 2008, to inspect an operation recently established there.

15. Illegal trade in caviar, although apparently not as active as earlier in this decade, undoubtedly continues and the Secretariat distributes whatever intelligence it receives on this subject. Alert No. 33, issued in January 2009, relates to a specific form of illegal trade in caviar.

Conclusion

16. The Committee is invited to note the contents of this report.

Comprehensive technique of the stock assessment and TAC determination for the sturgeon species in the Azov Sea

[As agreed by the Ukraine-Russian Commission concerning Fisheries in the Azov Sea at its 20th session (Berdiansk, Ukraine, 22-24 October 2008)]

Stock assessment

The sturgeon species stocks in the Azov basin were assessed with methods of biological statistics till the late 1960s (Makarov, 1970).

Since 1958, scientists have assessed the abundance of the Azov Sea demersal fish species through direct counts in trawl catches taken at particular stations during biomass surveys. In the early 1970s, this technique became the principal one in determination of abundance and biomass of the Azov sturgeon species.

The population abundance (N) is computed with a common formula (Mayskiy, 1967):

$$N = x \cdot F / f \cdot q, \text{ where} \quad (1)$$

$\bar{x}$ is the mean catch at a given station,

F is the area of the sea (region),

f is the area covered by the given gear,

q is the catchability coefficient.

The trawling area is computed with the following formula:

$$f = v \cdot t \cdot l, \text{ where} \quad (2)$$

v is the trawling velocity, m/min;

t is the trawling time, min;

l is the length of the trawl horizontal opening, m.

Empirically, we have found that the optimal time of trawling equals 30 minutes and the trawling velocity totals 1,5 m/s.

The length of the trawl horizontal opening (i.e. distance between the boards) depends on the trawl size and resistance, the board performance, as well as the trawl length, and could be determined with the help of the following techniques:

1. To test the angle (α) between warps with the known length (a): $l = 2a \cdot \sin(\alpha/2)$
2. To tie buoys to the boards and measure the distance between the buoys floating on the surface.
3. To tie the trawl boards with threads of the definite length and observe at what length the thread does not break.

Determination of the catchability coefficients is a rather difficult task. Table 1 summarizes catchability coefficients which have been used for the Azov sturgeon species for many years; these coefficients were estimated through comparison of biological statistics and direct counts, as well as determination of the fish abundance on basis of catches taken with mobile and stationary fishing gear.

Table 1 – Catchability coefficients of various fishing gear used to catch the Azov sturgeon species

Species	Catchability coefficients
	Trawl
Starred sturgeon	0.50
Russian sturgeon	0.50

Traditionally, the mean catch at a given station is computed as the arithmetic mean of catches taken at all the surveyed stations:

$$x = \frac{\sum_{i=1}^{n} x_i}{n}, \text{ where} \tag{3}$$

x_i is the catch at a station and

n is the number of the surveyed stations.

Here, the essential condition for use of the arithmetic mean is that fish is uniformly or normally distributed over the entire sea area. But as a rule, catches at the stations were distributed asymmetrically. J.W.Tukey showed that the more the actual distribution differed from the normal one, the less the arithmetic mean fitted the role of a reliable value of the distribution center (cited by Dubrov, 1978). To get a more reliable estimate of the mean catch of the sturgeon species we have also used other mean values.

1. Transformation of the asymmetric distribution to the normal one

First of all, we could normalize the asymmetric distribution through the following transformation (Klepikov and Sokolov, 1964):

$$y(x) = \int \frac{dx}{h(x)}, \text{ where} \tag{4}$$

x is the initial random variable,

$h(x)$ is the function which represents relationship between the mean deviation and the standard one for different samples from a general population:

$$\sigma_{x_i} = h(x_i) \tag{5}$$

Such relationships are often represented by the following expression:

$$h(x) = a + b \cdot x \tag{6}$$

Finally, we obtain the transformation formula:

$$y(x) = \frac{1}{b} \ln|a + b \cdot x| \tag{7}$$

After computing the arithmetic mean of the normalized series, we can translate the mean value into the initial data with the following formulas:

$$X_{cp} = \frac{1}{b} e^{b \cdot \left(y_{cp} + \frac{\sigma_y^2}{2} \right) - a}, \tag{8}$$

$$\sigma_x^2 = e^{2 \cdot y_{cp} + \sigma_y} \cdot e^{\sigma_y^2 - 1} . \tag{9}$$

2. Rule of "three σs".

Assuming that catches taken at different stations are normally distributed (which is sometimes true for some populations), we can use the rule of 3σs and reject extreme values which have significant influence on the mean value of the catch, but are highly improbable (Ventcel, 1970). First, we should find the arithmetic mean of catches taken at all the surveyed stations and the standard deviation, and then develop the confidence interval: $x_{mean} - 3\sigma <= x_i <= x_{mean} + 3\sigma$. The catch values which do not fit into the interval are rejected; the rest are used to reestimate the mean value and the standard deviation.

3. α - truncation.

The mean catch could be also assessed with the α - truncation and α - winsorization techniques (Gasukov, 1975). In accordance with the α - truncation method, the initial data are arranged in an ascending order and values of α are set in the interval (0.0, 0.5). The preset number of the extreme values [α*n] are rejected. The rest are used to compute the mean catch:

$$C_t(\alpha, n) = \frac{1}{n - 2 \cdot [\alpha \cdot n]} \cdot \sum_{i=1+[\alpha \cdot n]}^{n-[\alpha \cdot n]} y_i , \tag{10}$$

where [α*n] is the integral part of a number, determined as [α*n+0.5].

Dispersion is found with the following formula:

$$\sigma_t^2(\alpha) = \frac{1}{(1 + 2 \cdot \alpha)^2} \cdot \frac{1}{n \cdot (n-1)} \cdot \left(\sum_{i=[\alpha \cdot n]+1}^{n-[\alpha \cdot n]} (y_i - C_t(\alpha, n))^2 + 2 \cdot \alpha \cdot (y_{[\alpha \cdot n]+1} - C_t(\alpha, n))^2 \right) , \tag{11}$$

4. The α - winsorization method

Similarly to the above mentioned technique, there is an arrangement of the initial series with the choose of the α value. Then, the mean catch is found with the following formula:

$$C_w(\alpha, n) = \frac{1}{n} \cdot \left(\sum_{i=[\alpha \cdot n]+2}^{n-[\alpha \cdot n]-1} y_i + [\alpha \cdot n] \cdot \left(y_{[\alpha \cdot n]+1} + y_{n-[\alpha \cdot n]} \right) \right) \tag{12}$$

Dispersion is determined as follows:

$$\sigma_w^2(\alpha)=\frac{1}{n\cdot(n-1)}\cdot\left(\sum_{i=[\alpha\cdot n]+1}^{n-[\alpha\cdot n]}(y_i-C_w(\alpha,n))^2+[\alpha\cdot n]\cdot\left(y_{[\alpha\cdot n]+1}-C_w(\alpha,n)\right)^2+[\alpha\cdot n]\cdot\left(y_{n-[\alpha\cdot n]}-C_w(\alpha,n)\right)^2\right) \quad (13)$$

The mean values obtained with formulas (10) and (12) are biased. To reduce the bias we should make additional transformations:

$$C_n^o=\frac{1}{n}\cdot\sum_{i=1}^{n}C_{n_i}^o; \quad (14)$$

$$C_{n_i}^o=n\cdot C_n(y_1,y_2\ldots y_n)-(n-1)\cdot C_{n-1}(y_1,y_2\ldots y_{i-1},y_{i+1}\ldots y_n), \text{ where} \quad (15)$$

C_n is the mean value.

Besides, there is software which allows for the fish stock assessment without computing of the mean catch, e.g. SURFLINE based on the SURFER utility. The sea is divided into 650×650 squares, which allows for a fairly precise determination of the area of the surveyed region, the fish stock and areas with different density of the fish distribution, as well as the total stock. This tool produces a map of the Sea of Azov with distribution of the surveyed object either in the bay, or in the proper sea, or both in the bay and the proper sea, etc. We can even obtain zones of a high mortality of fish due to the oxygen deficit. SURFLINE produces a table which contains the stock levels, areas with the preset density, and the total stock size.

Another approach to the stock assessment without computation of the mean catch is the area method (e.g. FISHERY and Ichthyoanalyst software). This technique allows for drawing isolines of areas with the same density of the fish distribution.

With both these approaches, the input data are taken from the data base which comprises observations collected during ichthyologic surveys.

Upon the ichthyologists' requests, the same materials could be used to perform the following:

1. Stock assessment.

The assessment included eleven regions in the Sea of Azov:

1. The eastern bay;

2. The western bay;

3. The Kamyshivat region;

4. The Akhtarsk region;

5. The Achuev region;

6. The Temruk region;

7. The central region;

8. The south-western region;

9. The Obitochniy bay;

10. The Berdyansk bay;

11. The Belosaraysk bay.

The areas of the regions are determined automatically: the software uses the reference and adds together all areas of the squares in the given region. The mean catch at a station in the given region is represented by the arithmetic mean in the given region.

Abundance of different size groups of fish (i.e. commercial-sized fish, undersized fish, and yearlings) should be assessed separately.

The obtained values allow for determination of the age composition of the given population (either the total, or by regions). The following variables are computed:

- Abundance of fish in each age group;
- Percentage of fish of each age group;
- Abundance of mature fish; and
- Percentage of mature fish.

2. Composition of the size variation series.

The size variation series can be built on various scales: a fishing square, a region, or a total basin. Three kinds of requests are possible:

- abundance + percentage;
- abundance + weight; and
- mean variables.

There are two reports produced for each of the first requests: one on the fish of the commercial size and undersized fish and the other on yearlings. Our specialists have developed transfer of data to the Excel utility to be able to draw diagrams, etc.

3. Computation of mean variables.

It is possible to compute mean variables for each region and all the surveyed regions altogether. The results are presented as follows:

Size groups	L mean, cm	W mean, g
Commercial size	**NNN**	**NNNNN**
Undersized fish	**NNN**	**NNNNN**
TOTAL	**NNN**	**NNNNN**
Yearlings	**NN**	**NNN**

4. Determination of the age composition.

In this case, it is possible to obtain tables with the following variables for each age group:

i. Total: Abundance and percentage.
    - Females: Abundance and percentage.
    - Males: Abundance and percentage.
    - Non-identifiable sex (NIS): Abundance and percentage.

    Total: females, males, NIS: Weight and percentage.

ii. Mature fish (abundance and weight):
    - Females, percentage mature females of the total females,
    - Males, percentage mature males of the total males,
    - Both females and males, percentage of the total.

iii. Four groups (juvenile fish, females, males, and total for each age groups):
    - Mean length,
    - Mean weight,

- Abundance, and
- Percentage of the total abundance

iv. An extended request concerning the same four age groups could include the following variables:

- Mean length,
- The length range (min-max),
- Mean weight,
- The weight range (min-max),
- Abundance,
- Percentage of the total abundance,
- Weight,
- Percentage of the total weight, and
- Percentage of the mature fish (except the juvenile fish)

It is possible to make estimates for each preset region or for the entire selected area of distribution.

5. The size-at-age variation series.

The resultant tables are similar to the above mentioned ones, but in this case there is indication of a mean age for each size group.

For the age composition and the size-at-age variation series, it is possible to plot diagrams, charts, and histograms with one or four variables.

6. The size-at-age key.

Here, the table includes the percentage of fish in each size-at-age group. Additionally, there is the total percentage and abundance for each size group.

7. Feed stocks.

For each kind of feed organisms, the table presents frequency of occurrence separately in the proper sea and in the Taganrog Bay.

The total allowable catch (TAC) forecast for one or two years, or even longer terms requires evaluation of rates of natural and fishing mortality. If there is ample information about the age composition of the population and about commercial catches, the assessment will be quite easy. The computation is made with the common formulas (Zasosov, 1976). Rates of the instant mortality are found with the following formulas:

Total mortality:

$$Z = \ln (N_i/N_{i+1}), \text{ where} \tag{16}$$

Z is the rate of the total instant mortality,
N_i, N_{i+1} are the abundance of the generation at age I and in the subsequent year.

Natural mortality:

$$M = - \ln (N_{i+1} - C_{i+1}))/N_i, \text{ where} \tag{17}$$

M is the rate of the instant natural mortality,
C_{i+1} is the catch of the generation at age i+1.

Fishing mortality:

$$F = \ln (C_i/N_i). \tag{18}$$

Rates of the annual total, natural, and fishing mortality are calculated with the following formulas:

Total mortality:

$$\varphi = (N_i - N_{i+1})/ N_i. \tag{19}$$

Natural mortality:

$$\varphi_M = (N_i - C_i)/ N_i \tag{20}$$

Fishing mortality:

$$\varphi_F = C_i / N_i \tag{21}$$

Scientists have developed a program to compute rates of the instant and annual mortality (natural, fishing, and total). These rates are determined by age groups. As there are errors in the abundance assessment on the levels of both populations and generations, it has become conventional to decrease errors in computation of the mortality rates through finding mean rates for age groups of several generations which dwell in similar habitats. The mortality rates should be revised each time when there are any abrupt changes in feed stocks, fishery intensity, the fish stock abundance, reproduction conditions, etc.

Mortality rates of the Azov sturgeon species are computed for various periods and various levels of the year-class strength. Proceeding with the TAC forecast, an expert determines the population state and what rates of mortality are more appropriate.

FORECAST OF THE TOTAL ALLOWABLE CATCH

The essentials of the TAC forecast are generally the same for all fish species. One should know abundance, rates of natural and fishing mortality, mean weight in the age groups, maturation rates, and abundance of recruits in the given stock. Nevertheless, biological peculiarities of a fish species introduce some variations in forecast of the respective TAC.

The technique of the Azov sturgeon species TAC determination is a modification of 'conventional' biological statistics (see Babayan, 1985). The core of this technique is estimate of the expected catch of generations, which form the fish stock, under the preset catch level. Rates of fishing mortality are computed by age groups through the VPA analysis using data on the actual catch of generations and could be called weight factors, which make the basis for estimation of the rate of removal. Abundance of the generations in the fish stock is assessed with the use of the survey data.

The forecast abundance of individual generations is found with the following formula:

$$N_{t+1} = N_t \cdot e^{-(F_t + M_t)} , \quad \text{where} \tag{22}$$

F_t, M_t are rates of instant fishing and natural mortality, respectively.

A catch from a generation is computed as follows:

$$C_{t+1} = \frac{N_{t+1} \cdot F_{t+1}}{F_{t+1} + M_{t+1}} \cdot \left(1 - e^{-(F_{t+1} + M_{t+1})}\right) \tag{23}$$

VIF we know the abundance of generation R_{t+1} in year t+1 and the age distribution of the fishing mortality rate (F_i), we can determine the TAC:

$$TAC_{t+1} = w_i \cdot F^i_{t+1} \cdot R_{t+1} + \sum_{i=1}^{g-1} \frac{\left(w_{i+1} \cdot F^{i+1}_{t+1} \cdot N^i_t\right)}{F^{i+1}_{t+1} + M^{i+1}_{t+1}} \cdot \left(1 - e^{-\left(F^{i+1}_{t+1} + M^{i+1}_{t+1}\right)}\right) \cdot e^{-\left(F^i_t + M^i_t\right)} , \text{ where} \tag{24}$$

i is the age group index,

g is the index of the eldest age group in the fish stock.

The overall rate of removal (F) is distributed between age groups in accordance with the following relationship:

$$F_i = \varepsilon_i \cdot F \quad (25)$$

To draw the curve of a balanced catch, we should determined catches at various values of the fishing mortality rate (F).

In case of sturgeon species, this calculation is made for males and females separately. Because the maturation of the sturgeon species comes late, the recruitment is determined with the survey data. The TAC estimate is based on abundance of the spawning stock.

The basic input data are:

- abundance of generations in the given population in the year of the forecast development;

- rates of fishing mortality by age groups obtained with the VPA;

- rates of natural mortality by age groups.

Because of the biological peculiarities of sturgeon species (difference in the maturation age between females and males), all the calculations are made separately, for mature and immature females and males. Hence we classify generations by sex and maturation. Here, we use the modeling results, i.e. percentages of females, mature females, and males in the population under various degrees of intensity of the fish stock exploitation. The intensity of removal is identified by the sex ratio in the biological samples from catches taken at the inspection points.

The input data for the TAC determination are:

- rates of natural mortality by age groups of immature fish;

- rates of natural mortality by age groups of mature fish;

- mean weight by age groups of mature and immature fish (classified by sex);

- percentage of mature females, males, and females in the population (by age groups);

- abundance of the population (by age groups);

- rates of fishing mortality;

- rates of fishing removal.

Here is a short algorithm for calculating the TAC of sturgeon species:

1. Determination of the female and male abundance in the population:

$$ZISSK_i = ZIS_i \cdot PRSK_i; \quad (26)$$

$$ZISSM_i = ZIS_i \cdot ZISSK_i, \text{ where} \quad (27)$$

ZIS_i is the abundance of age group *i*;

$ZISSK_i$, $ZISSM_i$ are the abundance of females and males in age group *i*, respectively;

$PRSK_i$ is the percent of females in age group *i*.

2. Determination of the mature female and male abundance:

$$ZISKZ_i = ZISSK_i \cdot ZRELSK_i; \quad (28)$$

$$ZISMZ_i = ZISSM_i \cdot ZRELSM_i, \text{ where} \quad (29)$$

$ZISKZ_i$, $ZISMZ_i$ are the abundance of mature females and males in age group *i*, respectively;

$ZRELSK_i$, $ZRELSM_i$ are the percent of mature females and males, respectively.

3. Determination of abundance of immature fish in the 1st year of the forecast term (this is the difference between the total abundance and the abundance of the mature stock).

4. Calculation of biomass of mature, immature females and males.

5. The preset overall rate of fishing mortality (*F* is the fishing intensity) is distributed between age groups in accordance with the following relationship:

$$F_i = \varepsilon_i \cdot F, \text{ where} \quad (30)$$

F_i is the rate of fishing mortality for age group *i*;
ε_i is the proportionality constant or the age factor of the fishery selectivity.

6. Catch in the current year is estimated for each age group in the mature stock..

$$CATCH_{i,j} = ZREL_{i,j} \cdot F_j/Z_j \cdot (1-\exp(-Z_j)). \quad (31)$$

7. Abundance of females and males for the subsequent year is calculated in accordance with the formula:

$$ZIS2_{i+1,j} = ZISN_{i,j} \cdot \exp(-yest_j) + ZREL_{i,j} \cdot \exp(-Z_j). \quad (32)$$

8. To determine abundance, biomass and catch of mature and immature fish follow steps 2-6.
Biomass is calculated with the weights by age groups of mature and immature females and males.

The determined values of possible catches at various rates of fishing mortality allow us to draw the curve of a balanced catch and to determine the TAC.

This technique was used by AzNIIRKh specialists to develop a program for Delphi.

Tables 2-11 summarize normative/reference data for Russian sturgeon and starred sturgeon which are used in the forecast development.

The program called "Model of populations of the Azov Russian sturgeon and starred sturgeon exploited with different intensity" provided the sex ratio and percentage of mature females and males. The mean weight of mature and immature females and males was based on the mean long-term data.

Table 2 – Mean weight of Russian sturgeon, Kg

Age	Females		Males	
	mature	immature	mature	immature
1	-	0.2	-	0.2
2	-	0.8	-	0.8
3	-	1.6	-	1.6
4	-	2.1	-	2.1
5	-	2.9	-	2.9
6	-	3.8	5.8	4.0
7	-	4.9	7.4	5.0
8	-	6.0	8.2	6.1
9	-	7.0	8.8	7.2
10	11.6	8.1	9.7	8.9
11	13.4	9.4	10.5	10.0
12	16.5	11.6	11.4	11.3
13	18.9	13.5	13.1	12.8
14	20.0	15.5	14.1	13.8
15	21.6	16.7	15.5	15.1
16	22.3	17.4	15.8	15.4
17	23.6	18.3	16.7	16.3
18	26.3	20.4	-	-
19	29.5	22.9	-	-
20	32.5	25.2	-	-
21	34.7	26.9	-	-
22	35.1	27.2	-	-

Table 3 – Number of females in the Russian sturgeon spawning stock, %

Age	Removed percentage									
	0.0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
11	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
12	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.9	1.9	1.9
13	8.6	8.8	9.1	9.3	9.6	9.9	10.2	10.5	10.9	11.2
14	15.4	16.3	17.2	18.1	19.2	20.6	22.1	23.9	25.8	28.2
15	23.9	25.7	27.6	29.7	32.2	35.4	39.1	44.0	49.6	57.3
16	39.6	42.1	44.8	47.7	50.9	54.9	59.3	64.7	70.5	77.6
17	51.0	54.4	57.9	61.6	65.6	70.3	75.3	80.8	86.4	92.7
18	48.0	51.9	56.1	60.5	65.3	70.8	76.6	82.8	88.8	94.8
19	43.1	47.5	52.3	57.5	63.3	70.0	77.0	84.4	90.8	96.5
20	43.5	47.4	51.7	56.4	61.7	68.0	74.9	82.5	89.5	95.9
21	53.1	56.4	60.0	63.9	68.1	73.2	78.7	84.9	91.0	96.9
22	73.1	75.6	78.2	80.6	83.2	86.1	88.9	91.9	94.8	97.8
23	77.3	79.6	81.9	84.2	86.5	89.0	91.5	94.0	96.3	98.6
24	80.6	82.6	84.5	86.4	88.3	90.4	92.4	94.5	96.4	98.3
25	93.8	94.6	95.3	96.0	96.7	97.4	98.1	98.7	99.2	99.7
26	98.0	98.3	98.5	98.7	98.9	99.2	99.4	99.6	99.8	99.9
27	98.9	99.1	99.2	99.3	99.4	99.5	99.6	99.7	99.8	99.9
28	99.8	99.8	99.9	99.9	99.9	99.9	99.9	100.0	100.0	100.0
29	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4 – Number of mature females in the Russian sturgeon population, %

Age	Removed percentage									
	0.0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
12	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
13	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.5	2.5
14	3.9	3.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
15	8.2	8.2	8.3	8.4	8.4	8.5	8.5	8.6	8.7	8.7
16	16.7	17.0	17.2	17.5	17.7	18.0	18.3	18.6	18.8	19.1
17	26.5	27.3	28.2	29.1	30.1	31.2	32.3	33.6	35.0	36.4
18	18.7	19.6	20.6	21.7	22.9	24.5	26.3	28.5	31.0	34.2
19	18.1	19.2	20.5	21.9	23.6	25.9	28.6	32.3	37.0	43.8
20	17.4	18.3	19.3	20.6	22.1	24.2	27.0	31.3	37.4	48.9
21	20.8	21.4	22.2	23.0	24.0	25.3	27.2	30.2	35.0	47.0
22	28.0	28.9	29.8	30.8	31.9	33.3	34.8	36.8	39.5	45.9
23	20.4	21.5	22.7	24.1	25.7	27.8	30.5	34.5	40.8	58.9
24	19.7	20.8	22.2	23.7	25.6	28.2	31.6	36.7	45.2	77.6
25	19.2	20.2	21.3	22.7	24.5	27.0	30.8	37.3	51.0	100.0
26	24.0	24.6	25.2	26.1	27.2	29.0	31.9	38.0	56.8	100.0
27	38.0	38.4	38.8	39.5	40.3	41.8	44.6	51.9	88.9	100.0
28	37.8	38.6	39.5	40.7	42.4	45.3	51.2	69.4	100.0	100.0
29	47.2	48.6	50.3	52.5	55.9	62.1	76.3	100.0	100.0	100.0

Table 5 – Number of mature males in the Russian sturgeon population, %

Age	Removed percentage									
	0.0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
6	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
9	7.6	7.6	7.6	7.6	7.7	7.7	7.7	7.7	7.7	7.7
10	12.9	13.0	13.2	13.3	13.4	13.6	13.7	13.8	14.0	14.1
11	22.3	22.8	23.4	23.9	24.5	25.1	25.7	26.4	27.1	27.8
12	23.4	24.3	25.3	26.3	27.5	28.8	30.3	32.1	33.9	36.1
13	26.4	27.6	28.9	30.3	31.9	34.0	36.5	39.7	43.4	48.5
14	22.2	23.0	24.0	25.0	26.3	28.1	30.3	33.5	37.9	45.2
15	27.2	28.0	29.0	30.0	31.1	32.6	34.4	36.8	40.3	46.8
16	27.4	28.8	30.2	31.9	33.8	36.3	39.4	43.8	50.3	64.0
17	28.4	29.6	31.0	32.6	34.4	36.8	39.9	44.2	50.5	65.9
18	24.7	25.5	26.4	27.5	28.8	30.7	33.3	37.5	44.9	73.2
19	33.8	34.3	34.8	35.5	36.3	37.6	39.6	43.4	52.3	100.0
20	42.7	43.4	44.2	45.3	46.6	48.8	52.3	59.7	81.5	100.0
21	52.2	53.1	54.1	55.4	57.1	60.0	65.3	79.7	100.0	100.0
22	53.6	54.9	56.6	58.8	62.2	68.6	83.5	100.0	100.0	100.0
23	59.6	62.1	65.5	70.8	80.1	100.0	100.0	100.0	100.0	100.0
24	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
25	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
27	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
28	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 6 – Number of females in the Russian sturgeon population, %

Age	Removed percentage									
	0.0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
6	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
7	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
8	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.1
9	50.0	50.1	50.1	50.2	50.2	50.3	50.4	50.4	50.5	50.5
10	50.0	50.3	50.6	50.8	51.0	51.3	51.6	51.8	52.1	52.4
11	50.1	50.7	51.3	51.9	52.5	53.1	53.8	54.4	55.1	55.8
12	50.2	51.4	52.6	53.8	55.1	56.5	58.0	59.5	61.1	62.8
13	50.4	52.2	54.1	56.0	58.0	60.3	62.8	65.6	68.4	71.5
14	50.7	53.1	55.7	58.4	61.2	64.6	68.3	72.4	76.6	81.5
15	51.1	54.0	57.1	60.3	63.7	67.8	72.2	77.1	82.1	87.8
16	51.8	55.1	58.7	62.4	66.4	71.0	75.9	81.2	86.4	92.1
17	52.8	56.4	60.2	64.2	68.6	73.7	79.0	84.7	90.2	95.9
18	55.0	58.4	62.1	66.0	70.2	75.2	80.6	86.4	92.0	97.5
19	58.5	61.7	65.1	68.7	72.6	77.3	82.3	87.9	93.3	98.4
20	65.4	68.1	71.0	74.0	77.3	81.1	85.2	90.0	94.9	98.0
21	74.0	76.2	78.6	81.0	83.6	86.6	89.9	93.7	96.7	98.5
22	83.9	85.5	87.1	88.8	90.6	92.7	95.1	96.9	97.9	99.0
23	90.9	91.9	92.9	94.0	95.2	96.7	97.2	97.8	98.4	99.1
24	95.5	95.8	96.1	96.4	96.7	97.1	97.5	97.9	98.3	98.7
25	98.7	98.9	99.0	99.1	99.2	99.3	99.4	99.5	99.6	99.7
26	99.5	99.6	99.6	99.7	99.7	99.8	99.8	99.9	99.9	99.9
27	99.6	99.6	99.7	99.7	99.7	99.8	99.8	99.8	99.8	99.9
28	99.9	99.9	99.9	99.9	100.0	100.0	100.0	100.0	100.0	100.0
29	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 7 – The starred sturgeon mean weight, Kg

Age	FEMALES		MALES	
	mature	immature	mature	immature
1	-	0.1	-	0.1
2	-	0.8	-	0.8
3	-	1.6	-	1.6
4	-	3.3	3.4	3.2
5	-	3.9	3.8	3.7
6	6.0	4.5	4.5	4.3
7	6.6	5.3	5.3	4.9
8	7.3	6.0	5.9	5.4
9	8.0	6.5	6.5	5.9
10	8.7	7.1	6.9	6.2
11	9.4	8.0	7.2	7.1
12	10.2	8.4	8.0	7.9
13	11.6	9.4	8.5	8.4
14	12.2	10.5	9.0	8.9
15	13.0	11.4	9.6	9.5
16	13.6	12.5	10.2	10.1
17	14.3	13.4	10.6	10.5
18	15.1	14.7	12.2	12.1
19	15.9	15.4	12.7	12.6
20	16.6	16.1	13.2	13.1
21	18.7	18.1	13.7	13.6
22	19.7	19.1	14.2	14.1
23	20.7	20.1	14.7	14.6
24	21.7	21.0	15.2	15.0
25	22.7	22.0	15.7	15.5
26	23.7	23.0	16.2	16.0
27	24.7	24.0	16.7	16.5
28	25.7	24.9	17.2	17.0

Table 8 –Number of females in the starred sturgeon spawning stock, %

Age	Removed percentage									
	0.0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
7	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
8	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
9	4.0	4.0	4.1	4.1	4.2	4.3	4.3	4.4	4.4	4.4
10	14.8	15.5	16.3	17.2	18.2	19.2	20.5	21.9	22.4	23.2
11	35.8	37.9	40.3	43.0	46.1	49.5	53.6	58.5	60.5	63.3
12	40.5	43.0	46.1	49.4	53.4	58.0	63.6	70.5	73.4	77.5
13	53.0	55.8	59.1	62.5	66.4	70.7	75.5	81.0	83.1	86.1
14	55.4	59.0	63.0	67.1	71.5	76.1	80.8	85.8	87.7	90.0
15	51.3	55.6	60.5	65.6	71.2	77.0	82.8	88.6	90.6	93.0
16	53.9	57.5	61.8	66.2	71.4	76.9	82.9	89.1	91.3	94.0
17	58.1	61.2	64.8	68.5	72.8	77.4	82.4	87.9	90.0	92.6
18	75.3	77.7	80.3	82.8	85.5	88.1	90.8	93.4	94.4	95.7
19	78.8	81.2	83.8	86.1	88.5	90.8	93.1	95.2	95.9	96.9
20	90.5	91.8	93.1	94.3	95.6	96.7	97.7	98.6	98.9	99.2
21	93.2	94.0	94.8	95.6	96.4	97.1	97.8	98.5	98.8	99.1
22	96.2	96.6	96.9	97.3	97.7	98.0	98.4	98.8	98.9	99.1
23	98.8	99.0	99.1	99.3	99.4	99.5	99.6	99.7	99.7	99.8
24	99.3	99.4	99.5	99.6	99.6	99.7	99.8	99.9	99.9	99.9
25	99.3	99.4	99.5	99.5	99.6	99.7	99.7	99.8	99.8	99.9

Table 9 – Number of mature females in the starred sturgeon population, %

Age	Removed percentage									
	0.0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
7	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
8	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
11	13.6	13.6	13.7	13.8	13.8	13.9	14.0	14.1	14.1	14.1
12	17.6	17.9	18.2	18.5	18.8	19.1	19.4	19.8	19.9	20.1
13	24.9	25.8	26.7	27.6	28.7	29.8	31.1	32.4	33.0	33.6
14	20.1	21.3	22.6	24.1	25.9	27.9	30.3	33.2	34.4	36.0
15	18.9	20.2	21.7	23.5	25.7	28.4	32.0	36.8	39.0	42.3
16	21.6	22.3	23.2	24.2	25.5	27.3	29.9	33.9	36.0	39.5
17	22.1	22.6	23.4	24.2	25.2	26.6	28.6	31.9	33.8	37.1
18	29.9	30.9	32.0	33.3	34.8	36.6	39.1	43.0	45.2	49.3
19	26.6	27.8	29.2	30.8	32.7	35.1	38.3	43.3	46.2	51.7
20	33.9	35.2	36.8	38.8	41.3	44.8	49.9	59.5	65.9	80.4
21	31.8	33.0	34.6	36.5	39.3	43.5	51.0	70.0	87.6	100.0
22	41.3	42.5	44.2	46.5	50.0	56.0	69.4	100.0	100.0	100.0
23	44.2	46.3	49.2	53.2	60.1	73.8	100.0	100.0	100.0	100.0
24	56.6	60.3	66.0	74.8	93.5	100.0	100.0	100.0	100.0	100.0
25	65.1	74.1	91.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 10 – Number of mature males in the starred sturgeon population, %

Age	Removed percentage									
	0.0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
5	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
6	11.2	11.2	11.3	11.3	11.3	11.4	11.4	11.4	11.5	11.5
7	22.5	22.8	23.2	23.5	23.8	24.2	24.6	24.9	25.1	25.3
8	28.8	29.9	31.1	32.3	33.7	35.1	36.7	38.5	39.2	40.1
9	25.9	27.4	29.1	30.9	33.2	35.9	39.1	43.2	44.9	47.4
10	21.8	22.7	23.8	25.0	26.7	28.8	31.7	36.0	38.0	41.3
11	28.7	29.4	30.2	31.2	32.4	33.9	36.1	39.5	41.3	44.4
12	33.2	34.2	35.4	36.5	37.8	39.3	40.9	42.9	43.9	45.3
13	31.7	33.4	35.3	37.5	40.1	43.2	47.0	52.3	54.7	58.7
14	26.0	27.2	28.8	30.6	33.2	36.6	41.5	50.0	55.0	64.4
15	33.1	33.9	35.0	36.3	38.2	41.0	45.8	56.1	63.9	84.2
16	43.5	44.2	45.0	46.0	47.6	50.1	55.1	70.4	87.5	100.0
17	55.3	56.8	58.9	61.5	65.6	72.5	88.1	100.0	100.0	100.0
18	59.1	62.2	66.7	73.2	85.2	100.0	100.0	100.0	100.0	100.0
19	77.8	85.2	98.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0
20	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
21	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
22	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
23	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
24	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
25	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 11 – Number of females in the starred sturgeon population, %

Age	Removed percentage									
	0.0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
4	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
5	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
6	50.1	50.2	50.3	50.3	50.4	50.5	50.6	50.7	50.7	50.7
7	50.4	50.8	51.1	51.5	51.8	52.2	52.6	53.0	53.1	53.3
8	51.0	51.9	52.9	53.8	54.9	55.9	57.0	58.1	58.5	59.1
9	51.9	53.5	55.3	57.2	59.2	61.4	63.7	66.2	67.2	68.5
10	52.8	55.1	57.7	60.4	63.4	66.7	70.4	74.5	76.1	78.3
11	54.1	56.8	59.8	63.0	66.6	70.5	74.9	79.8	81.8	84.4
12	56.2	59.1	62.5	65.9	69.8	74.0	78.6	83.8	85.9	88.6
13	58.9	62.1	65.7	69.3	73.4	77.7	82.3	87.3	89.1	91.5
14	61.6	64.8	68.4	72.1	76.3	80.7	85.3	90.1	91.9	94.2
15	64.8	67.8	71.2	74.7	78.6	82.8	87.3	92.2	94.0	96.4
16	70.2	72.9	75.9	78.9	82.3	85.9	89.9	94.4	96.2	97.5
17	77.6	79.9	82.3	84.7	87.4	90.3	93.5	95.8	96.4	97.1
18	85.8	87.5	89.5	91.4	93.5	95.3	96.2	97.1	97.4	97.8
19	91.6	93.0	94.6	95.3	95.9	96.6	97.2	97.9	98.1	98.4
20	96.5	96.9	97.4	97.7	98.1	98.5	98.8	99.1	99.3	99.4
21	97.7	97.9	98.1	98.3	98.5	98.7	98.9	99.0	98.9	99.1
22	98.4	98.5	98.6	98.7	98.8	98.9	98.9	98.8	98.9	99.1
23	99.5	99.5	99.6	99.6	99.6	99.6	99.6	99.7	99.7	99.8
24	99.6	99.6	99.7	99.7	99.7	99.7	99.8	99.9	99.9	99.9
25	99.5	99.5	99.5	99.5	99.6	99.7	99.7	99.8	99.8	99.9

Reference: All citations are taken from the "Methodology of fishery and conservation studies in the Azov and Black seas" – Krasnodar, 2005, 352 p. in Russian.