

TOTAL ALLOWABLE CATCH (TAC) ESTIMATION FOR STURGEON SPECIES IN THE CASPIAN SEA¹

Introduction

The amount of sturgeon that can be harvested from the Caspian Sea is determined through two independent methods widely used in fisheries management worldwide. The four former CIS countries (Azerbaijan, Kazakhstan, Russian Federation, Turkmenistan) developed a method for deriving total allowable catch (TAC) limits from sample trawling to estimate the abundance of each species, the number of reproductively mature individuals and the probable size of the spawning stock for that year. The Islamic Republic of Iran uses a catch-per-unit-effort (CPUE) stock assessment within an adaptive management approach to determine total allowable catch limits. Both groups of countries have a considerable time series of data on sturgeon stocks and catches, and have used their methods to adjust TACs upwards or downwards as circumstances require. The Caspian States are aware that the two methods are complementary but not directly compatible, but will over the coming year, as part of their undertakings in the Paris Agreement concerning the development of a regional fisheries management and conservation strategy, work towards the use of a standard method applicable to all five countries.

It has been said that the Caspian States have not been able to adjust TACs effectively to compensate for illegal fishing. It should be noted that both the trawl-based and catch-per-unit-effort methods of stock assessment can be used as valid indicators of the status of stocks, including the impact of illegal fishing. It may consequently be asked why catches appear to have declined or stabilized at a relatively low level if TACs were effective as claimed. The fishing of sturgeons primarily involves the fraction of the reproductively mature stock that becomes reproductively active each year. The size of this fraction depends on the age structure of the stock. Sturgeon stocks currently have relatively uneven age structures, possibly as the result of variable spawning success and thus recruitment in previous years. The spawning component of each stock consists primarily of individuals that have recently reached sexual maturity, as well as smaller numbers of individuals from older year classes that will spawn for the second or subsequent time.

It is well known that large-scaled illegal fisheries have occurred subsequent to the dissolution of the Soviet Union (i.e. primarily in the northern and central parts of the Sea), and several older year classes have been severely affected. Previous impacts from the loss of spawning grounds due to the damming of rivers and changes in the level of the Sea are also discernible in the age structure (and the abundance of stocks). The Caspian States have responded to these impacts in order to promote the recovery of sturgeon stocks by (1) embarking on one of the largest and longest-running fisheries enhancement (restocking) programmes in the world, while at the same time (2) drastically reducing catch limits. This stock enhancement programme could not have been implemented without continuing with legal harvesting, as the funding for enhancement is derived from the revenues from legal harvesting and trade. The outcome of these responses is (1) that sturgeon stocks in the Caspian Sea as a whole appear to have stabilized or are beginning to increase, and (2) that the age structures of the stocks are heavily biased to younger year classes as the result of the introduction of tens of millions of juvenile sturgeon over the past two decades.

These conditions are, in effect, ideal for recovery over the longer-term, even if the caviar yield from fisheries is likely to remain at relatively low levels for some time. It should also be noted

¹ *This report has been prepared by the Management Authority for Sturgeon of the Russian Federation, submitted by A. Moiseev, the First Deputy Chairman of the Committee, the Deputy Head of the CITES Sturgeon Management Authority of Russia, on behalf of the five littoral States of the Caspian Sea.*

that several stocks are effectively dependent on the introduction of individuals through the enhancement programme, because spawning in the wild is still severely compromised. While all States with rivers that could potentially be used for spawning, hope to be able to rehabilitate natural spawning to the greatest extent possible, it should be recognized that a major part of the Caspian sturgeon fisheries is based on, essentially, an artificial breeding programme. It could even be argued that several stocks should be considered as captive bred rather than wild, in the CITES context.

The Caspian States, while confident that the sharp decline in stocks has been halted, are fully aware that problems related to the management and recovery of sturgeon stocks are far from over. Efforts to improve cooperation amongst the States have been hampered by political changes within the region, very severe socio-economic problems, as well as an ongoing dispute about the status of the Caspian Sea. Recent advances have been made to improve cooperation amongst all five States, e.g. the unprecedented joint stock assessment survey of 2001 and the cooperative establishment of TACs for 2002 and export quotas in compliance with Decision 11.58 of CITES as well as the Paris Agreement. This agreement, established as the result of the significant trade review process of CITES, provides further opportunities to strengthen collaboration and develop a harmonized approach to sturgeon fisheries and conservation in the Caspian Sea. The five States have, for example, agreed to undertake a second stock assessment survey in the spring of 2002, partly to address deficiencies identified in the survey of 2002, but also to collect standardized information in another part of the annual cycle. A further improvement is envisaged for the setting of TACs and export quotas for 2003, namely to harmonize the methods used to derive TACs.

What is the real status of the beluga *Huso huso*?

Concern has been expressed by certain groups concerning the status of the beluga *Huso huso* in the Caspian Sea. This species is the most valuable of the sturgeon species in the Caspian Sea, and one of the world's largest fish species that occur (for part of its life cycle) in fresh water.

Although undoubtedly affected by illegal fishing, the loss of spawning grounds and all the other environmental impacts on the Caspian Sea, the status of this species is far from precarious. For instance:

- The current estimate of the size of the stock in the northern Caspian Sea alone is in the order of 9 million individuals, based on the 2001 stock assessment trawl surveys (which, although relatively few belugas were caught compared to other species, represents a valid sampling design for estimating the size of a fish stock).
- An average number of 11.7 million beluga fingerlings have been produced in hatcheries (primarily in the Russian Federation, followed by Iran and Kazakhstan) and released per year (average for the 1996 to 2001 period).
- At a nominal survival rate of 1% (and actual survival rates, which depend on the size of the fingerling at the time of release, are estimated to range from 1.5% to 3%), 0.117 million mature individuals are thus effectively added to the Caspian stock each year (but note that all countries have started to rear beluga fingerlings to a larger size with dramatically higher survival rates).
- In 2001, the biomass of reproductively mature belugas amounted to 69.150t in the northern and central Caspian alone, representing 1.4 million individuals, of which approximately 5,000 individuals were expected to spawn in 2002.
- The average number of belugas caught per year in the period 1998 to 2001 was 2,913. In 2002, the catch quota for belugas in the Caspian Sea is c. 1780 individuals.

A. Determining sturgeon TAC in the northern and central Caspian Sea

The annual determination of TACs for sturgeons in this part of the Caspian is carried out according to the following steps:

1. Estimating the total abundance of Caspian sturgeon populations at sea

Estimating sturgeon abundance at sea is based on seasonal trawl survey data, collected in spring, summer, and autumn. The northern Caspian Sea is trawled by vessels (with main engines of 150-300 hp) using a 9 meter trawl; the middle and southern Caspian Sea are surveyed by SRTM-800 or RS-300 type vessels applying a 24.7 meter trawl.

Trawl surveys cover a fixed network of stations in the Caspian Sea. The areas surveyed are squares measuring 10 nm latitudinally by 7 nm longitudinally [one nautical mile (nm) equals 1 852 m]. The trawling velocity is kept at 2.5 kts and trawls last for half an hour. Each sampling square is trawled once.

The basic equation for assessing sturgeon abundance at sea is:

$$N = Sx/Kg$$

In this equation N is the estimated abundance of the sturgeon population, in individuals; S is the distribution area in m^2 ; x is the average number of individuals caught per trawl sample, K is the fishing efficiency of the applied gear, and g is the area of one trawling in m^2 .

(Note: The fishing efficiency of a 9 meter trawl in the northern Caspian Sea is taken as 0.1 for Russian sturgeon, 0.07 for stellate sturgeon, and 0.04 for beluga. The fishing efficiency of a 24.7 meter trawl in the middle and southern Caspian Sea for all the three species is taken as 0.1.)

2. Determining the total Caspian sturgeon stock (biomass)

The total stock of Caspian sturgeons (biomass) is estimated by multiplying the estimated number by the mean fish weight:

$$Bo = N\hat{w}$$

In this equation Bo is the total sturgeon stock (by weight); N is the estimated abundance of the sturgeon population, in individuals; and \hat{w} is the mean individual weight in kg.

3. Determining the size of the Caspian sturgeon fishing stock

The size of the sturgeon fishing stock (i.e. the stock of legally harvestable size, by weight) is estimated by multiplying the number of fish above the minimum length by the estimated abundance of individuals by the mean weight. The minimum length limits are established in regulations for fisheries in the Caspian Sea, and are ≥ 180 cm for beluga, ≥ 86 cm for Russian sturgeon and stellate sturgeon.

$$B_{n3} = aN\hat{w}$$

In this equation B_{n3} is the fishing stock (by weight); a is the number of fish above the minimum length requirement; N is the estimated abundance of a fish population expressed as the number of individuals, and \hat{w} is the mean individual weight in kg.

4. Determining the size of the Caspian sturgeon spawning stock

The sturgeon spawning stock (fishes at maturity stages III, III-IV, and IV, referring here to the stage of development of the oocytes), by weight, is determined by multiplying the number of mature fish by the mean weight, with the following equation:

$$B_H = (N_1\hat{W}_1) + (N_2\hat{W}_2) + (N_3\hat{W}_3)$$

In this equation B_H is the sturgeon spawning stock (by weight); N_1 , N_2 , and N_3 , are the numbers of fish at maturity stages III, III-IV, and IV respectively; and \hat{W}_1 , \hat{W}_2 and \hat{W}_3 , are the mean weight of individuals at maturity stages III, III-IV, and IV respectively.

Immunological and biochemical indices are used to determine the percentage of spawning stocks that migrate into Russian rivers. The current percentage of the beluga spawners that migrate into the Volga River is 50%, while the figures for Russian and stellate sturgeons are 80% and 44.6%, respectively.

Table A-1 summarizes the number of sturgeons caught during trawl surveys and passive catches.

Table A-1. Number of sturgeons caught in the feeding grounds of the Caspian Sea for population sampling

Year	Trawl catch			Net catch (passive catching)		
	<i>H. huso</i>	<i>A.gueldenstaedtii</i>	<i>A. stellatus</i>	<i>A. stellatus</i>	<i>H. huso</i>	<i>A.gueldenstaedtii</i>
1998	50	315	154	74	59	65
1999	37	349	116	45	21	81
2000	18	312	91	35	17	81
2001	73	382	89	12	22	84

At the present mean sea level of 27.0 m, the area of the northern Caspian Sea totals 104 600 m², and the possible survey area with depths of > 3 m extends to 61,800 m². Current surveys have, in fact, covered 51.1 - 63.65% of this area (see Table A-2).

Table A-2. Area of the Caspian Sea covered by trawl surveys (percent)

Parameters	1998	1999	2000	2001
Northern Caspian Sea				
Total area (km ² x 10 ³)	102.9	105.1	105.1	104.3
Area of a feasible survey at depths of 3 - 27 m (km ² x 10 ³)	60.8	62.1	62.1	61.6
Actual survey area at depths of 3 - 27 m (km ² x 10 ³)	38.7	33.7	34.6	31.5
Percentage of surveyed area in the northern Caspian Sea feeding grounds (3 – 27 m deep)	63.65	54.27	55.72	51.11
Middle and southern Caspian Sea (0-50 m)				
Total area (km ² x 10 ³)	97.6	98.0	98.0	97.8
Area of a feasible survey at depths of 10 – 50 m (km ² x 10 ³)	90.4	90.8	90.8	90.6
Actual survey area at depths of 10 – 50 m (km ² x 10 ³)	22.6	15.6	-	6.7
Percentage of the surveyed area in the middle and southern Caspian Sea feeding grounds (10 – 50 m deep)	25.0	17.2	-	7.4

Sturgeon abundance in the feeding grounds with depths of between 50-70 m is monitored in the middle and southern Caspian Sea. However, because of limitations on vessel equipment, it is not possible to survey deeper layers. Therefore, no more than 17.2 – 25.0 % of the feeding grounds are actually covered, and estimates of abundance are therefore considered to be conservative.

Table A-3 summarizes estimates of population size and biomass of sturgeons in the Caspian Sea and Table A-4 provides data on sturgeon abundance and fishing stock in the Ural River.

5. Determining allowable catches of sturgeon

Considering basic biological principles and the ability of each species to sustain certain fishing rates, tentative allowable catches can be determined that correspond to each of the stock estimations. This approach is based on Malkin's (1999)² theory of relationships between the reproduction rates (Ricklefs, 1976)³ and maturity-at-age rates for these populations. In the case of beluga, allowable removal is 9.4% of the stock, where 50% of individuals in the stock mature at 14 years of age. For Russian sturgeon, where 50% of individuals in the stock mature at 10 years of age, the allowable removal is 13.7%; and for stellate sturgeon, where 50% of individuals in the stock mature at 8 years of age, 16.7% may be removed.

² Malkin, E.M. 1999. Variability of reproduction and abundance in commercial fish populations. – Moscow, VNIRO, 146 p.

³ Ricklefs, R.E. 1976. The economy of Nature. A textbook in basic ecology. University of Pennsylvania. Chiron Press. Inc. Portland, Oregon, 390 p.

Natural mortality rates estimated with Turin's method (1968)⁴ are applied as a reference point for fishery management. These are used in an annual TAC review for sturgeons that is based on the given population status (e.g. growth rates, weight rates, maturity-at-age, and maximum age of the population). Retrospective estimates for the period of 1961-1995 show that mortality rates of Russian sturgeon stocks varied from 13.3 to 14%. Mortality rates of stellate sturgeon in the Volga River and the Ural River were in the range of 10.5-16.3%. These figures correspond with the Malkin estimates of the allowable catch limit for sturgeons.

For 2001, the mean catch limit was set at 14.3% for Russian sturgeon whose spawning stock includes individuals ranging from ages 7 to 30-35, while for stellate sturgeon, whose current age range is 20-21 years, the mean catch limit is set at 10%. This is likely to be associated with a significantly smaller scale of artificial reproduction of stellate sturgeon in hatcheries than Russian sturgeon.

6. Monitoring the status of sturgeon spawning stocks

Monitoring the status of sturgeon spawning stocks that migrate into rivers in the Russian Federation is done through trial fishing with a drag seine in the rivers. Trial fishing starts from when the ice starts melting in April, and carries on until the river freezes in October. This length of time is required to sample both races of the spawning stock, i.e. vernal spawners that enter rivers in spring to spawn, and ones that enter rivers later in the year to overwinter before spawning the following spring.

⁴ Turin, P.V. 1968. Biological foundation of fishery regulations for in-land basins. Moscow, Voprosi ikhtiologii, Vol. 8, No. 3 (50), 473-491.

Table A-3. Estimates of sturgeon population size and biomass in the Caspian Sea

Year	<i>H. huso</i>				<i>A. gueldenstaedtii</i>				<i>A. stellatus</i>			
	Number of individuals 10 ⁶	Fishing biomass t x 10 ³	Spawning biomass t x 10 ³	Mean weight kg	Number of individuals 10 ⁶	Fishing biomass t x 10 ³	Spawning biomass t x 10 ³	Mean weight kg	Number of individuals 10 ⁶	Fishing biomass t x 10 ³	Spawning biomass t x 10 ³	Mean weight kg
1998	7.6	23.3	0.1	27.3	23.0	69.1	1.4	5.5	11.6	51.9	1.0	5.0
1999	9.3	37.3	0.66	23.3	29.2	104.0	1.54	4.9	13.8	62.8	3.7	5.5
2000 *	5.0	20.0	0.41	21.0	23.1	104.0	1.035	7.0	10.4	41.8	2.47	5.5
2001	9.3	69.15	0.524	25.3	24.4	72.7	1.81	3.0	14.76	43.8	3.52	4.82

* only the northern Caspian Sea was surveyed

Table A-4. Estimated sturgeon abundance (numbers of fish) and fishing stock (in tons) in the Ural River, Kazakhstan

Year	<i>H. huso</i>	Fishing stock t	<i>A. stellatus</i>	Fishing Stock t	<i>A. gueldenstaedtii</i>	Fishing stock t	<i>A. nudiventris</i>	Fishing stock t
1998	2 400	197.6	103 600	839.2	11 500	189.8	6 300	145.1
1999	2 100	183.0	89 000	836.9	10 900	174.5	6 600	135.8
2000	2 500	226.7	97 000	785.3	10 500	171.8	7 200	118.8
2001	2 800	226.7	87 400	795.3	10 700	171.8	5 200	118.8

The river sampling sites are chosen with consideration of the intensity of the sturgeon run in all migration routes in the Volga River delta. The main sampling sites in the western part of the delta are the fishing sites *OGNEVKA-10* and *CHKALOVSKAYA* located 35-40 km from the coast, and the Kirov Bank, a fishing site of *SREDNE-RITAYA* located 32 km from the coast. The main sampling sites in the eastern part of the delta are the Berlin Bank, a fishing site of *OGNEVKA-5* located 30 km from the coast, and the main channel above the fishing zone (a fishing site of *MUZHICHYA*, located 245 km from the coast. The latter is used to determine the fishing intensity and the number of spawners that pass through to the remaining spawning grounds.

Quantitative indicators of the population structure, including assessment of stocks and abundance are derived from studies of the stock composition during spawning migrations to rivers. Assessment of abundance and biomass of sturgeon spawners that migrate into rivers is based on a modified biostatistical method of estimation using historical data sets on age composition and retrospective abundance estimates for year-classes that make up the core of the exploitable stock. The estimated abundances of year-classes are assessed annually. These assessments are based on data acquired directly from annual observations, including yields to the fishery of natural spawning and artificial reproduction, as well as actual data on fishing intensity. Actual catches-by-brood values are used for annual review of estimated catches of various sturgeon species (beluga, Russian sturgeon, and stellate sturgeon).

Long-term studies show that a representative sample can be obtained in six drag seinings. Fishes for the median sample are collected at random in accordance with statistical rules. Thus, the stock composition is fully represented. Numbers of sturgeons collected in the trial drag seines are presented in Table A-5.

Table A-5. Numbers of sturgeons caught during river sampling with drag seines in the Volga River delta

Species	1998	1999	2000	2001	Total
<i>H. huso</i>	266	281	236	180	963
<i>A. gueldenstaedtii</i>	8 770	7 976	14 014	8 453	39 213
<i>A. stellatus</i>	7 297	7 349	11 490	6 615	32 751
Total	16 333	15 606	25 740	15 248	72 927

Since 1962–1964, the commercial sturgeon fishery in the northern and middle Caspian Sea has been closed and fishing activities is allowed only in rivers of the Caspian Sea watershed. The fishery regulations in the Volga River delta have changed several times, following scientific advice aimed at sturgeon conservation and improving sturgeon reproduction.

Since 1996, the targeted commercial fishing for sturgeons in the Volga River has been closed, though sturgeon landings are legal if they are taken as bycatch during fishing for other fishes (the Russian Federation Committee of Fisheries; Order No. 72 of April 15, 1996). The commercial fishery for beluga has been closed since 2000, and this species can be caught only for scientific and reproduction purposes (the Russian Federation Committee of Fisheries; Order No. 55 of February 28, 2000). However, the meat and caviar byproducts of these catches may be sold.

Assessments are made of absolute and relative abundance of sturgeons entering Russian rivers, their fishing stock, annual numbers of spawning fish that reach the spawning grounds,

and the qualitative structure of sturgeon populations. The CaspNIRKH data are the basis for short term and long term forecasting of TACs of sturgeons in the Volga-Caspian basin, as well as the basis of advice on changes in the fishery regime in this area. Table A-6 presents data on catches of sturgeons in the Volga River (representing the most comprehensive data set).

Table A-6. Catches of Sturgeon Species in the Volga River, 1998-2001 (in tons and number of fish)

Species	1998		1999		2000		2001	
	TAC		TAC		TAC		TAC	
	tons	number	tons	number	tons	number	tons	number
Russia								
<i>A. gueld-enstaedtii</i>	570	43 846	230.1	17 698	230.7	186 048	227.0	19 912
<i>A. stellatus</i>	700	100 000	342.0	51 045	223.0	34 308	178.1	29 683
<i>H. huso</i>	71	710	501.0	500	45.0	450	41.9	419
Total	1 341	144 556	624.1	69 243	498.7	53 363	447.0	50 014
Turkmenistan								
<i>A. gueld-enstaedtii</i>	27.4	2 108	35.8	2 757	15.5	1 250	15.3	1 342
<i>A. stellatus</i>	12.6	1 800	8.6	1 287	14.8	2 277	12.1	2 017
<i>H. huso</i>	3.5	35	0.3	3,0	-	-	-	-
Total	43.5	3 943	44.8	4 047	30.3	3 527	27.4	3 359
Azerbaijan								
<i>A. gueld-enstaedtii</i>	46.2	3 554	22.7	1 746	12.8	1 032	12.7	1 114
<i>A. stellatus</i>	6.5	929	19.3	2 876	12.2	1 877	9.9	1 650
<i>H. huso</i>	3.4	34	-	-	-	-	-	-
Total	56.1	4 517	42.0	4 622	25.0	2 909	22.6	2 764
Kazakhstan								
<i>A. gueld-enstaedtii</i>	70.0	4 242	79.4	4 962	55.0	3 374	41.3	2 581
<i>A. stellatus</i>			216.6	23 042	251.3	31 024	188.6	20 725
<i>Huso huso</i>	100.0	1 221	62.3	705	72.6	809	54.5	672
<i>A. nudiventris</i>	50.0	2 164	46.2	2 254	38.0	2 317	28.6	1 243
Total	220.0	7 627	404.5	30 963	416.9	37 524	313.0	25 221

Results of long-term research on sturgeon species spanning more than 35 years are summarized in numerous publications and outputs of VNIRO, TSNIORX, CaspNIRKH, and other research institutions.

7. Sturgeon hatchery and fingerling production

There are seven active fishing hatcheries engaged in sturgeon reproduction in the Astrakhan Region: FGU *Alexandrov Sturgeon Farm*, FGU *Kizan Sturgeon Farm*, FGU *Bertulsk Sturgeon Farm*, FGU *Lebyazhinsk Sturgeon Farm*, FGU *Sergiev Sturgeon Farm*, FGU *Zhitnensk Sturgeon Farm*, and *BIOS*. Table A-7 summarizes the amounts and mean weights of sturgeon fingerlings released in the Caspian watershed rivers by these hatcheries.

Table A-7. Sturgeon fingerlings released by Russian hatcheries

Year	<i>H. huso</i>		<i>A. gueldenstaedtii</i>		<i>A. stellatus</i>	
	quantity (millions)	weight (grams)	quantity (millions)	weight (grams)	quantity (millions)	weight (grams)
1996	15.67	3.9	23.1	3.21	12.91	2.19
1997	17.14	3.58	32.3	3.43	8.83	2.3
1998	11.9	4.38	30.7	3.03	15.4	1.66
1999	7.783	5.31	27.7	4.02	20.4	2.27
2000	2.809	5.85	24.0	4.14	17.1	2.38
2001	5.24	4.92	27.8	3.35	24.3	2.32

Variations in the number of grown fingerlings are associated not only with the number of spawners collected, but also with the condition of hatchery equipment and general hatchery modernization, pond maintenance, and recent improvements in the release size of fingerlings, whereby fingerlings now exceed the standard release weight of 2-3 g by 1.66 to 2.5 times.

Data on fingerling releases by Kazakhstan hatcheries are presented in Table A-8.

Table A-8. Sturgeon Fingerlings Released in the Ural River, 1998-2001

Year	<i>H. huso</i> quantity (millions)	<i>A. gueldenstaedtii</i> quantity (millions)	<i>A. stellatus</i> quantity (millions)	<i>A. nudiventris</i> quantity (millions)
1998	-	0.653	1.066	-
1999	0.516	1.493	2.518	1.822
2000	1.860	1.265	0.375	0.028
2001	1.684	2.156	2.419	1.721

8. Assessing the survival of hatchery fish by species, size and weight

Studies of specialists from VNIRO indicate that fingerlings of beluga and Russian sturgeon below 3 grams (in mass), and fingerlings of stellate sturgeon below 2.5 grams that are released from hatchery ponds demonstrate active feeding in rivers and marine feeding grounds of the Caspian Sea, and upon reaching maturation, they perform spawning migrations to rivers of the Caspian Sea watershed. The yield-to-the-fishery coefficient for fish of these weights is 1%. However, the release of sturgeon fingerlings below 3 grams from hatchery ponds leads to a decrease in juvenile survival because of natural mortality in rivers. Estimations show that fingerlings of a lower weight-at-release provide a lower yield-to-fishery coefficient (YFC) (see Table A-9).

Table A-9. Estimates of the yield-to-fishery coefficient (YFC) for sturgeon fingerlings of various weights

Indices	Weight (g)				
	1.0	3.0	5.0	10.0	20.0
<i>H. huso</i>					
YFC, % survival	0.56	1.1	1.52	2.33	3.6
<i>A. gueldenstaedtii</i>					
YFC, % survival	0.47	1.08	1.59	2.7	4.58
<i>A. stellatus</i>					
YFC, % survival	0.38	0.8	1.13	1.82	3.0

9. The TAC and actual catches in the Volga-Caspian basin

On the basis of the above steps and information, the total allowable catches are determined. Table A-10 presents data on the Total Allowable Catch (TAC) and actual catches of sturgeon species in the Volga-Caspian basin for 1990-2001.

Table A-10. The sturgeon TAC and actual catches 1990-2001 (in thousand tons)

Year	The USSR		Russian Federation				
	1990	1991	1992	1993	1994	1995	1996
TAC (forecast)	14.6	11.0	8.7	4.5	2.943	2.015	1.296
Fishery Statistics	11.65	8.54	7.5	4.24	3.25	2.26	1.27
Year	1997	1998	1999	2000	2001		
TAC (forecast)	1.296	1.296	0.63	0.555	0.428		
Fishery Statistics	1.302	0.98	0.63	0.47	0.420		

Table A-11 provides the breakdown of these catches by species.

Table A-11. Catches by species (in thousand tons)

Year	1990	1991	1992	1993	1994	1995	1996
<i>Huso huso</i>	0.82	0.58	0.52	0.38	0.2	0.12	0.1
<i>A. gueldenstaedtii</i>	7.62	5.18	4.25	2.47	1.53	1.16	0.48
<i>A. stellatus</i>	3.21	2.78	2.73	1.39	1.52	0.98	0.69
<i>A. ruthenus</i>	0	0	0	0	0	0	0
Total	11.65	8.54	7.5	4.24	3.25	2.26	1.27
Year	1997	1998	1999	2000	2001		
<i>Huso huso</i>	0.13	0.068	0.039	0.0442	0.03583		
<i>A. gueldenstaedtii</i>	0.72	0.617	0.357	0.2496	0.22683		
<i>A. stellatus</i>	0.45	0.294	0.233	0.1759	0.15636		
<i>A. ruthenus</i>	0.002	0.001	0.001	0.00066	0.00111		
Total	1.302	0.98	0.63	0.47036	0.42013		

10. Caviar exports from the Russian Federation, Kazakhstan, Azerbaijan and Turkmenistan 1998-2001

Data on caviar exports from the Russian Federation, Kazakhstan, Azerbaijan and Turkmenistan for 1998-2001 are presented in Table A-12.

Table A-12. Caviar exports from the Russian Federation, Kazakhstan, Azerbaijan and Turkmenistan 1998-2001 (in tons)

Year	Russian Fed.	Kazakhstan	Azerbaijan	Turkmenistan
1998	107.0	34.2	7.9*	3.5*
1999	50.0	37.0	10.1*	*
2000	57.0	30.0	6.5*	3.30*
2001	33.2	32.21	9.21*	6.59*

* the figures include the export quotas allocated for those countries within the export quotas of the Russian Federation and Kazakhstan.

B. Stock assessment of sturgeons in waters of the Islamic Republic of Iran

1. Determining sturgeon TAC in waters of the Islamic Republic of Iran

Sturgeons are migratory species, and are looked upon as shared stocks by the five littoral States of the Caspian Sea. However, it should be noted that conducting individual stock assessments for each species by each of the littoral States will not provide a true picture of the present status of sturgeon stocks. Prior to 2001, the stock assessment of sturgeons in the five littoral States was not conducted in a collaborative way or covering the entire Sea, because of a lack of co-ordination on project planning and the various methodologies used for sampling and analysis.

In order to scientifically exploit sturgeons in the Caspian Sea and to have a better understanding of their standing stocks, the Iranian Fisheries Organization has conducted an elaborate and extensive statistical and biological assessment of sturgeons since 1988. All data pertaining to this study were recorded for each year. Thus on the basis of statistics and figures recorded and estimates of stocks in the past year, annual quotas for sturgeon for the next year were recommended.

Initial recommendations for catch amounts are presented and discussed in the Lower Commission of the Iranian Fisheries Organization, and following their approval they are discussed in the Higher Commission for sturgeons. This latter Commission is attended by high-ranking scientific authorities from research centers and fishery science universities. After the final approval the catch quotas are established and put into effect for the following year.

All data regarding sturgeons are collected from 48 fishery catching stations. This information is recorded on a routine basis at these stations. Nine of these catch stations are considered as control and scientific catch stations, where detailed information including species, weight, age, sex, physiological state of fish, fork length, amount and grade of caviar as well as caviar harvested per unit effort for each of the five species is recorded and analyzed.

During 1992 to 2000 more than 114 477 mature sturgeons were examined in these control stations. These included 3 484 *H. huso*, 12 621 *Acipenser gueldenstaedtii*, 35 217 *A. persicus*, 1 399 *A. nudiventris* and 61 756 *A. stellatus* specimens. On the basis of studies conducted through 1998 to 2001 the mean weight recorded for each species is presented in Table B-1.

Table B-1. Mean weight (kg) for sturgeon species during 1998 – 2001

Species	1998	1999	2000	2001
<i>H. huso</i>	108.7	92.8	83.8	83.9
<i>A. gueldenstaedtii</i>	20.7	20.5	19.7	20.3
<i>A. persicus</i>	25.3	25.1	25.0	25.1
<i>A. nudiventris</i>	25.3	24.5	22.7	26.5
<i>A. stellatus</i>	9.3	9.0	9.3	9.2

On the basis of these studies the catch figures (male and female) and mean caviar harvests recorded for each species during 1992-2001 have been presented in Table B-2.

The annual catch quota for the following year is established on the basis of information obtained from the statistical and biological assessments of sturgeons and also the catch figures for each species for the previous year. According to catch-per-unit-effort (CPUE, boats x days x nets) for the previous year the catch quota for the following year as well as the caviar quotas for each species is calculated. The information available on caviar harvests from female sturgeons of each species for the past three years is used to calculate the caviar harvest. Catch and caviar quotas are calculated using the regression formula:

$$\gamma = \exp(a + bx)$$

In this equation x = years of exploitation (independent variable), γ = amount of caviar harvested (dependant variable), and a and b are coefficients for each species that can be calculated from Table B-3.

Table B-3. Calculated values for coefficients a and b for different species

	a	b	γ
<i>A. stellatus</i>	430.148	0.29926	0.992376
<i>H. huso</i>	111.076	0.0513991	0.81717
<i>A. gueldenstaedtii</i>	508.922	0.250296	0.971645
<i>A. persicus</i>	69.9445	0.0424704	0.517927
<i>A. stellatus</i>	98.5698	0.0530808	0.752509

Table B-2. Catch figures (male and female) and mean caviar harvests (kg) from sturgeon species during 1992-2001

Product	Species		Years									
			1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Catch figures	<i>H. huso</i>	Female	1590	1185	98	812	1209	1152	1265	875	737	1135
		Male	971	577	567	608	789	298	352	512	472	744
		Total	2551	1762	1565	1420	1998	1450	1617	1387	1209	1879
	<i>A. gueldenstaedtii</i>	Female	14004	8741	5885	3460	5220	3547	3209	2317	1995	1329
		Male	2831	1270	972	2188	1546	978	689	626	516	343
		Total	16835	9911	6857	5648	6766	4525	3898	2943	2511	1672
	<i>A. persicus</i>	Female	13254	11088	12127	9642	13993	13727	17237	13628	13332	13519
		Male	10014	6141	5378	5656	7063	6029	7160	6243	6596	8042
		Total	23268	17229	17505	15298	21056	19756	24397	19871	19928	21561
	<i>A. nudiventris</i>	Female	409	413	426	341	361	328	445	424	418	404
		Male	309	249	329	245	272	200	296	400	507	362
		Total	718	662	755	586	632	528	741	824	925	766
	<i>A. stellatus</i>	Female	82062	51172	56562	47225	40088	35299	28710	24258	18014	16851
		Male	21538	12520	12958	10645	13263	11356	9152	848	6089	5468
		Total	103600	63692	69520	57870	53351	46655	37862	33106	24102	22319
Mean caviar harvest	<i>H. huso</i>		11.3	9.8	10.9	12.3	10.3	7.8	8.0	8.0	12.1	10.1
	<i>A. gueldenstaedtii</i>		3.9	3.7	3.3	3.9	3.5	3.1	3.3	3.5	3.0	3.5
	<i>A. persicus</i>		5.4	5.2	4.6	4.9	4.5	4.4	4.5	4.3	4.7	4.7
	<i>A. nudiventris</i>		4.8	5.2	4.5	4.7	7.2	4.7	7.0	8.4	9.1	6.2
	<i>A. stellatus</i>		2.2	2.5	2.2	2.3	2.3	1.9	2.1	2.1	2.0	2.2

Selective catch is conducted in order to conserve and restore sturgeon stocks. On the basis of morphological characteristics of each species, the number of nets, the locality of setting of nets and mesh sizes are determined. Therefore, owing to the selective catch and strict regulations enforced by the Fisheries Research and Fishery Coastal Guards, all elements related to production, such as fishermen who are all government employed, are controlled. Any kind of violation of laws is reported to the Higher Commission and serious action is taken accordingly.

To address the issue of conservation of sturgeon stocks and also to employ strict regulations on catching, the government has decreased the catch effort (i.e. decrease in the number of nets used, number of days for fishing and number of boats). Furthermore, to support the stocks of *A. gueldenstaedtii* and *A. stellatus* in the southern shores of the Caspian Sea, the catch season for these two species commences 20 days later than that for other sturgeon species in the region. On the basis of catch figures for 2001, the catch quotas for the year 2002 have been established as follows:

- catch figures for *A. gueldenstaedtii* decreased by 42.3 % of that in 2001 and are estimated at 20 475 kg for 2002;
- catch figures for *A. stellatus* decreased by 39.8 % of that in 2001 and are estimated at 96 375 kg for 2002;
- catch figures for *H. huso* decreased by 25.3 % of that in 2001 and are estimated at 85 555 kg for 2002;
- catch figures for *A. nudiventris* decreased by 13.13 % of that in 2001 and are estimated at 15 963 Kg for 2002; and
- catch figures for *A. persicus* increased by 3.02 % of that in 2001 and are estimated at 467 422 kg for 2002.

2. How the TAC is determined for sturgeon in Iranian waters

The TAC for Iranian waters is determined on the basis of information and statistics available from the statistical and biological study of sturgeons and the catch figures obtained for each species. According to the CPUE of the previous years and the variation trends determined on the basis of regression analysis, the CPUE and the amount of harvestable caviar for the next year is calculated.

The harvestable caviar of each species is determined from the mean caviar harvested in the past ten years and thus the number of mature females capable of producing caviar is calculated. Ultimately on the basis of the relative number of mature females caught and their ratio to mature males (determined from the ratio of males to females during the past 15 years) the total number of sturgeons is estimated.

The expected catch for each species is estimated and after being approved first in the Scientific and Specialized Committee for sturgeons and then Higher Commission for Sturgeons communicated to the five fishery zones for sturgeons located along 900 Km of coastal line of the Caspian Sea for implementation. Therefore, on the basis of the established sturgeon catch quota, the quotas for each of the fishery catch stations (48 fishery catch stations) for each species is determined. The authorities of the catch stations and fishery zones as well as fishery experts are obliged to control and regulate catch amounts for each species at each catch station. In view of this the catch and caviar produced pertaining to the period 1995 – 2001 and the expected catch for 2002 are presented in Table B-4.

In some years caviar production is higher than expected because of the catch of mature sturgeons caught by fishermen belonging to the cooperative societies who sell these fish to

Table B-4. Catches and caviar produced (in kg) for five sturgeon species

Year	<i>A. stellatus</i>		<i>H. huso</i>		<i>A. gueldenstaedtii</i>		<i>A. persicus</i>		<i>A. nudiventris</i>	
	Produced	Expected	Produced	Expected	Produced	Expected	Produced	Expected	Produced	Expected
1995	90 070	84 563	4 460	5 090	10 487	14 498	42 131	48 729	12 40	1 520
1996	76 030	68 551	6 080	4 835	13 852	11 288	57 737	50 741	1 570	1 603
1997	54 620	55 570	4 720	4 593	8 788	8 788	53 556	52 837	1 270	1 690
1998	49 582	45 048	4 631	4 363	8 040	6 842	67 479	55 019	1 968	1 782
1999	36 456	36 518	4 227	4 144	5 806	5 327	48 732	57 291	2 008	1 880
2000	28 601	29 603	4 056	3 937	4 315	4 147	53 136	59 657	2 200	1 982
2001	22 041	23 997	3 299	3 740	2 811	3 229	67 043	62 121	2 127	2 090
2002		19 453		3 552		2 514		64 687		2 204

the Iranian Fisheries. The expected catch figures for 2002 are higher than the quotas communicated to CITES, and catch will be terminated as soon as the communicated amounts are reached.

3. The hatchery release programme

The Iranian Fisheries Organization has directed its attention towards increasing the release of sturgeon fingerlings and has invested millions of dollars in this interest during the past two decades as a measure to address conservation and restoration of sturgeon stocks in the Caspian Sea. Control and count of sturgeon fingerlings released from the five sturgeon hatcheries in Iran is one of the most effective research activities of the fishery research centers and International Sturgeon Research Institute in Iran. Four different departments of the research centers operate actively in this field every year from the time the spawners are transported to the hatcheries up to the time of release of fingerlings. Their activities can be summarized as follows:

- **Department of breeding and rearing:** Conduct complete biometric measurements of breeders, age determination, amount of caviar harvested, number of eggs per gram, fertilization rate, hatching percentage, and number of fry produced up to the onset of exogenous feeding.
- **Department of biology:** Mean weight of larvae with exogenous feeding, stocking density in ponds, survival rate in each pond, assessment of hydrobiological and hydrochemical state of ponds (count of estimation of phytoplankton, zooplankton and benthic biomass and physical and chemical parameters).
- **Department of pathology:** Assessment and monitoring of all fungal, bacterial and parasitical diseases from in breeders and fingerlings released.
- **Department of stock assessment:** Counting sturgeon fingerlings, determination of mean weight, condition factor, determination of suitable place of release, determination of fishery return coefficient and tagging operations.

On the basis of these activities the release of sturgeon fingerlings during 1996-2001 are presented in Table B-5. The Islamic Republic of Iran is the only country among the littoral states of the Caspian Sea that releases fingerlings of all five sturgeon species into the Caspian Sea.

Table B-5. Released numbers of fingerlings of five species into the Caspian Sea

Species	1996	1997	1998	1999	2000	2001
<i>H. huso</i>	344 800	1 436 981	687 400	406 100	1 900 919	700 000
<i>A. gueldenstaedtii</i>	673 981	919 500	418 170	960 300	1 327 480	450 000
<i>A. persicus</i>	11 018 938	18 751 121	22 586 417	17 199 732	13 711 199	16 200 000
<i>A. nudiventris</i>	102 000	230 770	678 600	303 778	1 113 826	1 800 000
<i>A. stellatus</i>	316 214	288 281	181 461	960 300	226 373	820 000
Total	12 455 933	21 626 653	24 552 048	19 830 210	18 279 797	19 970 000

The mean weight of fingerlings released of the different sturgeon species in Iran was 3-5 g. However in order to strengthen their stocks the weight of fingerlings belonging to *H. huso*, *A.*

nudiventris and *A. stellatus* were increased at the time of release during the past five years. At the time of release the mean weight of *H. huso* was about 30 g, that of *A. nudiventris* was about 15-20 g and the mean weight of *A. stellatus* was about 10 g.

4. Tagging and tracking hatchery releases

On the basis of information collected from clipping of a part of pectoral fin (as a marker) the survival percentage of fingerlings weighing 3 g was 3 %, those weighing 5 g was 5 % and in those weighing 10 g the survival was 8 %. Fishes weighing above 30 g that are being released since the past five years, are expected to show a return coefficient of 20 %. Tagging of sturgeon fingerlings using micro coded wire tags has begun since the past two years and every year 100 000 fingerlings at different weights are being tagged. We hope these methods will give us more accurate information regarding the fishery returns of sturgeon in the years to come.

5. Catch figures and meat and caviar production for 1992-2000

The actual catch figures and meat (without entrails) and caviar harvests during 1992 – 2000 are presented in Table B-6. During this period the biometric measurements of about 13-18 % of the fishes caught have not been recorded accurately and this is related to the 9 control catch stations. The implied catch was conducted using beach seine that is an encircling net and the premature sturgeons were returned to the Caspian Sea. Three per cent of the actual catch was used for breeding and restocking programs. Illegal catch was negligible.

Table B-6. Catch, meat and caviar harvests and export quotas for sturgeon species 1992-2000

Product		Actual catch										
		Year										
		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Catch (tons)	<i>H. huso</i>	198.409	137.872	140.190	137.616	167.189	135.408	139.629	117.674	104.228	93..900	85..555
	<i>A. gueldenstaedtii</i>	363.104	212.709	142.165	114.339	130.924	86.341	75.343	56.783	46.664	27..3	20.475
	<i>A. persicus</i>	559.663	415.032	408.962	386.538	488.300	448.262	547.364	439.903	448.460	349.0	467.422
	<i>A. nudiventris</i>	19.050	17.575	17.358	15.716	16.614	13.511	19.436	21.015	24.543	14.7	15.963
	<i>A. stellatus</i>	917.968	679.114	672.527	562.228	507.131	360.109	346.381	288.108	204.286	123.0	96.375
	Total	2058.194	1462.301	1381.202	1216.437	1310.157	1043.631	1128.153	923.483	828.180	607.9	685.79
	Meat (tons) (without entrails)	<i>H. huso</i>	162.63	113.01	114.91	112.8	137.04	110.99	114.45	96.454	85.433	75.0
<i>A. gueldenstaedtii</i>		279.311	163.622	109.358	87.953	100.711	66.416	57.956	43.679	35.895	11.0	0.0
<i>A. persicus</i>		430.51	319.255	314.586	297.337	375.615	344.817	421.049	338.387	344.969	140.0	150.0
<i>A. nudiventris</i>		15.24	14.06	13.886	12.573	13.291	10.809	15.549	16.812	19.634	0.0	0.0
<i>A. stellatus</i>		695.43	514.48	509.49	425.93	384.19	272.81	262.41	218.264	154.762	50.0	30.0
Total		1583.121	1124.427	1062.23	936.593	1010.847	805.842	871.414	713.596	640.693	276.0	240.0
Caviar (tons)		<i>H. huso</i>	6.28	5.29	4.85	4.46	6.08	4.72	4.631	4.227	4.056	3.95
	<i>A. gueldenstaedtii</i>	38.66	23.147	14.854	10.487	13.852	8.788	8.04	5.806	4.315	3.64	2.1
	<i>A. persicus</i>	61.780	51.556	51.006	42.131	57.737	53.556	67.479	48.732	53.136	52.9	55.89
	<i>A. nudiventris</i>	1.48	1.52	1.42	1.24	1.57	1.27	1.968	2.008	2.2	1.6	0.0
	<i>A. stellatus</i>	153.44	111.81	109.71	90.07	76.03	54.62	49.582	36.456	28.601	24.6	14.827
	Total	261.645	193.323	181.84	148.388	155.269	122.954	131.7	97.229	92.308	86.69	75.676
	Export caviar (tons)	<i>H. huso</i>	3.385	2.275	2.625	4.048	3.129	5.192	4.471	3.113	2.452	3.950
<i>A. gueldenstaedtii</i>		-	-	-	-	-	-	-	-	-	3.460	2.1
<i>A. persicus</i>		50.548	44.752	56.851	51.420	39.390	44.332	82.512	47.865	43.684	51.000	55.89
<i>A. stellatus</i>		111.656	112.930	95.057	88.350	55.617	55.006	53.327	36.694	24.277	1.000	0.00
Pressed caviar		0.000	0.000	1.079	2.490	1.441	1.591	1.839	1.824	1.050	23.400	14.827
Total		165.589	159.957	154.533	143.818	98.136	104.530	140.310	87.672	71.463	82.81	75.767