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

Twenty-fifth meeting of the Animals Committee
Geneva (Switzerland), 18-22 July 2011

Sturgeons and paddlefish

PROGRESS REPORT ON THE EVALUATION OF THE EXISTING STURGEON STOCK ASSESSMENT AND TOTAL ALLOWABLE CATCH (TAC) DETERMINATION METHODOLOGY IN THE CASPIAN RANGE STATES

1. This document has been prepared by the Secretariat.

2. In Resolution Conf. 12.7 (Rev. CoP14) on *Conservation of and trade in sturgeons and paddlefish*, the Conference of the Parties:

   DIRECTS the Animals Committee, in collaboration with the Secretariat, interested Parties, international organizations and relevant experts, to monitor progress on the relevant provisions of this Resolution and to carry out on a three-year cycle starting in 2008, and using information from preceding years, an evaluation of the assessment and the monitoring methodologies used for stocks of Acipenseriformes species subject to the provisions under RECOMMENDS further, paragraph a),...

   and

   DIRECTS the Animals Committee to provide to the Standing Committee its recommendations on actions to be taken based upon the above-mentioned monitoring of progress and three-year cycle evaluation.

3. At its 24th meeting (Geneva, April 2009), the Committee *inter alia*:

   a) endorsed the conclusions and recommendations of FAO and of the CITES Technical Workshop presented in document AC24 Doc. 12.2;

   b) requested the Standing Committee to urge the range States to consider all recommendations in document AC24 Doc. 12.2, including those provided in the Appendices in working with the Commission on Aquatic Bioresources to continue to improve the sturgeon stock assessment and Total Allowable Catch (TAC) determination methodology;

   c) requested the Standing Committee to ask the Caspian range States to implement the above recommendations and report at the 25th meeting of Animals Committee on progress made in improving the existing sturgeon stock assessment and Total Allowable Catch (TAC) determination methodology through a detailed report describing how the recommendations in document AC24 Doc. 12.2 have been implemented and whether they have been accepted by all range States. This report should be submitted to the Secretariat four months prior to the 25th meeting of Animals Committee for the purposes of external review as mentioned below;

   d) requested that the Secretariat have the above report reviewed by FAO (or the outside experts who contributed to document AC24 Doc. 12.2) and make that review available at the 25th meeting of the Animals Committee; and

e) requested that the Standing Committee ask the range States to provide a report at the 15th meeting of the Conference of the Parties on progress made in improving the existing sturgeon stock assessment and Total Allowable Catch determination methodology.

4. These recommendations were presented by the Chair of the Animals Committee at the 58th meeting of the Standing Committee (Geneva, July 2009). The Standing Committee:

   a) urged the range States concerned to consider all recommendations in document AC24 Doc. 12.2, including those provided in the Appendices, in working with the Commission on Aquatic Bioresources to continue to improve the sturgeon stock assessment and Total Allowable Catch (TAC) determination methodology;

   b) asked the Caspian range States to implement the above recommendations and report at the 25th meeting of Animals Committee (AC25) on progress made in improving the existing sturgeon stock assessment and Total Allowable Catch (TAC) determination methodology through a detailed report describing how the recommendations in document AC24 Doc. 12.2 have been implemented and whether they have been accepted by all range States. This report should be submitted to the Secretariat four months prior to AC25 for the purposes of external review;

   c) asked the range States concerned to provide a report at CoP15 on progress made in improving the existing sturgeon stock assessment and Total Allowable Catch determination methodology; and

   d) recognized that, contrary to the information provided in the report of the FAO and CITES Technical Workshop (document AC24 Doc. 12.2), the Islamic Republic of Iran had been applying, since 2002, the unified methodology for sturgeon stock assessment and TAC estimation.

5. Subsequently, under a project entitled *Capacity building for the recovery and management of the sturgeon fisheries of the Caspian Sea* (TCP/INT/3101), the Food and Agriculture Organization of the United Nations (FAO) organized a *Technical Workshop on Survey-based Abundance Estimation Methods and Application of Modern Methods of Stock Assessment and Total Allowable Catch (TAC) Determination for Sturgeon Fisheries in the Caspian Sea*. This was held in Antalya, Turkey, from 24 to 29 September 2009 with representatives from Azerbaijan, the Islamic Republic of Iran, Kazakhstan and Turkmenistan. The results of the workshop can be found here: http://www.fao.org/docrep/012/al085b/al085b.pdf.

6. Following the decision of the Standing Committee in paragraph 4 b) of the present document, the Secretariat reminded the Caspian littoral States in November 2010 to provide a report describing how the recommendations in document AC24 Doc. 12.2 have been implemented and whether they have been accepted by all range States by 18 March 2011. No replies were received by the deadline, although Azerbaijan replied on 5 April 2011.

7. In accordance with the requests of the Animals Committee mentioned in paragraph 3 d) of the present document, the Secretariat contracted a review of the reports. This was undertaken by Dr Alexi F. Sharov, Program Chief, Maryland Department of Natural Resources, United States of America (an outside experts who contributed to document AC24 Doc. 12.2), with technical oversight provided by FAO. Funding for this exercise was provided by the European Commission. The Secretariat takes this opportunity to thank the European Commission for its generous contribution and FAO for kindly providing expert oversight for this analysis without charge.

8. In view of the poor response of the Caspian littoral States to the call for information, Dr Sharov was asked to provide expert analysis of the stock assessment and TAC determination for sturgeon species in the Caspian Sea more generally. His report is attached as an Annex to the present document

9. In Resolution Conf. 12.7 (Rev. CoP14), the Conference of the Parties directs the Animals Committee to draft recommendations on actions regarding progress on the relevant provisions of Resolution Conf. 12.7 (Rev. CoP14) and its evaluation of the assessment and the monitoring methodologies used for shared stocks of Acipenseriformes species, for the consideration of the Standing Committee. The Animals Committee is invited to draft these recommendations, *inter alia* in the light of the content of the Annex to the present document.

Current status of stock assessment and TAC estimation methodology for Caspian Sea sturgeon species

REPORT TO THE 25TH MEETING OF CITES ANIMALS COMMITTEE BY DR ALEXEI SHAROV[*]

I. Background

Following a request from the Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), FAO provided an assessment of the methodologies used in managing the sturgeon fisheries in the Caspian Sea (FAO, 2004). Growing concerns over the state of the sturgeon stocks in the five Caspian Sea littoral states led them to request technical assistance from FAO in improving their management of the sturgeon fisheries. To assist the Caspian countries in amending the weaknesses identified at that time, FAO and CITES jointly organized a Technical Workshop on Stock Assessment and Total Allowable Catch (TAC) Methodologies in November 2008 in Rome (FAO, 2008). The 14th meeting of the CITES Animals Committee on April 20-24, 2009 in Geneva endorsed the recommendations of the 2008 Rome workshop and urged the Caspian range states to adopt all recommendations in document AC24 Doc. 12.2 and improve the sturgeon stock assessment and TAC determination methodology in working with the Commission on Aquatic Bioresources. Following the recommendation of the first workshop and a request from Caspian states for further technical assistance, FAO organized a second technical workshop on survey-based abundance estimation methods and application of modern methods of stock assessment and total allowable catch determination for sturgeon fisheries in the Caspian Sea (FAO, 2009). The second workshop continued the discussion of current assessment methods and means for improvement and produced a series of recommendations for implementation. The Standing Committee asked the Caspian range states to implement the recommendations developed at both workshops and report at the 25th meeting of Animals Committee on progress made in improving the existing sturgeon stock assessment and TAC determination methodology through a detailed report describing how the recommendations in document AC24 Doc. 12.2 (CITES, 2009) have been implemented and whether they have been accepted by all range States.

This document has been prepared for the Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) who requested to:

1. Assess the extent to which the recommendations in document AC24 Doc. 12.2, including those provided in its Appendices, have been implemented by each Caspian littoral state;

2. Make prioritized proposals for actions required to implement any of recommendations that have not been fully applied. Make prioritized proposals for any improvements to existing sturgeon stock assessment and Total Allowable Catch (TAC) determination methodology;

3. Provide recommendations to the CITES Animals Committee for further steps that can be taken to improve the non-detriment findings being made, as well as a road map for- implementation of the recommendations (including data catalogue and exchange, assessment and TAC determination methods, survey design, and rebuilding strategies).

II. Estimation of stock abundance

a) Current methods of abundance estimation

In 2006 Caspian countries adopted the “Interstate Programme on the study of the distribution, abundance, stocks assessment, food supply and TAC determination of Caspian Sea sturgeons in 2007-2009” (Anonymous, 2006). The goals of the program were defined as follows:

1. To assess the abundance, exploitable stocks size and distribution of sturgeon populations in the different parts of the Caspian Sea under the present ecological conditions.

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[*] *The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat or the United Nations Environment Programme concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.*

2. To determine TAC (total allowable catch) of sturgeons for 2009-2011 using all available international methods of abundance and sturgeons stocks determination.

3. To provide recommendations on the conservation, reproduction and rational use of sturgeons populations in the Caspian Sea.

According to the Programme the Caspian-wide trawl survey is defined as the principal method of sturgeon stock assessment. The Russian Federation, Kazakhstan, Azerbaijan and Turkmenistan adopted a fixed-station sampling design with stations allocated along fixed transects (Figure 1). This design was established in the early 1960s when these countries were members of the Soviet Union. In contrast, following the FAO advice, the Islamic Republic of Iran adopted a stratified random sampling scheme. For depth greater than 10 m, a 24.7 m bottom trawl is used by all countries. For areas with depth less than 10 m, a 9 m bottom trawl is used for the survey. Each country samples its territorial waters during summer time. Sampling in winter is usually conducted on an ad hoc basis in Middle and Southern Caspian. Northern Caspian is not sampled in winter due to ice coverage. A total of 450 stations are sampled across the Caspian Sea (Table 1).

All countries estimate absolute abundance of each species using the swept area method described in the Interstate Program. Estimated mean catch per area swept is corrected for gear efficiency (catchability coefficient). For the 9 m trawl the following catchability coefficients are applied: 0.1 for Russian sturgeon, 0.07 for stellate sturgeon and 0.04 for beluga. Catchability coefficient for the 24.7 m trawl is assumed to be constant for all species at 0.1. These coefficients were estimated by the KASPNIRKH, Russia. Catchability corrected mean density is applied to the total sampled area to estimate absolute abundance:

$$N = \frac{C}{q}\frac{A}{s}$$

where N is an absolute abundance, C – mean catch per trawl, q – trawl catchability (efficiency) coefficient, A - total area under investigation and s- average area sampled per trawl.

All countries supplement trawl survey with gillnet sample collection. Gillnets are used in shallow areas to collect additional information on abundance, size and species composition of sturgeon present in the area. However, no standard procedures are currently adopted to convert gillnet catch data into trawl based density estimates or absolute abundance.

b) Other methods

A suite of traditional stock assessment models of various complexities that rely on catch and fishing effort data can be used to estimate stock abundance. Unfortunately none of the stock assessment models are currently used for sturgeon in the Caspian region, although some exploratory analyses were completed. At the stock assessment workshop in Rome, a document was presented by Dr. Babayan from Russian Federation (Babayan et al., 2006) in which an instantaneous VPA (ISVPA) version of a retrospective cohort age structured model was applied to Russian sturgeon data and estimates of exploitable stock size, total abundance, spawning stock, recruitment and fishing mortality were produced for Russian sturgeon for 1985-2203 period. This paper further showed how the catchability coefficient used in trawl survey estimates can be corrected via comparison of survey based estimates of abundance against model based (ISVPA results. The paper also proposed a potential method of estimating illegal harvest by combining survey and model based estimates of abundance with various indirect indicators of illegal fishing. This modeling approach has not been adopted yet by any of the Caspian range states, including Russia.

c) Minimum requirements for survey based assessment

Survey design

All former Soviet Union member countries continue to employ a fixed transect trawl survey, while Iran has adopted a stratified random survey design following FAO's recommendation. Although transect-based fixed stations are utilized in other areas of the world, there are certain limitations to the use of fixed stations. Fixed station design is suitable for monitoring changes in relative abundance over the period of years with the purpose of detecting trend in abundance over time. However, the major deficiency of fixed station surveys is potential bias in the estimates of fish density due to non-randomness in the selection of sample stations.

If absolute abundance estimate is the goal, a switch to random station allocation design is recommended. The advantages of randomized survey design are unbiased estimates of fish density and quantification of the uncertainty involved. Further improvements in increasing survey precision may be achieved by post stratification based on reanalysis of historic data and progressing to a stratified random survey.

Uncertainty estimates

Sampling error estimates (i.e. standard error of the mean, coefficient of variation) should be reported for the density estimates (mean catch per trawled area). Lack of such estimates makes it impossible to make any conclusions regarding the reliability of relative and absolute abundance estimates.

Survey precision

Accumulated trawl data can be used to determine the relationship between relative standard error and sample size and estimate the number of trawl station samples to achieve a selected level of precision. This analysis may provide valuable information on the cost and benefits of survey precision improvements.

Catchability coefficient

The catchability coefficient is a critical parameter in current assessment methodology, as it is used to correct the observed mean catch per trawl in order to convert a relative index of abundance to an absolute abundance estimate. The reliability of gear efficiency estimates for all sturgeon species is currently unknown. No documentation has been made available on how trawl catchability was estimated, and no uncertainty estimates were presented. The issue of reliability of current estimates was raised many times during two workshops in Rome (2008) and Antalya (2009). The gear catchability coefficient is notoriously difficult to estimate. Kushnarenko (2003) reported that experiments for catchability coefficient estimation were conducted in the 1970s. Instead of further investigation, species specific constant values were assigned for sturgeon. He states further that “we do not have sufficient data that support or dispute these values” (Kushnarenko, 2003, p.140). The catchability coefficient is affected by a variety of factors such as depth, visibility, trawl speed, length of weirs, fish size, behavioral aspects, etc. Consideration of uncertainty involved in the gear efficiency estimate is very important. However, the methodology used by the Caspian countries treats the survey estimate as absolute population abundance without consideration of measurement error and associated management risks. Until further studies are conducted, both corrected and uncorrected data should be viewed as a relative index of abundance. New scientifically sound experiments should be designed and executed with appropriate statistical data analysis and results should be well documented and peer reviewed.

d) Consistency among countries

Application of standard methodology across all countries is very important. The adoption of the Interstate Programme was a significant achievement. In general, the Programme provided unified framework for trawl surveys across all countries. However, it allowed for the use of two different sampling designs – fixed and random. In addition, it called for the use of other modern stock assessment techniques, but no specific methods were identified.

In general, it is agreed by all countries that national surveys conducted to provide abundance estimates for the Caspian Sea should have uniform design and be carried out at the same time, preferably within a short period. Any inconsistency in design, timing, gear and vessel will necessitate standardization or unknown bias may be introduced. The countries using fixed-stations design were advised to consider switching to random station sampling. A combination of fixed and random stations was suggested to be tried as a compromise for a transitional period. However, there seemed to be a significant reluctance to change among the countries using fixed transects, citing loss of continuity of a long historical time series. In fact, there will be little loss and possibly more gain with respect to obtaining unbiased and more precise estimates of population densities.

e) Data sharing

All Caspian countries share and exploit sturgeon stocks. The need for joint effort and unified methodology in monitoring and stock assessment has been recognized by all countries. True collaboration will not be possible without data exchange and mutual trust. Assessment and management of sturgeon stocks will require integration of data collected in different regions and by different methods (fishery dependent and fishery independent). A data catalogue was developed during the second stock assessment workshop for catch and survey data. Free data exchange will build trust, provide the best and most complete information and benefit all countries. Establishment of the centralized data base will considerably contribute to the improvement of stock

assessment. Such data storage could be provided either by one of the Caspian countries or be maintained by independent organization to ensure unbiased data processing.

III. TAC Estimation and rebuilding plan

a) Stock assessment

No stock assessment models are officially agreed upon at present for the assessment of Caspian sturgeon stocks. However, the paper by Babayan et al. (2006) was presented at the FAO stock assessment workshop in Rome in 2008, where an internationally recognized version of the retrospective age structured model, instantaneous separable VPA (Kizner and Vasiliev, 1997) was applied to Russian sturgeon data and estimates of exploitable stock size, total abundance, spawning stock, recruitment and fishing mortality were produced for 1985-2203 period. In addition, the yield per recruit model was used in this analysis to develop an estimate of fishing mortality producing the maximum yield per recruit (F_{max}) which can be used as a reference point. Finally, the paper introduced the concept of a widely used management tool called control rule. A control rule defines target and limit values (reference points) for fishing mortality (F) and spawning biomass (SSB). A comparison of current levels of F and SSB with reference points allows for the definition of the status of the stock (overfished or not overfished, overfishing occurring or not occurring) which is followed by the management action according to the status of the stock. Thus, all principal elements of stock assessment and TAC estimation framework were developed for Russian sturgeon. The analytical framework proposed in Babayan et al. (2006) is consistent with modern stock assessment methodology and is recommended for application. Nonetheless neither the stock assessment model nor the proposed control rule have been formally adopted by any of the Caspian range states, including Russia.

b) Minimum requirements

Several vital parameters of exploited population that are required for successful management include estimates of fishing mortality, population abundance and biomass, spawning biomass and recruitment. The ability to estimate these parameters depends on the quality of the data and the type of analytical models selected. As mentioned earlier, there is a variety of fisheries models available varying in complexity from very simple to highly complex. The choice of the model is primarily dictated by the data available and the assessment goal. Models providing higher detalization require more inputs. List of candidate models should be made and matched with the database on existing data. Models recommended for use in sturgeon data analysis include simple models describing length–weight relationship, size and fecundity, growth and maturity curves, catch curve analysis, index based methods, yield per recruit and spawner per recruit analysis, surplus production models, age structured models.

c) TAC Estimation

Current TAC method relies on trawl survey data and species specific target exploitation rates. TAC calculation steps include:

1. Estimation of the biomass of sturgeon that are expected to mature and migrate to the spawning grounds in the year for which TAC is estimated. The calculation is made in accordance with the method of the fish number with the gonads of maturity stages III, III-IV:

$$B_{sp} = N_1 \hat{w}_1 + N_1 \hat{w}_2 + N_1 \hat{w}_3,$$

   where: B_{sp}- spawning stock biomass, N_1,N_2, N_3- abundance of fish with the gonads of III,III-IV maturity stages; $\hat{w}_1 + \hat{w}_2 + \hat{w}_3$ – average weight of the specimens with the gonads of III,III-IV maturity stages.

2. Estimation of spawning biomass for specific stock. The fraction of each river specific stock in the mixed Caspian wide stock (for example, beluga from the Volga river versus beluga from the Ural river), is determined from collected samples using immunogenetic methods. Thus the expected biomass of spawners entering river X is estimated as

$$B_X = A_x B_{sp}$$

   where: B_x- spawning stock biomass of river X, A_x fraction of stock X in the sample collected in trawl survey, B_{sp} - total biomass of spawners.

3. Finally, TAC is estimated by applying a target exploitation rate to estimated spawning biomass:

$$TAC = B_x U$$

where U is target exploitation rate.

Currently target exploitation rate is determined by the method of Malkin (1999) and varies from 6 to 14% depending on the species.

d) TAC allocation among countries

The Commission on aquatic bioresources of the Caspian Sea approved the methods for TAC allocation of aquatic resources (including sturgeon species) to Caspian range states based on their contribution to reproduction and conservation of bioresources (Khodorevskaya, 2006). This rather sophisticated procedure allocates the quota based on several factors: the volume of freshwater flow, use of territorial waters by sturgeon for feeding, size of the stock present in territorial waters, annual food consumption in the area, yield to the fishery from natural spawning, abundance of spawning population, number of spawners entering the spawning grounds, spawning area, releases of juveniles from hatcheries and yield to the fishery of hatchery origin fish. These factors were rated by their importance and each was assigned a weight or coefficient of contribution (the sum of all coefficients should equal 1). Other factors considered were include historical share of each country in total harvest, the contribution of each country to research and protection of the resource, as well as factors with a negative net effect (pollution, poaching). It appears that a significant effort was directed towards development of an objective procedure for quota allocation that accounts for the major factors describing each nation's contribution towards production, exploitation and protection of sturgeon stocks. Definition of specific weights for each factor is challenging and there will likely be various improvements and modifications in the future. While TAC allocation among the countries is an internal business, any country's TAC should not result in a fishing mortality rate for any stock exceeding the threshold level defined by the control rule.

Control rule concept

The use of a control rule has become very popular in fisheries management in recent years. A control rule describes a plan for pre-agreed management actions as a function of variables related to the status of the stock. For example, a control rule can specify how fishing mortality should vary with biomass. Standard harvest control rules utilized in the management of world fisheries almost uniformly use two control parameters- fishing mortality (F) and some measure of stock size – absolute or relative abundance, biomass or spawning stock biomass. A control rule defines target and limit values for F and biomass reference points used to evaluate the status of the stock (Figure 2). Thus the control rule defines the status of the stock and management measures needed. Management actions prescribed in the management plan are taken when fishing mortality exceeds the F limit or when stock biomass falls below the biomass threshold. Biomass threshold is of particular importance as it guards against population decline below a critically low value. The TAC methodology used for Caspian sturgeon is an example of a simple harvesting strategy utilizing constant harvest rate with only one parameter – target fishing mortality. No limit to fishing mortality is specified, no actions are prescribed and no estimates of F are produced. Thus the determination of stock status is absent. The development of a control rule for each stock is a critical task, which will require a selection of target and limit reference points. The target fishing mortality should be selected at the level that corresponds to the long term maximum sustainable yield, such as F_{msy} or its proxy. It is a common practice to use a precautionary approach when choosing target fishing mortality. A smaller than originally estimated target fishing mortality is used in calculation of TAC to account for uncertainty in the estimate of target F. The more uncertain is the target F estimate, the larger is the reduction in F used for the TAC calculation. A control rule corresponding to these principles should be developed for each stock.

e) Rebuilding plans

Current stocks status

As discussed above, there are currently no formal "overfished" definitions in existence for sturgeon species in the Caspian Sea. Neither biomass nor fishing mortality reference points have been formally established. Nonetheless, dramatic declines in the number of spawners entering spawning rivers, corresponding landings and declines in catches per trawl in the trawl surveys are clear signs of severe overfishing of all sturgeon species in Caspian region (with the possible exception of the south Caspian stocks of Persian sturgeon). The decline is thought to be primarily due to illegal uncontrolled and unreported fishing (IUU). In response to the significant decline in abundance of sturgeon stocks, commercial and recreational harvest of beluga was

banned in Russia in 2000, followed by the ban on all sturgeon species in 2005. Azerbaijan banned fishing for ship and beluga in 2009 and stellate sturgeon in 2010. This was followed by total ban on sturgeon fishing in Kazakhstan in 2010 (Anonymous, 2010). Recent reports on trawl survey results indicate low or continued decline in survey CPUE for all species (Anonymous, 2010). In February 2011 delegations of all five Caspian countries discussed a plan for a five year moratorium on harvest of all sturgeon species in the Caspian Sea.

Rebuilding plan

When the stock size declines below the biomass threshold B_{limit} such that the fish could become threatened as a consequence of increased fishing pressure, the stock rebuilding process should be immediately initiated. To achieve stock restoration, a rebuilding plan for each species should be developed, which must end overfishing and rebuild the resource in as short a time as possible, given the biology of the resource and considering the needs of fishing communities.

Rebuilding targets

The principal goal of rebuilding is to rebuild a given fish stock to at least the abundance that can support maximum sustainable yield in the long-term. When a reliable estimate of stock biomass corresponding to maximum sustainable yield (B_{msy}) is not available due to data limitations, an alternative can be used , such as an average population biomass during period of relative stability as a proxy to B_{msy}. In order to achieve a rebuilding target biomass, required reductions in landings and corresponding fishing mortality ($F_{rebuild}$) should be calculated that will ensure stock rebuilding in specified time period. Thus the B_{target} should always be accompanied by the target F. If zero fishing mortality is required for stock rebuilding, a closure of fishery will be required and any additional measures leading to improvement of reproduction and survival should be considered.

Every sturgeon population in the Caspian sea is a mix of river specific stocks that differ by various degrees in morphology, genetics, ecology and behavior. It is critically important to develop separate target and threshold biomass levels for each stock. Failure to do so may result in overfishing when the contribution of the stock to a mixed population is not known.

Rebuilding time frame

The overfished stock should be rebuilt in as short a time as possible given the biology of the resource.

Rebuilding measures

Rebuilding measures can include various options that result in the reduction of harvest such as minimum size limits, seasonal and areal closures, quotas and moratorium.

Monitoring process

When in the rebuilding mode, estimates of stock size and fishing mortality should be made on annual basis and compared to the expected trajectory of stock dynamics to monitor the recovery rate. If adequate progress to end overfishing and rebuild the resource is not made, then revisions should be made to further reduce fishing pressure.

IV. IUU Fishing

a) Current state of IUU fishing

With the dissolution of the Soviet Union in 1991, large scale poaching in the Caspian Sea region has developed in the Post-Soviet territory associated with the liberalization of the economy. New economic policies have led to massive closures of state owned enterprises, unemployment and overall significant decline in socio - economic conditions. These factors combined with the lack of law enforcement have led to sharp increases in IUU throughout the area. Strong demand for sturgeon caviar at international markets stimulated development of a black market with a large network of catchers, processors and distributors. As a consequence, the stocks of all sturgeon species in the Caspian rapidly declined, as indicated by the Caspian wide trawl survey as well as catches at the control stations used by legal commercial fisherman. For example, the survey based estimate of Russian sturgeon biomass declined from 15 thousand tons in 2003 to 1.72 thousand tons in 2006, stellate sturgeon from 8.3 to 1.62 thousand tons and beluga – to 0.38 thousand tons (Khodorevskaya and Romanov, 2007). It is universally accepted that illegal, unreported and unregulated (IUU) fishing and trade in sturgeon

products is the most serious threat to sustainable exploitation and existence of the sturgeon stocks of the Caspian Sea. Reliable and official estimates of total IUU harvest are not available. It is believed that IUU harvest substantially exceeded legal harvest. Law enforcement officers each year detain thousands of poachers and confiscate thousands of illegal nets, boats and other fishing accessories. It is obvious that law enforcement intercepts only very small fraction of total harvest and products. According to the Russian media, total fines applied to poachers, illegal processors and distributors in 1996 intercept campaign "Putina" were equal to 20 million US dollars, while proceeds from legal caviar export were around 15 million dollars. Estimates of IUU volume for Russia only were at 30-50% of legal harvest in 1997, 4-5 times of legal harvest in 1998 and 10-15 times in 2000-2002 . In 2001 r. KASPNIRKH scientists estimated illegal harvest at 12-14 thousand tons of fish and 1.2 thousand tons of caviar.

b) Existing measures to stop IUU fishing

There are a large number of measures in use in every Caspian country directed at reduction of illegal harvest, distribution and consumption. Marine and river patrols, confiscation of catch, fishing gears, boats and vehicles, legal cases, fines and imprisonment are used to deter illegal fishing. Uncovering illegal processing facilities and controlling legality of products on the market are also used to combat distribution of illegal sturgeon products. Other efforts include verification of data related to export as well as domestic trade in sturgeon, strengthening regulation of the sturgeon trade, licensing fishing operations and traders who have access to trade processes and necessary documentation such as CITES permits and certificates. Efforts to raise public awareness on the current situation of sturgeon are also underway. A technical workshop on combating IUU convened by the FAO recommended that each country develop national plan of action using FAO technical guidelines for responsible fisheries to prevent, deter and eliminate IUU fishing in the basin according to the Code of Conduct for Responsible Fisheries, and the 1982 Law of the Sea etc.

c) Minimum requirements

Reliable quantification of the size of illegal removals in each country is extremely important. Data on all removals are necessary for correct estimation of stock abundance, fishing mortality and identification of major factors driving stock dynamics. However, due to the scale of the issue and the nature of illegal fishing, estimation of IUU level presents a formidable challenge. Analytical models that measure total mortality paired with absolute measures of stock size can be tried to derive an estimate of illegal harvest, leading to the observed total mortality. An example of such application is presented in Babayan et al. (2006). Alternatively, attempts could be made to produce an estimate that would include local and regional estimates of the number of fisherman involved in illegal fishing, average illegal catch size and total removals. Another alternative is to estimate the amount of fish available on the market using sampling methods and estimate illegal harvest by subtracting legally harvested and sold fish from the estimated total. Clearly, these estimates are subject to low or unknown precision and bias. Whenever such an estimate is produced and presented, an associated uncertainty level should accompany either in quantitative form (plus minus X tons of fish or percent) or qualitative form – "certain", "rather certain", uncertain", etc.

V. Roadmap to improving Stock assessment methods

Despite general endorsement of stock assessment workshops recommendations by participants, no changes were made in the assessment methodology by any Caspian country based on information made available to FAO and CITES up to date. It is important to note that the Caspian range states adopted FAO code of conduct for responsible fisheries and a precautionary approach concept, which are listed in the Regional Program on the Joint Management, Conservation and Sustainable Use of the Bioresources of the Caspian Sea (Anonymous, 2003). In addition, a modern framework for stock assessment and TAC determination that complies with best international standards was developed by the Russian Federation (Babayan et al, 2006) and presented to other members of the Caspian region on several occasions, but it was not officially adopted for management by any state, including the Russian Federation.

Therefore all previous recommendations outlined in workshops reports remain applicable. There are several possible reasons for the lack of progress such as lack of knowledge of modern assessment methods, inertia and fear of change, lack of properly trained stock assessment scientists, lack of trust among the countries and lack of political will and leadership.

Considering the current status of major sturgeon stocks in the Caspian Sea, the effort on improving the assessment methodology should be shifted from the TAC to the stock status determination (stock assessment) and development of rebuilding plans.

The Regional Program on the Joint Management, Conservation and Sustainable Use of the Bioresources of the Caspian Sea established principles and criteria on management and conservation of bioresources, among which is avoiding overfishing, applying the precautionary approach, ensure reversibility and rebuilding. Thus the management goals are clearly established.

The program also declares that stock specific target and limit reference points should be determined and actions should be taken if they are exceeded. However, no reference points and no control rule have been accepted for practical management so far. Establishing limit and target reference points for fishing mortality and population biomass and developing control rule should be a matter of highest priority. To achieve these goals, the following actions for improving the principal elements of stock assessment methodology are suggested:

1. Trawl survey
   - Develop time series of average catch per trawl by species .
   - Evaluate trends in relative abundance (catch per trawl or unit area).
   - Calculate confidence limit intervals for mean catch per trawl and coefficient of variation.
   - Use mean catch per trawl as an index of relative abundance.
   - Develop the technical report describing the estimation procedure for catchability coefficients.
   - Develop error estimates for catchability coefficient.
   - Consider designing a new study for catchability coefficient estimation.
   - Consider alternative methods for gear efficiency estimation such as comparison of survey based data and absolute abundance estimates from stock assessment models.
   - Evaluate survey precision and required sample size for various levels of precision
   - Implement stratified random design for trawl survey.

2. Model based absolute abundance and fishing mortality estimate
   - Evaluate data requirements and data availability for dynamic surplus production and age structured models.
   - Estimate fishing mortality using a catch curve model if age structure data are available.
   - If data allow, fit a surplus production model to estimate population biomass and fishing mortality.
   - If data allow, fit an age structured model to estimate population abundance, biomass, recruitment and fishing mortality.
   - Report uncertainty estimates (errors) of absolute abundance and fishing mortality (usually a standard feature of stock assessment software).
   - Repeat the analysis for each stock when stock specific data are available.

3. Control Rule and TAC estimation
   - For each stock establish target and limit reference points for fishing mortality.
   - Complete yield per recruit analysis to estimate F_{max} $F_{0.1}$ or F corresponding to a selected percentage of maximum spawning potential (F%MSP) that can serve as targets and limits for the current set of fishing regulations.
   - Estimate fishing mortality producing maximum sustainable yield (F_{msy}) with surplus production model or by combining yield per recruit and stock recruitment models (Shepherd – Sissenwine method). The F_{msy} should be considered as a possible threshold fishing mortality, while a more precautionary value should be considered for a target.
   - Establish target and limit reference points for stock biomass.
   - Estimate B_{msy} and consider it as a potential biomass target.

4. Rebuilding plan
   - Develop a rebuilding plan for each stock that is considered overfished.
   - Specify the rebuilding time frame.
   - Specify target stock biomass for rebuilding period
   - Estimate the fishing mortality allowed, if any, that will ensure stock recovery within a specified time.
   - Establish a monitoring procedure to control progress and make appropriate adjustments.

5. TAC estimation
   - Develop TAC on a precautionary basis.
   - In calculating TAC, adjust target fishing mortality to a lower value to account for uncertainty in fishing mortality estimate.

To initiate a progress and assist CITES with improving the process of non detrimental findings, the following steps are suggested:

1. The Commission on Aquatic Bioresources of the Caspian Sea should establish a stock assessment committee that will be responsible for data analysis, stock assessment and development of management recommendations. The committee should include principle biologists studying sturgeon, data analysts and stock assessment scientists from each state. Due to the scarcity of properly trained stock assessment personnel in the region, it is critical that FAO or any other international organization provide technical assistance to this group at the initial stage. This could be done by either providing training or appointing a well-regarded stock assessment scientist(s) to the committee or both. The role of such an individual(s) will be to provide technical assistance and leadership, serve as a guarantor of objectivity and assure that the decisions are made based on best science available.

2. Within the first year the stock assessment committee should develop a work plan, complete a data inventory, review historical survey data, conduct additional survey data analysis and address all recommendations on trawl survey improvements. The committee will also develop target and limit reference points.

3. Within the second year the committee will review candidate assessment models and select those applicable given data availability. Once a suite of models is selected for the analysis, the committee will conduct a data workshop and a stock assessment workshop to produce estimates of mortality and population size and evaluate the status of stocks in relation to reference points. The committee will also consider necessary changes to the survey design.

4. Upon successful completion of these tasks, the committee will review its progress and revise the work plan according to the recommendations provided in this and other documents and following the outcomes of the committee's work and emerging needs.

5. The committee will report its progress to the Commission of Bioresources and the Commission members will submit state reports to CITES.

APPENDIX 1

List of Cited Documents

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Table 1 Number of trawling stations sampled in Caspian Sea by state and depth areas

State	Fishery zones	Depth (m)		
		2-10	10-100	Total
Azerbaijan Republic	1 2	4 7	16 28	20 35
Total		11	44	**55**
Iran	1 2 3 4 5	5 3 2 3 21	17 5 9 18 2	22 8 11 21 23
Total		34	51	**85**
Kazakhstan Republic	1 2 3	87 2 1	– 4 22	87 6 23
Total		**90**	**26**	**116**
Russian Federation	1 2 3	67 9 2	2 27 45	69 36 47
Total		**78**	**74**	**152**
Turkmenistan	2	1	41	42
Total		**1**	**41**	**42**

Figure 1 Distribution of trawl stations in fixed transect design used by Russia, Kazakhstan, Turkmenistan and Azerbaijan

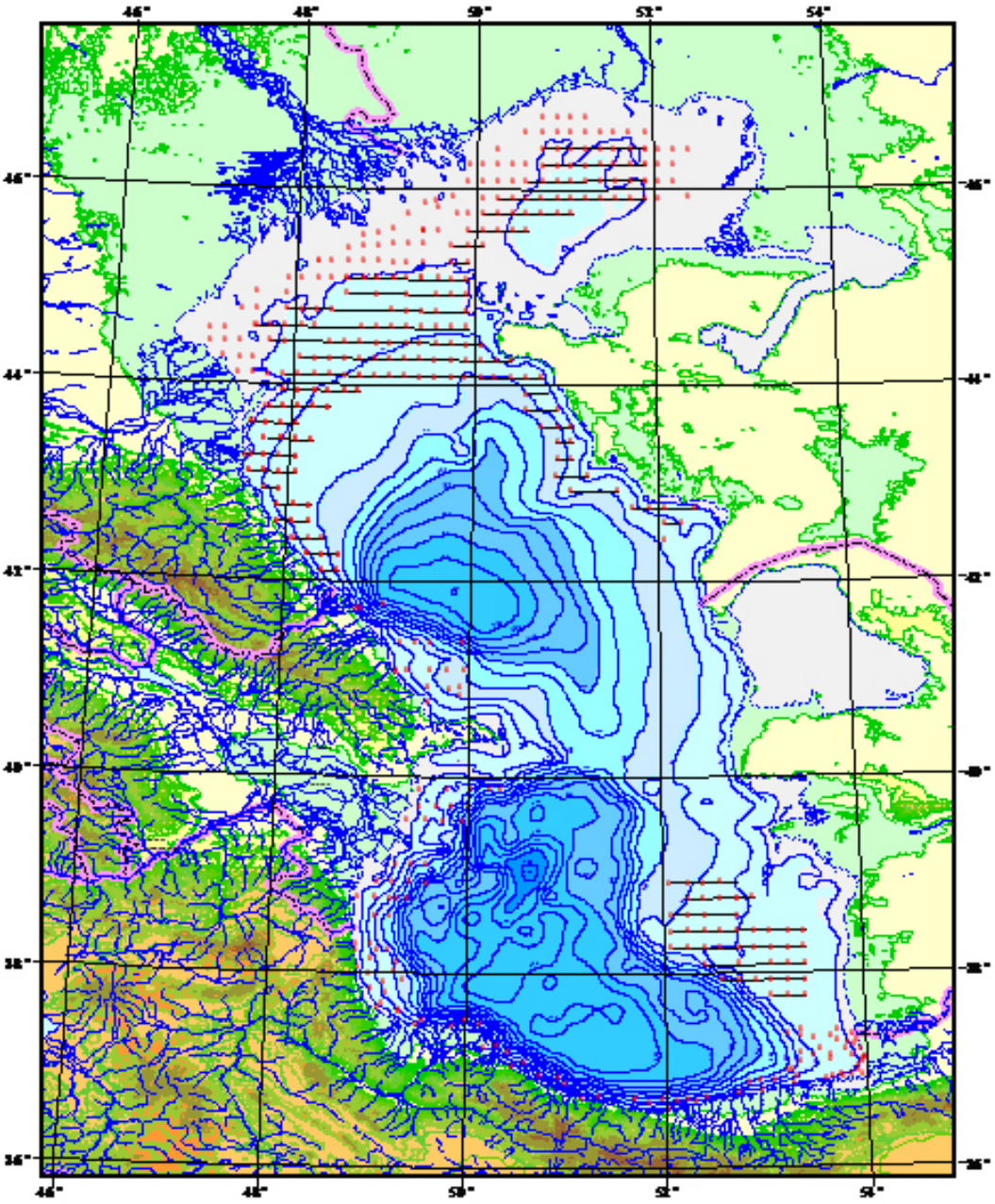

Figure 2 Harvest Control Rule (from Restrepo et al., 1998)