A Scientific Response to the CITES Justification for Setting the 2002 Total Allowable Catch of Beluga Sturgeon (*Huso huso*) in the Caspian Sea

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October 28, 2002

Executive Summary

This report provides a scientific critique of the information CITES relied upon for setting 2002 catch and export quotas for Caspian Sea sturgeon populations and discusses the implications for quota setting and population persistence. In general the CITES report is plagued by inadequate description and justification of methodologies used, a lack of statistical rigor, and a failure to describe the scientific uncertainty associated with various estimates. One of the major weaknesses of the CITES report is the unjustified use of an extremely low trawl survey catchability coefficient of 0.04 for beluga sturgeon. This value is much smaller than the typically used value of 1.0, and is an order of magnitude smaller than any other values the authors could find in the published literature. The impact of using such a small value is an overestimation of beluga sturgeon abundance by a factor of 25. Another major weakness is an overly optimistic assumed value of natural mortality rate for beluga sturgeon.

Whereas the CITES report emphasizes the intensity of hatchery release efforts during the period 1996 to the present, it neglects to point out the alarming overall decrease in the number of individuals released during this time period. This decline is consistent with the observed decline in broodstock available to supply hatcheries, and will result in reductions in recruitment to the adult portion of the beluga population through at least 2015. Furthermore, given the many obstacles to beluga survival (harvest pressure, habitat destruction) the actual recruitment success of released individuals remains unclear. The legal catch quotas approved by CITES represent a very substantial fraction of the total population, and when illegal catch is factored in, the situation looks even more grim. It appears likely that under current conditions virtually all mature beluga sturgeon will fall prey to either legal or illegal fishing, stalling any chance of recovery, and leaving the population at greater risk of extinction.

Based on the critique, it is concluded that the information CITES relied upon provides an overly optimistic view of the condition of the beluga sturgeon population in the Caspian Sea. In turn, this led CITES to approve beluga sturgeon quotas for 2002 that were hazardously high. In summary, this critique confirms the precarious situation of the beluga sturgeon in the Caspian Sea, and finds the quotas established for 2002 to jeopardize the continued persistence of the beluga population.

Introduction

In late 2001 a cooperative survey to assess the status of sturgeon populations of the Caspian Sea sturgeon population was conducted. The results of that survey were used by the Secretariat for the Convention on International Trade in Endangered Species (CITES) to help set total allowable catch (TAC) and export levels for sturgeon for each of the Caspian range states (Azerbaijan, Iran, Kazakhstan, Russia, Turkmenistan) for 2002.

The results of the survey, particularly the findings for beluga sturgeon (*Huso huso*) generated great concern for scientists interested in the recovery of the Caspian beluga sturgeon population which has been classified as "Endangered" by the IUCN.[1] The survey reported finding only 27 beluga sturgeon in the northern part of the Caspian and just one beluga in the southern and middle portions of the sea.[2] More than 85% of the beluga found in the northern part of the Caspian were immature, suggesting that this population is severely overfished. The four mature beluga that were caught during the survey were very young adults, just beginning the reproductive phase of their lives and very important to the future of the stock.

In early 2002 CITES established catch and export quotas for the Caspian Sea sturgeon populations and issued a document entitled "Total Allowable Catch (TAC) Estimation for Sturgeon Species in the Caspian Sea."[3] (hereinafter referred to as the "CITES report"). The CITES report, prepared by the Management Authority for Sturgeon for the Russian Federation on behalf of the five littoral states of the Caspian Sea, explains the methods used to determine sturgeon catch and export quotas for 2002**.** In general the CITES report is plagued by inadequate description and justification of methodologies used, a lack of statistical rigor, and a failure to describe the scientific uncertainty associated with various estimates. In addition, the document's conclusions, are based on several highly risky assumptions for which no scientific justification is provided. Using these assumptions to determine beluga sturgeon quotas will result in excessive fishing pressure on a population that has been recognized as endangered and that continues to face a number of severe threats.

The current document is a scientific response to the CITES report which critically examines some of the scientific assumptions that management action has relied upon. Biological indicators that have been published in the peer-reviewed scientific literature suggest that beluga sturgeon remain very depleted in the Caspian Sea. Peer-reviewed scientific publications have been calling for cessation of the Caspian beluga fishery since

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[1] Birstein, V.J., W.E. Bemis, and J.R. Waldman. 1997. The threatened status of acipenseriform species: a summary. Environmental Biology of Fishes 48:427-435.
[2] TACIS/CEP. 2001. Report on the Results of the Caspian Marine Expedition, p. 57. (The CEP report).
[3] Available at: www.cites.org/eng/programme/Sturgeon/catch.pdf

1997,[4] yet the Secretariat and range states have not followed this scientific advice. While some important first steps were taken during 2001, they were only the beginning of a long road to rebuilding beluga sturgeon populations to a point where they can support a sustained fishery.

Scientific Response

In addressing the question, "What is the real status of the beluga *Huso huso*?" the CITES report makes six flawed assertions which are apparently used to justify the 2002 beluga sturgeon catch and export quotas. These assertions and the scientific concern over their use will be examined and addressed individually below.

CITES Assertion #1: *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*.[5]

***Scientific Response**:* The number of beluga sturgeon in the Caspian Sea has declined precipitously due to overfishing, poaching, significant loss of spawning grounds and other environmental impacts on the sea. Of particular concern is the small number of reproductively mature fish, which are presently at an all-time historic low point. These mature fish not only form the basis for caviar production, but are needed to produce the next generation of beluga sturgeon – through either natural spawning or by providing broodstock for hatchery production. The current status of beluga sturgeon is precarious, and the factors that have led to their steady decline remain serious threats. Specifically,

- beluga sturgeon have lost up to 90% of their spawning grounds;[6]
- a 1990 survey found that 100% of sturgeon eggs (a mixture of beluga, stellate and Russian sturgeon) on the lower Volga River showed abnormalities attributable to toxic levels of water pollution and 100% of embryos were nonviable;[7]
- the illegal trade in Caspian sturgeon products is estimated to be 6-10 times greater than the legal trade.[8]

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[4] Raspopov, V.M. and A.S. Novikova. 1997. Size and age composition of larvae and spawners of the great sturgeon, *Huso huso*, migrating in the Volga River. Journal of Ichtyhology 37:166-173.

[5] In the CITES report the remaining five assertions are listed immediately after this statement to support it. For simplicity of presentation, we address the assertions one by one in this response.

[6] Secor, D.H., V. Arefiev, A. Nikovaev, and A. Sharov. 2000. Restoration of sturgeons: lessons from the Caspian Sea sturgeon ranching program: Fish and Fisheries 1: 215-30.

[7] Khodorevskaya, R.P., G.F. Dovgopol, O.L. Zhuraleva, and A.D. Vlasenko. 1997. Present status of commercial stocks of sturgeons in the Caspian Sea basin. Environmental Biology of Fishes 48:209-19 *and* Altuf'ev, Y. 1997. Morphofunctional abnormalities in the organs and tissues of the Caspian Sea sturgeons caused by ecological changes, *in* Birstein, V.J., A. Bauer, and A. Kaiser-Pohlmann (eds) 1997. Proceedings of the Sturgeon Populations and Caviar Trade Workshop, IUCN SSC.

[8] TRAFFIC Europe-Russia. 1999. Estimation of the stock and population conditions of sturgeons in Russia and monitoring of domestic trade in sturgeon products.

While allowable quotas have declined, they still represent a major fraction of the estimated total spawning stock and in themselves, pose a significant threat to the continued survival of the species. When rampant, uncontrolled illegal fishing is considered, the situation looks dire indeed. Contrary to the report's unjustified assertion, these threats combine to leave the Caspian's beluga sturgeon population in a highly precarious state, as proven by a number of biological indicators, including:

- the number of beluga sturgeon entering the Volga to spawn dropped from 26,000 in the period 1961-65 to 7,000 in the 1991-95 period;[9]

- the population structure of beluga sturgeon has changed, with the relative percentage of larger and older fish (>26 years old) dropping from 16.9% in 1966-70 to 3.7% in 1991-95;[10]

- shorter migration distances for juveniles have contributed to smaller average size of juveniles in the Volga[11] and unstable hydrologic conditions in the period 1972-1980 contributed to lower growth rates for beluga sturgeon of the Volga River.[12]

CITES Assertion #2: *The current estimate of the size of the stock in the northern and central Caspian Sea alone is in the order of 9 million individuals, based on the 2001 stock assessment trawl survey.*

Scientific Response: The 2001 stock assessment trawl survey caught only 28 beluga sturgeon, of which 85% were immature fish below commercial size. While the survey area sampled included the northern, central and southern Caspian, the vast majority (96%) of beluga sturgeon caught were obtained in the northern Caspian, and no beluga were caught in the Southern Caspian. The estimate of 9 million beluga sturgeon in the Caspian Sea is based on the catch of these 28 individuals extrapolated upwards through the application of a scientifically unjustified and extremely low catchability coefficient of 0.04.

The catchability coefficient allows scientists to estimate the number of fish in the area as a function of the number of fish encountered by the survey gear. A low catchability coefficient implies that the fish are extremely difficult to catch and/or that the fishing gear is extremely inefficient. Specifically, the value of 0.04 assumed for beluga sturgeon implies that if 100 fish were in the immediate path of the trawl net, 96 fish would evade capture while only four fish would be retained. Thus each captured fish is assumed to represent 25 fish in the population. This is an absurd assumption and falls far outside the range of catchability coefficients we have found in the literature. Moreover, the net effect of using this unjustified low value is to overestimate population size by a factor of twenty-five times.

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[9] Khodorevskaya, R.P., E.V. Krasikov, G.F. Dovgopol, and O.L. Zhuravlev. 2000. Formation of the stock of Caspian Acipenserids under present-day conditions. Journal of Ichthyology 40 (8): 632-39.
[10] Khodorevskaya et al, 2000.
[11] Khodorevskaya et al, 1997.
[12] Raspopov, V.M. 1993. Growth rate of Caspian Sea beluga. Journal of Ichthyology 33(9):72-84.

Direct estimates from field trials of the proportion of fish in the area swept by trawl gear that is retained are rare; as such studies are difficult and expensive to conduct. Where such studies have been performed, using for example acoustically tagged fish or underwater visual recordings, the results vary among species. Catchability coefficients can exceed a value of 1.0 if fish are herded by the trawl gear, would equal 1.0 if all fish in the path of the trawl are retained, and can fall short of 1.0 is there is significant gear avoidance. Dickson[13] suggested a value of 1.0 be used in the absence of direct estimates, whereas Sparre and Venema[14] indicate that a value between 0.5 and 1.0 is commonly selected in trawl survey work. The United States National Marine Fisheries Service's Alaska Fisheries Science Center trawl survey assumes a value of 1.0 for all species, in default of other information[15]. However, when the catchability is estimated in the assessment, the value can differ from 1.0. For Pacific Ocean Perch the best estimate of catchability for the trawl surveys was 2.78 in 1998 and 2.99 in 2000[16]. For northern rockfish, the estimate of trawl survey catchability varied between 0.4 and 0.5, depending upon the model[17].

It has been shown that smaller fish tend to escape under the footrope more easily than larger fish[18], and that larger fish tend to herd at higher proportions than smaller fish[19]. Hence, it would be expected that large fish such as sturgeon would tend to be herded by trawl doors and sweeps and would not easily escape under the footrope. Thus, a catchability coefficient of 1.0 or greater seems most justifiable for beluga sturgeon given the current state of scientific information on fish catchability by trawl gear. If this more widely accepted coefficient of 1.0 were used, the estimate of total beluga sturgeon abundance, based on the 2001 trawl survey would be only 374,000 individuals. Of these, the survey showed that only about 15% or 55,320 fish would be expected to be mature.

Further, applying CEP & CITES ratios[20], respectively, to these estimate of the number of mature fish, yields estimates of between 140 and 844 individuals that would be expected to spawn in 2001.

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[13] Dickson, W., 1974. A review of the efficiency of bottom trawls. Bergen, Norway, Institute of Fisheries Technology and Research, 44p

[14] Sparre, P. and S.C. Venema. 1998. Introduction to Tropical Fish Stock Assessment – Part I: Manual. FAO Fisheries Technical Paper 306/1 Rev. 2, FAO, Rome.

[15] Weinberg, K.L., M.E. Wilkins, F. R Shaw, and M. Zimmerman. 2002. The 2001 Pacific West Coast Bottom Trawl Survey of Groundfish Resources: Estimates of Distribution, Abundance, and Length and Age Composition. NOAA Technical Memorandum NMFS-AFSC-128. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center.

[16] National Marine Fisheries Service. 2001. Environmental Assessment for the Total Allowable Catch Specifications for the Year 2002 Alaska Groundfish Fisheries. Appendix B. Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of Alaska.

[17] National Marine Fisheries Service. 2000. Environmental Assessment for the Total Allowable Catch Specifications for the Year 2001 Alaska Groundfish Fisheries. Appendix B. Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska.

[18] Godo, O.R. and S.J. Walsh. 1992. Escapement of fish during bottom trawl sampling – implications for resource management. Fisheries Research 13: 281-292.

[19] Engas, A. and O.R. Godo. 1989. The effect of different sweep lengths on the length composition of bottom-sampling trawl catches. J. Cons. Int. Explor. Mer, 45: 263-268.

[20] The estimates of the fraction of mature fish that spawn in a given year differ between the CEP and CITES

CITES Assumption #3: *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).*

Scientific Response: Table A-7 of the CITES report shows the number of beluga sturgeon fingerlings released by Russian hatcheries from 1996 to 2001. While the average number released is 11.7 million beluga sturgeon, there is a large and steady decrease (about a 75% decline) in fingerling releases over this time period. Hatchery output in the last two years of this period is just 16-33% of that during the first two years. The decreasing hatchery output between 1996 and 2001 is alarming, and is consistent with a decline in mature broodstock to supply the hatcheries. No matter what the cause of the decline, the net effect will be a significant decline in hatchery-reared fish over time, with the effects of diminished 2000-2001 hatchery releases being evidenced as a reduction in recruitment to the adult stock through at least 2015 (i.e., when the fish achieve maturity).

CITES Assertion #4: *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).*

Scientific Response: While substantial numbers of fingerling beluga were released from 1996 onwards and might ultimately increase the numbers of mature fish added to the Caspian stock each year, the first of these fish would only enter the mature population in 2011 (when they reach maturity at 15 years of age). This is not a valid basis for allowing a fishery on the extremely depleted adult population that exists today.

Further, there is no documentation provided in this report to substantiate any specific survival rate for beluga sturgeon, and thus to support the optimism expressed in the report. While a nominal rate of 1% survival may appear reasonably low at first glance, it is important to note that some stocks of hatchery reared salmonids, which have a much longer and better documented history of production than sturgeons, have been shown to have lower survival rates than 1% [21]. Sturgeon juveniles must survive not only the hazards of natural mortality, but are also subject to poaching for their meat for several years prior to reaching maturity. In addition, salmonids mature much earlier than sturgeon (2-5 years for salmonids vs. 15 years for beluga sturgeon), so the number of years of relevant survival is smaller for salmonids. The relevant statistic for beluga sturgeon is survival until maturity (i.e., 15 years), and this is not directly estimable at the present time for any year-class released from 1996 onwards, as none of those fish would mature until 2011.

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reports, and no documentation or rationale is provided in either case.

[21] Coronado, C. and R. Hilborn. 1998. Spatial and temporal factors affecting survival in coho salmon (*Oncorhynchus kisutch*) in the Pacific Northwest. Can. J. of Fish. Aquat. Sciences. Vol. 58: 2067-2077. (see, eg. Figure 3 showing survival under 1% survival to age 3 for all California coho populations, and for some populations in other Pacific states).

CITES Assertion #5: *In 2001, the biomass of reproductively mature belugas amounted to 69,150 t in the northern and central Caspian alone, representing 2.7 million individuals, of which approximately 21,000 individuals were expected to spawn in 2002.*

Scientific Response: The figure of 69,150 tons is based on the flawed 9.3 million fish total population estimate and overestimates the biomass of reproductively mature beluga in the Caspian to the same degree. That is, it should be reduced by a factor of 25. Moreover, the 2.7 million individual number is not consistent with the survey's findings that just 15% of the population is mature. Adjusting to a more standard catchability coefficient (i.e., dividing the results by 25) yields 140 spawners in 2001 given the estimate of 3500 spawners in the CEP report, or 844 spawners based on the CITES report.

CITES Assertion #6: *The average number of belugas caught legally 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.*

Scientific Response: When one takes into account the overinflation of the population abundance estimates due to use of an improper catchability coefficient, one finds that the estimated number of beluga sturgeon that could spawn in 2001 is fewer than 1,000 fish. The 2002 catch quota for belugas in the Caspian of approximately 1780 individuals is greater than the estimated number of spawning fish. Clearly, this is a hazardously high level – even before taking into account the huge amount of illegal fishing that continues to plague the region. In order to allow for a recovery of the beluga population, the mature fish component of the population must be protected so that it may be replenished. At the current low abundance level, any level of fishing activity is incompatible with a recovery.

Discussion and Conclusions

Future assessments should take account of the concerns raised in this critique, and provide full documentation and justification of methods used, as well as measures of scientific uncertainty associated with each of the estimates. The catchability coefficient used to extrapolate total abundance from trawl survey catch is of particular concern. The difficulty of reliably estimating catchability coefficients has led many scientific investigators to abandon the use of trawl surveys to estimate the absolute abundance of fish populations. Instead, trawl survey results are used as a time series of relative abundance indices in a comprehensive, quantitative fisheries assessment. This is a direction that is recommended for the Caspian range states in the development of a basin-wide stock assessment and management program for all sturgeon species. In the interim, a catchability coefficient of 1.0 for all sturgeon species is much more defensible than the currently used values.

An accurate estimate of the survival of young sturgeon to maturity is also of critical importance to the long-term health of sturgeon populations and to projecting future trends in abundance. This is especially important at this point in time, when the majority of sturgeons in the Caspian are substantially younger than the age of first maturity. In order

to reliably examine these questions a large-scale coordinated tagging program is recommended for the region. Such a program would also assist determination of the optimal size and timing of release of hatchery-reared fish.

Based on the critique, it is concluded that the information CITES relied upon to set quotas for 2002 provides an overly optimistic view of the condition of the beluga sturgeon population in the Caspian Sea. In turn, this led CITES to approve beluga sturgeon quotas that were hazardously high. In summary, this critique confirms the precarious situation of the beluga sturgeon in the Caspian Sea, and finds the quotas established for 2002 to jeopardize the continued persistence of the beluga population.