July 31, 2012

Mr. Paul Diodati, Chair
Dr. Louis Daniels, Vice Chair
Atlantic States Marine Fisheries Commission

VIA ELECTRONIC MAIL

Dear Mr. Diodati and Dr. Daniels:

We write to make available to you and other members of the Atlantic States Marine Fisheries Commission additional information for the August 8 deliberations of the Sturgeon Board.

Since May, our respective organizations have been working with Dr. Mike Dadswell, Professor of Biology at Acadia University, to gain a clearer understanding of the data used by NOAA which led to the decision to list Atlantic Sturgeon under the Endangered Species Act. Over the years, Dr. Dadswell's research has focused on biological aspects of Atlantic sturgeon and shortnose sturgeon. His knowledge and expertise has been an asset to furthering our understanding.

The document attached is under final review. We intend on submitting a final report for your records in the near future but didn't want to miss the opportunity afforded by the upcoming Sturgeon Board meeting to share the preliminary findings and conclusions as they stand in this draft document today.

We continue to be encouraged by the commitment and efforts put forth by the Atlantic States Marine Fisheries Commission as it relates to Atlantic Sturgeon and hope we can assist you in your work moving forward.

We request that you distribute the attached document to members of the Sturgeon Board as soon as possible.

Sincerely,

Tom Dempsey
Cape Cod Commercial Hook Fishermen's Association

Ted Platz
Commercial Fisheries Center of Rhode Island

Maggie Raymond
Associated Fisheries of Maine

Jackie Odell
Northeast Seafood Coalition

Cc: Kate Taylor, Fishery Management Plan Coordinator, ASMFC

An Analysis of the Scientific Data Used In the NOAA Listing of the USA Atlantic Coast Atlantic Sturgeon Population as Endangered

Michael J. Dadswell
Department of Biology
Acadia University
Wolfville, NS. Canada B4P 2R6

and

Steven Nack
140 German Church Rd.
Ghent, NY 12975
United States

Draft: Dadswell and Nack

Submitted July 27, 2012.

Executive Summary

A review of the scientific data used by the NOAA Fishery Service in their April 12, 2012 Endangered Species Listing Document for Atlantic sturgeon was undertaken. First, the scientific information used by NOAA was out of date and second, some of the scientific analysis was incorrect. In their endangered listing NOAA used a scientific document that was published in 2007 but which analyzed data for the Hudson River Atlantic sturgeon commercial fishery from 1980-1995 and the conclusions are 16 years out of date. Additionally, scientific information that has become available after 2000 and which suggests the Atlantic coast population of Atlantic sturgeon is rebounding because of numerous State and Federal moratoriums on directed commercial fishing, was not considered (Collins et al. 2000; Eyler et al. 2009, Dunton et al. 2010; Schueller and Peterson 2010; Erickson et al. 2011; Dunton et al. 2012).

The Hudson River adult population estimate of 863 adults used by NOAA (2012) to calculate the population size of the five, Atlantic sturgeon DPS units was actually an estimate of only the Hudson River annual spawning run size (Kahnle et al. 2007). Atlantic sturgeon females and some males do not spawn annually and these would be out at sea during the spawning run. The analysis of the annual spawning run data indicated that the ratio of male to females was a relatively stable 4:1 during 1980-1995 suggesting the spawning periodicity of the females could be as high as once every four years and these females need to be included in an estimate of the total adult population. Additionally, Erickson et al. (2011) demonstrated with a pop-off satellite tagging study of Hudson River Atlantic sturgeon in the spawning run that the females do not return each year. For these reasons the adult population size of the Hudson River used for the NOAA endangered listing document was determined to be underestimated by a factor of at least 2X and that the probable total size of the Hudson River Atlantic sturgeon population was in the range of 1800 - 2200 adults in 1996.

The NOAA endangered listing document (2012) also failed to recognize that the Hudson River commercial fishery was closed in 1996 which means that 16 year classes of adults unexploited while in the Hudson, had recruited to the population by 2012.

Draft: Dadswell and Nack

A Virtual Population Analysis indicated that the 2012 Hudson River population could be as large as 3600 adults, which would be greater than the F_{50} restoration level recommended by Kahnle et al. (2007) for a resumption of the commercial fishery. Our analysis also indicated that the estimated, late 1800's virgin adult female abundance for the Hudson River (Secor 2002), on which the recommended F_{50} restoration level was based was overestimated by a factor of 2-3X which means that the 2012 female abundance could now be approaching the actual 1890 level.

Since the Hudson River spawning run size was used to estimate the population size of all other US east coast populations in the NOAA listing document an underestimated Hudson population was a major fault in the decision process. Underestimating the total Hudson River population by a factor of 2X, results in an overestimation of the by catch mortality of Atlantic sturgeon in the US east coast non-directed fisheries by 2X. Using the NOAA bycatch methodology and an estimated Hudson River population of 2000, we obtained a revised Hudson River intercept rate of 16.4%. This intercept rate results in an estimated US Atlantic coast subadult and adult population of Atlantic sturgeon of 19,000. Based on a population of 19,000 and the NOAA determined annual bycatch of 3118 sturgeons with a mortality rate of 25%, we calculated a annual bycatch exploitation rate of 4% or F =0.04 for Atlantic sturgeon. A bycatch of F =0.04 is similar to the level of exploitation found in current, managed, sustainable sturgeon fisheries including some Atlantic sturgeon fisheries and would not threaten the east coast population of Atlantic sturgeon. Based on our analysis it is recommended that the endangered species designation for the US east coast Atlantic sturgeon be revised and the population be managed as a recovering fisheries resource.

Draft: Dadswell and Nack

Introduction

The US east coast population of Atlantic sturgeon has been exploited by natives for millennia (Holzkamm and Waisberg 2004) and by European and African settlers since the 1600's (Smith 1985). High exploitation of Atlantic sturgeon, however, did not begin until the 1880's when a caviar and oil, industrial fishery began in the eastern United States and Canada (Rogers 1936; Saffron 2004). The industrial fishery was persecuted at a time when natural resources were not managed scientifically and the Atlantic coast Atlantic sturgeon stock was effectively mined out during 1880-1900 (Secor 2002). The saving factor for Atlantic sturgeon was that sturgeon populations have numerous, juvenile cohorts, that when recruited, can restore spawning stock levels relatively quickly. This type of life history allowed Atlantic sturgeon populations to recover when other natural resources, such as the plains buffalo, nearly went extinct because of over exploitation during the late 1800's.

Beginning in the 1970's and continuing until the mid 1990's, in response to rising worldwide demand for caviar and because of a collapse of the Russian sturgeon fishery caused by the breakup of the Soviet Union, Atlantic sturgeon stocks were again heavily exploited (Smith and Clugston 1997). This time, however, state and federal agencies charged with fisheries management closed the fishery before a complete collapse (Secor 2002; Dadswell 2006). Between 1973 and 1998 most US east coast states closed their Atlantic sturgeon fisheries and in 1998 the fishery was closed federally for a minimum of 20 years (ASSRT 2007). Through all this, however, some Atlantic sturgeon fisheries persisted at or near a sustainable level because of traditional low levels of exploitation (Hudson River; Kahnle 2007) or because of management at a sustainable level (Trencia et al. 2002; Dadswell 2006).

Declaring a fish species endangered is an extreme step, especially for one whose biology and population status is poorly known (Doremus and Pagel 2001; Stokstad 2005). Terrestrial species are simpler to observe and population trends can be determined more readily making it easier to develop management practices and restore population levels. Examples of this situation are the

American alligator and the peregrine falcon. Both were declared endangered in 1966, but have now been declared recovered (USFWS 2002). Conversely, the shortnose sturgeon, which was also declared endangered in 1966, remains listed even though there is ample evidence that it should be designated as recovered (Dadswell et al. 1984; Bain et al. 2007). In fact no fish species in the United States declared endangered, has ever been declared recovered (Bain et al. 2007). The use of up-to-date scientific data and extensive, peer-reviewed, scientific analysis must precede an endangered listing.

We have undertaken an extensive review of the biology and fisheries of Atlantic sturgeon and other sturgeon species for comparison to the Atlantic sturgeon. We have reanalyzed the data used to estimate the Hudson River Atlantic sturgeon population size (Kahnle et al. 2007) which was used in the NOAA Endangered Species Listing (2012). We find that the population size for the Hudson River Atlantic sturgeon stock was underestimated and this fact led to incorrect assumptions in the endangered listing including an underestimation of the size of the US east coast population and an over estimation of potential bycatch mortality by non-targeted fisheries. Furthermore, there was an incorrect analysis concerning the size of the former Hudson River Atlantic sturgeon population before industrial exploitation began in 1880 and this fact led to an inflated concept of the former size of the Hudson River population and a possible restoration target.

Draft: Dadswell and Nack

The Reanalysis of Data Concerning Present and Past Population Sizes of Atlantic Sturgeon on the Atlantic Coast of the United States.

Scientific problems with the Hudson River population size used in calculations by NOAA (2012) include:

1. **The Hudson River Atlantic sturgeon adult population estimate (863 adults) used by the NOAA Fisheries Service (2012) was based on Atlantic sturgeon population data taken from the Hudson River commercial fishery during 1980-1995 (Kahnle et al. 2007) and was out of date.**

   Biological populations of commercial fishes vary over time, especially if a fishery is closed and exploitation ceases. The Hudson River Atlantic sturgeon fishery was **closed after the 1996 fishing season** and the annual Atlantic sturgeon spawning run has been unexploited since 1997. This factor alone makes it scientifically incorrect to use data gathered from 1980 – 1995 to make a management decision based on population size during 2012 or 16 years after the fact.

2. **Kahnle et al. (2007) estimated the annual spawning run size of Atlantic sturgeon in the Hudson River not the size of the total adult population.**

   The Hudson River Atlantic sturgeon population estimate used in the listing document (**863 adult Atlantic sturgeon;** NOAA Fisheries Service 2012) was taken from research on the Atlantic sturgeon commercial fishery in the Hudson River during 1980-1995 (Kahnle et al. 2007) and was incorrect. First, the actual statistic estimated by Kahnle et al. (2007) using fisheries exploitation data **was the annual spawning run size not the total population or spawning stock size** (Table 1). Second, the method used to estimate the spawning run size was a mathematical process based on further mathematical manipulations to determine exploitation rates, the basis for some of which were debatable. Kahnle et al. (2007) should have used a direct method to estimate spawning run size and exploitation. A mark-recapture experiment similar to that used by Peterson et al. (2008) to estimate the annual spawning run size of Atlantic sturgeon in the Altamaha River, Georgia would have provided usable data. A final Hudson River total population size could have then been estimated based on the scientific knowledge of Hudson River Atlantic sturgeon (spawning periodicity of males and females; total age distribution of females, etc.)

Table 1. Number and total landings of Atlantic sturgeon harvested in the commercial fishery of the Hudson River during 1980-1995 (after Kahnle et al. 2007) with the Male:Female ratio calculated by MJ Dadswell.

Year	Males	Females	Total	M:F Ratio	Total Landings (kg)
1980	172	42	214	4.1:1	6451
1981	92	23	115	4.0:1	3459
1982	161	40	201	4.0:1	6053
1983	197	48	246	4.1:1	7404
1984	121	30	151	4.0:1	4536
1985	182	45	227	4.0:1	6825
1986	119	29	148	4.1:1	4448
1987	86	21	107	4.1:1	3234
1988	18	4	23	4.5:1	682
1989	48	12	60	4.0:1	1815
1990	472	116	588	4.1:1	17713
1991	288	71	359	4.1:1	11115
1992	254	62	317	4.1:1	9541
1993	86	15	101	5.7:1	4493
1994	117	25	142	4.7:1	5807
1995	118	43	161	2.7:1	7779
Means (n = 16)	158.2	39.1	197.5	4.0:1	6316

Kahnle et al. (2007) related that the mean annual harvest of males during 1986-1995 was 161 and for females during 1985-1995 was 40. Why they chose to ignore the data back to 1980 was unexplained but makes little difference since the average catch/year was nearly identical to the complete data set (Table 1 above). Then, Kahnle et al. (2007) used the average annual commercial Hudson River harvest between 1985/1986 and 1995 and an average estimated exploitation rate (u) to determine the spawning run size where:

as Males = #/u = 161/0.27 = 596 and for females #/u = 40/0.15 = 267

for a total spawning run size of 596 + 267 **= 863 or the estimated population number for the Hudson River used in the NOAA Fisheries Service 2012 listing document.**

Kahnle et al. (2007), however, used their highest estimates of exploitation rate for both males (see Table 3 in Kahnle et al. 2007; ages 15 – 22, u = 0.27) and females (ages 22 -30, u = 0.15) although they had data that suggested their chosen exploitation rates were not justified or based on the complete age distribution of the spawning run which contained males aged 15-31 with a lower estimated u of 0.18 (see their Fig. 5) and females 22 – 62 with a lower estimated u < 0.01 (see their Fig. 6). If Kahnle et al. (2007) had used these more conservative rates, because their data suggested they were closer to reality, the average spawning run size would have been:

Males 161/0.18 = 894 and for females 40/0.01 = 4000

which also appears to be incorrect (probably too many females). Hence the problems of fisheries statistics estimated without a direct method such as a mark- recapture experiment.

Finally, using the median exploitation rates for males and females calculated by Kahnle et al. (2007; see their Table 3) based on an age structure of 15-24 yr for males (u = 0.23) and 22-34 yr for females (u = 0.08) the population estimate would have been:

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Males 161/0.23 = 700 and for females 40/0.08 = 500

for a total spawning run of 1200 sturgeon which is probably nearer the real spawning run size based on the selectivity characteristics of the gill nets used in the fishery. The Hudson River commercial fishery formerly used mainly 13 inch stretched mesh gill nets (Kahnle et al. 2007; S. Nack, personnel observation) which catch Atlantic sturgeon predominately between the ages of 10-20 yr of age (Stevenson 1997). That fact means catches in the Hudson River spawning run would have been biased towards males which mature at a younger age and size (Kahnle et al. 2007).

3. **The Kahnle et al. (2007) estimate of the population size of the Hudson River Atlantic sturgeon population did not consider spawning periodicity of females and males (ie. Females and males that do not spawn every year) or that females live longer than males.**

One of the major oversights in the Kahnle et al. (2007) estimate of the Hudson River population size was not considering spawning periodicity of females or males (ie. females or males not spawning every year) as demonstrated by Van Eeneennaam et al. (1996, 1998) and Erickson et al. (2011) for the Hudson River population. The data presented by Kahnle et al. (2007) indicates that the annual spawning run in the Hudson River had a male:female sex ratio of 4:1 based on 16 years of data (1980 – 1995; Table 1 above; Dadswell calculated here).

A high ratio of males to females is typical of sturgeon spawning runs because some portion of the female population does not spawn each year (Table 2; Roussow 1957; Cuerrier 1966; Sokolov and Malytin 1978; Dadswell 1979; Pine et al. 2001; Erickson and Webb 2007) and spawning success requires large numbers of males because of the way all sturgeon species reproduce (broadcast spawning in groups with few females and many males; Magnin 1962; Sokolov and Malytin 1978). For instance, Erickson and Webb (2007), using acoustically tagged green sturgeon and passive receivers for relocation in the Rogue River, Oregon over a four year period, found the mean spawning periodicity was 2.3 yr for males and 2.75 yr for females and the spawning runs had a male:female ratio of 2:1 (Table 2).

Table 2. Sex ratio determined from spawning runs of different sturgeon species.

Species and Location	Males	Females	Sex Ratio	Source
Atlantic sturgeon				
Saint John R, NB	264	171	1.5:1.0	Ceapa 2009
Kennebec R., ME	27	4	6.7:1.0	ASSRM 2007
Hudson R., NY	161	40	4.0:1.0	Kahnle et al. 2007
" "	66	28	2.4:1.0	Van Eenennaam et al. 1996
" "	103	22	4.7:1.0	Arend 1998
" "	53	6	8.8:1.0	Erickson et al. 2011
Edisto R. SC	21	7	3.0:1.0	Collins et al. 2000
Green sturgeon				
Rogue R., OR	101	50	2.0:1.0	Erickson and Webb 2007
Lake sturgeon				
St. Lawrence R.	37	13	2.8:1.0	Cuerrier 1966
Surgeon R., MN	333	159	2.1:1.0	Auer 1996
Wolf R., WI.	2467	436	5.7: 1.0	Folz and Meyers 1985
Siberian sturgeon				
Lena R.	352	262	1.3:1.0	Sokolov and Malyutin 1978
Shortnose sturgeon				
Connecticut R., MA	33	7	4.7:1.0	Buckley and Kynard 1985

Juvenile sturgeon populations have a male:female ratio of 1:1 (Smith 1985; Fortin et al. 1993) but males have a shorter life span than females and the population of older fish often consists almost entirely of females (Table 3; Probst and Cooper 1955; Cuerrier 1966; Stevenson and Secor 1999; Pine et al. 2001; Erickson et al. 2007; Kahle et al 2007).

Table 3. Sex ratios by age among mature populations (not spawning runs except for the Hudson River) of different sturgeon species

Sturgeon Species and Location	Adult Population Sampled Age (yr)	Total Sampled	%Females	Source
Atlantic sturgeon				
Hudson R.	10-19	296	10.4	Kahnle et al. 2007
	20-29	80	42.5	
	20-64	11	81.8	
St. Lawrence R.	20-29	114	16.0	Caron et al. 2002
	30-39	28	80.0	
Lake sturgeon				
Wisconsin	10-19	294	44.4	Probst and Cooper 1955
	20-29	207	59.5	
	30-82	112	95.2	
St. Lawrence R.	10-19	2057	52.4	Fortin et al. 1993
	20-29	282	56.0	
	30-39	19	75.0	
	40-91	12	84.0	
Shortnose sturgeon				
Saint John R., NB	10-19	67	51.1	Dadswell 1979
	20-29	73	78.9	
	30-67	21	90.6	

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It is well known that older sturgeon females, including Atlantic sturgeon, do not spawn every year and some have a relatively long period between spawning events (Table 3; Smith 1985). Lake sturgeon females apparently have a period of 5-11 yr between spawning events (Roussow 1957; Guenette et al. 1992), Russian sturgeon, 5-14 yr (Shilov et al. 1971); shortnose sturgeon; 3 yr (Dadswell 1979); Green sturgeon, 2-4 yr (Erickson and Webb 2007) and Atlantic sturgeon, 2-5 yr (Van Eenennaam et al. 1996; Pine et al. 2001). It would be possible to estimate the spawning periodicity of Hudson River female Atlantic sturgeon using a number of methods including: mark-recapture experiments (Pine et al. 2001), pop-off satellite tags (Erickson et al. 2011), long-life acoustic tags (Erickson et al. 2007), examination of maturing females for ripening stages (Trusov 1975; Van Eenennaam et al. 1996, 1998) and the cyclic presence of Strontium-90 in hard tissue (bones, pectoral rays) because of ocean residence (Veinott et al. 1999; Allen et al. 2009).

Table 4. Spawning periodicity of females and males of different sturgeon species.

Sturgeon Species	Periodicity (yr)		Source
	Males	Females	
Atlantic sturgeon	1?	2-5	Dovel and Berggren 1983; Van Eenennaam and Doroshov 1998; Kahnle et al. 2007; Erickson et al. 2011
Gulf sturgeon	?	6 -10	Huff 1975; Sulak and Clugston 1999; Pine et al. 2001
Green sturgeon	2.3	2.7	Erickson and Webb 2007
Lake sturgeon	1-3	4-7	Roussow 1957; Guenette et al. 1992
Shortnose sturgeon	2	3	Dadswell 1979
Russian sturgeon	5.5-7.6	7.2-7.7	Shilov et al. 1971

Kahnle et al. (2007) estimated, based on data collected from harvested Atlantic sturgeon in the Hudson River over a 16 year period (1980-1995), that the male:female ratio in the annual spawning run was approximately 4:1. Arend (1998) described the Hudson River spawning run male: female ratio based on research catches in 1995 and 1996 as 4.8:1. This stable characteristic of the Hudson River spawning run suggests that mature females from this population may have a minimum spawning periodicity of once every four years. Since the average number of females in the spawning run over a 16 year period was estimated to be 40 (Kahnle et al. 2007), the maximum number of mature females in the total population may have been underestimated by a factor of 4X.

The actual number of females in the Hudson population may be even larger because of the long life span of female sturgeon (Table 3). Males in the Hudson population have been found to live to age 36 but most are under 30 yrs (Stevenson and Secor 1999), whereas females have been aged to 42 (Stevenson and Secor 1999) and estimated to be over 60 yr (Kahle et al. 2007). Atlantic sturgeon in other locations have been aged at 60 yr (St. Lawrence R, Magnin 1962) and 64 yr (Minas Basin; Dadswell, unpub. data) but the size of neither of these fish (2.7m) was as large as the maximum size known for an Atlantic sturgeon. An Atlantic sturgeon taken from the Saint John River, New Brunswick, Canada was 4.6m (15 ft) long and weighted 367 kg (811lbs; Scott and Scott 1988). This Atlantic sturgeon could have been over 100 years old. Atlantic sturgeons of 3-4 m in length are relatively common in the Hudson (S. Nack, personnel observation). Atlantic sturgeon of this size were caught by Nack and his father (Everett Nack) in the Hudson but never landed because they were too large for them to handle safely. Dadswell (personnel observation) observed five Atlantic sturgeons between 4-5m in the Saint John River, NB during 1973 - 1976.

The maximum age known for sturgeon was a lake sturgeon caught in the Lake of the Woods which was aged at 157 yr (Scott and Crossman 1973). White sturgeon have been aged to 104 yr (Rien and Beamesderfer 1994) and lake sturgeon from the St. Lawrence R. have been aged at 97 years (Fortin et al. 1993). The oldest shortnose sturgeon known is 67 yr (Dadswell et al. 1979) and green sturgeon have been aged to 53 yr (Beamesderfer et al. 2007).

Kahnle et al. (2007) estimated that the annual spawning run size in the Hudson consisted of 596 males and 267 female (863 fish) during 1985/1986-1995. Since, however, the male:female ratio for the Hudson River annual spawning run was 4:1 then the actual adult population size should be adjusted for females (and possibly the males) that were not present in the river in a given year. Based on this fact the minimum Hudson River population during the period 1985/1986-1995 could have been:

# of males + 4 X (# of females) or 596 + 4 X 267 = 596 + 1068 = 1664

A total of 1664 Atlantic sturgeon in the 1993 -1995 Hudson River population is almost twice the 863 population number used in the 2012 NMFS listing document. It should also be added that if Kahnle et al. (2007) had used exploitation rates based on the actual, observed age structure of the Hudson River population (see their Table 3) then the estimated spawning run size would have been larger (see below).

A mature Atlantic sturgeon population (spawning stock) with females representing at least 50-65% of the total is also more consistent with the characteristics of mature populations for other sturgeon as well as other *Acipenser oxyrinchus* populations (Table 5).

Table 5. Proportions of females in the total adult population of various sturgeon species.

Sturgeon Species and Location	Males	Females	Total	Female %	Source
Gulf sturgeon, FL	301	331	632	52	Huff 1975
Lake sturgeon WI	169	209	378	55	Probst and Cooper 1955
Lake sturgeon, PQ	1112	1258	2370	53	Fortin et al. 1993
Shortnose sturgeon, NB	56	115	171	67	Dadswell 1979
Green sturgeon, OR	52	52	104	50	Erickson and Webb 2007

What then would be a best estimate of the base Atlantic sturgeon adult population in the Hudson River when the fishery was closed in 1996?

Using the data from Kahnle et al. 2007 and the review of the above population characteristics from other Atlantic sturgeon and sturgeon species it is possible to develop a number of estimates for comparison.

Kahnle et al. (2007) using their maximum calculated exploitation rates yielded a population estimate of:

596 males + 267 females = 863 adults, with a female proportion of 31% .

This population estimate includes a bias for males caused by the 13" stretched-mesh, gill nets, does not take into account spawning periodicity of females and results in a total sturgeon population that lacks the 50-65% female proportion found among other known sturgeon populations. Also it uses the highest calculated exploitation rates which are not justified by the age structure of the population or tested by a direct estimate of exploitation. **REJECT**

If the total population size is adjusted for the stable 1980-1995 4:1 ratio of males:females it results in an estimate of:

596 + 4 X 267 = 596 + 1068 = 1664 adults.

This estimate accounts for spawning periodicity of females but still retains a gill net selectivity bias for males. The proportion of females in the total population is 64% which brings it into the normal range for adult sturgeon populations.
POSSIBLE

If the lowest calculated exploitation rates from Kahnle et al. (2007) are used then the population estimate is:

894 males + 4000 females = 4894 adults.

This estimate has a far too high proportion of females (82%) when compared to other known sturgeon populations. **REJECT**

If the median calculated exploitation rates from Kahnle et al (2007) are used then the estimated total population of adults is:

700 males + 500 females = 1200 adults.

In this estimate the proportion of females (42%) is too low to meet the criteria for other populations (50-65%) and spawning periodicity is not accounted for. **REJECT**

If, however, the median calculated exploitation estimate is adjusted for a spawning periodicity based on the 4:1 male:female ratio in the Hudson River spawning run (Kahlne et al. 2007) then the estimate is

700 males + 4 X 500 females = 700 + 2000 = 2700 adults

But again the female proportion (74%) compared to other sturgeon populations is too high and male gill net selectivity bias is not accounted for. **REJECT**

But, since it is known the 13" mesh nets are biased for males (Stevenson 1997), by lowering the spawning run ratio of males:females to an median spawning periodicity of 3 yr (Table 4) the total population estimate would be:

700 males + 3 X 500 females = 700 + 1500 = 2200 adults.

In this scenario, the female proportion in the total population is 68% which is closer to observed data (see Table 5), the female spawning periodicity is justified by observed data (3 yr; see Table 4) and some of the bias in the male fishery catch has been accounted for. **POSSIBLE AND PROBABLE, ACCEPT.**

In our opinion, a basal, total adult population of 2200 adults in 1995 for the Hudson River is closest on all accounts to an acceptable estimate based on the data available and until further data, including male and female spawning periodicities and direct estimates of exploitation rates in the fishery can be obtained, will be used in this analysis.

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4. **A further, major oversight in the 2012 NOAA Fishery Service listing document concerns the recruitment to the Hudson River population that would have occurred because of the 1996 closure of the Hudson River and New York Bight directed fisheries (Stevenson and Secor 1999) and the 1998 -1999 US east coast moratorium (ASSRT 2007).**

A minimum of 14 – 16 year classes of partially or completely unexploited sturgeon would have been added to the Hudson River population between the original spawning run size estimate of 1993- 1995 and the 2012 use of the 1993-95 spawning run estimate as the total adult population estimate in the NMFS Listing Document. Consequently, for this reason as well, the **Hudson River population size estimate used in the 2012 NMFS Listing Document was incorrect and underestimated.**

Evidence in support of substantially increased recruitment can be found in Erickson et al. (2011). During field work on the Hudson in 2006 and 2007 for satellite tagging of Atlantic sturgeon they found that the male:female ratio in the spawning run had increased from the stable 4:1 ratio, as found during 1980-1995 (Table 1), to a ratio of 8.8:1. Such a sharp increase in a population characteristic that had been stable for a long time indicates the 1996 closure of the Hudson River and Hudson Bight fisheries and the 1998 coastal moratorium had probably enhanced recruitment to the population as was planned, especially among the earlier maturing males. Additionally, the cessation of fishing would have improved recruitment of females.

Using the most probable, Hudson River total adult population estimate for 1996 of 2200 adults as determined above, it is possible to use a Virtual Population Analysis Model to estimate the recruitment that has taken place since the 1996 closure and determine the subsequent change in the now unexploited, Hudson River adult population.

Since 1996 there have been 16 cohorts or year classes unexploited by the Hudson River fishery and recruited to the Hudson River adult population. As presented in Kahnle et al. (2007), the Hudson River fishery had remarkably stable catch numbers, landing totals and male:female ratio in the catches during the period 1980-1995 (see Table 1 above). These data describe a fishery that was sustainable but probably near maximum yield. Basically to maintain this situation over the period 1980-1995 the annual catch would have been approximately equal to the annual recruitment of adults. Since the average, annual catch of males was 161, males recruit after 10 yr of age (Kahnle et. al (2007) and male:female ratios among young adult sturgeon are 1:1 (Table 3 above) then approximately 320, 10 year old sturgeon would have recruited to the population annually since 1997 if year class strength was the same each year.

Kahnle et al. (2007) estimated that the natural mortality (M) of the Hudson River population was 0.07. If this natural mortality is converted to an annual survivorship (S) of 0.93 (Ricker 1975) and if a Virtual Population Analysis (Ricker 1975) is used to model the Dec. 31, 1996 base population of 2200 between 1997 and 2012 there would be 689 adult survivors in 2012. If natural mortality of 0.07 is again applied to each year class as it entered the adult population over the same period and resulting survivors of each year class summed there would be 3028 fish added to the population between 1997 and 2012 where the 1986 year class enters the adult population in 1997 (320 recruits) and are reduced to 115 individuals by 2012 and so on.

Then, the population of Hudson River adults in 2012 would consist of:

689 + 3028 = 3717 adult Atlantic sturgeon.

On the other hand, constant, similar annual recruitment to fish populations is seldom observed and 3717 adults in the population by 2012 may be a high estimate. Peterson et al. (2000) and Kahnle et al. (2007) presented evidence that during the period 1985-2004 recruitment of juvenile Atlantic sturgeon to the Hudson River estuary population varied and attributed this to recruitment overfishing. Data from the Hudson River Estuary Monitoring Program (HREMP) indicated that the juvenile Atlantic sturgeon population in the estuary varied from a high of 8-12 juveniles per tow between1978 – 88, to a low of 1-2/tow between1990-1996 and then increased to 2-4 juveniles/tow up to 2004. It should be noted also, that during the period 1989-1993 the abundance of shortnose sturgeon juveniles in the estuary nearly tripled (Anon 1994) and interspecific competition for food resources may have been a reason for the decline in Atlantic sturgeon juvenile abundance (Bain 1997).

Regardless of the cause, the change in recruitment of juvenile Atlantic sturgeon in the Hudson estuary is well documented and needs to be considered during life history modeling. A Virtual Population Analysis model similar to the one above used to estimate the 2012 population after constant recruitment can also be simulated (Appendix 1). The considerations are as follows: the base, Dec 31, 1996 population of 2200 sturgeon is subjected to the same annual natural mortality of 0.07 (S = 0.93), reducing it to 689 survivors in 2012. Similarly, each year class from 1997 to 2012 is reduced by a survivorship of 0.93/yr but in this model male and female components must be separated to adjust for different time spans of recruitment to the adult population (males recruit at age 10, females at age 15; Kahnle et al. 2007) because juvenile year classes vary.

Again we can start at age 10 in 1997 with 160 males that would have been born during the high juvenile recruitment year of 1986 but in this model females recruiting in 1997 would be from the 1981 year class (which was also large; Anon 1994) and their survivorship to 1997 would only be 111. Year classes of males recruiting between 1997 and 1999 and females recruiting between 1997 and 2004 would be from the period of high recruitment in the 1980's and would have a recruitment ratio of 1.0 (ie 160 males or 111 females recruit each year, Appendix 1). Juvenile abundance during 1989 and the period 1997-2001 were at medium levels of abundance (Kahle et al. 2007) and were considered to have a recruitment ratio of 0.4. In this case their cohorts (2008 – 2010) would start as 64 males and 44 females. Similarly, for years of low abundance of juveniles (1990-1996) the recruitment ratio of 0.2 is applied to males (2001 – 2007) and females (2006-2010) recruiting at 32 and 22/yr, respectfully. Each year class is reduced to its 2012 survivorship, all year classes are summed and added to the survivors from the 1996 base adult population (Appendix 1) as follows:

Base population survivors to 2012 + 1981 female and 1986 male survivors to 2012 + and so on, where:

689+90+98+105+72+64+68+74+80+45+35+37+63+69+74+79+108 = 1850

This estimate of 1850 adult sturgeon in the Hudson River population is reasonably close to our base 1996 population estimate of 2200 and would reflect a lower confidence limit that takes into consideration the years of low juvenile recruitment. Also, based on the model and assuming the 1996 population had a female proportion of 60% this total adult population estimate would consist of 877 males and 973 females for a female proportion of 52.5% or similar to other, known Atlantic sturgeon and sturgeon populations (Table 5 above).

In conclusion, probable estimated total adult populations for the Hudson River both in 1996 at 2200 adults and for 2012 at 1850 – 3717 adults are 2 – 4X larger than the population estimate of 863 adults used in the NOAA Fisheries Service Listing Document (2012).

Based on published work on Atlantic sturgeon during the last ten years there are strong indications that the closure of the sturgeon fishery in the Hudson River and Bight in 1996, the former US coastal sturgeon fisheries moratorium put in place during 1998-1999 along with earlier moratoriums in some states (Table 6) was rapidly regenerating the US coastal and Hudson River Atlantic sturgeon stocks.

Table 6. Date of actual closure of the commercial fishery and number of unexploited year classes of Atlantic sturgeon by US States with known Atlantic sturgeon populations. Number of unexploited year classes for each state is based on closure date and the population characteristics of sturgeon in each state.

State	Fishery Closure date	Female 50% Maturity (yr)	Unexploited Year Classes and (Generations) by 2012
Maine	1992	20	20 (1.0)
Connecticut	1998	15	14 (1.0)
New York	1996	15	16 (1.1)
New Jersey	1996	15	16 (1.1)
Pennsylvania	1990	15	22 (1.6)
Delaware	1998	15	14 (1.0)
Maryland	1973	15	39 (2.6)
Virginia	1973	15	39 (2.6)
North Carolina	1991	10	21 (2.1)
South Carolina	1985	10	27 (2.7)
Georgia	1997	10	15 (1.5)

Most southern stocks of Atlantic sturgeon that mature at a young age (6-9 years; Peterson et al. 2008) have now had more than two complete, unexploited generations (1.5 - 2.6) since their moratoria and have substantially increased their representation in the marine, mid-Atlantic Bight DPS region. Formerly, Atlantic sturgeon examined for genetic, population characteristics (DNA) from the Mid-

Atlantic Bight consisted of almost all Hudson River stock (1993; 97.2%; Waldman et al. 1996). During the period 1993 – 2009 the representation of southern DPS stocks in the Mid-Atlantic Bight DPS rose to 27% (Dunton et al. 2012). The Hudson River stock has also had 13-16 years of partial (after 1996) and complete (after 1998) unexploited recruitment. Research during 2006 and 2007 demonstrated that the ratio of males to females from the Hudson River spawning run had increased from 4:1 during 1980-1995 to a ratio of 8.8:1 by 2007, perhaps indicating strong recruitment of the early maturing males to the spawning stock (Erickson et al. 2011). It would appear that the management regime established for Atlantic sturgeon by state and federal agencies was working well and that it was unnecessary to federally list a fish as valuable as Atlantic sturgeon as endangered (NOAA 2012).

5. **The existence of US Atlantic sturgeon throughout its complete marine range (north to Canada) was unaccounted for by both the 2007 ASSRT and the 2012 NOAA Listing Document.**

For instance a Delaware River acoustic tagged sturgeon was located moving north at the Halifax, Nova Scotia acoustic receiver line in spring 2011 and back south at the same line in fall 2011 (ie it was not spawning that year; Fox, personnel communication). A pop-off tag from a female Atlantic sturgeon that spawned in the Hudson River the previous year (2007) surfaced in Minas Basin in June, 2008 (during the spawning season; Erickson et al. 2011) indicating the periodicity of female spawning in the Hudson River (ie not every year). Tags have also been returned from Minas Basin during summer from Atlantic sturgeon tagged off the Merrimack and Connecticut Rivers.

Recent research indicates that 36% of the Atlantic sturgeons found in Minas Basin, inner Bay of Fundy during summer are from US stocks (Wirgin et al. in press). An Atlantic sturgeon feeding aggregation forms each year in Minas Basin between May and September (Wehrell 2005; Wehrell et al. 2008). This group consists of mainly of subadult and adult sturgeon predominately of 15-25 yrs of age from the Saint John River, NB and the northern US DPS units (Kennebec R., Hudson R.; Wirgin et al. in press). All of these sturgeon, of course, would not be spawning in the year that they are in Minas Basin and many acoustic tagged fish return in successive years (77%; McLean et al. unpublished data) indicating that spawning periodicity among Atlantic sturgeon is at least 2 years or greater.

Since the Minas Basin summer aggregation has been estimated at 9000 sturgeon (95% CF, 7000-14,000; Dadswell, unpub. data) and their age structure is dominated by fish 15-25 yrs old, (Stokesbury et al. 2011) they represent 3000 - 4000 additional subadult and adult Atlantic sturgeon from the US stocks which were not considered in the 2007 ASSRT status review document or the 2012 NOAA listing decision.

6. **Catches and landings of Atlantic sturgeon in the Hudson River commercial fishery between 1980 and 1995 were more or less stable (160 M, 40 F per year and approx. 7000kg/yr; see Table 1 above) indicating the annual exploitation rate in the river fishery (Kahnle et al. 2007) was within the range of other sustainable sturgeon fisheries .**

There are a number of sustainable sturgeon fisheries in North America that have existed since the late 1800's and the early to late 1900's. These include angling fisheries for white sturgeon on the west coast (Semakula and Larkin 1968; Kohlhorst 1980; Galbreath 1985), a spearing fishery for lake sturgeon in Wisconsin (Probst and Cooper 1955; Preigel and Wirth 1975; Foltz and Meyers 1985), the commercial gill net fishery for lake sturgeon in the Ottawa and St. Lawrence Rivers (Cuerrier 1966; Fortin et al. 1993) and those operated by natives across Manitoba to Quebec (Harkness and Dymond 1961), and Atlantic sturgeon fisheries in the St. Lawrence River (Trencia et al. 2002) and the Saint John River in New Brunswick (Ceapa 2009; DFO 2011).

Draft: Dadswell and Nack

All these fisheries function under a management regime that maintains the exploitation rate at a low level. The angling fishery for white sturgeon in the Columbia River uses an exploitation window of 122-183 cm total length (TL) to protect adults before first maturity and to allow large females to escape exploitation (Galbreath 1985). The Atlantic sturgeon fishery in the St. Lawrence is also managed with an exploitation window to protect large females except there is also a quota of 60 MT/yr (Trencia et al. 2002). The lake sturgeon spear fishery in Wisconsin has remained at an exploitation rate of approximately 15% since the 1950's by restricting capture methods (Foltz and Meyers 1985). The Saint John River Atlantic sturgeon fishery is managed by a short season, a size limit and a harvest quota of 200-400 fish (Ceapa 2009; DFO 2011). All these fisheries have exploitation rates in a similar range to the former Hudson River Atlantic sturgeon fishery (u = 0.08-0.23; Kahnle et al. 2007) which may explain why the Hudson River fishery had stable landings during 1980-1996.

These data suggest that the Hudson River Atlantic sturgeon fishery was operating at a sustainable level.

7. **The number of females in the Hudson River spawning stock prior to the 1890 - 1900 period of overexploitation was overestimated (Secor 2002) resulting in an inflated estimate of the necessary target size for the female spawning stock size in the Hudson River (Kahnle et al. 2007).**

Kahnle et al. (2007) state that Secor (2002) estimated the Hudson River virgin spawning stock before overexploitation during the 1880-1900's at 6000 females and because of Secor's estimate set a F_{50} target abundance for mature females of 3000 for the Hudson River. Kahnle et al. (2007) also stated that fisheries data for the Hudson River for the period 1880-1900 was incomplete (see their Figure 1) but if it had been 'the total reported harvest and estimated stock size from the Hudson River would have been greater'. It is necessary then to investigate both these assertions. The first statement will require more information to be presented, so we will deal with the latter assertion, first.

In Kahnle et al. (2007) the caption for figure 1 clearly states 'Reported landings (1000 kg) of Atlantic sturgeon from **New York State**.' In that case the New York State landings have always been made up of catches from both the Hudson River and the ocean fisheries and these data cannot be used to estimate the size of the Hudson River total 1890-1901 spawning stock since the ocean fishery is a mixed stock (Waldman et al. 1996). As late as 1993 the ocean fishery contributed 61.5% of the total New York State landings (Young 1994) and that was also the situation during the 1880-1901 high catch period (Murawski and Pacheco 1977; Secor 2002, see his figure 2). Consequently the assertion by Kahnle et al. (2007) that the virgin female stock size would have been larger is incorrect.

Based on New York State landings data during 1880-1901 and a mathematical model for predicting the abundance of females in Atlantic sturgeon populations, Secor (2002) estimated the female stock size of the Hudson River was 6000 adult females. Unfortunately Secor's estimate was based on data from the Delaware River Atlantic sturgeon commercial catches during 1880-1900 (Secor and Waldman 1999) and are not applicable to the Hudson River fishery.

The Delaware Atlantic sturgeon fishery was almost completely situated in the mesohaline portions of Delaware Bay (Rkm 55-127; Brundage and Meadows 1981; Secor and Waldman 1999) and exploited mostly 'ripe' females that were best for caviar production (ie. Not quite ready to spawn; Cobb 1900), whereas the Hudson River fishery was mainly in the upper, freshwater portions of the estuary (Rkm 124-200; Dovel and Berggren 1983; Von Eenennaam et al. 1996) and captured both females and males for flesh.

The sturgeon catch in the Delaware during 1880-1900 was 90% females and only 10% males (Cobb 1900). In the Hudson the catches during 1980-1995 were 20% female and 80% males (Kahnle et al. 2007) and were probably similar in the 1890's. For that reason Secor (2002) was incorrect when he used the Delaware female abundance data to estimate the Hudson River female population size without adjusting for the different proportion of females in the Hudson River stock.

Cobb (1900) and Borodin (1925) both describe the Delaware River fishery as capturing mainly large females (80-90%). Borodin (1925), the good, white Russian sturgeon biologist he was, was surprised at this fact and wrote **'In my experience with other species of sturgeons the males are more numerous during the spawning runs than the females'**. Most sturgeon biologists would agree with this statement and see Table 2 above. Borodin (1925), however, did describe the taking of seven 'running' ripe females and three males off Delaware City (Rkm 98) in mid-May. Based on this evidence only, it is impossible to know if spawning was actually occurring at that location rather than upriver in freshwater. Capturing and handling of sturgeon nearing their spawning event often results in release of eggs or milt due to stress and handling.

Atlantic sturgeon eggs and larvae cannot survive even at low salinities (Smith et al. 1997; Bain et al. 2000) and probably would not survive in the mesohaline mid-estuary where the Delaware fishery took place. Simpson and Fox (2007) describe very rapid movement of adult Atlantic sturgeon from the mesohaline portion of the Delaware estuary (Rkm 100) to the freshwater region (Rkm 200) and Borodin (1925) may have sampled adults that were about to move upstream rapidly to spawn.

Additional evidence also indicates spawning is probably in freshwater portions of the Delaware estuary. First, this is the only region in the Delaware estuary where YOY Atlantic sturgeons have been captured (Brundage and Meadows 1981; Lazzari et al. 1986). Second, the high proportion of females in the Delaware fishery during 1880-1900 was probably related to the fact that sturgeon males on a spawning run usually move upriver sooner than females (Classen 1944; Dovel and Berggren 1983; Van Eeneennaam et al. 1996). This characteristic is common to many anadromous fishes including striped bass and American shad (Leggett 1976; Setzler et al. 1980). Also, spawning sturgeon may have remained in the salt wedge region of the middle Delaware estuary during the 1890's because pollution levels in the upstream Philadelphia region were beginning to increase (Chittenden 1974). From the mid-estuary the sturgeon could move upstream to spawn quickly. Based on the average cruising speed of 2 body lengths/s for most fishes (Moyle and Cech 2002), a 3m female Atlantic sturgeon could swim 21.6 km/h and would be able to swim from Delaware City (Rkm 100) to Trenton, NJ (Rkm 200) in 5 hours.

After 1905 the estuary above Delaware City had oxygen levels during October that dropped to near zero and decimated the Delaware River shad and striped bass populations (Chittenden 1974). Sturgeon are capable of withstanding limited periods of hypoxia (Burggren and Randall 1978) which would allow them to pass the low oxygen zone but they may have remained in the less polluted, deep zone of the salt wedge until virtually ready to spawn to reduce stress. The high levels of pollution in the Delaware River after 1905 probably had as much to do with the decline of the Delaware River Atlantic sturgeon stock as did the overexploitation during 1880-1900.

The high portion of females during the 1890's was a characteristic of the Delaware fishery but probably not the Hudson fishery (Kahnle et al. 2007). This fact would make Secor (2002) incorrect in his estimate of 6000 females in the Hudson River stock since he assumed a spawning run containing 90% females. On the other hand, adult female abundance for the Hudson River after 1890, can be recalculated using Secor's (2002) method once adjusting for the difference in the female proportion in the Hudson River fishery and adult population or by using alternate, available landing records.

Secor (2002) determined the mean annual catch for each major Atlantic sturgeon fishery by state during 1880-1901. Then he calculated the proportion of each states fisheries landings in relation to the total east coast US landings and applied this percentage to the calculated abundance of females in the Delaware stock (180,000; Secor and Walden 1999). To complete the calculation Secor (2002) assumed all east coast stocks had 90% females in their landings as follows:

State	Mean Catch (kg) (1880-1901)	% contribution	Hudson River 1890 Female Abundance Secor (2002)
NY	57042	57042/2.4X 10^6 = 2.4%	6000
Total US	2.4X 10^6 (Secor 2002)		

There are some problems with the final number for 1890 female stock abundance in the Hudson River obtained by Secor (2002); which are, 1) whether the NY landings were only from the Hudson River or included the ocean fishery and 2) the math seems incorrect (2.4% X 180000 = 4320). There are also problems with Secor's conclusions. He based his assumptions and calculations on a spawning run and a fishery that focused on and selected for large caviar bearing females. His assumptions, like that of Kahnle et al. (2007) for the Hudson River, are probably biased by the characteristics of the respective spawning runs and/or the sites of the fishery and neither are a true representation of the characteristics of their respective, total adult populations.

Using the Kahnle et al. (2007) data on the spawning run size of Atlantic sturgeon in the Hudson River during 1980-1995 and average proportions of mature females in sturgeon populations (Table 3 above) it would be possible to estimate a range for the total Hudson River adult female abundance during 1880-1901.

During 1980-1995 the proportion of females in the Hudson River spawning run was 20% (Table 1 above). Assuming this proportion of females was similar during the 1890's, the total estimated Delaware female stock abundance X 20% or (180,000 X 0.20 = 36000) can be used to covert for the proportion of females in the Hudson River spawning run in relation to the Delaware fishery.

Then to account for total landing proportions during 1880-1901 using the NY State landings:

36000 X 0.024 = 864 adult females in the 1890-1901 Hudson River Atlantic sturgeon spawning run.

Kahnle et al. (2007) estimated there was approximately 270 mature females or approximately 30% of this estimated 1890's female population in the annual Hudson River spawning run during 1985-1995 (using NY landings).

On the other hand most mature sturgeon populations have a female abundance of approximately 50-60% (Table 3 above). Using this characteristic we could also make an estimate of the total Hudson River mature female population size during 1880-1901 as follows:

(estimated Delaware female stock abundance X 60%) or 180,000 X 0.60 =108,000.

Then converting for the New York share of the Atlantic coast fishery during 1880-1901 becomes:

108,000 X 0.024 = 2592 adult females

If the 1880-1901 Hudson River spawning run size is converted to the total mature female stock size by considering the spawning periodicity of once every three years (as used above) then the total female adult stock size would be 3 X 864 = 2592 which is the same as the estimated mature female population of 2592 assuming 60% females in the adult population indicating that perhaps our approach is correct.

If this total female abundance is compared to the estimated female spawning run for 1980-1995 (Kahnle et al. (2007) after adjusting for a spawning periodicity of once every 3 years then the Hudson River spawning stock would have consisted of approximately 810 females in 1980-1995 or 31% of the 1880-1901 total mature female population which is close to our estimate of the proportion of the adult females in the total population, above. A target of F_{50} for population restoration would be approximately 1300 females or about half that estimated by Kahnle et al. (2007).

On the other hand, if alternate landing data for the Hudson River from the 1890's is used there is a different conclusion. Secor (2002) presents in his figure 2 the Atlantic sturgeon landings by county for the Hudson River taken from the US Fish Commission for the year 1890. The landings are shown as rounded estimates to 1000 kg and were a maximum of 9000 kg for 1890, which are the same order of magnitude as the average landings of from 1980 –1995 (6316 kg; Table 1 above; Kahnle et al. 2007). Using these data we avoid the problem of using New York State landings.

Using the 1890 landings for the Hudson River and the Secor (2002) method for estimating mature female stock abundance the stock size would be:

Mean % contribution 1880 -1901 9000/1836091 = 0.008

Delaware female abundance X % contribution 180000 X 0.008 = 1440 females

Using these data the F_{50} for the Hudson River adult female spawning stock would be 720 females. It should be remembered, however, these data are only for the year 1890 and could have easily been affected by year class size and fishing effort. They do, however, agree closely with the 1980-1995 data in what appears to be a sable population and which can be used with some confidence (Table 1 above).

In our opinion, estimates of 1440 – 2600 adult females in the Hudson River spawning stock during 1880-1901 is far more probable and justified than the 6000 estimated by Secor (2002). This estimate is also in the same range as total female population level of 1500 estimated earlier above and none of these estimates agree with the Kahnle et al. (2007) estimate of 270 females in the Hudson River adult population that was used in the NOAA Fishery Service Listing Document (2012).

Until more precise data for the fishery landings in the Hudson River (not New York State) during 1880-1901 are available it is difficult to obtain a better estimate. The question remains then: at what level of female abundance do we consider the Hudson population as a management problem or some level of endangered. In our opinion the situation is a management problem that has already been largely resolved by the 16 year closure of the Hudson River fishery.

What we have resolved by our analysis is that the total population of Atlantic sturgeon in the Hudson River was approximately 1850 - 2200 adults in 1996 and was probably in the F_{50} range of the virgin stock size of 1880-1901. Furthermore, the total population of Atlantic sturgeon in the Hudson River in 2012 is probably between 1850-3500 adults because of the 16 year moratorium and reduced exploitation and not the 863 adults used in the NOAA Listing Document (2012).

Draft: Dadswell and Secor

A Reassessment of the Potential Bycatch Mortality of Atlantic Sturgeon in US Atlantic Coast Non-directed Fisheries.

The NOAA Endangered Species Listing (2012) for Atlantic sturgeon used a series of data sets taken from observers on board commercial fishing vessels and genetic data derived from samples collected by the observers. These data sets resulted in an estimated bycatch of 3118/yr adult and subadult Atlantic sturgeon taken by non-directed fisheries in the Northeast coastal area (Virginia to Maine) and do not include vessels fishing south of Virginia (ASMFC 2007). Based on DNA samples of 726 bycatch sturgeon, this mixed stock contained 3-13% Gulf of Maine origin (GOM), 41-51% New York Bight origin (NYB), 11-21% Chesapeake Bay origin (CB) and 24-34% South Atlantic origin (SA; North Carolina –Georgia; NOAA 2012). The observers estimated that trawls had a direct bycatch mortality of 5% and sink gill nets, 20% with no estimate of delayed mortality. The observer data also indicated that approximately 75% of the catch was Atlantic sturgeon subadults (<150 cm) and 25% of the bycatch was adults (>150mm).

Using these data and the Hudson River population estimate of 863 adults (Kahnle et al. 2007) as well as averaging the genetic stock estimates of each DPS NOAA (2012) estimated the population size of adults and subadults in each DPS unit using a Hudson River intercept rate. The Hudson intercept rate was calculated as:

Estimated Catch	X	Genetic Proportion NY Bight	X	Genetic Proportion Hudson R	X	%Adults	# Hudson Adults	Adults/ Est. Hudson Population	Intercept Rate
3118	X	0.46 = 1434	X	0.91 = 1305	X	0.25 =	327	327/863	0.38

for a Hudson River intercept rate of 38% (NOAA 2012).

Draft: Dadswell and Nack

A standard calculation to estimate the population in each DPS unit was as follows for the Gulf of Maine DPS (NOAA 2012):

Estimated Total Catch		% Genetic		GOM Proportion		Adult Proportion		# Adults		Hudson Intercept Rate		Total Adult Population
3118	X	0.08	=	250	X	0.25	=	63	/	0.38	=	386

This exercise resulted in a Table of DPS population estimates as follows:

Table 7. Number of estimated adults and subadults vulnerable to fisheries in the five DPS units calculated with an estimated total Hudson River adult population of 863 adults. *Subadults were calculated as 3 X # adults (NOAA 2012).

DPS	Mature adults	Subadults*	Combined Population
Gulf of Maine	166	498	664
NY Bight	950	2850	3800
Chesapeake	329	987	1316
South Atlantic	598	1794	2392
Total			8172

There are a number of problems with these estimates. For example in the Altamaha River alone, Peterson et al. 2008 captured 213 individual mature adults in 2004 and 2005, or 36% of the South Atlantic DPS estimate (none twice). Also, Peterson et al. 2008 estimated the total spawning run size in the two years as 710 adults in the Altamaha which is greater than the NOAA total estimated adults (598) for the entire South Atlantic DPS where there are 10 other rivers with a known spawning population (Collins et al. 2000; ASSRT 2007). Balazik et al. (2012)

reports that 150 adults were captured on spawning runs in the James River between 2007 and 2011 and a further 30 adult mortalities from vessel strikes for a total of 180 adults or 55% of the NOAA (2012) adult estimate for the Chesapeake region. In the Gulf of Maine DPS researchers have caught 165 Atlantic sturgeons in three rivers with little relative effort (Saco, Kennebec, Penobscot; Eyler et al. 2009). Of these 80% (132) were over 100 cm and represent 20% of the NOAA (2012) estimated adult and subadult population for this DPS. In four years of intensive sampling on the Saint John River, NB, Dadswell (1979) caught over 4000 shortnose sturgeon which represented only 22% of the estimated population of 18,000. It seems unlikely that such a large proportion of an estimated population in a DPS can be encountered so easily.

If, on the other hand, an approximate Hudson River total adult population estimate of 2000 adults is taken from our range of estimates (1850-2200), and used in the NOAA (2012) calculations in place of their 863 adults to estimate DPS unit populations the results fit observed data better:

3118 X 0.46 = 1434 X 0.91 = 1305 X 0.25 = 327 Hudson adults/yr as above.

Then the Hudson intercept rate is calculated as 327/2000 = 16.4%.

Table 8. Number of estimated adult and subadults vulnerable to fisheries in the five DPS units calculated with an estimated total Hudson River adult population of 2000 using the methodology of NOAA (2012)

DPS	Mature Adults	Subadults	Combined Population
Gulf of Maine	386	1158	1544
NY Bight	2202	6608	8810
Chesapeake	767	2301	3068
South Atlantic	1393	4179	5572
		Total	18994

Using these estimates the proportion of Atlantic sturgeon caught in the Altamaha River spawning run (Peterson et al. 2008) is reduced to 15.3% of the total estimated adults in the South Atlantic DPS (Table 8). This estimate makes much more sense in relation to how many sturgeon must be in the other 10 rivers of the South Atlantic DPS region (ASSRT 2007). Also, in this scenario the 39 adults caught in the Edisto River watershed (Collins et al. 2000a) are accounted for. Finally, the 180 adults encountered in the James River (Balazik et al. 2012) are reduced to 23% of the estimated total for the Chesapeake DPS much more in accordance with the effort that has gone into the James River study.

With approximately 12,000 tagged Atlantic sturgeons at large on the US Atlantic coast (Eyler et al. 2009), an estimated total of about 19,000 adult and subadult Atlantic sturgeon in the same region (Table 8) is probably closer to reality then the NOAA (2012) estimate of a little over 8000 (Table 7).

If the estimated bycatch of 3118/yr Atlantic sturgeon in non-directed fisheries is accurate and the total mortality is actually 25% (NOAA 2012) then the non-targeted annual exploitation rate or fishing mortality using the 16.4% Hudson intercept rate at this population level is F = 0.04 (ie 3118 X 0.25 = 779/19000 = 0.04). This estimated exploitation rate is well within the limits for sustainable exploitation of a slow-growing, long-lived species (Boreman et al. 1984: Boreman 1997).

Dunton et al. (2010) report that 1112 Atlantic sturgeon were caught in 77,428 tows by research cruises during 1973-2007 (0.014/tow) among five fisheries agencies along the NE US Atlantic coast, which demonstrate the extremely low level of bycatch in trawls. In the South Atlantic DPS, 97 juvenile Atlantic sturgeons were captured in gill nets in Georgia and 51 in South Carolina over 2 year periods and 16% or 24 were mortalities (Collins et al. 1996). Based on our juvenile Atlantic sturgeon population estimate for this DPS (5572; Table 8) the exploitation rate is 24/5572 or an F = 0.004. A survival rate from gill net fisheries of over 99% hardy seems a threat to the species.

In another study, 28 adult Atlantic sturgeon which were found along the shores of Delaware Bay during a four year period which designated as vessel strikes (Brown and Murphy 2010). These mortalities amount to an annual exploitation rate of 3.5% based on our estimate of a possible 202 adults in the Delaware River population of Atlantic sturgeon, again well within the range of allowable mortality in sturgeon populations (Boreman et al. 1984; Boreman 1997). And finally Collins et al. (2000b) list habitat degradation of sturgeon nurseries as more important in 7 of 9 Southern Atlantic sturgeon river/estuaries than commercial fishing mortalities.

Conclusion: The NOAA Endangered Species Listing for Atlantic sturgeon of the Atlantic coast of the United States on April 12, 2012 is based on questionable scientific data and analysis. Examination of the biology and population characteristics of Atlantic sturgeon indicate that the population estimate for the Hudson River adult Atlantic sturgeon used by NOAA (2012) in their listing document was underestimated by a factor of 2X. This underestimate caused an underestimate of the total Atlantic coast population of Atlantic sturgeon which resulted in an overestimate of the fishing mortality in non-targeted fisheries. Our estimated fishing mortality from non-targeted fisheries is F = 0.04 which is well within an acceptable range for sturgeon and will not cause endangerment. The listing of the Atlantic coast population of Atlantic sturgeon as endangered is based on out-of date data, incorrect analysis and poor understanding of the life history characteristics of this species and should be reconsidered.

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VIRTUAL POPULATION ANALYSIS OF THE ADULT, ATLANTIC STURGEON POPULATION
IN THE HUDSON RIVER, 1997 - 2012.
The starting population is 2200 on Dec. 31, 1996 with an annual natural mortality M = 0.07
Kahnle et al. 2007, which is an annual survivorship of S = 0.93.
Recruitment of males is at age 11 and females at age 15.

	1996 pop	YEAR CLASS, Date													
YR DATE	size	1986		1987		1988		1989		1990		1991		1992	
	2200	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1997	2046	160	111												
1998	1903	148	103	160	111										
1999	1769	138	96	149	103	160	111								
2000	1646	129	89	138	96	149	103	64	111						
2001	1530	120	83	129	89	138	96	59	103	32	111				
2002	1423	111	77	120	83	129	89	55	96	30	103	32	111		
2003	1323	103	71	111	77	120	83	51	89	28	96	30	103	32	111
2004	1231	96	66	103	71	101	77	47	83	26	89	28	96	30	103
2005	1144	87	62	96	66	103	71	44	77	24	83	26	89	28	96
2006	1064	83	57	87	62	96	66	41	71	22	77	24	83	26	89
2007	990	77	53	83	57	87	62	38	66	21	71	22	77	24	83
2008	921	72	50	77	53	83	57	35	62	19	66	21	71	22	77
2009	856	66	46	72	50	77	53	32	57	18	62	19	66	21	71
2010	796	62	43	66	46	72	50	30	53	17	57	18	62	19	66
2011	740	58	40	62	43	66	46	28	50	15	53	17	57	18	62
2012	689	53	37	58	40	62	43	26	46	14	50	15	53	17	57
population	689 +	90 +		98 +		105 +		72 +		64 +		68 +		74 +	
2012		males =		601 recruited and 0.40 x 689 = 276 total 877											

Recruitment of males from 1997 to 1999 has a factor of 1.0 (160 X 1 =160); for 2000, 0.4, from 2001-2007, 0.2, and from 2008-2012, 0.4 to account for average luvenile abundance in HREM trawl data (after Kahnle et al. 2007).

Draft: Dadswell and Nack

Year class date is only for males, for females subtract 5 yr (ie 1986 = 1981)

Annually 160 males and 111 females recruit

1993		1994		1995		1996		1997		1998		1999		2000		2001	
M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
32	111																
30	103	32	44														
28	96	30	41	32	22												
26	89	28	38	30	20	32	22										
24	83	26	35	28	19	30	20	64	22								
22	77	24	33	26	18	28	19	59	20	64	22						
21	71	22	31	24	16	26	18	55	19	59	20	64	22				
19	66	21	28	22	15	24	16	51	18	55	19	59	20	64	22		
18	62	19	26	21	14	22	15	47	16	51	18	55	19	59	20	64	44

80 + 45 + 35 + 37 + 63 + 69 + 74 + 79 + 108=1850

Females= 560 recruited + 0.6 X 689 = 973

Female proportion= 973/1850 = 52.5%

Recruitment of females from 1997 to 2004 has a factor of 1.0 (111 x 1.0 = 111), for 2005 a factor of 0.4, for 2006-2011, 0.2, and for 2012, 0.4 to account for juvenile abundance in HREM trawl data.

Draft: Dadswell and Nack

New York State Department of Environmental Conservation
Hudson River Fisheries Unit, Bureau of Marine Resources
21 S. Putt Corners Rd., New Paltz NY 12561

MEMORANDUM

TO: Sturgeon Management Board
FROM: Andy Kahnle, Hudson River Fisheries Unit
DATE: 1 August 2012

SUBJECT: Rebuttal to Dadswell and Nack (2012) Criticism of the Hudson Sturgeon Population Estimate

The following responds to comments made by Dadswell and Nack (2012) concerning population estimates of mature Atlantic sturgeon developed by Kahnle et al. (2007) for the Hudson River stock and used by NMFS in the listing determination. It does not respond to Dadswell and Nack comments about the Secor population estimates for the late 1890s or their criticism of the NMFS coast-wide sturgeon population estimate.

Kahnle et al. (2007) estimated the population of mature Hudson River Atlantic sturgeon as mean harvest of mature fish (85-95) / exploitation rate (u) for mature fish in the population. Result was 596 males and 267 females.

Exploitation rate is defined as the proportion of fish present at the start of the year that die from fishing. It was estimated as follows:

- Obtained sex specific estimates of instantaneous rate of total mortality (Z) from catch curve analyses of ages of mature fish as the slope of the natural log of catch at age on age
- Obtained an estimate of the instantaneous rate of fishing (F) from Z = F + M (instantaneous rate of natural mortality = 0.07)
- Converted F to u from u = FA/Z where A = annual rate of total mortality calculated as A = 1-S and S=e^-z.

Dadswell and Nack (2012) made the following basic criticisms of the Hudson estimates:

1. <u>Comment:</u> Kahnle et al. (2007) should have used a lower u. Specifically, they should have expanded the ages used in the catch curve analyses which would have lowered the resulting u and thus increased the population estimate.

<u>Response</u>: We examined catch at age for ages 15-31 for males and 22-40 for females. Catch curve approach involves an analysis of the rate of decline of the declining limb of the age structure. Analysis assumes that fishing rate remained stable over the time period and ages of analyses. Age data for males and females showed a concave declining limb which Ricker (1975) suggested indicates a changing rate of fishing. He further stated that the part of the curve with the greatest slope represented the most recent mortality rate. Since we were most interested in current status, we confined our analyses to that part of the curve indicating the most recent fishing rate. The selected ages were 15-22 for males and 22-30 for females. This choice, in turn dictated the years of harvest used in the calculation of population size in that we wanted to use those years of harvest that produced the age structure evaluated. Had we expanded the ages used in our analyses, we would have lowered the estimate of u because it would have expanded the age structure back into the early 1980s before fishing had ramped up. For example expanding the ages of males to 15-24 would have lowered u for males to 0.23. Expanding ages of females to 22-43 would have lowered u to 0.08. Further expansions are not warranted because they would have encompassed too many zeros in the age structure.

We would consider expanding ages in the analyses to lower u and thus provide an upper bound to the population estimate. However, the result would not be as meaningful because it would encompass years with changing mortality regimes.

2. Comment: The population estimate of Kahnle et al. (2007) is for the population of fish spawning in the river, not the population of mature fish at large. Since mature fish do not spawn every year, the spawning population in a given year is lower than the actual population of mature fish. Thus, the actual population is larger than the Kahnle et al. (2007) estimate.

Response: We agree that the estimate is a lower bound, but it is a lower bound on the full population of mature fish. It is not an estimate of fish in the river. Here's why.

Our estimate used the following relationship to calculate population size: exploitation rate = harvest / population size and thus, population size = harvest / u. The population being estimated depends on whether the u and the harvest relates to a subpopulation or the full population. If these parameters related to the spawning component of the Hudson population, then the estimate is for the spawning population. If the parameters related to the full population then the estimate is for the full population. In our case, both related to the full population.

Exploitation Rate. We estimated exploitation rate from age structure as described above. The age structure came from a sample of fish in the spawning population. Unless the spawning interval varies with age, this in turn was a sample of the full population. Since the population age structure was used to calculate Z and then u, the estimated u is the rate of fishing in the population. There is no estimate of u available for the river population segment because we don't know the proportion of the river population that was taken in the fishery. If available, the u for the in river part of the population would be higher than u for the full population.

Harvest: Our estimate of population size was that for the number of mature fish. Therefore, the harvest used in the estimate had to be that of mature fish and include all mature fish harvested. Harvest during the years of analyses included mature fish in the spawning population in the Hudson River and fish taken in ocean commercial fisheries in NY and NJ. The harvest used in our analyses was mean annual harvest from the river fishery from 1986 through 1995. We did not include fish taken in the ocean fisheries because length data suggested that most were immature subadults until 1993 when NY and NJ implemented a 152 cm minimum size limit. Moreover, ocean harvest was not segregated by fish sex. We feel that the river harvest represented the bulk of the mature fish harvest from the population, but it certainly was not all of it. Since our estimate did not include mature fish taken in the ocean, it is indeed biased low to some degree. However, since our u was for the full population, our estimate is a lower bound on the full population, not an estimate of the spawning subpopulation.

For some perspective on potential size of the estimate bias, we assumed that ocean harvest had a 50:50 sex ratio, all fish became mature at 150 cm, and that 100% of the ocean harvest came from the Hudson River stock. Adding in the ocean harvest of fish greater than 150 cm in 93-95 with the above assumptions increased the mean harvest of mature fish in the time series from 161 males and 40 females to 215 males and 96 females. Population estimates increased from 596 males and 267 females to 795 males and 637 females. This estimate is probably too low for males and high for females because it uses a 150 cm lower bound for mature fish and the 50:50 sex ratio.

This example verifies that, use of the proper harvest levels in estimates is a valid issue. We are currently researching historical data for insight on size distribution of catches prior to the imposition of size limits in 1993 and will develop some upper bound estimates for the population which will be larger than those in Kahnle et al (2007).

3. Comment: The in-river spawning population estimate must be inflated to account for spawning interval.

Response: Agreed that the in river spawning population is a subset of the full population of mature fish because the fish do not spawn every year. However this is irrelevant because the population estimate in Kahnle et al. (2007) is for the entire mature population.

4. Comment: The 13 inch mesh gill nets used in the fishery were biased for males thus it missed females in the population and biased the female population low.

Response: Sexual bias in the fishery harvest is irrelevant as long as the population estimates were generated from sex specific harvest and exploitation rates. Moreover, we monitored the sturgeon fishery during the last few years of the fishery and noted mesh sizes from 9 to 20 inches depending on fishing location and focus of the operation. Those operations that fished for the meat market used smaller mesh sizes than those that fished for the caviar market.

5. Comment: An increase in mature fish in the Hudson River population since the 1990s would be expected because directed harvest ended by 1998. Therefore, the population estimates used by NMFS in the listing document are out of date and too small. Supporting evidence included:

- Erickson et al. (2011) noted that sampling of the Hudson spawning stock found a male:female sex ratio of 8:8.1, much higher than that noted by Kahnle et al. (2007).
- Assumed harvest in 80-95 was sustainable and thus annual recruitment was at least 320 sturgeon to make up for the annual loss
- Grew up a base population of 2200 in 1996 and the assumed annual recruitment above through 2012. Both were decremented by a natural mortality of M = 0.07 through present (No bycatch mortality).

- Repeated analyses using assumed recruitment adjusted by empirical changes in relative juvenile abundance

<u>Response</u>: Agree that the number of mature fish should have increased since the fishery closure if bycatch was not excessive. Responses to supporting evidence include:

- Looked at Erickson (2011) and noted a male:female sex ration of 4.8:1. Certainly a slight increase, but not to the level claimed by Dadswell. Moreover, our sample crews caught the fish for the Erickson et al (2011) study and they reported very few females.
- No basis to assume that the annual harvest in 80-95 was sustainable. Since the fishery did not ramp up until the mid 1980s and there were many mature age classes in the population, the fishery in 80-95 may have just mined the ages present at the start of the fishery. The fact that the fish do not spawn every year would have added to the reservoir of fish to be harvested.
- Approach to estimating a current population is creative and conceptually valid, but has input problems. As applied, it assumes that the starting population estimate in 1996 is valid, the fishery in 80-95 was sustainable, and that only natural mortality acts on the population (no bycatch mortality). The first two are questionable and the last is not correct. However, these are input issues. We suggest that the approach be revised to include a range of potential starting populations and a more realistic range of mortality rates <u>if</u> an estimate of recruitment can be developed.

6. <u>Comment:</u> Harvest of some 7000 kg/yr from the Hudson stock in 1980-1995 was sustainable because harvest governed by restrictions from other North American sturgeon stocks is sustainable.

<u>Response:</u> Can't evaluate without detailed information about harvest restrictions, resulting exploitation rates, time frame of reference, and definition of sustainable.

CC: J. Gilmore
S. Heins
P. Augustine

Atlantic States Marine Fisheries Commission

N. Highland Street • Suite 200A-N • Arlington, VA 22201
703.842.0740 • 703.842.0741 (fax) • www.asmfc.org

MEMORANDUM

August 2, 2012

TO: Sturgeon Management Board
FROM: Sturgeon Technical Committee
SUBJECT: Actions Options in Response to Atlantic Sturgeon ESA Listing

In May 2012 the Board tasked the Technical Committee (TC) with coordinating a meeting with NMFS Protected Resources staff to review the data and methodology used in the Atlantic sturgeon endangered and threatened listing determination. Additionally, the Board requested the TC advise the Board as to the appropriateness of the listing methodology, recommended methods to reduce bycatch, and begin the initial phase in the development of a petition to delist Atlantic sturgeon. In response to these tasks, a workshop with the Sturgeon TC and NMFS staff was organized and held in July 2012. A summary of the items reviewed and discussed at the workshop follows. In order to avoid any perceived conflict of interest, all federal service TC members/proxies recused themselves from any discussion regarding the action options.

Data and Methodology Review

- ASMFC requested NMFS provide the TC with the data sources and methodology used in the status determination for each DPS. Prior to this workshop, NMFS provided the TC with a list of references used in the listing determination. From what the TC could determine based on the references, information contained in the 2007 Atlantic Sturgeon Status Review, and the listing notice, the majority of data that were available at the time of final ruling or the status review were most likely used. There were a few data sets that were identified by TC members as potentially not being included in the listing determination.
- The TC could not comment on the appropriateness of the analyses used in the listing determination as NMFS did not provide adequate information. The TC inquired if it would be possible to again request additional information on methodology used in the extinction risk modeling and final ruling. A recent draft unpublished manuscript that reviewed the scientific information and analysis used in the sturgeon listing (Dadswell and Nack 2012) was sent to the TC just prior to the meeting. The TC only briefly discussed the manuscript but did not have time to adequately review the research. A. Kahnle (NY DEC) provided written comments to the white paper.
- The TC identified a significant amount of data that are now available (post-listing petition, 2010), which provides insight into sturgeon abundance, behavior, and life history. Additional information may be available if other agencies/organizations are contacted.

Action Options

The TC reviewed the possible options for action in response to the listing determination.

1. Delisting of DPS or species –A species may be delisted if the Secretary determines, on the basis of the best scientific and commercial data available, that the species or DPS is no longer endangered or threatened based on a number of factors, such as population size, recruitment, stability of habitat quality and quantity, and control or elimination of the threats. New information is critical in this process. Social or economic impacts cannot be considered. Delisting can occur because of extinction, recovery, or initial listing being in error. The TC further discussed this option.
2. Downlisting of DPS or species – A species shall be reclassified if the Secretary determines, on the basis of the best scientific and commercial data available after conducting a review of the species' status, the species is endangered or threatened because of any one or a combination of the five listing factors. New information is critical in this process. Social or economic impacts associated with delisting cannot be considered. Downlisting can occur because of extinction, recovery, or initial listing being in error. Although this was not included in the initial direction from the Board the TC felt that downlisting might be supported in some instances and should be considered by the Board.
3. Legal challenge to listing – A challenge to a listing can occur when subsequent investigations may show that the best scientific or commercial data available when the species was listed, or the interpretation of such data, were in error. Challenges to listing decisions are not based upon competing scientific opinions and data (i.e. new information cannot be presented). Rather, the standard for a legal challenge is that an agency Final Rule is "arbitrary and capricious" in the listing. Federal courts tend to defer to agency expertise. The TC did not discuss this issue further.

Delisting or Downlisting Petition Approaches and Considerations

- The TC discussed the scope a petition could potentially include. Any petition to delist or downlist could (1) maintain the current DPS classification, (2) propose reclassification of the DPS determination, or (3) approach the stock as a coastwide unit. There was some discussion in support of river specific DPS. While there is some information available to support more than five DPSs, additional genetic work needs to be conducted.
- A petition to delist or down list would have to go through the same steps as a listing petition (NMFS receipt of petition, 90 Day Finding, Proposed Rule, Final Rule) and would take a similar amount of time (~2 years).
- An Atlantic Sturgeon Recovery Team has not yet been coordinated by NMFS to develop the Atlantic Sturgeon Recovery Plan. This plan, when completed, would typically include targets for delisting or down listing. Even without a recovery plan in place, any petition to delist or down list would still have to develop targets to support the status change request. The most appropriate way to develop targets would be through a stock assessment.
- Even for species without a recovery plan, NMFS should conduct a five year review of the species status. However, these reviews are not held to any mandated timeframe. It took 25 years for a shortnose sturgeon Recovery Plan to be published and the current status review begun in

2007 remains unfinished. In a more recent example, a five year review was initiated 13 years after the listing of the Eastern DPS for Stellar sea lions as threatened. The Eastern DPS for Stellar sea lions is currently under consideration for delisting.

- The TC discussed the positive and negative aspects associated with pursuing downlisting, delisting and maintaining the status quo.

	Down list		**Delist**		**SQ**	
	positive	negative	positive	negative	positive	negative
Burden on states/ASMFC		X		X		
Specified Timeline Mandated	X		X			
Could be long process		X		X		
Public Perception	X	X	X	X	X	X
New Scientific Data can be considered	X		X			
Restrictive Regulations put in place after listing (e.g. monkfish fisheries) can be considered	X		X			
Better scientific understanding of stock	X		X		X	X
Would not have to focus on all DPSs	X		X			
Critical habitat designation	X	X	X	X	X	X
Loss Section 6 funding				X		
Industry data collection cooperation						X
Cost associated with pursuing		X		X	X	X
Still need to submit Section 10 apps / risk of litigation until applications processed		X		X		X
Uncertainty surrounding BiOps and ITS		X		X		X

For any action the TC recommends that the following:

- New stock assessment
- Independent genetic study for re-evaluation of DPS, which should focus on YOY and age 1 fish (could be incorporated into assessment)
- Development of delisting criteria in advance of a NMFS Recovery Plan
- Bycatch analysis update (could be incorporated into assessment or formation of subcommittee)
- Information on NMFS listing analysis and methodology

Timeline

- In addition to the time it would take to develop a petition to delist or down list, it would also take an additional two years for NMFS to go through the required petition process.
- If a stock assessment was prioritized, it would take, at a minimum one to two years to complete. The TC noted that the same people who could work on a delisting or down listing petition or a stock assessment would also most likely be the same people developing the Section 10 permit applications for the states. Additionally, once a stock assessment was completed and peer reviewed it would still take more than two years to go through the petition process.
- The TC notes that during the development of a petition or stock assessment states would still need to be covered by applicable Section 10 permits.

TC Consensus

Based on the discussion at the workshop, the TC came to a consensus on the following recommendations to the Board:

1. The TC recommends the Sturgeon Board initiate a benchmark stock assessment and peer review for Atlantic sturgeon, as well as other appropriate data analyses as necessary.

2. The results of the stock assessment and peer review should inform the determination on which petition type (down listing or delisting) or other action may be appropriate to address any discrepancies or concerns with the listing.

3. The TC recommends the Board form a subcommittee to work on bycatch analysis, identify new data, and develop ways to improve analysis to reduce bycatch. Given the time constraints of the meeting, the TC was unable to further review and discuss methods to reduce sturgeon bycatch. The TC noted that if a subcommittee is developed outside of the stock assessment process then it would allow for the subcommittee to assist the states with the development of their section 10 applications.