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November 30, 2010 F/SEC2: TJ

MEMORANDUM TO: Emily Menashes
Acting Director, Office of Sustainable Fisheries

FROM: Bonnie Ponwith, Ph.D. Theo R. Brainard
Science Director

SUBJECT: SEFSC Scientific Review of Scalloped Hammerhead Stock Assessment by Hayes, *et al.* (2009)

As you requested, the Southeast Fisheries Science Center (SEFSC) reviewed the paper by **Hayes, Jiao and Cortes. 2009. *Stock Assessment of Scalloped Hammerheads in the Western North Atlantic Ocean and Gulf of Mexico***, and determined that it can serve as the basis for U.S. management decisions. Specific comments are provided below. The answers to specific questions posed by the Sustainable Fisheries Office on the data and analytical methods employed by the authors are also attached.

1) The paper by Hayes et al. (2009) is complete and represents an improvement over the current aggregated species assessment.

2) This paper uses classic stock production models, along with standard data that are typically used under data poor situations, to produce a set of possible estimates of the status of the stock.

3) The assumptions were well spelled out. Sensitivity to the various assumptions was demonstrated as well as inclusion/exclusion of datasets in an effort to determine their contribution to the fit. Several recommendations from the NMFS (2006) review were also addressed, such as using observer data rather than logbook data [i.e., NMFS (National Marine Fisheries Service). 2006. *SEDAR 11: stock assessment report—large coastal shark complex, blacktip and sandbar shark.* National Marine Fisheries Service, Silver Spring, Maryland].

4) It would have been helpful to include the annual coefficient of variations associated with the various indices of abundance in Table 3.

5) It was noteworthy that the removal of the fishery-dependent CPUE time series made for a more optimistic assessment. Since these sharks tend to school, it is possible that the fishery CPUE may have been somewhat inflated in the beginning years due to this schooling effect.

As the schools declined in size and their catchability decreased, the CPUE may have taken an exaggerated drop relative to the fishery independent indices

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RESPONSES TO QUESTIONS

In a May 17, 2010, memorandum to the Director of the SEFSC, the SF requested that "SEFSC make a determination with regard to the overfished and overfishing findings in the Hayes et al. (2009) paper and its appropriateness on which to base U.S. management. Additionally, SF requested that SEFSC answer the following questions.

Question I

I. Landings

SF has been trying to reconcile the data reported in the Hayes *et al.* (2009) paper with what has been supplied to SF by the SEFSC. In doing so, SF poses the following questions regarding scalloped hammerhead landings:

1. Commercial landings of scalloped hammerheads are reported to SF by the SEFSC by weight (*i.e.*, pounds dressed weight) whereas Hayes *et al.* (2009) reported commercial landings in numbers of scalloped hammerhead sharks. Thus, SF can make no easy comparison between landings reported by the SEFSC to SF and the landings reported in the Hayes *et al.* (2009) paper. What was the average weight used for scalloped hammerhead sharks to convert commercial weights to numbers of sharks as shown in Table 2 of Hayes *et al.* (2009)?
2. The recreational numbers reported in Table 2 of Hayes *et al.* (2009) are different from those reported in SF's Stock Assessment and Fishery Evaluation (SAFE) reports (*e.g.*, NMFS, 2009; see tables below) even though both sets of numbers are supplied by the SEFSC. Is there any additional information that the SEFSC can provide to help reconcile the apparent discrepancy? Did Hayes *et al.* use just scalloped hammerheads numbers in their assessment or were unclassified hammerhead shark numbers also included in the assessment?

Table 1 Recreational Harvest of Atlantic Large Coastal Shark by Species, in number of fish, from the 2009 SAFE Report (NMFS, 2009).

Species	1999	2000	2001	2002	2001	2004	2005
Scalloped Hammerhead Sharks	606	3,623	1,373	996	2,921	879	5,021
Great Hammerhead Sharks	434	925	3,422	4	47	9	55
Smooth Hammerhead Sharks	1	2	703	2	1	0	0
Unclassified Hammerhead Sharks	0	3,693	0	5,247	0	0	2,676
Total	**1,041**	**8,243**	**5,498**	**6,249**	**2,969**	**888**	**7,752**

Table 2 Number of scalloped hammerhead sharks caught by year in the recreational fishery as reported in Table 2 of Hayes *et al.* (2009)

Species	1999	2000	2001	2002	2001	2004	2005
Scalloped Hammerhead Sharks	545	6,350	1,112	6,113	2,859	803	803

Answer to Question I:

SF should always rely on the latest set of landings estimates provided by the SEFSC, because commercial landings and, especially recreational catch estimates, often undergo adjustment and the most recent year(s) of data must always be considered preliminary estimates.

1. Commercial landings (for the three hammerhead species combined, which are scalloped, great, and smooth hammerhead) were obtained as follows. For the period 1982-1994, they came directly from dealer weigh-out data, which are reported in both weight and numbers. Numbers were used for the Hayes et al. (2009) assessment. For the period 1995-2005, landings estimates were obtained by summing dealer reports from the southeast and northeast regions. For the southeast, they were the maximum of the values reported in the PDC (formerly QMS) and the ALS (formerly general canvass). For the northeast, they were the values from the general canvass. Southeast and northeast values were then summed to generate total landings estimates in pounds dressed weight (lb dw). Annual estimates in numbers were produced by dividing landings in weight by average weights (for the hammerhead shark complex) obtained from dealer weigh-outs. The average weights used to generate commercial landings in numbers for 1995-2005 are given below:

year	Hammerhead complex mean wt (weigh-out)	Scalloped hammerhead mean wt (CSFOP)
1995	70.77	83.99
1996	62.83	74.52
1997	65.81	38.86
1998	72.12	64.76
1999	70.42	76.29
2000	62.85	61.27
2001	61.39	52.72
2002	68.61	64.90
2003	55.98	50.66
2004	68.92	51.41
2005	51.46	40.16

The weights above are in lb dw. For comparison, a column with now available average weights for scalloped hammerhead sharks from the Commercial Shark Fishery Observer Program (CSFOP) has been added.

The second step for producing commercial landings estimates specifically for scalloped hammerhead sharks was to use the proportional catch composition from the CSFOP to apportion the commercial landings estimates for the hammerhead shark complex into estimates for the three individual species for the period 1994-2005. For the period before the CSFOP existed (1981-1993), the average composition for 1994-2005 was taken (59.1% for scalloped hammerhead).

2. The difference between the recreational catch estimates provided in Hayes et al. (2009) and those in the SAFE report is due to the inclusion of unclassified hammerhead sharks (genus *Sphyrna*) in the former and in some cases to the estimates for scalloped hammerheads having changed since the time they were produced for the Hayes et al. (2009) paper and when they were submitted for inclusion in the 2009 SAFE report. Annual estimates in Hayes et al. (2009) were generated by adding: a) the estimates for scalloped hammerheads and; b) the product of unclassified hammerheads by the proportional species composition that scalloped hammerheads made up of the three hammerhead species (scalloped, great, and smooth) every year. The estimates from Hayes et al. (2009) are larger for 2000 and 2002 when estimates for unclassified hammerheads were also large and scalloped hammerheads made up 70% and 99% respectively of the total hammerhead catches. In the remaining years (1999, 2001, 2003-05), no unclassified hammerheads were reported and the estimates from the SAFE report are generally a little larger, except for 2005 in which they are substantially larger. As explained above, this is due to re-estimations or updates in one or more of the three recreational surveys (MRFSS, Headboat, and TXPWD) used to produce total recreational catch estimates.

Question II

II. Discards

Hayes *et al.* (2009) indicated that dead discard data were obtained from the SEFSC, which used the pelagic longline observer program data and dealer weight-out data to produce annual estimates (page 1408). In addition, Hayes *et al.* (2009) indicated that average discards were used for 1982-1986 and 2002-2005 based on average discards in 1987-1992 and 1993-2001 because discard estimates were not available prior to 1987 and scalloped hammerheads were lumped into a generic "hammerhead" category on dealer forms after 2001.

1. How were dealer data used to estimate dead discards?
2. Were discards in the bottom longline and gillnet fisheries included in the discard estimates?
3. Why were bottom longline or gillnet observer data not used to estimate discards at least from 1994 to 2005?

<u>Answer to Question II:</u>

Dead discard data in Hayes et al. (2009) were obtained from estimates provided by the SEFSC, which use pelagic longline observer program (PLLOP) and pelagic longline logbook data (see e.g., Cramer, 2000). References to *dealer weigh-out data* and *dealer forms* in the Hayes et al. (2009) article are incorrect.

1. As just mentioned, dealer data were not used to estimate dead discards. Dead discard estimates from the pelagic longline fishery were estimated as follows. First, for the period 1987-2001, estimates were produced by the SEFSC based on pelagic longline observer program and logbook data. However, these estimates were for the hammerhead shark complex. Estimates specifically for scalloped hammerheads were computed as follows. For 1992-2001, annual estimates were calculated by multiplying the hammerhead complex values by the proportion that scalloped hammerheads made up of the hammerhead complex as reported in the PLLOP. For the period immediately preceding the PLLOP went into operation (1987-1991), annual estimates were obtained by multiplying hammerhead

complex values by the average composition that scalloped hammerheads made up of the hammerhead complex during 1994-2000 (40.5%). For 1981-1986 and 2002-2005, the average discards of scalloped hammerheads in 1987-1992 (1,487 sharks) and 1993-2001 (431 sharks), respectively, were used.

2. Dead discards in the bottom longline and gillnet fisheries were not included.
3. Gillnet fishery discards were not included. Data from the Drift Gillnet Fishery Observer Program indicate that small juveniles are caught as bycatch in that fishery. Bottom longline discards were not included because at the time of the assessment reported in Hayes et al. (2009) discard proportions from the CFSOP were not readily available. Had dead discards been included, it would have been as a proportion of the commercial landings.

Question III

III. Biological Reference Points

1. Based on the estimates given for fishing mortality (F) at maximum sustainable yield (F_{MSY}), number of shark at MSY (N_{MSY}), current relative fishing mortality rate (F_{2005}/F_{MSY}), and current relative biomass level (N_{2005}/N_{MSY}) in Hayes *et al.* (2009), SF estimated F_{2005} and N_{2005} to be 0.14 and 27,900, respectively. Is this correct?
2. The article stated the following total allowable catches (TAC): a TAC of 2,853 scalloped hammerhead sharks/year (69% of 2005 catch) would allow a 70% probability of rebuilding within 10 years; a TAC of 2,068 scalloped hammerhead sharks/year (50% of 2005 catch) would give an 85% probability of rebuilding within 10 years; and a TAC of 0 (or F=0) would give a 95% probability of rebuilding within 10 years. Do you concur with these numbers?
3. Was the TAC calculated based on landings of unclassified hammerhead sharks and scalloped hammerhead sharks or just scalloped hammerhead shark landings? Understanding how the TAC was calculated will help SF formulate management options for applying the TAC (*i.e.*, to the entire hammerhead complex or just scalloped hammerhead sharks).

<u>Answer to Question III:</u>

1. F_{2005}=0.17 (1.14 x 0.15) and N_{2005}=24,850 (71,000 x 0.35)
2. Yes.
3. The TAC was calculated as a percentage of the total catch in 2005, the terminal year for the Hayes et al. (2009) assessment. As has been presented above, total catches consist of three components: commercial landings, recreational catches, and dead discards. Commercial landings for scalloped hammerheads were obtained as a proportion of the hammerhead complex landings, which include unclassified hammerheads (see item I.1). Recreational data included catches of unclassified hammerhead sharks (see item I.2). Pelagic longline discards were also obtained as a proportion of the hammerhead shark complex, which include unclassified hammerheads (see item II.1). Thus, the total catch estimates for scalloped hammerheads implicitly include unclassified hammerhead sharks.

Question IV

IV. Population structure

1. Is there any evidence of population structure for scalloped hammerhead sharks?
2. If there is any population structure, do we have the appropriate data to consider multiple assessments?
3. If there is no population structure and North Atlantic scalloped hammerheads can be considered one population, is using only U.S. fishery data appropriate for the assessment?

Answer to Question IV:

1. Scalloped hammerheads appear to form a single population in the western North Atlantic according to genetic data. However, Quattro et al. (2006) reported the occurrence of a cryptic species of scalloped hammerhead in the western North Atlantic in coastal areas from North Carolina to Florida, which apparently can only be distinguished from the scalloped hammerhead through genetic analysis and vertebral counts. Quattro et al. (2006) reported that the abundance of this cryptic species is lower than that of its sister species *S. lewini* and that South Carolina bays are the most important nursery grounds for the cryptic species. In another study, Duncan et al. (2006) examined the global genetic structure of scalloped hammerhead and found that "nursery populations linked by continuous coastline have high connectivity, but that oceanic dispersal by females is rare". They also reported minor genetic structure along continental margins, the habitat most occupied by this species. In contrast, a more recent study by Chapman et al. (2009) found that western Atlantic scalloped hammerheads are structured into at least 3 distinct mitochondrial stocks: the "northern" (US Atlantic and Gulf of Mexico), "central" (Belize and Panama) and "southern" (Brazil) stocks. Presently, genetic data do not support splitting the US Atlantic and Gulf of Mexico into two separate stocks (D. Chapman, pers. comm.), but immigration of females from the south or across the Atlantic should not be expected (Chapman et al. 2009).
2. See above. If the occurrence of this sister species is true there are no data to distinguish between the two of them and thus separate assessments are not possible.
3. The situation for scalloped hammerheads would be analogous to that of other large coastal shark species (e.g., sandbar, blacktip, dusky) for which domestic (U.S only) assessments are undertaken. There is presently no consistent evidence of large-scale migrations by this species that would warrant an international assessment, as is done for highly migratory pelagic shark species under ICCAT.

Question V

V. Staff contact

1. If your review indicates that Hayes *et al.* (2009) is appropriate for management, we expect to have additional information requests. Who should my staff contact with those requests?

Answer to Question V

The SEFSC (c/o Enric Cortes) can answer questions related to landings/catches as addressed in the present document. However, other questions should be addressed to the article's first author, Chris

Hayes, who conducted the assessment with a specific piece of software (MATLAB) that is not used by the SEFSC.

References Cited:

Chapman, D.D., D. Pinhal and M.S. Shivji. 2009. Tracking the fin trade: genetic stock identification in western Atlantic scalloped hammerhead sharks *Sphyrna lewini*. Endangered Species Research 9: 221-228.

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