HMS Gulf of Mexico Blacknose Shark Assessment Summary

The Summary Report provides a broad but concise view of the salient aspects of the stock assessment. It recapitulates: (a) the information available to and prepared by the Data Workshop; (b) the application of those data, development and execution of one or more assessment models, and identification of the most reliable model configuration as the base run by the Assessment Process (AP); and (c) the findings and advice determined during the Review Workshop.

Stock Status and Determination Criteria

The Review Panel (RP) had substantial concerns regarding the proposed modeling approach's ability to accurately determine the stock status for GoM blacknose shark. Specifically, sensitivity runs requested by the RP demonstrated that the assessment model was unable to fit apparent trends in the abundance indices at all, unless implausible additional historical catches were also estimated. This fundamental lack of fit of the model to the input data caused the RP to reject the blacknose GoM assessment model.

Stock Identification and Management Unit

- After considering the available data, the working group concluded that blacknose sharks inhabiting the U.S. waters of the western North Atlantic Ocean (including the Gulf of Mexico) should be considered two separate stocks; one in the U.S. waters of the western North Atlantic Ocean (referred to in the document as South Atlantic Bight) and one in the Gulf of Mexico.
- Since SEDAR 13, tagging efforts have increased and there is still a lack of exchange between the Gulf of Mexico and South Atlantic Bight.
- While genetic information still doesn't not provide data to discriminate distinct stocks, the continued lack of exchange between the two basins and the difference in reproductive cycle (1 year vs. 2 year) led the group to conclude that the stocks should be split.

Stock Life History - summary of life history characteristics of the stock under assessment

- There are currently no natural mortality estimates for blacknose shark available based on direct empirical data.
- It was determined that the *maximum* of the four life history invariant methods for estimating natural mortality discussed at the Data Workshop (Hoenig [1983], Chen and Watanabe [1989], Peterson and Wroblewski [1984], and Lorenzen [1996]), be used as the estimate of M.
- Due to the low sample sizes of younger individuals in the growth model from the South Atlantic Bight and larger animals from the Gulf of Mexico, the working group chose to adopt the combined growth model to describe both areas.
- Observed maximum age of blacknose sharks is 14.5 years for females and 20.5 years for

males. The working group agreed that it was reasonable to assume a maximum age of 20.5 years for females as well.

- The reproductive periodicity in the Gulf of Mexico is considered to be annual while the periodicity is considered biennial in the South Atlantic Bight.
- A litter size of 5 should be adopted for both regions. This value represents the median of all data available on blacknose shark fecundity.

Assessment Methods

The state-space, age-structured production model (ASPM) was used as the primary assessment modeling approach. The ASPM has been used extensively for assessing shark stocks domestically (including the sandbar and blacknose sharks) and under the auspices of ICCAT since 2002. The ASPM allows incorporation of many of the important biological (mortality, growth, reproduction) and fishery (selectivity, effort) processes in conjunction with observed catches and CPUE indices (and length and age compositions if available).

Principal data inputs for the blacknose GoM assessment were historical catches and the abundance indices. Evidence of the acceptability of the assessment depends in particular on how well the model was able to fit to the input data. The abundance indices generally either showed no trend or an increasing trend over recent years – particularly for those indices given a high ranking by the DW (NFMS SE LL, SEAMAP summer and fall and SEFC shark BLL OB indices). Sensitivity runs requested by the RP demonstrated that the blacknose GoM assessment model was unable to fit apparent trends in the abundance indices at all, unless implausible additional historical catches were also estimated. This fundamental lack of fit of the model to the input data caused the RP to reject the blacknose GoM assessment model. A remedy for the situation would involve the development and application of a model with additional but plausible flexibility (e.g. in perhaps annual recruitment variation) to provide improved fits to observation data.

Assessment Data

- Commercial landings were decomposed into three separate gears: bottom longlines, nets, and lines, by taking the product of the annual landing estimates and the proportional gear composition for the Gulf of Mexico
- Annual recreational catch estimates are the sum of estimates reported in the MRFSS (fish landed [A] and discarded dead [B1]), Headboat survey (fish landed) and Texas Parks and Wildlife Department survey (fish landed).
- Dead discards from the commercial shark bottom longline fishery are estimated using the annual dead discard percentage observed in the Shark Bottom Longline Observer Program in the Gulf of Mexico multiplied by the annual commercial landings of blacknose sharks caught on longlines in the Gulf of Mexico.

- Dead discards from the commercial shrimp trawl fishery in the Gulf of Mexico are included. The pre-TED and post-TED series were imputed as a single series into the model to address poor-fit issues
- Length-frequency information from animals caught in scientific observer programs, recreational fishery surveys, and various fishery-independent surveys was used to generate age-frequency distributions through age-length keys
- Eight indices were recommended for use in the assessment: seven fishery-independent series (NMFS LL SE, PCGN adults, PCGN Juveniles, NMFS SEAMAP Groundfish Trawl Summer, NMFS SEAMAP Groundfish Trawl Fall, DISL LL, and MML LL) and one fishery-dependent series (the commercial BLLOP observer index), all of which were standardized by the respective authors through GLM techniques
- Life history inputs to the model include age and growth, as well as several parameters associated with reproduction, including sex ratio, reproductive frequency, fecundity at age, maturity at age, and month of pupping, and natural mortality.

Catch Trends

- Catches of blacknose shark in the Gulf of Mexico were dominated by discards in the shrimp trawl fishery. These discard estimates should be considered superior to those used in the 2007 stock assessment because they stemmed from a collaboration between NOAA and the shrimp industry.
- There is a general increase in landings from the early eighties to a peak in 2006 for the sectors other than shrimp bycatch.
- Commercial landing come primarily from bottom longline gear

Stock Abundance and Biomass

Although the Review Panel believed the methods used to calculate population and management benchmarks were appropriate, given their concerns regarding model performance they were unwilling to accept that stock status could be determined.

There were two main issues that were not sufficiently reconciled at the Review Workshop (RW):

- The first of these is the uncertainty in the status of the population at the start of the historical period, when the population is assumed to be at a virgin size. In the case of GoM blacknose shark, the shrimp bycatch comprises most of the catches, and this fishery existed before the start of the historical period (1950). Although it is not known whether bycatch levels would have been similar in the past, this assumption is difficult to justify, but statements about the status of relative to a biomass benchmark are based on this assumption.

- The second issue pertains to difficulties fitting to both the catches and the survey indices simultaneously. The catch series shows relatively stable catches until about 2005 followed by gradual decline. Given the low productivity of the stock, when these catches are reasonably fit, the model estimates a general downward trend in abundance from 1950 to about 2008. In contrast, the BLLOP, NMFS SE LL, SEAMAP summer and SEAMAP fall indices appear to indicate stable or increasing abundance trends and the marked residual patterns indicate how poorly the model results fits these indices.

- At the RW, the Assessment Team did a model run with a very low weight on the catch data in order to see what the predicted catch series would look like if the indices were fit well. Both the magnitude and trend of the predicted catches were sufficiently different from the observed catches, that it was not possible to reconcile the catch and abundance index time series at the RW.

Projections

The Review Panel did not feel that the projection methods presented for their review were appropriate, but given their greater concerns regarding model performance did not recommend performing additional projections.

Scientific Uncertainty

- Uncertainty in parameter estimates was quantified by computing asymptotic standard errors for each parameter.
- Uncertainty in data inputs and model configuration was examined through the use of sensitivity scenarios. Seven alternative runs, along with retrospective analyses were also examined.
- The Review Panel identified several additional sensitivity analyses in an attempt to verify the model outputs. These runs did not prove satisfactory and the model was ultimately rejected.
- Many of the indices of relative abundance showed interannual variability that does not seem to be compatible with the life history of sharks, suggesting that the GLMs used to standardize the indices did not include all factors to help track relative abundance or that the spatial scope of sampling is too limited to allow for precise inference about stock-wide trends.
- The uncertainty associated with biological parameters was only investigated through the scenario with a U-shape natural mortality curve and resulted in a higher degree of overfishing and a substantially less productive stock.
- The estimation of selectivities externally to the model may not have captured the uncertainty associated with the sample size used to fit age-length curves, the computation of the age-length key, and subsequent transformation of lengths into ages to produce age-frequency distributions to which selectivity curves were fitted.

Sources of Information

All information was copied directly or generated from the information available in the final Stock Assessment Report for SEDAR 21: HMS Gulf of Mexico Blacknose shark.

Table 1: Life history inputs used in the assessment. All these quantities are treated as constants in the model. (*Table 2.4 in the Assessment Process Report*)

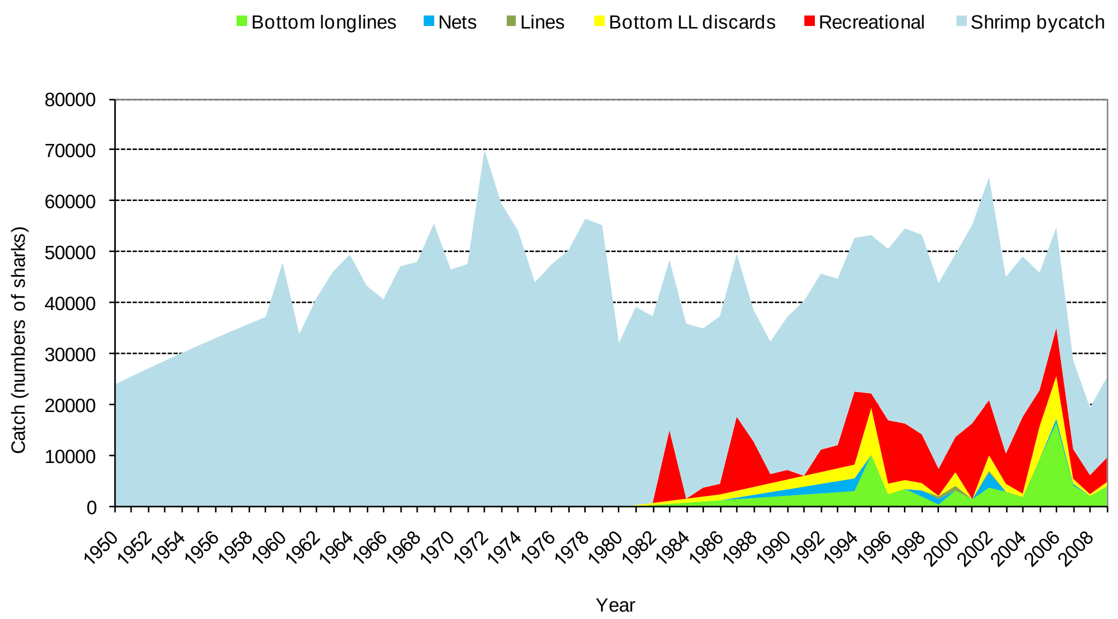
Age	Proportion mature	M
1	0.0000	0.2939
2	0.0005	0.2555
3	0.0099	0.2337
4	0.1751	0.2201
5	0.8191	0.2112
6	0.9897	0.2051
7	0.9995	0.2009
8	1.0000	0.1979
9	1.0000	0.1957
10	1.0000	0.1941
11	1.0000	0.1930
12	1.0000	0.1922
13	1.0000	0.1915
14	1.0000	0.1911

Sex ratio:	1:1
Reproductive frequency:	1 yr
Fecundity:	5 pups
Pupping month:	June
L_{inf}	104.3 cm FL
k	0.3
t_0	-1.71
Weight vs length relation:	$W=0.00000165L^{3.34}$

Table 2: Catches of blacknose shark by fleet in numbers. Catches are separated into six fisheries: commercial longline, commercial gillnet, commercial lines, recreational, shrimp bycatch, and commercial bottom longline discards. Highlighted in red are the numbers that changed with respect to what was reported in the SEDAR21 DW Report. (*Table 2.1 of the Assessment Process Report*)

Year	Commercial landings			Recreational	Shrimp	Bottom LL
	Bottom longlines	Nets	Lines		bycatch	discards
1950	0	0	0	0	0	0
1951	0	0	0	0	3721	0
1952	0	0	0	0	8622	0
1953	0	0	0	0	13524	0
1954	0	0	0	0	18524	0
1955	0	0	0	0	23327	0
1956	0	0	1	0	28228	0
1957	0	0	1	0	33129	0
1958	0	0	1	0	38031	0
1959	0	0	1	0	42932	0
1960	0	0	1	0	47833	0
1961	0	0	1	0	33862	0
1962	0	0	1	0	40773	0
1963	0	0	1	0	46081	0
1964	0	0	1	0	49405	0
1965	0	0	1	0	43301	0
1966	0	0	2	0	40661	0
1967	0	0	2	0	47119	0
1968	0	0	2	0	47967	0
1969	0	0	2	0	55478	0
1970	0	0	2	0	46466	0
1971	0	0	2	0	47557	0
1972	0	0	2	0	69855	0
1973	0	0	2	0	59445	0
1974	0	0	2	0	54073	0
1975	0	0	2	0	43974	0
1976	0	0	2	0	47515	0
1977	0	0	3	0	50258	0
1978	0	0	3	0	56419	0
1979	0	0	3	0	55117	0
1980	0	0	3	0	32121	0
1981	224	0	3	0	38772	193
1982	448	0	3	0	36504	387
1983	672	0	3	13837	33245	580
1984	897	0	3	0	34228	774
1985	1121	0	3	1746	31129	967
1986	1345	0	3	2068	32788	1161
1987	1569	313	4	14486	31829	1354
1988	1793	626	4	8905	25715	1548
1989	2017	939	4	1793	25888	1741
1990	2242	1252	4	1875	29903	1934

1991	2466	1565	4	0	34196	2128
1992	2690	1878	4	4383	34392	2321
1993	2914	2191	4	4547	32511	2515
1994	3138	2505	4	14305	30019	2708
1995	10218	0	20	2814	30909	9245
1996	2515	0	4	12413	33461	2106
1997	3545	0	43	11078	38115	1744
1998	2072	1185	23	9573	38961	1450
1999	510	1128	511	5294	36315	84
2000	3244	0	956	6894	35703	2671
2001	1555	24	14	14854	38769	0
2002	3806	2940	398	10808	43518	3045
2003	3027	16	5	5906	34529	1552
2004	1931	0	80	15071	31306	652
2005	9221	103	26	7101	22953	6475
2006	16355	937	17	9438	19554	8416
2007	4255	314	48	5809	17381	967
2008	2166	9	31	3716	13193	368
2009	3929	69	32	4775	15668	896



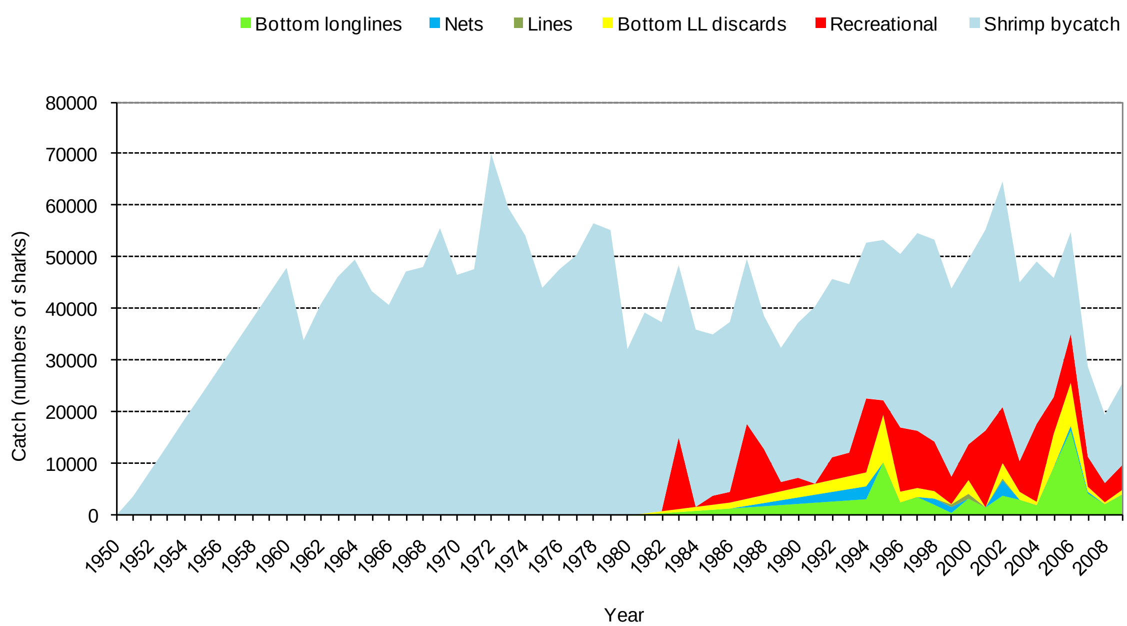


Figure 1. Catches of blacknose shark by fleet. Catches are separated into six fisheries: commercial longline, commercial gillnet, commercial lines, recreational, shrimp bycatch, and commercial bottom longline discards. The commercial lines series is not visible in the figures due to its small magnitude. The top figure shows catches as reported in the SEDAR21 DW Report; the bottom figure shows the change introduced to the shrimp bycatch series for 1950-1959 (*Figure 2.1 in the Assessment Process Report*).

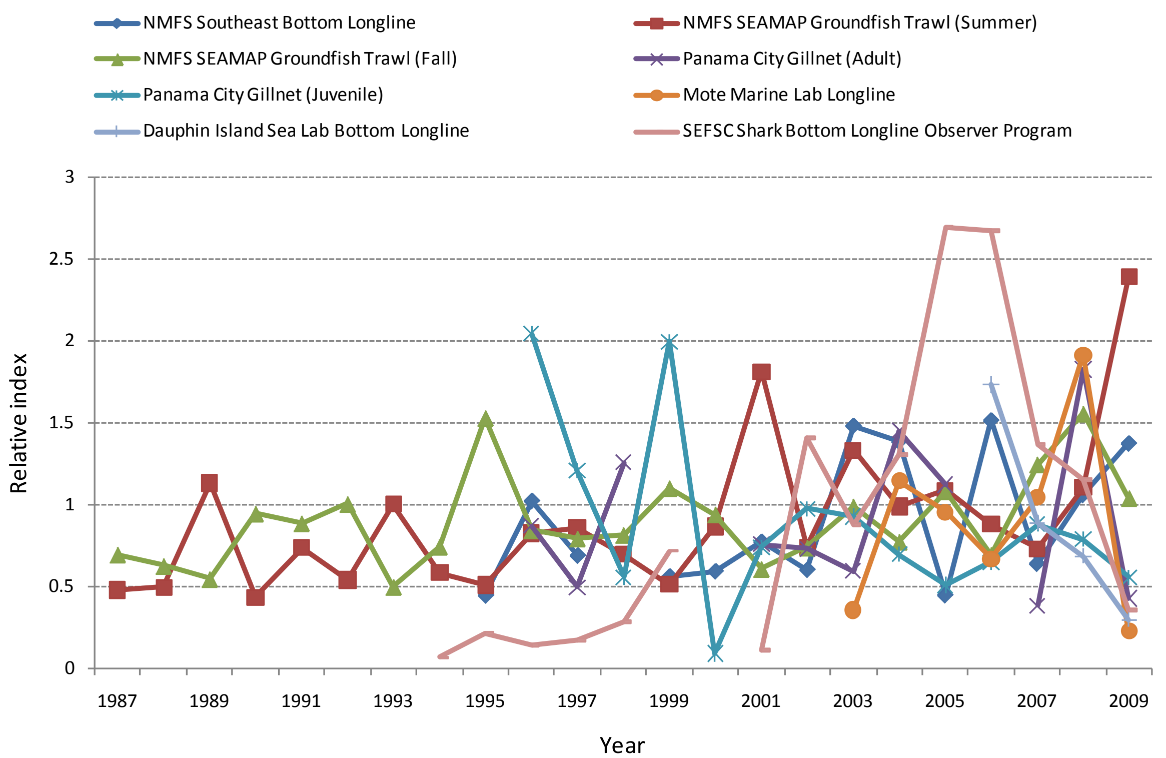


Figure 2: Indices of relative abundance used for the baseline scenario. All indices are statistically standardized and scaled (divided by their respective mean and a global mean for overlapping years for plotting purposes). Note that the earliest series start in 1987. (*Figure 2.4 in the Assessment Process Report*)