SEDAR65-AW01: Hierarchical analysis of U.S Atlantic blacktip shark recruitment indices.

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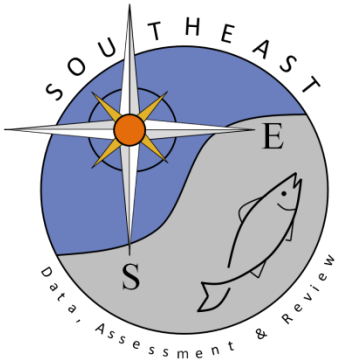

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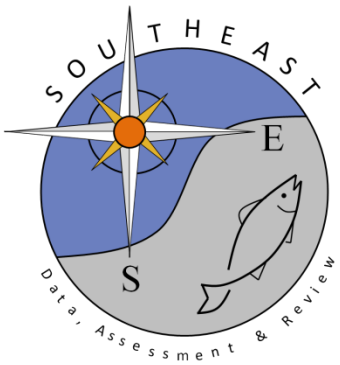

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SEDAR 65 ASSESSMENT WORKSHOP DOCUMENT

Hierarchical analysis of U.S Atlantic blacktip shark recruitment indices

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Summary

This document details the hierarchical trend for U.S. Atlantic blacktip shark indices of abundance recommended for use during the SEDAR 65 Data Workshop as recruitment indices. Recommended recruitment indices were the indices developed using only young-of-the-year data from the South Carolina Department of Natural Resources (SCDNR), Cooperative Atlantic States Shark Pupping and Nursery (COASTPAN) large and small gillnet surveys (SEDAR65-DW07 and SEDAR65-DW10, respectively) and the COASTSPAN longline survey (SEDAR65-DW08). The recommended indices (standardized to their means) and coefficients of variation were used in a hierarchical analysis to estimate individual index process error, assuming a lognormal error structure, and a hierarchical index of abundance. Hierarchical analysis of the Atlantic blacktip shark recruitment indices indicated a slight increasing trend in abundance across years with a notable peak in 2013 and little variation in process error across the individual surveys.

Introduction

Hierarchical analysis has been used in past shark SEDAR assessments to provide an overall abundance trend for multiple standardized indices of abundance. The standardization process is expected to capture the sampling error associated with each index of abundance, but does not account for the degree to which an index may measure 'artifacts' not related to the relative abundance of the entire population, referred to as process error (Conn 2010a, Conn 2010b). Process error can account for the variability in trends across multiple time series due to differences in catchability over time and space (Conn 2010b). The hierarchical method separates out the components of sampling and process error for each index and models the overall trend for all indices, while remaining robust to differences in trends of spatial mixing proportions and differing gear selectivities across surveys (Conn 2010b). This hierarchical analyses was conducted to produce an overall abundance trend for indices of abundance recommended by the SEDAR 65 Data Workshop as recruitment indices.

Data Analysis

Recruitment indices recommended by the SEDAR 65 Data Workshop were the indices developed using only young-of-the-year data from the South Carolina Department of Natural Resources (SCDNR), Cooperative Atlantic States Shark Pupping and Nursery (COASTPAN) large and small gillnet surveys (SEDAR65-DW07 and SEDAR65-DW10, respectively) and the COASTSPAN longline survey (SEDAR65-DW08). These indices (standardized to their means) and coefficients of variation were incorporated into a hierarchical analysis to produce estimates of individual index process error, assuming a lognormal error structure, and a hierarchical index of abundance with associated coefficients of variation and assessment model weights (based on the coefficients of variation). The relative abundance indices and CVs for each time series are provided in Table 1. The hierarchical analysis was conducted in a Bayesian framework using the same set of prior distributions as described by Conn (2010b) and used for other shark species for stock assessment purposes (Conn 2010a). All analyses were conducted using the R programming environment (R Development Core Team 2019).

Results

The hierarchical index values, coefficients of variation, and assessment model weights are reported in Table 2. Hierarchical analysis of the Atlantic blacktip shark recruitment indices indicated a slight increasing trend in abundance across years with a notable peak in 2013 (Figure 1) and little variation in process error across the individual surveys (Figure 2).

References

Conn. 2010a. Hierarchical analysis of blacknose, sandbar, and dusky shark CPUE indices. SEDAR21-AP-01.

Conn. 2010b. Hierarchical analysis of multiple noisy abundance indices. Can. J. Fish. Aquat. Sci. 67:108-120.

R Development Core Team. 2019. R: A language and environment for statistical computing, reference index version 3.6.0. R Foundation for Statistical Computing Platform: x86_64-w64-mingw32/x64 (64-bit), URL http://www.R-project.org.

Table 1. Relative abundance indices and coefficients of variation (CV) of Atlantic blacktip shark recruitment for use in hierarchical analysis, including the index name and SEDAR document number.

	SEDAR65 DW07		SEDAR65 DW10		SEDAR65 DW08	
YEAR	SC COAST large gillnet	CV	SC COAST small gillnet	CV	COAST LL	CV
2001	0.7001	0.3356				
2002	0.2226	0.6537				
2003	0.8146	0.3725				
2004	0.1451	1.3325				
2005	0.9064	0.4633			2.8189	0.3037
2006	1.0225	0.3704	0.4978	0.4516	1.4128	0.4026
2007	0.4904	0.5854	1.4930	0.5187	1.2135	0.5519
2008	0.5644	0.5376	0.3010	1.1630	2.8834	0.3891
2009	0.7493	0.4790	0.3086	1.1235	1.8817	0.3067
2010	0.6152	0.5843	0.5651	0.4762	1.7531	0.2862
2011	0.2755	0.7552	0.6010	0.4853	1.5969	0.2827
2012	0.8465	0.9029	1.0683	0.2875	2.6555	0.2460
2013	3.8455	0.4166	0.8272	0.4261	3.4398	0.2168
2014	0.8915	0.5349	0.2497	0.6939	1.8919	0.3177
2015	0.4001	0.5242	0.5397	0.4586	0.8971	0.3923
2016	0.1181	0.8992	0.2959	0.5259	1.6699	0.2699
2017	1.3561	0.4949	0.6881	0.4061	1.6069	0.2941
2018	0.9674	0.4563	1.2167	0.3111	1.0313	0.3190

Table 2. Hierarchical index values, associated coefficients of variation (CV) and assessment model weights.

Year	Index	CV	Weight
2001	0.9926	0.5452	0.2213
2002	0.4943	0.7051	0.2271
2003	1.1213	0.5360	0.5516
2004	0.5655	0.8586	0.2213
2005	1.3759	0.3785	0.2271
2006	0.9384	0.3559	0.5516
2007	1.0130	0.4100	0.2213
2008	1.0787	0.3999	0.2271
2009	0.9523	0.3645	0.5516
2010	0.9086	0.3475	0.2213
2011	0.7915	0.3536	0.2271
2012	1.4303	0.3352	0.5516
2013	2.0640	0.3442	0.2213
2014	0.9104	0.3684	0.2271
2015	0.6123	0.3704	0.5516
2016	0.6492	0.3726	0.2213
2017	1.0756	0.3508	0.2271
2018	1.0260	0.3705	0.5516

Figure 1. Hierarchical index for Atlantic blacktip shark recruitment indices.

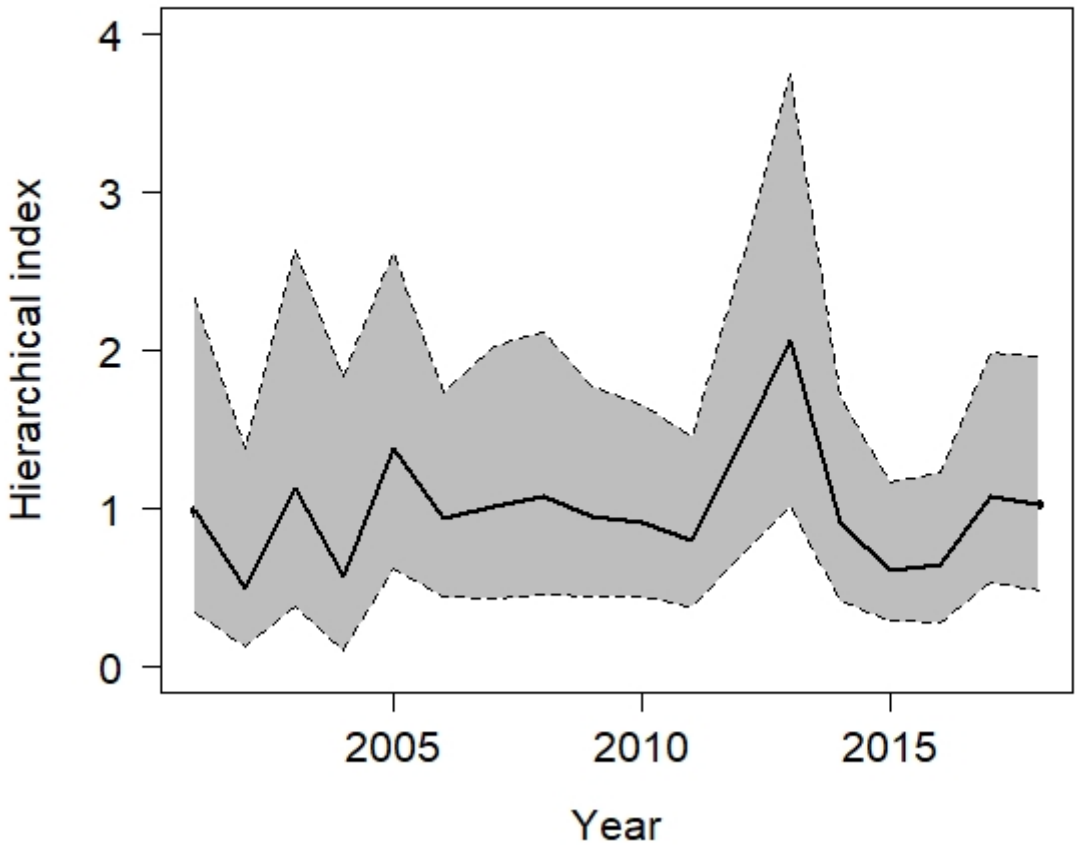

Figure 2. Process standard deviations for the indices used to develop the recruitment heirarchical index.