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Southeast Data, Assessment, and Review

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SEDAR 17 Assessment Workshop Working Paper

Development of an aging error matrix for the vermilion snapper catch-at-age stock assessment model

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The Caribbean Fishery Management Council
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Introduction

Aging error has not been addressed in previous SEDAR assessed species in the U.S. South Atlantic due to a lack of multiple age readings for sets of otoliths. The effect of not including aging error in stock assessments depends on the amount of inter-reader variability. Inclusion of aging error in a catch-at-age type stock assessment tends to accentuate recruitment estimates, as compared to the same estimates without aging error. Other estimates from a stock assessment are affected as well, but the direction and magnitude of change is often unpredictable due to other data sources and factors in the model. This analysis computes an aging error matrix for vermilion snapper in the U.S. South Atlantic.

Methods

A random set of 583 vermilion snapper otoliths were exchanged between South Carolina Department of Natural Resources (SCDNR) and National Marine Fisheries Service (NMFS) in Beaufort, North Carolina. The NMFS Beaufort lab had two personnel provide independent age readings of these otoliths. The SCDNR produced a consensus age reading for each otolith in the set.

This set of three separate age readings were then compared in a pairwise fashion. Agreement between the labs was generally good (Figure 1). Figure 1 suggests a slight bias with age-1 determinations, but this bias was viewed as a minor issue and therefore not addressed in the aging error matrix. Standard deviation of readings for each pairwise comparison of readers was computed for each age. This was accomplished by computing the standard deviation of readings from one reader based on the readings corresponding to a single age for another reader, resulting in six estimates of variance for each age (Table 1, Figure 2). The pattern in standard deviation suggests some changes with age, but ultimately it was decided to simply compute a single overall average standard deviation for use in the aging error matrix.

The aging error matrix was computed by assuming a normal distribution of aging error from readers with mean equal to the true age and the standard deviation from the paired readings above. At the oldest age a plus group was computed by adding in the portion of the normal distribution probability curve for ages older than the maximum age in the matrix. Probabilities of predicted ages not summing to one were re-scaled to sum to one.

An important assumption of this method is that reading variability equates to aging error. This may not be the case if the error is due to factors which inhibit the ability to detect the true age. The assumption is that the otoliths contain the information on true age and the readers differ in their interpretation.

Results

The resulting aging error matrix is shown in Table 2.

Table 1. Standard deviation of vermilion snapper otolith age readings from paired reader comparison. Readers are as follows; South Carolina Department of Natural Resources (SCDNR) and two readers from National Marine Fisheries Service, Beaufort (JP and SM). Column headings indicate paired readers, with the first representing the readers whose ages were the base for computing the standard deviation of age readings of the second reader.

Age	SCDNR-JP	SCDNR-SM	JP-SCDNR	JP-SM	SM-SCDNR	SM-JP
1	0.75	0.63	0.75	0.63	2.12	1.41
2	0.39	0.51	0.63	0.53	0.83	0.67
3	0.67	0.59	0.63	0.59	0.68	0.66
4	0.73	0.81	0.64	0.79	0.69	0.82
5	0.92	0.98	0.74	0.81	0.75	0.68
6	0.72	0.87	0.94	0.96	0.57	0.79
7	0.53	0.00	0.71	0.88	0.51	0.62
8	0.50	0.50	2.12	3.54		
9	1.41	0.00	0.50	0.58	0.00	0.58
10					0.58	1.15

Table 2. Vermilion snapper aging error matrix for use in the catch-at-age stock assessment model.

	True Age											
Pred Age	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	0.6711	0.2315	0.0205	0.0004	1E-06	1E-09	2E-13	5E-18	3E-23	3E-29	8E-36	4E-43
2	0.3012	0.5157	0.2267	0.0205	0.0004	1E-06	1E-09	2E-13	5E-18	3E-23	3E-29	8E-36
3	0.0272	0.2315	0.5052	0.2266	0.0205	0.0004	1E-06	1E-09	2E-13	5E-18	3E-23	3E-29
4	0.0005	0.0209	0.2267	0.505	0.2266	0.0205	0.0004	1E-06	1E-09	2E-13	4E-18	3E-23
5	2E-06	0.0004	0.0205	0.2266	0.505	0.2266	0.0205	0.0004	1E-06	1E-09	1E-13	4E-18
6	1E-09	1E-06	0.0004	0.0205	0.2266	0.505	0.2266	0.0205	0.0004	1E-06	1E-09	1E-13
7	2E-13	1E-09	1E-06	0.0004	0.0205	0.2266	0.505	0.2266	0.0205	0.0004	1E-06	1E-09
8	6E-18	2E-13	1E-09	1E-06	0.0004	0.0205	0.2266	0.505	0.2266	0.0205	0.0004	1E-06
9	4E-23	5E-18	2E-13	1E-09	1E-06	0.0004	0.0205	0.2266	0.505	0.2266	0.0203	0.0004
10	4E-29	3E-23	5E-18	2E-13	1E-09	1E-06	0.0004	0.0205	0.2266	0.5048	0.225	0.0202
11	1E-35	3E-29	3E-23	5E-18	2E-13	1E-09	1E-06	0.0004	0.0205	0.2266	0.5014	0.2231
12	5E-43	8E-36	3E-29	3E-23	5E-18	2E-13	1E-09	1E-06	0.0004	0.0212	0.2528	0.7564

Figure 1. Mean age of vermilion snapper otoliths from paired reader comparison. Readers are as follows; South Carolina Department of Natural Resources (SCDNR) and two readers from National Marine Fisheries Service, Beaufort (JP and SM). Labels indicate paired readers, with the first representing the readers whose ages were the base for computing the mean age of the second reader.

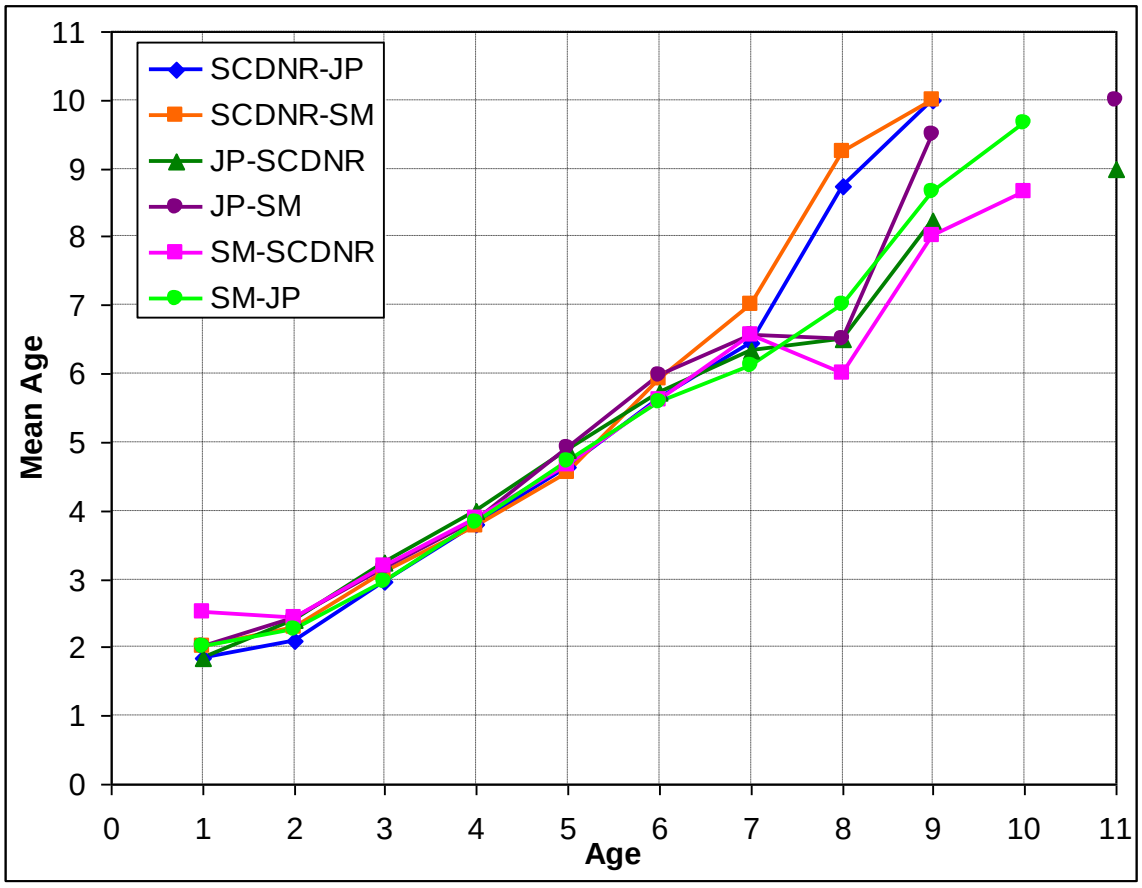

Figure 2. Standard deviation of age readings of vermilion snapper otoliths from paired reader comparison. Readers are as follows; South Carolina Department of Natural Resources (SCDNR) and two readers from National Marine Fisheries Service, Beaufort (JP and SM). Labels indicate paired readers, with the first representing the readers whose ages were the base for computing the standard deviation of age readings of the second reader.