Calibration and quality control of aging mutton snapper

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Introduction

Cooperation between NMFS and the FWRI fisheries aging laboratory has played an important role in providing age data for several Southeast Data Assessment and Review processes starting with the yellowtail snapper SEDAR 03 in 2003, followed by the red snapper SEDAR 07 in 2005, and the vermilion snapper SEDAR 09 in 2006. Since 2003, FWRI has provided 28,000 snapper ages for use in these and future SEDARs. Age data for SEDAR 15A will also come from these two labs: 1437 ages determined by M. Burton, from the NMFS Beaufort Lab (Burton, 2002), 1122 from an FWRI Independent survey in the Keys and Tequesta, and 4966 commercial and recreational samples read by FWRI St. Pete. In order to determine if aging methods between FWRI and NMFS were consistent and to insure that the quality of age data from all sources was up to par, an aging workshop was held in May 2006 and a calibration set of 500 otoliths was read by three laboratories.

Methods

On May 25 and 26, 2006, a mutton snapper aging workshop was held at the FWRI in St. Petersburg, FL. Participants were Mike Burton (NMFS Beaufort), Erick Ault (FWRI Tequesta), Laura Crabtree (FWRI St. Petersburg) and Janet Tunnell (FWRI St. Petersburg). The purpose of this workshop was 1) to discuss aging criteria such as the nature of the first annulus, edge type, and birth date and 2) to compare readings for 100 mutton snapper, *Lutjanus analis*, otoliths previously read by the participants. The preliminary set of 100 was comprised of headboat samples collected between the years 1987 and 2003 and ranged in ages 1 to 6. Results were analyzed and discrepancies in ages and edge type were resolved. Both Mike Burton and Erick Ault had previous experience with mutton snapper aging, while both Janet Tunnell and Laura Crabtree were experienced in reading otoliths from four other snapper species.

After aging criteria was agreed upon, we independently read an additional 408 mutton snapper otoliths sampled during the years 2000-2003. The calibration set as a whole was comprised of commercial and recreational fisheries samples collected throughout the calendar year and ranging in ages 1 to 25. The characterization of the calibration set is illustrated in Figure 1. Since no readers from the FWRI Keys lab were available for the workshop, a 20% sub sample of FWRI Keys lab otoliths were read by J. Tunnell for agreement and error calculation.

Otoliths were aged using a stereomicroscope and either transmitted or reflected light. Age data was entered into a spreadsheet for analysis. Annulus count, edge type and capture date were used to estimate the age of a fish based on a January 1st birth date. The first annulus was defined as an opaque band occurring between 450 and 1150 um when measuring from the core along the ventral edge of the sulcus (Figure 2). The nature of the first annulus (Figure 3) ranges from a close opaque ring that seems to merge with the core (late spawned fish), to a ring further from and completely separated from the core (early spawned fish). Three different classifications for edge type were used. Otoliths with an annulus on the margin of the section are classified as edge type 2. Otoliths with an edge type 4 have a translucent marginal zone up to 2/3 complete. Otoliths with an edge type 6 have a translucent marginal zone greater than 2/3 complete. The age of a fish with an edge type 2 or 4 is equal to the number of annuli. The age of a fish caught prior to June 1st with an edge type 6 is equal to the number of annuli plus 1. The age of a fish with edge type 6 caught after June 1st, is equal to the number of annuli.

Average percent error (APE) and Percent Agreement (PA) were calculated as indices of precision and accuracy (Campana, 2001). An APE of 5%, the standard for previous snapper studies (Allman, 2004), was the goal of this exercise. Paired reader age bias plots were examined for variability.

Results and Discussion

The discussion surrounding the workshop and training set seemed to provide clarification and a basis for aging mutton snapper. Initially, APE and PA for all readers was 6.89% and 72% respectively, with 99% agreement within 1 year of age. No reader bias was apparent. 46 out of 47 discrepancies were resolved as a group.

Opaque band deposition throughout the calibration set occurred by June. The APE for all readers and all slides was 6.47% (Table 1). Paired APE ranged from 1.57% to 7.71%. The Percent Agreement between readers was 70.8% and 98.4% within 1 year of age (Table 2). Readers agreed within 2 years of age for all samples. Paired reader bias plots (Figure 4) showed a bias in the paired readings where “MB” was a variable. In these scenarios, “MB” aged up to 1 year less in comparison to all other readers. There was a high level of agreement between all other readers.

The highest level of disagreement occurred between “LC” and “MB.” The slightly higher ages of otoliths read by "LC" compared to "MB" was most likely due to the interpretation of the first annulus. Of the 235 ages where the two readers differed, 206 discrepancies were due to 1st annulus interpretation, and 29 due to margin and/or 1st annulus interpretation. It is the late spawned fish with a close first annulus that sparked the most debate. In conclusion, an under-aging bias of MB due to 1st annulus interpretation is likely the cause of the relatively high APE. An error correction will be applied to the age- length model to adjust for potential age bias.

The APE and PA for J. Tunnell versus the FWRI Keys lab was 0.54% and 94% respectively, well below the APE benchmark of 5%. Likewise, the APE and PA were acceptable between FWRI St. Pete and FWRI Tequesta. Therefore, the Keys and Tequesta Independent age data is compatible with the FWRI St. Pete age data.

References

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Table 1 Average Percent Error between readers.

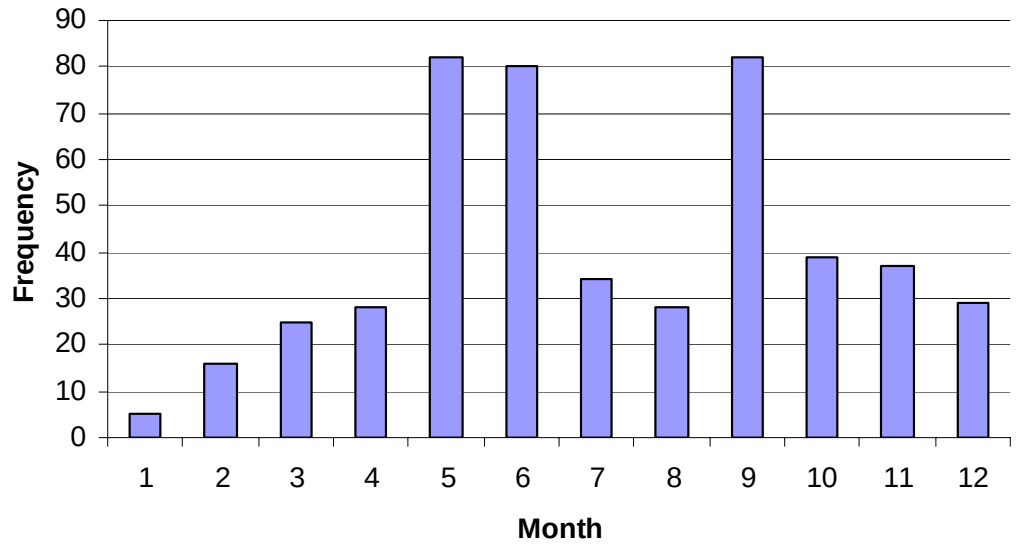
	MB:LC	MB:JT	MB:EA	LC:JT	LC:EA	JT:EA	All readers
Preliminary 100	6.13%	6.16%	6.14%	3.69%	4.52%	2.65%	7.02%
200-500	7.71%	5.97%	6.59%	2.47%	2.24%	1.57%	6.33%
All slides	7.38%	6.01%	6.50%	2.72%	2.71%	1.79%	6.47%

Table 2 Percent Agreement between readers.

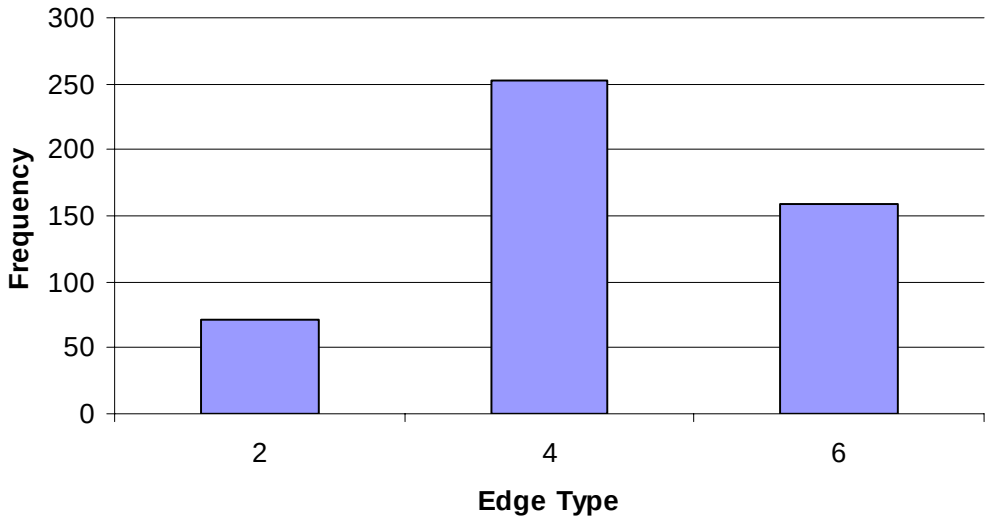
		MB-LC	MB-JT	MB-EA	LC-JT	LC-EA	JT-EA	All Readers
Preliminary 100	+/- 0 yrs	56.6%	61.0%	60.0%	79.8%	72.7%	83.0%	68.8%
	+/- 1 yr	100.0%	100.0%	98.0%	98.0%	98.0%	100.0%	96.9%
200-500	+/- 0 yrs	50.1%	61.7%	58.9%	82.9%	84.9%	89.7%	71.3%
	+/-1 yr	96.4%	96.9%	96.4%	99.7%	99.7%	100%	98.2%
All slides	+/- 0 yrs	51.4%	61.5%	59.1%	82.3%	82.4%	88.3%	70.8%
	+/- 1 yr	97.1%	97.5%	96.7%	99.4%	99.4%	100%	98.4%

Figure 1. Characteristics of mutton snapper calibration set (a) sample size by month, (b) frequency of edge type, and (c) age frequency relative to other studies.

(a)



(b)



(c)

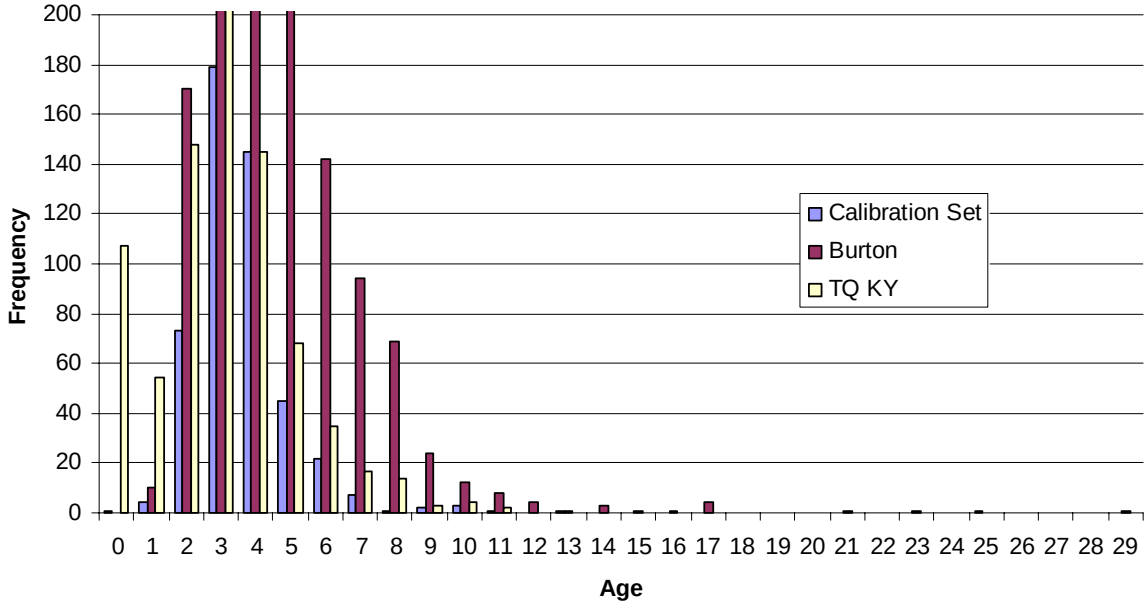


Figure 2: Placement of the first and second annulus in mutton snapper otoliths.

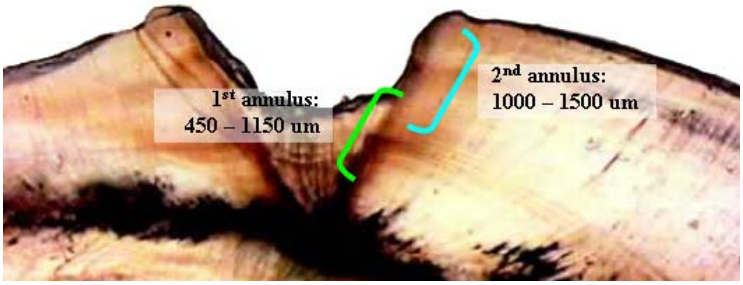
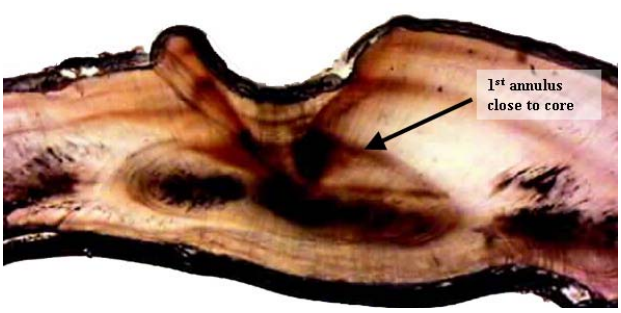


Figure 3: Nature of the first annulus in mutton snapper otoliths.



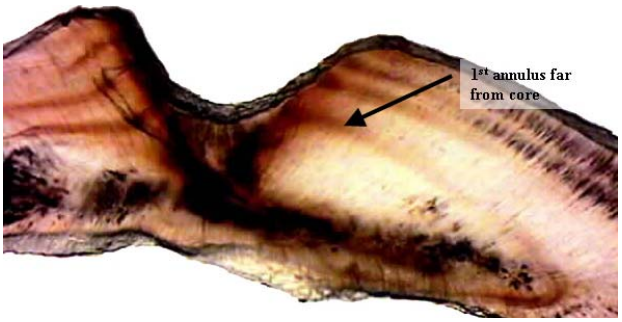


Figure 4. Reader age bias plots. Error bars are +/- 1 standard deviation.