

**Use of MARMAP Age Compositions in SEDAR-25 – Methods of Addressing Sub-Sampling Concerns
from SEDAR-2 and SEDAR-17**

Joseph C. Ballenger, Marcel Reichert, and Jessica Stephen

SEDAR25-RW07

Date Submitted: 4 August 2011



Use of MARMAP Age Compositions in SEDAR-25 – Methods of Addressing Sub-Sampling Concerns from SEDAR-2 and SEDAR-17

Joseph C. Ballenger, Marcel Reichert, and Jessica Stephen
South Carolina Department of Natural Resources
Marine Resources Research Institute
217 Fort Johnson Road
Charleston, SC 29412

Abstract:

Two issues concerning MARMAP age data were recognized in previous SEDAR assessments: 1) the sub-sampling of available life history samples for age determination and 2) the sub-sampling of the MARMAP total catch for the collection of life history samples. Issue one was first recognized in the SEDAR-2 benchmark assessment of black sea bass and precluded the use of MARMAP age composition data in the assessment model. Issue two was recognized during SEDAR-17 on vermilion snapper. In preparation for the SEDAR-25 black sea bass assessment, MARMAP alleviated the first concern by obtaining ages for all fish not initially aged from 1982 to 1998, re-aging many of the samples provided for SEDAR-2, and aging all samples collected from 1999 to 2010. Thus, in SEDAR-25 there was no sub-sampling of available life history samples for age determination. To address the second issue, we used the length frequency composition and the proportion of each age in each length bin for each year to correct for the non-random sampling of MARMAP Chevron trap catches. This provided non-biased estimates of the Chevron trap age compositions for the years 1990-2007. No such correction was needed for the years 2008-2010 as the MARMAP total catch was sub-sampled randomly for age determination during this period. Finally, during the period blackfish/Florida Antillean traps (1981-1987) were used to collect MARMAP data, there was no consistent sub-sampling strategy for the collection of life history samples from the total catch. Thus, the technique used to correct the age compositions of Chevron trap catches was not appropriate. However, the 1983 age compositions were valid because MARMAP collected age data from all black sea bass captured that year. As a result, the data workshop recommended the use of the blackfish/Florida Antillean trap age composition from 1983 in the assessment model.

SEDAR-25 Estimation of Age Compositions for MARMAP Fishery-Independent Samples:

Black sea bass is one of four snapper-grouper complex species (the others being vermilion snapper, red porgy, and gray triggerfish) for which MARMAP sub-samples the total catch for the collection of life history data. This is due to the abundance of these specimens in Chevron trap collections. In addition to the sub-sampling of total catches for life history studies, MARMAP non-randomly sub-sampled the available otoliths for age determination prior to the SEDAR-2 benchmark assessment of black sea bass. Thus, for the SEDAR-2 assessment, MARMAP had age data available that were collected from a non-random sub-sample of life history data, which in turn was based on a sub-sample of total MARMAP catches. During SEDAR-2, this led to concerns regarding the adequacy of age compositions based on this data (see SEDAR-2 Assessment Report for details). In the end MARMAP age compositions were not used in the parameterization of the assessment model.

Since SEDAR-2, MARMAP has subsequently addressed the (non-random) sub-sampling for aging from its larger life history data set during the period 1982-1998. This was accomplished by retroactively aging all otoliths collected by MARMAP for life history studies that were not initially aged. In addition, based on the results of the black sea bass aging workshop (SEDAR-25-RD41), many specimens from 1978-1998 were re-aged in order to assign edge codes to facilitate the conversion from increment count to calendar ages for use in the SEDAR-25 assessment model. Beyond these samples, all otoliths collected for life history studies from 1999-2010 were aged and assigned edge codes for the determination of calendar ages. All ages were determined using the techniques described in the black sea bass aging workshop report (SEDAR25-RD41). This resulted in the ages of more than 52,000 MARMAP black sea bass age samples being available for SEDAR-25.

Because there was no sub-sampling of MARMAP life history samples for age determination in SEDAR-25, the original concerns leading to the exclusion of MARMAP age data in the development of age compositions for the assessment model in SEDAR-2 have been alleviated. This allows the valid use of MARMAP age data in the development of age compositions in SEDAR-25.

Since then, it was also recognized in SEDAR17 that non-random sub-sampling from the MARMAP total catch (i.e. the selection of specimens retained for life history studies) needed to be accounted for when developing age composition indices for black sea bass, vermilion snapper, red porgy and gray triggerfish. The MARMAP methodology between 1990 and 2007 included sub-sampling the MARMAP Chevron trap total catch for life history studies by latitude degrees and cm length class for the purpose of constructing an age length key. The sub-sampling methodology for all latitudes except 32° N involved retaining the first 15 fish per each one cm length class per latitude for age, growth and reproductive analyses. Once the number of fish in a one cm length bin was met, no further fish were retained for that length class during the remainder of the season. Sub-sampling within the 32° N latitudes was different due to a higher sampling effort in this latitude, and consisted of retaining the first 5 fish per each one cm length bin per sampling trip (5-6 trips/year; each trip was 2-9 days). From 1990-2007, this sub-sampling regime resulted in MARMAP retaining 15-43% of the total number of black sea bass collected in Chevron traps for life history studies (age/growth and reproduction).

The following was done to correct the age composition for the non-random sub-sampling in the years 1990-2007 to obtain corrected age compositions for the MARMAP chevron trap index:

1. Each collection was assigned to a cruise in year t
2. For each year, the following were calculated:
 - a. Number of total fish captured by 1 cm length bin (LF) i
 - b. Number sub-sampled for age-growth by 1 cm length bin i (AG)
 - c. Calculated the ratio between AG and LF by year per length bin, using the following equation:

$$R_{i,t} = \frac{AG_{i,t}}{LF_{i,t}},$$

where R is the observed ratio, $AG_{i,t}$ is the number sub-sampled for age-growth by 1 cm length bin i and year t , and $LF_{i,t}$ is the number of fish captured in chevron traps by 1 cm length bin i and year t . This ratio provides an estimate of the percent of individuals in each 1 cm length bin retained for age-growth analysis each year, which is used to facilitate an expansion of age classes appropriately.

- d. For each year t and length bin i combination, the number of fish per age class were counted ($N_{a,i,t,org}$). This provided an estimate of the number at each age within each 1 cm length bin i during each year t (i.e. a year specific age-length key).
3. The new number of fish per age class was then estimated using the following equation:

$$N_{a,i,t,new} = \frac{N_{a,i,t,org}}{R_{i,t}},$$

where $N_{a,i,t,new}$ is the upwardly adjusted numbers at age a in length bin i and year t . Thus, providing a corrected estimate of the number of fish per age class a in length bin i and year t .

4. Finally, we summed together the numbers at age across each length bin i to obtain a total estimate of numbers at age a in year t :

$$\widehat{N}_{a,t} = \sum_{i=0}^{i=max} N_{a,i,t,new}.$$

5. These values were subsequently used to create a corrected age composition for each year.

In effect, this means that for each year, we used the length frequency composition and the proportion of each age in each length bin to correct for the non-random sampling of MARMAP Chevron trap catches. This is similar to the technique used to correct MARMAP Chevron trap age compositions for the years 2002-2007 in the SEDAR-17 assessment of vermilion snapper.

In the years 2008-2010, no such correction was needed for the age compositions as black sea bass retained for life history studies were randomly selected from the total MARMAP Chevron trap catches. Thus, age compositions calculated from this random sample should accurately represent the age composition captured via Chevron traps.

Finally, in the development of age compositions of blackfish/Florida Antillean traps, the data workshop recommended to use age composition data available from the year 1983 only. This is because no consistent non-random sub-sampling method was used during this period. Instead, the MARMAP total catch sub-sampling strategy varied within sampling years and from year to year depending on the stated goal of a respective cruise. The reason was that at that time, life history studies were not a consistent, routine part of the MARMAP scope of work. However, the age composition data from 1983 are valid, as all fish captured via blackfish/Florida Antillean traps were aged that year.