



Update on the length and age distribution of SBT in the Indonesian longline catch

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1 Abstract

This paper updates previous analyses of SBT length and age data from the Indonesian longline fishery operating out of the port of Benoa, Bali. Length-frequency data are presented for 20 spawning seasons (1993/94 to 2012/13) and age frequencies for 18 seasons (1993/94 to 2011/12, but excluding 1995/96). This year, ageing of 500 otoliths collected in the 2011/12 season was not undertaken and thus it was not possible to build a direct age-length-key (ALK) for the season. To estimate the age distribution of the catch, we developed an ALK using the direct age data for the two preceding spawning seasons (2009/10 and 2010/11) and applied it to the 2011/12 length frequency data.

As noted in previous reports to CCSBT-ESC, considerable change has occurred in the size and age distribution of SBT landed by the Indonesian longline fleet since monitoring began. In summary:

- 1) **Length distribution:** Between 1993/94 and 2002/03, the mean size of SBT landed declined from 188.1 to 166.8 cm fork length (FL), and it has fluctuated between 168.3 and 171.0 cm FL since that time. In the latest season, however, the mean length of SBT was only 162.1 cm FL. This is the lowest since monitoring began. Although a large proportion of fish ranged between 150 and 190 cm FL, 23.6% of fish were < 150 cm FL. In previous seasons, less than 2.6% of fish were < 150 cm FL. When the data were examined by month, 74.9% of the small (<150 cm) fish were landed in October and November 2012. The mean size of fish landed after November was only slightly below the mean size for the same time period in previous seasons. Investigations are in progress to determine whether the small SBT landed were caught on or south of the SBT spawning ground, and whether they can be considered part of the SBT spawning population.
- 2) **Age distribution:** Similarly, the mean age of SBT landed by Indonesia declined between the late 1990s and early 2000s from ~20 years to ~15 years old. In 2011/12 (the latest season we have data for), the mean age was 16.0 years. Although the mean age of SBT has been relatively stable since the 2001/02 season, there appears to be a decline in the average age of SBT ≥ 20 years. This may be driven by a general increase in the proportion of 20-30 year-olds in the catch, rather than a decline in very old age 30+ SBT (Fig. 6).

2 Introduction

Southern bluefin tuna spawn from September to April in an area between Indonesia and the northwest coast of Australia (Farley and Davis, 1998). An Indonesian-based longline fishery operates on this spawning ground year-round targeting yellowfin and bigeye tuna, with a bycatch of SBT. Obtaining an accurate estimate of the size and age composition of SBT landed by the Indonesian longline fishery is vital for population modeling and stock assessments, and to monitor changes in the spawning population over time.

Since the early 1990s, the size and age structure of the SBT spawning population has been monitored through a series of collaborative research programs between CSIRO, Indonesia's Research Centre for Capture Fisheries (RCCF) and Research Institute for Marine Fisheries (RIMF), the Indian Ocean Tuna Commission (IOTC), and Japan's Overseas Fishery Cooperation Foundation (OFCF). The program monitors the catch of SBT by Indonesia's longline fleet operating on the SBT spawning ground in the north-east Indian Ocean. Initially, the program collected data on SBT landed at the port of Benoa in Bali, but in 2002 this expanded to include the ports of Muara Baru (Jakarta) and Cilacap (south coast Central Java), and to comply with IOTC protocols. The majority of targeted SBT sampling, however, still occurs at Benoa, as this is the port where the bulk of SBT are landed.

The collection of such large quantities of length frequency data, and the development of validated methods to directly age SBT using the otoliths sampled, have allowed us to accurately estimate the age composition of the Indonesian catch. These data have shown that the parental stock of SBT has undergone substantial changes since monitoring began; the greatest change being a shift in the mode of SBT caught from 18-22 years in the mid-1990s to 12-15 years in the early-2000s.

In this paper we update the information given in Farley et al. (2012) by including the most recent length and age data available for the Indonesian fishery. Length frequency data are presented up to the 2012/13 season and age frequency data up to the 2011/12 season. The data provided to the CCSBT in the data exchange process included the estimated size and age distribution of the whole Indonesian SBT catch, and were not divided into those caught on or south of the spawning ground.

3 Methods

As in previous years, targeted sampling of SBT occurred at the Port of Benoa. Length measurements were obtained for 1373 SBT in the 2012/13 spawning season (Table 1).

Direct ageing of a subsample of 500 otoliths was not undertaken this year (due to funding restrictions) and thus it was not possible to build a direct age-length-key (ALK) for the season. However, to estimate the age distribution of the catch for 2011/12, we developed an ALK using the direct age data for the two preceding spawning seasons (2009/10 and 2010/11). The ALK gives the proportion of fish at age in each 5-cm length class, which enabled us to infer the age-frequency distribution of the catch from the 2011/12 length-frequency distribution. Using age-length data from two seasons, rather than one, reduced the issue of 'missing rows' where no ages were available for some length classes if only one season's data were used.

Previously, the iterative ALK method of Kimura and Chikuni (1987) was investigated (see Farley et al., 2011). That method accounts for situations where ALK's from one year are being applied to length frequency data collected in a different year. However, the age distribution obtained using that method for previous seasons (2007/08 and 2008/09) contained large 'spikes' for some ages, which were not consistent with previous seasons. This was primarily due to low sample sizes, or no samples, for some ages and the fact that age classes cannot be grouped together because of the catch-at-age data requirements of the operating model. Given this, the standard ALK method seemed more appropriate in the current circumstance.

4 Results and Discussion

4.1 Length distribution

Figure 1 shows the length frequency distributions for SBT caught by the Indonesian longline fishery by season. The data are separated into those caught on and those caught just south of the spawning ground (see Farley et al., 2007). SBT caught south of the spawning ground are not included in our examination of the size/age distribution of the spawning population as it is unknown if these southern fish were capable of spawning.

As noted in previous reports to CCSBT-ESC, considerable change has occurred in the size distribution of SBT caught on the spawning ground since monitoring began. In the mid- and late-1990s, the majority of SBT caught were between 165 and 190 cm FL with a median length of ~180 cm (Figure 1). In the early-2000s, the relative proportion of small SBT (<165 cm) in the catch increased (Figure 2). The mean size of SBT caught declined from 188.1 to 166.8 cm between 1993/94 and 2002/03, and remained between 168.3 and 171.0 cm until 2012/13 (Table 1).

In 2012/13, the mean length of SBT caught was 162.2 cm FL, the lowest since monitoring began (Table 1; Fig. 3). The size frequency of SBT appears bimodal with peaks at ~146 cm and ~170 cm FL (Fig. 1). Although a large proportion of fish ranged between 150 and 190 cm FL, 23.6% of fish were < 150 cm FL (Fig. 1; Fig. 2). In previous seasons, less than 2.6% of fish were < 150 cm FL. When the data were examined by month, 74.9% of the small (<150 cm) fish were landed in October and November 2012. The mean size of fish landed after November (165.8 cm FL) was only slightly below the mean size for the same time period in previous seasons (Fig. 3). Investigations are in progress to determine whether the small SBT sampled were caught on

