Updated report of direct ageing of the SBT caught by Taiwanese longliners in recent 5 years

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Otolith ageing technique was often used to understand the fish growth. To do that, age and size data collected from numerous fish individuals were fitted to a growth equation such as von Bertalanffy growth equation to estimate the growth parameters of the fish. Taiwanese observers started to collect SBT otoliths on the longline vessels in the Indian Ocean since 2003. The SBT otoliths collected by the scientific observers were sent to my lab in National Taiwan University where the samples were processed and the otolith ages were determined according to the ageing manual (Anonymous 2002) with some modifications mentioned in Shiao et al. (2017). The otolith ageing data of the SBT collected in 2003-2005 (n = 495) predominantly ranged from age 3 to 7, with very few otoliths collected from the SBT > 10 years and no otolith collected from the SBT < 2 years (Shiao et al. 2008). So far we have accumulated SBT ageing data from more than 2000 individuals although the data collected from young (< 2 years) and old (> 10) fish were still limited. The otolith ageing data together with the sampling information of the SBT were submitted to CCSBT every year to fulfill the data exchange requirements. The SBT ageing data collected from Taiwanese longline fishery together with the ageing data collected by other CCSBT members can be used to analyze the growth of the SBT.

Fish demography (or age compositions) provides useful information to understand the fish population dynamics. A reliable estimation of fish demography relies on enough ageing data that are randomly collected from the fish at different sizes and the sampling locations that can represent or cover the major fishing grounds. According to our recent study, 500 otoliths randomly collected from the fishery will be adequate for a reliable estimation of Pacific bluefin tuna demography landing in Taiwanese fishing ports by using the method of age-length key (Chang et al. 2019). The SBT otoliths collected by Taiwanese observers were usually fewer than 100 pairs each year. Using the age-length key method (Shiao et al. 2017) to estimate the SBT demography caught by Taiwanese longliners, we had to combine the ageing data collected from several years to reach effective sample sizes. In this report, the age compositions of the SBT caught by Taiwanese longliners in 2015-2019 were presented. The age compositions of the total catch in 2015-2016 were estimated by using the same age-length key that was built

based on 1794 ageing data of the SBT collected before year 2017. The age-length key gives the proportion of ages for each 10 cm fork length interval. The estimated age compositions in 2015-2016 shows highly consistent patterns with the dominant catch of the SBT at age 2-6 years while the SBT > age 7 was very few. However, the fork-length distribution of total catch varied between year 2015 and 2016 (Fig. 2). Therefore, applying the same age-length key to estimate the age compositions across years cannot reveal the real population dynamics such as the strong or weak year cohort. To improve the estimation of the age composition of the total catch that can better represent the population dynamic of the SBT, a year specific age-length key is necessary.

Since year 2018, we started to collect the otoliths samples from the SBT caught in 2017 and landed in Taiwanese fishing port. We bought a paired of head sections that contained the basi-occipital plates (located at the junction of the skull and first vertebra) from the tuna processing factories in Kaohsiung harbor, Taiwan. Each paired of head sections together with a plastic tag clamped on the fish at catch were sent to my lab where the otoliths were extracted and the ages were determined (Fig. 3). The ID number on the tag allows us to retrieve the biological and sampling information of each SBT sampled for the otolith from the catch documentation scheme database. Combing the otoliths collected by the scientific observers on longline vessels and the samples from the factories, the sample sizes were roughly enough to develop a year specific age-length key for the samples collected in 2017 (N = 342) and 2018 (N = 368). However, the sample sizes collected in 2019 (N = 161) were still not enough to build an effective age-length key. Therefore, we combined the ageing data of the SBT caught in 2018-2019 to build another age-length key for the estimation of the SBT age composition in 2019. The estimated age compositions in 2017 and 2018 showed predominant catch of the SBT at the age between 3-5 years (approximately 75-80%). The 3-year-old fish was the most abundant age class with approximately 40% in 2018 (Fig. 1). These results were different from age composition in 2015-2017, which showed the highest age class at 4-year-old fish. This disparity between 2014-2016 and 2017-2019 was due to the sampling bias and different age-length keys used to convert length frequency to age composition. It was worth to note that ageing data were too few for the fish of ages 5 and 6 in 2017 and the fish > age 7 in 2018, which would lead to underestimation the curtained age classes. However, the proportion of the SBT at age 7 in 2019 were likely overestimated due the sampling bias.

To improve the reliability of the age-length key method, we planned to collected

more otoliths (> 500) from the tuna processing factories in Kaohsiung harbor. However, due to the COVID-19 outbreak in the February 2020, the tuna consumption was largely reduced and the otolith sampling plans both from tuna processing factories and observer system were severely impeded. Due to the insufficient sample size, we still need to pool ageing data across years for the estimation of the age compositions. Nevertheless, the successive 5 years data suggested that the SBT caught by Taiwanese longliners were mainly the fish of age 3-5 years.

Reference

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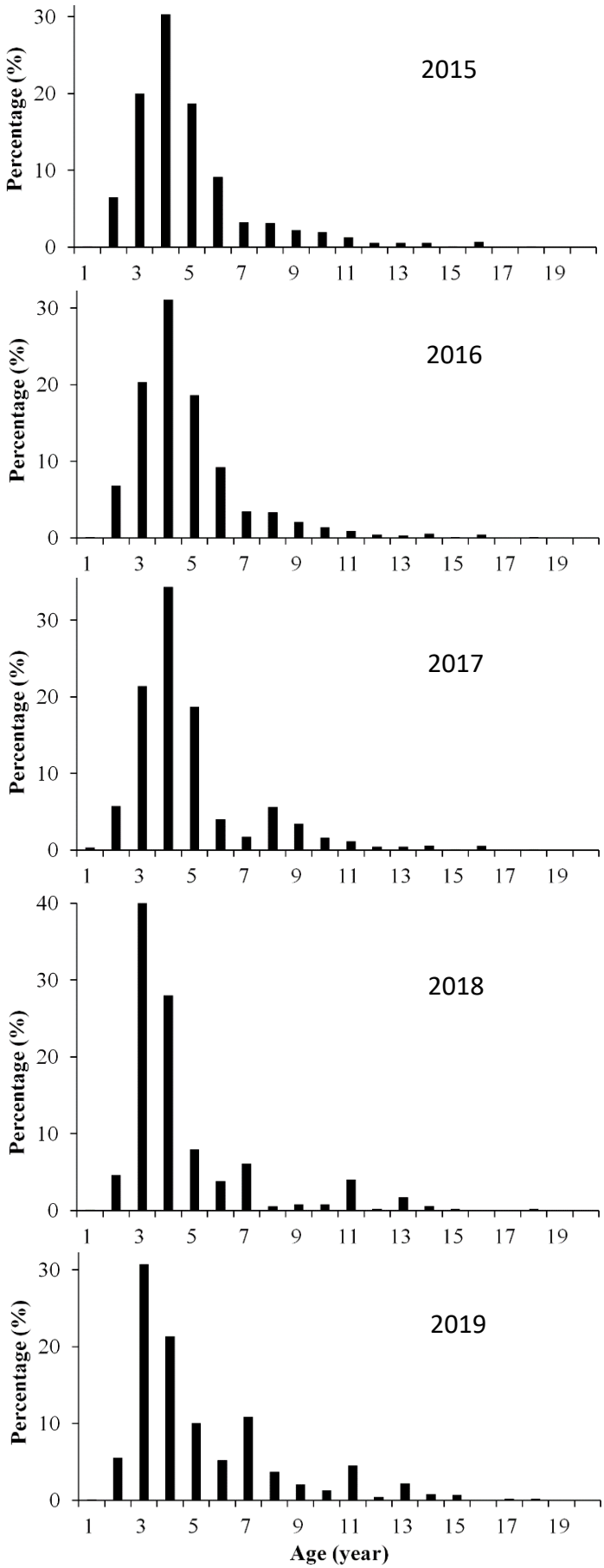

Figure 1. The estimated age composition of the total catch by Taiwanese longliners in 2015-2019.

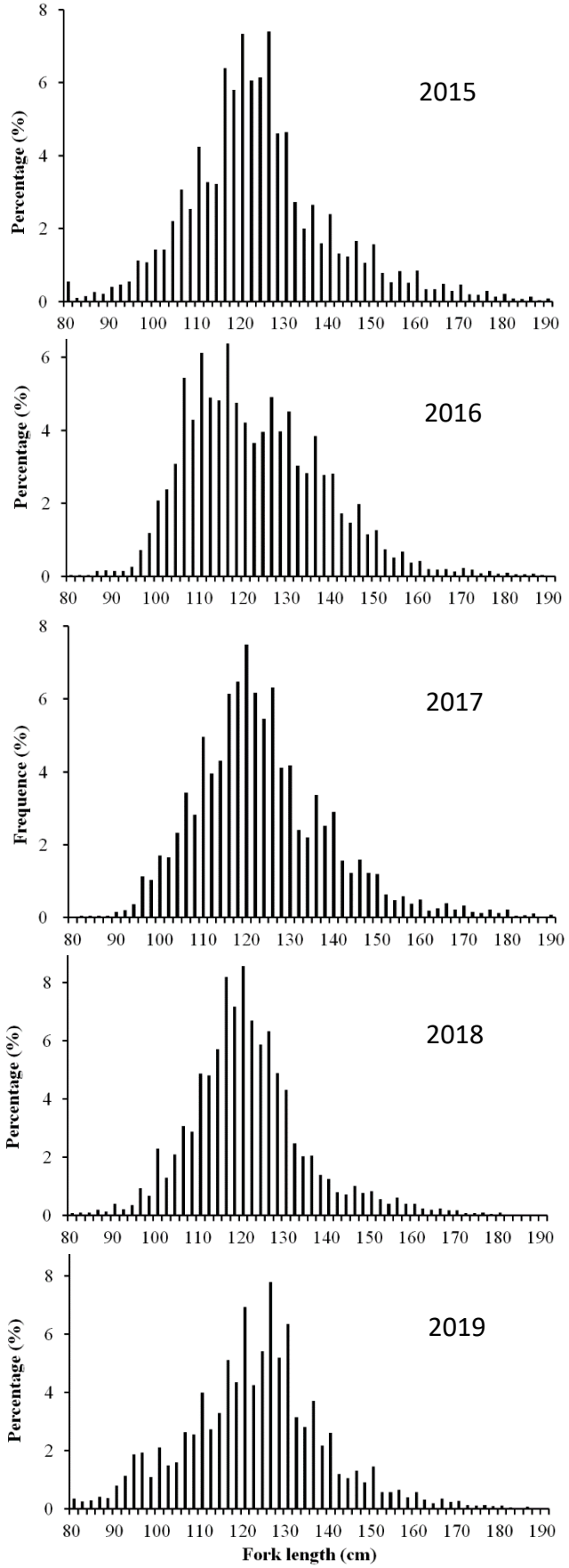

Figure 2. The length distribution of the total catch by Taiwanese longliners in 2015-2019.

Figure 3. A SBT head section that contained the basi-occipital plates. The sagittal otolith has been removed from the otic chamber pointed by the forceps. A plastic tag printed with the ID number of the fish was used to find out the biological and sampling information from the database.