Comparison of length compositions from Taiwan longline, Japan pole-and-line, and U.S. longline fisheries[1]

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ABSTRACT
Our objective in this study is to compare the length compositions of the Taiwan longline early (TWLL-1) and late periods (TWLL-2), Japan pole-and-line (large fish) (JPPL), and the US swordfish-targeting longline (USLL) fisheries. Overall length compositions were derived for these four fisheries using a variety of data sources, including logbooks, observers, and port sampling. As has been previously observed, the length compositions for TWLL-1 and TWLL-2 were relatively dissimilar. However, the USLL had a similar length composition to TWLL-2, indicating that TWLL-2 has relatively representative length compositions for that period. However, neither JPPL nor USLL had relatively similar length compositions to TWLL-1. Therefore, mirroring the selectivity of TWLL-1 to JPPL or USLL may not be ideal. If the ALBWG considers the TWLL-1 length compositions to be relatively representative of the albacore caught by the Taiwan longline fishery during that period, it may be more appropriate to use the 'superyear' concept to estimate a selectivity curve from the length compositions.

INTRODUCTION
The albacore working group (ALBWG) of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) reviewed the length composition data of the Taiwan longline fishery during a data preparation meeting at La Jolla, California in October 2010. After a lengthy discussion, the ALBWG concluded that length composition data from several years (1995, 1999, 2000, 2002) were not representative of the fishery in terms of spatial and temporal scope (the size data from these years were derived from a restricted area and time period as compared to the actual fishery) (Anonymous, 2010). Therefore, the ALBWG agreed to not use data from these years for the upcoming stock assessment in Spring 2011. In addition, length composition data were not available for the Taiwan longline fishery for 2001 nor the historical period 1966-1994. Therefore, length compositions for this fishery were available for two periods: early (1996-1998) and late (2003-2008) periods.

The ALBWG found that the length compositions during the early period were qualitatively different from the late period (Anonymous, 2010). The early period had higher proportions of smaller fish and the length compositions were highly variable. In contrast, the modes during the late period were relatively stationary and the fish were relatively larger. The ALBWG concluded that the length composition data from the late period are relatively representative of the current Taiwan longline fishery. In addition, the differences in length compositions between the early and late periods appear to be consistent with changes in targeting behavior of the Taiwan longline fleet. However, the ALBWG also thought that length compositions in the early period may be too sparse and too variable to estimate a good selectivity curve in SS3.

Two alternatives were proposed to deal with the length composition and selectivity issues in the early period: 1) aggregate length compositions for all early period years to form a "super-year" length composition, and 2) compare the length compositions of Taiwan longline with the Japan pole-and-line (large fish, Fishery 4) and US swordfish-targeting longline fisheries, and mirror the selectivity of the early period Taiwan longline fishery to one of these fisheries if length compositions are similar (Anonymous, 2010). In this study, our objective is to compare the length compositions of the Taiwan longline early (TWLL-1) and late periods (TWLL-2), Japan pole-and-line (large fish) (JPPL), and the US swordfish-targeting longline (USLL) fisheries and suggest if it is appropriate to mirror the selectivities of these fisheries.

MATERIALS AND METHODS

Quarterly length compositions for the Taiwan longline fishery, in 1-cm bins and number of fish, were derived from onboard length measurements of albacore collected by the Overseas Fisheries Development Council (OFDC) Taiwan, as described by Chen et al. (2010a). We subsequently divided the data into early (1996-1998) and late (2003-2009) periods for the TWLL-1 and TWLL-2 fisheries respectively.

Quarterly length compositions (1994-2009) for USLL, in 1-cm bins and number of fish, were derived from length measurements of albacore collected by onboard observers, as described by Teo et al. (2010b). We assumed that US longlines set north of 30°N were primarily targeting swordfish, which was previously shown to be a reasonable assumption (Teo, et al., 2010a). Only the data from north of 30°N were included in this study.

For the JPPL fishery, catch data were based on vessel logbooks and lengths of albacore were measured at landing ports or onboard. Quarterly length compositions (1968-2009) for JPPL, in 1-cm bins and number of fish, were derived from the lengths and catch data, as described by Matsumoto (2011). These quarterly length compositions are the catch-at-size data rather than raw length frequencies in Matsumoto (2011).

The overall length compositions for each 'fishery' (TWLL-1, TWLL-2, USLL, JPPL) were derived by summing the data from all quarters without weighting. Subsequently, we calculated the proportions and cumulative proportions of fish in each bin for each fishery.

RESULTS AND DISCUSSION

As noted previously by the ALBWG, there were clear differences in the overall length compositions from TWLL-1 and TWLL-2 (Fig. 1). The albacore from TWLL-2 were generally larger than fish from TWLL-1. The overall length composition from TWLL-2 appeared to be relatively similar to that of the USLL fishery (Fig. 2). This suggests that the USLL fishery would be more suitable as a mirror for the selectivity of the TWLL-2 fishery rather than the TWLL-1 fishery. In particular, the descending limb of the USLL length composition appeared to be 5-10 cm larger than that of the TWLL-1 fishery (Fig. 3).

Relative to the USLL fishery, the JPPL fishery length composition appeared to be more similar to the TWLL-1 fishery (Fig. 3 & 4). However, there were also clear differences between the overall length compositions of JPPL and TWLL-1. In comparison with the JPPL fishery, the TWLL-1 length compositions have a higher proportion of smaller fish (~50-70 cm) but a lower proportion of medium-sized fish (~70-85 cm) (Fig. 3). These differences remained apparent even if we only use data from 1996-1998 for the JPPL fishery (Fig. 5). Interestingly, the length composition of the USLL when only 1996-1998 data were used was relatively similar to when the entire dataset was used.

Overall, neither USLL nor JPPL length compositions are highly similar to TWLL-1 length compositions, even though the fishing areas overlap (Chen, et al., 2010b; Matsumoto, 2011; Teo, et al., 2010a). In contrast, USLL length compositions are similar to TWLL-2 length compositions, which suggest that TWLL-2 length compositions are relatively reliable. Therefore, mirroring the selectivity of TWLL-1 to JPPL or USLL may not be ideal. If the ALBWG considers the TWLL-1 length compositions to be relatively representative of the albacore caught by the Taiwan longline fishery during that period, it may be more appropriate to use the 'superyear' concept to estimate a selectivity curve from the length compositions.

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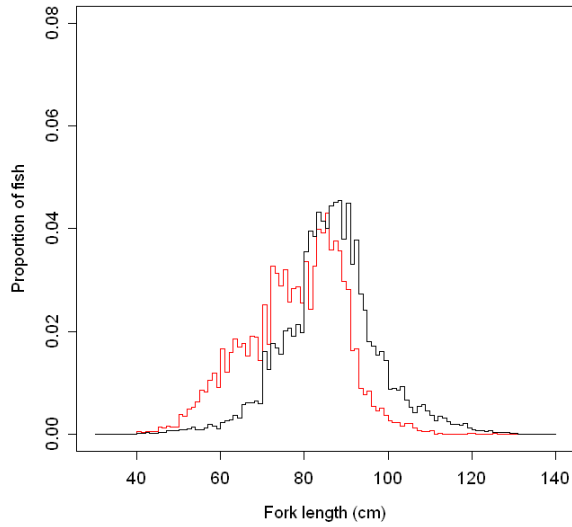
Figure 1. Overall length compositions of Taiwan longline fishery from the early (1996-1998, TWLL-1) (red) and late (2003-2009, TWLL-2) (black) periods.
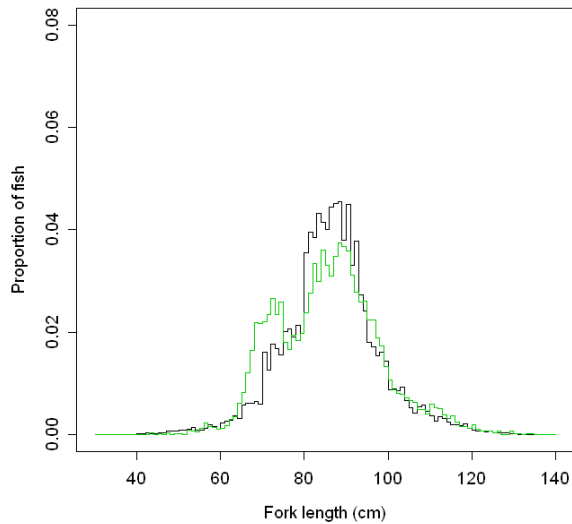

Figure 2. Overall length compositions of Taiwan longline fishery from late (2003-2009, TWLL-2) period (black) and the US longline fishery north of 30°N (USLL, 1994-2009) (green).
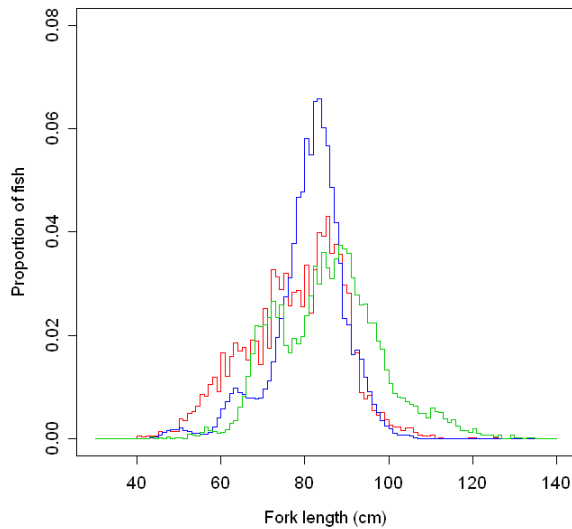

Figure 3. Overall length compositions of Taiwan longline fishery from the early (1996-1998, TWLL-1) period (red), the US longline fishery north of 30°N (USLL, 1994-2009) (green), and Japan pole-and-line fishery (large fish, JPPL) (blue).
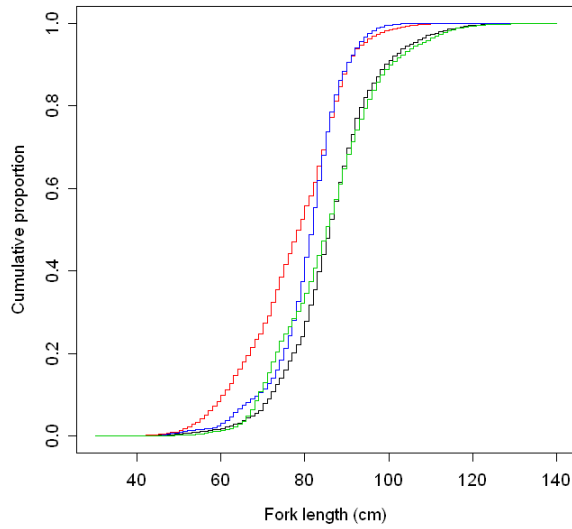
Figure 4. Cumulative proportions of Taiwan longline fishery from the early (1996-1998, TWLL-1) (red) and late (2003-2009, TWLL-2) (black) periods, the US longline fishery north of 30°N (USLL, 1994-2009) (green), and Japan pole-and-line fishery (large fish, JPPL) (blue).
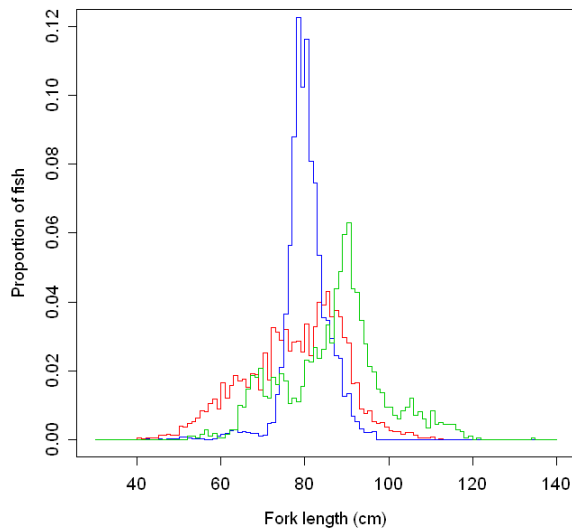

Figure 5. Overall length compositions of Taiwan longline fishery from the early (1996-1998, TWLL-1) period (red), the US longline fishery north of 30°N (USLL, 1996-1998) (green), and Japan pole-and-line fishery (large fish, JPPL, 1996-1998) (blue).