Input data of Pacific bluefin tuna fisheries for stock assessment model, Stock Synthesis 3; Update for 2016 assessment

Osamu Sakai, Shuya Nakatsuka, Yukimasa Ishida, Kazuhiro Oshima, and Hiromu Fukuda,

National Research Institute of Far Seas Fisheries,
Fisheries Research Agency

5-7-1, Orido, Shimizu-ku, Shizuoka 424-8633, JAPAN

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Summary

Update of stock assessment for Pacific bluefin tuna (PBF) will be conducted in February-March 2016. Input data for PBF fisheries has been revised and updated. Fleet definition was modified to treat the size frequency adequately (e.g. definition of new fleet for Japanese troll for farming, combination of Japanese set-net fisheries, division of EPO commercial purse seine fisheries). Quarterly catch data were updated up to fishing year 2014 (up to June in 2015 calendar year). Some size frequency data were revised and updated using improved estimation method (e.g. Japanese troll and set-net). Abundance indices (CPUE) from Japanese longliners, Japanese troll, and Taiwanese longliners were updated up to the 2014 fishing year and the CPUE standardization methods for Japanese and Taiwanese longline were revised.

1. Introduction

Reported catches of Pacific bluefin tuna (PBF) have fluctuated substantially over time. The catch statistics of PBF have been compiled from the second half of the twentieth century by major fishing countries, which shows that the historical maximum and minimum total catches of calendar year are 40,383 t in 1965 and 8,653 t in 1990, respectively (Table 1, Fig 1). During the last 10 years, the average of annual catch is 19,863 t (in 2005-2014 calendar years). PBF is caught in the western and eastern side of Pacific Ocean (WPO and EPO) by many fishing countries, thus its stock is managed by both of the WCPFC and the IATTC. Initial goal of rebuilding plan adopted by the WCPFC is to recover to SSB_{MED} (42,592 t) by 2024 with at least 60% probability. Implementation and progress of this plan shall be reviewed based on the results of stock assessments and SSB projections to be conducted by the ISC (WCPFC 2014).

The ISC updated the 2012 full stock assessment with simple addition of two-year data and without changes of specifications of settings for stock assessment model in 2014. According to the updated assessment results, (1) the spawning stock biomass (SSB) in 2012 was near the historically low levels, slightly higher than that in 2010, (2) the recruitment level in 2012 was estimated to be relatively low, and (3) estimated age-specific fishing mortalities on the stock in the period 2009-11 relative to 2002-04 increased for age 0-6, and decreased for age 7+. The future projection results showed that only a strict harvest scenario—50% cut in catch of small fish (<30kg) from the 2002-04 average level and F no greater than $F_{2002\text{-}04}$ in WPO, and 50% cut in catches from 5500t in EPO— can result in an increase in SSB even under a low recruitment situation (re-sampling from the past low recruitments during the period from 1980 to 1989). Based on the assessment results and management advice from ISC, WCPFC and IATTC strengthened their conservation measures to be applied in 2015 (ISC 2015b).

The stock assessment model used in 2014 was unable to reconcile all key data sources. In particular, poor fit of two adult abundance indices (Japanese and Taiwanese longline CPUE) and their associated size composition were noted as the source of high uncertainty (ISC 2014). Some sensitivity analysis showed that one of the causes of the misfit to the abundance indices and size composition data was in the data conflicts among the input fishery data (Kumegai et al. 2015). To solve these issues, the member of ISC PBFWG have improved and prepared the input data, brushed up them through the discussion at the workshop of WG, and agreed to use them for the stock assessment scheduled in February-March 2016. This

document summarizes those updated input data as the data catalog for the stock assessment using the Stock Synthesis 3 model (SS3). This document is also corresponding to the draft of "Stock assessment input data" section in the stock assessment report.

2. Definition of fishing year

In the stock assessment for PBF, a "fishing year" is from July 1st of one calendar year through June 30th of the following calendar year. Thus, the 2014 fishing year corresponds to 1st July 2014 to 30th June 2015. Recruitment is assumed to occur at the beginning of "Season 1" of fishing year (starting from July; see section 4) in the assessment model. Relationships between calendar year, fishing year, and year class are shown in Table 2.

3. Spatial stratification of the input data

PBF are distributed across the North Pacific Ocean and considered a single stock. Juvenile PBF move between the WPO and the EPO (Itoh et al. 2003, Boustany et al. 2010), but incorporation of this movement process into the stock assessment model is difficult due to a lack of information of movement rates. Thus the stock assessment of PBF has not used a spatially explicit model, but assumed an instantaneously mixed population and incorporated regional selection patterns as "areas-as-fleets approach (Waterhouse et al. 2014)". A simulation study suggests that this approach enable to provide reliable values of management quantities without spatial stratification (Lee et al. 2015a).

4. Temporal stratification of the input data

The time period modeled in the assessment of PBF is 1952-2014 (fishing year), with catch and size composition data compiled quarterly as follows;

Season 1: July-September,
Season 2: October-December,
Season 3: January-March, and
Season 4: April-June.

Although fisheries catching PBF have been operated since at least the beginning of the 20th century in the EPO (Bayliff 1991) and for several centuries in the WPO (Itoh 1961), the detailed fishery statistics prior to 1952—especially from the WPO—were not available. Therefore, the fishing year 1952 has been chosen as the starting year of the current stock assessment because catch-and-effort data from Japanese longline and EPO commercial purse seine fleets were available from that year onward.

5. Fishery definition

A total of 16 fleets were defined for the stock assessment of PBF according to the gear type, seasonality of fishing, and size of fish caught (Table 3). Representative fisheries for each fleet are as follows;

Fleet 1: Japanese longline fisheries (JPLL),
Fleet 2: Japanese small pelagic fish purse seine fishery in the East China Sea (JPSPPS),

Fleet 3: Korean offshore large purse seine (KROLPS),

Fleet 4: Japanese tuna purse seine fishery in the Sea of Japan (JP TPSJS),

Fleet 5: Japanese tuna purse seine fishery off the Pacific coast of Japan (JP TPSPO),

Fleet 6: Japanese troll (JP Troll),

Fleet 7: Japanese pole and line (JP PL),

Fleet 8-10: Japanese set-net fisheries (JP SetNet),

Fleet 11: Japanese other fisheries (JP Others), mainly small-scale fisheries in the Tsugaru Strait,

Fleet 12: Taiwanese longline fishery (TWLL),

Fleet 13: Eastern Pacific Ocean commercial purse seine of USA (USCOMM),

Fleet 14: Eastern Pacific Ocean commercial purse seine of Mexico (MXCOMM),

Fleet 15: Eastern Pacific Ocean sports fishery (EPOSP), and

Fleet 16: Japanese troll fishery for farming (JP Troll for Pen).

Fleet 2 and 3 correspond to Japanese and Korean purse seiners for PBF of age 0-1 operated in the East China Sea and the western Sea of Japan. These purse seine fisheries were treated as a fleet in the previous assessment, but it was agreed to separate into different fleets during the intersessional PBF WG meeting (ISC 2015a). Both of Fleets 4 and 5 are Japanese tuna purse seine fisheries, but their fishing grounds are different; Fleet 4 operates in the Sea of Japan, whereas Fleet 5 operates off the Pacific coast of Japan. They were defined as separate fleets because of differences in the length composition of the catch (Abe et al. 2012). Both Fleet 6 and 16 are Japanese troll fisheries, but the catch at length of Fleet 16 is smaller than that of Fleet 6 because smaller fish are preferred for the fish farming. Thus the troll for farming and conventional troll are defined as the separate fleets (ISC 2015a). Fleets 8-10 are Japanese set-net fisheries, which are separated based on the availability of length or weight measurements and seasonal changes of size compositions; size composition of Fleet 8-9 is based on the length measurement data, whereas that of Fleet 10 is based on the weight measurement data. Fleet 8 includes the Season 1, Season 2, and Season 3 of the quarter of fishing year (Jul.-Sep., Oct.-Dec., and Jan.-Mar.). Fleet 9 includes the Season 4 (Apr.-Jun.), because there are substantial seasonal differences in length compositions (Sakai et al. 2015a). Most of catch for Fleet 11 of Japanese other fisheries (JP Others) come from the small-scale fisheries in the Tsugaru Strain such as handline and longline. Both Fleet 13 and 14 are purse seine fisheries in the EPO, but separated by the time period of before and after 2002: During the early period, US target fishery was dominant while Mexican fishery was being developed (as Fleet 13). Then, since 2002, fully developed Mexican target fishery has existed and US fleets virtually extinguished (as Fleet 14) (Aires-da-Silva and Dreyfus 2012).

Some fisheries with small amount of PBF catch were also considered in the stock assessment. According to the previous stock assessment setting (ISC 2014), their catch amounts are included in the fleet with similar catch-at-size, fishing grounds, and seasons. For example, Korea has small catch amount by trawl, set-net, and troll fisheries, which are included in Fleet 3. Taiwanese purse seine catch is included in Fleet 4, the driftnet catch of both Japan and Taiwan is included in Season 1 of Fleet 7, and the other Taiwanese catches are included in Season 4 of Fleet 7. Japanese miscellaneous catches for Season 1-3 and

Season 4 are included in Japanese set-net fleets, Fleet 8 and 9, respectively. The other Japanese catch (by trawl and other small longline other than those from the Tsugaru Strait) is also included in Fleet 11. Non-members' catch are included in Fleet 12 (i.e. by New Zealand, Australia, etc.).

6. Catch data

Purse seine fisheries continued to occupy a large portion of the total catch throughout the assessment period (Fig. 2-(a)). The Japanese tuna purse seine fishery operating off the Pacific coast of Japan (Fleet 5) accounted for a large portion of the catch until the 1990s. However, catches of the Japanese small pelagic fish purse seine fishery operating in the East China Sea (Fleet 2) and the Japanese tuna purse seine fishery in the Sea of Japan (Fleet 4) have become relatively larger since the mid-2000s. The largest catches in the EPO came from the US and Mexican commercial purse seine fisheries (Fleet 13 and 14).

For almost all fleets, the time series of quarterly catch data from 1952 through 2014 (fishing year) has been developed (Table 4). For some of fisheries, the quarterly catches for the early period were estimated using recent quarterly catch proportions applied to annual catch data; e.g. Fleet 8-9 before fishing year 1994 (Kai 2007), Fleet 5 before fishing year 1971 (Takeuchi 2007), etc.. For other fleets, recent quarterly catches were directly derived from logbook or landing statistics. Fleet 11 includes small-scaled Japanese fisheries (e.g. trawl, small longline, etc.), and their annual total catch is placed in Season 2 of fishing year for the input data of assessment model. Combining Fleet 10 and 11 is a default option of the model setting (ISC 2015c), thus catches by Fleet 10 are also placed in Season 2 of fishing year aggregating their quarterly catch data.

Catch data for stock assessment were expressed in tones for all fleets except for Fleet 15 and 16, whose catches were expressed in thousands of fish (Fig. 2-(b)).

7. Abundance Indices

7-1. Overview

Abundance indices (CPUE) of PBF available for this assessment are listed in Table 5. These series were derived from fishery-specific catch and effort data which were standardized with appropriate statistical methods (Fig. 3 and Table 6).

Indices S1-3 were derived from the Japanese longline fisheries (Fleet 1), S4, 12, and 13 was derived from the Japanese tuna purse seine fishery in the Sea of Japan (Fleet 4), S5-8 were derived from the Japanese troll fisheries (Fleet 6), S9 was derived from the Taiwanese longline fishery (Fleet 12), and S10-11 were derived from EPO commercial purse seine fisheries (Fleet 13 and 14).

The ISC PBFWG decided to use four longline CPUE series as the adult abundance indices (S1, S2, S3, and S9), and a Japanese troll index (S5) as the recruitment index for the base case model of stock assessment (ISC 2015c). The other indices were provided in preparation for the sensitivity analysis.

Coefficients of variations (CVs) for the abundance indices of PBF are shown in Table 7. These values were estimated by the statistical models used to standardize the index. As the setting of input CVs for stock assessment model, ISC PBFWG agreed to employ "additive approach" where CVs will be uniformly

increased to have the average/minimum of 0.2 (ISC 2015c).

7-2. Japanese Longline CPUE (S1, S2, & S3)

Until the mid-1960s, PBF longline catches in Japanese coastal waters were made by offshore and distant-water longline vessels larger than 20 GRT. Since the mid-1960s, the coastal longline fleet has consisted of coastal longline vessels smaller than 20 GRT. A logbook system was not established until 1993 for the coastal longline fleet, whereas aggregated logbook data from 1952 onward are available for the offshore and distant-water longline fleets.

Japanese longline CPUE is based on the logbook data, thus recent CPUE series for the coastal longline fishery is only available from fishing year 1993 to 2014 (S1). Before fishing year 1993, offshore and distant water longline CPUE is available, but the indices to input the stock assessment has to be split up into two time series; fishing year 1952-1973 (S2; Fujioka et al. 2012a) and 1974-1992 (S3; Yokawa 2008). The reason for the separation is that the operational patterns of this fishery changed in the mid-1970s (e.g. the super-freezer was developed and targeting shifted from yellowfin tuna and albacore to bigeye tuna), in addition, hooks-per-basket information, which was used to standardize for these targeting changes, has only been collected since the mid-1970s (Yokawa et al. 2007).

The standardized method of S1 CPUE was revised after the previous stock assessment, which used the result of cluster analysis as an explanatory variable of Zero-Inflated Negative Binomial model (ZINB). This is effective approach to address the target shift of longliner (Sakai et al. 2015b), thus ISC PBFWG agreed that the increased CV for recent year in the previous assessment is no longer necessary (ISC 2015c).

7-3. Japanese Purse Seine CPUE in the Sea of Japan [old version] (S4)

Japanese purse seine CPUE in the Sea of Japan had been provided by Kanaiwa et al. (2012, 2014). For this CPUE series, there were two concerns as follows; 1) the flat annual trend of CPUE of purse seiners in the Sea of Japan may have reflected specific problems with purse-seine CPUE indices rather than abundance trends, and 2) fishing effort used in the CPUE calculation did not consider search time for the fish schools. Hence, changes in the CPUE might represent only the size of a school of fish, which may not be proportional to the abundance of the stock. Due to these issues this index was not used in the base case model in the previous stock assessment (ISC 2014). To resolve these points, new standardization approach has been proposed during the intersessional working grope meeting (ISC 2015a).

7-4. Japanese Troll CPUE (S5, S6, S7, & S8)

Catch-and-effort data for coastal troll fisheries targeting age-0 PBF in Kochi, Wakayama, and Nagasaki prefectures have been collected primarily from six, four, and five fishing ports in these prefectures, respectively (Ichinokawa et al. 2012). The units of effort in the catch-and-effort data are the cumulative daily number of unloading troll vessels, which is nearly equivalent to the total number of trolling trips because most troll vessels make one-day trips. The effort data in Kochi and Wakayama prefectures includes unloading without PBF catch (zero-catch data), thus a ZINB model was used to standardize CPUE for these prefectures. On the other hand, the effort data in Nagasaki prefecture doesn't include the unloading without

PBF catch: no zero-catch data was available. Therefore a log normal model was applied for standardization of the CPUE in Nagasaki prefecture. Based on these standardized CPUE series, four indices had been prepared in the previous stock assessment (S5 from Nagasaki prefecture, S6 from weighted average CPUE of Kochi and Nagasaki prefecture, S7 from Kochi prefecture, and S8 from Wakayama prefecture), however, only S5 CPUE series from Nagasaki prefecture since fishing year 1980 was fitted in the assessment model due to representativeness as the recruitment index (ISC 2014): The troll fishery in Nagasaki prefecture has dominant share in Japanese troll catch, and they can fish age-0 PBF from both two spawning grounds (around Ryuku Islands and the Sea of Japan) because of the geographical location of their fishing ground (Ichinokawa et al. 2012).

For the current stock assessment, only S6 CPUE has been updated. The CPUE was a record-low value in 2014 fishing year (Sakai and Oshima 2015).

7-5. Taiwanese Longline CPUE (S9)

Taiwanese new longline CPUE series for PBF from 2001 to 2014 fishing year, which was standardized using Delta lognormal model, is available. This CPUE series misses the oldest two years' data which was included in the previous series because of the difference of data set. But this new standardized series addressed the effect of fishing area (Chang et al. 2015a), thus ISC PBFWG considered it to be an improvement (ISC 2015c).

This CPUE was developed by following process; (1) Estimating PBF catch in number from landing weight for 2001-2003 based on an MCMC simulation, (2) Deriving fishing days for 2007-2009 from data of vessel monitoring system (VMS) and voyage data recorder (VDR), (3) Deriving fishing days for 2001-2006 from vessels trip information based on linear relationships between fishing days and at-sea days for a trip, by vessel size and fishing port, during 2007-2014, and (4) Estimating and standardizing the CPUE (catch number per fishing days) for fishing year 2001-2014.

7-6. US purse seine CPUE (S10)

Standardized catch rates for PBF are available for two periods of the US purse seine fishery: (1) the developed phase targeting PBF (1960-1982); and (2) the decline phase (post-1982). Jackknifing was used to estimate the CV (Aires-da-Silva et al. 2012). The availability of PBF in the EPO depends on migration of PBF from the WPO but it is likely variable and unknown. Due to unresolved issues concerning the representativeness of these data to reflect abundance, this index was not used in the assessment.

7-7. Mexican purse seine CPUE (S11)

Mexican standardized catch rates for PBF are available for two periods of the fishery: (1) the Mexican opportunistic fishery (1960-1998): and (2) the Mexican fishery that has targeted PBF since 1999. This fishery supplies PBF for pen rearing operations. Jackknifing was used estimate the CV (Aires-da-Silva et al. 2012). As mentioned above, the availability of the PBF in the EPO depends on the migration from the WPO at an unknown but likely variable rate. Therefore, this index was not used in the assessment

7-8. New CPUE series of Japanese Purse Seine CPUE in the Sea of Japan (S12 & S13)

Previous CPUE series of Japanese purse seine CPUE in the Sea of Japan (S4) had the problems caused by the annual differences in length distribution. As a solution, age separated standardized CPUE using "Random Forests" were proposed (Kanaiwa et al. 2015), which address the area, environment, and age factors. There is no problem on the standardization statistically, but the trend of standardized CPUE has conflict with other information. Therefore the ISC PBFWG decided not to use these CPUE series for the base case model of the stock assessment (ISC 2015c). These CPUE series are not contained in the input file for the stock assessment model (SS3) exchanged in January 2016.

8. Size composition data

8-1. Overview

Quarterly size composition data (length or weight) for PBF from 1952 to 2014 (fishing year) will be used for the stock assessment. The size composition data for Fleets 5, 7, and 15 were not updated after 2010 (Oshima et al. 2014). Length composition data are available for Fleets 1-9, and 12-15, while weight composition data are available for Fleets 10 and 11. Of these, the size compositions of for Fleets 2-3 and Fleets 10-11 are combined to simplify the assessment model (Table 8).

All length data in the model is "fork length" measured to the nearest cm. Length composition bins of 2, 4, and 6 cm width are used for 16-58, 58-110, and 110-290 cm FL fish, respectively. Weight composition bins are of variable width, ranging from 1 kg for fish 0-2 kg, to 30 kg for fish >243 kg, which set two bins for each age between 0 to 15 to minimize the misinterpretation of the data (Fujioka et al. 2012b). The lower boundary of each bin is used to define the bin. Fig. 4 -18 shows the quarterly size compositions of each fleet.

The souse of input sample sizes for the size composition data are summarized in Table 8. Depending on the corresponding fisheries, the information of sample size is based on four different criteria; "Number of fish measured", "Number of landing well measured", "Number of total month of well sampled port", and "Number of haul well measured".

8-2. Japanese Longline (Fleet 1)

Length-composition data for PBF from the Japanese longline fishery (Fleet 1) are available for the periods of fishing year 1952-1968 and 1994-2014 (Fig. 4). Until 1960s, the data were collected mainly from Tsukiji market. Since 1990s, sampling and market data have been collected at the major PBF unloading ports, e.g. Okinawa, Miyazaki, and Wakayama prefectures. Length measurements were relatively sparse from 1969 to 1993, and are not included in this assessment.

Length compositions for fishing year 1952-1968 were estimated based on the aggregated catch and length measurement data by year, month, and area (5x5 degree cells). Using this stratification, length composition was raised by catch number (Mizuno et al. 2012). Since fishing year 1993, the length compositions were estimated based on the quarterly landing amount and length measurement in each prefecture. Using quarter and prefecture strata, length composition was raised by landing weight (Sakai et

al. 2015c).

8-3. Japanese purse seines in the East China Sea (Fleet 2) and Korean purse seine (Fleet 3)

Size-composition data for PBF from the Japanese purse seine fishery in the East China Sea has been developed from length measurements taken at Fukuoka and Matsuura, which are the major landing ports for this fishery. The data is available for the periods of fishing year 2002-2014, but the data in Seasons 3-4 of 2014 is not used because amount of smaller fish were caught for farming without measurement (ISC 2015c).

Length-composition data from the Korean purse seine fishery is also available for fishing year 2010-2014 (Kim et al. 2015). The size of fish caught by Korean fleet is similar to the Japanese fleet which is fishing in neighboring waters. Thus the PBFWG agreed to share the size composition by both Fleet 2 and 3 after the inclusion the size data of Korean fleet into that of Japanese fleet (ISCWG 2015c: Fig. 5 and 6).

8-4. Japanese purse seines in the Sea of Japan (Fleet 4)

Length-composition data for PBF from the Japanese purse seine fleet in the Sea of Japan (Fleet 4) has been collected by port samplers in Sakai-minato and available since 1987, except for 1990 when there was no catch (Fig. 7). Size measurements have been high coverage and most of the landings were sampled (in average 98% landings were covered). This fleet catches mainly PBF older than age 3 (Fukuda et al. 2012). There is no new information which suggests the change of situation of this fishery, thus PBFWG agreed on a simple update of the length composition for the stock assessment (ISC 2015c).

8-5. Japanese purse seines off the Pacific coast of Japan (Fleet 5)

Size composition data for PBF from Japanese purse seiners operating off the Pacific coast of Japan were collected at Tukiji market and several unloading ports in the Tohoku region between the 1950s and 1993. Since 1994, length and weight composition data have been collected at Shiogama and Ishinomaki ports (Abe et al. 2012).

Although the length measurements for this fishery had been made since 1980s, and appropriate method to create catch-at-size data has not yet been established for the entire period. The size composition data for this fishery is highly variable (from 50 cm to very large) and further research especially for smaller fish is needed for this dataset. The PBFWG decided to use the length-composition for only fishing year 1995-2006 for the stock assessment, which is the same approach taken in the previous assessment (Fig. 8).

8-6. Japanese Troll (Fleet 6) and Pole-and-Line (Fleet 7)

Length-composition data for PBF from Japanese troll fishery (Fleet 6) and pole-and-line fishery (Fleet 7) have been collected comprehensively at their main unloading ports since 1994. Until then, the size measurements were very limited in both the number of sampling ports and fish (Oshima et al. 2007, Fukuda and Oshima 2012). Length-composition for Fleet 6 is available from 1994 to 2014 (fishing year), which was estimated by revised method: The length measurement data was pooled by “Area” and “month” as the minimum spatial and temporal strata, and then raised by catch number in corresponding strata (Fukuda et al. 2015). The size sampling for Fleet 7 was considered to be relatively poor compared to the numerous troll

vessels. Both troll and pole-and-line fisheries operate in the same area and catch similar-sized fish (primarily age-0 fish), thus the PBFWG decided not to fit the length-composition of Fleet 7 in the assessment model (mirror the selectivity information of Fleet 6), which is the same approach taken in the previous assessments (ISCWG 2015c: Fig. 9 and 10).

8-7. Japanese set-net fishery except for Hokkaido and Aomori prefectures (Fleet 8 and 9)

Size measurement data for PBF from Japanese set-net fisheries have been collected since 1993. The catch-at-size data were estimated based on the multi-stratified raising using the catch weight. The method was revised after the previous stock assessment; excessive estimation was avoided by the introduction of broad size category stratum (i.e. Small/Medium/Large) and limitation of over-strata calculation (Hiraoka et al. 2015, Sakai et al. 2015a). The length-composition data is available for the set-net fisheries except for Hokkaido and Aomori prefectures (see section 9-8). The catch by set-net is largely influenced by the environmental conditions and migration (Kai 2007), thus the catch-at-size is highly variable. According to the complexity of the dataset, the PBFWG decided to divide the set-net fisheries into 3 fleets: Fleet 8 is the Season 1, 2, and 3 (Jul.-Sep., Oct.-Dec., and Jan.-Mar.) of the fisheries in all prefectures except for Hokkaido and Aomori (Fig. 11), Fleet 9 is Season 4 (Apr.-Jun.) of them (Fig. 12), and Fleet 10 is all season of set-net fishery in Hokkaido and Aomori (ISCWG 2015c).

8-8. Japanese set-net fishery for Hokkaido and Aomori (Fleet 10) and Other Fisheries (Fleet 11)

Size composition for PBF from the set-net fishery in Hokkaido and Aomori prefectures (Fleet 10) is based on the weight measurement data (Sakai et al. 2015a). Fleet 11 also has weight-composition data, which includes Japanese hand line and small-scaled longline fisheries in the Tsugaru Strait and its adjacent waters. The estimation method for the weight composition data for Fleet 11 was revised after the previous stock assessment (Nishikawa et al. 2015). Both Fleet 10 and 11 probably target similar fish in similar area, thus the PBFWG agreed to combine their size-composition data to estimate and share the selectivity pattern (ISCWG 2015c; Fig. 13 and 14).

8-9. Taiwanese longline (Fleet 12)

Length-composition data for PBF from the Taiwanese longline fishery (Fleet 12) are available for the periods of fishing year 1992-2014. The data is based on the market landing information and port sampling. Since 2010, additional information has been also available from the catch documentation scheme (CDS) program, which provides much more size samples with higher quality (Chang et al. 2015b).

Length distribution has showed clear modal movement in the spawning ground: the proportion of smaller adult fish had declined since fishing year 2003 to the lowest level of 2012, and has recovered thereafter (Fig. 15). The catch of smaller adult fish has been observed in both the northern and southern fishing grounds, thus the appearance of smaller fish would not be caused by the shift of fishing grounds (ISCWG 2015c).

8-10. EPO commercial purse seine fisheries of US dominant period & transition period (Fleet 13) and Mexico dominant period (Fleet 14)

Length-composition data for PBF from EPO purse seine fishery are collected by port samplers from IATTC and national/municipal sampling programs (Bayliff 1993, Aires-da-Silva and Dreyfus 2012). Fleet 13 is US dominant & transition period of EPO purse seine fishery until 2001. For this fleet, length composition data for US dominant period from 1952 to 1982 is used to estimate the selectivity pattern for the stock assessment (ISCWG 2015c; Fig. 16). Fleet 14 is Mexico dominant period of EPO purse seine fishery (2002 onwards; Fig. 17). The length composition data for Fleet 14 had been obtained by IATTC at-sea observers and port sampling programs, but at-sea observation had bias towards smaller-sized fish because of the sampling from dead fish. After 2013, size composition data measured by stereoscopic cameras from the largest farming company is available (Dreyfus and Aires-da-Silva 2015).

8-11. US recreational fisheries (Fleet 15)

Size composition data for PBF from the US recreational fishery had been collected by IATTC staff since 1993, however the size sampling program by IATTC ended in 2012. From 2014, NOAA took over the sampling program (Lee et al. 2015b). These size data is not used to estimate the selectivity for Fleet 15 in the stock assessment: the selectivity pattern estimated for Fleet 13 is also used for Fleet 15 (Fig. 18).

8-12. Japanese troll fishery for farming (Fleet 16)

In Japan, lengths of PBF caught by troll for farming are apparently smaller than those of fish caught by conventional troll. The PBFWG concerned that the troll fishery for farming should be treated targeting age-0 fish specifically (ISCWG 2015a). There are no size composition data (dummy data is recorded in input file of SS3).

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Table 1. Pacific bluefin tuna (*Thunnus orientalis*) catches (in metric tons) by fisheries, for calendar year 1952-2014. "0"; fishing effort was reported but no catch, "+"; bellow 499kg catch, "-"; unreported or not available.

Calendar Year	Japan (JP)[1]									
	Purse Seine		Dist. & Off. Longline		Coastal	Troll[3]	Pole and Line	Set Net	Others[2]	Sub Total
	Tuna PS	Small PS	NP	SP	Longline[2]					
1952	7,680		2,694	9		667	2,198	2,145	1,700	17,094
1953	5,570		3,040	8		1,472	3,052	2,335	160	15,636
1954	5,366		3,088	28		1,656	3,044	5,579	266	19,027
1955	14,016		2,951	17		1,507	2,841	3,256	1,151	25,739
1956	20,979		2,672	238		1,763	4,060	4,170	385	34,268
1957	18,147		1,685	48		2,392	1,795	2,822	414	27,302
1958	8,586		818	25		1,497	2,337	1,187	215	14,666
1959	9,996		3,136	565		736	586	1,575	167	16,760
1960	10,541		5,910	193		1,885	600	2,032	369	21,531
1961	9,124		6,364	427		3,193	662	2,710	599	23,078
1962	10,657		5,769	413		1,683	747	2,545	293	22,107
1963	9,786		6,077	449		2,542	1,256	2,797	294	23,201
1964	8,973		3,140	114		2,784	1,037	1,475	1,884	19,406
1965	11,496		2,569	194		1,963	831	2,121	1,106	20,280
1966	10,082		1,370	174		1,614	613	1,261	129	15,243
1967	6,462		878	44		3,273	1,210	2,603	302	14,772
1968	9,268		500	7		1,568	983	3,058	217	15,601
1969	3,236		313	20	565	2,219	721	2,187	195	9,456
1970	2,907		181	11	426	1,198	723	1,779	224	7,448
1971	3,721		280	51	417	1,492	938	1,555	317	8,772
1972	4,212		107	27	405	842	944	1,107	197	7,840
1973	2,266		110	63	728	2,108	526	2,351	636	8,788
1974	4,106		108	43	1,069	1,656	1,192	6,019	754	14,948
1975	4,491		215	41	846	1,031	1,401	2,433	808	11,266
1976	2,148		87	83	233	830	1,082	2,996	1,237	8,697
1977	5,110		155	23	183	2,166	2,256	2,257	1,052	13,202
1978	10,427		444	7	204	4,517	1,154	2,546	2,276	21,577
1979	13,881		220	35	509	2,655	1,250	4,558	2,429	25,537
1980	11,327		140	40	671	1,531	1,392	2,521	1,953	19,574
1981	25,422		313	29	277	1,777	754	2,129	2,653	33,353
1982	19,234		206	20	512	864	1,777	1,667	1,709	25,988
1983	14,774		87	8	130	2,028	356	972	1,117	19,471
1984	4,433		57	22	85	1,874	587	2,234	868	10,161
1985	4,154		38	9	67	1,850	1,817	2,562	1,175	11,673
1986	7,412		30	14	72	1,467	1,086	2,914	719	13,714
1987	8,653		30	33	181	880	1,565	2,198	445	13,985
1988	3,583	22	51	30	106	1,124	907	843	498	7,163
1989	6,077	113	37	32	172	903	754	748	283	9,118
1990	2,834	155	42	27	267	1,250	536	716	455	6,282
1991	4,336	5,472	48	20	170	2,069	286	1,485	650	14,536
1992	4,255	2,907	85	16	428	915	166	1,208	1,081	11,063
1993	5,156	1,444	145	10	667	546	129	848	365	9,310
1994	7,345	786	238	20	968	4,111	162	1,158	398	15,186
1995	5,334	13,575	107	10	571	4,778	270	1,859	586	27,090
1996	5,540	2,104	123	9	778	3,640	94	1,149	570	14,008
1997	6,137	7,015	142	12	1,158	2,740	34	803	811	18,852
1998	2,715	2,676	169	10	1,086	2,876	85	874	700	11,191
1999	11,619	4,554	127	17	1,030	3,440	35	1,097	709	22,628
2000	8,193	8,293	121	7	832	5,217	102	1,125	689	24,577
2001	3,139	4,481	63	6	728	3,466	180	1,366	782	14,212
2002	3,922	4,981	47	5	794	2,607	99	1,100	631	14,186
2003	956	4,812	85	12	1,152	2,060	44	839	446	10,407
2004	4,934	3,323	231	9	1,616	2,445	132	896	514	14,099
2005	4,034	8,783	107	14	1,818	3,633	549	2,182	548	21,668
2006	3,644	5,236	63	11	1,058	1,860	108	1,421	777	14,178
2007	2,965	3,875	83	8	1,679	2,823	236	1,503	657	13,829
2008	3,029	7,192	19	8	1,371	2,377	64	2,358	770	17,189
2009	2,127	5,950	8	7	1,072	2,003	50	2,236	575	14,029
2010	1,122	2,620	5	6	885	1,583	83	1,603	495	8,401
2011	2,227	6,113	9	11	828	1,820	63	1,651	283	13,004
2012	1,043	1,419	6	8	667	570	113	1,932	343	6,101
2013	2,008	763	7	7	777	904	8	1,415[5]	529	6,418
2014	2,250	3,206	-	-	(715)[4]	1,023	5	1,907	499	9,604

1 Part of Japanese catch is estimated by the WG from best available source for the stock assessment use.

2 Japanese coastal longline and others catch data from 2007 to 2013 was revised as a result of deleting double counting and changing the data source (ISC15/STATWG/WP-4).

3 Japanese troll catch since 1998 includes catch for farming.

4 Catch of set net in 2013 were updated based on the Japanese official statistics of annual catch.

5 Catch of Jpanese coastal longline in 2014 is provisional value and includes catch of the distant water and offshore longline.

Table 1. Cont.

"0"; fishing effort was reported but no catch, "+"; bellow 499kg catch, "-"; unreported or not available.

Calendar Year	Korea (KR)[6]					Taiwan (TW)				
	Purse Seine	Setnet	Troll	Trawl	Sub Total	Longline	Purse Seine	Distant Driftnet	Others	Sub Total
1952										
1953										
1954										
1955										
1956										
1957										
1958										
1959										
1960										
1961										
1962										
1963										
1964										
1965						54				54
1966										0
1967						53				53
1968						33				33
1969						23				23
1970										0
1971						1				1
1972						14				14
1973						33				33
1974						47			15	62
1975						61			5	66
1976						17			2	19
1977						131			2	133
1978						66			2	68
1979						58				58
1980						114			5	119
1981						179				179
1982	31				31	207		2		209
1983	13				13	175	9	2		186
1984	4				4	477	5		8	490
1985	1				1	210	80	11		301
1986	344				344	70	16	13		99
1987	89				89	365	21	14		400
1988	32				32	108	197	37	25	367
1989	71				71	205	259	51	3	518
1990	132				132	189	149	299	16	653
1991	265				265	342		107	12	461
1992	288				288	464	73	3	5	545
1993	40				40	471	1		3	475
1994	50				50	559				559
1995	821				821	335			2	337
1996	102				102	956				956
1997	1,054				1,054	1,814				1,814
1998	188				188	1,910				1,910
1999	256				256	3,089				3,089
2000	2,401			0	2,401	2,780			2	2,782
2001	1,176			10	1,186	1,839			4	1,843
2002	932			1	933	1,523			4	1,527
2003	2,601			0	2,601	1,863			21	1,884
2004	773			0	773	1,714			3	1,717
2005	1,318			9	1,327	1,368			2	1,370
2006	1,012			3	1,015	1,149			1	1,150
2007	1,281			4	1,285	1,401			10	1,411
2008	1,866			10	1,876	979			2	981
2009	936			4	940	877			11	888
2010	1,196			16	1,212	373			36	409
2011	670		0	14	684	292			24	316
2012	1,421		1	2	1,424	210			3	213
2013	604	1	0	0	605	332			3	335
2014	1,305	6	0	0	1,311	480			3	483

6 Catch statistics of Korea derived from Japanese Import statistics for 1982-1999.

Table 1. Cont.

"0"; fishing effort was reported but no catch, "+"; bellow 499kg catch, "-"; unreported or not available.

Calendar Year	United States (US)[7]				Mexico (MX)			Out of ISC members		Grand Total
	Purse Seine	Others	Sport	Sub Total	Purse Seine	Others	Sub Total	New Zealand (NZ)[8]	Australia (AU)[9]	
1952	2,076		2	2,078						19,172
1953	4,433		48	4,481						20,117
1954	9,537		11	9,548						28,575
1955	6,173		93	6,266						32,005
1956	5,727		388	6,115						40,383
1957	9,215		73	9,288						36,590
1958	13,934		10	13,944						28,610
1959	3,506	56	13	3,575	171	32	203			20,539
1960	4,547	0	1	4,548						26,079
1961	7,989	16	23	8,028	130		130			31,236
1962	10,769	0	25	10,794	294		294			33,195
1963	11,832	28	7	11,867	412		412			35,481
1964	9,047	39	7	9,093	131		131			28,631
1965	6,523	77	1	6,601	289		289			27,224
1966	15,450	12	20	15,482	435		435			31,161
1967	5,517	0	32	5,549	371		371			20,745
1968	5,773	8	12	5,794	195		195			21,623
1969	6,657	9	15	6,681	260		260			16,419
1970	3,873	0	19	3,892	92		92			11,432
1971	7,804	0	8	7,812	555		555			17,140
1972	11,656	45	15	11,716	1,646		1,646			21,216
1973	9,639	21	54	9,714	1,084		1,084			19,619
1974	5,243	30	58	5,331	344		344			20,685
1975	7,353	84	34	7,471	2,145		2,145			20,948
1976	8,652	25	21	8,698	1,968		1,968			19,381
1977	3,259	13	19	3,291	2,186		2,186			18,811
1978	4,663	6	5	4,674	545		545			26,863
1979	5,889	6	11	5,906	213		213			31,715
1980	2,327	24	7	2,358	582		582			22,634
1981	867	14	9	891	218		218			34,641
1982	2,639	2	11	2,652	506		506			29,387
1983	629	11	33	673	214		214			20,557
1984	673	29	49	751	166		166			11,573
1985	3,320	28	89	3,437	676		676			16,089
1986	4,851	57	12	4,920	189		189			19,266
1987	861	20	34	915	119		119			15,507
1988	923	50	6	979	447	1	448			8,989
1989	1,046	21	112	1,180	57		57			10,943
1990	1,380	92	65	1,537	50		50			8,653
1991	410	6	92	508	9		9	2		15,781
1992	1,928	61	110	2,099	0		0	0		13,995
1993	580	103	283	966				6	0	10,797
1994	906	59	56	1,021	63	2	65	2	1	16,884
1995	657	49	245	951	11		11	2	1	29,213
1996	4,639	70	40	4,749	3,700		3,700	4		23,519
1997	2,240	133	131	2,504	367		367	14	1	24,607
1998	1,771	281	422	2,474	1	0	1	20	3	15,787
1999	184	184	408	776	2,369	35	2,404	21	5	29,178
2000	693	61	319	1,073	3,019	99	3,118	21	8	33,980
2001	292	48	344	684	863		863	50	7	18,846
2002	50	12	613	675	1,708	2	1,710	55	6	19,093
2003	22	18	355	395	3,211	43	3,254	41	12	18,593
2004		11	50	61	8,880	14	8,894	67	10	25,621
2005	201	7	73	281	4,542		4,542	20	13	29,222
2006		2	94	96	9,927		9,927	21	5	26,392
2007	42	2	12	56	4,147		4,147	13	4	20,745
2008		1	63	64	4,392	15	4,407	14	3	24,533
2009	410	6	156	572	3,019		3,019	16	3	19,467
2010		1	88	89	7,746		7,746	10	0	17,867
2011		118	225	343	2,730	1	2,731	28	1	17,107
2012		43	400	443	6,667	1	6,668	13	1	14,863
2013		11	809	820	3,154		3,154	24	0	11,356
2014	401	5	398	804	4,862		4,862	12	0	17,076

7 US in 1952-1958 contains catch from other countries - primarily Mexico. Other includes catches from gillnet, troll, pole-and-line, and longline.

8 Catches by New Zealand from 1991 to 2006 are derived from the Ministry of Fisheries, Science Group (Compilers) 2006: Report from the Fishery

9 Catches by Australia are provided by SPC.

Table 2. Relationships between fishing year and calendar year for the stock assessment of Pacific bluefin tuna (*Thunnus orientalis*).
Spawning stock biomass (SSB) is defined as the estimated values at the beginning of Season 4 (April-June).
Recruitment occurs at the beginning of Season 1.

Fishing year	2012				2013				2014				2015			
Season	Season 1	Season 2	Season 3	Season 4	Season 1	Season 2	Season 3	Season 4	Season 1	Season 2	Season 3	Season 4	Season 1	Season 2		
SSB				SSB in 2012				SSB in 2013				SSB in 2014				
Day of Birth in SS	Birthday of 2012 yr class				Birthday of 2013 yr class				Birthday of 2014 yr class				Birthday of 2015 yr class			
Recruitment	Recruitment in 2012				Recruitment in 2013				Recruitment in 2014				Recruitment in 2015			
Year class	2012 yr class				2013 yr class				2014 yr class				2015 yr class			
Calendar year	2012				2013				2014				2015			
Month	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12

Table 3. Definition of fleets for the stock assessment of Pacific bluefin tuna (*Thunnus orientalis*).

Fleet #	Fleet name	Unit of Catch	Gears included				Catch-at-size data (Size bin definition)	Abundance index
			Representative component	Component 2	Component 3	Component 4		
Fleet 1	JPLL	Weight	JP Longline				Length bin	S1, S2, S3
Fleet 2	JPSPPS	Weight	JP SPPS				Length bin	
Fleet 3	KROLPS	Weight	KR OLPS	KR Trawl*[1]	KR Setnet*[1]	KR Troll*[1]	Length bin	
Fleet 4	TPSJS	Weight	JP TPSJS	TW PS*[2]			Length bin	S4,S12, S13
Fleet 5	TPSPO	Weight	JP TPSPO				Length bin	
Fleet 6	Troll	Weight	JP Troll				Length bin	S5, S6, S7, S8
Fleet 7	PL	Weight	JP Pole-and-Line	JP Driftnet*[3]	TW Driftnet*[3]	TW Others*[4]	Length bin	
Fleet 8	SetNet_Seas1-3	Weight	JP Setnet (Season 1-3)	JP Miscellaneous (Season 1-3)			Length bin	
Fleet 9	SetNet_Seas4	Weight	JP Setnet (Season 4)	JP Miscellaneous (Season 4)			Length bin	
Fleet 10	SetNet_HK_AM	Weight	JP Set-net in Hokkaido and Aomori				Weight bin	
Fleet 11	JP Others	Weight	JP Handline & Tsugaru Longline	JP Trawl	JP OtherLL		Weight bin	
Fleet 12	TWLL	Weight	TW Longline	Out of ISC PBFWG members (NZ, AU, etc.)*[5]			Length bin	S9
Fleet 13	USCOMM (-2001)	Weight	US Commercial Fisheries (PS, Others)	MX Commercial Fisheries (PS, Others)			Length bin	S10
Fleet 14	MXCOMM (2002-)	Weight	MX Commercial Fisheries (PS, Others)	US Commercial Fisheries (PS, Others)			Length bin	S11
Fleet 15	EPOSP	Number	US Recreational Fisheries				Length bin	
Fleet 16	Troll4Pen	Number	JP Troll for Pen				Age (age-0 only)	

*1 Catch for Korean Trawl, Korean Setnet and Korean Troll are **not included** in the input data used for the 2014 stock assessment.
*2 Annual catches for Taiwanese PS are put into the Season 1 in the input data for the 2014 stock assessment.
*3 Annual catches for Japanese and Taiwanese Driftnets are put into the Season 1 in the input data for the 2014 stock assessment.
*4 Annual catches for Japanese and Taiwanese Others are put into the Season 4 in the input data for the 2014 stock assessment.
*5 Annual catches of out of ISC PBFWG members are put into the Season 1 in the input data for the 2014 stock assessment.
Note: Seasons follow the fishing year.

Table 4. Quarterly catch of Pacific bluefin tuna (*Thunnus orientalis*) by fleet for fishing year 1952-2014.

Fishing year	Season	Weight (mt)														Number (1000 fish)	
		Fleet1	Fleet2	Fleet3	Fleet4	Fleet5	Fleet6	Fleet7	Fleet8	Fleet9	Fleet10	Fleet11	Fleet12	Fleet13	Fleet14	Fleet15	Fleet16
1952	1	1073	0	0	0	4936	23	713	736	0	236	0	0	1951	0	0	0
1952	2	132	0	0	0	0	498	505	537	0	170	172	0	24	0	0	0
1952	3	145	0	0	0	0	282	796	503	0	0	0	0	0	0	0	0
1952	4	1898	0	0	0	1990	39	907	0	568	17	0	0	0	0	0	0
1953	1	764	0	0	0	3580	51	650	371	0	255	0	0	3843	0	3	0
1953	2	241	0	0	0	0	1098	706	458	0	186	131	0	590	0	1	0
1953	3	263	0	0	0	0	318	609	430	0	2	0	0	0	0	0	0
1953	4	1578	0	0	0	1917	44	815	0	1427	107	0	0	2289	0	0	0
1954	1	1096	0	0	0	3448	58	744	1109	0	861	0	0	6845	0	1	0
1954	2	178	0	0	0	0	1236	923	1032	0	613	219	0	403	0	0	0
1954	3	177	0	0	0	0	289	569	612	0	1	0	0	483	0	0	0
1954	4	1310	0	0	0	5008	40	761	0	1334	43	0	0	3131	0	1	0
1955	1	1172	0	0	0	9008	53	665	788	0	364	0	0	2467	0	4	0
1955	2	311	0	0	0	0	1125	862	889	0	260	101	0	93	0	0	0
1955	3	124	0	0	0	0	338	813	903	0	1	0	0	0	0	0	0
1955	4	1104	0	0	0	7496	47	1087	0	1180	38	0	0	0	0	0	0
1956	1	1521	0	0	0	13483	62	953	636	0	262	0	0	4753	0	30	0
1956	2	161	0	0	0	0	1316	1232	1134	0	185	192	0	974	0	2	0
1956	3	163	0	0	0	0	459	359	506	0	3	0	0	0	0	0	0
1956	4	905	0	0	0	6036	64	481	0	935	98	0	0	141	0	0	0
1957	1	566	0	0	0	12111	84	425	558	0	74	0	0	8779	0	6	0
1957	2	98	0	0	0	0	1785	545	830	0	25	194	0	296	0	0	0
1957	3	135	0	0	0	0	287	468	286	0	0	0	0	0	0	0	0
1957	4	384	0	0	0	3937	40	626	0	394	14	0	0	2635	0	0	0
1958	1	113	0	0	0	4650	52	541	189	0	10	0	0	11188	0	1	0
1958	2	211	0	0	0	0	1117	709	316	0	4	183	0	112	0	0	0
1958	3	371	0	0	0	0	141	117	365	0	1	0	0	0	0	0	0
1958	4	1573	0	0	0	4431	20	157	0	509	39	0	0	1278	0	0	0
1959	1	841	0	0	0	5565	26	135	227	0	29	0	0	2487	0	1	0
1959	2	916	0	0	0	0	550	178	408	0	10	153	0	0	0	0	0
1959	3	642	0	0	0	0	362	120	457	0	0	0	0	103	0	0	0
1959	4	4029	0	0	0	3475	50	161	0	562	15	0	0	1492	0	0	0
1960	1	706	0	0	0	7066	66	204	302	0	113	0	0	2912	0	0	0
1960	2	729	0	0	0	0	1407	182	504	0	80	302	0	40	0	0	0
1960	3	781	0	0	0	0	613	133	683	0	0	0	0	0	0	0	0
1960	4	3940	0	0	0	3356	85	177	0	863	16	0	0	1164	0	0	0
1961	1	1472	0	0	0	5768	112	170	430	0	12	0	0	6755	0	2	0
1961	2	597	0	0	0	0	2383	201	701	0	4	580	0	217	0	0	0
1961	3	800	0	0	0	0	323	149	566	0	1	0	0	108	0	0	0
1961	4	4331	0	0	0	3981	45	200	0	561	32	0	0	2376	0	0	0
1962	1	593	0	0	0	6677	59	176	744	0	71	0	0	8578	0	2	0
1962	2	459	0	0	0	0	1256	227	527	0	43	288	0	1	0	0	0
1962	3	541	0	0	0	0	488	251	528	0	2	0	0	72	0	0	0
1962	4	5130	0	0	0	3485	68	336	0	702	73	0	0	2428	0	0	0
1963	1	600	0	0	0	6301	89	305	406	0	240	0	0	9718	0	1	0
1963	2	255	0	0	0	0	1897	381	689	0	158	276	0	53	0	0	0
1963	3	313	0	0	0	0	534	208	598	0	1	0	0	17	0	0	0
1963	4	2321	0	0	0	3175	74	278	0	992	30	0	0	1768	0	0	0
1964	1	360	0	0	0	5798	97	246	562	0	49	0	0	7420	0	1	0
1964	2	260	0	0	0	0	2078	315	726	0	27	366	0	13	0	0	0
1964	3	322	0	0	0	0	377	229	518	0	1	0	0	26	0	0	0
1964	4	1945	0	0	0	4024	52	242	0	857	32	0	54	545	0	0	0
1965	1	160	0	0	0	7471	69	213	711	0	37	0	0	5400	0	0	0
1965	2	336	0	0	0	0	1465	200	690	0	18	313	0	918	0	0	0
1965	3	122	0	0	0	0	310	145	299	0	1	0	0	1	0	0	0
1965	4	862	0	0	0	3058	43	189	0	382	46	0	0	4873	0	0	0
1966	1	285	0	0	0	7025	56	188	161	0	57	0	0	11021	0	2	0
1966	2	275	0	0	0	0	1204	133	291	0	29	81	0	2	0	0	0
1966	3	218	0	0	0	0	628	285	847	0	2	0	0	16	0	0	0
1966	4	387	0	0	0	2376	87	373	0	570	61	0	53	3064	0	0	0
1967	1	246	0	0	0	4085	114	330	273	0	84	0	0	2768	0	3	0
1967	2	73	0	0	0	0	2443	261	728	0	44	259	0	40	0	0	0
1967	3	179	0	0	0	0	301	221	631	0	3	0	0	50	0	0	0
1967	4	140	0	0	0	3741	42	307	0	819	130	0	33	789	0	0	0
1968	1	135	0	0	0	5527	55	255	456	0	177	0	0	4812	0	1	0
1968	2	54	0	0	0	0	1171	206	755	0	93	206	0	325	0	0	0
1968	3	75	0	0	0	0	426	160	375	0	3	0	0	11	0	0	0
1968	4	661	0	0	0	1176	59	197	0	433	141	0	23	1608	0	0	0

Table 4. Cont.

Fishing year	Season	Weight (mt)														Number (1000 fish)	
		Fleet1	Fleet2	Fleet3	Fleet4	Fleet5	Fleet6	Fleet7	Fleet8	Fleet9	Fleet10	Fleet11	Fleet12	Fleet13	Fleet14	Fleet15	Fleet16
1969	1	109	0	0	0	2061	78	184	294	0	319	0	0	5258	0	1	0
1969	2	54	0	0	0	0	1656	213	426	0	196	160	0	49	0	0	0
1969	3	37	0	0	0	0	230	178	232	0	3	0	0	14	0	0	0
1969	4	524	0	0	0	1274	32	204	0	433	140	0	0	1416	0	0	0
1970	1	23	0	0	0	1633	42	210	282	0	190	0	0	2534	0	1	0
1970	2	35	0	0	0	0	894	194	398	0	99	161	0	2	0	1	0
1970	3	181	0	0	0	0	286	234	163	0	4	0	0	31	0	0	0
1970	4	505	0	0	0	2835	40	269	0	284	171	0	1	4039	0	0	0
1971	1	19	0	0	0	887	52	230	200	0	340	0	0	3349	0	1	0
1971	2	43	0	0	0	0	1114	240	261	0	202	212	0	939	0	0	0
1971	3	47	0	0	0	0	162	297	199	0	3	0	0	3	0	0	0
1971	4	446	0	0	0	2049	23	78	0	215	111	0	14	2879	0	0	0
1972	1	15	0	0	0	2163	29	449	127	0	164	0	0	8861	0	1	0
1972	2	31	0	0	0	0	629	159	233	0	89	124	0	1603	0	0	0
1972	3	57	0	0	0	0	405	73	485	0	2	0	0	11	0	0	0
1972	4	799	0	0	0	464	56	160	0	501	70	0	33	2043	0	2	0
1973	1	21	0	0	0	1803	74	419	359	0	277	0	0	8690	0	4	0
1973	2	25	0	0	0	0	1573	183	514	0	186	286	0	0	0	0	0
1973	3	30	0	0	0	0	318	450	1313	0	4	0	0	0	0	0	0
1973	4	1037	0	0	0	416	44	246	0	1403	155	0	47	1227	0	0	0
1974	1	105	0	0	0	3690	58	483	865	0	546	0	0	4238	0	6	0
1974	2	48	0	0	0	0	1236	363	1424	0	362	368	0	151	0	0	0
1974	3	29	0	0	0	0	198	806	287	0	1	0	0	0	0	0	0
1974	4	891	0	0	0	3415	28	132	0	349	73	0	61	3065	0	0	0
1975	1	121	0	0	0	1077	36	1096	309	0	605	0	0	5748	0	3	0
1975	2	61	0	0	0	0	769	50	378	0	431	132	0	769	0	0	0
1975	3	37	0	0	0	0	159	80	231	0	5	0	0	616	0	0	0
1975	4	298	0	0	0	1122	22	271	0	430	240	0	17	2283	0	0	0
1976	1	54	0	0	0	1026	29	1300	301	0	818	0	0	7250	0	2	0
1976	2	15	0	0	0	0	619	518	431	0	540	152	0	497	0	0	0
1976	3	69	0	0	0	0	416	169	320	0	2	0	0	2	0	0	0
1976	4	244	0	0	0	4063	58	1338	0	411	108	0	131	2015	0	0	0
1977	1	37	0	0	0	1047	76	1258	222	0	485	0	0	3094	0	2	0
1977	2	12	0	0	0	0	1617	377	378	0	331	168	0	348	0	0	0
1977	3	58	0	0	0	0	867	51	377	0	2	0	0	86	0	0	0
1977	4	243	0	0	0	10346	121	426	0	527	107	0	66	704	0	0	0
1978	1	340	0	0	3	78	158	2329	282	0	441	0	0	4403	0	1	0
1978	2	16	0	0	0	0	3372	380	512	0	298	246	0	21	0	0	0
1978	3	55	0	0	0	0	510	454	733	0	2	0	0	11	0	0	0
1978	4	580	0	0	0	11145	71	211	0	1011	115	0	58	2331	0	0	0
1979	1	104	0	0	0	2736	93	1720	527	0	768	0	0	3539	0	1	0
1979	2	24	0	0	0	0	1982	406	861	0	541	888	0	227	0	0	0
1979	3	43	0	0	0	0	294	572	363	0	3	0	0	0	0	0	0
1979	4	749	0	0	0	6168	41	195	0	379	140	0	114	1435	0	0	0
1980	1	20	0	0	0	5159	54	1641	322	0	574	0	0	1439	0	1	0
1980	2	41	0	0	0	0	1143	468	353	0	387	474	0	59	0	0	0
1980	3	185	0	0	0	0	283	85	406	0	1	0	0	0	0	0	0
1980	4	336	0	0	0	6344	0	115	0	404	54	0	179	356	0	0	0
1981	1	56	0	0	1297	17781	68	2382	271	0	352	0	0	742	0	1	0
1981	2	41	0	0	0	0	1426	302	393	0	248	523	0	1	0	0	0
1981	3	63	0	8	0	0	435	336	277	0	2	0	0	0	0	0	0
1981	4	583	0	12	0	5410	53	671	0	341	69	0	207	60	0	0	0
1982	1	73	0	6	1615	12209	5	1905	198	0	300	0	0	2682	0	1	0
1982	2	20	0	5	0	0	370	444	277	0	204	132	0	406	0	0	0
1982	3	38	0	3	0	0	81	31	189	0	1	0	0	91	0	0	0
1982	4	161	0	5	0	11951	0	107	0	207	35	0	175	8	0	0	0
1983	1	8	0	3	570	2262	21	897	143	0	113	0	0	631	0	1	0
1983	2	15	0	2	0	0	1925	131	210	0	74	310	0	125	0	1	0
1983	3	41	0	1	0	0	287	33	380	0	3	0	0	72	0	0	0
1983	4	94	0	2	0	2448	0	116	0	431	138	0	477	144	0	0	0
1984	1	20	0	1	807	1184	28	588	311	0	343	0	0	563	0	3	0
1984	2	9	0	1	0	0	1558	391	413	0	215	336	0	90	0	1	0
1984	3	24	0	0	0	0	538	1011	265	0	3	0	0	62	0	0	0
1984	4	74	0	0	0	2897	135	464	0	358	153	0	210	1572	0	0	0
1985	1	8	0	0	448	889	12	961	229	0	714	0	0	1264	0	5	0
1985	2	8	0	0	0	0	1165	120	352	0	488	447	0	1126	0	0	0
1985	3	19	0	84	0	0	224	74	369	0	3	0	0	109	0	0	0
1985	4	84	0	130	0	6340	0	460	0	547	118	0	70	428	0	0	0

Table 4. Cont.

Fishing year	Season	Weight (mt)														Number (1000 fish)	
		Fleet1	Fleet2	Fleet3	Fleet4	Fleet5	Fleet6	Fleet7	Fleet8	Fleet9	Fleet10	Fleet11	Fleet12	Fleet13	Fleet14	Fleet15	Fleet16
1986	1	8	0	70	16	1072	5	668	375	0	564	0	0	3759	0	1	0
1986	2	5	0	60	0	0	1238	212	553	0	387	403	0	801	0	0	0
1986	3	20	0	22	0	0	354	1089	274	0	2	0	0	93	0	0	0
1986	4	195	0	34	0	4874	15	132	0	299	89	0	365	31	0	0	0
1987	1	20	0	18	250	3550	6	519	193	0	612	0	0	813	0	1	0
1987	2	9	0	15	0	0	505	98	297	0	432	187	0	63	0	1	0
1987	3	19	0	8	0	0	89	146	94	0	1	0	0	0	0	0	0
1987	4	123	16	12	0	1027	0	357	0	113	45	0	108	221	0	0	0
1988	1	35	0	7	742	2010	15	796	87	0	228	0	0	974	0	0	0
1988	2	10	6	6	0	0	1020	42	118	0	157	127	0	227	0	0	0
1988	3	27	3	17	0	0	259	68	86	0	0	0	0	7	0	0	0
1988	4	190	3	27	0	2134	27	356	0	125	24	0	205	0	0	0	0
1989	1	20	88	15	580	3623	88	411	81	0	186	0	0	988	0	5	0
1989	2	4	20	12	0	0	529	146	114	0	132	110	0	130	0	1	0
1989	3	21	0	32	0	0	166	17	165	0	1	0	0	16	0	0	0
1989	4	280	5	50	0	360	92	213	0	133	26	0	189	1	0	0	0
1990	1	24	32	27	149	2474	3	830	64	0	90	0	0	1311	0	4	0
1990	2	10	118	23	0	0	990	47	179	0	60	199	0	194	0	0	0
1990	3	16	99	65	0	0	636	30	421	0	1	0	0	0	0	0	0
1990	4	193	26	100	0	646	161	79	0	288	49	0	342	86	0	0	0
1991	1	14	182	54	224	3466	82	429	123	0	146	0	2	334	0	5	0
1991	2	14	5165	46	0	0	1191	103	363	0	95	414	0	5	0	0	0
1991	3	36	394	71	0	0	274	18	183	0	2	0	0	0	0	0	0
1991	4	462	2061	109	0	1677	0	35	0	332	68	0	464	11	0	0	0
1992	1	10	255	59	469	2183	0	944	173	0	116	0	0	1650	0	8	0
1992	2	20	198	50	0	0	642	65	269	0	66	193	0	328	0	0	0
1992	3	15	582	10	0	0	145	12	102	0	1	0	0	0	0	0	0
1992	4	708	751	15	0	1243	34	38	0	280	27	0	471	45	0	0	0
1993	1	62	99	8	83	3831	48	204	161	0	32	0	6	525	0	10	0
1993	2	37	12	7	0	0	320	36	230	0	16	207	0	113	0	0	0
1993	3	42	25	12	0	0	67	0	70	0	1	0	0	2	0	0	0
1993	4	1085	562	19	0	2677	15	17	0	481	16	0	559	4	0	0	0
1994	1	77	14	10	694	3973	458	206	168	0	36	0	3	967	0	2	0
1994	2	22	185	9	0	0	3570	65	356	0	31	272	0	58	0	0	0
1994	3	11	406	202	0	0	2475	9	132	0	0	0	0	0	0	0	0
1994	4	616	254	309	0	2040	733	136	0	256	23	0	335	0	0	0	0
1995	1	35	4055	168	496	2798	440	143	243	0	213	0	2	716	0	16	0
1995	2	25	8860	142	0	0	1130	94	788	0	205	476	0	0	0	0	0
1995	3	31	1355	25	0	0	136	5	84	0	0	0	0	0	0	0	0
1995	4	827	140	38	0	3124	57	1	0	253	16	0	956	757	0	2	0
1996	1	25	451	21	450	1967	256	90	129	0	142	0	4	7652	0	1	0
1996	2	26	158	18	0	0	3191	66	416	0	110	503	0	0	0	0	0
1996	3	27	594	259	0	0	846	1	114	0	0	0	0	1	0	0	0
1996	4	1215	1113	397	0	1402	550	4	0	199	6	0	1814	61	0	3	0
1997	1	27	3000	215	708	4027	224	113	165	0	20	0	15	2638	0	5	0
1997	2	44	2309	183	0	0	1120	25	246	0	53	702	0	41	0	0	0
1997	3	18	559	46	0	0	605	2	158	0	1	0	0	4	0	0	0
1997	4	1150	518	71	0	13	515	2	0	131	15	0	1910	8	0	1	0
1998	1	53	549	38	326	2376	131	108	114	0	29	0	23	2017	0	21	47
1998	2	46	1049	33	0	0	1613	64	359	0	68	609	0	24	0	1	0
1998	3	33	686	63	0	0	798	10	317	0	1	0	0	0	0	0	0
1998	4	1076	986	96	0	5592	360	2	0	329	32	0	3089	2280	0	1	0
1999	1	25	2228	52	579	5448	129	65	133	0	16	0	26	442	0	35	214
1999	2	41	653	44	0	0	2101	17	391	0	46	482	0	49	0	1	0
1999	3	39	651	747	0	0	1456	1	168	0	0	0	0	0	0	0	0
1999	4	893	2380	1597	0	3403	770	83	0	164	5	0	2780	669	0	8	0
2000	1	15	3214	30	747	4042	117	66	154	0	87	0	29	3204	0	13	382
2000	2	12	2048	27	0	0	2780	6	475	0	72	638	0	0	0	0	0
2000	3	8	898	963	0	0	934	0	358	0	1	0	0	0	0	0	0
2000	4	749	2914	179	0	981	464	4	0	189	45	0	1839	382	0	1	0
2001	1	13	409	9	239	1918	83	167	73	0	174	0	57	821	0	21	549
2001	2	26	261	37	0	0	1847	113	293	0	232	683	0	0	0	1	0
2001	3	76	62	160	0	0	988	17	113	0	0	0	0	0	0	0	0
2001	4	671	2126	175	0	556	697	51	0	117	6	0	1523	0	275	1	0
2002	1	45	959	509	599	2767	37	224	157	0	235	0	61	0	1497	31	716
2002	2	56	1835	88	0	0	706	24	231	0	251	409	0	0	0	2	0
2002	3	95	99	238	0	0	520	11	84	0	0	0	0	0	0	0	0
2002	4	992	1771	394	0	185	824	34	0	87	54	0	1832	0	590	1	0

Table 4. Cont.

Fishing year	Season	Weight (mt)														Number (1000 fish)	
		Fleet1	Fleet2	Fleet3	Fleet4	Fleet5	Fleet6	Fleet7	Fleet8	Fleet9	Fleet10	Fleet11	Fleet12	Fleet13	Fleet14	Fleet15	Fleet16
2003	1	78	783	88	571	200	80	58	96	0	291	0	84	0	2704	21	884
2003	2	85	2159	1881	0	0	416	6	156	0	71	403	0	0	0	1	0
2003	3	116	38	53	0	0	182	5	109	0	3	0	1	0	0	0	0
2003	4	1380	1144	556	0	609	54	15	0	266	47	0	1698	0	3620	1	0
2004	1	154	10	59	2100	2225	78	114	136	0	81	0	93	0	5285	3	1051
2004	2	205	2131	105	0	0	1868	94	186	0	68	421	0	0	0	0	0
2004	3	122	586	720	0	0	1173	164	379	0	15	0	0	0	0	0	0
2004	4	1602	1888	264	0	264	906	321	0	572	217	0	1330	0	1986	0	0
2005	1	106	3280	222	3694	77	293	171	414	0	137	0	71	0	2764	5	908
2005	2	108	3029	121	0	0	1034	30	346	0	102	413	0	0	0	0	0
2005	3	81	59	220	0	0	513	68	284	0	7	0	0	0	640	0	0
2005	4	873	2412	339	0	940	85	23	0	356	135	0	1127	0	4714	5	0
2006	1	115	252	354	2012	692	251	315	148	0	328	0	48	0	4573	2	1265
2006	2	62	2513	102	0	0	695	17	229	0	69	331	0	0	1	0	0
2006	3	61	485	376	0	0	228	32	253	0	10	0	0	0	0	0	0
2006	4	1022	1059	13	0	479	70	15	0	270	127	0	1356	0	1424	0	0
2007	1	66	363	121	2123	364	101	238	150	0	381	0	61	0	2723	1	1753
2007	2	71	1968	776	0	0	1985	105	314	0	52	1013	0	0	44	0	0
2007	3	99	214	581	0	0	619	12	268	0	2	0	0	0	0	0	0
2007	4	802	1610	1003	0	1	220	30	0	844	239	0	959	0	1794	1	0
2008	1	33	3007	62	3028	0	72	287	389	0	186	0	37	0	2613	10	1214
2008	2	40	2361	230	0	0	1163	14	455	0	95	797	0	0	1	0	0
2008	3	39	702	518	0	0	868	1	449	0	1	0	0	0	0	0	0
2008	4	662	2177	213	0	1	241	13	0	1031	276	0	811	0	1209	1	0
2009	1	26	2891	97	1299	828	62	108	180	0	181	0	85	0	2221	12	512
2009	2	23	181	112	0	0	703	43	143	0	106	677	0	0	3	0	0
2009	3	35	718	617	0	0	264	0	342	0	1	0	0	0	0	0	0
2009	4	400	1390	424	0	35	38	36	0	566	264	0	338	0	2447	4	0
2010	1	27	123	26	1052	35	20	179	190	0	79	0	45	0	5300	4	1127
2010	2	10	388	145	0	0	979	44	237	0	9	693	0	0	1	1	0
2010	3	25	67	191	0	0	492	29	374	0	4	0	0	0	0	0	0
2010	4	372	3058	429	0	0	298	34	0	380	384	0	273	0	451	2	0
2011	1	49	611	21	1906	320	39	38	158	0	148	0	48	0	2379	29	808
2011	2	32	2377	43	0	0	789	22	217	0	36	567	0	0	19	1	0
2011	3	20	9	163	0	0	242	70	360	0	5	0	0	0	1	0	0
2011	4	189	530	674	0	3	7	45	0	500	151	0	198	0	1286	4	0
2012	1	24	261	559	841	199	2	103	205	0	514	0	26	0	5421	35	346
2012	2	13	620	28	0	0	233	0	176	0	54	644	0	0	3	1	0
2012	3	28	9	76	0	0	256	2	273	0	4	0	0	0	0	0	0
2012	4	237	743	493	0	12	19	6	0	372	170	0	315	0	1368	3	0
2013	1	28	10	1	1729	268	22	81	132	0	204	0	40	0	1788	57	519
2013	2	15	2	35	0	0	477	3	217	0	82	895	0	0	8	4	0
2013	3	9	79	516	0	0	789	0	306	0	2	0	0	0	2	0	0
2013	4	311	2459	783	0	0	60	43	0	818	285	0	473	0	4036	1	0
2014	1	21	654	6	2203	47	40	125	92	0	231	0	22	0	1228	26	149
2014	2	26	14	6	0	0	97	1	107	0	110	679	0	0	2	2	0
2014	3	16	246	607	0	0	61	0	81	0	1	0	0	0	1	1	0
2014	4	237	440	5	0	409	21	1	0	395	261	0	542	0	2414	2	0

Table 5. Definition of abundance indices of Pacific bluefin tuna (*Thunnus orientalis*) for the stock assessment.

#	Abundance index	Available period (fishing year)	Corresponding fisheries	Corresponding fleet for the selectivity setting	Data quality	Document for reference	Note
S1	Japanese coastal longline CPUE for spawning season.	1993-2014	JP Longline	Fleet 1 (JPLL)	Standardized by ZINB	ISC/16/PBFWG-1/01	Updated
S2	Japanese offshore and distant water longliners CPUE	1952-1973	JP Longline	Fleet 1 (JPLL)	Standardized by lognormal model	ISC/12/PBFWG-1/10	
S3	Japanese offshore and distant water longliners CPUE	1974-1992	JP Longline	Fleet 1 (JPLL)		ISC/08/PBFWG-1/05	
S4	Japanese tuna purse seine CPUE in Sea of Japan (old series)	1987-2010	JP TPSJS	Fleet 4 (TPSJS)	Standardized	ISC/12/PBFWG-1/09	
S5	Japanese troll CPUE in Nagasaki prefecture (Sea of Japan and East China sea)	1994-2014	JP Troll	Fleet 6 (Troll)	Standardized by lognormal model	ISC/15/PBFWG-2/08	Updated
S6	Japanese troll CPUE combined with Kochi and Wakayama by catch weighted average	1994-2010	JP Troll	Fleet 6 (Troll)	Standardized by ZINB & combined by ad-hoc way	ISC/12/PBFWG-1/11	
S7	Japanese troll CPUE in Kochi prefecture (Pacific coast)	1981-2010	JP Troll	Fleet 6 (Troll)	Standardized by ZINB		
S8	Japanese troll CPUE in Wakayama prefecture (Pacific coast)	1994-2010	JP Troll	Fleet 6 (Troll)			
S9	Taiwanese longline CPUE	2000-2014	TW Longline	Fleet 12 (TWLL)	Standardized by GLMM	ISC/16/PBFWG-1/	Updated
S10	EPO purse seine CPUE by US target fisheries	1960-1982	US Commercial Fisheries (PS)	Fleet 13 (USCOMM)	Standardized by delta lognormal model	ISC/12/PBFWG-1/18	
S11	EPO purse seine CPUE by Mexico target fisheries	1999-2010	MX Commercial Fisheries (PS)	Fleet 14 (MXCOMM)			
S12	Japanese tuna purse seine CPUE in Sea of Japan (age 4)	2003-2014	JP TPSJS	Using age selectivity	Standardized by random forest	ISC/15/PBFWG-1/05	Not included in exchanged input file
S13	Japanese tuna purse seine CPUE in Sea of Japan (age 5)						

Table 6. Abundance indices (CPUE) of Pacific bluefin tuna (*Thunnus orientalis*) in fishing year for the stock assessment. S1, S2, S3, S5, and S9 will be used for the base case model. The data points which were removed are shown in grey letters.

Fishing year	Jpn LL			Jpn TPSJS	Jpn Troll				TW LL	EPO PS		Jpn TPSJS	
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13
1952		0.0140											
1953		0.0126											
1954		0.0112											
1955		0.0085											
1956		0.0058											
1957		0.0067											
1958		0.0160											
1959		0.0263											
1960		0.0197								1.04			
1961		0.0193								1.54			
1962		0.0175								1.40			
1963		0.0123								1.75			
1964		0.0128								1.05			
1965		0.0100								1.20			
1966		0.0128								1.93			
1967		0.0062								1.55			
1968		0.0056								0.58			
1969		0.0065								0.82			
1970		0.0046								0.99			
1971		0.0029								0.92			
1972		0.0028								1.35			
1973		0.0019								0.65			
1974		0.0066	0.0016							0.61			
1975			0.0011							1.25			
1976			0.0026							0.82			
1977			0.0029							0.51			
1978			0.0035							0.98			
1979			0.0023							0.72			
1980			0.0030		0.66		3.72			0.62			
1981			0.0035		1.16		0.82			0.34			
1982			0.0020		0.61		0.25			0.38			
1983			0.0012		0.91		0.21						
1984			0.0013		0.93		1.14						
1985			0.0012		0.87		0.77						
1986			0.0014		0.98		0.28						
1987			0.0014	709.5	0.71		0.16						
1988			0.0016	353.9	0.82		0.58						
1989			0.0024	598.8	0.65		0.32						
1990			0.0024		1.28		0.64						
1991			0.0038	289.1	1.31		0.58						
1992			0.0041	485.5	0.58		0.30						
1993	2.00		0.0051	600.3	0.49		0.51						
1994	1.39		0.0037	2402.0	2.02	2.36	3.20	1.40					
1995	1.97		0.0059	1169.3	1.08	0.84	1.05	0.78					
1996	1.72		0.0066	706.3	1.61	0.85	0.90	1.26					
1997	1.65		0.0053	459.5	0.95	0.46	0.48	0.71					
1998	1.33		0.0045	550.6	0.83	1.11	1.54	0.55					
1999	1.06		0.0039	766.1	1.52	0.25	0.33	0.18			20.47		
2000	0.84		0.0032	754.8	1.16	0.32	0.32	0.53	2.34		0.56		
2001	1.06		0.0030	438.6	1.16	1.56	2.11	0.94	0.97		0.55		
2002	1.30			459.7	0.75	0.67	0.83	0.62	1.72		0.24		
2003	1.50			474.9	0.65	0.32	0.40	0.30	1.81		2.38	178.36	175.83
2004	1.75			752.8	1.29	3.17	3.47	4.37	1.26		1.64	141.50	150.27
2005	0.80			856.7	1.42	0.87	0.99	1.08	1.27		0.51	131.96	149.53
2006	0.92			388.4	0.73	0.82	0.93	1.04	0.86		0.29	113.09	134.25
2007	0.70			865.7	1.41	1.27	1.47	1.51	0.86		0.27	118.06	131.70
2008	0.37			751.6	1.43	0.68	0.66	1.20	0.71		0.41	118.03	132.95
2009	0.26			585.1	1.16	0.08	0.08	0.13	0.38		1.64	117.53	132.49
2010	0.21			603.5	1.12	1.35	1.97	0.40	0.50		3.01	115.11	133.91
2011	0.18				0.96				0.30		0.48	117.33	146.69
2012	0.32				0.50				0.43			117.52	148.01
2013	0.34				0.84				0.69			122.61	147.99
2014	0.33				0.42				0.89			145.24	148.76

Table 7. Coefficient of variation (CV) of the abundance indices (CPUE) of Pacific bluefin tuna (*Thunnus orientalis*), estimated by the statistical model for the standardization. The data points which were removed are shown in grey letters.

Fishing year	Jpn LL			Jpn TPSJS	Jpn Troll				TW LL	EPO PS		Jpn TPSJS	
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13
1952		0.026											
1953		0.024											
1954		0.023											
1955		0.022											
1956		0.022											
1957		0.023											
1958		0.027											
1959		0.028											
1960		0.026								1.07			
1961		0.027								0.80			
1962		0.026								0.79			
1963		0.023								0.79			
1964		0.022								0.72			
1965		0.020								0.73			
1966		0.022								0.55			
1967		0.020								0.83			
1968		0.020								0.97			
1969		0.020								0.95			
1970		0.019								0.89			
1971		0.019								0.86			
1972		0.020								0.81			
1973		0.020								1.01			
1974		0.029	0.008							1.06			
1975			0.007							0.87			
1976			0.008							0.88			
1977			0.008							1.11			
1978			0.008							0.94			
1979			0.008							1.10			
1980			0.007		0.03		1.02			1.03			
1981			0.007		0.03		0.51			1.32			
1982			0.007		0.04		0.51			1.25			
1983			0.007		0.03		0.58						
1984			0.008		0.03		0.51						
1985			0.007		0.03		0.49						
1986			0.007		0.02		0.49						
1987			0.007	-	0.03		0.46						
1988			0.009	-	0.03		0.33						
1989			0.008	-	0.03		0.32						
1990			0.008		0.02		0.28						
1991			0.009	-	0.03		0.31						
1992			0.008	-	0.03		0.31						
1993	0.03		0.007	-	0.03		0.24						
1994	0.03		0.008	-	0.02	-	0.19	0.09					
1995	0.03		0.008	-	0.03	-	0.21	0.11					
1996	0.03		0.008	-	0.02	-	0.19	0.06					
1997	0.03		0.008	-	0.03	-	0.23	0.08					
1998	0.03		0.008	-	0.03	-	0.22	0.15					
1999	0.04		0.008	-	0.02	-	0.21	0.11			1.90		
2000	0.02		0.007	-	0.03	-	0.21	0.09	-		0.77		
2001	0.02		0.008	-	0.03	-	0.20	0.07	-		0.93		
2002	0.03			-	0.03	-	0.21	0.08	-		0.75		
2003	0.02			-	0.03	-	0.23	0.13	-		0.63	0.18	0.12
2004	0.02			-	0.02	-	0.23	0.08	-		0.60	0.16	0.10
2005	0.03			-	0.03	-	0.19	0.07	-		0.64	0.15	0.10
2006	0.03			-	0.04	-	0.21	0.09	-		0.58	0.17	0.10
2007	0.04			-	0.03	-	0.20	0.08	-		0.59	0.17	0.11
2008	0.07			-	0.02	-	0.23	0.10	-		0.61	0.18	0.11
2009	0.06			-	0.03	-	0.25	0.14	-		0.68	0.20	0.11
2010	0.10			-	0.03	-	0.22	0.11	-		0.60	0.20	0.11
2011	0.06				0.03				-		0.62	0.19	0.12
2012	0.04				0.03				-			0.19	0.12
2013	0.04				0.03				-			0.19	0.11
2014	0.05				0.05				-			0.20	0.11

*1: CVs of S2 index are based on the output file of the standardization work (Fujioka K. pers. comm.). The others are based on the reference doc.

Table 8. Summary of the size composition data of Pacific bluefin tuna (*Thunnus orientalis*) for the stock assessment.

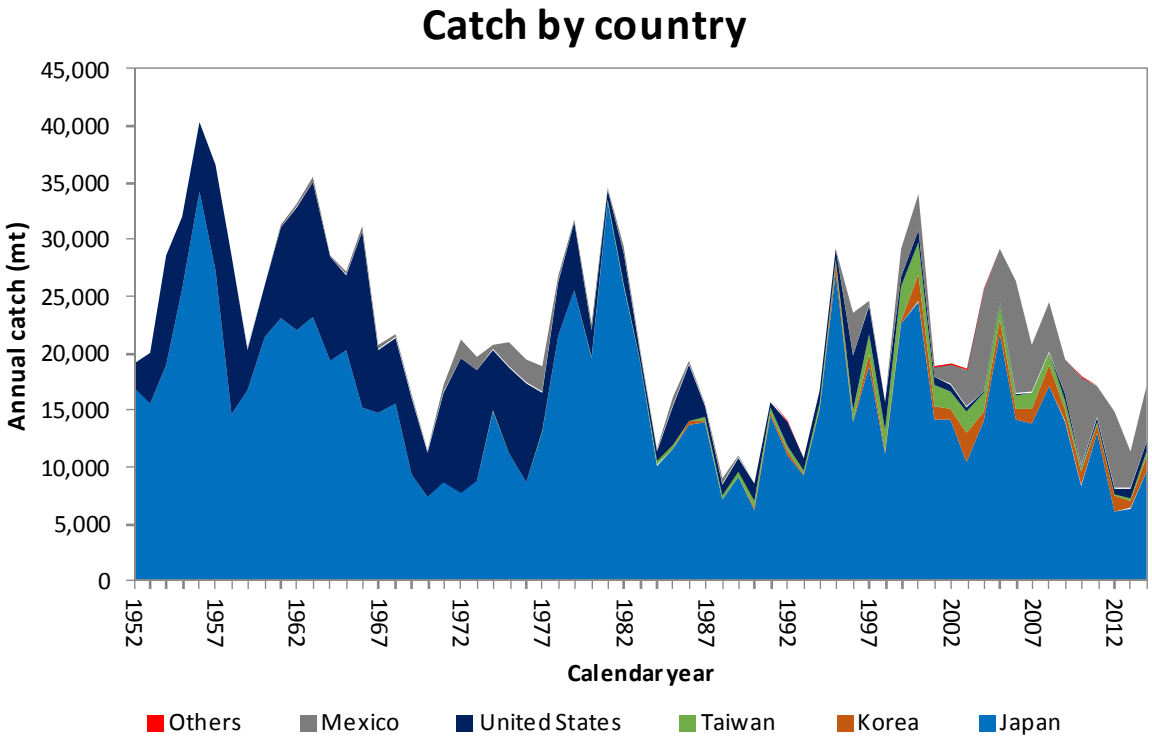
Fleet #	Fleet name	Unit of Comp data	Size bin definition	Size data included		Source of sample size
				Component 1	Component 2	
Fleet1	JPLL	Length	Length bin	JPLL		Scaled Number of fish measured
Fleet2[*1]	JPSPPS	Length	Length bin	JPSPPS	KROLPS	Number of landing well measured
Fleet3[*1]	KROLPS	Length	Length bin	KROLPS		
Fleet4	TPSJS	Length	Length bin	JP TPSJS		same value with the last assessment
Fleet5	TPSPO	Length	Length bin	JP TPSPO		Number of landing well measured
Fleet6	Troll	Length	Length bin	JP Troll		Total month of well sampled port
Fleet7	PL	Length	Length bin	JP Pole-and-Line		
Fleet8	SetNet_Seas1-3	Length	Length bin	JP Setnet (Season 1-3)		Total month of well sampled port
Fleet9	SetNet_Seas4	Length	Length bin	JP Setnet (Season 4)		Total month of well sampled port
Fleet10[*2]	SetNet_HK_AM	Weight	Weight bin	JP Setnet in Hokkaido and Aomori	JP Handline & Tsugaru Longline	Total month of well sampled port
Fleet11[*2]	JP Others	Weight	Weight bin	JP Handline & Tsugaru Longline		Total month of well sampled port
Fleet12	TWLL	Length	Length bin	TW Longline		Scaled Number of fish measured
Fleet13	USCOMM (-2001)	Length	Length bin	US Commercial Fisheries (PS)		Number of haul well measured
Fleet14	MXCOMM (2002-)	Length	Length bin	MX Commercial Fisheries (PS)		Number of haul well measured
Fleet15	EPOSP	Length	Length bin	US Recreational Fisheries		
Fleet16[*3]	Troll4Pen	Length (dummy)		JP Troll		

*1 Size composition data of Fleet 2 and 3 are already combined. A selectivity pattern is estimated and shared by those two fleets.

*2 Size composition data of Fleet 10 and 11 are already combined. A selectivity pattern is estimated and shared by those two fleets.

*3 Size composition data of Fleet 16 is a dummy data which is copy&paste of Fleet 6.

(a)



(b)

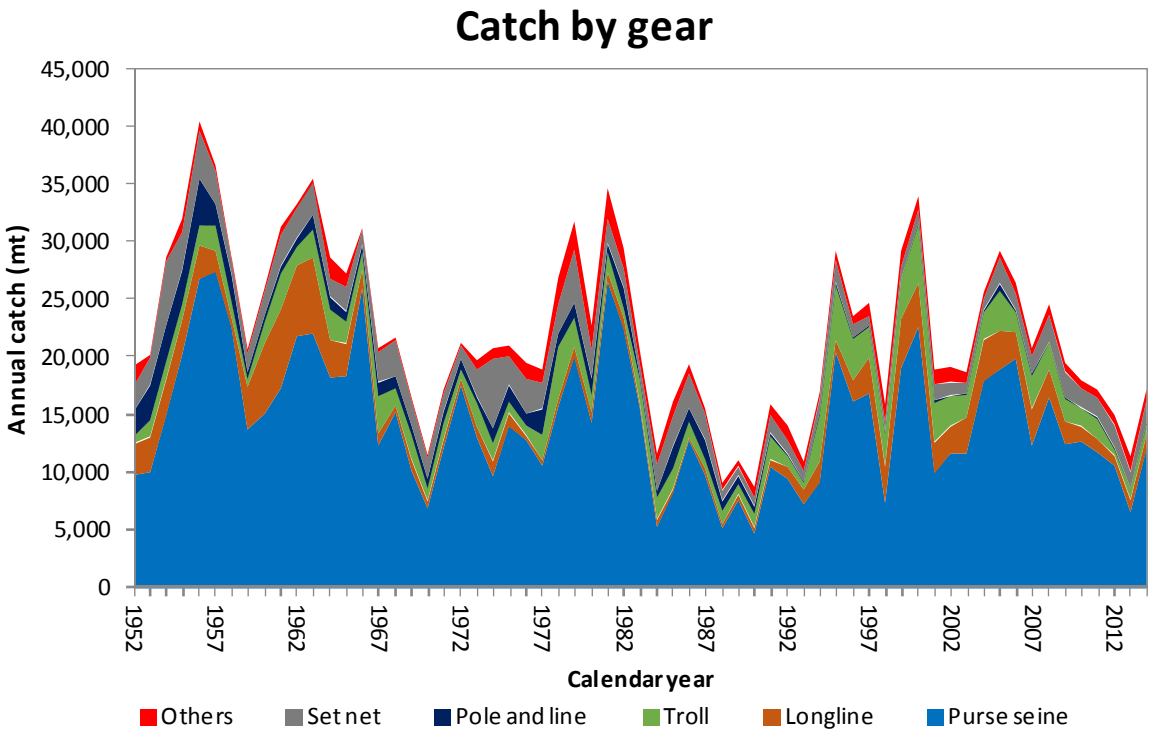
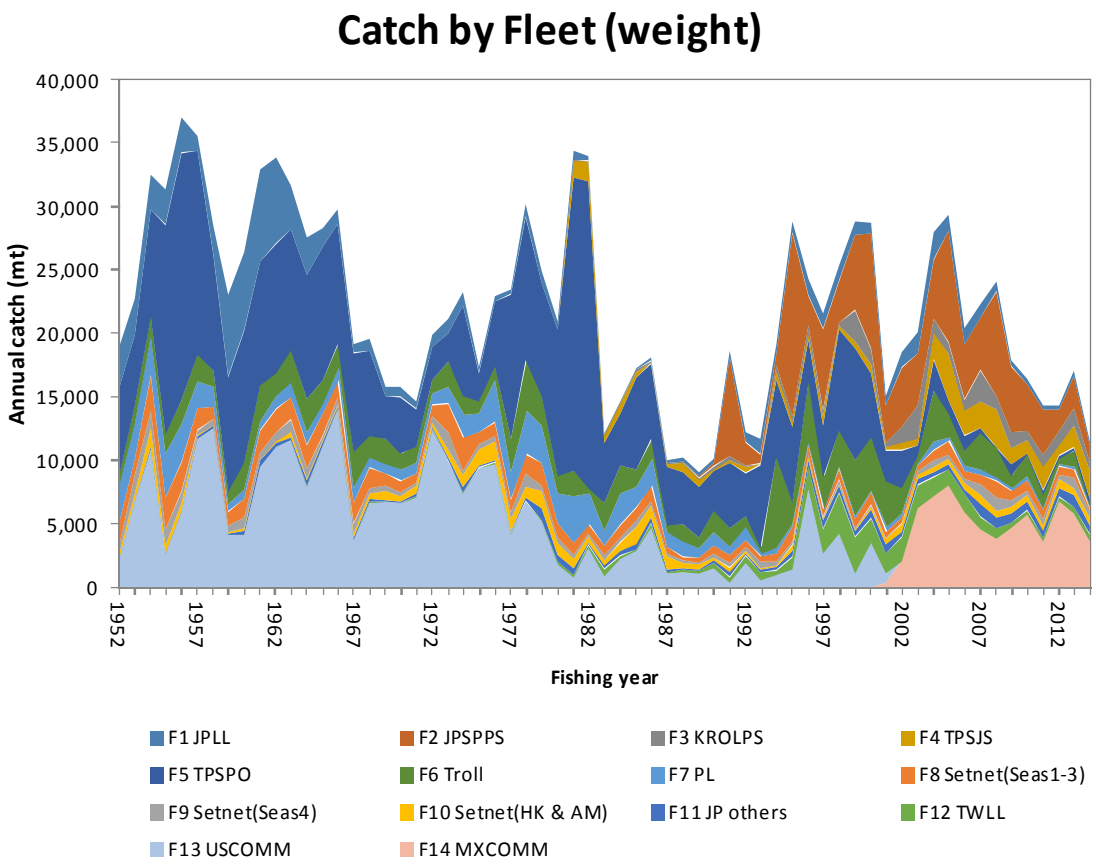


Fig. 1. Historical annual catch of Pacific bluefin tuna (*Thunnus orientalis*) by country (a: upper panel) and by gear (b: lower panel), for calendar year 1952-2014.

(a)



(b)

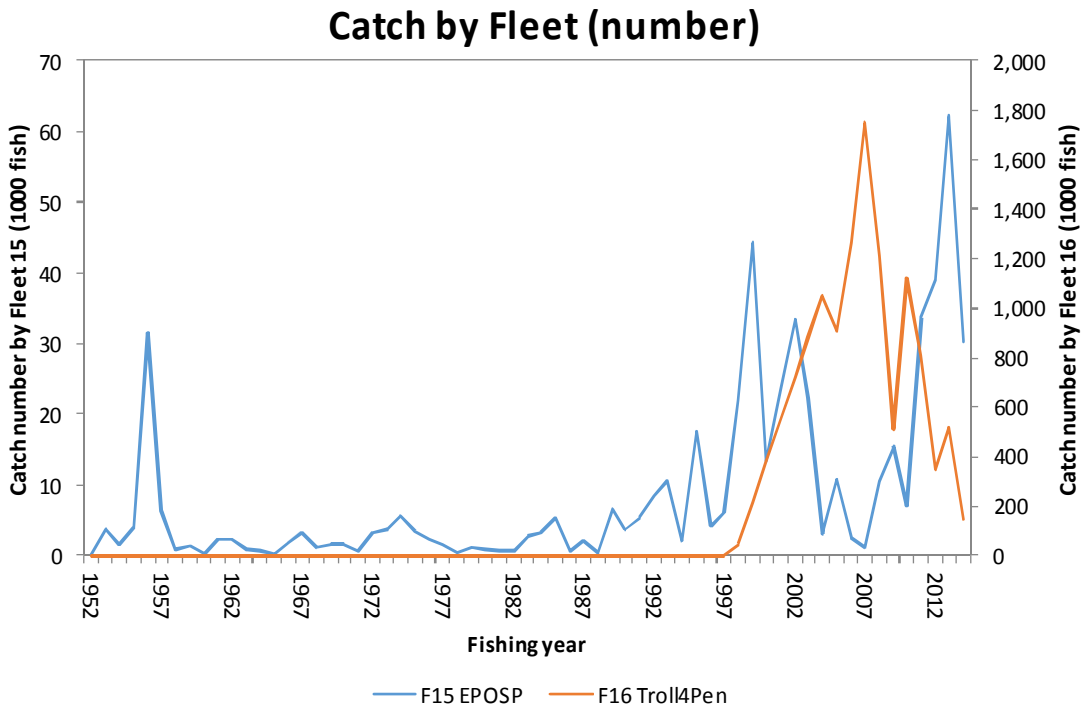


Fig. 2. Historical annual catch of Pacific bluefin tuna (*Thunnus orientalis*) by Fleet 1-14 (a: upper panel) and by Fleet 15 and 16 (b: lower panel), for fishing year 1952-2014.

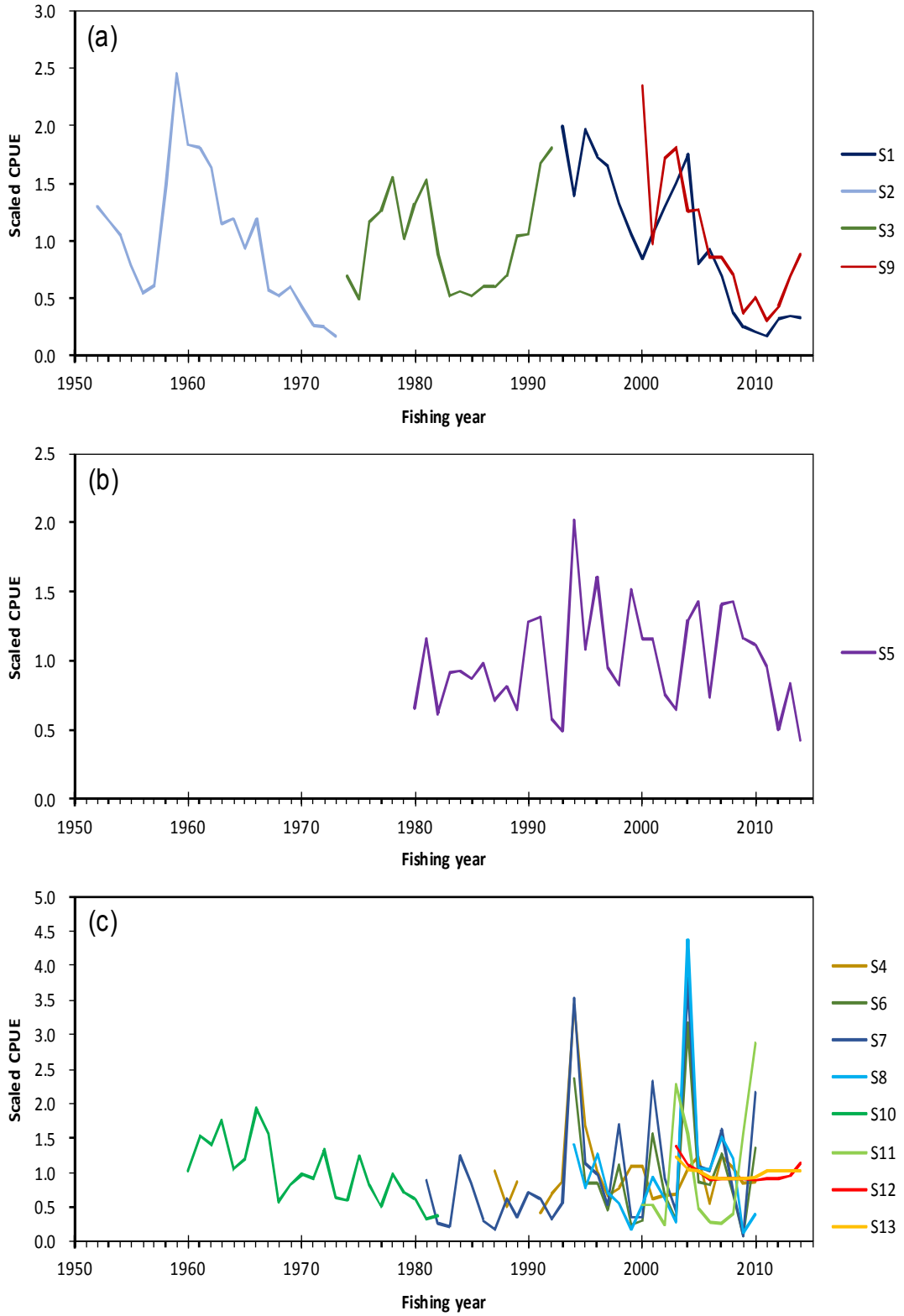


Fig. 3. Abundance indices of Pacific bluefin tuna (*Thunnus orientalis*) submitted to ISC PBFWG. The longline indices of Japanese fisheries (S1, S2, and S3) and Taiwanese fishery (S9) will be used to represent adult abundance (Fig.-(a)), and the index of Japanese troll fishery (S5) will be used to recruitment index (Fig.-(b)). The other indices would not be used for the base case assessment model (Fig.-(c)); e.g. the indices of Japanese tuna purse seine (S4, S12, S13), Japanese troll fisheries (S6, S7, S8), and EPO purse seine (S10, S11).

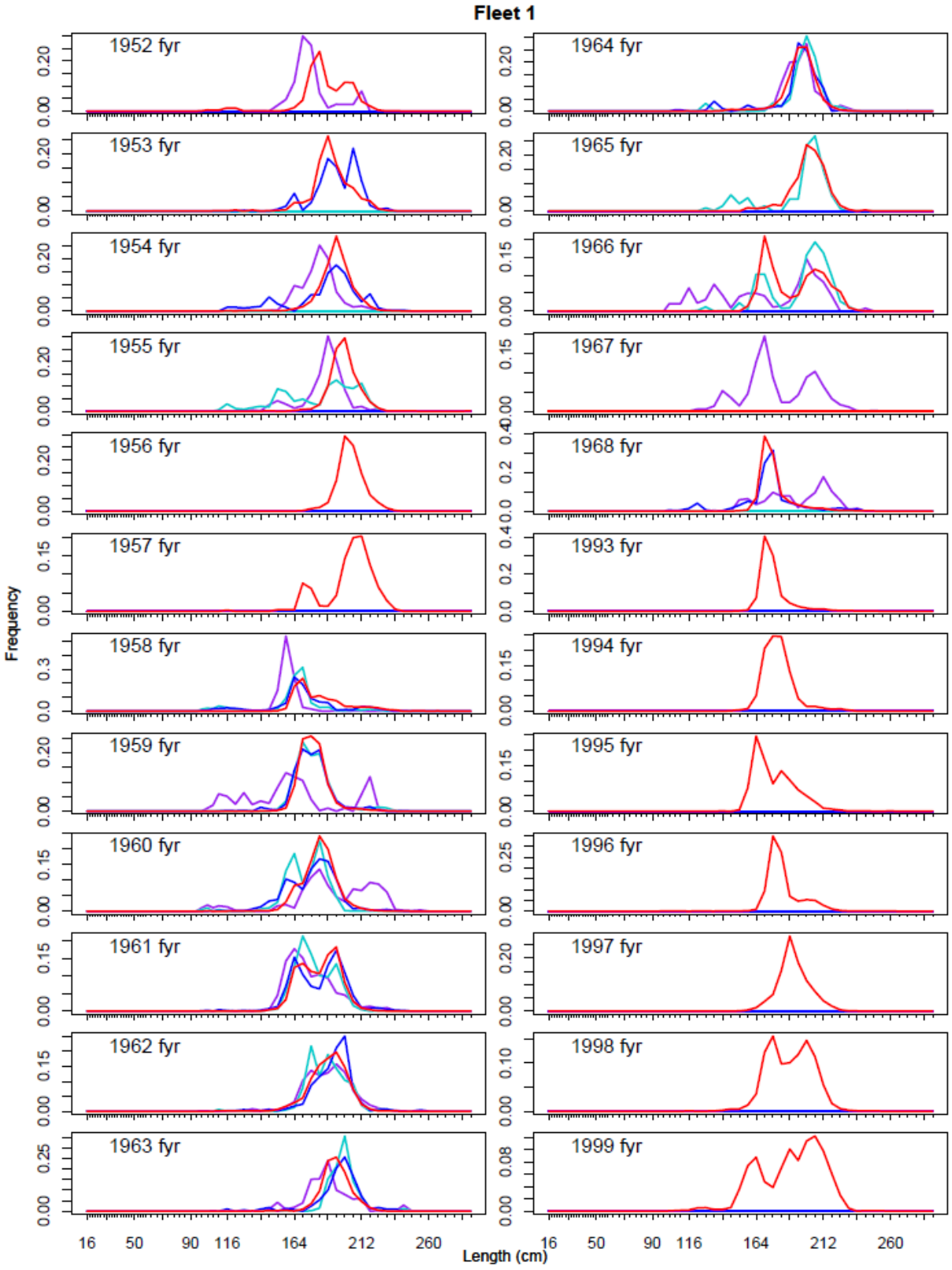


Fig.4. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) for Fleet 1 (JPLL). Fork length frequency is available from 1952 to 1968, and from 1993 to 2014 (fishing year).

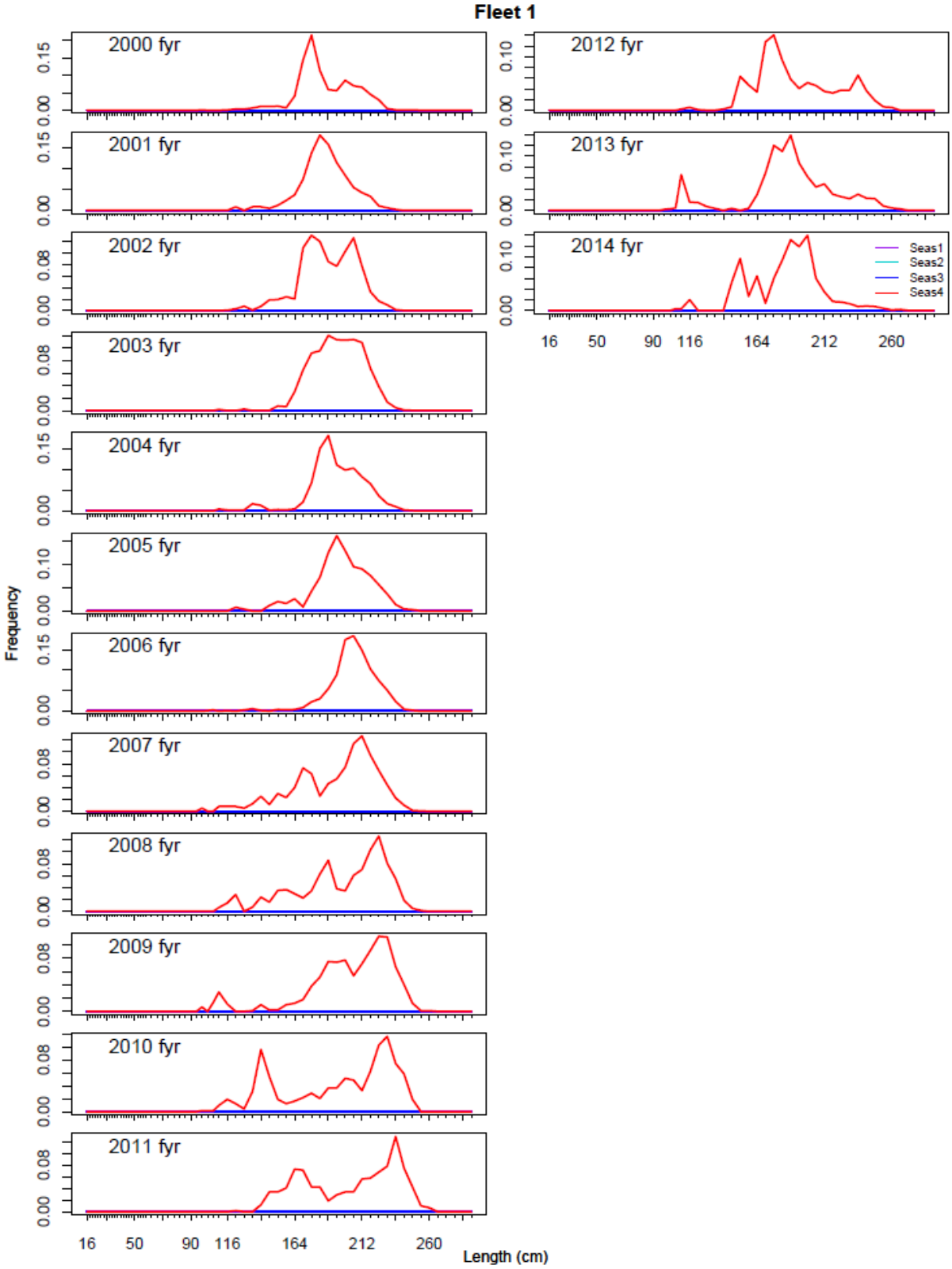

Fleet 1
2000 fyr
2001 fyr
2002 fyr
2003 fyr
2004 fyr
2005 fyr
2006 fyr
2007 fyr
2008 fyr
2009 fyr
2010 fyr
2011 fyr
2012 fyr
2013 fyr
2014 fyr
Seas1
Seas2
Seas3
Seas4
Frequency
Length (cm)
16
50
90
116
164
212
260

Fig. 4. Cont.

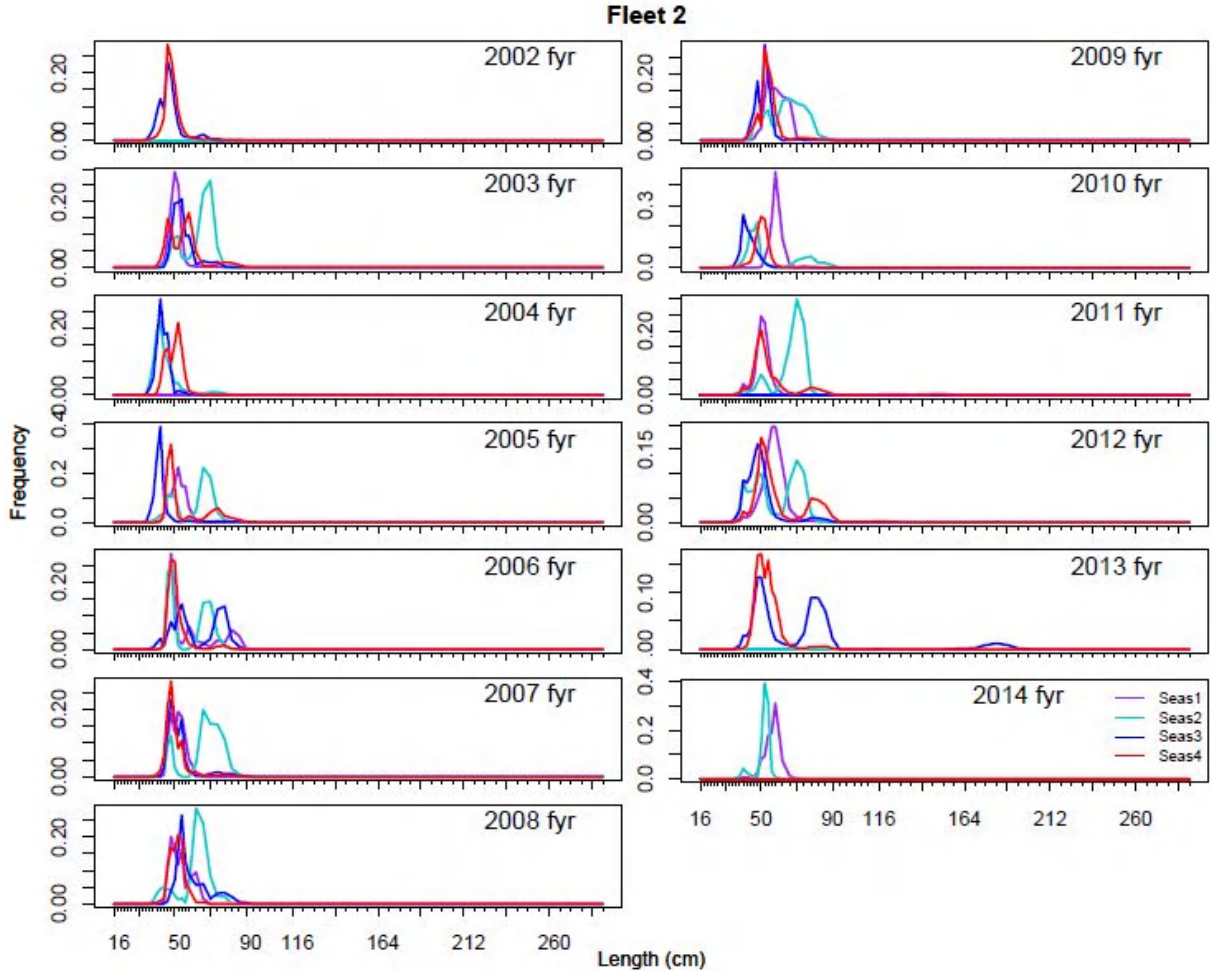


Fig.5. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) for Fleet 2 (JPSPPS) and Fleet 3 (KROLPS). Fork length frequencies from both fleets are combined. The data is available from 2002 to 2014 (fishing year).

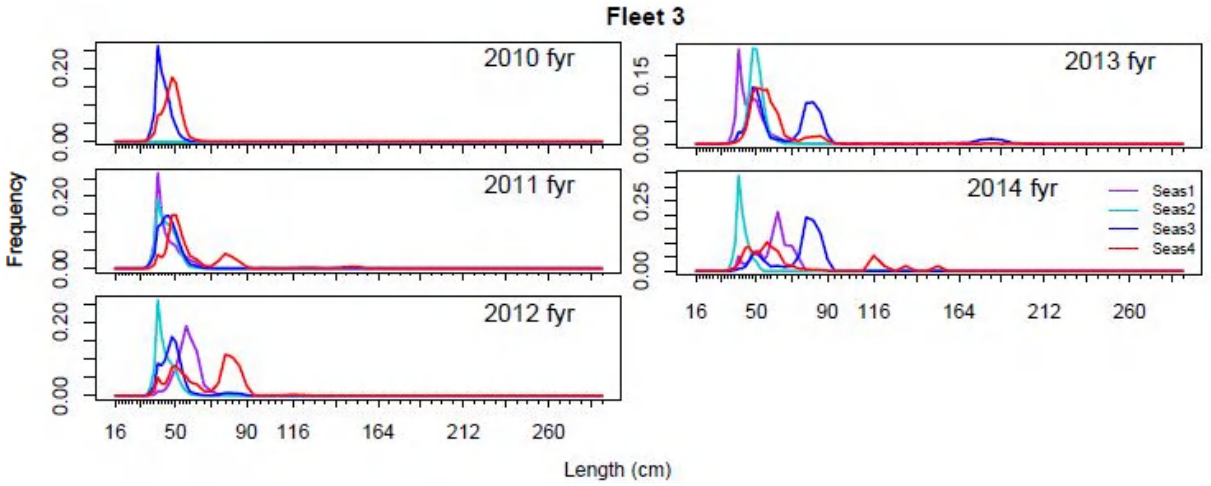


Fig.6. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) of Fleet 3 (KROLPS). These data are included in the size composition data shown in Fig. 5 (combined size composition). Size composition data from 2010 to 2014 (fishing year) are provided from Fleet 3.

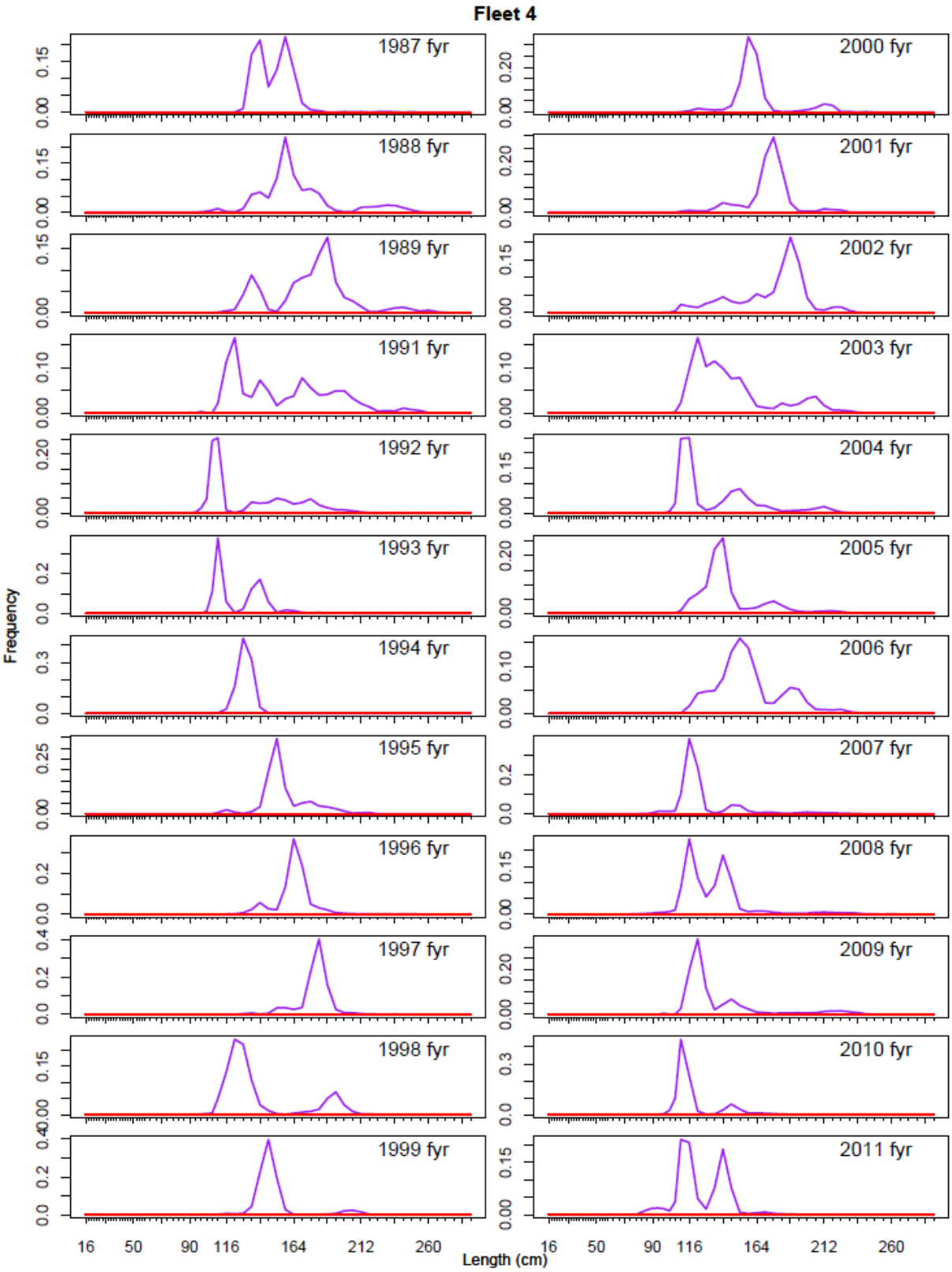


Fig.7. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) for Fleet 4 (TPSJS). Fork length frequency is available from 1987 to 1989, and from 1991 to 2014 (fishing year).

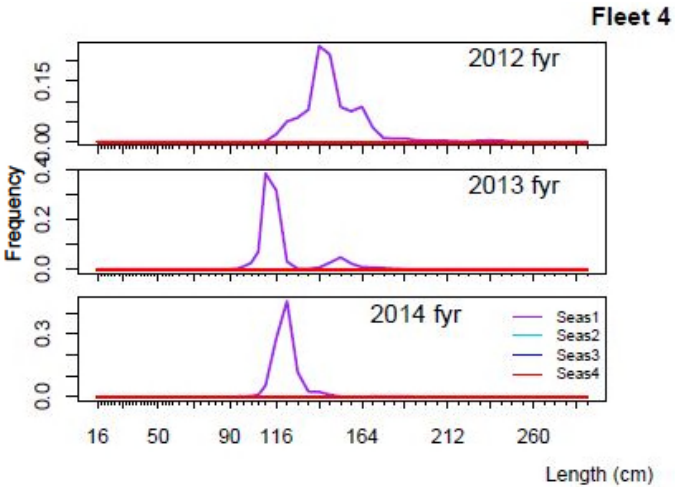


Fig. 7. Cont.

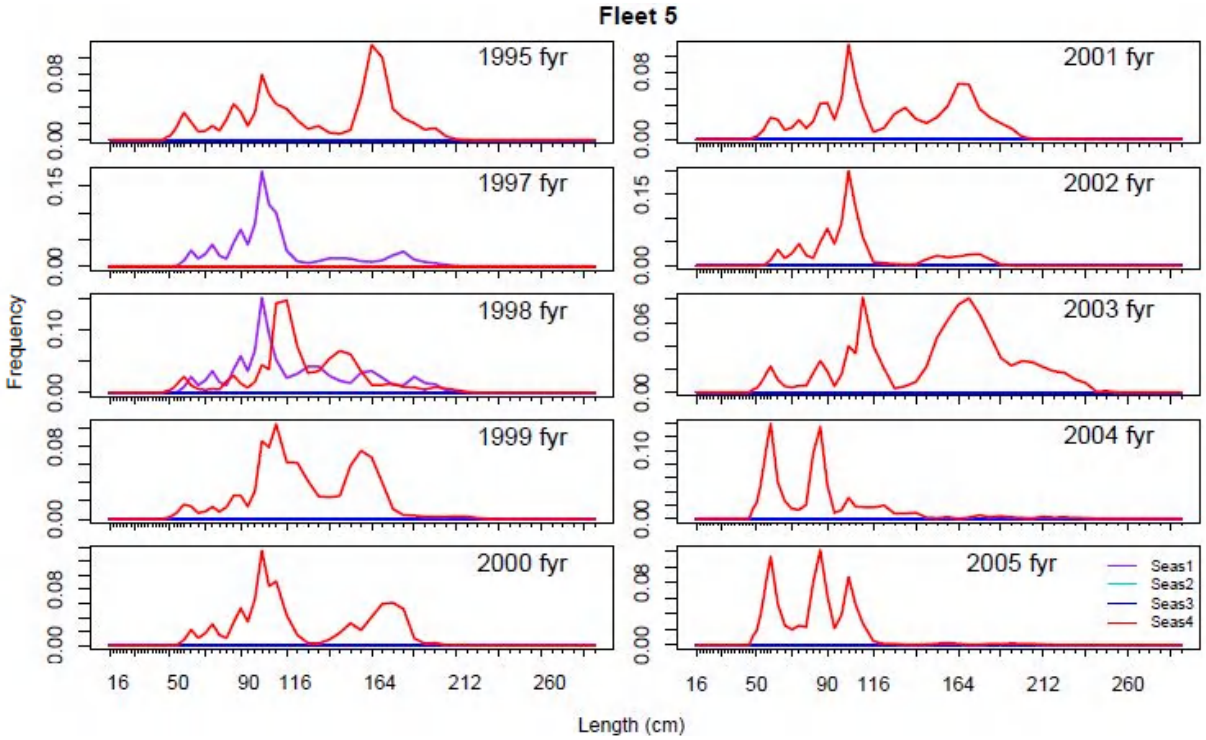


Fig.8. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) for Fleet 5 (TPSPO). Fork length frequency is available for 1995, 1997-2005 (fishing year).

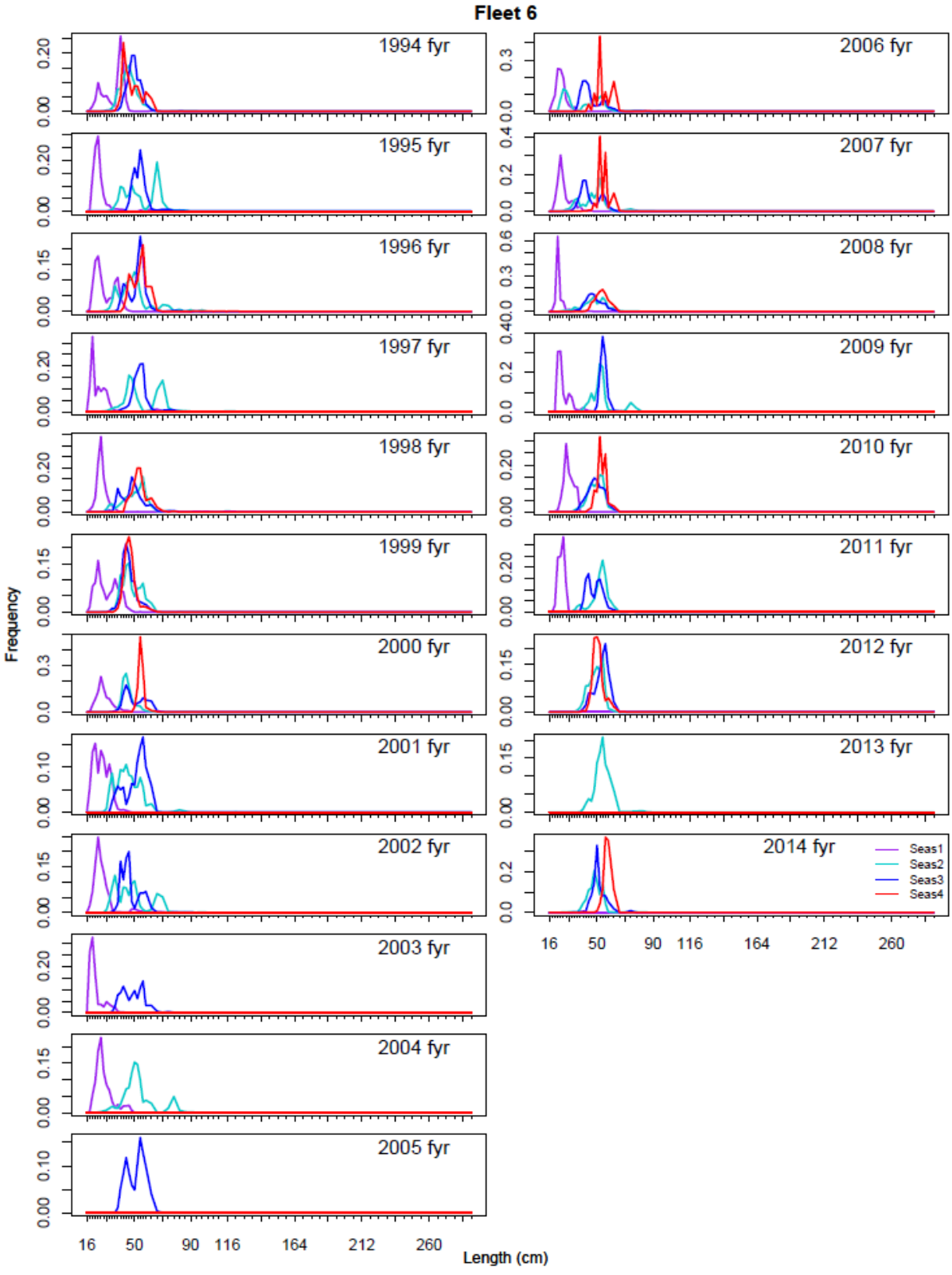


Fig.9. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) for Fleet 6 (Troll). Selectivity pattern estimated from this data-set is also used for Fleet 7 (PL). Fork length frequency is available from 1994 to 2014 (fishing year).

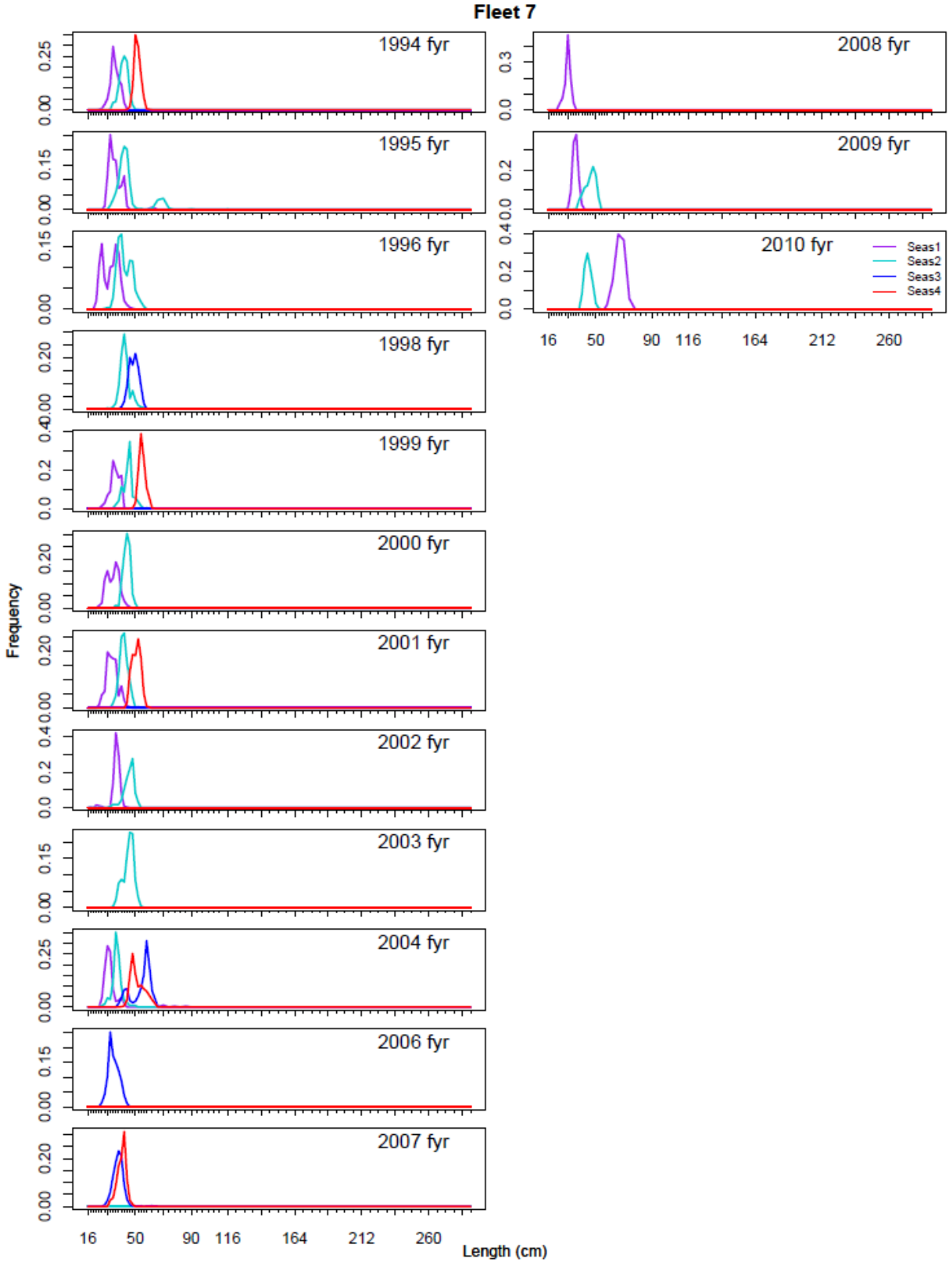


Fig.10. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) of Fleet 7 (PL). Fork length frequency is provided from this fleet for 1994-1996, 1998-2004, and 2006-2010 (fishing year). These data-set are not used for the estimation of selectivity for Fleet 7.

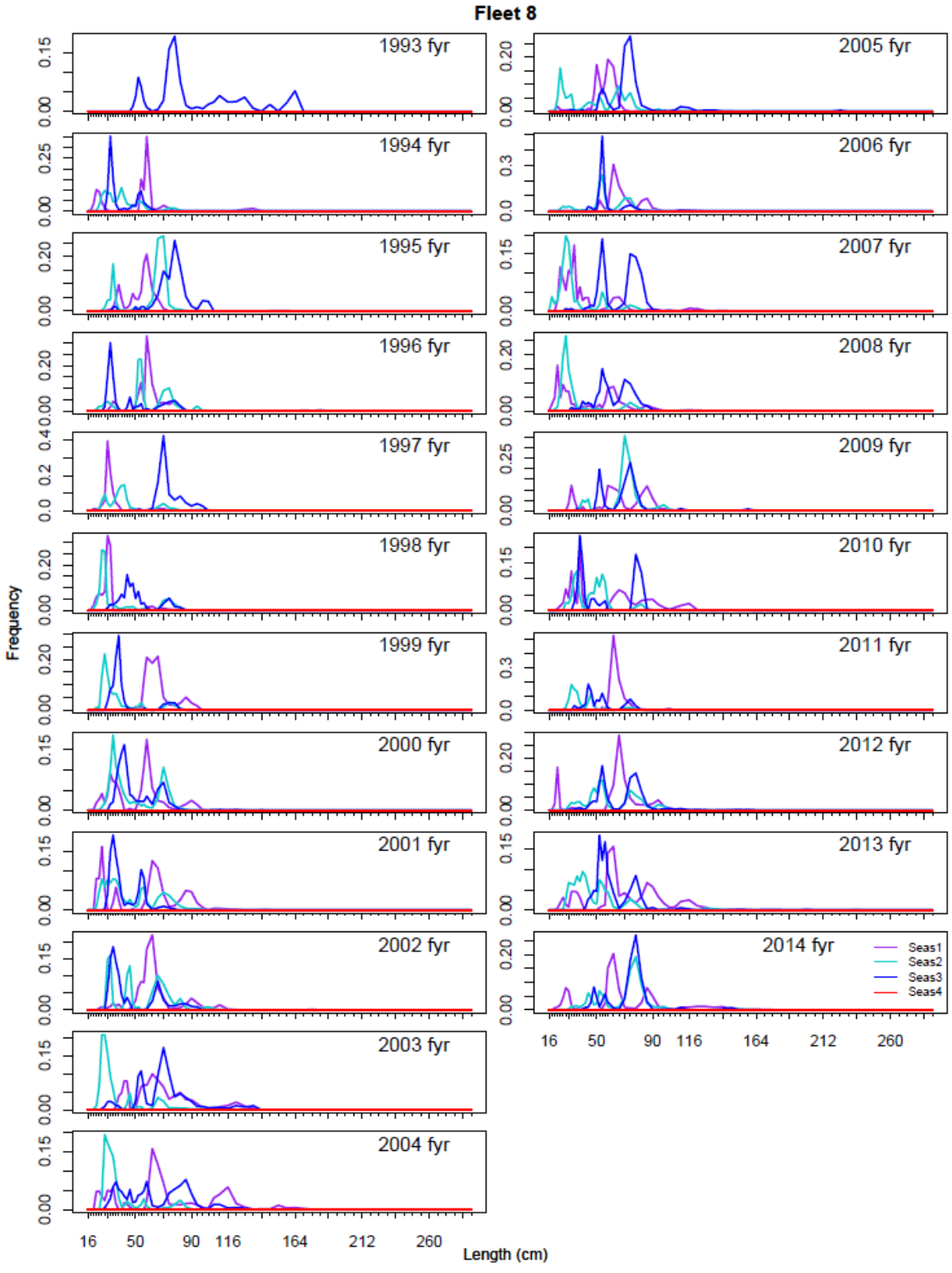


Fig.11. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) for Fleet 8 (SetNet Season 1-3). Fork length frequency is available from 1993 to 2014 (fishing year).

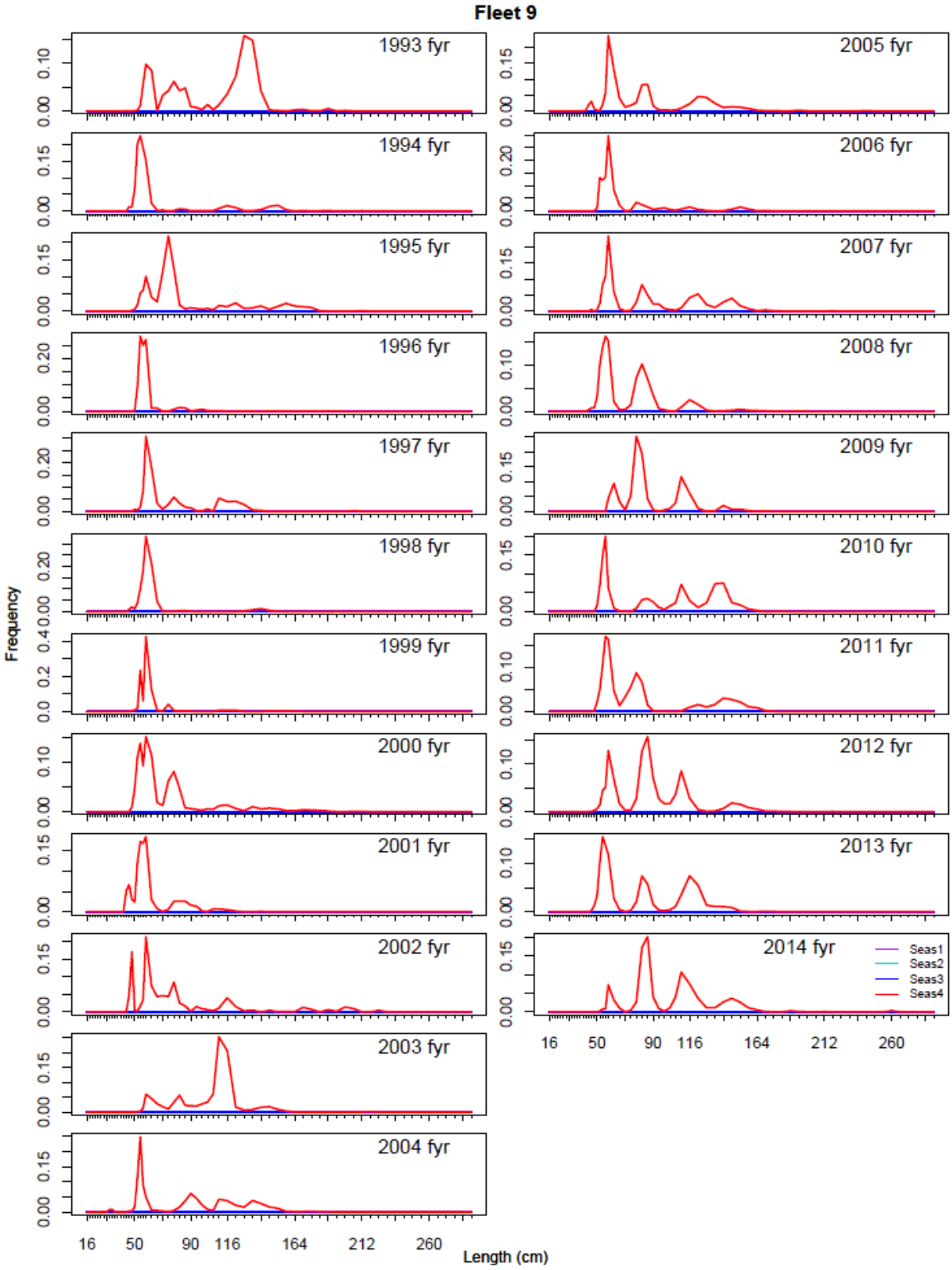


Fig.12. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) for Fleet 9 (SetNet Season 4). Fork length frequency is available from 1993 to 2014 (fishing year).

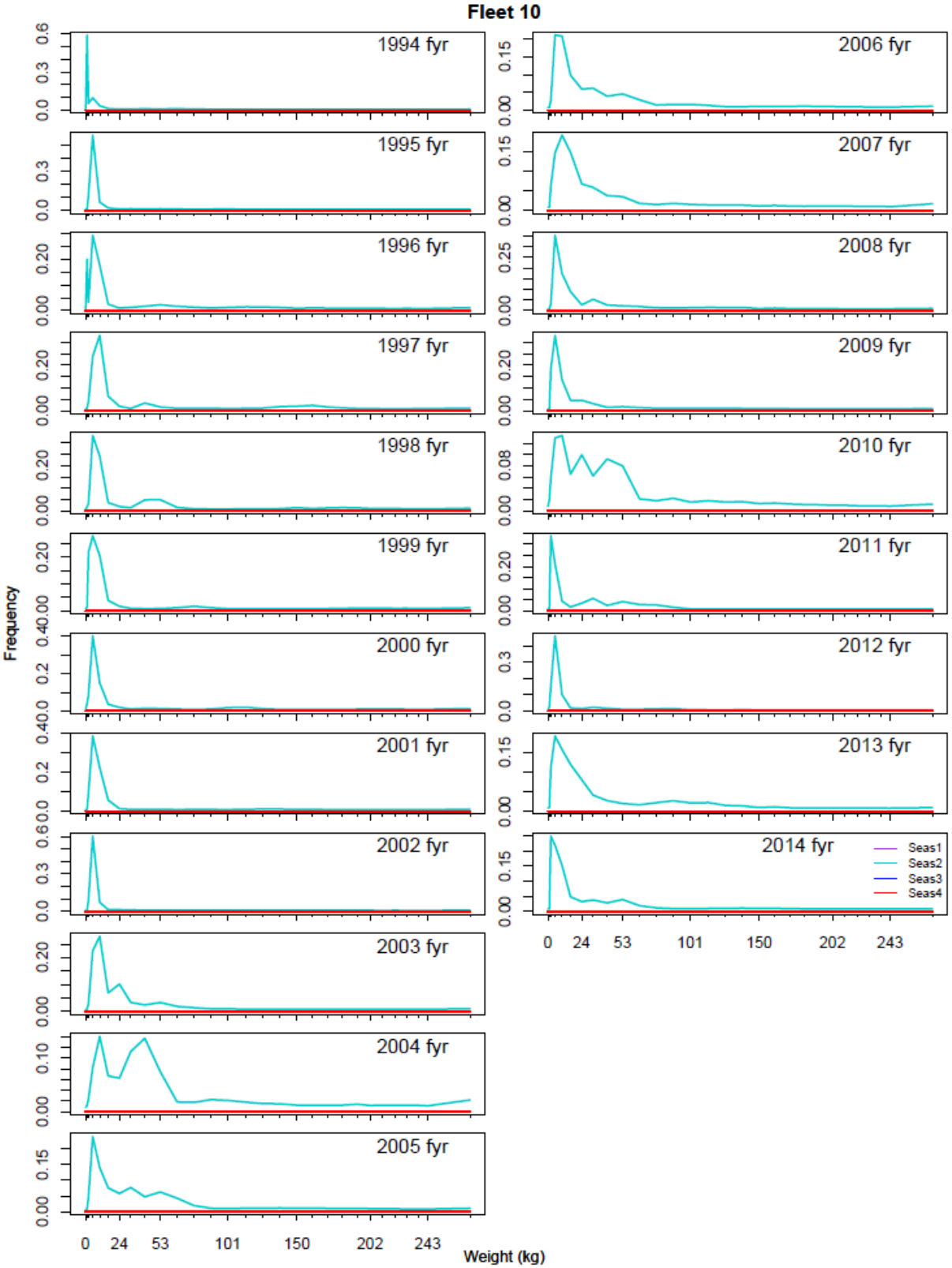


Fig.13. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) for Fleet 10 (SetNet in Hokkaido and Aomori prefectures) and Fleet 11 (JP Others). Weight frequencies from both fleets are combined. The data is available from 1994 to 2014 (fishing year).

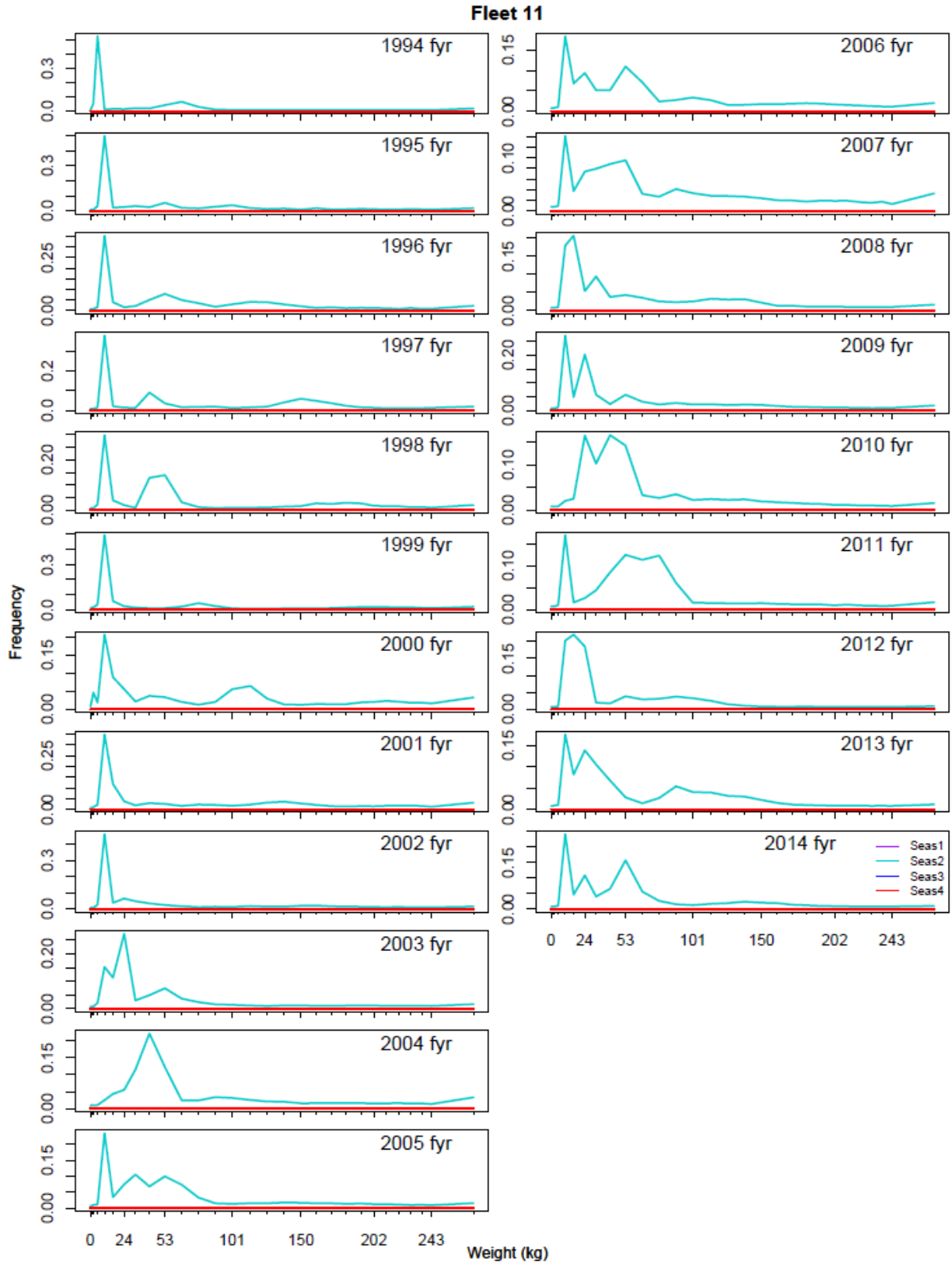


Fig.14. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) of Fleet 11 (JP Others). These data are included in the size composition data shown in Fig. 11 (combined size composition). Weight composition data from 1994 to 2014 (fishing year) are provided from Fleet 11.

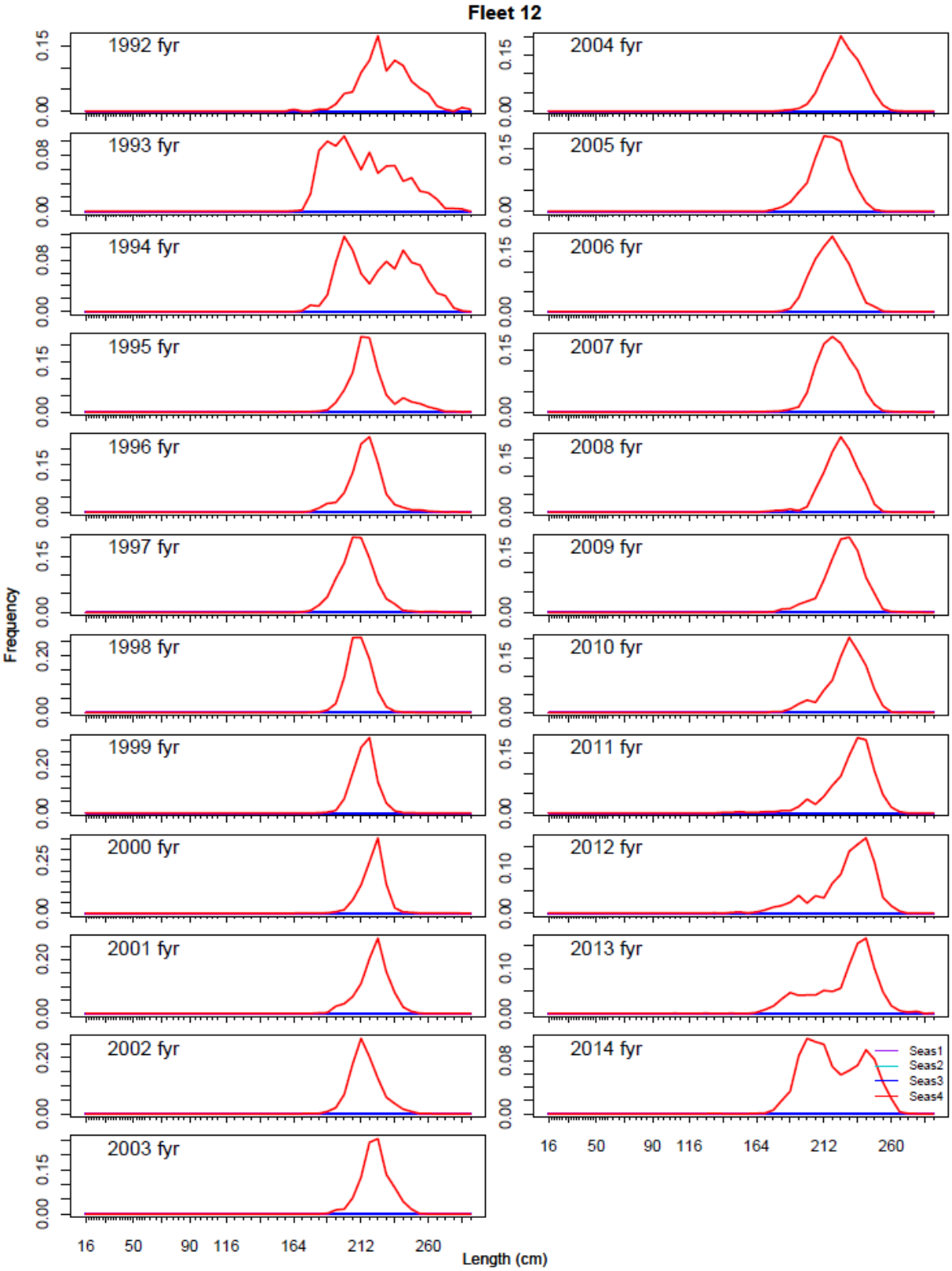


Fig.15. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) for Fleet 12 (TWLL). Fork length frequency is available from 1992 to 2014 (fishing year).

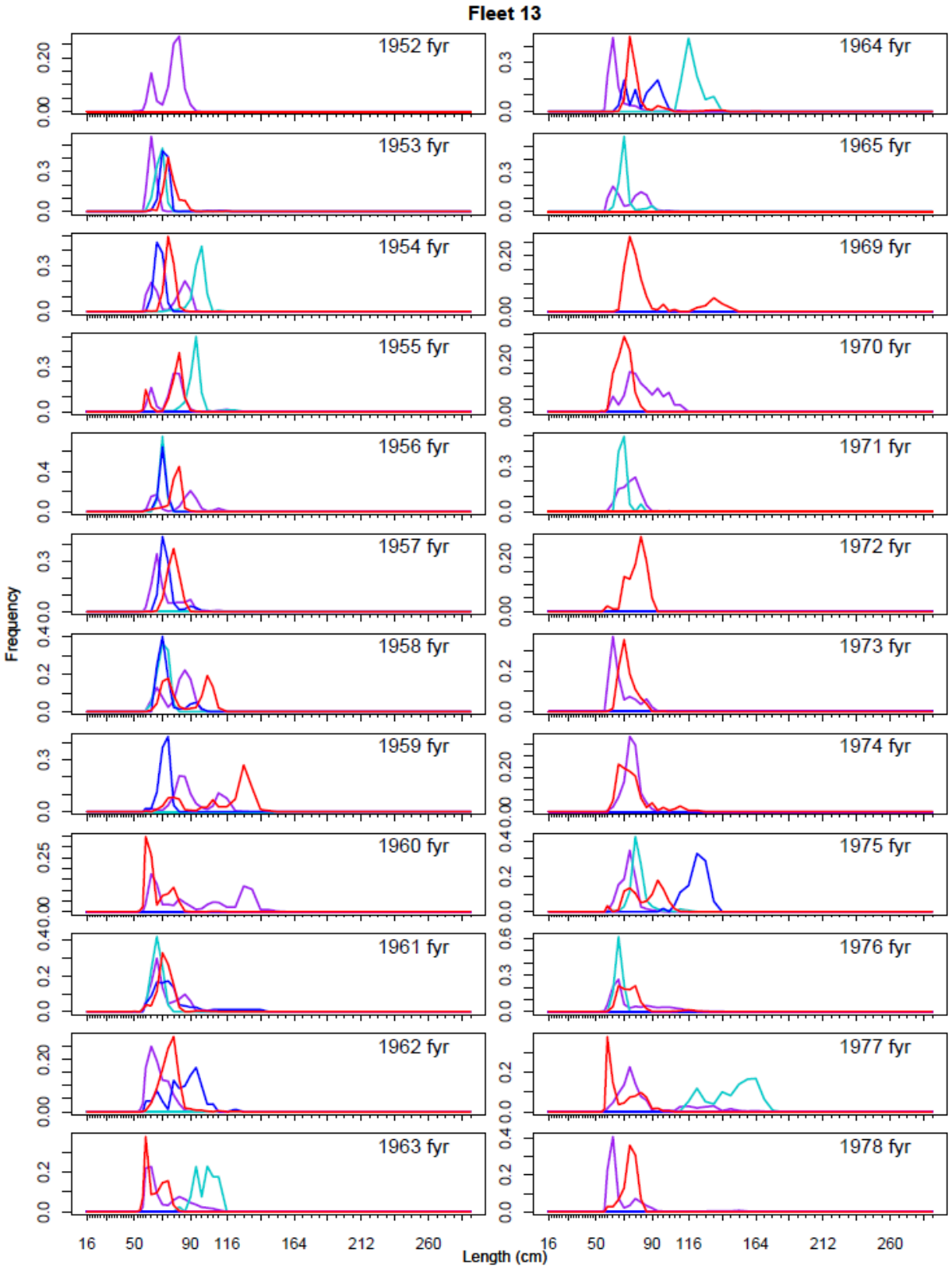


Fig.16. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) for Fleet 13 (USCOMM). Selectivity pattern estimated from this data-set is also used for Fleet 15 (EPOSP). Fork length frequency is available from 1952 to 1965, and from 1969 to 1982 (fishing year).

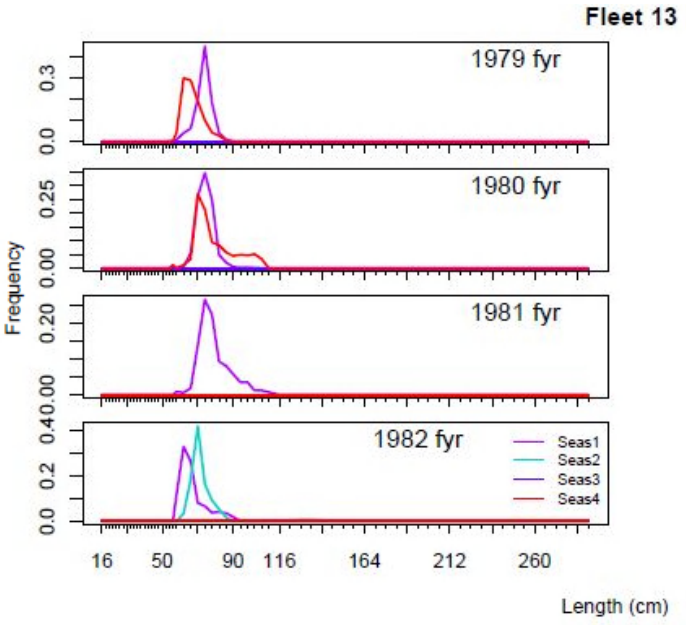


Fig.16. Cont.

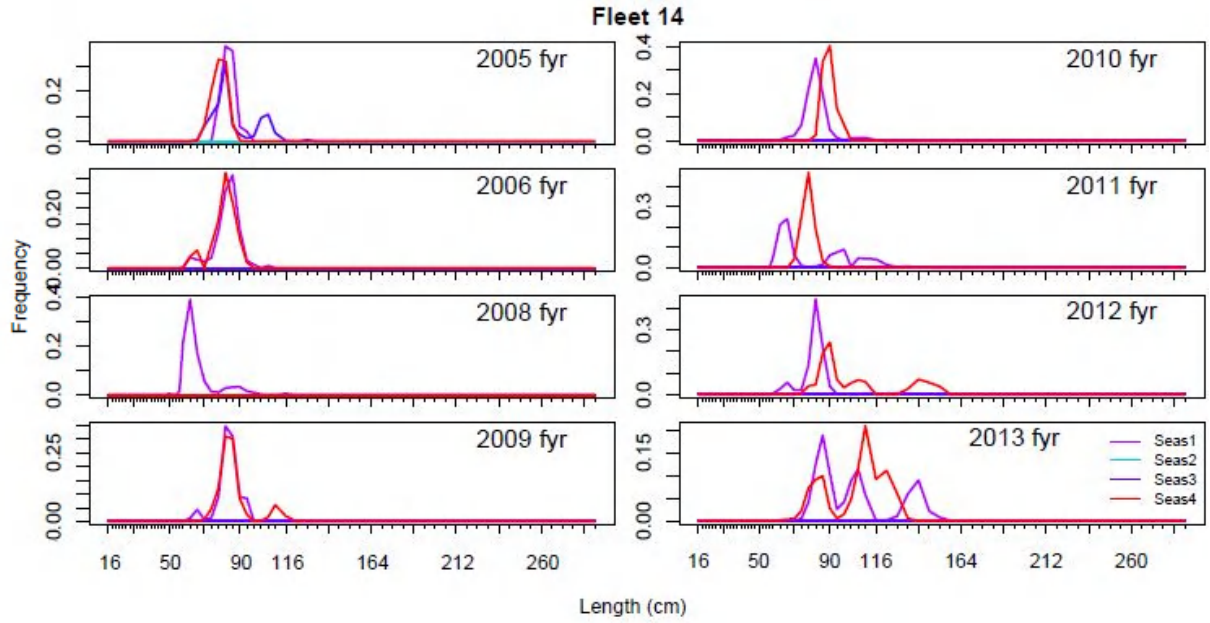


Fig.17. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) for Fleet 14 (MXCOMM). Fork length frequency is available in 2005-06 and 2008-13 (fishing year).

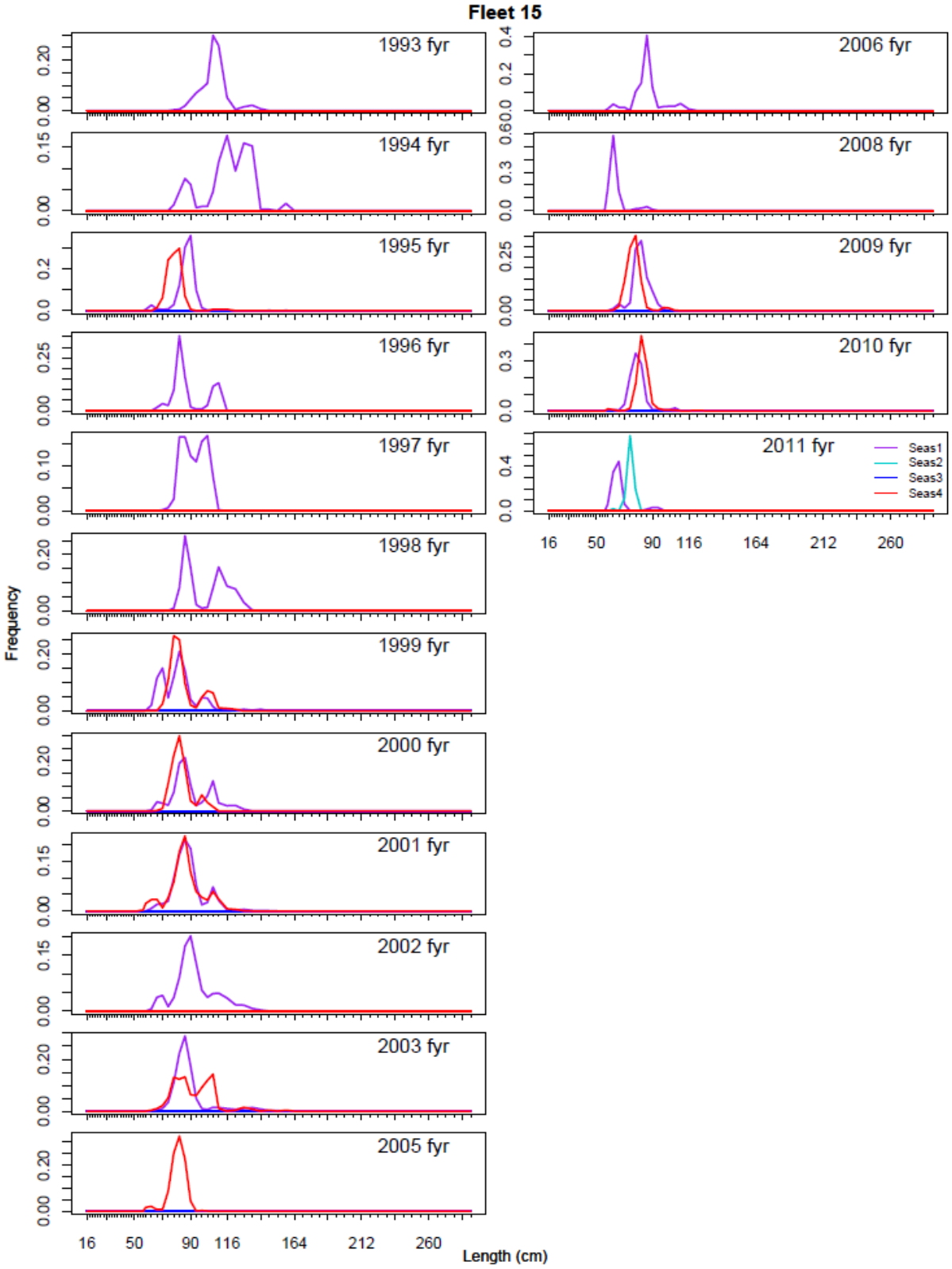


Fig.18. Size composition data of Pacific bluefin tuna (*Thunnus orientalis*) of Fleet 15 (EPOSP). These data-set are not used for the estimation of selectivity for Fleet 15. Fork length composition data in 1993-2003, 2005-2006, and 2008-2011 (fishing year) are provided from Fleet 15.