Input data of Pacific bluefin tuna fisheries for stock assessment model, Stock Synthesis 3; Update for 2024 assessment

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1.1. Spatial Stratification

PBFs are widely distributed across the North Pacific Ocean and are considered to be a single stock (Nakatsuka 2019). Juvenile PBFs move between the western Pacific Ocean (WPO) and the eastern Pacific Ocean (EPO) (Itoh et al. 2003, Boustany et al. 2010) before returning to the WPO for spawning. However, due to the absence of direct information on movement rates, a true spatial model has not yet been used for assessment purposes. Instead, this and previous assessments have relied on the assumption of an instantaneously mixed population and have incorporated regional selection patterns to implicitly model space (referred to as the "areas-as-fleets approach", Waterhouse et al. 2014). The effectiveness of the areas-as-fleets approach used by the PBFWG was evaluated in a simulation study, indicating that while the use of alternative model processes (i.e., selectivities) is not as effective as a true spatially explicit model, management quantities can still be well estimated when fishery selection is properly set up to account for both availability (spatial patterns) and contact gear selectivity (Lee et al. 2017). The development of a spatially explicit model remains to be an area for future research.

1.2. Temporal Stratification

A "fishing year" is defined as the period from July 1st to June 30th of the following calendar year. For example, the 2022 fishing year spans from July 1st, 2022 to June 30th, 2023. Unless stated otherwise, the term "year" in this report refers to the fishing year. The assessment of PBF covers the period from 1983 to 2022, 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.

Recruitment is assumed to occur at the beginning of "fishing month 1" (July in the calendar month) in the assessment model. The relationships between calendar year, fishing year, and year class are shown in Table 1-1.

1.3. Fishery Definition

A total of 26 fisheries were delineated for the PBF stock assessment based on stratification of country, gear type, season, area, and size of fish caught (Table 3-1). Below are the representative fisheries for each fleet:

Fleet 1: Japanese longline fisheries (JPN_LL) for all seasons for 1983-1992, and for season 4 for 1993-2016,

Fleet 2: Japanese longline fisheries (JPN_LL) for seasons 1-3 for 1993-2016 and all seasons for 2017-2022,

Fleet 3: Taiwanese longline fishery (TWN_LL) in southern fishing ground for 1983-2022,

Fleet 4: Taiwanese longline fishery (TW_LL) in northern fishing ground for 2000-2022,

Fleet 5: Japanese tuna purse seine fishery off the Pacific coast of Japan (JPN_TPS_ PO) for 1983-2022,

Fleet 6: Japanese tuna purse seine fishery in the Sea of Japan (JPN_TPS_SOJ) for 1983-2022,

Fleet 7: Japanese tuna purse seine fishery in the Sea of Japan for farming (JPN_TPS_SOJ Farming) for 2016-2022,

Fleet 8: Japanese small pelagic fish purse seine fishery in the East China Sea (JPN_SPPS) for seasons 1, 3, and 4 for 1987-2022,

Fleet 9: Japanese small pelagic fish purse seine fishery in the East China Sea (JPN_SPPS) for season 2 for 1988-2022,

Fleet -10: Japanese small pelagic fish purse seine fishery in the East China Sea for farming (JPN_SPPS Farming) for 2014-2022,

Fleet 11: Korean offshore large scale purse seine fishery (KOR_LPPS) for 1983-2022,

Fleet 12: Japanese troll fishery (JPN_Troll) for seasons 2-4 for 1983-2022 ,

Fleet 13: Japanese troll fishery (JPN_Troll) for season 1 for 1983-2022,

Fleet 14: Japanese troll fishery for farming (JPN_Troll Farming) for season 1 for 1998-2022,

Fleet 15: Japanese pole and line fishery (JPN_PL) for 1983-2022,
Fleet 16: Japanese set-net fisheries (JPN_Setnet) for seasons 1-3 for 1983-2022,
Fleet 17: Japanese set-net fisheries (JPN_Setnet) for season 4 for 1983-2022,
Fleet 18: Japanese set-net fisheries in Hokkaido and Aomori (JPN_Setnet (HK_AM)) for 1983-2022,
Fleet 19: Japanese other fisheries (JPN_Others), mainly small-scale fisheries in the Tsugaru Strait for season 2 for 1983-2022,
Fleet 20: Eastern Pacific Ocean commercial purse seine fishery (U.S. dominant) (EPO_COMM(-2001)) for 1983-2001,
Fleet 21: Eastern Pacific Ocean commercial purse seine fishery (Mexico dominant) (EPO_COMM(2002-)) for 2001-2022,
Fleet 22: Eastern Pacific Ocean sports fishery (EPO_SP(2014-)) for 2014-2022,
Fleet 23: Eastern Pacific Ocean sports fishery (EPO_SP(-2013)) for 1983-2013,
Fleet 24: Unaccounted mortality fisheries (in weight) in WPO (WPO_Disc_Weight) for 2017-2022,
Fleet 25: Unaccounted mortality fisheries (in number) in WPO (WPO_Disc_Num) for 1998-2022,
Fleet 26: Unaccounted mortality fisheries (in number) in EPO (EPO_Disc_Num) for 1999-2022.

Certain fisheries, characterized by minimal PBF catch, were integrated into fleets with similar size compositions. This determination was informed by expert insights from each country, emphasizing consistent compositions. For example, the catches from Korean trawl, set net, and troll fisheries were consolidated into Fleet 11. Taiwanese purse seine catches were designated to Fleet 6. The driftnet catches from Japan and Taiwan were allocated into season 1 of Fleet 15, with the remaining Taiwanese catches, excluding longline fisheries, allocated to season 4 of the same Fleet. Japanese miscellaneous catches for seasons 1-3 were included into Japanese set net Fleet 16, and those for season 4 were designated to Fleet 17. Additionally, the residual Japanese catches, comprising trawl and small longline catches, were accommodated within Fleet 19. Post-2014 catches from non-ISC members, including New Zealand and Australia, were incorporated into Fleet 3.

1.4. Catch and Discard Data

1.4.1. Catch data

While fisheries catching PBF have been operational since at least the early 20th century in the EPO (Bayliff 1991) and for several centuries in the WPO (Ito 1961), detailed fishery statistics, particularly from the WPO, were not available before 1952. Therefore, 1952 was chosen as the starting year for previous stock assessments due to the adoption of a more consistent catch reporting process and the availability of catch and effort data from the Japanese longline fleet from that year onwards. These assessment models faced challenges due to relatively data-poor periods before 1980, which constrained the estimation of productivity of population dynamics and led to convergence issues when alternative assumptions were examined. During the course of model improvement, a short time series model was developed to enhance flexibility by reducing these data-poor periods (Fukuda 2021, Fukuda et al.2022).

In this assessment, the short-period model starting in 1983 serves as the base case model. Throughout the assessment period, the total annual catch fluctuated widely, with the historical maximum and minimum total catches recorded in any calendar year being 33,975 t in 2000 and 8,585 t in 1990, respectively (Table 3-2, Figure 2-6). Annual catches averaged about 14,000 t over the last decade (2013-2022). The majority of PBF catches were attributed to the purse seine fisheries, including the Japanese tuna purse seine fishery operating off the Pacific coast of Japan (Fleet 5), the U.S. purse seine fishery (Fleet 20) with a large portion of the catch until the 1990s, the Japanese small pelagic fish purse seine fishery in the East China Sea (Fleets 8 and 9), the Japanese tuna purse seine fishery in the Sea of Japan (Fleet 6), the Korean Offshore large-scale purse seine fishery (Fleet 11), and the Mexican purse seine fishery (Fleet 21) (Figure 3-2).

For the assessment model, catches were compiled quarterly for each fleet (Table 3-3). Quarterly catches for some fisheries during the early period were estimated by applying recent quarterly catch proportions to annual catch data, as seen in Fleets 8 and 9 before 1994 (Kai 2007a). For most fleets, recent quarterly

catches were directly derived from logbook or landing statistics. Some fleets primarily operate in only one season, such as Fleet 19, which includes small-scale Japanese fisheries (e.g., trawl, small longline, etc.), with their annual total catch allocated to Season 2. Catch data for the stock assessment were expressed in tons for all fleets except for Fleets 7, 10, 14, 22, 23, 25, and 26, where quarterly catches were expressed in thousands of fish (Figure 3-2). The quarterly catch data were updated up to Season 4 of the fishing year 2022 (2023 calendar year Quarter 2). Corrections were made in the terminal year of the previous assessment (2020 FY) as fishery data in the terminal year are often provisional and subject to corrections when finalized as the official statistics.

1.4.2. Unaccounted Mortality

It is recognized that recent impactful management measures may have altered fishery practices. The PBFWG has agreed that the assessment should include catches from "unaccounted mortality" (ISC 2019). "Unaccounted mortality" refers to fishery-induced deaths not reflected in landing data, which can include predation from sportfishing catches and discard mortalities. Japan (Nakatsuka and Fukuda 2020), Korea (Lee et al. 2020), and the U.S. (Piner et al. 2020) provided discard information in response to PBFWG recommendations. Mexico indicated no reported discard or post-release mortality from the IATTC/AIDCP onboard observers with a 100% coverage rate. Taiwan also stated no sign of releasing PBF from their fishery, with a sufficient margin in their fishing quota.

Fleet 24 (unaccounted mortality fisheries from WPO, 2017-2022) includes estimated dead discards from Japanese fisheries (setnet, purse seine, longline, troll, etc.) and Korean purse seine fisheries by weight. Meanwhile, Fleet 25 (Unaccounted mortality fisheries in WPO, 1998-2022) and Fleet 26 (Unaccounted mortality fisheries in EPO, 1999-2022) include estimated dead discards from Japan fisheries for penning (troll and small pelagic purse seine) and from U.S. sport fisheries, respectively, by number.

Japanese discard mortality has been estimated as 5% of reported catch for all Japanese fisheries since 2017, recognizing the significance of PBF release (Nakatsuka and Fukuda 2020), and Korean discard amounts were estimated in the same manner (Lee et al. 2020) (Fleet 24). Fleet 25, representing discards from Japan fisheries for penning, is assumed to be the same as the reported catch for the Japanese troll fishery for penning (Fleet 14) and 5% of the reported catch of the purse seine for penning (Fleets 7 and 10). For the U.S. sport fishery (Fleet 26), catches, releases (discards), and predation events of hooked fish are recorded in California Commercial Passenger Fishing Vessels logbooks. An estimate of release mortality and subsequent discard mortality numbers were developed for this fleet, with a mortality rate (6%) determined through random-effect inverse variance meta-analysis (Piner et al. 2020). To account for the uncertainty of these removals, the CV for these unaccounted mortality fleets was set at the higher value (0.3).

1.5. Abundance Indices

1.5.1. Overview

Potential CPUE-based abundance indices discussed in the ISC PBFWG are detailed in Tables 3-4 and 3-5, and Figure 3-3. These series were derived from fishery-specific catch and effort data, standardized using appropriate statistical methods. In the previous assessment, the PBFWG used four longline CPUE series as adult abundance indices: Japanese longline (1993-2019), Japanese longline (1952-1973), Japanese longline (1974-1992), and Taiwanese longline in the south fishing ground (2002-2020). Additionally, a Japanese troll index (1980-2016) served as the recruitment index for the base-case model (ISC 2022).

In this assessment, three longline CPUE series serve as the adult abundance indices: Japanese longline (1993-2019), Japanese longline (1974-1992), and Taiwanese longline in the south fishing ground (2002-2022). Also, a Japanese troll index (1980-2010) served as the recruitment index. While the indices used in this assessment are not substantially different from those in the previous one, further details and decisions will be addressed in the following sections.

The input coefficients of variation (CV) for abundance indices were uniformly set at 0.2 for all indices, years, and seasons when the CV statistically estimated by the standardization model was below 0.2. In instances where the CV estimated by the standardization model exceeded 0.2, the actual CV value was utilized to accurately depict the sampling variability for the observation (Table 3-6). This approach mirrors that of the previous assessment conducted by PBFWG in 2022.

1.5.2. Japanese Longline CPUE indices (S1 and S2)

While Japanese longline indices have traditionally been a crucial indicator of spawning stock trends, they were discontinued after 2020 due to the implementation of an individual quota scheme in the 2020 FY (Tsukahara et al. 2022). Substantial declines in catch and nominal CPUE for this fishery during the main fishing season (April to June) in the 2020 FY were observed, despite recent increases in catch within their allocation. To mitigate the potential impact of changes in catchability resulting from the new management scheme on the CPUE time series, data from 2020 onwards were excluded from standardization for this assessment.

Derived from logbook data, Japanese longline CPUE indices comprise two components: one for coastal operations (post-1993) and one for offshore and distant water fisheries (pre-1993). The offshore and distant water longline CPUE index used in the 2024 stock assessment covers the period from 1983 to 1992 (S2; Yokawa 2008), while the coastal longline CPUE index (S1; Tsukahara et al. 2022) covers the period from 1993 to 2019.

Reviewing the coastal longline CPUE for the recent period revealed a trend of smaller fish sizes caught since 2017 compared to previous years. This shift could be attributed to various factors such as changes in fish availability, alterations in fishery operations like area or season, or a combination of both. While the exact cause of this change remained unclear, an additional data filtering method was introduced to maintain consistent size selectivity over time by excluding small-sized fish (Tsukahara et al. 2022).

1.5.3. Japanese Troll CPUE index (S3, S4)

While the Japanese troll index has been traditionally proven to be an informative indicator of recruitment, it was discontinued after 2017 due to the implementation of an individual quota scheme and minimum size limits in the 2017 FY (Nishikawa et al. 2021). Substantial increases in live releases at sea were observed thereafter. Notably, the data points from 2017 to 2020 of the Japanese troll fishery index were not included in the likelihood function of the previous assessment.

The index is derived from catch and effort data collected from five fishing ports in the Nagasaki prefecture from Japanese coastal troll fisheries targeting age 0 PBF. The troll fishery in the Nagasaki prefecture dominates Japanese troll catch, and the fishery can target age 0 PBF from both spawning grounds (Ryukyu Islands and the Sea of Japan) due to the geographical location of the troll fishing ground (Ichinokawa et al. 2012). The units of effort in the catch and effort data are the cumulative daily number of days 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 only records information when at least one PBF is caught; zero catch data is unavailable. Therefore, a lognormal model was applied for the standardization of the CPUE (S3).

The troll index post-2010 was identified as the cause of the negative retrospective pattern in the previous assessments (Fukuda 2023). The substantial increase in catch for juvenile PBF farming after 2010, coupled with the implementation of mandatory licensing for troll vessels starting after 2010, may have compromised the representativeness of the troll index after 2010. To mitigate the potential impact of changes in catchability resulting from the aforementioned changes in operations, this index (S3) was used in this assessment for the 1983-2010 period only.

An alternative information on recent recruitment trends was examined using the newly developed standardized CPUE index from the Japanese troll monitoring program for 2011-2023 (S4; Fujioka et al. 2023). This index,

however, is also impacted by the same management measures (implementation of an individual quota scheme and minimum size limits), resulting in possible changes in catchability from 2017. In 2021, a supplementary monitoring program called the charter monitoring (CM) program was started. This CM program chartered the same troll monitoring vessels to continue fishing even after their quota was reached, for a maximum of 10 days per fishing season. Although it was viewed premature to include this index in the base-case model, it was still considered that the index provided a good qualitative indication of recent recruitment trends. This index (S4) is included for the sensitivity analysis of the assessment and projections (See 4.5.7 and 5.5.1) but is not used in the base case model.

1.5.4. Taiwanese Longline CPUE indices for southern area (S5-S14)

An adult index of relative abundance was developed using data from Taiwanese longline fishing operations. The fishing grounds of the Taiwanese longline fleet are divided into southern and northern areas, with the southern area historically regarded as the main fishing ground in terms of both catch volume and historical importance. The CPUE utilized in previous and this assessments was derived from operations in the southern area and standardized using a Generalized Linear Mixed Model (GLMM) approach (S5: 2002-2022, as detailed by Yuan et al. 2024).

The development of this index followed a multi-step process: (1) estimation of PBF catch in terms of fish numbers from landing data in weight for the year 2003 based on Markov Chain Monte Carlo (MCMC) simulation techniques, (2) determination of fishing days for the years 2007-2009 using data from the vessel monitoring system (VMS) and voyage data recorder (VDR), (3) calculation of fishing days for the years 2003-2006 based on vessel trip information, establishing linear relationships between fishing days and days spent at sea for each trip, categorized by vessel size and fishing port for 2007-2022, and (4) estimation and subsequent standardization of CPUE (catch per unit effort,

measured in fish number per fishing day) for the years 2003-2022, as outlined by Yuan et al. (2024).

In addition to the aforementioned indices, the assessment model also incorporates nine additional indices from the Taiwanese longline, although they are not included in the likelihood function. These supplementary indices encompass various aspects of CPUE standardization such as spatial extent, type of statistical model used, or age-group specificity:

An index representing both the southern and northern areas derived from the GLMM model for the years 2002 to 2022 (denoted as S6).

Two indices for the southern or combined areas, derived from a spatiotemporal model covering the period from 2006 to 2022 (denoted as S7 and S8).

Six indices representing the combined area categorized by age classes, including all age classes (designated as S9), as well as specific age ranges such as 6-8, 9-11, 12-14, 15-17, and 18+ (denoted as S10-S14).

These indices are currently under evaluation for potential integration into future stock assessments, highlighting the ongoing efforts to refine and enhance the assessment methodology.

1.6. Size composition data

1.6.1. Overview

Quarterly size composition data (length or weight) for PBF from 1952 to 2022 were compiled for the stock assessment (Table 3-7, Fig. 3-4). All length data (fork length (FL)) were measured to the nearest centimeter (cm), while weight data were measured to the nearest kilogram (kg). In the assessment model, the length data was categorized into bins of 2, 4, and 6 cm width, representing fish lengths of 16-58, 58-110, and 110-290 cm FL, respectively. Weight composition data were organized into the following bin sizes (0, 1, 2, 5, 10, 16, 24, 32, 42, 53, 65, 77, 89, 101, 114, 126, 138, 150, 161, 172, 182, 193, 202, 211, 220, 228, 236, 243, and 273 kg). This bin strategy attempted to create two bins for each age between 0 and 15 (Fujioka et al. 2012). The lower boundary of each length or weight bin was used to define the bin.

For this assessment, the size composition data for Fleets 13, 14, 15, and 23 were excluded from the negative log-likelihood (NLL) function of the model, consistent with the previous assessment (ISC 2022). Fleets 13-14 (JPN_Troll), focusing solely on age-0 fish, does not require size composition data. Because of concerns about an ill-defined sampling process and the representativeness of their catch, size compositions of Fleet 15 (JPN_PL) were not fitted into the NLL function. Fleet 23 (EPO_SP(-2013)) size data was excluded due to the lack of information on how the size sampling program for the EPO sports fishery operated prior to 2012. Fleets 18-19 had their size compositions combined to streamline the assessment model (Table 3-7). Length and weight composition data were updated to 2022 FY for Fleets 2-12, 18, 21 and 22, while the composition data for the other fleets were not updated. Figure 3-5 shows the quarterly size compositions for each fleet.

Input sample sizes for the size composition data were sourced from various criteria for each fleet. Depending on the corresponding fisheries and available data, the input sample size includes “Number of fish measured”, “Number of landing wells sampled”, “Number of the total month of wells sampled by port”, and “Number of haul wells sampled”, as summarized in Table 3-7.

1.6.2. Japanese Longline (Fleets 1 and 2)

The Japanese longline fisheries were classified into two fleets based on the sizes of fish caught during different seasons in the coastal longliners. Fleet 1, representing the CPUE fishery with catch time-series in weight for all seasons in 1983-1992 and season 4 in 1993-2016, operates under the assumption of consistent catchability and selectivity. Conversely, Fleet 2, with catch time-series in weight for seasons 1-3 in 1993-2016 and all seasons in 2017-2022, primarily targets smaller fish. Length-composition data from the Japanese coastal longline fisheries in season 4 from 1993 to 2016 for Fleet 1 and in seasons 3 and 4 from 2021 to 2022 for Fleet 2 were used in the assessment (Figure 3-5).

The time-series of available length composition data was shorter compared to that of landings from the fishery. During the period from 1983 to 1993, length

measurements were relatively sparse, raising concerns about their representativeness. Consequently, these data are not included in the assessment. Since the 1990s, sampling and market data have been collected at the major PBF unloading ports (e.g., Okinawa, Miyazaki, and Wakayama prefectures). Quarterly landing amounts and length measurements in each prefecture were used to compile quarterly catch-at-length data, with length compositions being raised based on landing weight (Ohashi and Tsukahara 2019).

The majority of length samples were collected during seasons 3 and 4, with season 3 generally targeting smaller adults compared to season 4 (Tsukahara et al. 2021). Additionally, season 4 recorded higher numbers of both samples and catches. However, size composition data for both seasons 3 and 4 from 2017 to 2019 showed a notable increase in observations of smaller-sized fish. This was attributed to catches occurring earlier in the fishing season (season 3) than usual, leading to the consumption of the catch quota, comprising mainly of smaller-sized adults. While the implications of these observations remain uncertain, they could suggest a shift in selectivity (i.e., operating smaller fish in more eastern areas not factored into CPUE calculations) and/or a change in availability (i.e., an influx of the newly abundant young cohorts into the fishery). Catch-at-length data for season 3 from 1993 to 2020 were not included in this assessment due to low sample sizes.

The implementation of Individual Quota management since 2021 has led to a more balanced distribution in the size of fish caught, encompassing both small and large adults. Hence, catch-at-length data during seasons 3 and 4 from 2021 to 2022 were included in Fleet 2 in this assessment.

1.6.3. Taiwanese longline (Fleets 3 and 4)

The Taiwanese longline fisheries were classified into two fleets based on the sizes of fish caught in two regions. Fleet 3 representing the CPUE fishery with catch time-series in weight from 1983 to 2022, operates primarily in the southern region targeting largest adults under the assumption of consistent catchability

and selectivity. In contrast, Fleet 4, with catch time-series in weight beginning after 2000, operates in the northern region.

Length-composition data for PBF from the Taiwanese longline fishery (Fleets 3 and 4) have been derived from the market landing information and port sampling, which had high coverage since most landings were sampled. Since 2010, the catch documentation scheme (CDS) program has provided additional data, enhancing the quality and quantity of size samples (Chang et al. 2015). Catch-at-length data after 1992 for fleet 3 and after 2009 for fleet 4 were used in the assessment (Figure 3-5).

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

The Japanese purse seine fisheries off the Pacific coast of Japan recorded catch time-series in weight from 1983 to 2022 (Fleet 5) and was the largest fleet in terms of catch before 2000. Size composition data have been collected by weight pre-1994 and by length and weight post-1994. Weight measurements were initially collected at Tsukiji market and several unloading ports in the Tohoku region between 1983 and 1993 and converted to length measurements. However, concerns arose regarding the conversions from gilled and gutted weight and round weight to length and the very low coverage rate of certain weight categories (<10 kg) during this period, resulting in doubts about the representativeness of these data. Since 1994, comprehensive length and weight composition data have been collected at primary landing sites, namely Shiogama and Ishinomaki ports (Abe et al. 2012).

With a sharp decline in catch amounts in weight since 1999, size measurements were unable to be conducted after 2006. Consequently, the length compositions for this fleet included in past assessments were limited to the fishing years 1995-2005 (Figure 3-5). During this period, the size composition data exhibited high variability from 50 cm to over 200 cm, with multiple size modes varying year over year, highlighting the need for further research, particularly focusing on smaller fish.

Since the 2014 fishing year, catch amounts by this fleet have increased compared to previous years (2007-2013). In response to the change, the port sampling program was strengthened, resulting in composition data becoming available for the fishing years 2014-2022 (Fukuda 2019). During this period, the size of fish caught was predominantly composed of fish larger than 120 cm, whereas in the 2000s, this fleet also caught smaller fish, such as those measuring around 50 cm.

Quarterly landing amounts, length measurements, and length conversions from weight measurements in each size category were used to compile the quarterly catch-at-length data before 2006 (Abe et al. 2012). After 2014, quarterly landing amounts and length measurements in each landing were used to compile the quarterly catch-at-length data (Fukuda 2019). Catch-at-length data from 1995 to 2006 and from 2014 to 2022 were used in the assessment.

1.6.5. Japanese purse seines in the Sea of Japan (Fleets 6 and 7)

The Japanese purse seine fisheries in the Sea of Japan, targeting larger-sized PBF aged older than 3 years (Fukuda et al. 2012), were classified into two fleets based on their types of operation and units of catch (Nishikawa and Fukuda 2023a). Fleet 6 comprises typical tuna purse seiners with catch time-series in weight from 1983 to 2022, while Fleet 7 consists of the same fishery but for farming, with catch time-series in number beginning after 2016. This fishery was one of the largest fisheries in terms of catch in the 2000s until the introduction of catch quotas in 2011. A portion of the PBF caught by this fishery has been used for farming since the early 2010s, resulting in an increased ratio of farming large PBF over the catch for the fisheries.

Length-composition data for Fleet 6 have been collected by port samplers in Sakai-minato and have been available since 1987, except for 1990 when there was no catch (Figure 3-5). The size measurements have high coverage, with most of the landings being sampled. Additionally, length composition data for Fleet 7 have been collected by fishermen and farming companies in farming locations using stereoscopic camera and have been available since 2017.

Quarterly landing amounts and length measurements in each landing or operation were used to compile the quarterly catch-at-length data (Kanaiwa et al 2012, Nishikawa and Fukuda 2023a). Catch-at-length data from 1987 to 2022 for Fleet 6 and from 2017 to 2022 for Fleet 7 were used in the assessment.

1.6.6. Japanese small pelagic fish purse seines in the East China Sea (Fleets 8-10)

The Japanese purse seine fisheries in the East China Sea, targeting smaller-sized PBF aged 0-1 years, were classified into three fleets based on their types of operation, the size of fish caught in different seasons, and units of catch. Fleet 8 comprises typical small pelagic purse seiners with catch time-series in weight from 1987 to 2022, mainly targeting age 0 fish during seasons 1, 3, and 4. Fleet 9 shares the same fishery, with catch time-series from 1988 to 2022, capturing both age 0 and 1 fish in season 2. Fleets 8 and 9 were once the largest fisheries in terms of catch during the 1990s and 2000s until the introduction of catch quotas in 2011, and have subsequently been under stricter management year after year. Fleet 10 consists of the same fishery but for farming during seasons 1 and 4, with catch time-series in number beginning after 2014.

Length composition data for the fisheries are derived from the port sampling program at the major landing ports (Fukuoka and Matsuura ports) (Kumegai et al. 2015) and have been available since 2002 for Fleet 8, with exceptions for seasons 3-4 in 2014 when measurements were uncertain due to changes in the landing procedures at the ports. Length composition data have been available since 2003 for Fleet 9, with exceptions for 2013 and 2015 when catches were very limited. Additionally, measurements have been collected since 2016 using a stereoscopic camera for farming operations in Fleet 10 during season 4 when catch amounts are higher compared to season 1 (Fukuda and Nakatsuka 2019).

Quarterly landing amounts and length measurements in each landing or operation were used to compile the quarterly catch-at-length data (Kumegai et al. 2015, Fukuda and Nakatsuka 2019). Catch-at-length data from 2002 to 2021 for Fleet 8, from 2003 to 2022 for Fleet 9, and from 2016 to 2022 for Fleet 10 were used in the assessment.

1.6.7. Korean offshore large purse seine (Fleet 11)

The Korean offshore large purse seine fisheries in Korean waters have documented catch time-series in weight from 1983 to 2022 (Fleet 11) (Park et al. 2023, Kwon et al. 2024). Typically targeting PBF weighing less than 30 kg (ages 0-2), purse seiners have observed an increase in fish over 30 kg since 2019. Fleet 11 also includes PBF caught from Korean setnet, trawl, and other fisheries, with purse seiners being the primary source of catch. Set net catch has been on the rise since 2018**,** contributing over 20% of Fleet 11's catch in 2021-2022.

The composition data for purse seiners are available during season 3 for 2003-2022 through the size sampling at port by scientists or observers as well as the measurement at the laboratory by scientists (Lim et al. 2021). Quarterly landing amounts and length measurements in each size category were used to compile the quarterly catch-at-length data, with length compositions being raised based on landing weight in each size category (Kwon et al. 2024).

1.6.8. Japanese Troll and Pole-and-Line (Fleets 12-15)

The Japanese troll fisheries, targeting age 0 PBF, were classified into three fleets based on their types of operation, the size of fish caught in different seasons, and units of catch. Fleet 12, representing the CPUE fishery, has a catch time-series in weight from 1983 to 2022 during seasons 2, 3, and 4. It primarily operates in the Sea of Japan under the assumption of consistent catchability and selectivity. Fleet 13 comprises the same fishery with catch time-series in weight from 1983 to 2022 during season 1. It typically catches smaller-sized young of year PBF (< 50 cm, Fukuda et al. 2015a) hatched from April to August. Fleet 14 consists of the same fishery but for farming during season 1, with a catch time-series in number beginning after 1998. Additionally, the Japanese pole-and-line fisheries, which occasionally capture PBF, target age 0 fish and have a catch time-series in weight from 1983 to 2022 (Fleet 15).

Length composition data for Fleets 12 and 13 are obtained from the port sampling program at major landing ports in Nagasaki, Wakayama, and Kochi

Prefectures (Fukuda and Oshima 2012), with records available since 1994. In contrast, representative size composition data for Fleet 14 are lacking. For Fleet 15, length composition data are available for limited years between 1994 and 2010. Since Fleet 15 operates in the same fishing ground as Fleet 12 and catches similar-sized fish, length compositions for Fleet 15 were not used, and its selectivity is mirrored to that of Fleet 12.

Quarterly landing amounts and length measurements in each port and area were used to compile the quarterly catch-at-length data for Fleets 12 and 13, with exceptions applied when more than 20% of the catch lacked corresponding size data (Fukuda et al. 2015a). Following this criterion, catch-at-length data for certain quarters were excluded from the assessment model. The catch-at-length data for Fleet 13 were not fitted into the log-likelihood function due to its spiky nature, focusing on a very narrow range of sizes for age 0. Consequently, its selectivity is specified as full-selection for age-0 fish.

1.6.9. Japanese set-net and other fisheries (Fleets 16-19)

The Japanese set-net fisheries, operating along the coastal regions of Japan, target a wide range of PBF sizes. These fisheries were classified into three fleets based on locations, units of size measurement, and the size of fish caught in different seasons (Nishikawa and Fukuda 2023b). Fleet 16 represents a typical set-net fishery in all prefectures except for Hokkaido and Aomori, with catch time-series in weight from 1983 to 2022 during seasons 1, 2, and 3. Fleet 17 comprises the same fishery as Fleet 16, with catch time-series in weight from 1983 to 2022 during season 4. Additionally, Fleet 18 comprises the same fishery operating in Hokkaido and Aomori prefectures, with catch time-series in weight from 1983 to 2022 throughout the year. Fleet 19 consists of hand line and small-scaled longline fisheries in the Tsugaru Strait and its adjacent waters, with catch time-series in weight from 1983 to 2022 during season 2 (Nishikawa et al. 2015).

Length measurement data for Fleets 16 and 17 from Japanese set-net fisheries have been collected since 1993 by port samplers, while weight measurement data for Fleet 18 are obtained in Hokkaido and Aomori prefectures

(Sakai et al. 2015). The size range for Fleet 16 is generally smaller than that for Fleet 17, with small-sized PBF (< 50cm) being rarely observed. Fleet 19 also has weight composition data, with records available since 1994. Since Fleets 18 and 19 captured similar sizes, the weight composition data were combined, and one selectivity was estimated for both fleets.

The catch-at-size data were estimated based on the multi-stratified raising method using the catch weight. Excessive estimation was avoided by introducing broad size category strata (i.e., Small/Medium/Large) and limiting over-strata calculation (Hiraoka et al. 2018). These data showed that the catch-at-size data were highly variable from year to year and quarter to quarter, probably because of the influence of environmental conditions and migration (Kai 2007a).

Likely due to the COVID-19 pandemic and other reasons such as opportunistic fishery unloading due to domestic management to protect small (young) fish, the data sampling in FY 2019-2022 for those coastal fisheries was sparser than in the past period (Nishikawa et al. 2022). Accordingly, the composition data for those years were not included in this assessment.

1.6.10. EPO commercial purse seine fisheries (U.S. dominant) for 1983-2001 (Fleet 20) and (Mexico dominant) after 2002 (Fleet 21)

The commercial fisheries operate along the coastal regions of the U.S. and Mexico in the Eastern Pacific Ocean, primarily using purse seine techniques. Minor fisheries such as hook and line, and large-mesh drift gillnet are included in the commercial fisheries. These fisheries were classified into two fleets based on the relative importance of the catch between the U.S. and Mexico. Fleet 20 represents the EPO catch time-series in weight from 1983 to 2001, which encompasses a transition phase involving the decline of the U.S. fisheries and the rise of Mexican PBF opportunistic fisheries, with U.S. purse seine landings still being higher during this period. Subsequently, after 2001, Mexican landings increased, while U.S. landings decreased substantially. Fleet 21 represents the EPO catch time-series in weight from 2001 to 2022 when Mexican purse seine landings were dominant.

Length composition data for PBF from the EPO purse seine fishery have been collected by port samplers from IATTC and national/municipal at-sea observers and sampling programs (Bayliff 1993, Aires-da-Silva and Dreyfus 2012) since 1952. Due to the low representation of the sample sizes during the transition phase (1983-2001) when catches were relatively low, size measurements from 1983 were used to estimate selectivity for Fleet 20. In the assessment, length measurements for Fleet 21 were used after 2005 from port samplers and after 2013 from stereoscopic cameras provided by the largest farming company (Dreyfus and Aires-da-Silva 2015). Landing amounts and length measurements in each set were used to compile the quarterly catch-at-length data (Dreyfus 2024).

1.6.11. EPO sports fisheries (Fleets 22 and 23)

The sports fisheries in the Eastern Pacific Ocean operate along the coastal regions of the U.S. and Mexico. These fisheries were classified into two fleets based on the years when size sampling was conducted. Fleet 22 represents the EPO sports catch time-series in number from 2014 to 2022 throughout the year, while Fleet 23 represents the EPO sports catch time-series in number from 1983 to 2013 throughout the year.

Length measurement data from the sport fishery had been collected by IATTC staff from 1993 to 2011 (Hoyle 2006). There was no information about how the size sampling program operated prior to 2012, thus the PBFWG has agreed that the size composition data before 2012 are not used. Selectivity for Fleet 23 was assumed to be similar to that for Fleet 22.

Since 2014, NOAA took over the sampling program (Heberer and Lee 2019), and size composition data are measured by port samplers. However, due to the COVID-19 pandemic, the port sampling program by the SWFSC NOAA was discontinued (Lee 2021). As an alternative, another on-board sampling program by the Sportfishing Association of California (SAC) was suggested for the size data during 2019-2022, although it had a lower coverage than the port

sampling by NOAA. Despite the variability in both the SAC data and NOAA data, each dataset seemed to provide more appropriate information on the catch-at-age than borrowing the information from the EPO commercial fleet or relying solely on the most recent data in the same fleet. Therefore, for the 2022 stock assessment, the WG agreed to use the annual aggregated port sampling data from 2014 to 2018 and the annual aggregated on-board sampling data from 2019 to 2022.

1.6.12. Unaccounted mortality fleets (Fleets 24, 25 and 26)

Unobserved mortality related to the possible post-release mortality of discards were included as removals. This unobserved mortality was separated into three separate fleets. Because there is no available data to represent the size distribution of unobserved fish, the size selectivity for these fleets was assumed to be similar to that of the associated fisheries

1 LITERATURE CITED

Abe M., Kanaiwa M., Oshima K. and Takeuchi Y. 2012. Estimation of catch at size of PBF, *Thunnus orientalis*, caught by Japanese tuna purse seine operated in Pacific ocean. Working paper submitted to the ISC PBF Working Group Meeting, 31 January-7 February 2012, La Jolla, California, USA. ISC/12/PBFWG-1/03: 18p. Available at: http://isc.fra.go.jp/pdf/PBF/ISC12_PBF_1/ISC12 1PBFWG03_Abe.pdf

Aires-da-Silva A. and Dreyfus M. 2012. A critical review on the PBF length composition data for the EPO purse seine fishery with new data collected at Mexican PBF pen rearing operations. Working paper submitted to the ISC PBF Working Group Meeting, 10-17 November 2012, Honolulu, Hawaii, USA. ISC/12/PBFWG-3/02:15p. Available at: http://isc.fra.go.jp/pdf/PBF/ISC12_PBF_3/ISC12_PBFWG 3_02_daSilva&Dreyfus_2012rev.pdf

Bayliff W. H. 1991. Status of northern bluefin tuna in the Pacific Ocean. Pp. 29-88. In: R. B. Deriso and W. H. Bayliff (eds.). World meeting on stock assessment of bluefin tunas: strengths and weakness. Special Rep. 7, Inter-Amer. Trop. Tuna Comm., La Jolla, CA.

Bayliff W. H. 1993. Growth and age composition of Northern bluefin tuna, *Thunnus thynnus*, caught in the eastern Pacific Ocean, as estimated from length-frequency data, with comments on trans-Pacific migrations. Inter-American Tropical Tuna Commission Bulletin 20, 503-540.

Boustany A., Matteson R., Castleton M., Farwell C. and Block B. 2010. Movements of pacific bluefin tuna (*Thunnus orientalis*) in the Eastern North Pacific

Chang S. K., Fu Y. W. and Liu H. I. 2015. Brief review on size distribution of Taiwanese PBF catch. ISC/15/PBFWG-2/16: 6p. Available at: http://isc.fra.go.jp/pdf/PBF/ISC15_PBF_2/ISC_15_PBFWG-2_16_Eric.pdf

Dreyfus, M. and Aires-da-Silva, A. 2012. A critical review on the PBF length-composition data for the EPO purse seine fishery with new data collected at Mexican PBF pen rearing operations. ISC/15/PBFWG-3/02

Dreyfus, M. and Aires-da-Silva, A. 2015. PBF catch-composition of the Mexican purse seine fishery from data collected at pen rearing operations: and update for 2013 2014. ISC/15/PBFWG-2/05: 8p.

Dreyfus M and M. Betancourt. 2024. PBF size composition 2022-2023 from the Mexican purse seine fishery. Data collected during pen transfer operations.. ISC/24/PBFWG-1/02Fujioka K., Asai S., Tsukahara Y., Fukuda H. and Nakatsuka S. 2023. Recruitment abundance index of immature Pacific bluefin tuna, derived from real-time monitoring survey data of troll fisheries. ISC/23/PBFWG-1/03

Fujioka, K., Asai, S., Tsukahara Y., Fukuda, H. and Nakatsuka, S. 2023. Recruitment abundance index of immature Pacific bluefin tuna, derived from real-time monitoring survey data of troll fisheries. ISC/23/PBFWG-1/03

Fujioka, K., Asai, S., Tsukahara Y., Fukuda, H. and Nakatsuka, S. 2024. Recruitment abundance index of Pacific bluefin tuna based on real-time troll monitoring survey data using Vector Autoregressive Spatio-Temporal (VAST) model analysis. ISC/24/PBFWG-1/04

Fujioka, K., H. Fukuda, K. Oshima, M. Abe, S. Iwata, M. Kai, and Y. Takeuchi. 2012. Modification introduced to the input fishery data for Stock Synthesis III model used in the 2010 Pacific bluefin tuna stock assessment. ISC/12/PBFWG-2/3: 6p. Fukuda H. 2019. Estimation of the PBF length-composition for the Japanese purse seine operating in the Pacific side. ISC/19/PBFWG-2/05

Fukuda H. 2021. How to improve a flexibility of the Stock Synthesis model for Pacific bluefin stock to the alternative assumptions with keeping its performance. ISC/21/PBFWG-02/12

Fukuda H. and Nakatsuka S. 2019. Estimation of the PBF length-composition for the Japanese purse seine with new data collected at young PBF farming operation using stereoscopic camera. ISC/19/PBFWG-2/02

Fukuda H. and K. Oshima. 2012. Estimation of catch at size of young Pacific bluefin tuna caught by Japanese troll fisheries. ISC/12/PBFWG-1/04

Fukuda H., Tsukahara Y. and Nishikawa K. 2022. Update of the PBF population dynamics model using short time series data (1983-) and the sensitivity runs for the robustness test. ISC22/PBFWG-01/06.

Fukuda H., Uyama H. and Oshima K. 2015. A minor change in the estimation of length composition data of Japanese troll fisheries. ISC/15/PBFWG-2/03: 13p. Available at: http://isc.fra.go.jp/pdf/PBF/ISC15_PBF_2/ISC_15_PBFWG 2_03_Fukuda.pdf

Fukuda H., Kanaiwa M., Tsuruoka I. and Takeuchi Y. 2012. A review of the fishery and size data for the purse seine fleet operating in the Japan Sea (Fleet 3). Working paper submitted to the ISC PBF Working Group Meeting, 10-17 November 2012, Honolulu, Hawaii, USA. ISC/12/PBFWG-3/03: 12p. Available at: http://isc.fra.go.jp/pdf/PBF/ISC12_PBF_3/ISC12_PBFWG-3_03_Fukuda.pdf

Heberer L. and Lee H.-H. 2019. Updated size composition data from the San Diego Commercial Passenger Fishing Vessel (CPFV) recreational fishery for Fleet 15: Eastern Pacific Ocean Sport Fisheries, 2014-2019. ISC/19/PBFWG-2/06

Hiraoka Y., Kanaiwa M., Fukuda H., Oshima K. and Kai M. 2018. Size distribution of Pacific bluefin tuna caught with Japanese set nets estimated via stratigied stepwise weighting method. Nippon Suisan Gakkaishi 84(1), p2-13.

Hoyle S. 2006. Sampling the catch of bluefin tuna (*Thunnus thynnus*) for length composition. ISC/06/PBFWG/16

Ichinokawa M., Oshima K. and Takeuchi Y. 2012. Abundance indices of young PBF, derived from catch-and-effort data of troll fisheries in various regions of Japan. Working paper submitted to the ISC PBF Working Group Meeting, 31 January-7 February 2012, La Jolla, California, USA. ISC/12/PBFWG-1/11: 35p. Available at: http://isc.fra.go.jp/pdf/PBF/ISC12_PBF_1/ISC12-1PBFWG11_ichinokawa.pdf

ISC. 2019. Report of the Pacific Bluefin tuna working group intersessional workshop. 18-23 November, 2019.

ISC. 2022. Stock assessment of Pacific Bluefin Tuna in the Pacific Ocean in 2022.

Ito S. 1961. Fishery biology of the sardine, *Sardinops melanosticta* (T. & S.), in the waters around Japan. Bull. Jap. Sea Reg. Fish. Res. Lab. 9, 1-227 [in Japanese]

Itoh T., Tsuji S. and Nitta A. 2003. Migration patterns of young PBF (*Thunnus orientalis*) determined with archival tags. Fish. Bull. 101: 514-534.

Kai M. 2007a. Estimation of quarterly catches by Japanese set net. ISC/07/PBFWG 1/06.

Kumegai Y., Tei Y., Fukuda H. and Oshima K. 2015. Updates of catch at size for Japanese small pelagic fish purse seiners. Presentation submitted to the ISC PBF

Working Group Meeting, 18-25 November 2015 Kaohsiung, Chinese Taipei. ISC/15/PBFWG-2

Lee H. H. 2021. What is next? Lessons learned from sensitivity model runs using length compositions collected by the Sportfishing Association of California. ISC/21/PBFWG-02/08

Lee H.H., Piner K.R., Maunder M., Taylor I. G. and Methot R.D. 2017. Evaluation of alternative modelling approaches to account for spatial effects due to age-based movement. Can. J. Fish. Aquat. Sci. 74(11): 1832-1844

Lee, M. K., Kim D. N., Lee S. I. and An D. H. 2020a. Status and future plans for information on discard mortality rates of Korean fisheries for Pacific bluefin tuna, *Thunnus orientalis*. ISC/20/PBFWG-1/13

Lim J., Lee M. K., Lee S. I., Kwon Y. and Kim D. N. 2021. Update of Korean fisheries information for Pacific bluefin tuna, *Thunnus orientalis*. ISC21/PBFWG-2/06

Nakatsuka S. 2019, Stock Structure of Pacific Bluefin Tuna (*Thunnus orientalis*) for Management Purposes—A Review of Available Information, Reviews in Fisheries Science & Aquaculture, DOI: 10.1080/23308249.2019.1686455

Nakatsuka S. and Fukuda H. 2020. Estimation of Unaccounted Mortality in the Japanese Fisheries. ISC/20/PBFWG-1/08

Nishikawa K. and Fukuda H. 2023a. Estimation of the length composition for the Japanese tuna purse seine with new data collected at PBF farming operation using stereoscopic camera. ISC/23/PBFWG-2/02

Nishikawa K. and Fukuda H. 2023b. Estimation of catch at size of Pacific bluefin tuna caught by Japanese set net fisheries. ISC/23/PBFWG-2/03

Nishikawa K., Fukuda H. and Oshima K. 2015. Estimation of weight composition fore Japanese small scale fisheries in Tsugaru Strait: Fleet 14 (Other fisheries). ISC/15PBFWG-2/07: 10p. Available at: http://isc.fra.go.jp/pdf/PBF/ISC15_PBF_2/ISC_15_PBFWG-2_07_Nishikawa.pdf

Nishikawa K., Tsukahara Y., Fujioka K., Fukuda H. and Nakatsuka S. 2021. Update of Age-0 PBF index based on catch per unit effort data from Japanese troll fishery and its associated issues. ISC/21/PBFWG-01/05

Ohashi Y. and Tsukahara Y. 2019. Estimation of catch-at-length of Pacific bluefin tuna caught by Japanese coastal longliners: Update up to 2018 fishing year. ISC/19/PBFWG-2/01

Piner K., Lee H.H., Hellmers E. and Stohs S. 2020. Estimates of Recreational release Mortality for the US Commercial Passenger Vessel Fleet (2000-2019). ISC/20/PBFWG-1/07

Sakai O., Hiraoka Y., Fukuda H. and Oshima K. 2015. Estimation of catch at size of Pacific bluefin tuna caught by Japanese set net fisheries: Updated up to 2014

fishing year. ISC/15/PBFWG-2/04: 26p. Available at: http://isc.fra.go.jp/pdf/PBF/ISC15_PBF_2/ISC_15_PBFWG-2_04_Sakai.pdf

Tsukahara Y., Fukuda H. and Nakatsuka S. 2022. Standardized CPUE for Pacific Bluefin tuna caught by Japanese coastal and offshore longline in 2022 update assessment ISC/22/PBFWG-01/01

Tsukahara Y., Asai S., Fukuda H. and Nakatsuka S. 2021. CPUE and Catch at Size for Pacific Bluefin tuna (*Thunnus orientalis*) caught by Japanese coastal and offshore longline. ISC/21/PBFWG-02/01

Waterhouse L., Sampson D. B., Maunder M. and Semmens B. X. 2014. Using areas as-fleets selectivity to model spatial fishing: Asymptotic curves are unlikely under equilibrium conditions. Fisheries Research 158: 15-25.

Yokawa K. 2008. Correction of the standardized CPUE of Pacific bluefin tuna caught by Japanese offshore and distant-water longliners. Working paper submitted to the ISC PBF Working Group Meeting, 28 May-4 June 2008, Shimizu, Japan. ISC/08/PBFWG-1/05.

Yuan T.-L., S.-K. Chang and H. Xu. 2024. Developing abundance indices for Taiwanese PBF longline fishery using GLMM and VAST, incorporating SST and size data. ISC/24/PBFWG-1/05

Tables and figures

Table 1. 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	2020												2021												2022												2023					
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		
Fishing month	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	1	2	3	4	5	6
SSB										SSB in 2020												SSB in 2021												SSB in 2022								
Day of birth in SS	Birthday of 2020 yr class												Birthday of 2021 yr class												Birthday of 2022 yr class												Birthday of 2023 yr class					
Recruitment	Recruitment in 2020												Recruitment in 2021												Recruitment in 2022												Recruitment in 2023					
Year class	2020 yr class												2021 yr class												2022 yr class												2023 yr class					

Calender year	2020						2021												2022												2023											
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 2. Definition of fleets for the stock assessment of Pacific bluefin tuna.

Fleet #	Fleet name	Unit of Catch	Gears included				Abundance index
			Representative component	Component 2	Component 3	Component 4	
Fleet 1	JPN_LL (Seas 4)	Weight	JPN Longline (1952-1992)	JPN Longline (1993-2016, Season 4)			S1, S2
Fleet 2	JPN_LL (1993-) (Seas 1-3)	Weight	JPN Longline(1993-2016, Season 1-3)	JPN Longline(2017-2020)			
Fleet 3	TWN_LLSouth	Weight	TWN Longline (South area)	Out of ISC members (NZ, AU, etc.)*5			S5, S7
Fleet 4	TWN_LLNorth	Weight	TWN Longline (North area)				S6, S8-14
Fleet 5	JPN_TPS_PO	Weight	JPN Tuna Purse seine in Pacific Ocean				
Fleet 6	JPN_TPS_SOJ	Weight	JPN Tuna Purse seine in the Sea of Japan	TWN Purse seine*2			
Fleet 7	JPN_TPS_SOJ (Farming)	Number	JPN Tuna Purse seine in the Sea of Japan for Farming				
Fleet 8	JPN_SPPS (Seas 1,3,4)	Weight	JPN Small Pelagic Purse seine (Season 1,3,4)				
Fleet 9	JPN_SPPS (S2)	Weight	JPN Small Pelagic Purse seine (Season 2)				
Fleet 10	JPN_SPPS (Farming)	Number	JPN Small Pelagic Purse seine for Farming				
Fleet 11	KOR_LPPS	Weight	KOR Large Pelagic Purse Seine	KOR Trawl*1	KOR Setnet*1	KOR Troll*1	
Fleet 12	JPN_Troll (Seas 2-4)	Weight	JPN Troll (Season 2-4)				S3, S4
Fleet 13	JPN_Troll (Seas 1)	Weight	JPN Troll (Season 1)				
Fleet 14	JPN_Troll (Farming)	Number	JPN Troll for Farming				
Fleet 15	JPN_PoleLine	Weight	JPN Pole-and-Line	JPN Driftnet*3	TWN Driftnet*3	TWN Others*4	
Fleet 16	JPN_Setnet (Seas 1-3)	Weight	JPN Setnet (Season 1-3)	JPN Miscellaneous (Season 1-3)			
Fleet 17	JPN_Setnet (Seas 4)	Weight	JPN Setnet (Season 4)	JPN Miscellaneous (Season 4)			
Fleet 18	JPN_Setnet (HK_AM)	Weight	JPN Setnet in Hokkaido and Aomori				
Fleet 19	JPN_Other	Weight	JPN Others				
Fleet 20	EPO_COMM (-2001)	Weight	USA Commercial Fisheries (PS, Others)	MEX Commercial Fisheries (PS, Others)			
Fleet 21	EPO_COMM (2002-)	Weight	MEX Commercial Fisheries (PS, Others)	USA Commercial Fisheries (PS, Others)			
Fleet 22	EPO_Sports (2014-)	Number	USA Recreational Fisheries (2014-)				
Fleet 23	EPO_Sports early (-2013)	Number	USA Recreational Fisheries (-2013)				
Fleet 24	WPO_Disc_Weight	Weight	Discard amount for WPO				
Fleet 25	WPO_Disc_Num	Number	Discard number for WPO				
Fleet 26	EPO_Sports_Disc_Num	Number	Discard number for EPO				

*1 Catch for Korean Trawl, Korean Setnet and Korean Troll are **included** in the input data until the 2022 stock assessment.

*2 Annual catches for Taiwanese PS are put into the Season 1 in the input data.

*3 Annual catches for Japanese and Taiwanese Driftnets are put into the Season 1 in the input data.

*4 Annual catches for Japanese and Taiwanese Others are put into the Season 4 in the input data.

*5 Annual catches of out of ISC PBFWG members are put into Season 1 in the input data.

Note: Seasons follow the fishing year.

Table 3. Pacific bluefin tuna catches (in metric tons) by fisheries, for calendar year 1952-2022. “0”; fishing effort was reported but no catch, “+ ”; bellow 499kg catch, “-“; unreported or not available.

	Western Pacific States																								
Calendar Year	Japan (JP)[1]							Calendar Year	Korea (KR)[4]							Taiwan (TW)								Sub total
	Purse Seine	Longline	Troll[2]	Pole and Line	Set Net	Others	Sub Total		Purse Seine	Longline	Setnet	Troll	Trawl	Sub Total		Longline	Set-net	Purse Seine	Gill-net (not specified)	Distant Driftnet	Others	Sub Total		
1952	7,680	2,694	667	2,198	2,145	1,700	17,084	1952																17,084
1953	5,570	3,040	1,472	3,052	2,335	160	15,629	1953																15,629
1954	5,366	3,088	1,656	3,044	5,579	266	18,999	1954																18,999
1955	14,016	2,951	1,507	2,841	3,256	1,151	25,722	1955																25,722
1956	20,979	2,672	1,763	4,060	4,170	385	34,029	1956																34,029
1957	18,147	1,685	2,392	1,795	2,822	414	27,255	1957																27,255
1958	8,586	818	1,497	2,337	1,187	215	14,640	1958																14,640
1959	9,996	3,136	736	586	1,575	167	16,196	1959																16,196
1960	10,541	5,910	1,885	600	2,032	369	21,337	1960																21,337
1961	9,124	6,364	3,193	662	2,710	599	22,652	1961																22,652
1962	10,657	5,769	1,683	747	2,545	293	21,694	1962																21,694
1963	9,786	6,077	2,542	1,256	2,797	294	22,752	1963																22,752
1964	8,973	3,140	2,784	1,037	1,475	1,884	19,293	1964																19,293
1965	11,496	2,569	1,963	831	2,121	1,106	20,086	1965								54						54		20,140
1966	10,082	1,370	1,614	613	1,261	129	15,069	1966							-							0		15,069
1967	6,462	878	3,273	1,210	2,603	302	14,728	1967								53						53		14,781
1968	9,268	500	1,568	983	3,058	217	15,594	1968								33						33		15,627
1969	3,236	878	2,219	721	2,187	195	9,436	1969								23						23		9,459
1970	2,907	607	1,198	723	1,779	224	7,438	1970							-							0		7,438
1971	3,721	697	1,492	938	1,555	317	8,720	1971		0						1						1		8,721
1972	4,212	512	842	944	1,107	197	7,814	1972		0						14						14		7,828
1973	2,266	838	2,108	526	2,351	636	8,725	1973		0						33						33		8,758
1974	4,106	1,177	1,656	1,192	6,019	754	14,904	1974		0						47					15	62		14,966
1975	4,491	1,061	1,031	1,401	2,433	808	11,225	1975		3						61					5	66		11,291
1976	2,148	320	830	1,082	2,996	1,237	8,613	1976		5						17					2	19		8,632
1977	5,110	338	2,166	2,256	2,257	1,052	13,179	1977		0						131					2	133		13,312
1978	10,427	648	4,517	1,154	2,546	2,276	21,568	1978		3						66					2	68		21,636
1979	13,881	729	2,655	1,250	4,558	2,429	25,502	1979		0						58				-		58		25,560
1980	11,327	811	1,531	1,392	2,521	1,953	19,535	1980		0						114					5	119		19,654
1981	25,422	590	1,777	754	2,129	2,653	33,325	1981		0						179				-		179		33,504
1982	19,234	718	864	1,777	1,667	1,709	25,969	1982	31	0				31		207				2 -		209		26,209
1983	14,774	217	2,028	356	972	1,117	19,464	1983	13	0				13		175		9		2 -		186		19,663
1984	4,433	142	1,874	587	2,234	868	10,138	1984	4	1				5		477		5	-		8	490		10,633
1985	4,154	105	1,850	1,817	2,562	1,175	11,663	1985	1	0				1		210		80		11 -		301		11,965
1986	7,412	102	1,467	1,086	2,914	719	13,700	1986	344	0				344		70		16		13 -		99		14,143
1987	8,653	211	880	1,565	2,198	445	13,952	1987	89	13				102		365		21		14 -		400		14,454
1988	3,605	157	1,124	907	843	498	7,134	1988	32	0				32		108		197		37	25	367		7,533
1989	6,190	209	903	754	748	283	9,087	1989	71	0				71		205		259		51	3	518		9,676
1990	2,989	267	1,250	536	716	455	6,213	1990	132	0				132		189		149		299	16	653		6,998
1991	9,808	218	2,069	286	1,485	650	14,516	1991	265	0				265		342	-			107	12	461		15,242
1992	7,162	513	915	166	1,208	1,081	11,045	1992	288	0				288		464		73		3	5	545		11,878
1993	6,600	812	546	129	848	365	9,300	1993	40	0				40		471		1			3	475		9,815
1994	8,131	1,206	4,111	162	1,158	398	15,166	1994	50	0				50		559				-		559		15,775
1995	18,909	678	4,778	270	1,859	586	27,080	1995	821	0				821		335					2	337		28,238
1996	7,644	901	3,640	94	1,149	570	13,998	1996	102	0				102		956 -	-	-		-		956		15,056
1997	13,152	1,300	2,740	34	803	811	18,840	1997	1,054	0				1,054		1,814 -	-	-		-		1,814		21,708
1998	5,391	1,255	2,876	85	874	700	11,181	1998	188	0				188		1,910 -	-	-		-		1,910		13,279
1999	16,173	1,157	3,440	35	1,097	709	22,611	1999	256	0				256		3,089 -	-	-		-		3,089		25,956
2000	16,486	953	5,217	102	1,125	689	24,572	2000	2,401	0			0	2,401		2,780 -	-		1		1	2,782		29,755
2001	7,620	791	3,466	180	1,366	782	14,205	2001	1,176	0			10	1,186		1,839 -	-		2		2	1,843		17,234
2002	8,903	841	2,607	99	1,100	631	14,181	2002	932	0			1	933		1,523 -	-		3		1	1,527		16,641
2003	5,768	1,237	2,060	44	839	446	10,394	2003	2,601	0			0	2,601		1,863 -	-		10		11	1,884		14,879
2004	8,257	1,847	2,445	132	896	514	14,091	2004	773	0			0	773		1,714 -	-		1		2	1,717		16,581
2005	12,817	1,925	3,633	549	2,182	548	21,654	2005	1,318	0			9	1,327		1,368	1 -	-			1	1,370		24,351
2006	8,880	1,121	1,860	108	1,421	777	14,167	2006	1,012	0			3	1,015		1,149	1 -	-		-		1,150		16,332
2007	6,840	1,762	2,823	236	1,503	657	13,821	2007	1,281	0			4	1,285		1,401	2 -		8	-		1,411		16,517
2008	10,221	1,390	2,377	64	2,358	770	17,180	2008	1,866	0			10	1,876		979	1 -		1	-		981		20,037
2009	8,077	1,080	2,003	50	2,236	575	14,021	2009	936	0			4	940		877	1 -		10	-		888		15,849
2010	3,742	890	1,583	83	1,603	495	8,396	2010	1,196	0			16	1,212		373	29 -		7	-		409		10,017
2011	8,340	837	1,820	63	1,651	283	12,994	2011	670	0	+		14	684		292	16 -		7		1	316		13,994
2012	2,462	673	570	113	1,932	343	6,093	2012	1,421	0			2	1,423		210	2 -	-			2	214		7,730
2013	2,771	784	904	8	1,415	529	6,411	2013	604 -		1 +		0	605		331	2 -		1	-		334		7,350
2014	5,456	683	1,023	5	1,907	499	9,573	2014	1,305		6	0 -		1,311		483	38 -		4	-		525		11,409
2015	3,645	648	413	8	1,242	431	6,387	2015	676		1	0		677		552	25 -		1	-		578		7,642
2016	5,095	691	778	54	1,228	508	8,354	2016	1,024		3	0	2	1,029		454 -	-	+		-		454		9,837
2017	4,540	913	605	49	2,221	665	8,993	2017	734		3		6	743		415 -	-	-		+		415		10,151
2018	4,049	700	371	9	645	431	6,205	2018	523		7		5	535		381 +	-		3	+		384		7,124
2019	4,464	1,002	720	0	951	372	7,509	2019	542		36		3	581		486	2 -		2		2	492		8,582
2020	3,960	1,416	760	1	1,342	532	8,011	2020	567		35		3	605		1,149	1 -	-		-		1,150		9,766
2021	4,198	1,551	653	0	1,742	440	8,584	2021	422		84		3	509		1,478 +	-	+		-		1,478		10,571
2022	4,702	1,587	1,079	13	2,126	605	10,112	2022	654		221		6	881		1,496 +	-	+		-		1,496		12,489

Table 3. Cont.

Calendar Year	Eastern Pacific States													Out of ISC members		Grand Total
	United States (US)[5]									Mexico (MX)			Sub total			
	Drift gill-net	Longline	Pole and line	Troll	Hook and Line	Others	Purse seine	Sport	Sub Total	Others	Purse seine	Sub Total		New Zealand (NZ)[6]	Australia (AU)[7]	
1952							2,076	2	2,078	-	-		2,078			19,162
1953							4,433	48	4,481	-	-		4,481			20,110
1954							9,537	11	9,548	-	-		9,548			28,547
1955							6,173	93	6,266	-	-		6,266			31,988
1956							5,727	388	6,115	-	-		6,115			40,144
1957							9,215	73	9,288	-	-		9,288			36,543
1958							13,934	10	13,944	-	-		13,944			28,584
1959			56				3,506	13	3,575	32	171	203	3,778			19,974
1960			+				4,547	1	4,548	-	-		4,548			25,885
1961			16				7,989	23	8,028	-	130	130	8,158			30,810
1962			+				10,769	25	10,794	-	294	294	11,088			32,782
1963			28				11,832	7	11,867	-	412	412	12,279			35,031
1964			39				9,047	7	9,093	-	131	131	9,224			28,517
1965			11	+		66	6,523	1	6,601	-	289	289	6,890			27,030
1966			12				15,450	20	15,482	-	435	435	15,917			30,986
1967			+				5,517	32	5,549	-	371	371	5,920			20,701
1968			8				5,773	12	5,793	-	195	195	5,988			21,615
1969			9				6,657	15	6,681	-	260	260	6,941			16,400
1970			+				3,873	19	3,892	-	92	92	3,984			11,422
1971			+				7,804	8	7,812	-	555	555	8,367			17,088
1972			3			42	11,656	15	11,716	-	1,646	1,646	13,362			21,190
1973			5	+		20	9,639	54	9,718	-	1,084	1,084	10,802			19,560
1974			+	+		30	5,243	58	5,331	-	344	344	5,675			20,641
1975			83			1	7,353	34	7,471	-	2,145	2,145	9,616			20,907
1976			22	+		3	8,652	21	8,698	-	1,968	1,968	10,666			19,298
1977			10			3	3,259	19	3,291	-	2,186	2,186	5,477			18,789
1978			4			2	4,663	5	4,674	-	545	545	5,219			26,855
1979			5			1	5,889	11	5,906	-	213	213	6,119			31,679
1980			+			24	2,327	7	2,358	-	582	582	2,940			22,594
1981	4		+	10		+	867	9	890	-	218	218	1,108			34,612
1982	9		1			+	2,639	11	2,660	-	506	506	3,166			29,375
1983	31		59			2	629	33	754	-	214	214	968			20,631
1984	6	1	5			18	673	49	752	-	166	166	918			11,551
1985	8					20	3,320	89	3,437	-	676	676	4,113			16,078
1986	16					41	4,851	12	4,920	-	189	189	5,109			19,252
1987	2					18	861	34	915	-	119	119	1,034			15,488
1988	4					46	923	6	979	1	447	448	1,427			8,960
1989	3					18	1,046	112	1,179	-	57	57	1,236			10,912
1990	11					81	1,380	65	1,537	-	50	50	1,587			8,585
1991	4	2				+	410	92	508	-	9	9	517	2		15,761
1992	9	38				14	1,928	110	2,099	-	0	0	2,099	0		13,977
1993	32	42				29	580	283	966	-	0		966	6	0	10,787
1994	28	30				1	906	86	1,051	2	63	65	1,116	2	1	16,894
1995	20	29				+	657	245	951	-	11	11	962	2	1	29,202
1996	43	25		2		+	4,639	40	4,749	-	3,700	3,700	8,449	4		23,509
1997	58	26		1		48	2,240	131	2,504	-	367	367	2,871	14	1	24,594
1998	40	54		128		59	1,771	422	2,474	-	1	1	2,475	20	3	15,777
1999	22	54		20		88	184	408	776	35	2,369	2,404	3,180	21	5	29,162
2000	30	19		1		11	693	319	1,073	99	3,019	3,118	4,191	21	8	33,975
2001	35	6		6		1	292	344	684	-	863	863	1,547	50	7	18,838
2002	7	2		1		2	50	613	675	2	1,708	1,710	2,385	56	6	19,088
2003	14	1				3	22	355	395	43	3,211	3,254	3,649	41	12	18,581
2004	10	1				+		50	61	14	8,880	8,894	8,955	67	10	25,614
2005	5	1				1	201	73	281	-	4,542	4,542	4,823	29	13	29,216
2006	1	1				+		94	96	-	9,806	9,806	9,902	23	5	26,262
2007	2	+				+	42	12	56	-	4,147	4,147	4,203	14	4	20,738
2008	1	+				+		63	64	15	4,407	4,422	4,486	14	3	24,540
2009	3	1		0		2	410	156	572	-	3,019	3,019	3,591	16	3	19,459
2010	1	0				0		88	89	-	7,746	7,746	7,835	14	0	17,866
2011	18	0		0		100		225	343	1	2,731	2,732	3,075	28	1	17,098
2012	4	0		0		38		400	442	1	6,668	6,669	7,111	13	1	14,855
2013	7	1		0		3		809	820		3,154	3,154	3,974	24	0	11,348
2014	5	+		+	2	-	401	420	828		4,862	4,862	5,690	12	0	17,111
2015	4	+			7	-	86	400	497		3,082	3,082	3,579	17	0	11,238
2016	9	1		0	31	-	316	372	729		2,709	2,709	3,438	19	0	13,294
2017	1	1		+	18	+	466	463	949		3,643	3,643	4,592	14	0	14,757
2018	18	1		+	31	4	12	535	601		2,840	2,840	3,441	20	0	10,585
2019	10	2		1	36	1	226	479	755		2,249	2,249	3,004	23	0	11,609
2020	28	2		+	87	1	116	750	984		3,285	3,285	4,269	46	0	14,081
2021	55	1		+	116	3	43	1,249	1,467		3,027	3,027	4,494	42	0	15,107
2022	20	2		0	149	1	198	1,367	1,737		3,194	3,194	4,931	34	0	17,454

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

6 Catches by New Zealand from 1991 to 2006 are derived from the Ministry of Fisheries, Science Group (Compilers) 2006: Report from the Fishery Assessment Plenary, May 2006: stock assessments and yield estimates. 875 p. Catches by New

7 Catches by Australia are provided by SPC.

Table 4. Quarterly catch of Pacific bluefin tuna by fleet for fishing year 1983-2022.

Fishing year	Season	Weight (mt)																		Number (1000 fish)						
		Fleet 1	Fleet 2	Fleet 3	Fleet 4	Fleet 5	Fleet 6	Fleet 8	Fleet 9	Fleet 11	Fleet 12	Fleet 13	Fleet 15	Fleet 16	Fleet 17	Fleet 18	Fleet 19	Fleet 20	Fleet 21	Fleet 24	Fleet 7	Fleet 10	Fleet 14	Fleet 22	Fleet 23	Fleet 25	Fleet 26
1983	1	8				2262	570			3	0	21	897	143		113		631							1.4		
1983	2	15				0	0			2	1925		131	210		74	310	125							1.1		
1983	3	41				0	0			1	287		33	380		3		72							0.0		
1983	4	94		477		2448	0			2	0		116		431	138		144							0.2		
1984	1	20				1184	807			1	0	28	588	311		343		563							2.7		
1984	2	9				0	0			1	1558		391	413		215	336	90							0.5		
1984	3	24				0	0			0	538		1011	265		3		62							0.0		
1984	4	74		210		2897	0			0	135		464		358	153		1572							0.0		
1985	1	8				889	448			0	0	12	961	229		714		1264							4.9		
1985	2	8				0	0			0	1165		120	352		488	447	1126							0.3		
1985	3	19				0	0			84	224		74	369		3		109							0.0		
1985	4	84		70		6340	0			130	0		460		547	118		428							0.1		
1986	1	8				1072	16			70	0	5	668	375		564		3759							0.6		
1986	2	5				0	0			60	1238		212	553		387	403	801							0.0		
1986	3	20				0	0			22	354		1089	274		2		93							0.0		
1986	4	195		365		4874	0			34	15		132		299	89		31							0.0		
1987	1	20				3550	250			18	0	6	519	193		612		813							0.8		
1987	2	9				0	0			15	505		98	297		432	187	63							1.2		
1987	3	19				0	0			8	89		146	94		1		0							0.0		
1987	4	123		108		1027	0	16		12	0		357		113	45		221							0.0		
1988	1	35				2010	742			7	0	15	796	87		228		974							0.2		
1988	2	10				0	0		6	6	1020		42	118		157	127	227							0.2		
1988	3	27				0	0	3		17	259		68	86		0		7							0.0		
1988	4	190		205		2134	0	3		27	27		356		125	24		0							0.0		
1989	1	20				3623	580	88		15	0	88	411	81		186		988							5.2		
1989	2	4				0	0		20	12	529		146	114		132	110	130							1.3		
1989	3	21				0	0			32	166		17	165		1		16							0.0		
1989	4	280		189		360	0	5		50	92		213		133	26		1							0.0		
1990	1	24				2474	149	32		27	0	3	830	64		90		1311							3.5		
1990	2	10				0	0		118	23	990		47	179		60	199	194							0.2		
1990	3	16				0	0	99		65	636		30	421		1		0							0.0		
1990	4	193		342		646	0	26		100	161		79		288	49		86							0.0		
1991	1	14		2		3466	224	182		54	0	82	429	123		146		334							4.9		
1991	2	14				0	0		5165	46	1191		103	363		95	414	5							0.4		
1991	3	36				0	0	394		71	274		18	183		2		0							0.0		
1991	4	462		464		1677	0	2061		109	0		35		332	68		11							0.1		
1992	1	10		0		2183	469	255		59	0		944	173		116		1650							8.3		
1992	2	20				0	0		198	50	642		65	269		66	193	328							0.2		
1992	3	15				0	0	582		10	145		12	102		1		0							0.0		
1992	4	708		471		1243	0	751		15	34		38		280	27		45							0.0		

Table 4. Cont.

Fishing year	Season	Weight (mt)																			Number (1000 fish)						
		Fleet 1	Fleet 2	Fleet 3	Fleet 4	Fleet 5	Fleet 6	Fleet 8	Fleet 9	Fleet 11	Fleet 12	Fleet 13	Fleet 15	Fleet 16	Fleet 17	Fleet 18	Fleet 19	Fleet 20	Fleet 21	Fleet 24	Fleet 7	Fleet 10	Fleet 14	Fleet 22	Fleet 23	Fleet 25	Fleet 26
1993	1		62	6		3831	83	99		8	0	48	204	161		32		525							10.4		
1993	2		37				0		12	7	320		36	230		16	207	113							0.1		
1993	3		42				0	25		12	67		0	70		1		2							0.0		
1993	4	1085		559		2677	0	562		19	15		17		481	16		4							0.1		
1994	1		77	3		3973	694	14		10	0	458	206	168		36		967							2.1		
1994	2		22				0		185	9	3570		65	356		31	272	58							0.0		
1994	3		11				0	406		202	2475		9	132		0		0							0.0		
1994	4	616		335		2040	0	254		309	733		136		256	23		0							0.0		
1995	1		35	2		2798	496	4055		168	0	440	143	243		213		716							16.0		
1995	2		25				0		8860	142	1130		94	788		205	476	0							0.0		
1995	3		31				0	1355		25	136		5	84		0		0							0.0		
1995	4	827		956		3124	0	140		38	57		1		253	16		757							1.6		
1996	1		25	4		1967	450	451		21	0	256	90	129		142		7652							1.1		
1996	2		26				0		158	18	3191		66	416		110	503	0							0.0		
1996	3		27				0	594		259	846		1	114		0		1							0.0		
1996	4	1215		1814		1402	0	1113		397	550		4		199	6		61							3.0		
1997	1		27	15		4027	708	3000		215	0	224	113	165		20		2638							5.4		
1997	2		44				0		2309	183	1120		25	246		53	702	41							0.0		
1997	3		18				0	559		46	605		2	158		1		4							0.0		
1997	4	1150		1910		13	0	518		71	515		2		131	15		8							0.7		
1998	1		53	23		2376	326	549		38	0	131	108	114		29		2017				23.5			20.5	23.5	
1998	2		46				0		1049	33	1613		64	359		68	609	24							0.8		
1998	3		33				0	686		63	798		10	317		1		0							0.0		
1998	4	1076		3089		5592	0	986		96	360		2		329	32		2280							0.6		
1999	1		25	26		5448	579	2228		52	0	129	65	133		16		442				107.2			35.2	107.2	
1999	2		41				0		653	44	2101		17	391		46	482	49							1.0		
1999	3		39				0	651		747	1456		1	168		0		0							0.1		0.0
1999	4	893		2780		3403	0	2380		1597	770		83		164	5		669							8.0		0.0
2000	1		15	29		4042	747	3214		30	0	117	66	154		87		3204				190.9			12.6	190.9	0.0
2000	2		12				0		2048	27	2780		6	475		72	638	0							0.0		0.0
2000	3		8				0	898		963	934		0	358		1		0							0.1		0.0
2000	4	749		1834	5	981	0	2914		179	464		4		189	45		382							0.7		0.0
2001	1		13	57		1918	239	409		9	0	83	167	73		174		821	0			274.6			20.8	274.6	0.0
2001	2		26				0		261	37	1847		113	293		232	683	0	0						1.4		0.0
2001	3		76				0	62		160	988		17	113		0		0	0						0.1		0.0
2001	4	671		1513	10	556	0	2126		175	697		51		117	6		0	275						1.3		0.0
2002	1		45	61		2767	599	959		509	0	37	224	157		235			1497			358.2			30.9	358.2	0.0
2002	2		56				0		1835	88	706		24	231		251	409		0						1.9		0.0
2002	3		95				0	99		238	520		11	84		0			0						0.0		0.0
2002	4	992		1832		185	0	1771		394	824		34		87	54			590						0.5		0.0

Table 4. Cont.

Fishing year	Season	Weight (mt)																		Number (1000 fish)						
		Fleet 1	Fleet 2	Fleet 3	Fleet 4	Fleet 5	Fleet 6	Fleet 8	Fleet 9	Fleet 11	Fleet 12	Fleet 13	Fleet 15	Fleet 16	Fleet 17	Fleet 18	Fleet 19	Fleet 20	Fleet 21	Fleet 24	Fleet 7	Fleet 10	Fleet 14	Fleet 22	Fleet 23	Fleet 25	Fleet 26
2003	1		78	84		200	571	783		88	0	80	58	96		291			2704				441.9		20.8	441.9	0.0
2003	2		85				0		2159	1881	416		6	156		71	403		0						0.9		0.0
2003	3		116	1			0	38		53	182		5	109		3			0						0.0		0.0
2003	4	1380		1698		609	0	1144		556	54		15		266	47			3620						0.7		0.0
2004	1		154	93		2225	2100	10		59	0	78	114	136		81			5285				525.6		2.8	525.6	0.0
2004	2		205				0		2131	105	1868		94	186		68	421		0						0.0		0.0
2004	3		122	0			0	586		720	1173		164	379		15			0						0.0		0.0
2004	4	1602		1287	43	264	0	1888		264	906		321		572	217			1986						0.4		0.0
2005	1		106	71		77	3694	3280		222	0	293	171	414		137			2764				453.8		5.3	453.8	0.0
2005	2		108				0		3029	121	1034		30	346		102	413		0						0.1		0.0
2005	3		81	0			0	59		220	513		68	284		7			640						0.0		0.0
2005	4	873		1078	49	940	0	2412		339	85		23		356	135			4714						5.4		0.0
2006	1		115	48		692	2012	252		354	0	251	315	148		328			4573				632.6		2.3	632.6	0.0
2006	2		62				0		2513	102	695		17	229		69	331		1						0.0		0.0
2006	3		61				0	485		376	228		32	253		10			0						0.0		0.0
2006	4	1022		1261	95	479	0	1059		13	70		15		270	127			1424						0.3		0.0
2007	1		66	58	4	364	2123	363		121	0	101	238	150		381			2723				876.4		0.7	876.4	0.0
2007	2		71				0		1968	776	1985		105	314		52	1013		44						0.0		0.0
2007	3		99	0			0	214		581	619		12	268		2			0						0.0		0.0
2007	4	802		784	175	1	0	1610		1003	220		30		844	239			1794						0.5		0.1
2008	1		33	35	2		3028	3007		62	0	72	287	389		186			2613				607.0		10.0	607.0	0.1
2008	2		40				0		2361	230	1163		14	455		95	797		1						0.0		0.0
2008	3		39	0			0	702		518	868		1	449		1			0						0.0		0.0
2008	4	662		625	186	1	0	2177		213	241		13		1031	276			1209						0.5		0.0
2009	1		26	82	3	828	1299	2891		97	0	62	108	180		181			2221				255.8		11.6	255.8	0.0
2009	2		23				0		181	112	703		43	143		106	677		3						0.3		0.0
2009	3		35				0	718		617	264		0	342		1			0						0.0		0.0
2009	4	400		260	78	35	0	1390		424	38		36		566	264			2447						3.5		0.0
2010	1		27	45		35	1052	123		26	0	20	179	190		79			5300				563.4		4.2	563.4	0.0
2010	2		10				0		388	145	979		44	237		9	693		1						0.8		0.0
2010	3		25	0			0	67		191	492		29	374		4			0						0.0		0.0
2010	4	372		197	76		0	3058		429	298		34		380	384			451						1.9		0.0
2011	1		49	48		320	1906	611		21	0	39	38	158		148			2379				375.0		28.6	375.0	0.0
2011	2		32				0		2377	43	789		22	217		36	567		19						1.2		0.0
2011	3		20				0	9		163	242		70	360		5			1						0.0		0.0
2011	4	189		148	50	3	0	530		674	7		45		500	151			1286						4.0		0.0
2012	1		24	26		199	841	261		559	0	2	103	205		514			5421				180.4		35.0	180.4	0.0
2012	2		13				0		620	28	233		0	176		54	644		3						1.0		0.0
2012	3		28				0	9		76	256		2	273		4			0						0.0		0.0
2012	4	237		192	123	12	0	743		493	19		6		372	170			1368						3.0		0.0

Table 4. Cont.

Fishing year	Season	Weight (mt)																			Number (1000 fish)						
		Fleet 1	Fleet 2	Fleet 3	Fleet 4	Fleet 5	Fleet 6	Fleet 8	Fleet 9	Fleet 11	Fleet 12	Fleet 13	Fleet 15	Fleet 16	Fleet 17	Fleet 18	Fleet 19	Fleet 20	Fleet 21	Fleet 24	Fleet 7	Fleet 10	Fleet 14	Fleet 22	Fleet 23	Fleet 25	Fleet 26
2013	1		28	40		268	1729	10		1	0	22	81	132		204			1788				263.9		56.7	263.9	0.1
2013	2		15	0		0	0		2	35	477		3	217		82	895		8						4.6		0.0
2013	3		9	0			0	79		516	789		0	306		2			2						0.0		0.0
2013	4	311		257	216	0	0	2459		783	60		43		818	285			4036						1.4		0.0
2014	1		21	21	1	47	2203	654		6	0	40	125	92		231			1228				61.3	24.7		61.3	0.1
2014	2		26				0		14	6	97		1	107		110	679		2					1.7			0.1
2014	3		39	0			0	246		607	60		7	76		1			1					0.7			0.0
2014	4	191		308	237	939	0	86		5	18		12		388	261			3133			121.2		2.2			0.0
2015	1		25	26	0		1864	27		0	0	19	11	88		210			43			27.4	242.6	25.5		242.6	0.3
2015	2		47				0		7	65	233		6	77		167	808		3					0.2			0.0
2015	3		72	0			0	1		981	153		5	116		0			0					0.0			0.0
2015	4	217		237	215	1287	0	97		33	82		5		199	283			2716			267.4		2.4			0.1
2016	1		83	23			3545	463		6	0	224	8	135		183			329			1.5	260.5	8.1		260.5	0.2
2016	2		20				0		805	9	213		52	254		62	769		16					2.0			0.0
2016	3		50				0	83		738	178		31	479		1			1					0.1			0.0
2016	4	358		232	172	1620		131		0	6		64		368	175			3650		1.9	218.7		1.7			0.0
2017	1		37	30	1		1412	111		3	0	82	32	259		518			479	0	1.0		163.9	9.6		163.9	0.3
2017	2		35						375	2	299		1	109		316	1038		0	205				5.2			0.1
2017	3		59					11		530	81		30	148		1			418	27				0.6			0.0
2017	4		354	257	115	1571		81		0	15		28		209	36			2429	171	2.9	245.5		1.9		12.3	0.0
2018	1		11	38			1229	124		0	0	42	5	98		37			40		0.6	0.6	217.9	6.6		217.9	0.4
2018	2		33						95	5	196		8	110		7	533		17	168				5.0			0.1
2018	3		195					8		542	375		36	312		1			2007	116				0.0			0.0
2018	4		429	304	173	1567		152		16	51		12		233	52			7	1	4.3	232.1		5.2		12.1	0.0
2019	1		14	34	0		1072	449		10	0	39	7	101		171			248	0	2.1	3.3	155.0	10.3		155.0	0.0
2019	2		29	2					216	12	198		6	76		12	647		12	199				3.2			0.0
2019	3		126					9		447	293		20	433		0			3288	149				0.2			0.0
2019	4		740	951	194	1556		66		115	108		26		260	191			11	6	3.4	182.8		1.9		10.9	0.0
2020	1		19	49	2		1308	2		32	0	55	8	146		124			165	2	0.8	30.7	126.1	28.4		126.1	0.3
2020	2		110						289	12	246		4	147		43	907		47	194				7.3			0.0
2020	3		124	1				4		99	305		23	799		0			3029	193				0.1			0.0
2020	4		591	1150	320	1495		20		327	44		16		282	176			5	16	4.2	240.0		18.5		12.7	0.1
2021	1		22	7	0		1210	35		32	0	57	13	148		156			147		1.0	8.4	136.0	33.8		136.0	0.4
2021	2		279						370	12	197		3	159		27	972		56	191				4.8			0.0
2021	3		405	0				105		99	507		44	937		0			3200	203				0.2			0.0
2021	4		537	999	490	1676		49		327	176		29		472	145			14		5.0	287.7		22.7		14.9	0.3
2022	1		47	6	1		1306	69		32	0	45	9	189		191			300		1.7	2.7	135.9	25.7		135.9	0.1
2022	2		111	0					257	12	273		4	162		58	1052		42	212				10.9			0.1
2022	3		340	1				61		99	441		34	766		0			3400	217				0.1			0.0
2022	4		527	1501	588	716		41		327	254		34		451	170			15		7.8	244.0		16.1		12.6	0.3

Table 6. Abundance indices (CPUE) submitted to the PBFWG.

CPUE #	Abundance index	Available period (fishing year)	Corresponding fisheries	Corresponding fleet for the selectivity setting	Data quality	Document for reference	Update
S1	Japanese coastal longline CPUE for spawning season.	**1993-2019**	JPN Longline	Fleet 1 : JPN_LL(Seas4)	Standardized by VAST	ISC/22/PBFWG-1/01	
S2	Japanese offshore and distant water longliners CPUE	**1974-1992**	JPN Longline	Fleet 1 : JPN_LL(Seas4)	Standardized by lognormal model	ISC/08/PBFWG-1/05	
S3	Japanese troll CPUE in Nagasaki prefecture (Sea of Japan and East China sea)	**1980-2016**	JPN Troll	Fleet 12 : JPN Troll (Seas 2-4)	Standardized by lognormal model	ISC/20/PBFWG-1/04	
S4	Japanese Recruitment monitoring in the East China Sea	**2017-2021**	JPN Troll	Fleet 12 : JPN Troll (Seas 2-4)	Standardized by VAST	ISC/23/PBFWG-1/03	X
S5	Taiwanese longline CPUE (South area)	**2002-2022**	TWN Longline	Fleet 3 : TWN_LL (South)	Standardized by GLMM	ISC/23/PBFWG-2/04	X
S6	Taiwanese longline GLMM CPUE (Whole area)	**2002-2022**	TWN Longline	Fleet 4 : TWN_LL (North)	Standardized by GLMM	ISC/23/PBFWG-2/04	X
S7	Taiwanese longline geo-stat CPUE (South area)	**2006-2022**	TWN Longline	Fleet 4 : TWN_LL (South)	Standardized by VAST	ISC/23/PBFWG-2/04	X
S8	Taiwanese longline geo-stat CPUE (Whole area)	**2006-2022**	TWN Longline	Fleet 4 : TWN_LL (North)	Standardized by VAST	ISC/23/PBFWG-2/04	X
S9	Taiwanese longline geo-stat CPUE (All age, Whole area)	**2009-2022**	TWN Longline	Fleet 4 : TWN_LL (North)	Standardized by VAST	ISC/23/PBFWG-2/04	X
S10	Taiwanese longline geo-stat CPUE (Age 6-8, Whole area)	**2009-2022**	TWN Longline	Fleet 5 : TWN_LL (North)	Standardized by VAST	ISC/23/PBFWG-2/05	X
S11	Taiwanese longline geo-stat CPUE (Age 9-11, Whole area)	**2009-2022**	TWN Longline	Fleet 6 : TWN_LL (North)	Standardized by VAST	ISC/23/PBFWG-2/06	X
S12	Taiwanese longline geo-stat CPUE (Age 12-14, Whole area)	**2009-2022**	TWN Longline	Fleet 7 : TWN_LL (North)	Standardized by VAST	ISC/23/PBFWG-2/07	X
S13	Taiwanese longline geo-stat CPUE (Age 15-17, Whole area)	**2009-2022**	TWN Longline	Fleet 8 : TWN_LL (North)	Standardized by VAST	ISC/23/PBFWG-2/08	X
S14	Taiwanese longline geo-stat CPUE (Age 18+, Whole area)	**2009-2022**	TWN Longline	Fleet 4 : TWN_LL (North)	Standardized by VAST	ISC/23/PBFWG-2/04	X

Table 7. Available annual abundance indices (CPUE) of Pacific bluefin tuna. S1, S2, S3, and S5 will be fitted to the assessment model (numbers in bold). Numbers in grey indicate that data points were removed.

Fishing year	JP LL		JP Troll	JPN Troll Monitoring	TW LL									
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
1983		**0.36**	**0.91**											
1984		**0.39**	**0.92**											
1985		**0.36**	**0.86**											
1986		**0.42**	**0.98**											
1987		**0.42**	**0.71**											
1988		**0.48**	**0.82**											
1989		**0.73**	**0.65**											
1990		**0.73**	**1.27**											
1991		**1.17**	**1.32**											
1992		**1.26**	**0.58**											
1993	**2.29**		**0.48**											
1994	**1.67**		**2.00**											
1995	**2.03**		**1.09**											
1996	**2.09**		**1.60**											
1997	**1.93**		**0.94**											
1998	**1.49**		**0.82**											
1999	**1.06**		**1.51**											
2000	**0.77**		**1.14**											
2001	**0.92**		**1.15**											
2002	**1.40**		**0.74**		**1.70**	1.76								
2003	**1.50**		**0.64**		**1.65**	1.59								
2004	**1.53**		**1.28**		**1.14**	1.14								
2005	**0.88**		**1.41**		**1.38**	1.27								
2006	**0.96**		**0.73**		**1.04**	0.82	1.49	1.24						
2007	**0.60**		**1.41**		**0.85**	0.79	0.81	0.78						
2008	**0.35**		**1.44**		**0.73**	0.74	0.52	0.55						
2009	**0.22**		**1.14**		**0.41**	0.41	0.30	0.29	0.26	0.06	0.14	0.86	1.48	0.68
2010	**0.18**		**1.11**		**0.33**	0.34	0.21	0.26	0.24	0.06	0.08	0.84	1.50	0.92
2011	**0.14**		**0.97**	0.61	**0.25**	0.24	0.18	0.20	0.20	0.03	0.06	0.40	1.33	1.50
2012	**0.30**		**0.49**	0.46	**0.30**	0.35	0.19	0.23	0.19	0.07	0.05	0.42	1.11	1.38
2013	**0.30**		**0.89**	0.99	**0.55**	0.67	0.27	0.37	0.30	0.19	0.10	0.39	1.36	2.08
2014	**0.38**		**0.42**	0.23	**0.55**	0.64	0.33	0.44	0.38	0.36	0.20	0.37	0.82	2.07
2015	**0.40**		**0.49**	0.42	**0.54**	0.65	0.32	0.44	0.39	0.29	0.32	0.32	0.89	1.70
2016	**0.65**		**1.08**	1.46	**0.69**	0.65	0.42	0.46	0.42	0.28	0.45	0.53	0.50	0.82
2017	**0.66**			1.87	**0.66**	0.54	0.71	0.63	0.62	0.50	0.65	0.92	0.46	0.66
2018	**0.90**			1.26	**0.64**	0.71	0.65	0.73	0.76	0.74	0.78	0.81	0.84	0.54
2019	**1.38**			0.51	**1.31**	1.27	2.20	2.14	2.05	1.98	2.34	1.94	0.91	0.64
2020				0.64	**1.54**	1.38	2.26	2.11	2.10	2.70	2.12	1.36	0.70	0.36
2021				2.18	**2.26**	2.27	2.65	2.56	2.54	2.34	3.16	1.92	0.94	0.34
2022				1.37	**2.47**	2.75	3.50	3.57	3.54	4.40	3.55	2.92	1.16	0.34

Table 8. 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	JP LL		JP Troll	JPN Troll Monitoring	TW LL									
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
1983		0.20	0.20											
1984		0.20	0.20											
1985		0.20	0.20											
1986		0.20	0.20											
1987		0.20	0.20											
1988		0.20	0.20											
1989		0.20	0.20											
1990		0.20	0.20											
1991		0.20	0.20											
1992		0.20	0.20											
1993	0.20	0.01	0.20											
1994	0.20	0.01	0.20											
1995	0.20	0.01	0.20											
1996	0.20	0.01	0.20											
1997	0.20	0.01	0.20											
1998	0.20	0.01	0.20											
1999	0.20	0.01	0.20											
2000	0.20	0.01	0.20											
2001	0.20	0.01	0.20											
2002	0.20		0.20		0.20	0.20								
2003	0.20		0.20		0.20	0.20								
2004	0.20		0.20		0.20	0.20								
2005	0.20		0.20		0.20	0.20								
2006	0.20		0.20		0.20	0.20	0.20	0.20	0.20					
2007	0.20		0.20		0.20	0.20	0.20	0.20	0.20					
2008	0.20		0.20		0.20	0.20	0.20	0.20	0.20					
2009	0.20		0.20		0.20	0.20	0.20	0.21	0.20	0.20	0.20	0.20	0.20	0.20
2010	0.20		0.20		0.20	0.20	0.21	0.23	0.21	0.20	0.20	0.20	0.20	0.20
2011	0.20		0.20	0.20	0.20	0.20	0.20	0.23	0.20	0.20	0.20	0.20	0.20	0.20
2012	0.20		0.20	0.20	0.20	0.20	0.23	0.23	0.23	0.20	0.20	0.20	0.20	0.20
2013	0.20		0.20	0.20	0.20	0.20	0.21	0.20	0.21	0.20	0.20	0.20	0.20	0.20
2014	0.20		0.20	0.20	0.20	0.20	0.21	0.20	0.21	0.20	0.20	0.20	0.20	0.20
2015	0.20		0.20	0.20	0.20	0.20	0.20	0.21	0.20	0.20	0.20	0.20	0.20	0.20
2016	0.20		0.20	0.20	0.20	0.20	0.21	0.20	0.21	0.20	0.20	0.20	0.20	0.20
2017	0.20			0.23	0.20	0.20	0.20	0.22	0.20	0.20	0.20	0.20	0.20	0.20
2018	0.20			0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
2019	0.20			0.21	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
2020				0.22	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
2021				0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
2022				0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

Table 9. Summary of the size composition data of Pacific bluefin tuna for the stock assessment.

Fleet #	Fleet name	Catch-at-size data (Size bin definition)	Size data included		Available period (Fishing year)	Source of sample size	Update
			Component 1	Component 2			
Fleet 1	JPN_LL (Seas 4)	Length bin	JPN Longline (1952-1992)	JPN Longline (1993-2016, Season 4)	1952-1968, 1993-2016	Scaled Number of fish measured	X
Fleet 2	JPN_LL (1993-) (Seas 1-3)	Length bin	JPN Longline(1993-2016, Season 1-3)	JPN Longline(2017-2020)	1993-2022		X
Fleet 3	TWN_LLSouth	Length bin	TWN Longline (South area)	Out of ISC members (NZ, AU, etc.)*5	1992-2022	Scaled Number of fish measured	X
Fleet 4	TWN_LLNorth	Length bin	TWN Longline (North area)		2009-2022	Scaled Number of fish measured	X
Fleet 5	JPN_TPS_PO	Length bin	JPN Tuna Purse seine in Pacific Ocean		1995-2006 and 2014-2022	Number of landing well measured	X
Fleet 6 *1	JPN_TPS_SOJ	Length bin	JPN Tuna Purse seine in the Sea of Japan	TWN Purse seine*2	1987-1989, 1991-2022	Number of landing well measured	X
Fleet 7 *1	JPN_TPS_SOJ (Farming)	Length bin	JPN Tuna Purse seine in the Sea of Japan for		1987-1989, 1991-2022	Number of landing well measured	X
Fleet 8 *2	JPN_SPPS (Seas 1,3,4)	Length bin	JPN Small Pelagic Purse seine (Season		2002-2022	Number of landing well measured	X
Fleet 9	JPN_SPPS (S2)	Length bin	JPN Small Pelagic Purse seine (Season 2)		2012-2022	Number of landing well measured	X
Fleet 10	JPN_SPPS (Farming)	Length bin	JPN Small Pelagic Purse seine for		2016-2022		X
Fleet 11 *2	KOR_LPPS	Length bin	KOR Large Pelagic Purse Seine	KOR Trawl*1	2010-2022	Number of landing well measured	X
Fleet 12	JPN_Troll (Seas 2-4)	Length bin	JPN Troll (Season 2-4)		1994-2022	Total month of well sampled port	X
Fleet 13	JPN_Troll (Seas 1)	Length bin	JPN Troll (Season 1)		1994-2004, 2006-2008, 2011,2012, 2016, 2018	Total month of well sampled port	X
Fleet 14 *3	JPN_Troll (Farming)	Age (age-0 only)	JPN Troll for Farming				
Fleet 15 *4	JPN_PoleLine	Length bin	JPN Pole-and-Line	JPN Driftnet*3	1994-1996, 1998-2004, 2006-2010		
Fleet 16	JPN_Setnet (Seas 1-3)	Length bin	JPN Setnet (Season 1-3)	JPN Miscellaneous (Season 1-3)	1993-2018	Total month of well sampled port	X
Fleet 17	JPN_Setnet (Seas 4)	Length bin	JPN Setnet (Season 4)	JPN Miscellaneous (Season 4)	1993-2018	Total month of well sampled port	X
Fleet 18 *5	JPN_Setnet (HK_AM)	Weight bin	JPN Setnet in Hokkaido and Aomori		1994-2018	Total month of well sampled port	X
Fleet 19 *5	JPN_Other	Weight bin	JPN Others		1994-2018	Total month of well sampled port	X
Fleet 20	EPO_COMM (-2001)	Length bin	USA Commercial Fisheries (PS, Others)	MEX Commercial Fisheries (PS, Others)	1952-1965, 1969-1982	Number of haul well measured	
Fleet 21	EPO_COMM (2002-)	Length bin	MEX Commercial Fisheries (PS, Others)	USA Commercial Fisheries (PS, Others)	2005-2006, 2008-2022	Number of haul well measured	X
Fleet 22 *6	EPO_Sports (2014-)	Length bin	USA Recreational Fisheries (2014-)		2014-2022		X
Fleet 23	EPO_Sports early (-2013)	Length bin	USA Recreational Fisheries (-2013)		1993-2003, 2005-06, 2008-11		

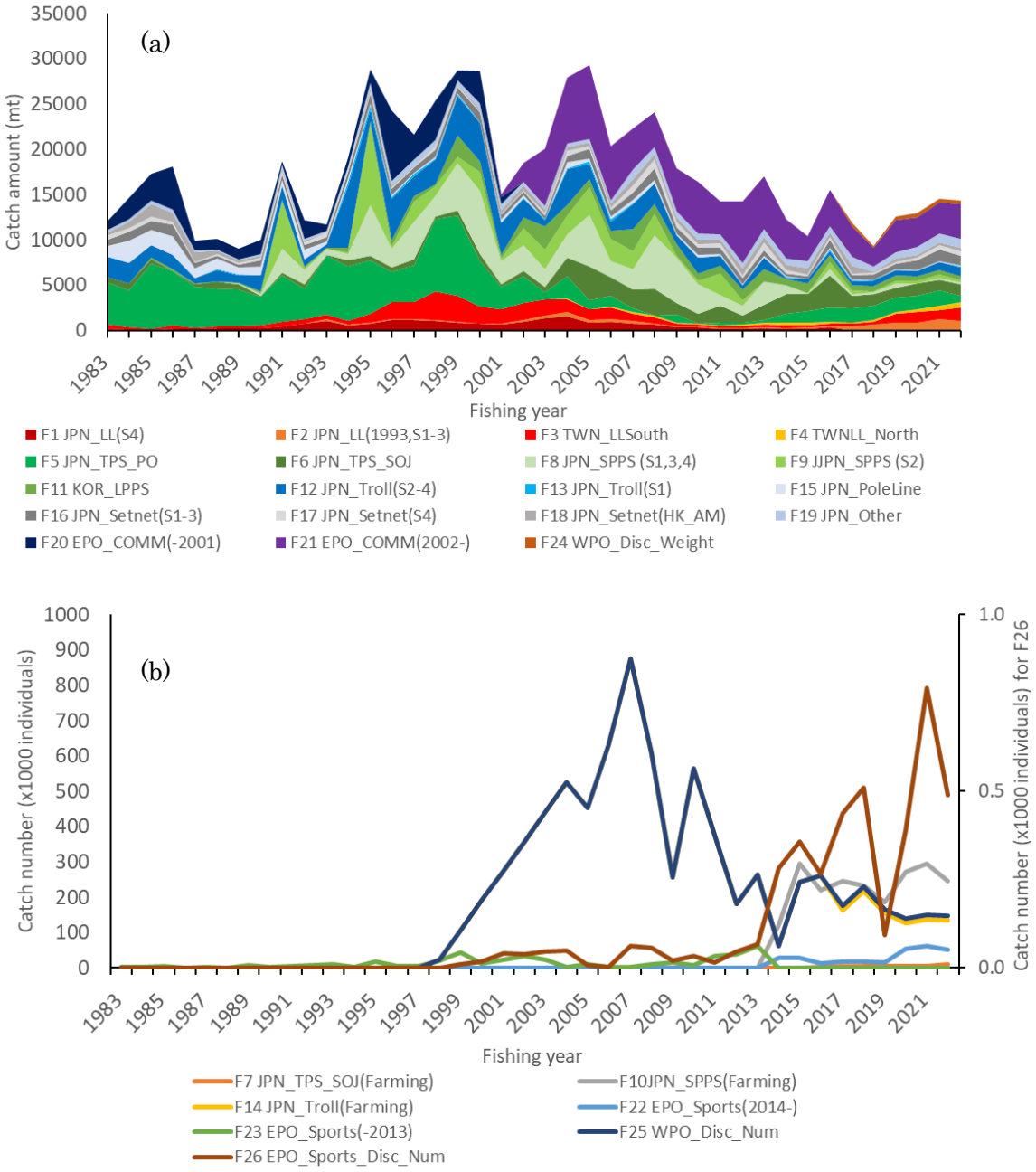

Fig. 1. Historical annual catch of Pacific bluefin tuna by Fleets 1-14,17-19 (a: upper panel) and by Fleets 15, 16, 20 and 27 (b: lower panel), for fishing year 1983-2022.

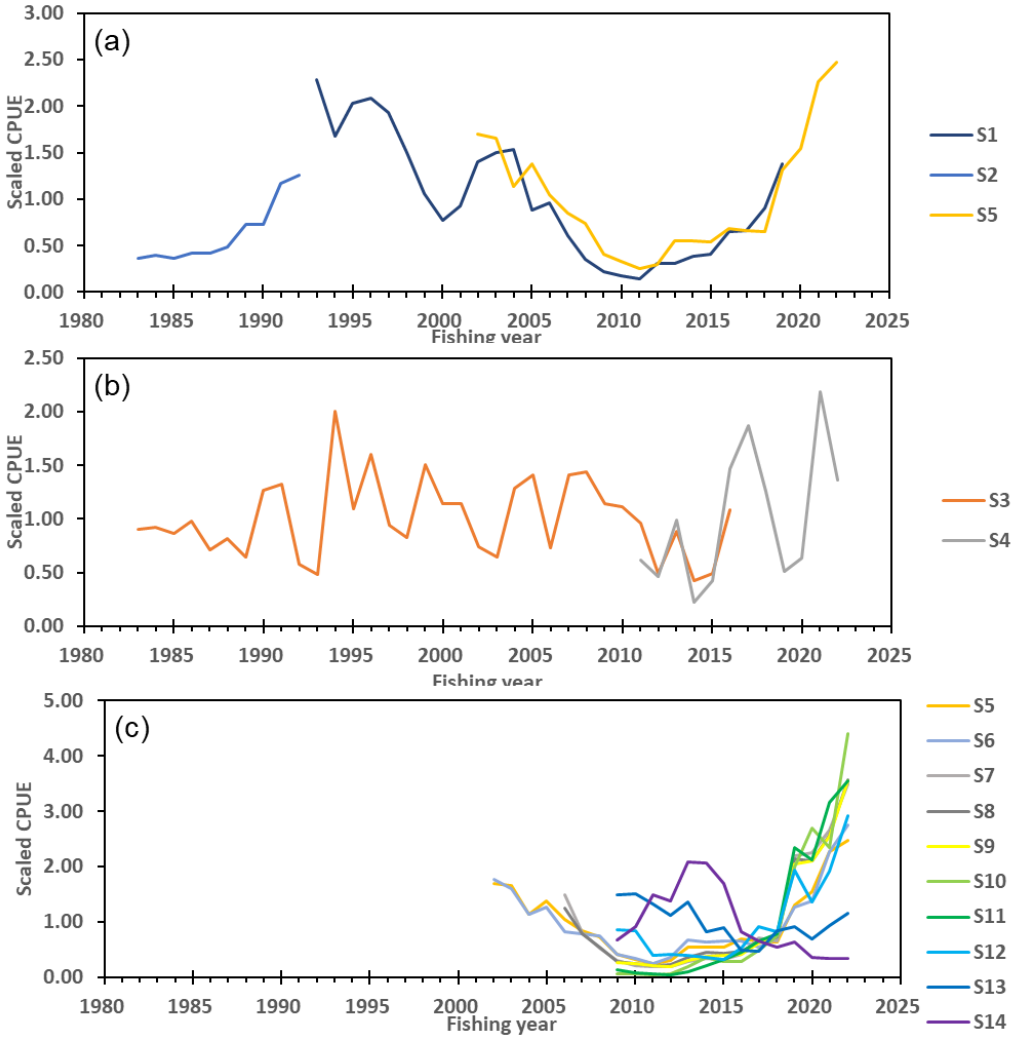

Fig. 2. Abundance indices of Pacific bluefin tuna submitted to ISC PBFWG. The longline indices of Japanese fisheries (S1 and S2) and Taiwanese fishery in southern area (S5) will be used to represent adult abundance (Fig.-(a)), and the index of Japanese troll fishery (S3) will be used as recruitment index (Fig.-(b)). The other indices will not be fitted to the assessment model (Fig.-(c)); e.g. the indices of Taiwanese longline fishery (S5-14) and Japanese troll monitoring (S4) .

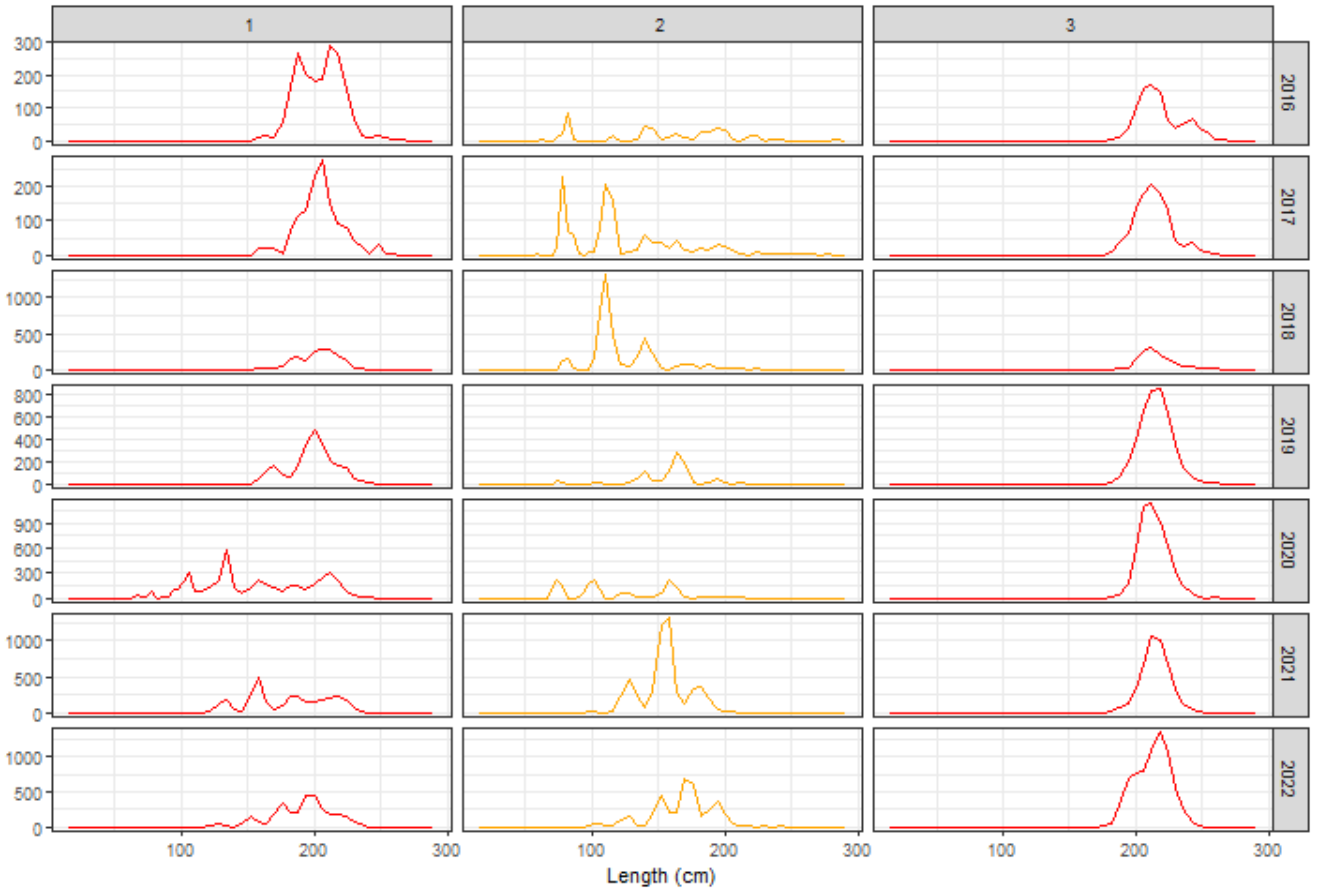

Fig.3. Size composition data of Fleet 1-3 for recent 7 years and updated periods. Fork length frequencies are available. Blue is for Fqt 1, green is for Fqt 2, orange is for Fqt 3 and red is for Fqt 4.

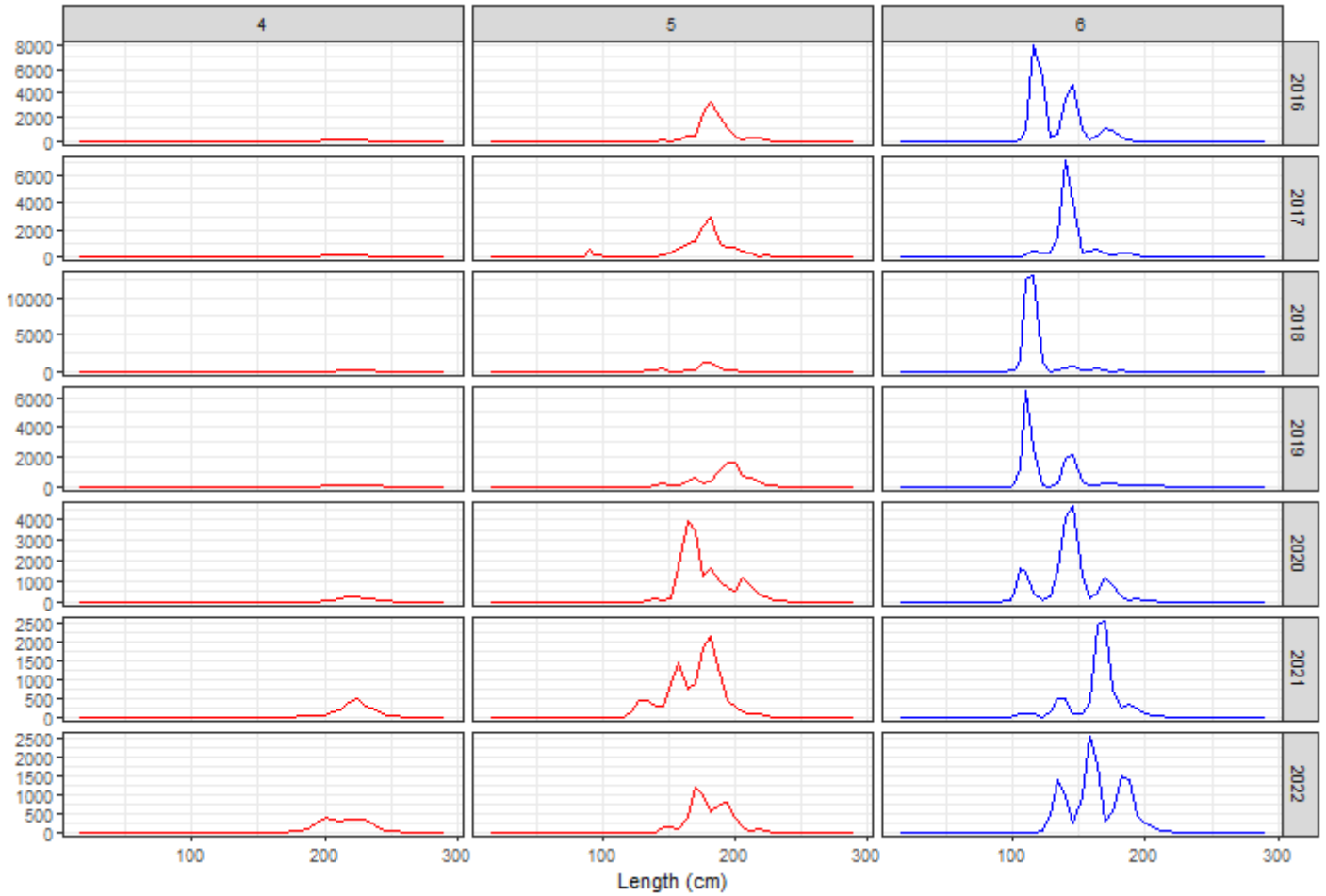

Fig. Cont. Size composition data of Fleet 4-6 for recent 7 years and updated periods. Fork length frequencies are available. Blue is for Fqt 1, green is for Fqt 2, orange is for Fqt 3 and red is for Fqt 4.

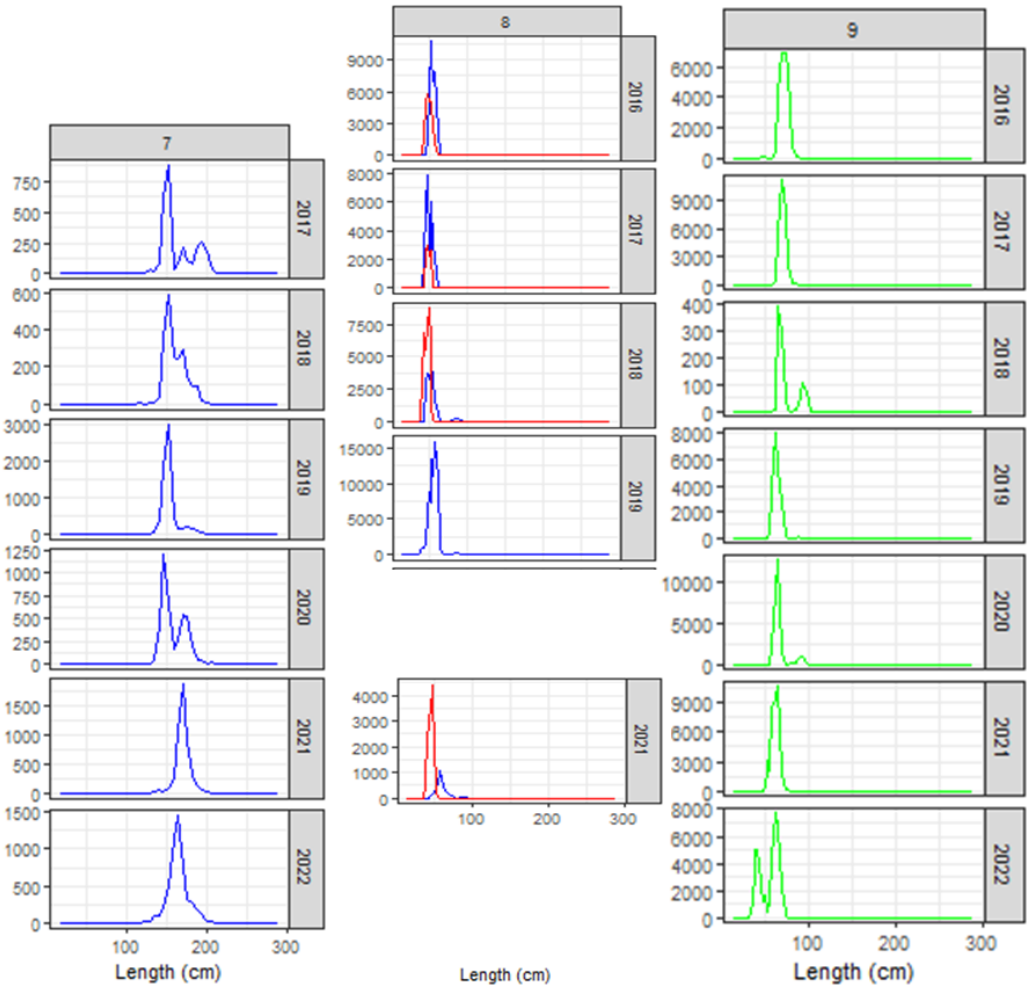

Fig. Cont. Size composition data of Fleet 7-9 for recent 7 years and updated periods. Fork length frequencies are available. Blue is for Fqt 1, green is for Fqt 2, orange is for Fqt 3 and red is for Fqt 4.

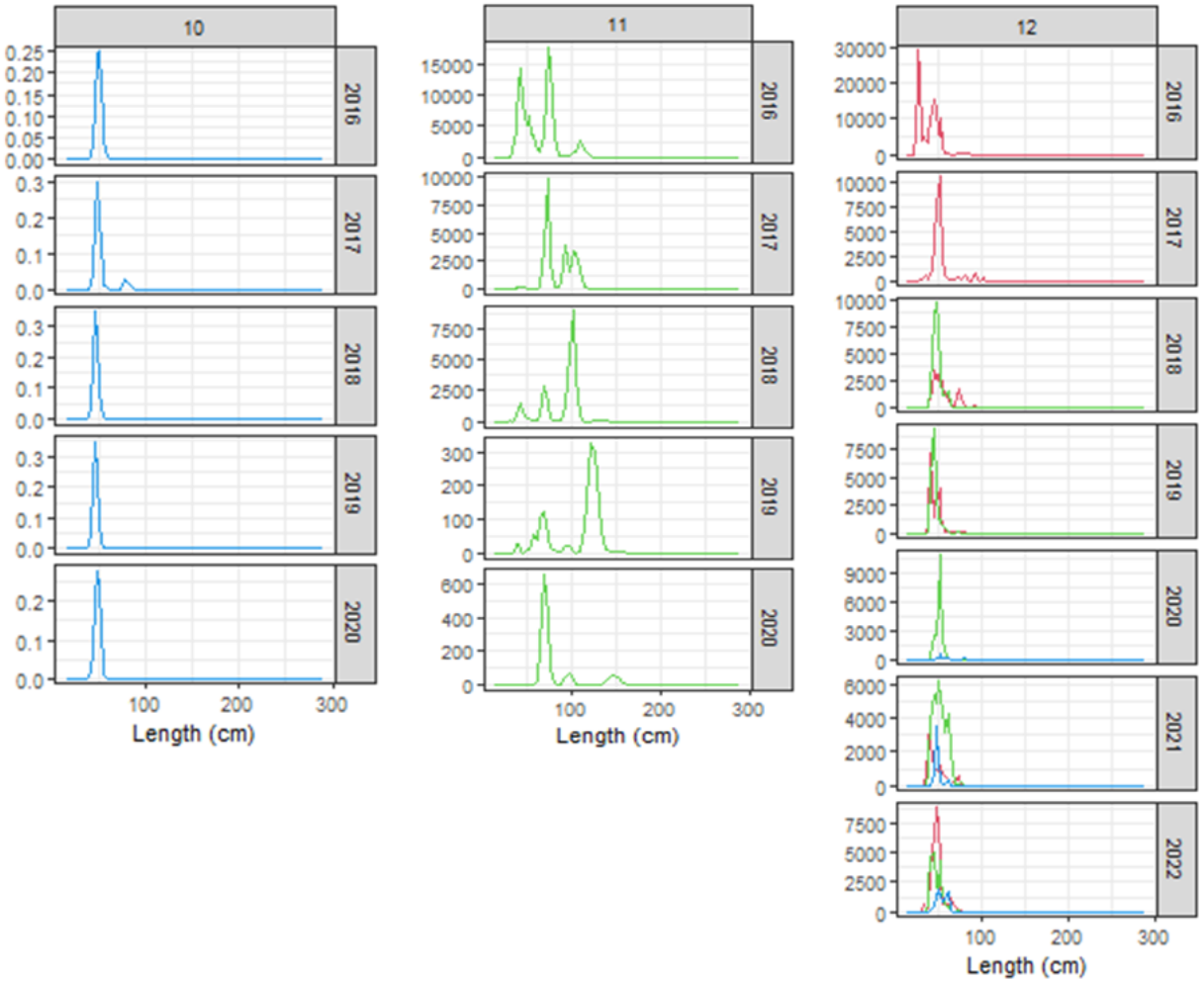

Fig. Cont. Size composition data of Fleet 10-12 for recent 7 years and updated periods. Fork length frequencies are available. Blue is for Fqt 1, green is for Fqt 2, orange is for Fqt 3 and red is for Fqt 4.

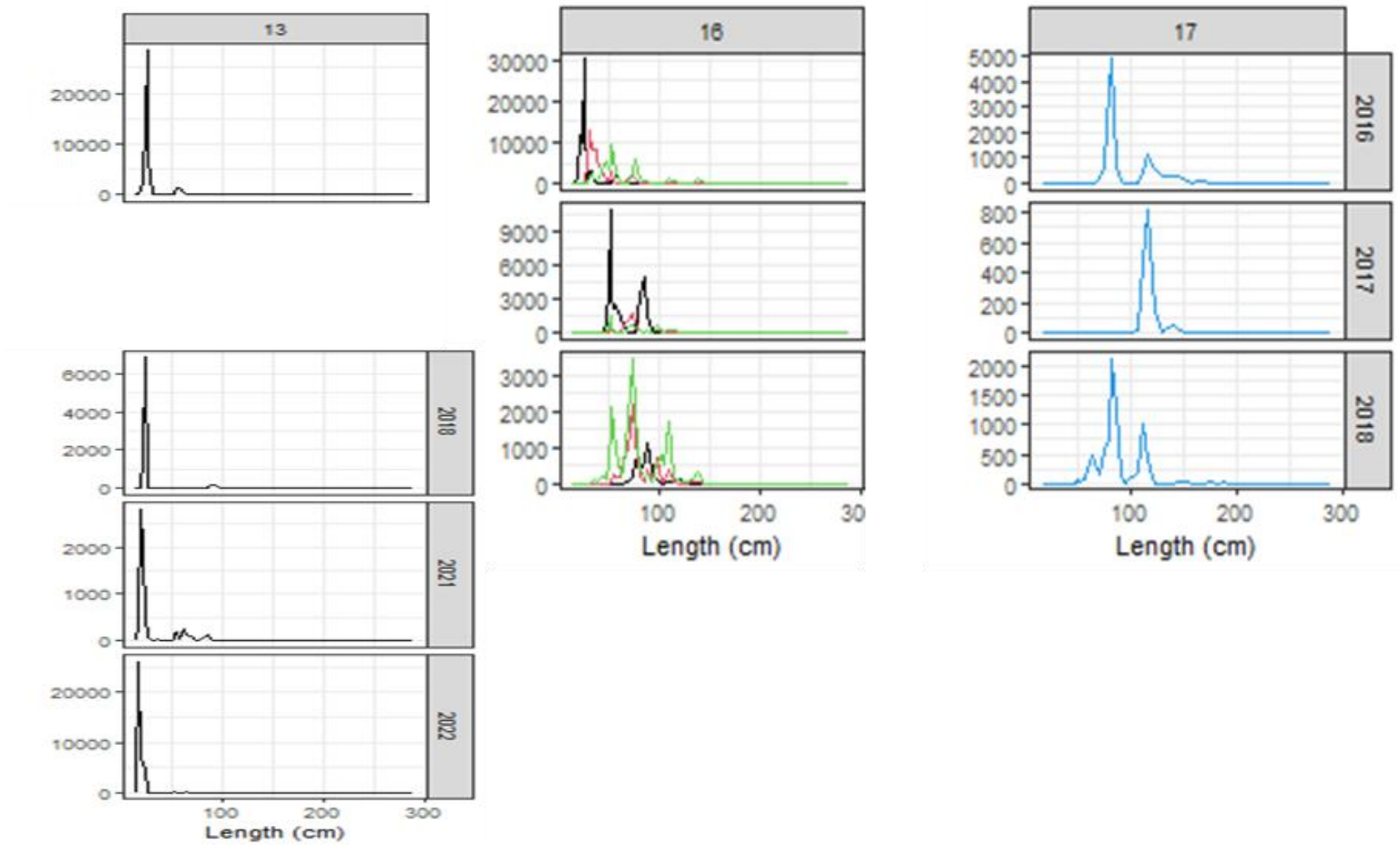

Fig. Cont. Size composition data of Fleet 13,16 and 17 for recent 7 years and updated periods. Fork length frequencies are available. Blue is for Fqt 1, green is for Fqt 2, orange is for Fqt 3 and red is for Fqt 4.

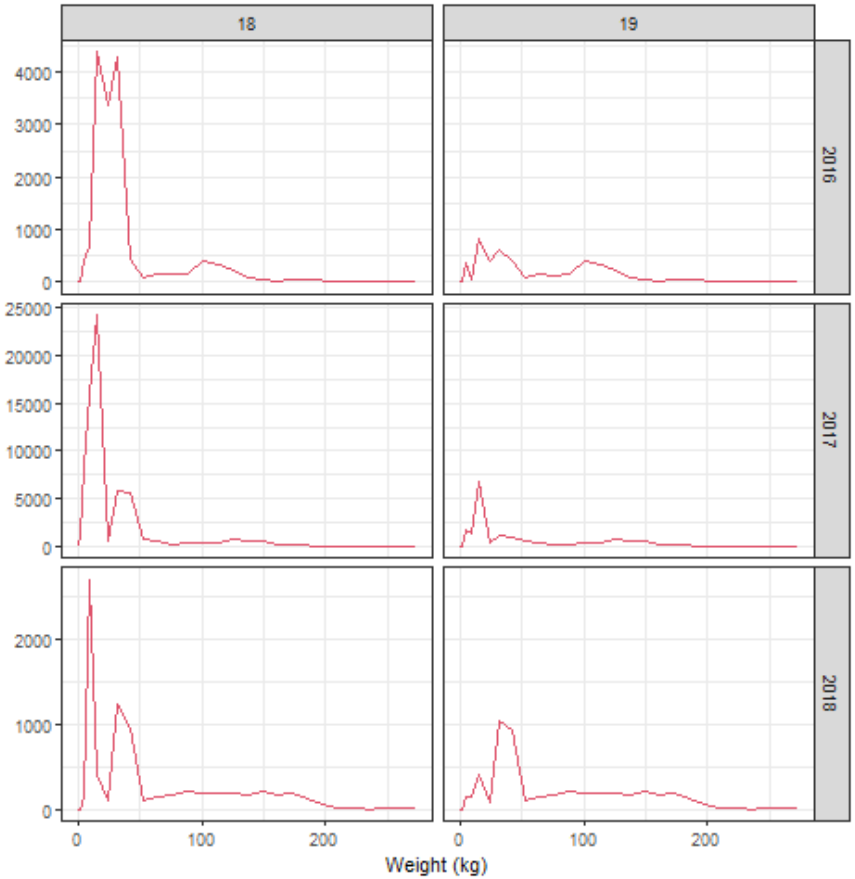

Fig. Cont. Size composition data of Fleet 18 and 19 for 2016-2018 and updated periods. Fork length frequencies are available. Blue is for Fqt 1, green is for Fqt 2, orange is for Fqt 3 and red is for Fqt 4.

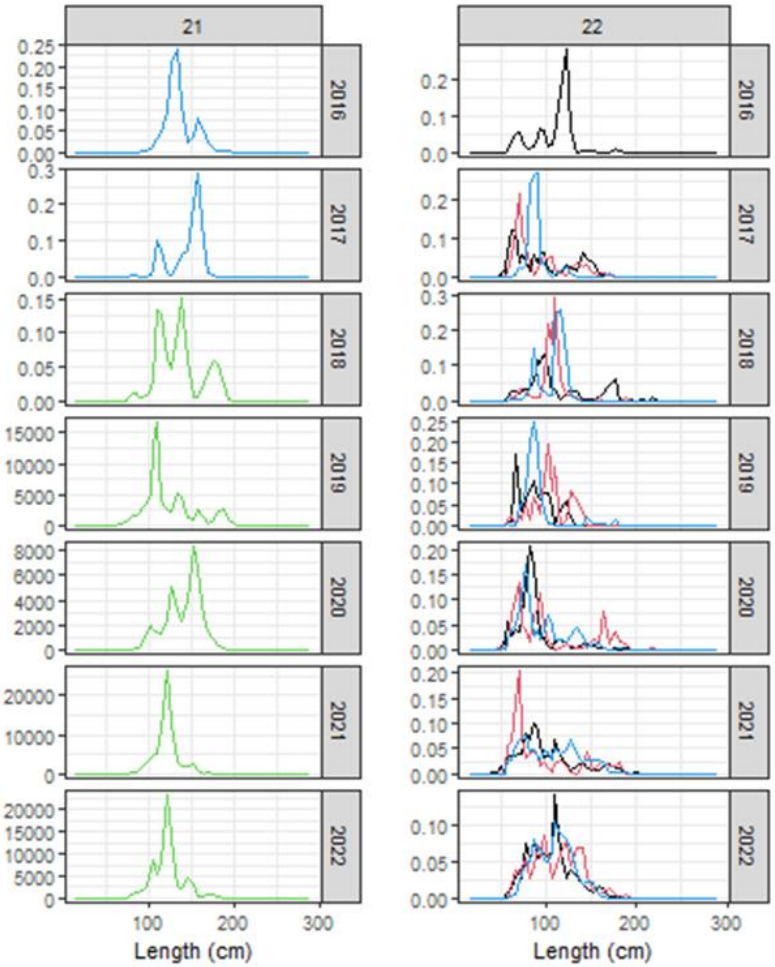

Fig. Cont. Size composition data of Fleet 21 and 22 for recent 7 years and updated periods. Fork length frequencies are available. Blue is for Fqt 1, green is for Fqt 2, orange is for Fqt 3 and red is for Fqt 4.