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Fisheries indicators for the southern bluefin tuna stock 2020–21

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Summary

The annual review of fisheries indicators is an important input for the management of southern bluefin tuna (SBT). The information is included in the development of the Extended Scientific Committee (ESC) advice to the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) on the status of the stock. It also forms part of the management procedure's metarule process to determine whether exceptional circumstances exist and if the global total allowable catch needs to be reconsidered.

The indicators include various catch per unit effort (CPUE) indicators, size composition indicators and abundance indices. Given there are a range of factors that can contribute to changes in the indicators, it is important that changes are interpreted with caution.

The 2020–21 update of fishery indicators for the SBT stock includes indicators in two groups: (1) indicators unaffected by the unreported catch identified by the 2006 Japanese Market Review and Australian Farm Review; and (2) indicators that may be affected by the unreported catch. Given the time since these reviews, the recent trends for some of these indicators are unlikely to be affected by unreported catches. In this paper, interpretation of indicators is restricted to the subset considered to be unaffected by the unreported catch.

Recent trends in indicators are summarised in Appendix 1. Only one indicator of juvenile (age 1–4) SBT abundance was updated as the piston-line trolling survey did not take place in 2021. The gene-tagging abundance estimate increased. Indicators of age 4+ SBT exhibited mixed trends. The close-kin mark recapture index of abundance decreased for the latest year it was calculated (2016). The age and size data from the Indonesian spawning ground were not updated this year. The standardised CPUE from the New Zealand domestic longline fishery increased while the Japanese longline nominal CPUE decreased in 2020, but was still above the 10-year mean. In contrast, the Japanese standardised, normalised CPUE series for all vessels and core vessels increased.

1 Introduction

Fishery indicators have played an important role in the provision of advice to the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) on the status of the southern bluefin tuna (SBT) stock by the CCSBT Extended Scientific Committee (ESC). In 2001 it was agreed to monitor and review fishery indicators on an annual basis (CCSBT-SC 2001). The review of fishery indicators forms part of the management procedure's metarule process, undertaken by the ESC, to determine whether exceptional circumstances exist (Attachment 6, ESC25). Indicators can provide a broad perspective on recent changes in the status of the SBT stock and include some information that may not otherwise be incorporated into model-based assessments.

Some fisheries-dependent indicators could have been affected by unreported catches and potential biases identified by the 2006 Japanese Market Review (Lou et al. 2006) and Australian Farm Review (Fushimi et al. 2006). Data collected in the longline fisheries after 2006 are unlikely to be affected by unreported catches because of the catch characterisation and documentation activities that have been undertaken by the CCSBT members. The 2020–21 update of fishery indicators for the SBT stock summarises indicators in the same groups presented in previous updates in 2007 to 2020, including the new gene tagging and close-kin mark recapture indices added in 2019 (Hartog et al. 2007; Hartog & Preece 2008; Phillips 2009; Patterson 2020; Patterson et al. 2010, 2011, 2012, 2013, 2016, 2017, 2018; Patterson & Hennecke 2019; Patterson & Stobutzki 2014, 2015). The scientific aerial survey data have been retained for information, although the survey ceased in 2017. The list of indicators explored here includes:

(1) Indicators unaffected by the unreported catch:

- Scientific aerial survey in the Great Australian Bight (for reference only)
- Trolling index (piston line)
- Gene tagging
- Close-kin mark recapture
- New Zealand catch per unit effort (CPUE domestic fleets)
- New Zealand longline fishery size composition (domestic fleets)
- Indonesian longline fishery size/age composition.

(2) Indicators that may be affected by the unreported catch

- Japanese, Korean and Taiwanese CPUE
- Size/age composition in the Japanese and Taiwanese longline fisheries
- Age composition in the Australian surface fishery.

2 Indicators unaffected by unreported catch

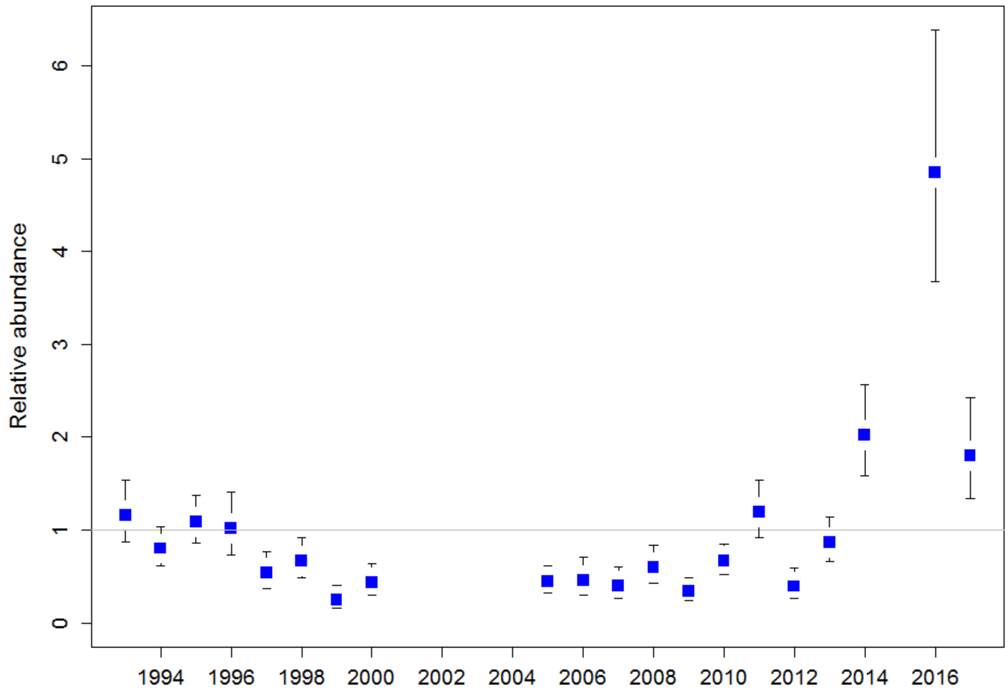
2.1 Scientific aerial survey

The final scientific aerial survey index was updated in 2017 through the CCSBT data exchange (Sec-AerialSurvey (1993_2017)).

A line-transect aerial survey conducted in the Great Australian Bight between January and March provides a fisheries-independent estimate of the relative abundance of aggregated 2–4 year-old SBT (Eveson & Farley 2016). The survey was suspended in 2001 because of logistical problems, but re-established in 2005 after analyses demonstrated that the survey provides a suitable indicator of relative juvenile abundance. The survey was not conducted in 2015 and was discontinued after 2017.

The historic trend in the scientific aerial survey index and the spatial distribution of sightings is discussed fully in Eveson & Farley (2017). This index of relative juvenile abundance in 2016 (the 2015–16 fishing season) was substantially higher than the 2014 estimate (2013–14 fishing season); the 2016 index was the highest index obtained for the scientific aerial survey over the past 10 years. The 2017 index declined and was on par with the 2014 index, although it remained above the mean for the series.

Figure 1. Scientific aerial survey of relative abundance for juvenile SBT in the Great Australian Bight, January–March (hence the 2014 value represents the 2013–14 fishing season etc) from Eveson & Farley (2017). Vertical lines are 90% confidence intervals. The horizontal line represents relative abundance of 1.0.



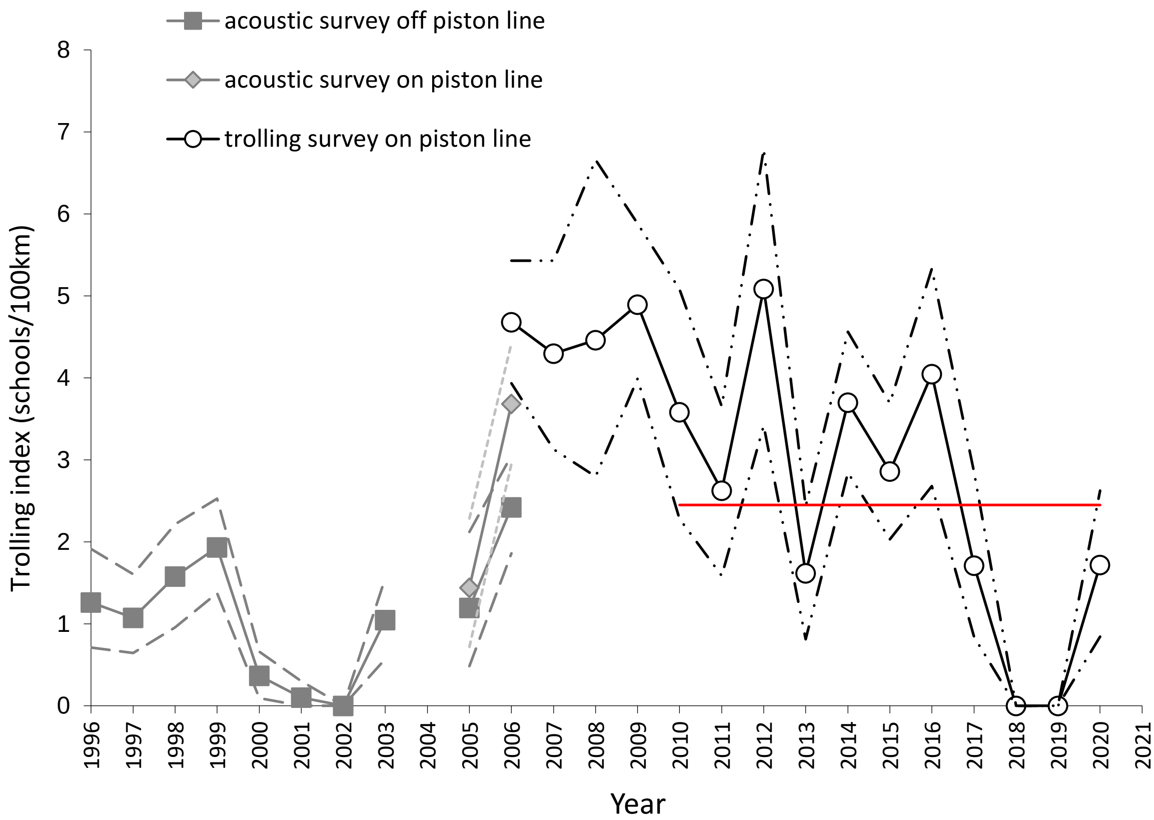
2.2 Trolling index

The piston-line trolling survey index was updated in 2020 from data provided by Japan through the CCSBT data exchange (JP_Trollindex_2020). There was no update of the piston-line data in 2021.

The trolling survey is conducted by the Japanese National Research Institute of Far Seas Fisheries and is designed to provide a qualitative index of relative recruitment strength of age 1 SBT off the Western Australian coast (CCSBT-ESC13 2008, para 115). The objective of the recent piston-line trolling survey has been to provide a recruitment index at low cost (Itoh et al. 2013). The ESC 2015 identified research needed if the index was to be considered for use in a candidate MP in future (CCSBT-SC 2015). The trolling index is comprised of: (1) a piston-line trolling survey, 2006–20; (2) trolling catch data from the acoustic survey 'on' the piston line, 2005–06; and (3) trolling catch data from the acoustic survey off the piston line, 1996–2003 and 2005–06 (Itoh & Sakai 2009). Methods used to obtain comparable data from these three sources are documented by Itoh (2007) and Japan has noted that all the indices reflect the number of SBT schools per 100 km, but have not been merged or converted to be quantitatively the same (CCSBT-SC 2010, para 81).

In 2012, the index steeply declined to the lowest level recorded for the piston-line survey and well below the average median value (red line, Fig 2). In 2016, the index was above the average median value, but declined in 2017 and declined again in 2018 to zero. It remained at zero in 2019 before increasing in 2020. The piston-line survey did not take place in 2021.

Figure 2. Trolling index, showing number of schools per 100 km off the Western Australian coast in January. Dashed lines are 90% confidence intervals. The red line shows the average median value of the piston line survey from 2010–20.



2.3 Gene tagging

A pilot study examining the feasibility of conducting a large-scale SBT gene-tagging program was undertaken in 2016 to determine if this method could be used to provide a fisheries-independent estimate of the absolute abundance of juveniles; this would replace the scientific aerial survey which was discontinued in 2017 (Preece et al. 2018). The pilot project successfully demonstrated the technical feasibility of using this technique to provide abundance estimates for monitoring and management.

New data (2019) from the ongoing program were provided in July 2021 (Ann Preece, CSIRO, pers comm). The estimate of absolute abundance of 2-year old fish increased in 2019.

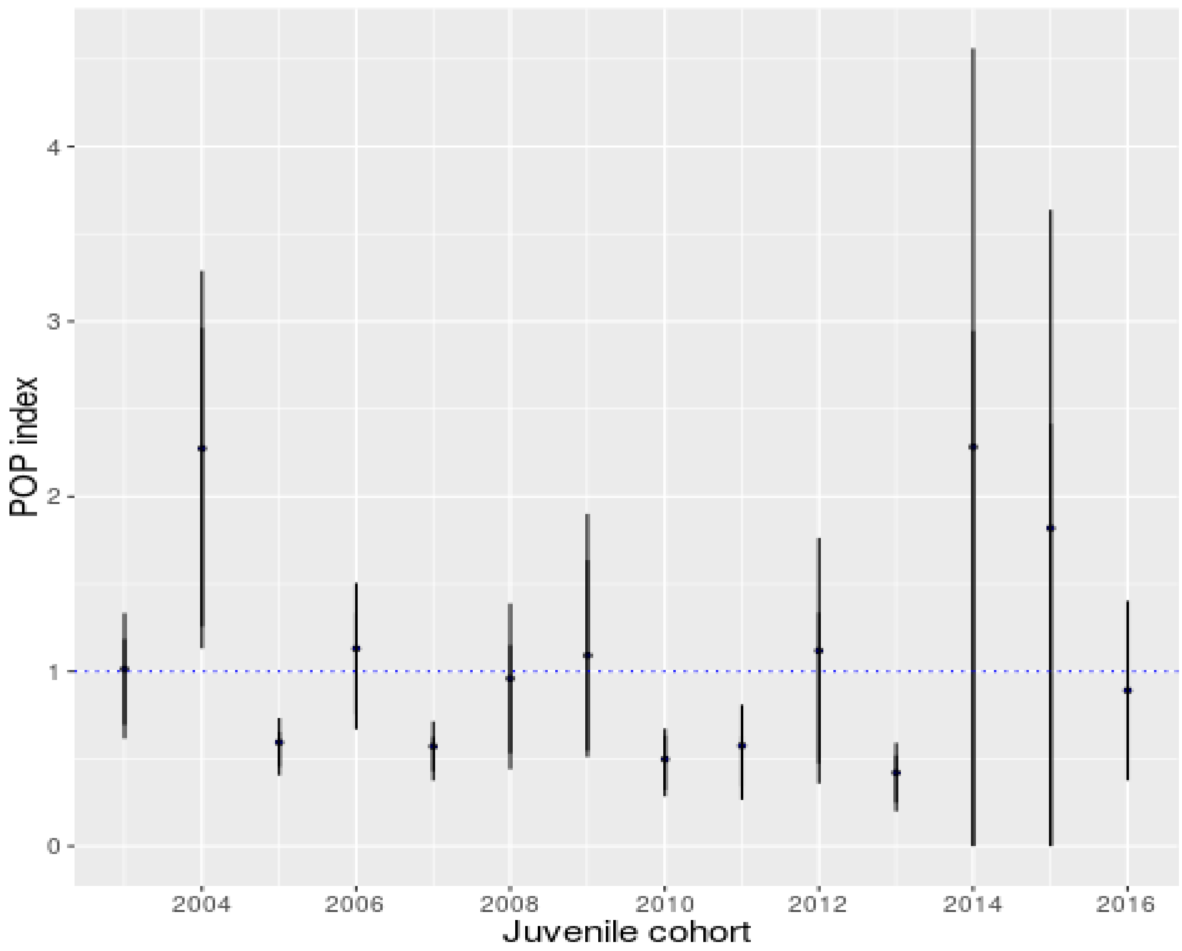
Table 1. Gene-tagging estimates for 2016 to 2019

	N release	N harvest	N Matches	Abundance estimate (millions)	CV
2016	2,952	15,390	20	2.27	0.224
2017	6,480	11,932	67	1.15	0.122
2018	6,295	11,980	66	1.14	0.123
2019	4,242	11,109	31	1.52	0.180

2.4 Close-kin mark recapture

Close-kin mark recapture (CKMR), which began tissue collection in 2014–15, is a high priority for CCSBT as it provides an estimate of abundance and is included in the Operating Model. An empirical index of spawning stock abundance has been developed for inclusion in this paper and for use in the review of fisheries indicators by the ESC. Information on this index is provided in Hillary et al. (2016) and Hillary et al. (2020). The index for 2016, the latest year for which it is calculated, decreased.

Figure 3. Empirical index of spawning stock abundance from CKMR parent-offspring pairs (POPs) for use in CCSBT ESC review of fisheries indicators. The raw index, for a given juvenile birth year (juvenile cohort), is calculated as the number of comparisons (across all adult capture ages and years) divided by the number of identified POPs (across all adult capture ages and years) in the time-series. The CV on the index is 1/square-root (number of POPs). The index plotted in the figure above has been standardised to the mean of the series. The error bars are +/- one standard error.



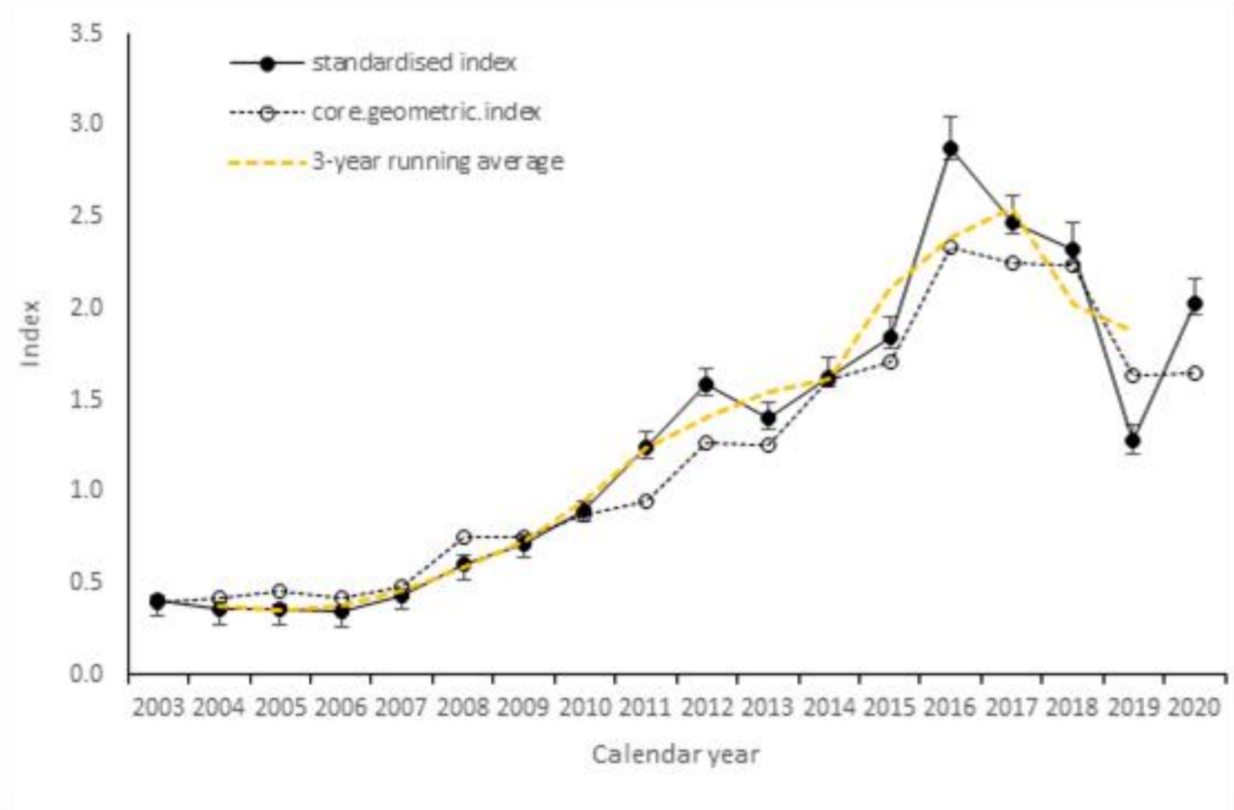
2.5 Catch per unit effort

2.5.1 New Zealand domestic longline CPUE

In previous years the nominal CPUE for the NZ domestic fishery has been provided, based on aggregated catch and effort data provided in the interim update of the CCSBT database. New Zealand updated their national report to include a standardised CPUE in 2020. For consistency, Fig 4 uses the values provided by New Zealand. The methodology used in generating these data are provided in CCSBT-ESC/2108/SBT Fisheries - New Zealand.

Overall, catch rates in the NZ domestic fishery increased from 2007, with a sharp increase seen in 2016 (Fig 4). CPUE then decreased from 2016 to 2019, but increased in 2020.

Figure 4. Standardised CPUE for the NZ domestic longline fishery, core geometric index and 3-year running average. Figure provided by New Zealand.



2.6 Catch size/age composition

2.6.1 New Zealand domestic longline fishery size composition (< 6 years)

Size composition data for SBT caught by the NZ domestic fisheries were extracted from the interim update of the CCSBT database and were examined for trends in juvenile fish less than 6 years of age. The data for the early years of the domestic fishery are dominated by handline and troll caught fish and in more recent years by longline vessels. As such, caution should be used in interpreting the full time series because of this discontinuity (Hartog & Preece 2008).

It has been assumed that the following size categories represented ages 0–2, 3, 4 and 5:

≤86 cm: age 0–2

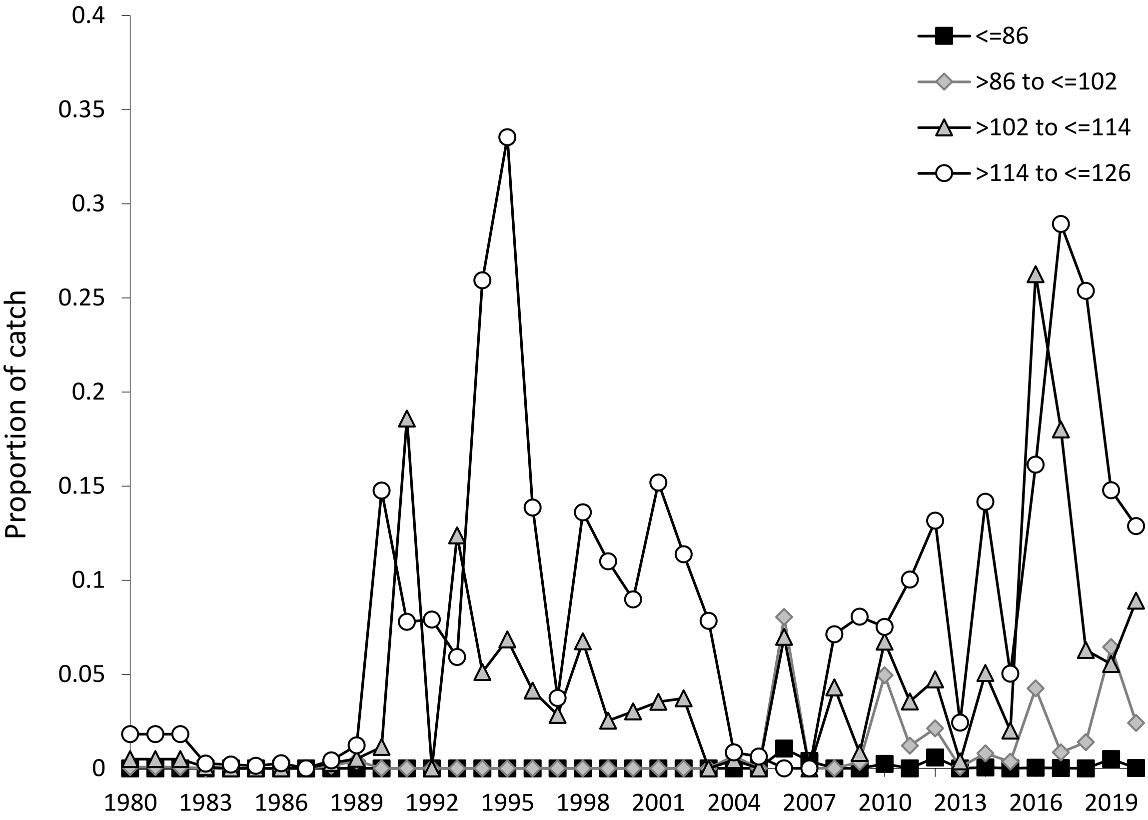
>86 to ≤102 cm: age 3

>102 to ≤114 cm: age 4

>114 to ≤126 cm: age 5

In the size/age categories examined, the NZ domestic fishery has historically landed age 4 and 5 SBT, with some small spikes in the landing of age 3 SBT in 2006, 2010, 2016 and 2019 (Fig. 5). The relative abundance of the juvenile age classes declined in 2003 and 2004 and has been variable since that time, increasing in 2016. The oldest age class decreased in 2020, while the second oldest increased slightly (Fig. 5). The age 3 class also decreased. The 0–2 age class, which has been virtually zero throughout the time series, remained near zero.

Figure 5. Size composition of juvenile fish (< 6 years) for the NZ domestic longline fishery, where age 0–2<86 cm, 86<age 3≤102 cm, 102<age 4≤114 cm, 114<age 5≤126 cm.



2.6.2 Indonesian spawning ground size/age composition

The Indonesian catch data provide an important source of information about the spawning population if we assume that the selectivity of this fishery has been constant over time. The Indonesian size and age data for the 2018–19 season were provided in the 2019 and 2020 data exchanges (Sulistyaningsih et al. 2020). Data could not be updated in 2021 due to COVID-19 restrictions.

Since the mid- to late-1990s the size of SBT landed in this fishery has declined. As reported previously, since 2012–13 the length data indicate a new mode of relatively small fish in the catch that have progressed through the fishery, although this mode seems to be disappearing (Fig. 6, Fig. 7; Sulistyaningsih et al. 2020). The mean size class decreased from 170.4 cm in 2011–12 to 161.1 cm in 2018–19.

There was also an increase in the catch of young SBT (7–10 years) in 2012–13 (Sulistyaningsih et al. 2020). The mean age of SBT on the spawning ground decreased substantially from 16.8 years in 2010–11 to 13.2 years in 2018–19. The median age remained at 12.5 in 2019 (Fig. 8, Fig. 9; Sulistyaningsih et al. 2020).

It has been determined that SBT caught by Indonesia are taken in CCSBT statistical areas 1, 2 and 8. It is therefore possible that the small fish noted in the data are not being caught on the spawning grounds, but rather are being caught south of the spawning grounds (Farley et al. 2017). Resolving the location of this catch is important for interpreting the indicators, as well as the use of these data in the operating model. A preliminary study to confirm the catch location in Indonesia was undertaken in 2019 (Fahmi et al. 2019). This study found that the proportion of small fish in the spawning area had increased in recent years.

Figure 6. Length frequency (2 cm intervals) of SBT caught on the spawning ground (bars) by spawning season (Sulistyaningsih et al. 2020). The grey bar shows the median size class. For comparison, the length distribution of SBT thought to be caught south of the spawning ground (Processor A) is shown for the 2003/04 (n=121), 2004/05 (n=685), 2005/06 (n=311) and 2006/07 (n=452) seasons (grey line) (see Farley et al. 2007).

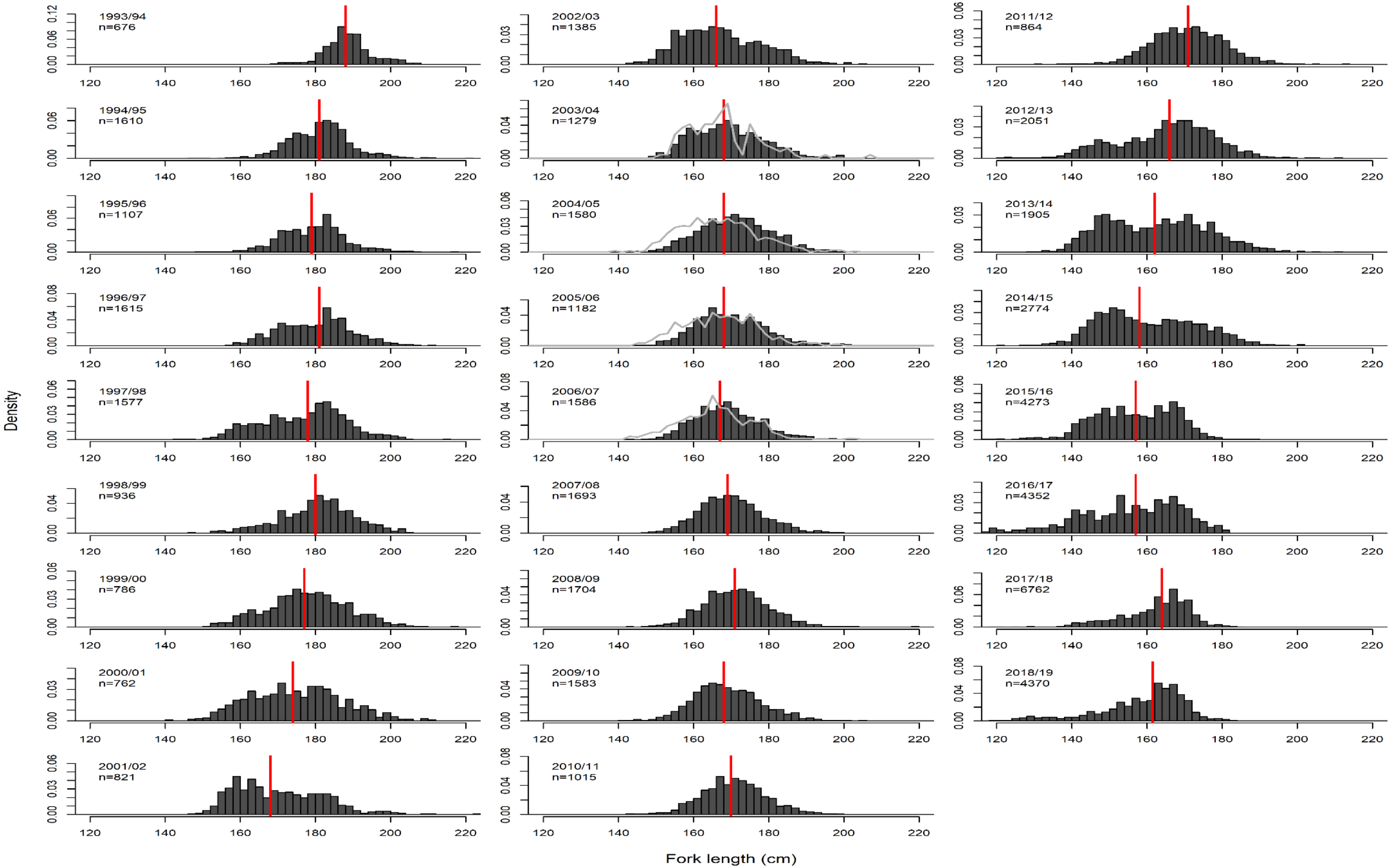


Figure 7. Size composition of SBT caught on the spawning grounds by the Indonesian longline fishery by spawning season (from Sulistyaningsih et al. 2020). Data from Processor A are excluded.

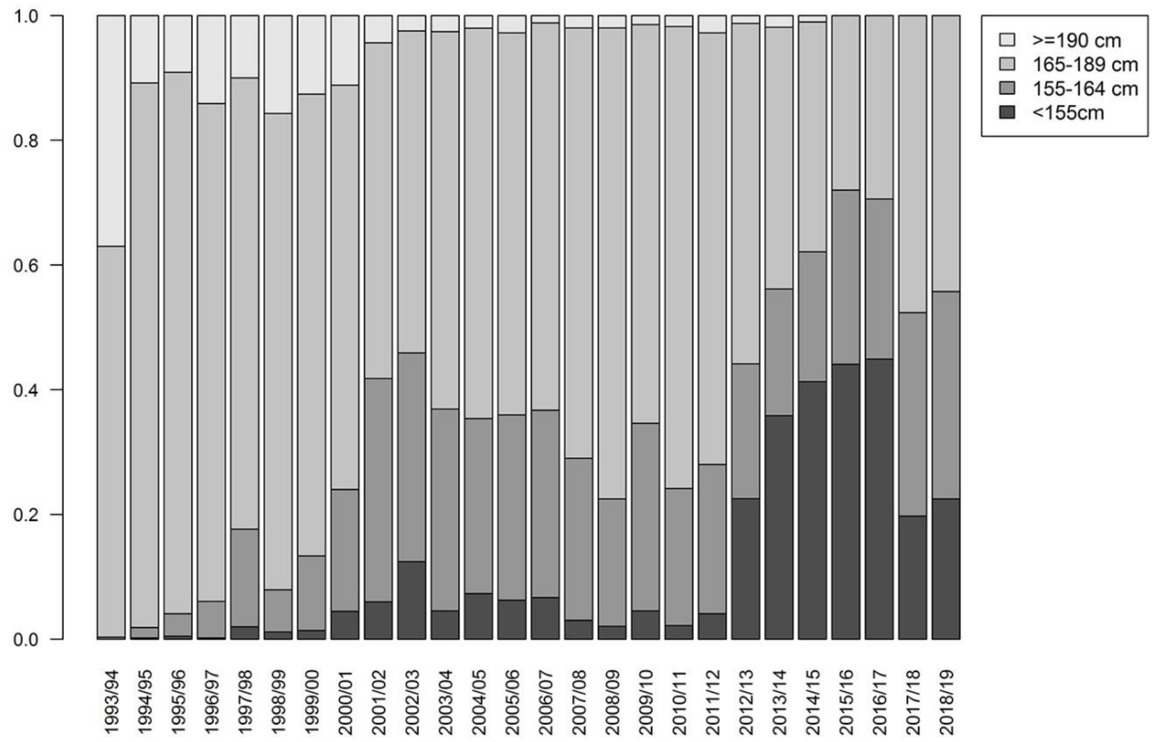


Figure 8. Mean estimated age (years) of SBT caught on the spawning grounds by Indonesian longliners (from Sulistyaningsih et al. 2020). Data from Processor A are excluded. Note that there are no age data for the 1995–96 season.

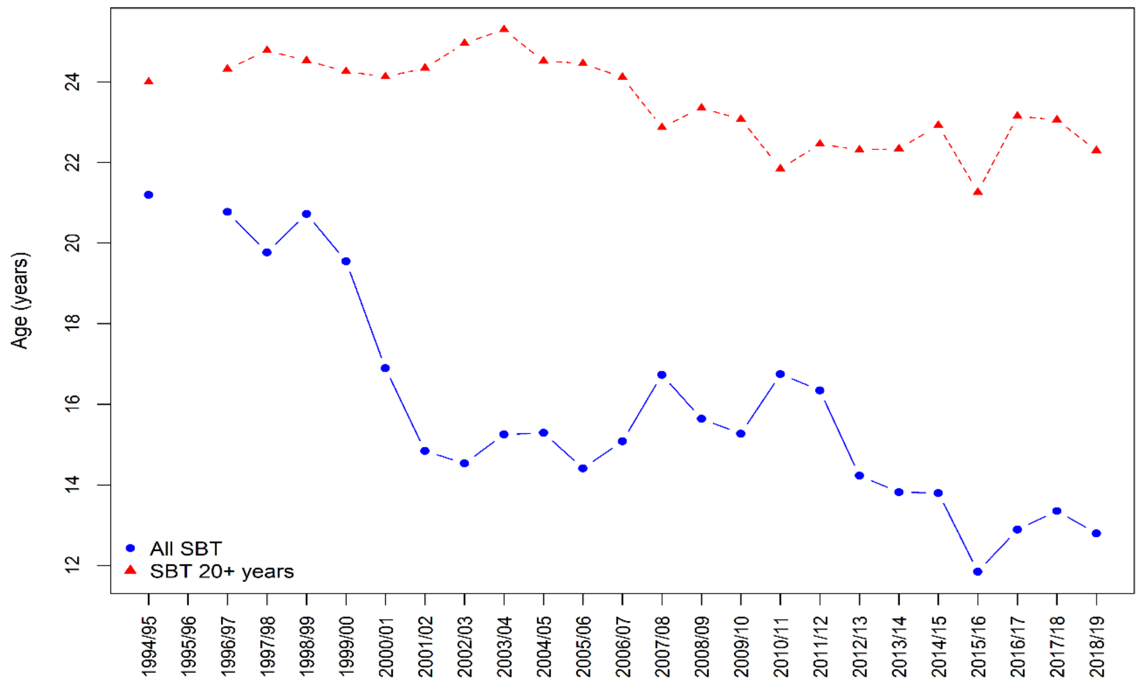
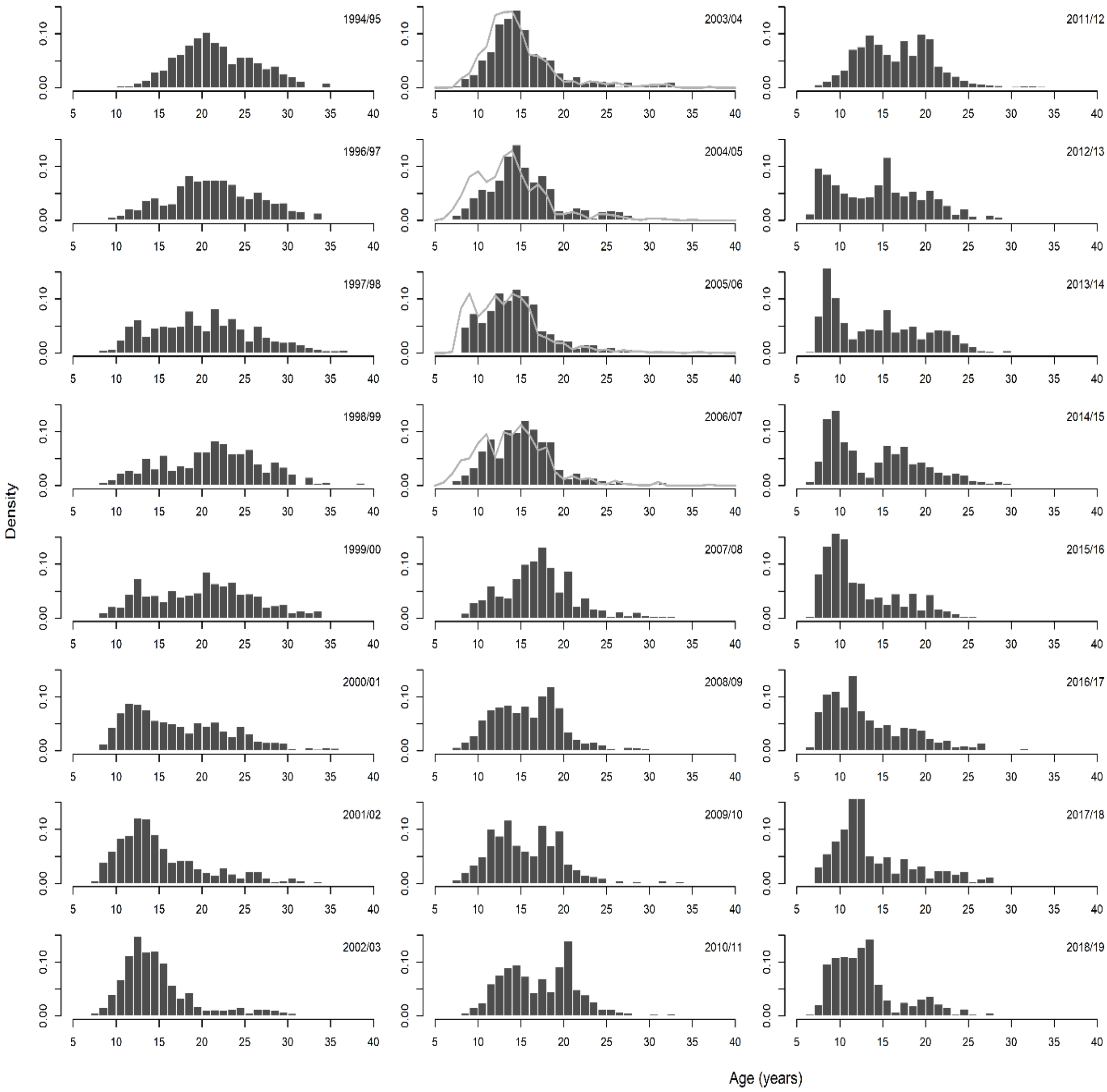


Figure 9. Age frequency distribution of SBT in the Indonesian catch on the spawning ground by spawning season estimated using age-length keys from sub-samples of direct aged fish and length frequency data obtained through the Indonesian monitoring program (from Sulistyaningsih et al. 2020). There was no direct ageing of the 2012–13 otoliths; age frequency is based on the age-length key from the previous two seasons and 2012–13 length frequency data. For comparison, the age frequency of SBT thought to be caught south of the spawning ground (Processor A) is shown for the 2004–05 to 2006–07 seasons (grey line) (see Farley et al. 2007).



3 Indicators potentially affected by unreported catch

The indicators included in this section are based on fishery-dependent data and may or may not have been affected by unreported catches identified in the Japanese Market Review (Lou et al. 2006) or the Australian Farm Review (Fushimi et al. 2006). These indicators have been updated with information provided through the CCSBT data exchange. Recent trends in some of these indicators are unlikely to be affected by unreported catches because of the improvements in catch documentation that have been implemented since 2006.

3.1 Catch per unit effort (CPUE)

3.1.1 Japanese longline CPUE

Nominal CPUE series for Japanese longliners was extracted from the CPUE input data provided in the CCSBT data exchange (CPUEInputs_1965–2020). Standardised CPUE series were obtained from updates provided by Japan (JP_CPUE_w05_08_for_monitoring_2020ESC and JP_CorevesselCPUE_1969_2020) through the CCSBT data exchange.

There have been several perturbations significantly affecting the continuity of the Japanese longline CPUE series. Major changes were made to the management of the Japanese longline fleet in April 2006 (introduction of individual quota and removal of restrictions on fishing area and season) (Itoh 2006). It is not known to what extent the Japanese longline CPUE series would be affected by the unreported catches identified in 2006 (Polacheck et al. 2006). In addition, the Japanese TAC has increased, as has the global TAC, with the adoption of the management procedure in 2011. The standardised CPUE series are still potentially affected and should be interpreted with caution.

The following updates for 2020 have been compiled (note that age data are cohort slices from length composition):

- Nominal aggregate CPUE for age 4+ SBT in areas 4–9 in months 4–9. The series showed an overall decline until 2006–07, followed by an increase to 2015. The data point for 2020 decreased slightly, but is above the 10-year mean (Fig. 10, horizontal line).
- Nominal CPUE for age 4–7, 8–11 and 12+ SBT. The nominal CPUE series for ages 4–7 decreased in 2020, while the CPUE for ages 8–11 increased. The CPUE of age 12+ SBT has remained low with little variability since the early 1970s (Fig. 11).
- Nominal CPUE for age 0–2, 3, 4 and 5 SBT. Since 2010, age 4 and 5 SBT were the dominant year classes. However, both declined substantially in 2020 and are at the same level of age 3 SBT. Ages 0–2 remain near zero (Fig. 12).
- Standardised CPUE. The standardised and normalised monitoring CPUE series from all vessels (W0.5, W0.8) and the normalised series from the core vessels (Base W0.5 and Base W0.8) increased in 2020 (Fig. 13).

Figure 10. Nominal CPUE of age 4+ SBT for Japanese longliners operating in statistical areas 4–9 in months 4–9. The 1995 and 1996 values are plotted as grey circles to indicate increased uncertainty about these points due to changes in retention policies for small fish in these two years, when a policy of releasing small fish applied. The horizontal line is the 2011–20 mean.

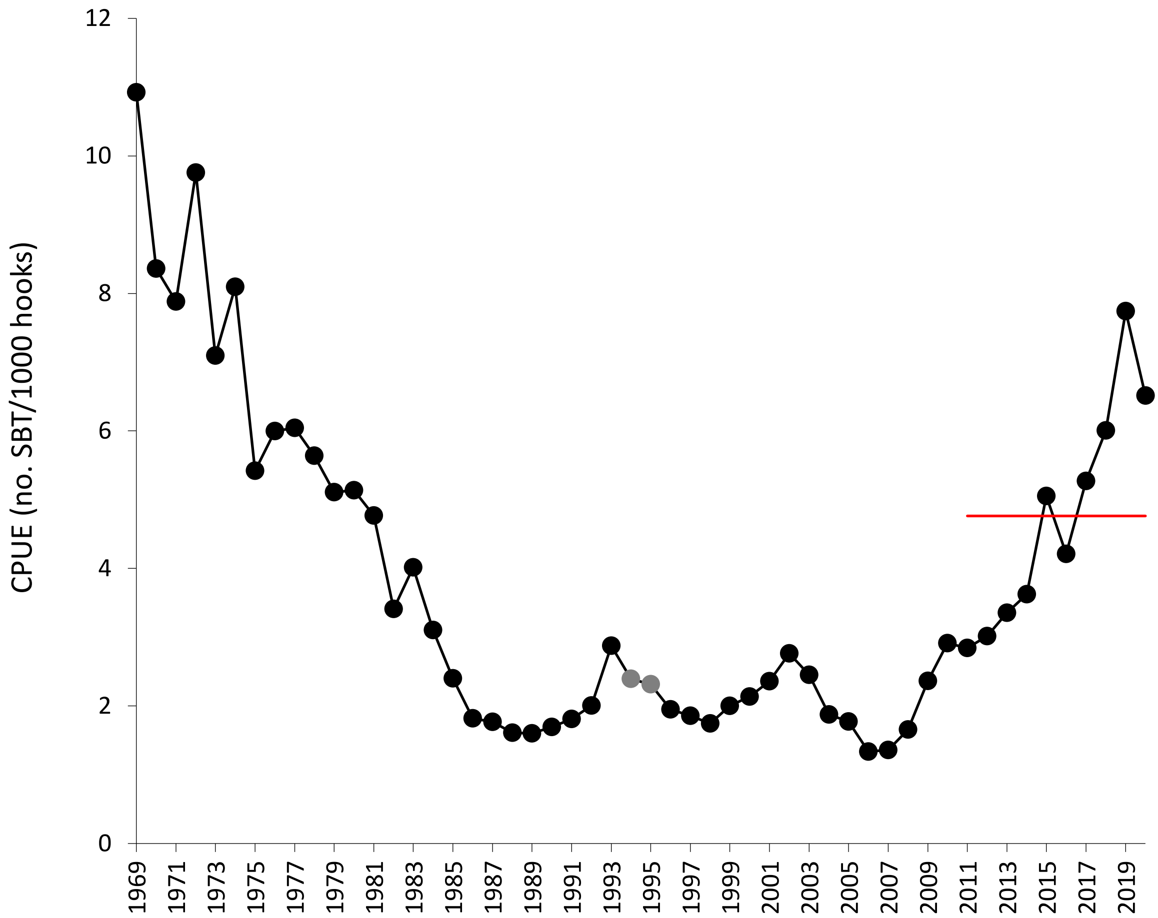


Figure 11. Nominal CPUE of ages 4–7, 8–11 and 12+ SBT for Japanese longliners operating in statistical areas 4–9 in months 4–9. The 1995 and 1996 values for ages 4–7 are plotted as grey squares to indicate increased uncertainty about these points due to changes in retention policies for small fish in these two years.

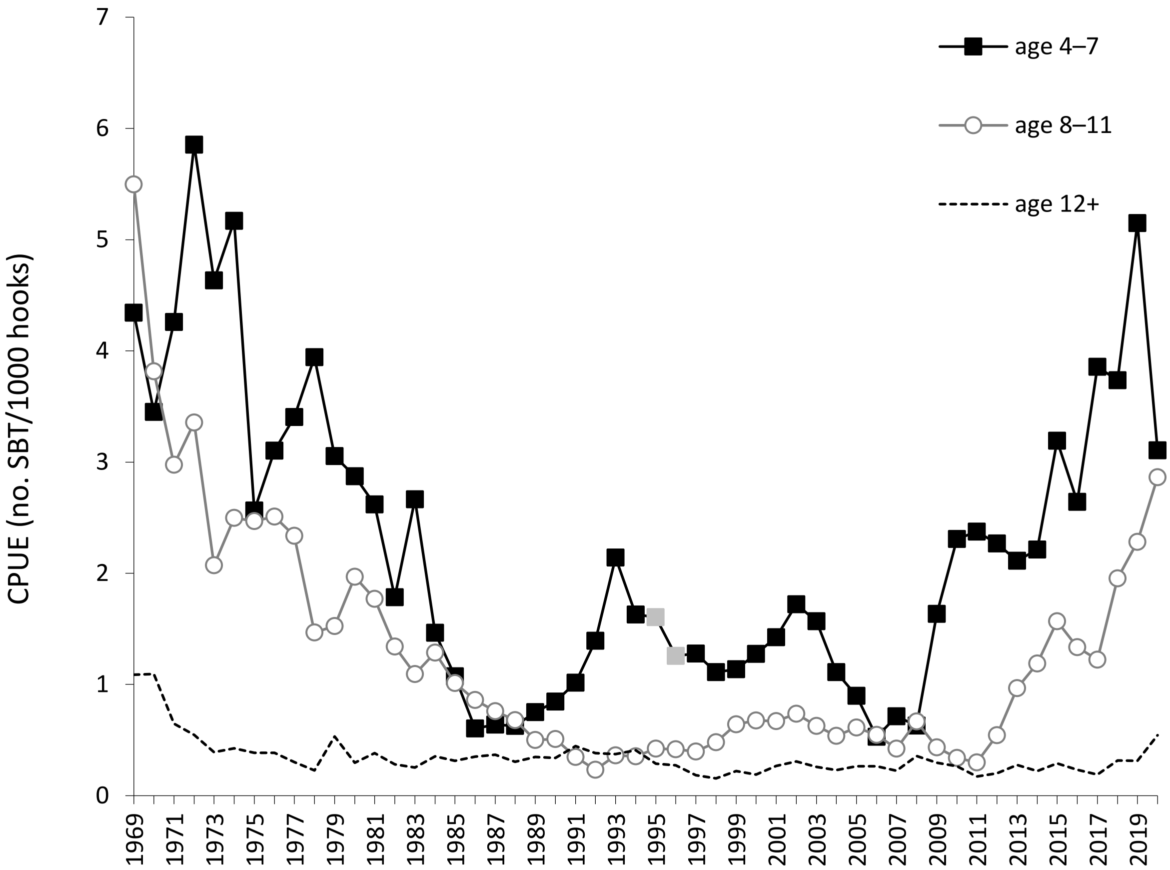


Figure 12. Nominal CPUE of ages 0–2, 3, 4 and 5 SBT for Japanese longliners operating in statistical areas 4–9 in months 4–9.

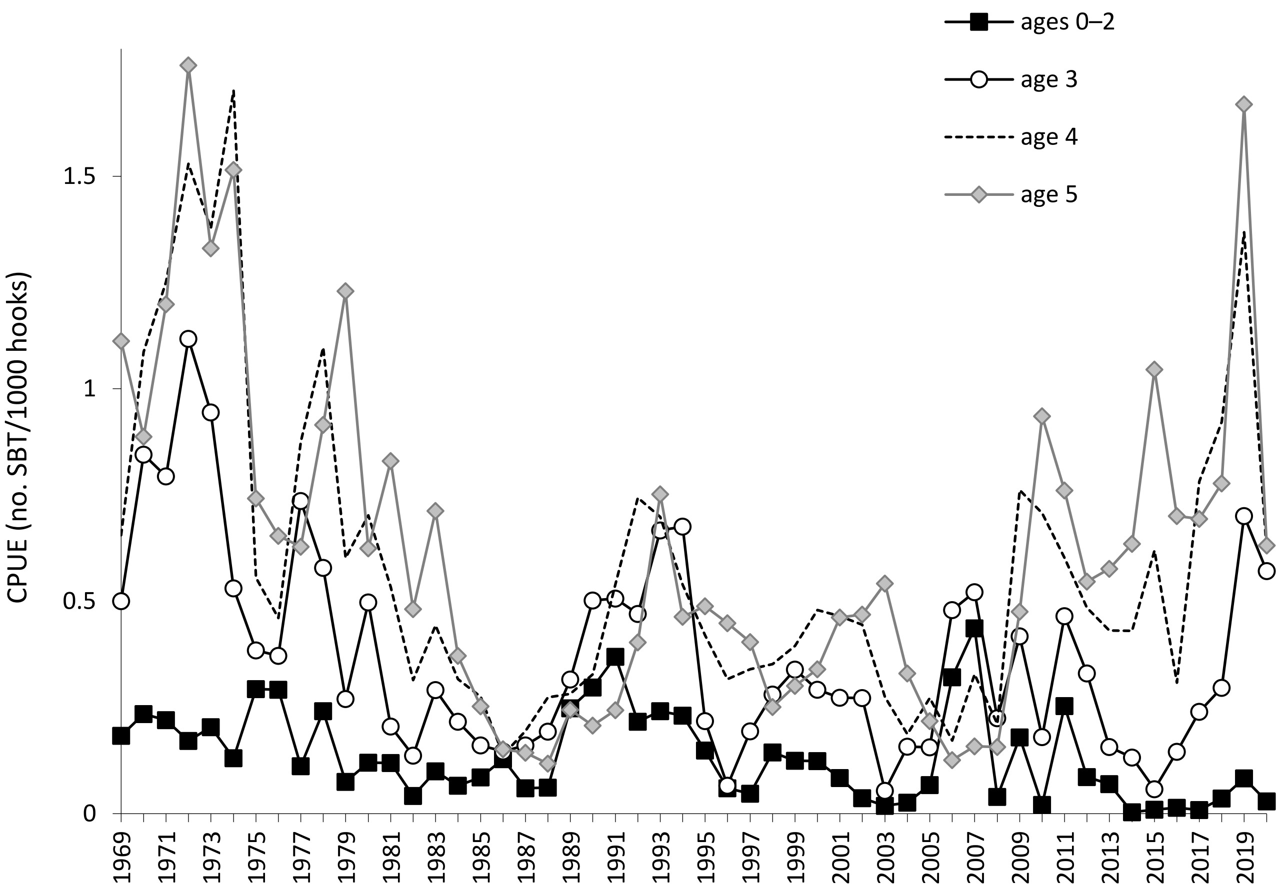
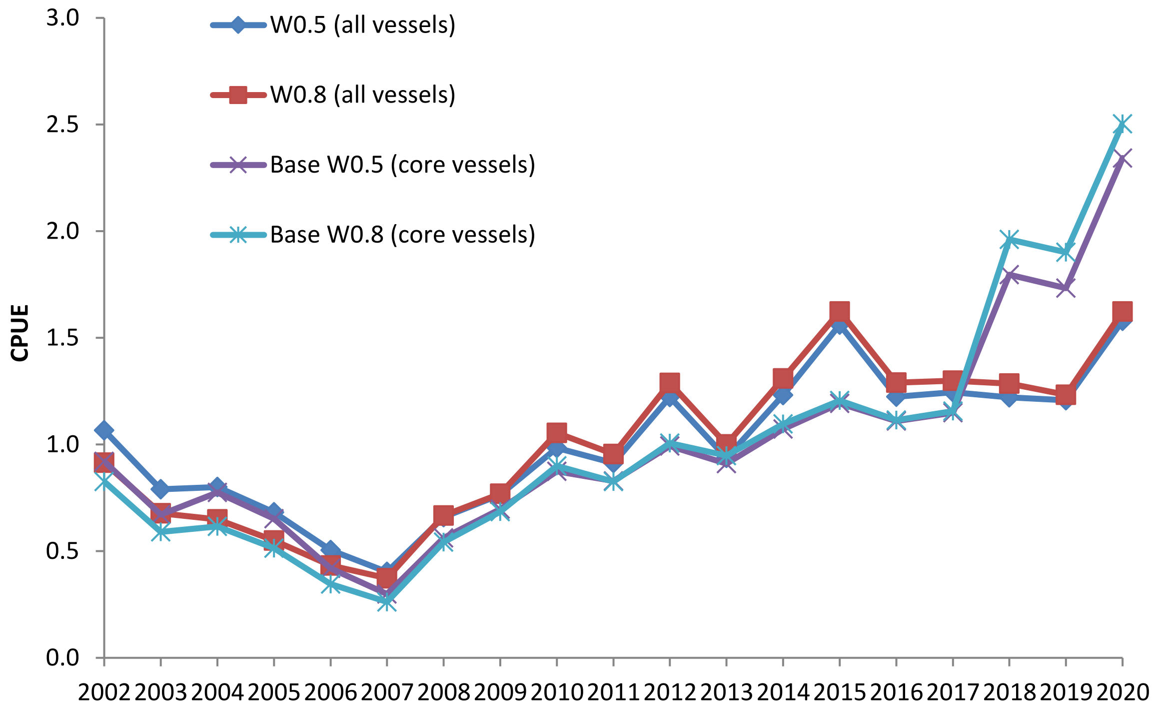


Figure 13. Comparison of subsets of the standardised CPUE series. Each subset has been normalised by dividing by the mean.

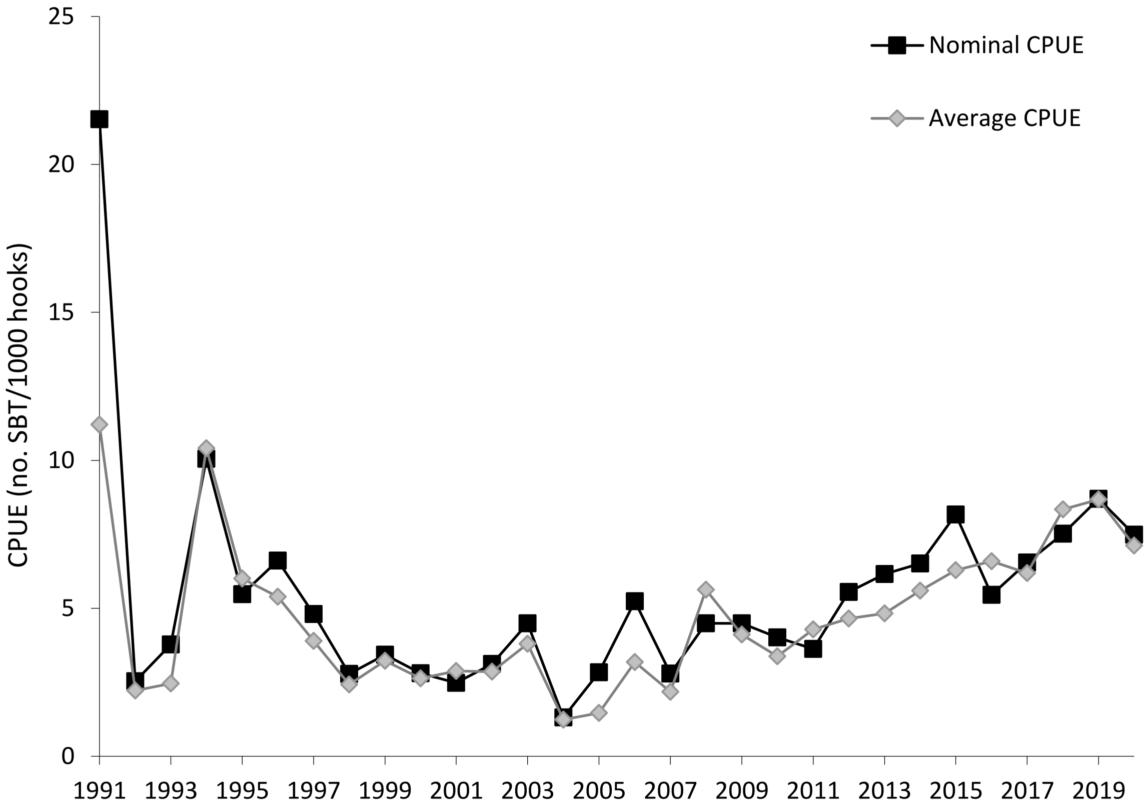


3.1.2 Korean longline CPUE

Nominal CPUE series for Korean longliners were obtained from aggregated catch and effort data provided in the interim update of the CCSBT database.

Both CPUE series have been reasonably stable since 1995 (Fig. 14). In 2007 and 2008, the spatial distribution of the fleet shifted from its normal pattern to take catches from western and central fishing grounds in the Indian Ocean (An et al. 2008). In 2020, both series declined slightly and remain very similar.

Figure 14. Nominal and average CPUE of total SBT for Korean longliners operating in statistical areas 4–9 in months 4–9. Nominal CPUE is the total number of SBT over total effort (1000 hooks), while average CPUE is the mean of the nominal rate in each 5×5° grid square per month.



3.1.3 Taiwanese longline CPUE

Nominal CPUE series of Taiwanese longliners were obtained from aggregated catch and effort data provided in the 2020 interim update of the CCSBT database.

The number of vessels in the Taiwanese fishery targeting SBT and catching SBT as bycatch has fluctuated since 2002 when records became more accurate (CCSBT-ESC/1309/SBT Fisheries-Taiwan). The Taiwanese fishery operates in both the northern fishery (areas 2, 14, 15), and the southern fishery (areas 8, 9) (Fig. 15, 16). The main area of effort is the southern 5 degrees of latitude in statistical areas 2, 14 and 15, where vessels have historically targeted albacore.

Catch rates have fluctuated over time, with a slight decline in areas 2, 14 and 15 in 2020 (Fig. 15). Catch rates in 2020 were highest in areas 2, 14 and 15 south, with the catch rates in 2, 14 and 15 north and middle, and 8 and 9, very similar (Fig. 16). Taiwan informed the 2009 ESC that changes in collection of fishery statistics was largely responsible for the increase seen in nominal catch rates in areas 2, 14 and 15 since 2000 (Fig. 15, 16; Anon 2009). Effort in all areas remained stable in 2020 (Fig 17).

Figure 15. Nominal CPUE of SBT for Taiwanese longliners operating in statistical areas 8 and 9 (pooled) and 2, 14 and 15 (pooled) in months 4–9.

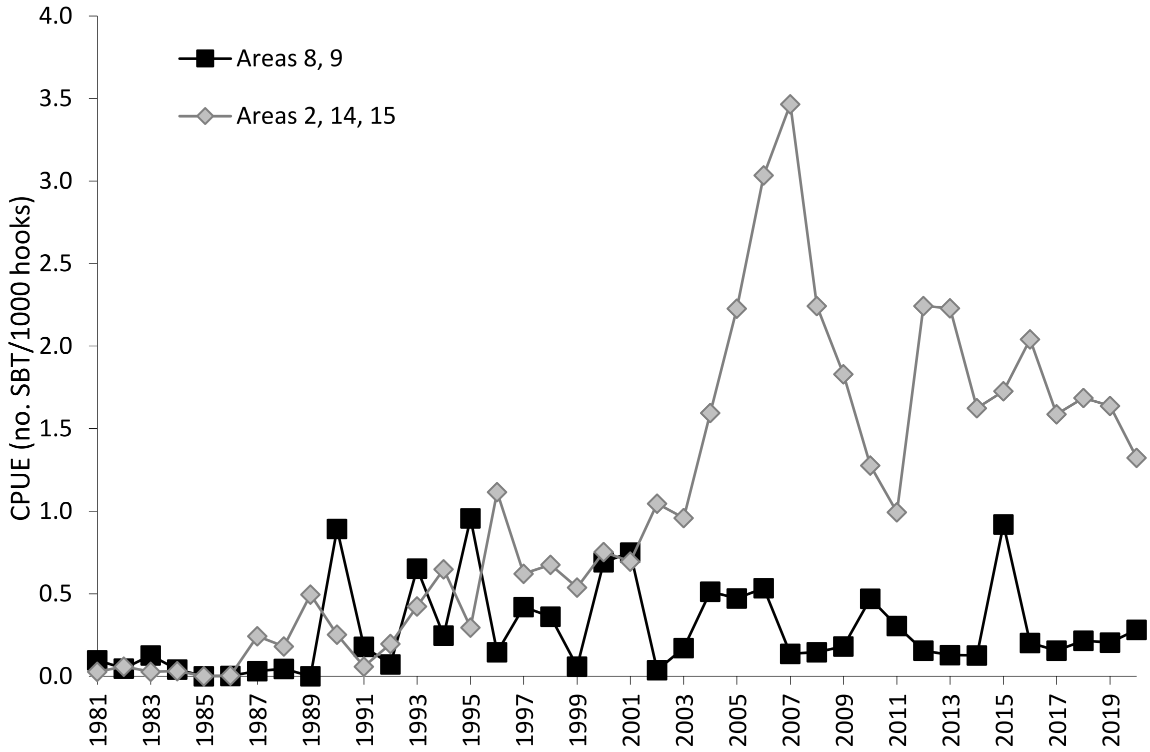


Figure 16. Nominal CPUE of SBT for Taiwanese longliners operating in statistical areas 2, 14 and 15 (pooled) by 5° latitudinal strips: South = 30–35°S; Middle = 25–30°S; North = 20–25°S. Nominal CPUE in areas 8 and 9 (pooled) shown for comparison. Data are from months 4-9 only.

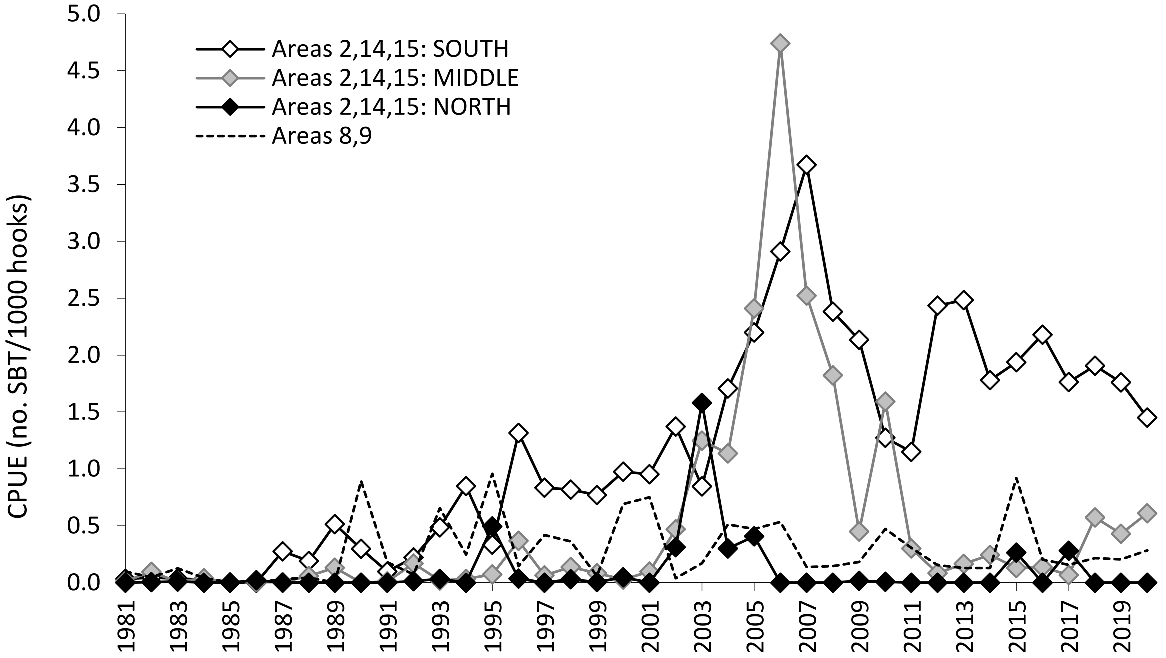
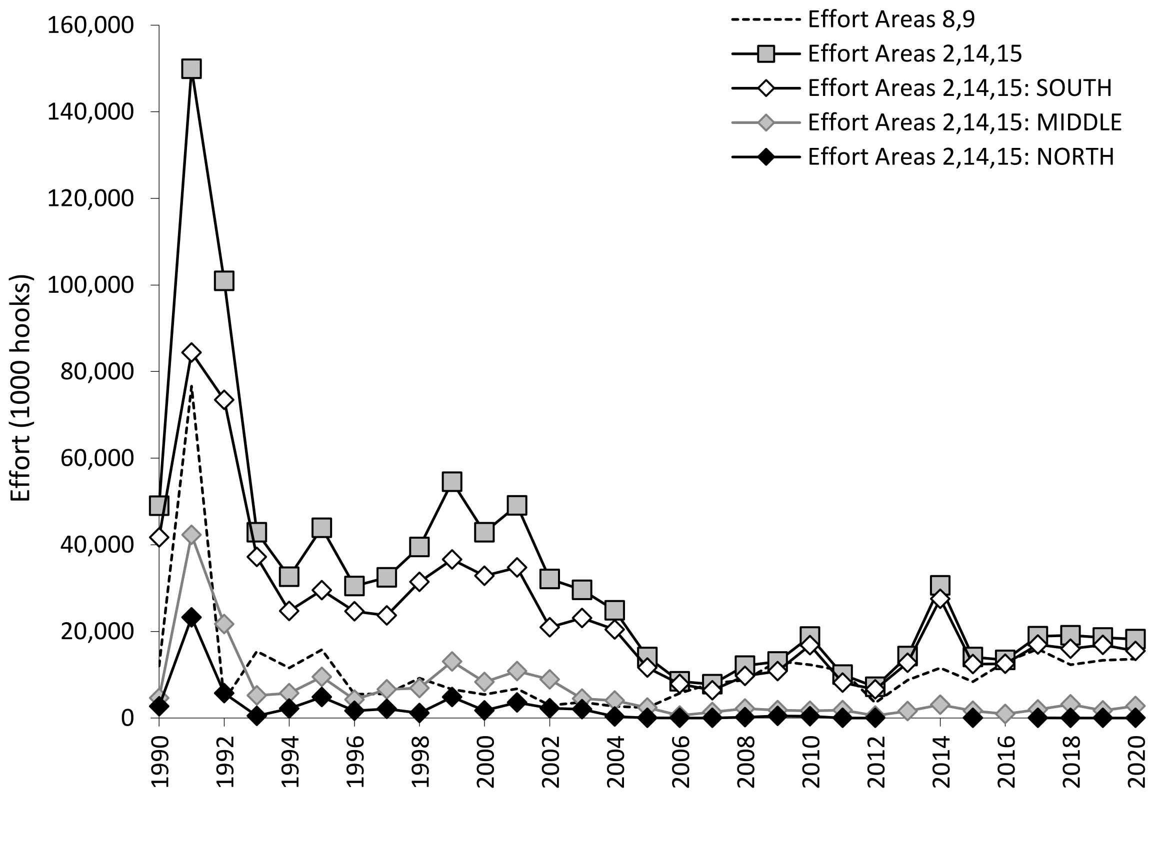


Figure 17. Effort (1000 hooks) from Taiwanese longliners in statistical areas 8 & 9 (pooled) and 2, 14 and 15 (pooled). Areas 2, 14 and 15 are also separated into 5° latitudinal strips: South = 30–35°S; Middle = 25–30°S; North = 20–25°S. Data are from months 4–9 only.



3.2 Catch size/age composition

Size and age composition of the unreported catch identified by the 2006 Japanese Market Review is unknown and the effect on age/size data from the bias identified in the Australian Farm Review has not been resolved. Therefore, the long-term trends in these data should be interpreted with caution. Data collected since 2006 for the longline fisheries are unlikely to be affected by unreported catches.

3.2.1 Japanese longline fishery size/age composition

Size composition data for SBT caught by Japanese longliners were obtained from the CCSBT data exchange in June 2021. These data are examined below for trends for juvenile fish aged less than 6 years.

For comparison with size/age composition in the NZ and Taiwanese longline fisheries, Japanese length data have also been compiled for < 6-year olds, assuming that the following size categories represented ages 0–2, 3, 4 and 5:

≤86 cm: age 0–2

>86 to ≤102 cm: age 3

>102 to ≤114 cm: age 4

>114 to ≤126 cm: age 5

The age composition of SBT (derived from cohort slicing) caught by the Japanese longline fishery has been highly variable over time. The relative proportion of the oldest age class examined here decreased in 2020, as did the second oldest age class. The third oldest remained stable while the youngest age class remained near zero (Fig. 18).

Trends in size composition of < 126 cm indicate the proportion of all the size classes, except the smallest, declined in 2020; the smallest size class remained near zero (Fig. 19).

Discarding of juveniles has been reported since 2009 but may have commenced earlier and would impact the size/age composition (Sakai & Itoh 2013).

Figure 18. Age composition (proportion of total catch) of ages 0–2, 3, 4 and 5 in the Japanese longline fishery in statistical areas 4–9, months 4–9.

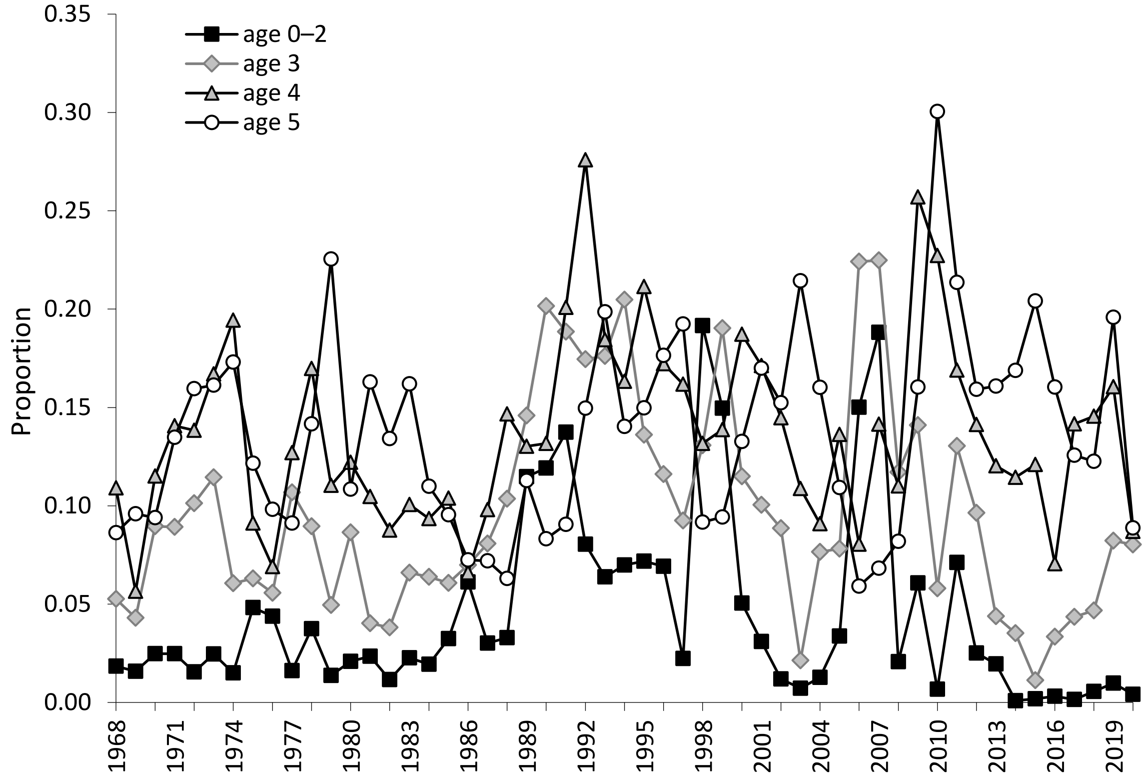
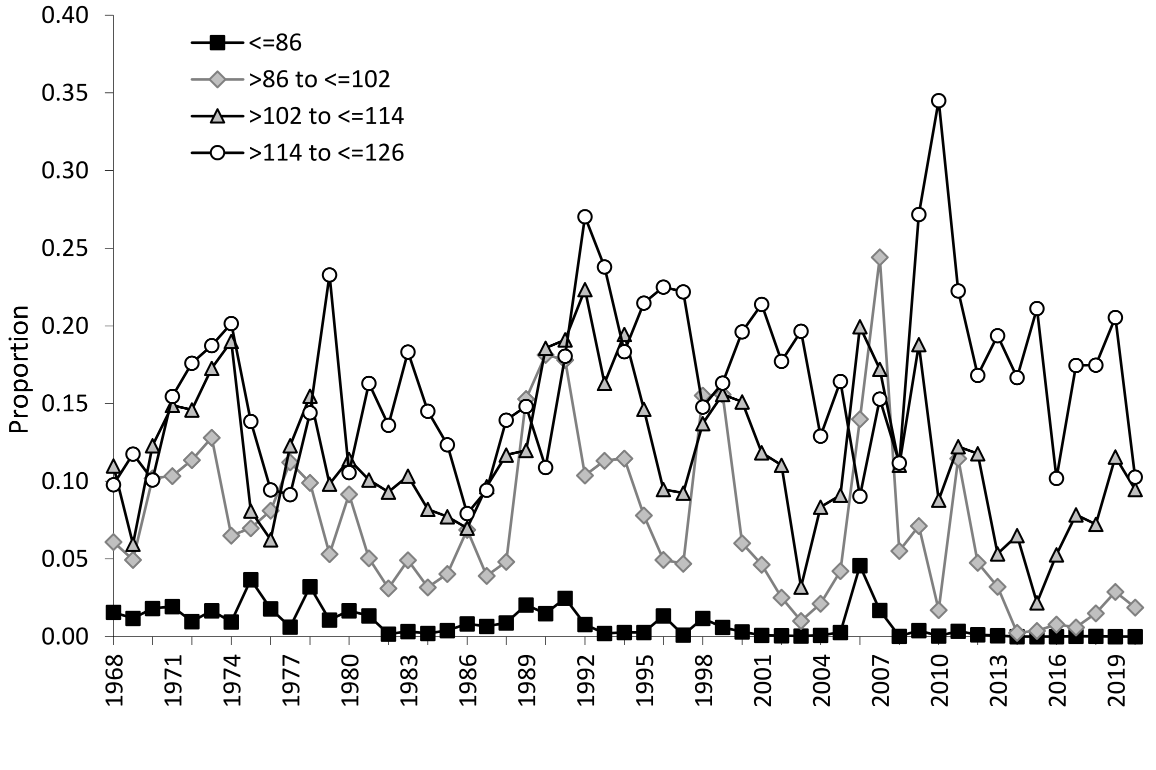


Figure 19. Size composition (proportion of total catch) of juvenile SBT caught by Japanese longliners in statistical areas 4–9, months 4–9, where age 0–2≤86 cm, 86<age 3≤102 cm, 102<age 4≤114 cm, 114<age 5≤126 cm.



3.2.2 Taiwanese longline fishery size/age composition

Size composition data for SBT caught by Taiwanese longliners were obtained from the 2020 interim update of the CCSBT database. Data in this table are not linked to statistical area or month of capture. Therefore, all available size data in this table have been aggregated.

It has been assumed that the following size categories represented ages 0–2, 3, 4 and 5:

≤86 cm: age 0–2

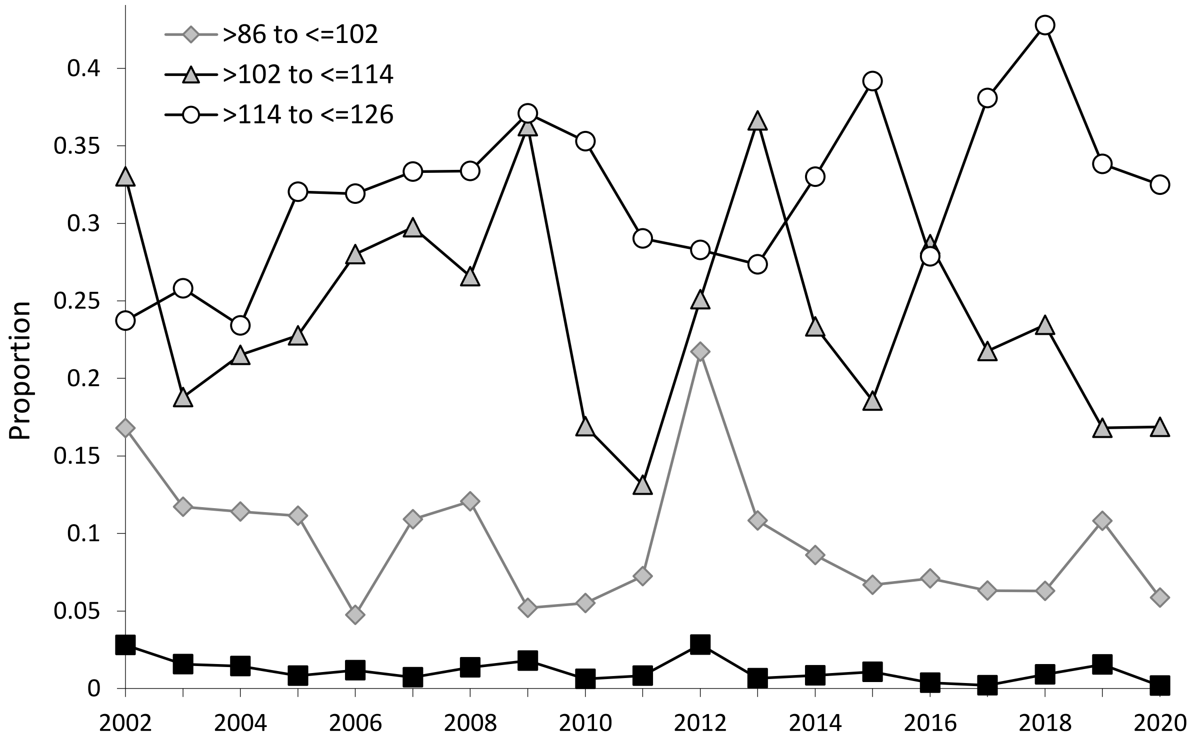
>86 to ≤102 cm: age 3

>102 to ≤114 cm: age 4

>114 to ≤126 cm: age 5

Taiwanese longliners have historically targeted albacore in the southern sections of statistical areas 2, 14 and 15, and generally catch higher proportions of juvenile SBT (Hartog & Preece 2008). In 2020, proportions of all size classes declined, except for 102–114 cm which remained stabled (Fig. 20).

Figure 20. Size composition (proportion of total catch) of juvenile SBT caught by Taiwanese longliners, where age 0–2≤86 cm, 86<age 3≤102 cm, 102<age 4≤114 cm, 114<age 5≤126 cm.

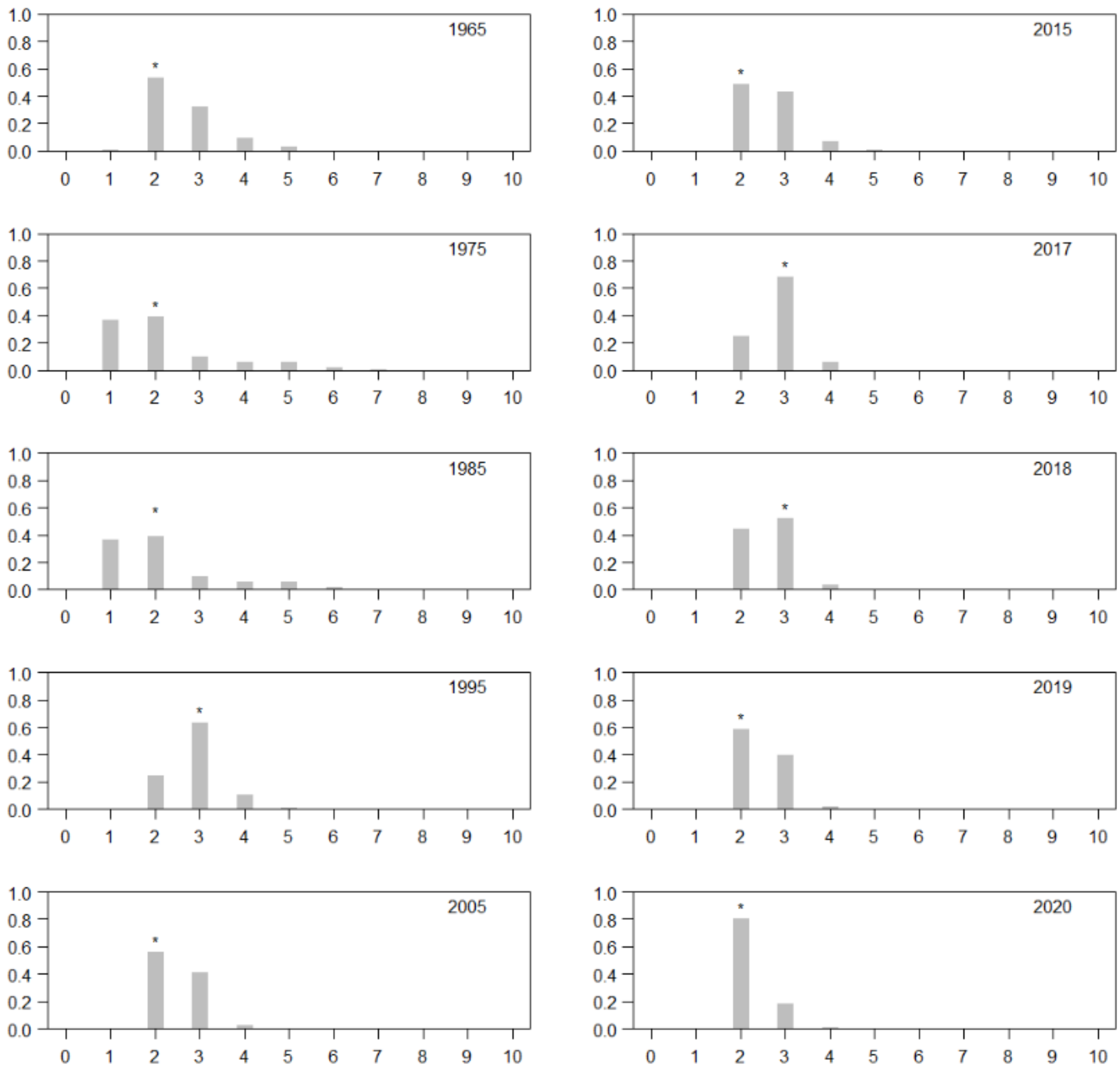


3.2.3 Australian surface fishery age composition

The age composition of SBT caught by the Australian surface fishery was updated directly from the proportional catch-at-age data prepared by the Secretariat and provided through the CCSBT data exchange (SEC_ManagementProcedureData_1952_2020). The catch at age is calculated from length frequency data (Preece et al. 2004).

The 2006 Australian Farm Review was unable to resolve whether there were biases in the 40-fish sampling program that would affect the size/age composition of the reported catch (Fushimi et al. 2006). Age composition in the Australian surface fishery has not changed markedly and continues to be dominated by age 2 and age 3 SBT (Fig. 21). These two age classes have historically comprised around 90% of the catch. In 2020, the 2 and 3-year old age classes accounted for about 99% of the catch.

Figure 21. Age composition in the Australian surface fishery. Median age classes are indicated with asterisks.



Appendix A: Recent trends in all indicators of the SBT stock

Table 2. Recent trends in all indicators of the SBT stock. Minimum and maximum values in the time series are also shown.

Indicator	Period	Min.	Max.	2017	2018	2019	2020	2021	12 -month trend
Scientific aerial survey	1993–2000 2005–17	0.25 (1999)	4.85 (2016)	1.80	–-	–-	–-	–-	–-
Trolling index	1996–2003 2005–06 2006–20	0.00 (2018, 2019)	5.09 (2011)	1.71	0.00	0.00	1.72	–-	–-
Gene tagging	2016–18	1.15 (2017)	2.27 (2016)	1.15	1.14	1.52	–-	–-	↑
NZ domestic standardised CPUE	2003–2020	0.355 (2006)	2.99 (2016)	2.46	2.42	1.22	2.05		↑
NZ domestic age/size composition (proportion age 0–5 SBT)*	1980–2020	0.001 (1985)	0.48 (2017)	0.48	0.33	0.27	0.24		↓
Indonesian mean size class**	1993–2019	156 (2016)	188 (1994)	154.7	161.9	161.1	–-		–-
Indonesian age composition:** mean age on spawning ground, all SBT	1994–2019	11.8 (2016)	21.2 (1995)	12.9	13.4	13.2	–-		–-
Indonesian age composition:** mean age on spawning ground 20+	1994–2019	21.3 (2016)	25.3 (2004)	23.1	23.1	22.4	–-		–-
Indonesian age composition:** median age on spawning ground	1994–2019	11.5 (2017)	21 (1994–95; 1996–97; 1998–99)	11.5	12.5	12.5	–-		–-

Table 2. (cont'd). Recent trends in all indicators of the SBT stock. Minimum and maximum values in the time series are also shown. Japanese age composition refers to ages in statistical areas 4–9 for months 4–9 only.

Indicator	Period	Min.	Max.	2017	2018	2019	2020	12-month trend
Japanese nominal CPUE, age 4+	1969–2020	1.338 (2006)	22.123 (1965)	5.271	6.001	7.742	6.513	↓
Japanese standardised CPUE (W0.5, W0.8, Base w0.5, Base w0.8)	1969–2020	2007 (0.269–0.347)	1969 (2.284– 2.706)	0.926–1.307	0.925–2.269	0.888–1.756	1.164–2.646	↑
Korean nominal CPUE	1991–2020	1.312 (2004)	21.523 (1991)	6.552	7.518	8.702	7.487	↓
Taiwanese nominal CPUE, Areas 8+9	1981–2020	<0.001 (1985)	0.956 (1995)	0.156	0.217	0.204	0.283	↑
Taiwanese nominal CPUE, Areas 2+14+15	1981–2020	<0.001 (1985)	3.672 (2007)	1.588	1.686	1.638	1.324	↓
Japanese age comp, age 0–2*	1969–2020	0.004 (1966)	0.192 (1998)	0.002	0.006	0.009	0.004	↓
Japanese age comp, age 3*	1969–2020	0.011 (2015)	0.228 (2007)	0.044	0.047	0.082	0.080	↓
Japanese age comp, age 4*	1969–2020	0.091 (1967)	0.300 (2010)	0.142	0.145	0.160	0.087	↓
Japanese age comp, age 5*	1969–2020	0.072 (1986)	0.300 (2010)	0.126	0.123	0.196	0.089	↓
Taiwanese age/size comp, age 0–2*	1981–2020	<0.001 (1982)	0.251 (2001)	0.002	0.009	0.015	0.002	↓
Taiwanese age/size comp, age 3*	1981–2020	0.024 (1996)	0.349 (2001)	0.063	0.063	0.108	0.059	↓
Taiwanese age/size comp, age 4*	1981–2020	0.027 (1996)	0.502 (1999)	0.218	0.234	0.168	0.169	↑
Taiwanese age/size comp, age 5*	1981–2020	0.075 (1997)	0.428 (2018)	0.381	0.428	0.338	0.325	↓
Australia surface fishery median age composition	1964–2020	age 1 (1979–80)	age 3 (multiple years)	age 3	age 3	age 2	age 2	-–

*derived from size data; ** Indonesian catch not restricted to just the spawning grounds since 2012–13;

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