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Fisheries indicators for the southern bluefin tuna stock 2021–22

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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 2021–22 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. Two indicators of juvenile (age 1–4) SBT abundance were updated. The piston-line trolling survey decreased from the last index in 2020, while the grid-type trolling index increased from 2021. The gene-tagging abundance estimate was not updated in 2021. Indicators of age 4+ SBT exhibited mixed trends. For close-kin, the Parent-Offspring-Pairs detection rate decreased for the latest year it was calculated (2018), which is consistent with an increase in population size. 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, as did the Japanese longline nominal CPUE in 2021. In contrast, the new Japanese standardised CPUE series (the new GAM series) decreased slightly.

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). The 2021–22 update of fishery indicators for the SBT stock summarises indicators in the same groups presented in previous updates in 2007 to 2021, including the gene tagging index added in 2019 and a new close kin index added this year (Hartog et al. 2007; Hartog & Preece 2008; Patterson 2021; Phillips 2009; Patterson 2020; Patterson et al. 2010, 2011, 2012, 2013, 2016, 2017, 2018; Patterson & Hennecke 2019; Patterson & Stobutzki 2014, 2015). The new standardised Japanese CPUE (new GAM series) is also included this year. 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 and grid)
- 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

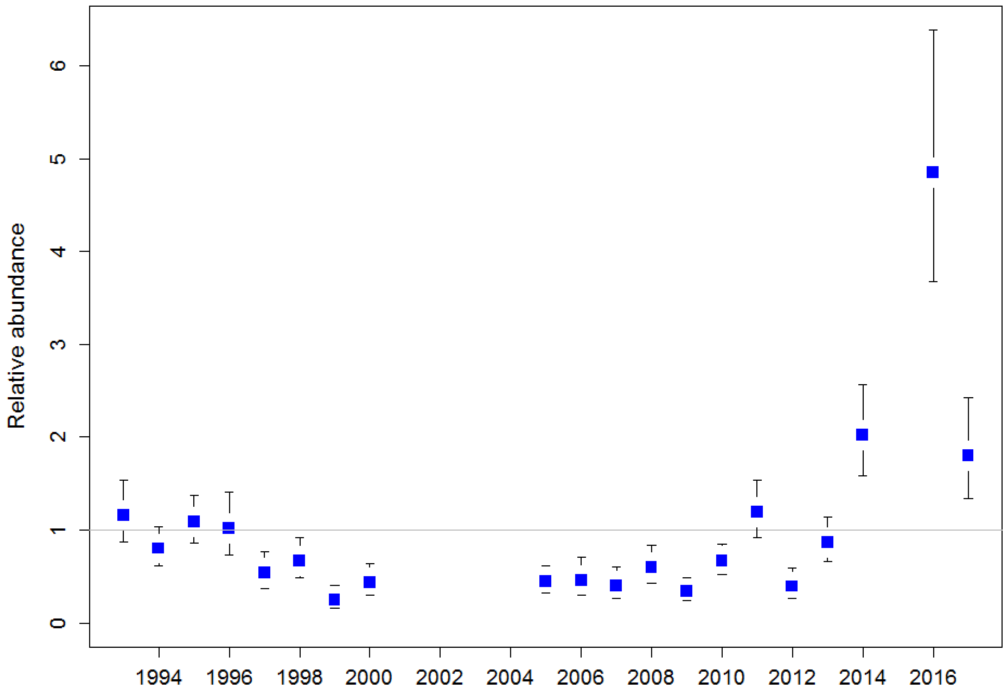
2.1 Scientific aerial survey

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 and grid-type trolling index (TRG) was updated in 2022 from data provided by Japan through the CCSBT data exchange (JP_Trollindex_2022).

The trolling survey 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 trolling index is comprised of: (1) a piston-line trolling survey, 2006–22; (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). The grid type trolling index (TRG) for 1996–2022 was added to this section this year. The TRG is a standardisation of the trolling survey index and is described in Itoh (2021).

The piston-line survey did not take place in 2021, but in 2022 was below 2020 levels (Fig 2). The 5-year average (excluding 2021) was also below the indices since 2018. The TRG index increased slightly in 2022 (Fig 3), and is on par with the 5-year average.

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 5-year median value.

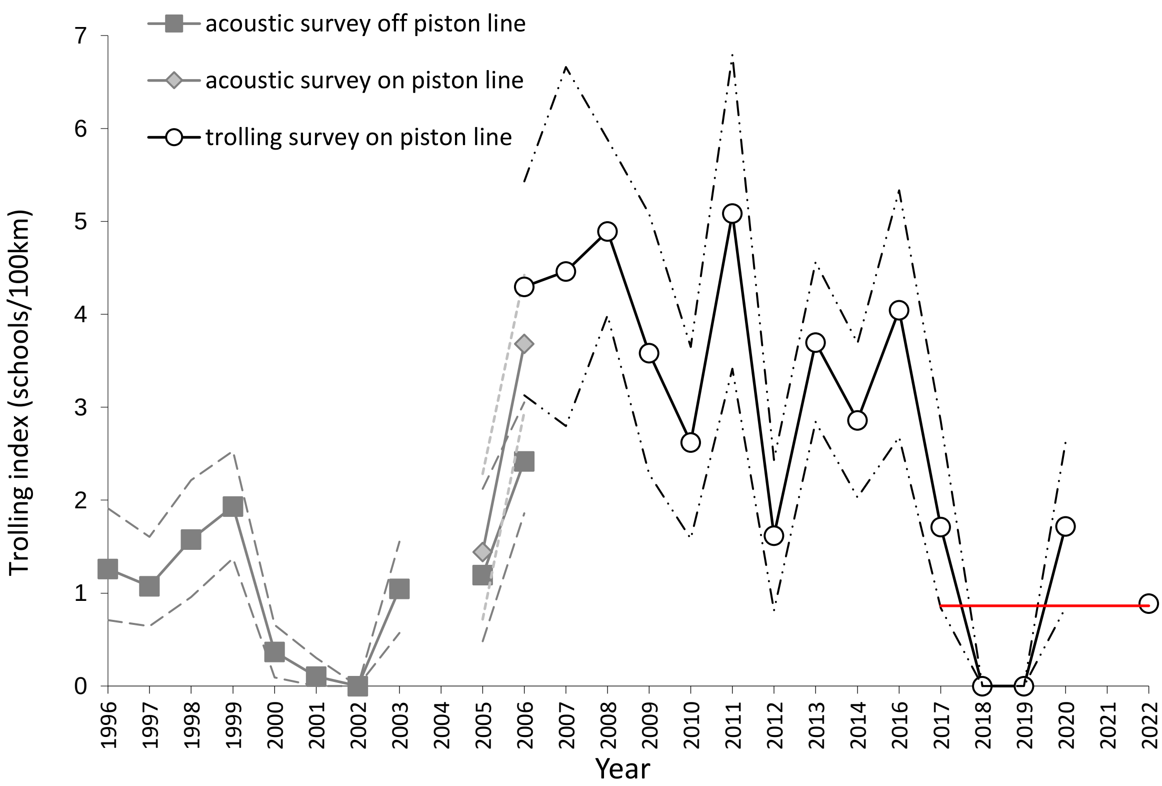
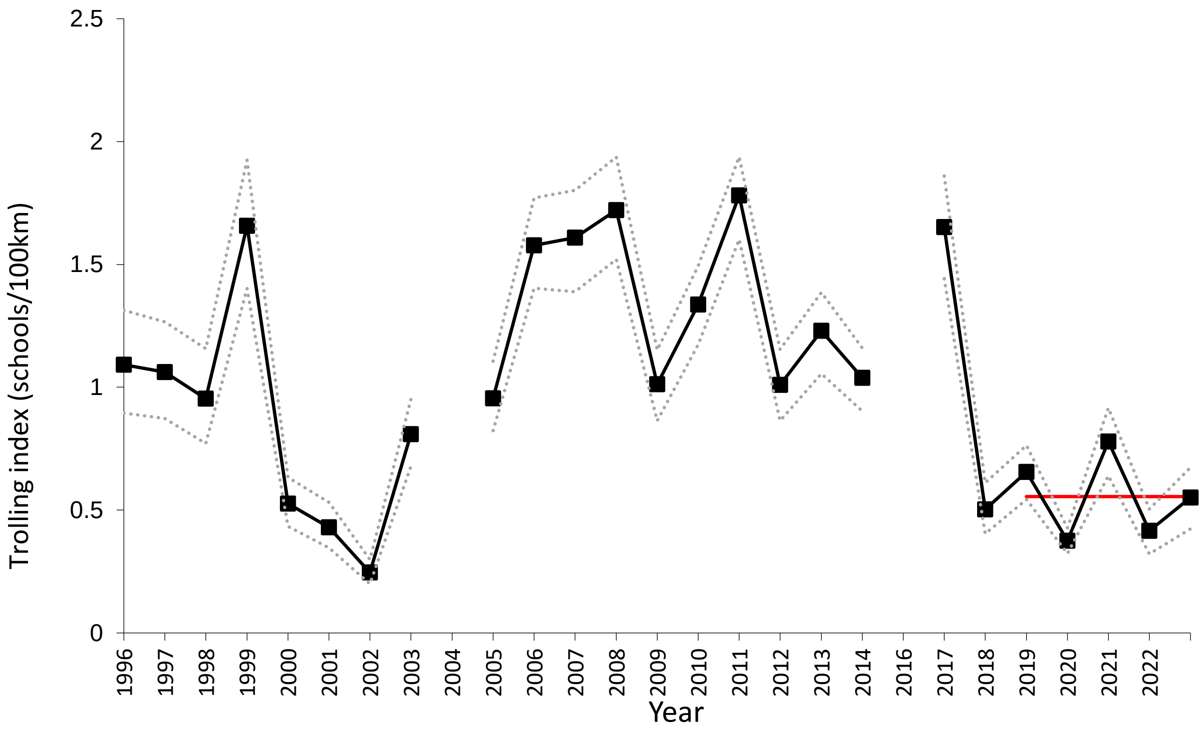


Figure 3. Grid-type trolling index, showing number of schools per 100 km off the Western Australian coast in January. Dashed lines are 90% confidence intervals. The red line shows the average 5-year median value.



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.

No new data from the ongoing program were provided in July 2022 because of the impacts of COVID -19 (Ann Preece, CSIRO, pers comm). The estimate of absolute abundance of 2-year old fish increased in 2019.

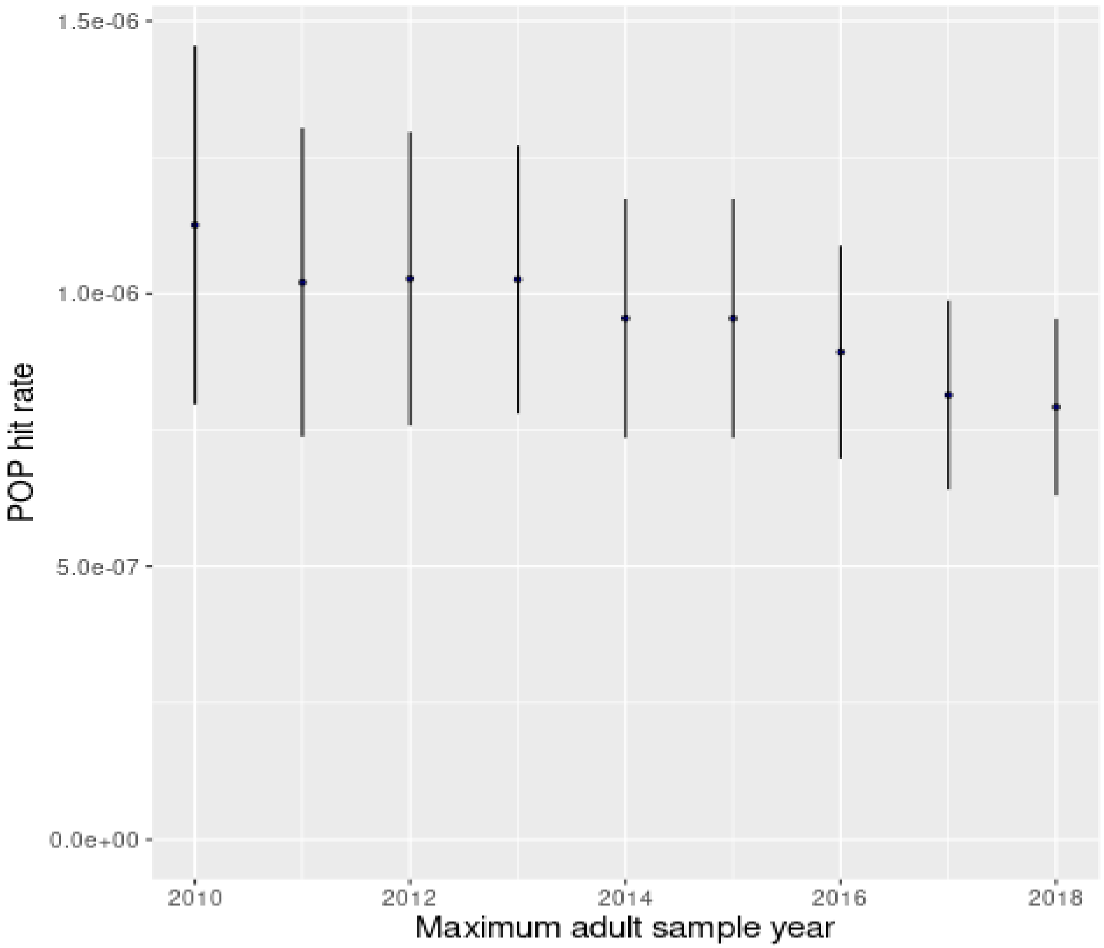
Table 1. Gene-tagging estimates for 2016 to 2019

	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. The detection rate for Parent-Offspring-Pairs is provided in Figure 4. Further information on CKMR is provided in Hillary et al. (2016) and Hillary et al. (2020). The index for 2018, the latest year for which it is calculated, decreased, which is consistent with the adult abundance increasing.

Figure 4. Mean (circles) and approximate 95% confidence interval (full line) for the Parent-Offspring Pair (POP) detection rate (number of kin pairs per juvenile-adult comparison) for a maximum adult sampling year (x-axis). With respect to interpretation, as we move along the x-axis we effectively move further forward in time with regards to the adult population, so an increasing/decreasing detection rate can be qualitatively inferred as a decreasing/increasing overall adult abundance.



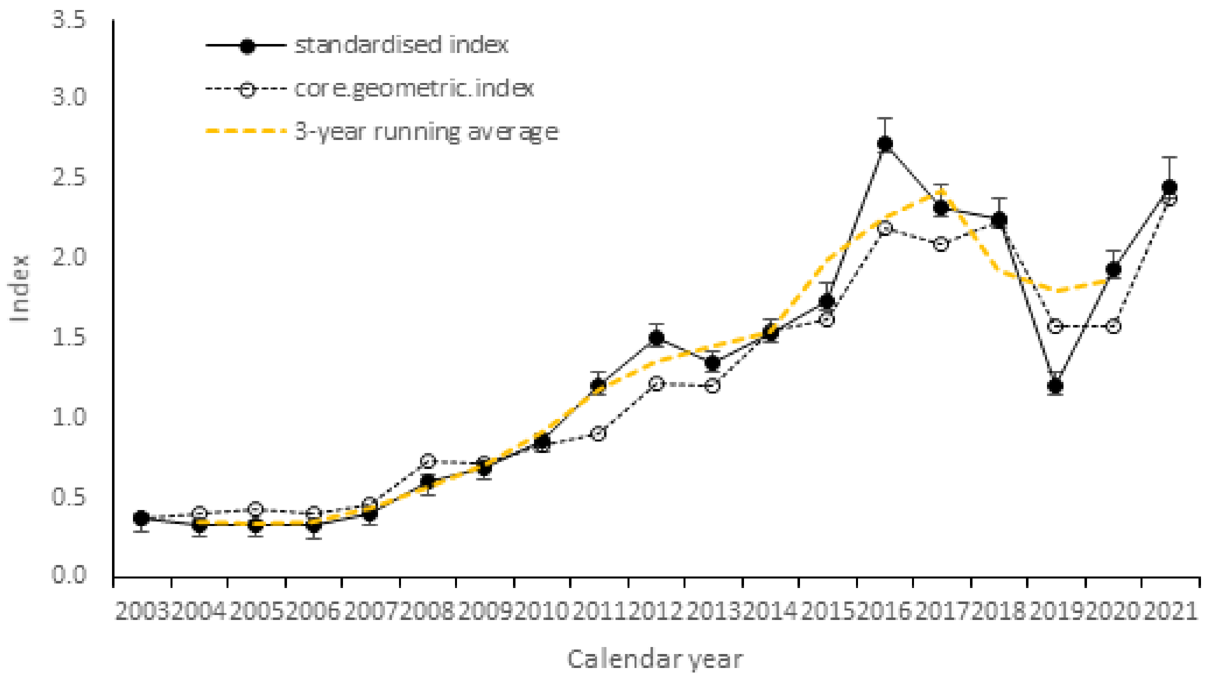
2.5 Catch per unit effort

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 2021. For consistency, Fig 4 uses the values provided by New Zealand. The methodology used in generating these data are provided in CCSBT-ESC/2208/SBT Fisheries - New Zealand.

Overall, catch rates in the NZ domestic fishery increased from 2007, with a sharp increase seen in 2016 (Fig 5). CPUE then decreased from 2016 to 2019, but increased in 2020 and 2021.

Figure 5. 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

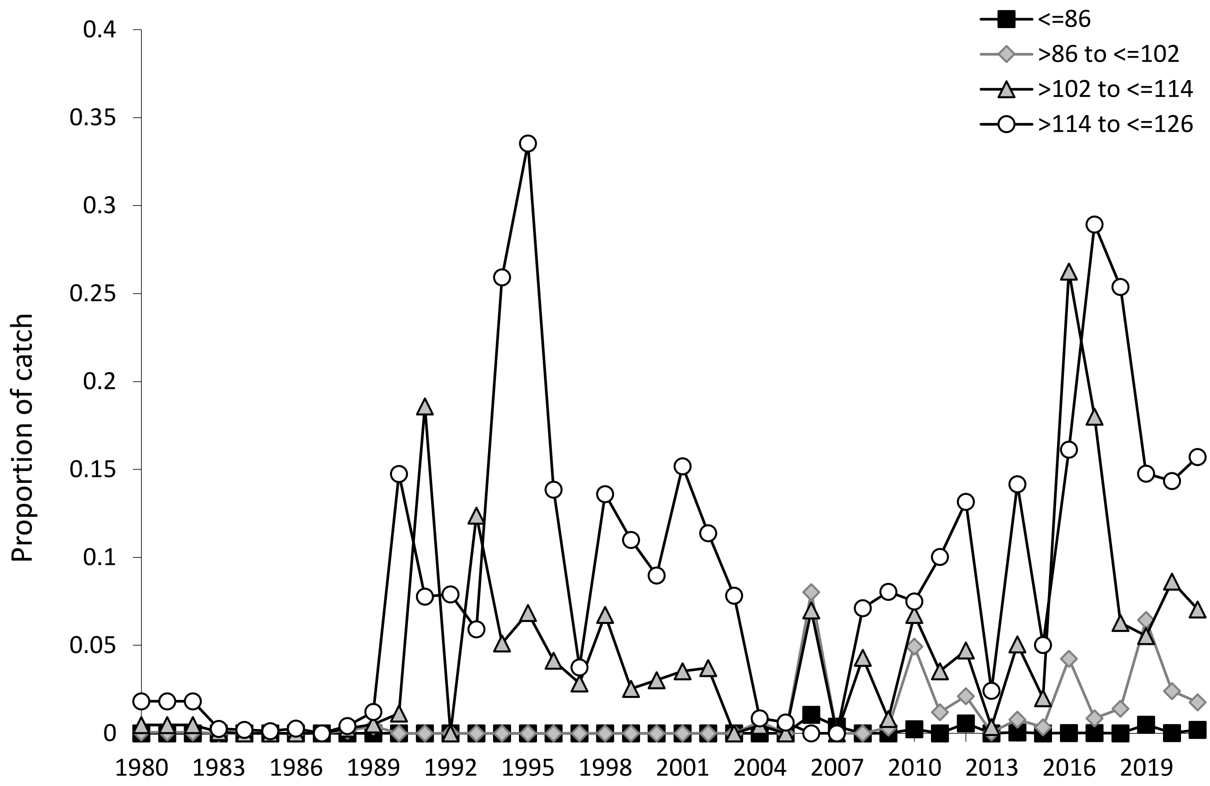
>86 to ≤102 cm: age 3

>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. 6). 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 increased in 2021, while the second and third oldest age classes decreased. The 0–2 age class, which has been virtually zero throughout the time series, remained near zero.

Figure 6. 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 2022 due to impacts from COVID-19.

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. 7, Fig. 8; 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. 9, Fig. 10; 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. A preliminary review of the data in 2021 found that size data from two sources resulted in different age composition results (Farley et al. 2021). Further work is needed to determine the reasons for these differences and improve the quality of the data. Given the importance of the size and age composition estimates from the Indonesian fishery to the assessment and management of SBT, this work was recommended as a high priority.

Figure 7. 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).

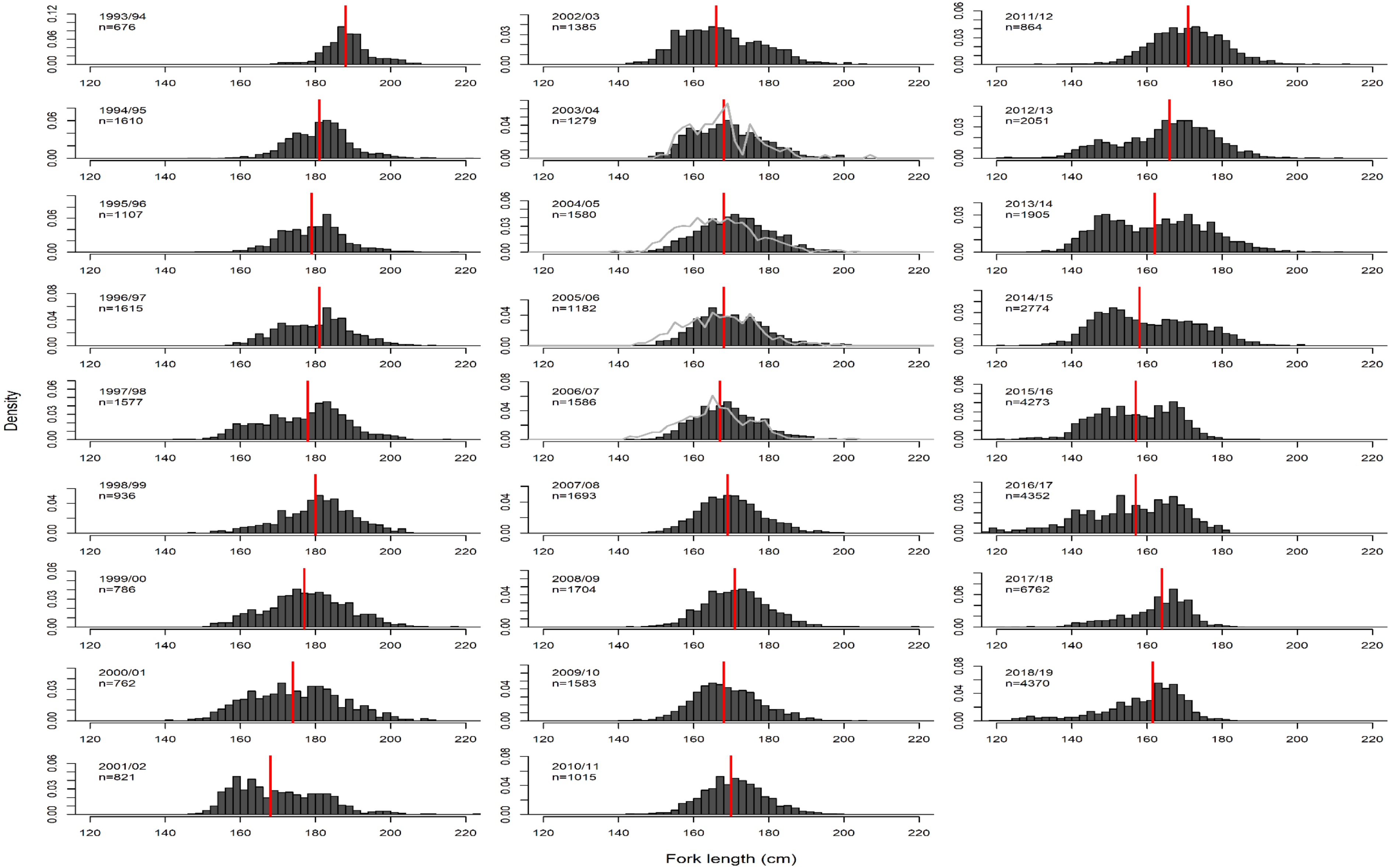


Figure 8. Size composition of SBT caught on the spawning grounds by the Indonesian longline fishery by spawning season (from Sulistyaningsih et al. 2020). Data from Processor A are excluded.

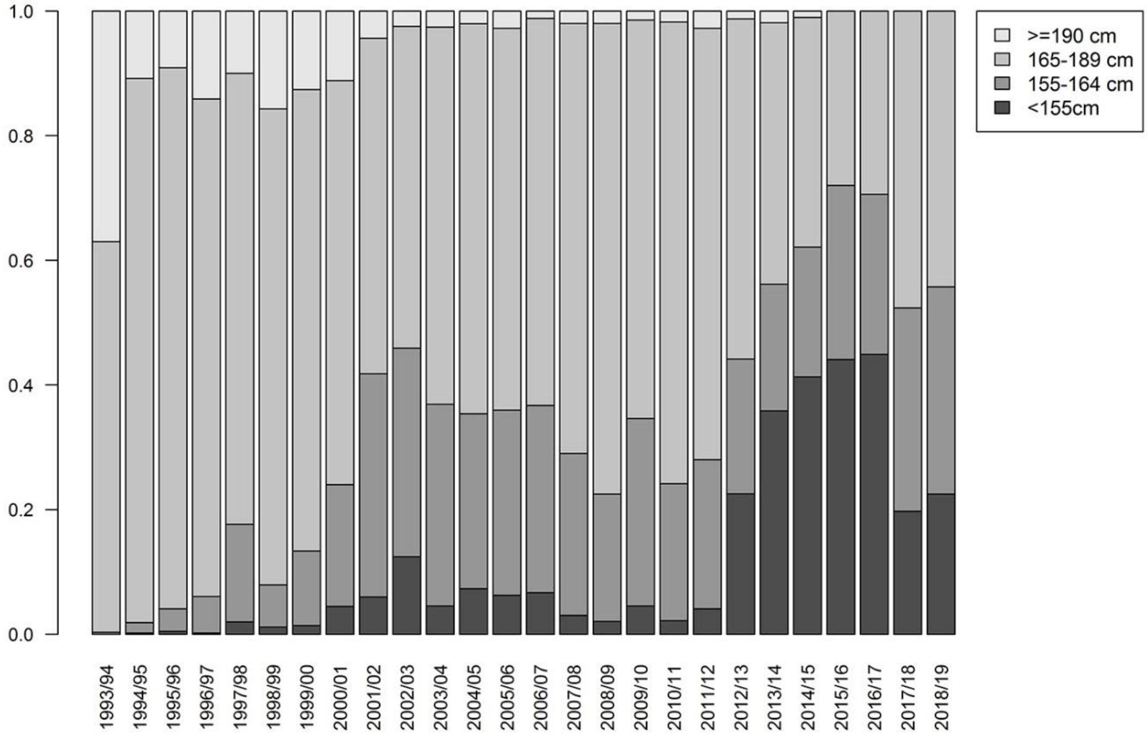


Figure 9. Mean estimated age (years) of SBT caught on the spawning grounds by Indonesian longliners (from Sulistyaningsih et al. 2020). Data from Processor A are excluded. Note that there are no age data for the 1995–96 season.

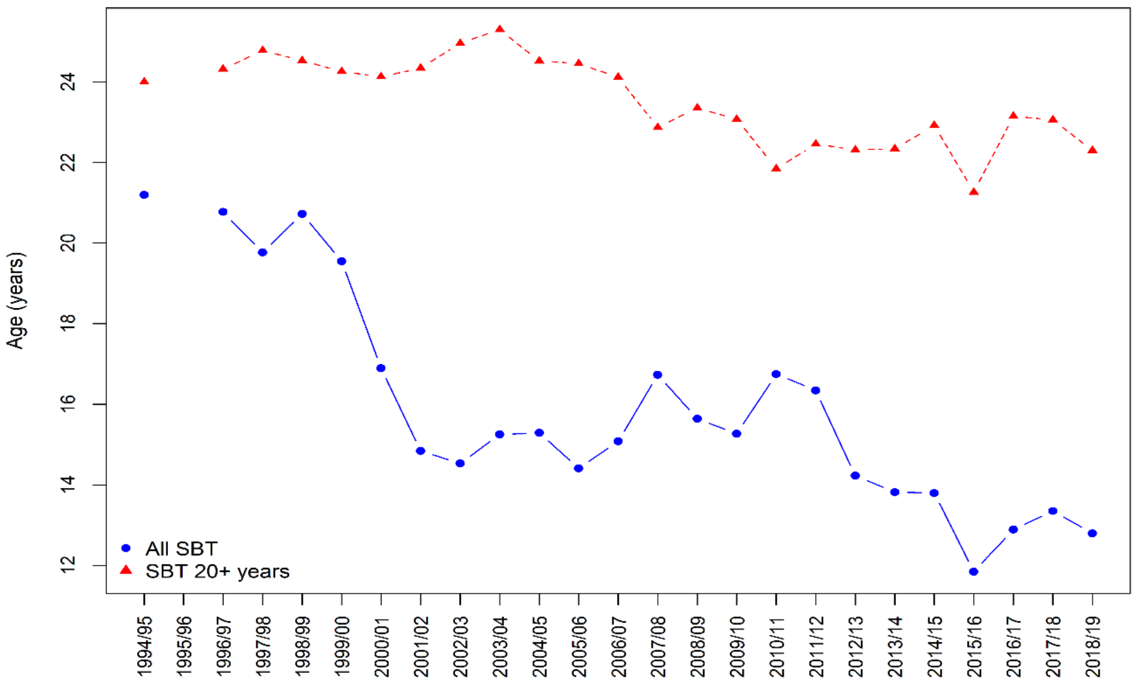
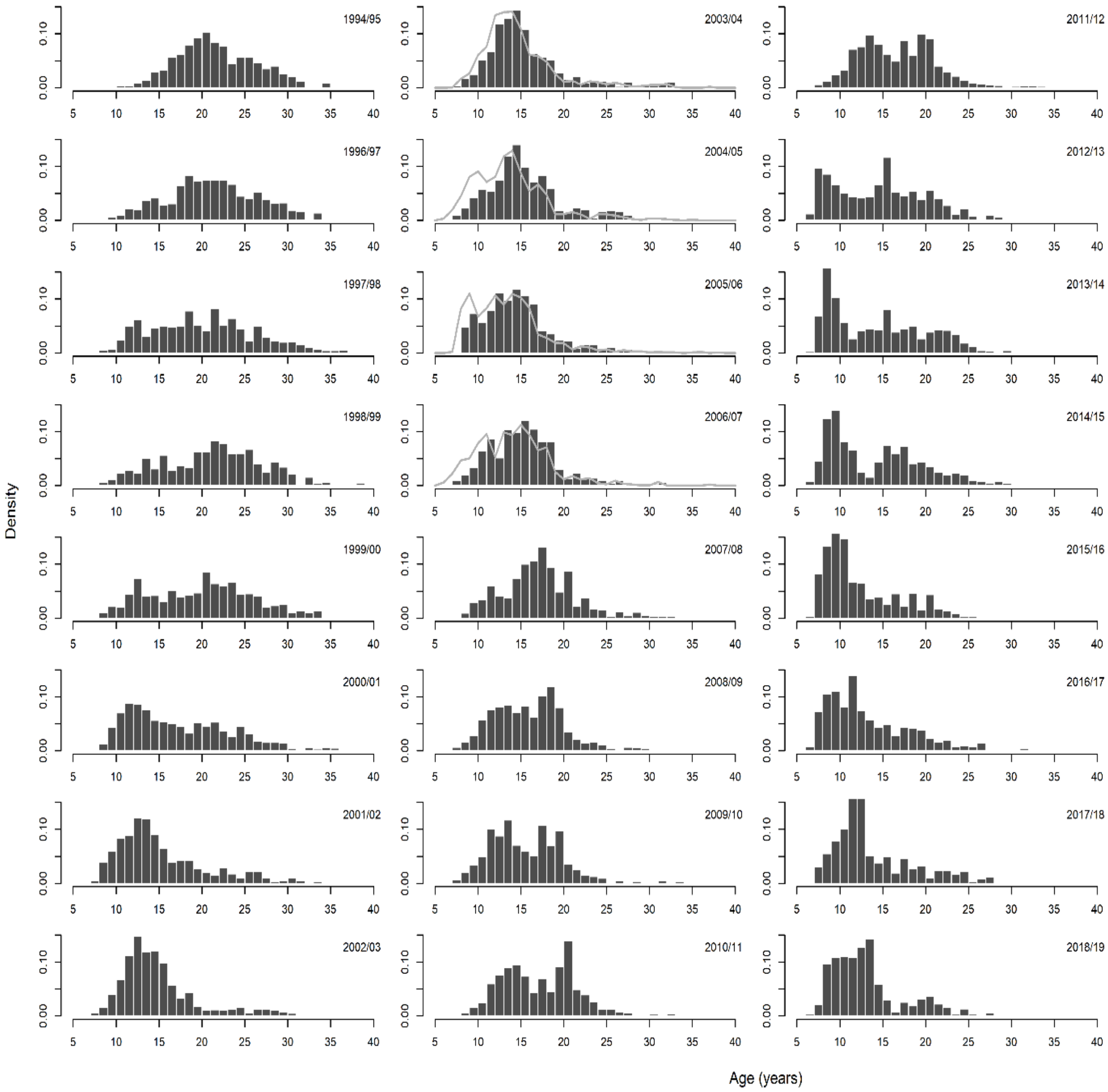


Figure 10. Age frequency distribution of SBT in the Indonesian catch on the spawning ground by spawning season estimated using age-length keys from sub-samples of direct aged fish and length frequency data obtained through the Indonesian monitoring program (from Sulistyaningsih et al. 2020). There was 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_1965–2021). The standardised CPUE series previously used were replaced this year with the new GAM series.

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 2019, the CPUE series used to test the management procedure had a very high value for 2018, resulting from very high estimates in strata that had no observations. The CCSBT CPUE Working Group identified an alternate methodology and series (GAM) that will replace the series previously used (CCSBT 2022).

The following updates for 2021 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 2021 increased, and is above the 10-year mean (Fig. 11, horizontal line).
- Nominal CPUE for age 4–7, 8–11 and 12+ SBT. The nominal CPUE series for ages 4–7 increased in 2021, as did the CPUE for ages 8–11. The CPUE of age 12+ SBT has remained low with little variability since the early 1970s (Fig. 12).
- Nominal CPUE for age 0–2, 3, 4 and 5 SBT. Since 2010, age 4 and 5 SBT have been the dominant year classes. While both declined substantially in 2020, both have increased in 2021, as has age 3. Ages 0–2 remain near zero (Fig. 13).
- Standardised CPUE. The newly adopted GAM series decreased slightly in 2021 (Fig. 14).

Figure 11. 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 10-year mean.

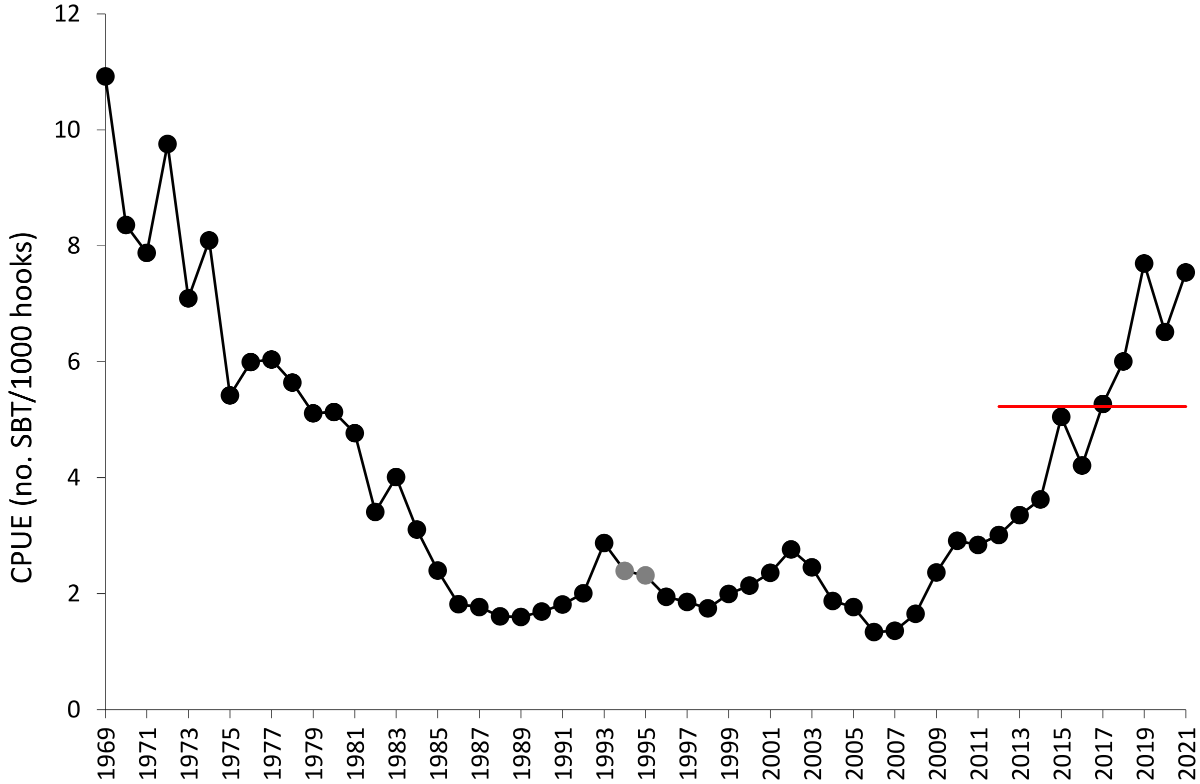


Figure 12. Nominal CPUE of ages 4–7, 8–11 and 12+ SBT for Japanese longliners operating in statistical areas 4–9 in months 4–9. The 1995 and 1996 values for ages 4–7 are plotted as grey squares to indicate increased uncertainty about these points due to changes in retention policies for small fish in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

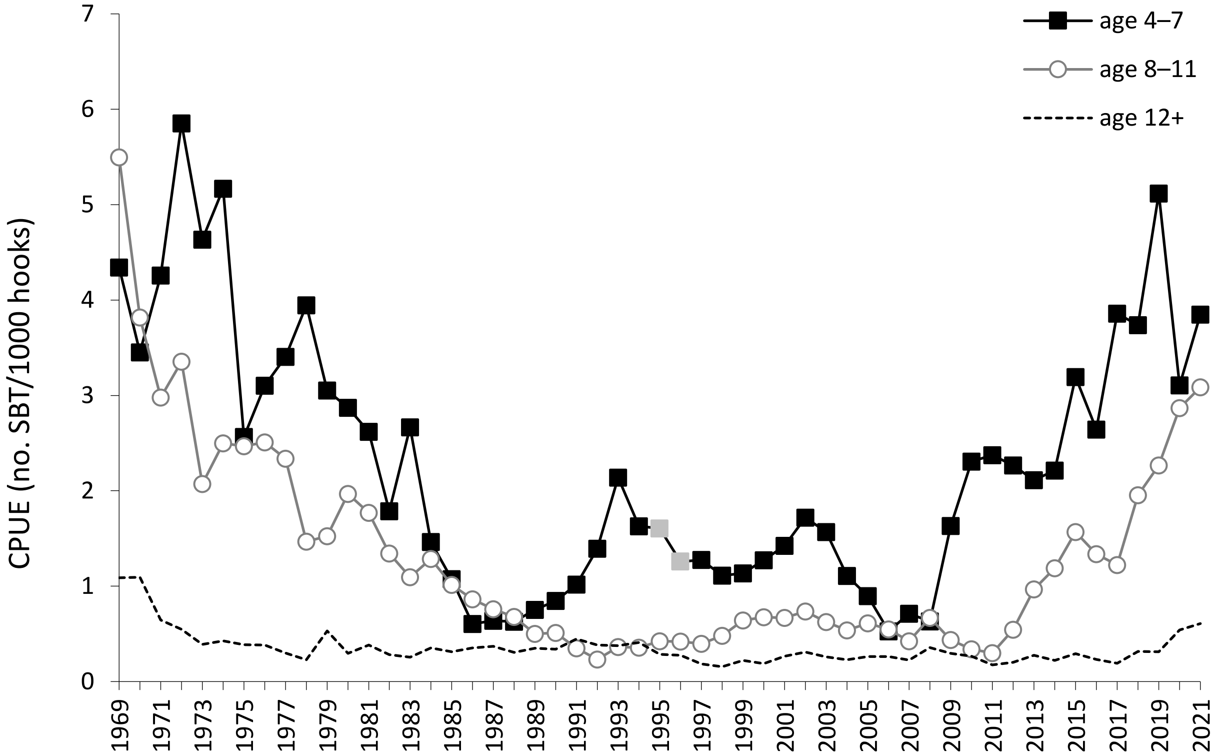


Figure 13. Nominal CPUE of ages 0–2, 3, 4 and 5 SBT for Japanese longliners operating in statistical areas 4–9 in months 4–9.

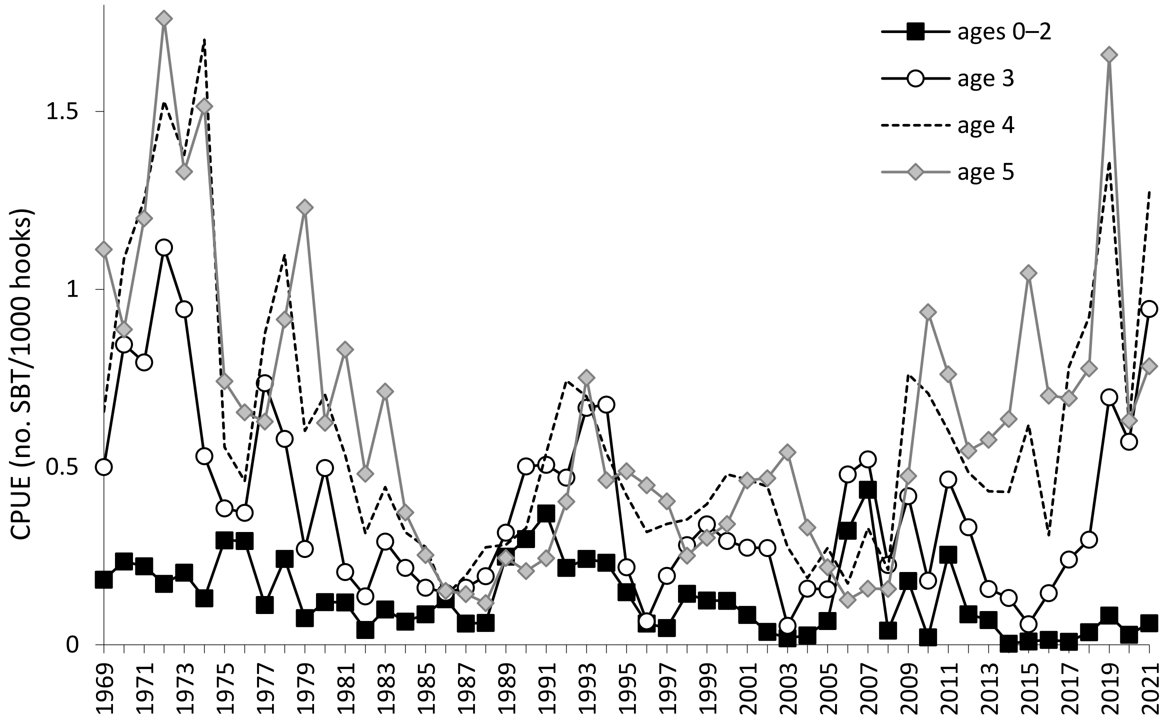
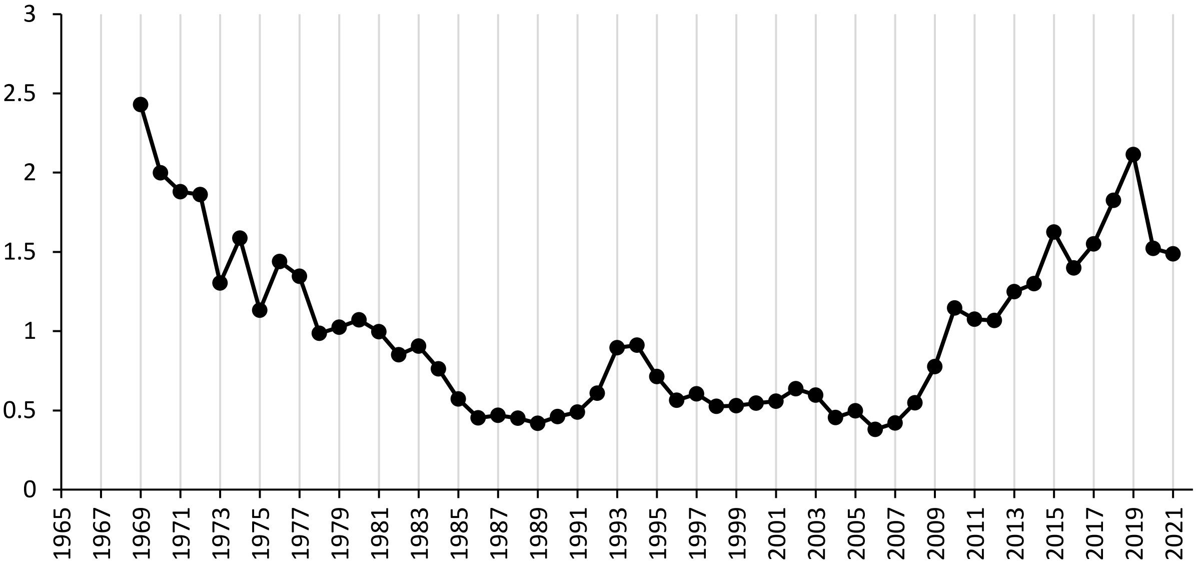


Figure 14. Standardised CPUE of age 4+ SBT for Japanese longliners (GAM).

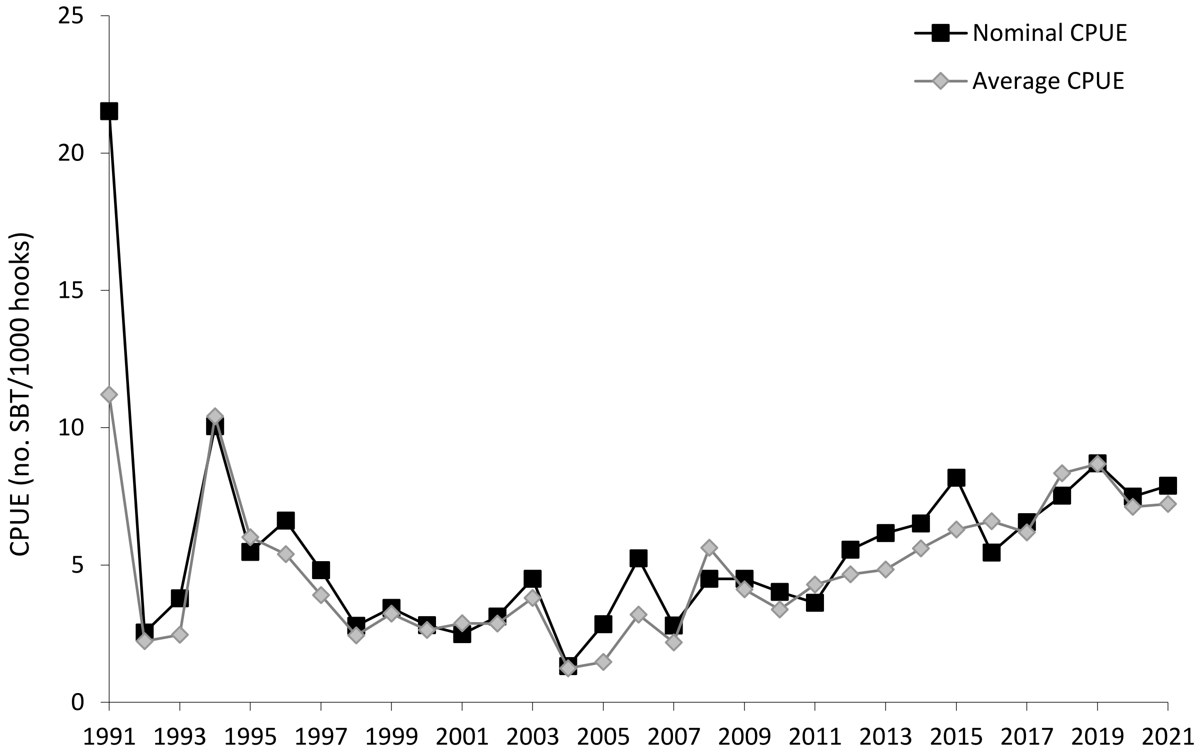


3.1.2 Korean longline CPUE

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. 15). 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 2021, both series increased slightly and remain very similar.

Figure 15. 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. 16, 17). 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 increases in areas 2, 14 and 15 and areas 8 and 9 in 2021 (Fig. 16). Catch rates in 2021 were highest in areas 2, 14 and 15 south. Catch rates in the north section of 2, 14 and 15 increased in 2021, although the overall catch and effort were very small.(Fig. 17). 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 relatively stable in 2021 (Fig 18).

Figure 16. 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.

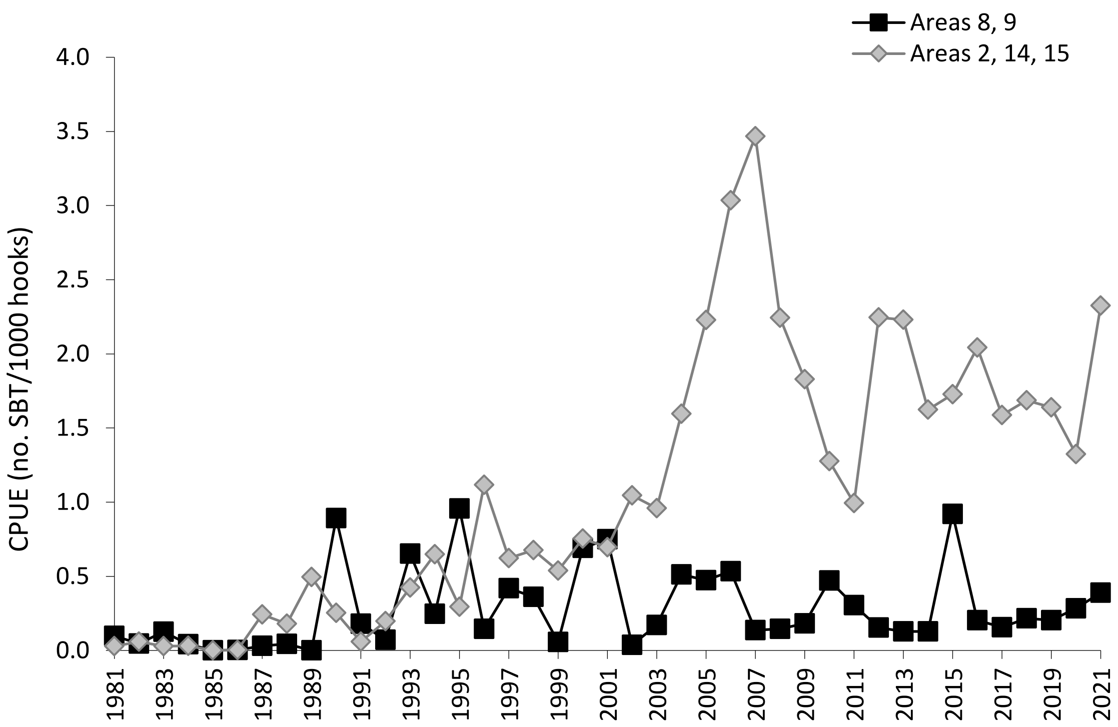


Figure 17. Nominal CPUE of SBT for Taiwanese longliners operating in statistical areas 2, 14 and 15 (pooled) by 5° latitudinal strips: South = 30–35°S; Middle = 25–30°S; North = 20–25°S. Nominal CPUE in areas 8 and 9 (pooled) shown for comparison. Data are from months 4-9 only.

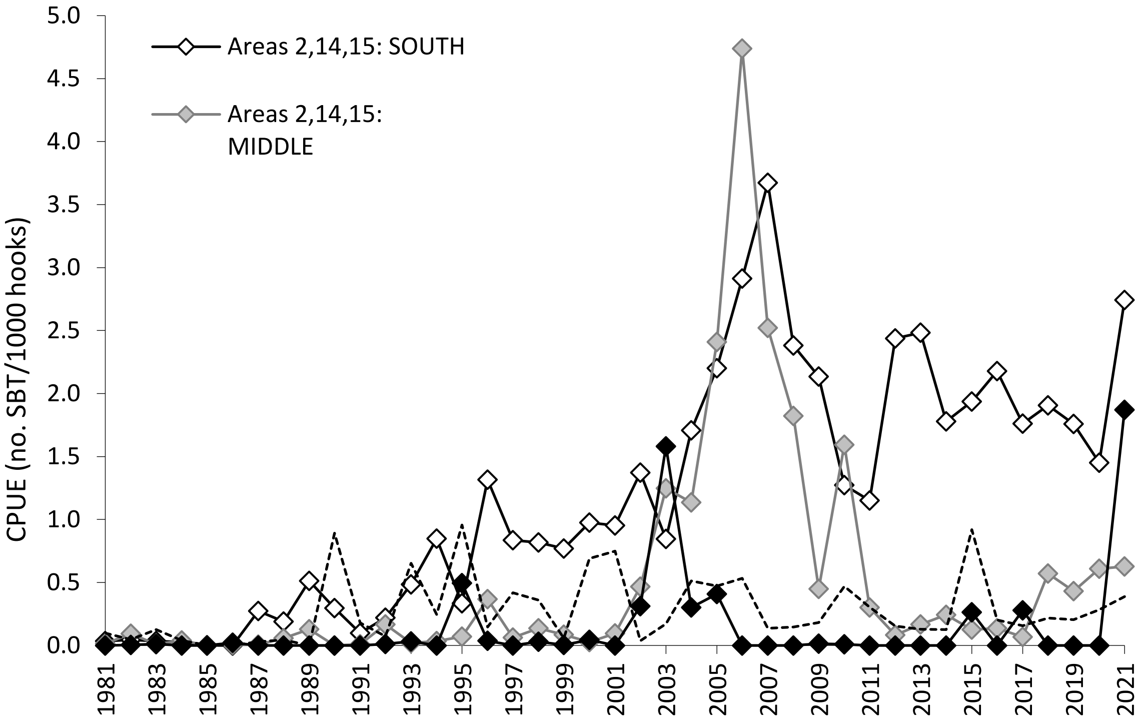
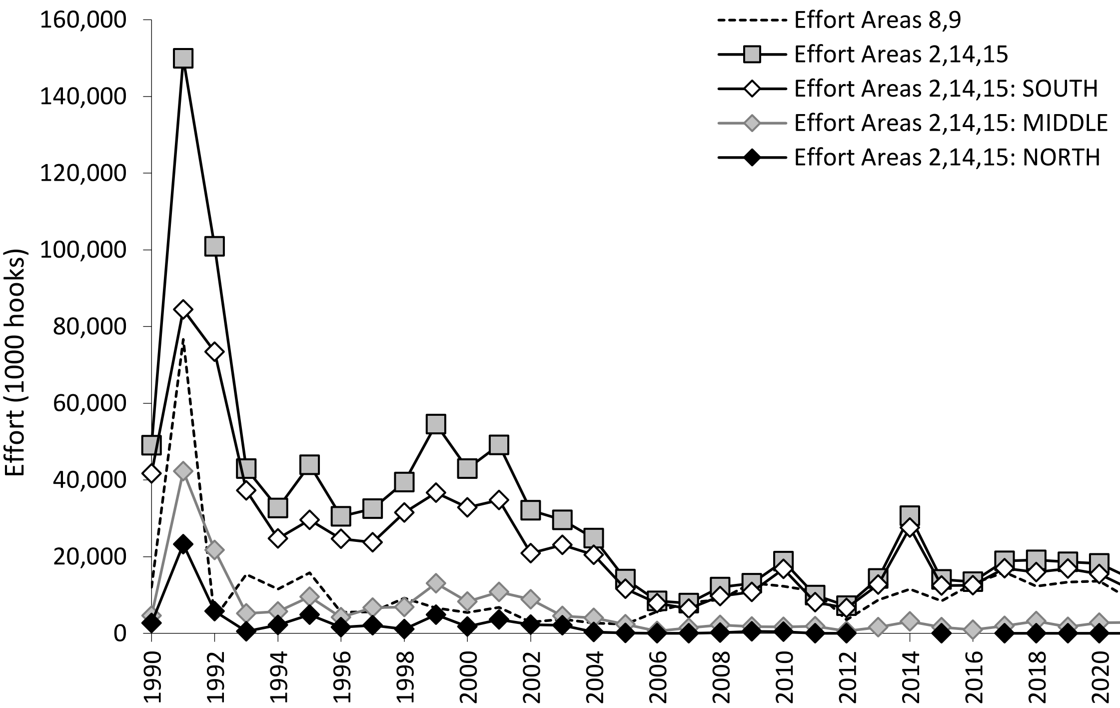


Figure 18. Effort (1000 hooks) from Taiwanese longliners in statistical areas 8 & 9 (pooled) and 2, 14 and 15 (pooled). Areas 2, 14 and 15 are also separated into 5° latitudinal strips: South = 30–35°S; Middle = 25–30°S; North = 20–25°S. Data are from months 4–9 only.



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 three oldest age classes examined here increased in 2021, while the youngest age class remained near zero (Fig. 19).

Trends in size composition of < 126 cm indicate the proportion of all the size classes, except the largest, increased in 2021; the smallest size class remained near zero (Fig. 20).

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

Figure 19. 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.

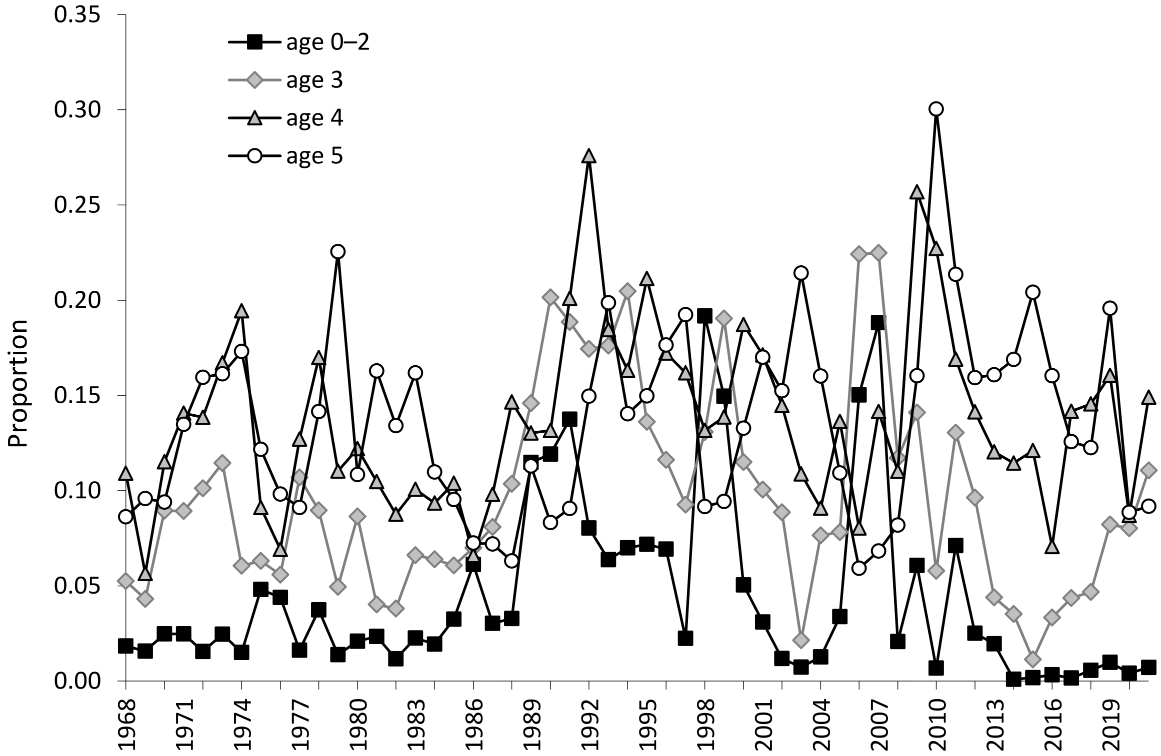
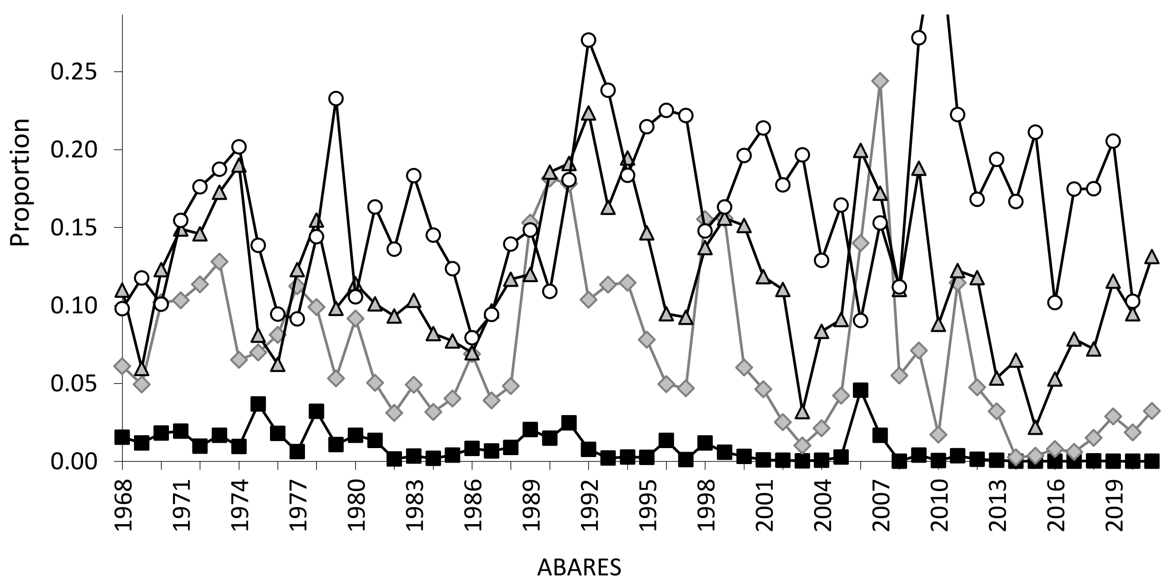


Figure 20. Size composition (proportion of total catch) of juvenile SBT caught by Japanese longliners in statistical areas 4–9, months 4–9, where age 0–2≤86 cm, 86<age 3≤102 cm, 102<age 4≤114 cm, 114<age 5≤126 cm.



3.2.2 Taiwanese longline fishery size/age composition

Size composition data for SBT caught by Taiwanese longliners were obtained from the 2021 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

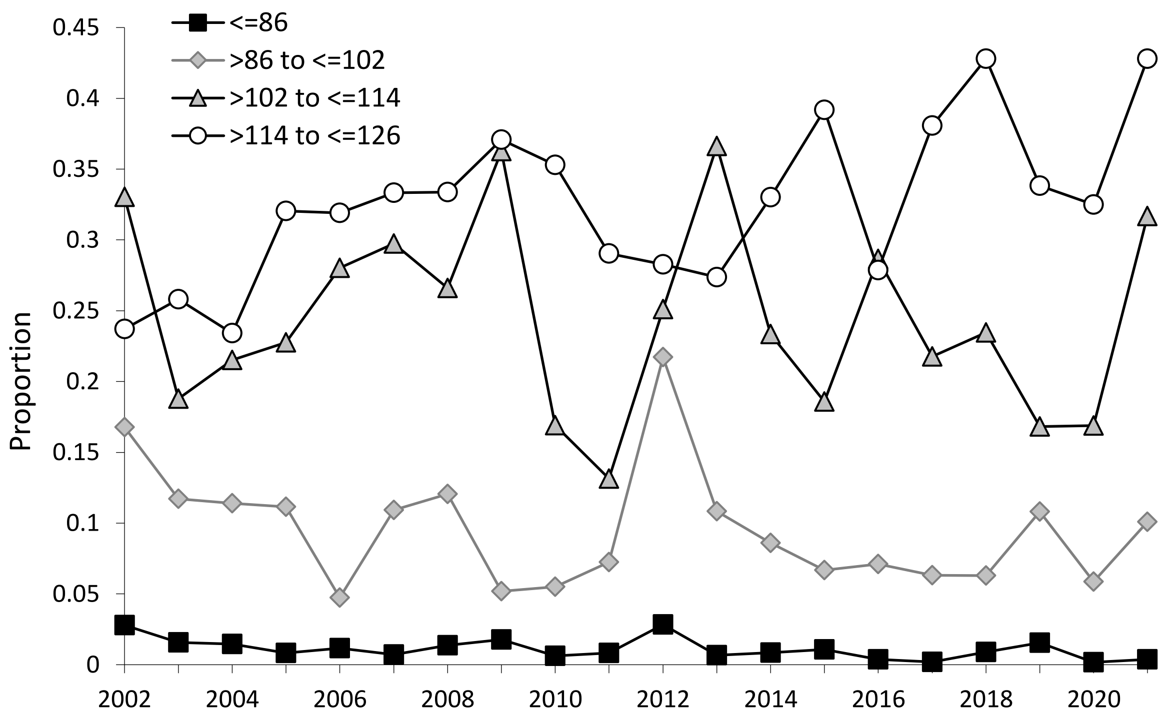
>86 to ≤102 cm: age 3

>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 2021, proportions of all size classes increased, except for the smallest size class, which remained near zero (Fig. 21).

Figure 21. 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.

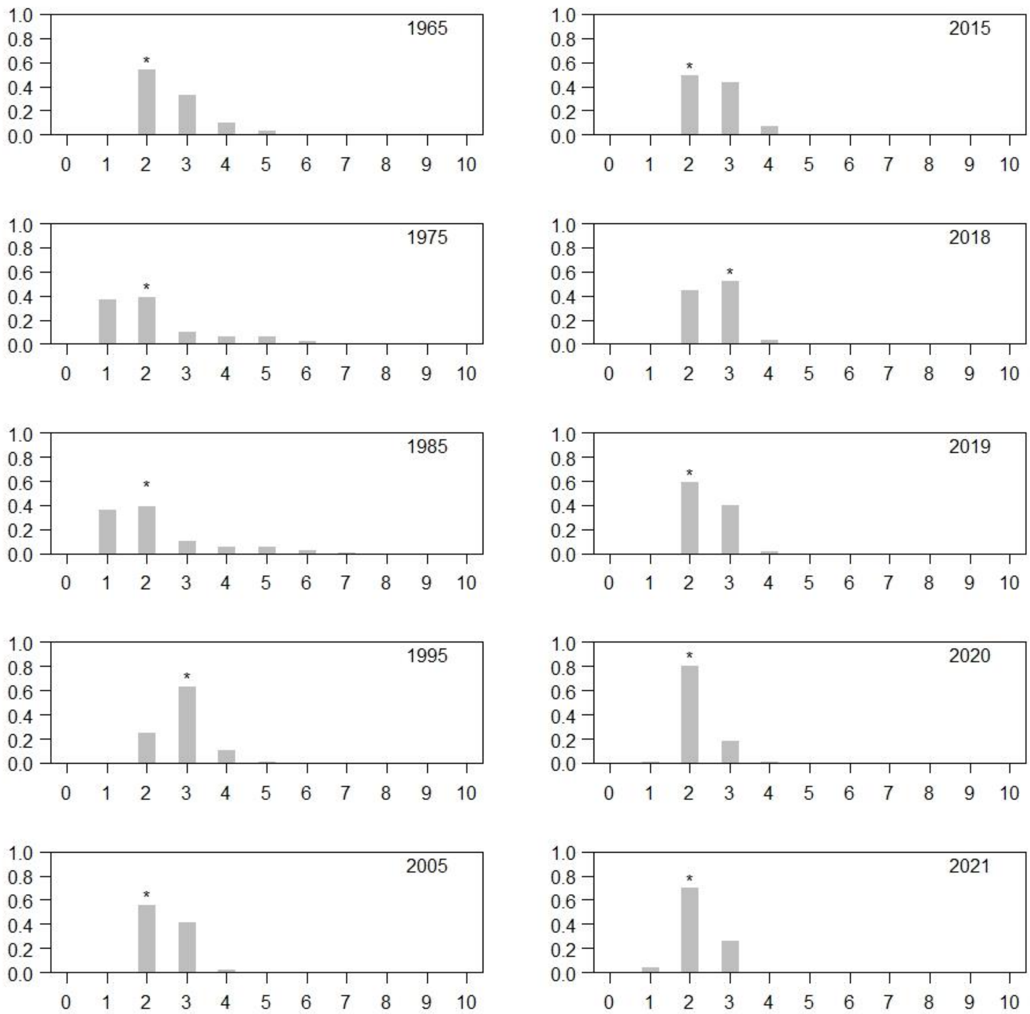


3.2.3 Australian surface fishery age composition

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_2021). 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. 22). These two age classes have historically comprised around 90% of the catch. In 2021, the 2 and 3-year old age classes accounted for about 96% of the catch.

Figure 22. 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.	2018	2019	2020	2021	2022	12 -month trend
Trolling index (piston line)	1996–2003 2005–06 2006–22	0.00 (2018, 2019)	5.09 (2011)	0.00	0.00	1.72	-–	0.887	-–
Trolling index (grid)	1996–2022	0.26 (2002)	1.77 (2011)	0.655	0.375	0.779	0.416	0.551	↑
Gene tagging	2016–19	1.15 (2017)	2.27 (2016)	1.11	1.52	-–	-–		-–
NZ domestic standardised CPUE	2003–2021	0.355 (2006)	2.99 (2016)	2.25	1.21	1.94	2.45		↑
NZ domestic age/size composition (proportion age 0–5 SBT)*	1980–2020	0.001 (1985)	0.48 (2017)	0.33	0.27	0.24	0.25		↑
Indonesian mean size class**	1993–2019	156 (2016)	188 (1994)	161.9	161.1	-–	-–		-–
Indonesian age composition:** mean age on spawning ground, all SBT	1994–2019	11.8 (2016)	21.2 (1995)	13.4	13.2	-–	-–		-–
Indonesian age composition:** mean age on spawning ground 20+	1994–2019	21.3 (2016)	25.3 (2004)	23.1	22.4	-–	-–		-–
Indonesian age composition:** median age on spawning ground	1994–2019	11.5 (2017)	21 (1994–95; 1996–97; 1998–99)	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.	2018	2019	2020	2021	12-month trend
Japanese nominal CPUE, age 4+	1969–2021	1.338 (2006)	22.123 (1965)	6.001	7.698	6.515	7.542	↑
Japanese standardised CPUE, age 4+ (new GAM series)	1969–2021	0.38 (2006)	2.43 (1969)	1.82	2.11	1.52	1.49	↓
Korean nominal CPUE	1991–2021	1.312 (2004)	21.523 (1991)	7.518	8.702	7.487	7.879	↑
Taiwanese nominal CPUE, Areas 8+9	1981–2021	<0.001 (1985)	0.956 (1995)	0.217	0.204	0.283	0.388	↑
Taiwanese nominal CPUE, Areas 2+14+15	1981–2021	<0.001 (1985)	3.672 (2007)	1.686	1.638	1.324	2.325	↑
Japanese age comp, age 0–2*	1969–2021	0.004 (1966)	0.192 (1998)	0.006	0.009	0.004	0.007	↑
Japanese age comp, age 3*	1969–2021	0.011 (2015)	0.228 (2007)	0.047	0.082	0.080	0.111	↑
Japanese age comp, age 4*	1969–2021	0.091 (1967)	0.300 (2010)	0.145	0.160	0.087	0.149	↑
Japanese age comp, age 5*	1969–2021	0.072 (1986)	0.300 (2010)	0.123	0.196	0.089	0.092	↑
Taiwanese age/size comp, age 0–2*	1981–2021	<0.001 (1982)	0.251 (2001)	0.009	0.015	0.002	0.004	↑
Taiwanese age/size comp, age 3*	1981–2021	0.024 (1996)	0.349 (2001)	0.063	0.108	0.059	0.101	↑
Taiwanese age/size comp, age 4*	1981–2021	0.027 (1996)	0.502 (1999)	0.234	0.168	0.169	0.317	↑
Taiwanese age/size comp, age 5*	1981–2021	0.075 (1997)	0.428 (2018)	0.428	0.338	0.325	0.428	↑
Australia surface fishery median age composition	1964–2021	age 1 (1979–80)	age 3 (multiple years)	age 3	age 2	age 2	age 2	-–

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

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