



Australian Government
**Department of Agriculture
and Water Resources**
ABARES

Fisheries indicators for the southern bluefin tuna stock 2016–17

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Research by the Australian Bureau of Agricultural
and Resource Economics and Sciences

August 2017



Working Paper CCSBT-ESC/1708/13 prepared for the CCSBT
Extended Scientific Committee for the 22nd Meeting of the Scientific
Committee

28 August–2 September 2017, Yogyakarta, Indonesia

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Cataloguing data

Patterson, H, Helidoniotis, F & Nicol, S 2017, *Fisheries indicators for the southern bluefin tuna stock 2016–17*, ABARES, Canberra, August. CC BY 3.0.

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Acknowledgements

The authors thank Patty Hobsbawn (ABARES) and Jessica Farley (CSIRO) for their assistance in preparing this report. Contributions by the authors were funded by ABARES and the Fisheries Resources Research Fund.

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Summary

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) and its trilateral predecessor.

In 2001, it was agreed to monitor and review fishery indicators on an annual basis and fishery indicators are included in the development of the Scientific Committee's advice on status of the stock. Fishery indicators are particularly important in years where the stock assessment has not been updated.

In 2011, the Commission agreed on the Management Procedure (MP) that would be used to guide the setting of the SBT global total allowable catch (TAC) to ensure that the SBT spawning stock biomass achieves the interim rebuilding target of 20 per cent of the original spawning stock biomass. The review of fishery indicators forms part of the MP's metarule process to determine whether exceptional circumstances exist.

The 2016–17 update of fishery indicators for the SBT stock summarises 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. Data collected in the longline fisheries after 2006 are unlikely to be affected by unreported catches because of the catch documentation activities that have been undertaken by CCSBT members, and therefore only the historical data and some standardised indicators are possibly affected.

In this paper, interpretation of indicators is limited to subset 1, and recent trends in some indices from subset 2. Two indicators of juvenile (age 1–4) SBT abundance (i.e. scientific aerial survey index and the trolling index) were undertaken in 2017. Both the scientific aerial survey and trolling index decreased since the last update. Indicators of age 4+ SBT exhibited mixed trends with the catch per unit effort (CPUE) from the New Zealand domestic longline fishery increasing in 2016. In contrast, the Japanese longline nominal CPUE for ages 4+ decreased, as did the standardised CPUE series. The mean length of SBT has generally decreased since 2011, although it increased slightly 2016–17 compared to the previous seasons. There remains a strong need to understand the location of the small SBT catches. The median age of SBT decreased in 2016.

1 Background

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 10, ESC18).

Indicators can provide a broad perspective on recent changes in the status of the SBT stock and include some information that is not otherwise incorporated into model-based assessments. In particular, some indicators reflect the status of the juvenile portion of the stock and represent the only fisheries-independent data available to the ESC.

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 2016–17 update of fishery indicators for the SBT stock summarises indicators in the same groups presented in previous updates in 2007 to 2016 (Hartog et al. 2007, Hartog & Preece 2008, Phillips 2009, Patterson et al. 2010, 2011, 2012, 2013, Patterson & Stobutzki 2014, 2015, Patterson et al. 2016), although the paper has been streamlined and indicators that are no longer relevant (i.e. SAPUE, NZ charter fleet indicators) or that are not considered useful have been deleted. Global catch has also been removed as these data are provided by the Secretariat. The updated list of indicators explored here includes:

(1) Indicators unaffected by the unreported catch:

- Scientific aerial survey in the Great Australian Bight
- Trolling index
- New Zealand catch per unit effort (CPUE; charter and domestic fleets)
- New Zealand longline fishery size composition (charter and 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.

In this paper, the interpretation of indicators is restricted to the subset (1) considered to be unaffected by the unreported catch, and recent trends in some indicators from subset 2. This paper updates the information provided by Patterson et al. (2016) with the most recent data available through the CCSBT data exchange in June 2017.

2 Indicators unaffected by unreported catch

Scientific aerial survey

The 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 and 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 historic trend in the scientific aerial survey index and the spatial distribution of sightings is discussed fully in Eveson and 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.

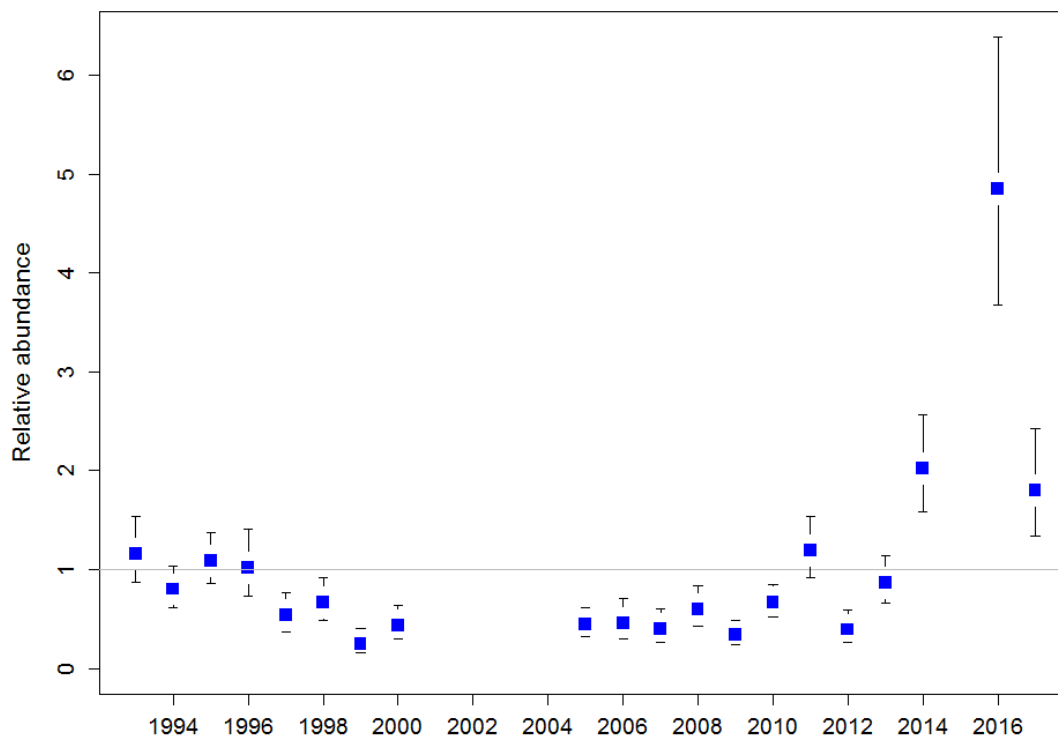


Figure 1. Scientific aerial survey of relative abundance for juvenile SBT in the Great Australian Bight, January–March (hence the 2014 value represents the 2013–14 fishing season etc) from Eveson and Farley (2017). Vertical lines are 90 per cent confidence intervals. The horizontal line represents a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

Trolling index

The trolling survey index was updated in 2017 from data provided by Japan through the CCSBT data exchange (JP_Trollindex2017). No trolling survey was conducted in 2015.

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 rough recruitment index at low cost (Itoh et al. 2013). The ESC 2015 identified research needed if the index was to be considered for the MP in future (CCSBT-SC 2015). The trolling index is comprised of: (1) a piston-line trolling survey, 2006–14; (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). However, in 2013 the index increased to just below the average median value and declined slightly in 2014. In 2016, the index was above the average median value, but declined in 2017 to a value close to that in 2012.

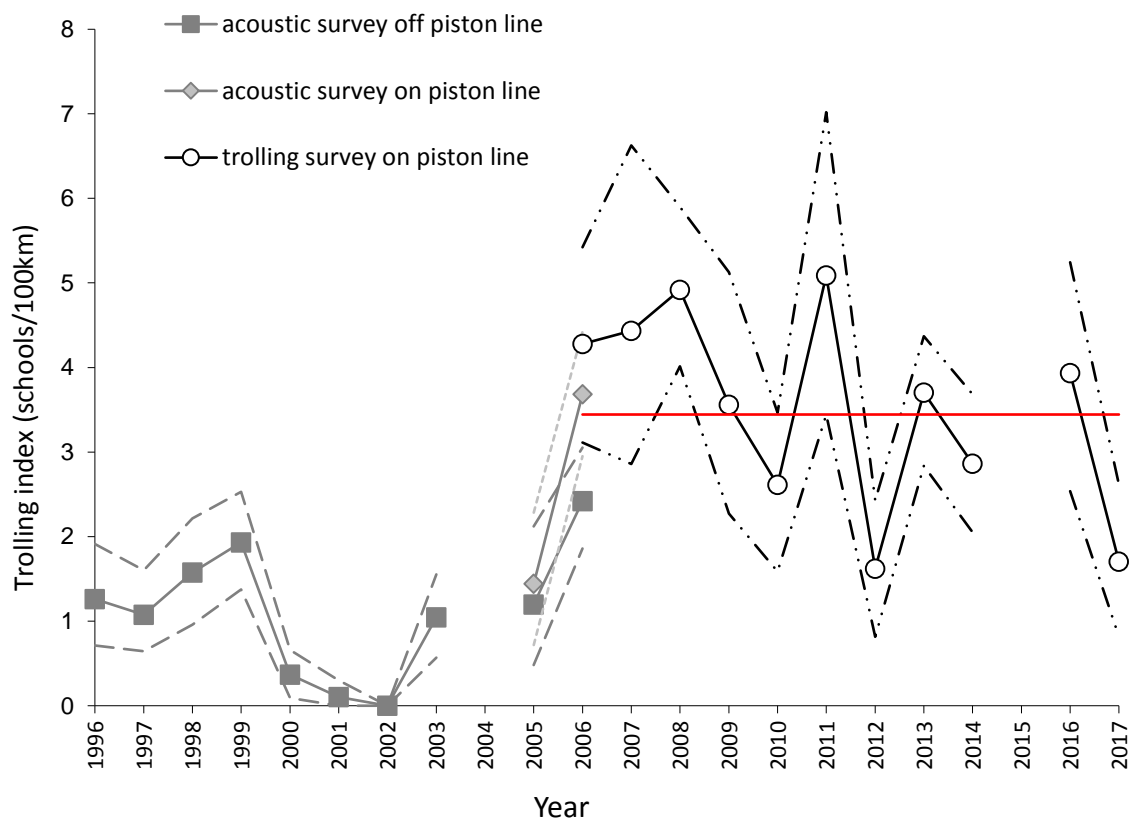


Fig. 2. Trolling index, showing number of schools per 100 km off the Western Australian coast in January. Dashed lines are 90 per cent confidence intervals. The red line shows the average median value of the piston line survey from 2007–17.

Catch per unit effort

New Zealand domestic longline CPUE

The NZ domestic nominal CPUE was updated from aggregated catch and effort data provided in the 2017 interim update of the CCSBT database. The CPUE series has been compiled for longline vessels only; the handline/troll fishery virtually disappeared in the 1990s. The NZ domestic nominal CPUE is aggregated across all age classes and all catch, irrespective of target species. The observer coverage in the NZ domestic fishery is lower than in the NZ joint venture fishery (CCSBT-ESC/1509/SBT Fisheries - New Zealand). With the increase in TAC to NZ in recent years, the domestic fishery catches have more than doubled since 2008–09.

Overall, catch rates in the NZ domestic fishery have increased over the last decade, with a sharp increase seen since 2007 (Fig 3). There was a marked increase in 2014, with a smaller increase in 2015 and another sharp increase in 2016. This nominal CPUE does not take into account any fleet or operational changes. CCSBT-ESC/1409/SBT Fisheries - New Zealand notes that due to changes in the domestic fleet structure and the "Olympic system" under which the NZ fishery operated prior to 2004, trends in the domestic fishery CPUE may not provide reliable information on trends in the vulnerable biomass.

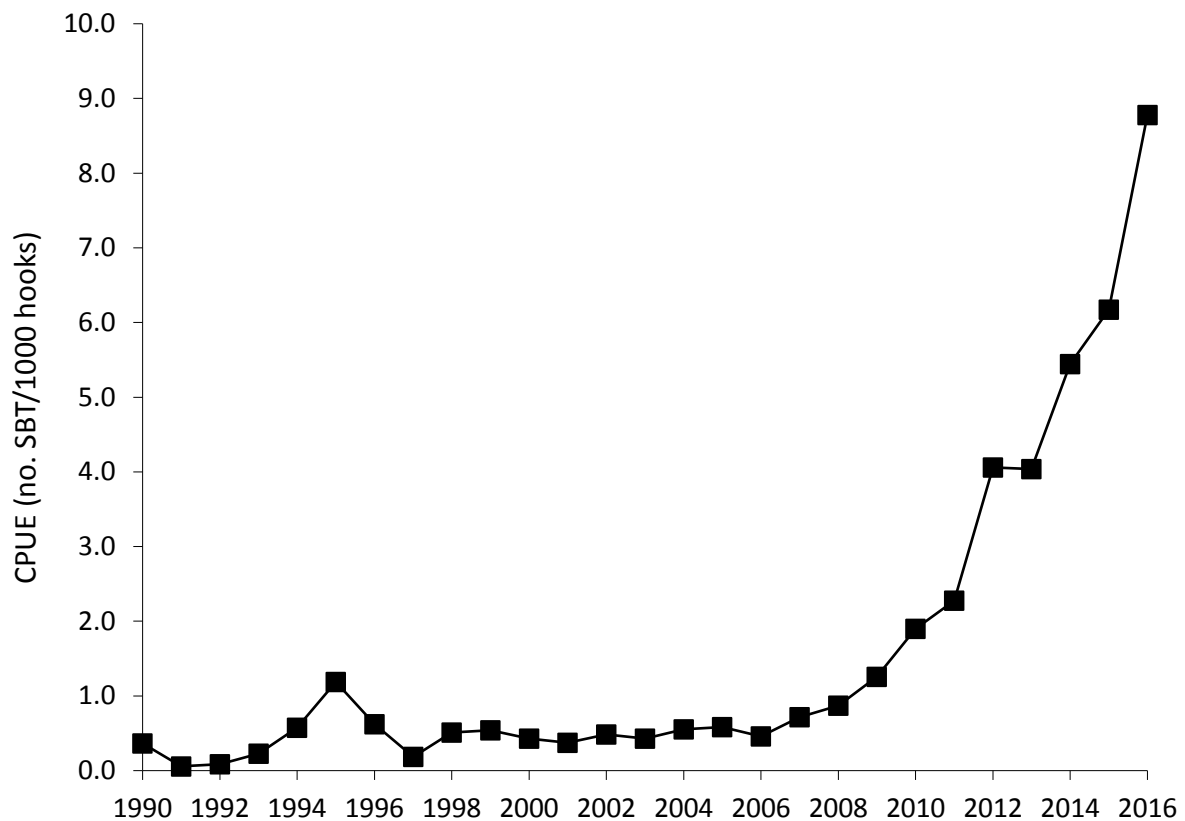


Fig. 3. Nominal CPUE (number per 1000 hooks) for the NZ domestic longline fishery.

Catch size/age composition

New Zealand 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 (Figs. 6 & 7). In the NZ domestic fishery, juvenile fish aged less than 6 years have comprised on average 18 per cent of the catch, although size composition is not as well estimated for this fleet as for the charter fleet. All size composition data for the charter fishery are derived from longline vessels. 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, recent spikes in the landing of age 3 SBT (2006 and 2010) (Fig. 4). The abundance of the juvenile age classes declined in 2003 and 2004 and has been variable since that time. The three oldest age classes increased in 2016 (Fig. 4), the age 4 class in particular. The 0–2 age class, which has been virtually zero throughout the time series, remained near zero.

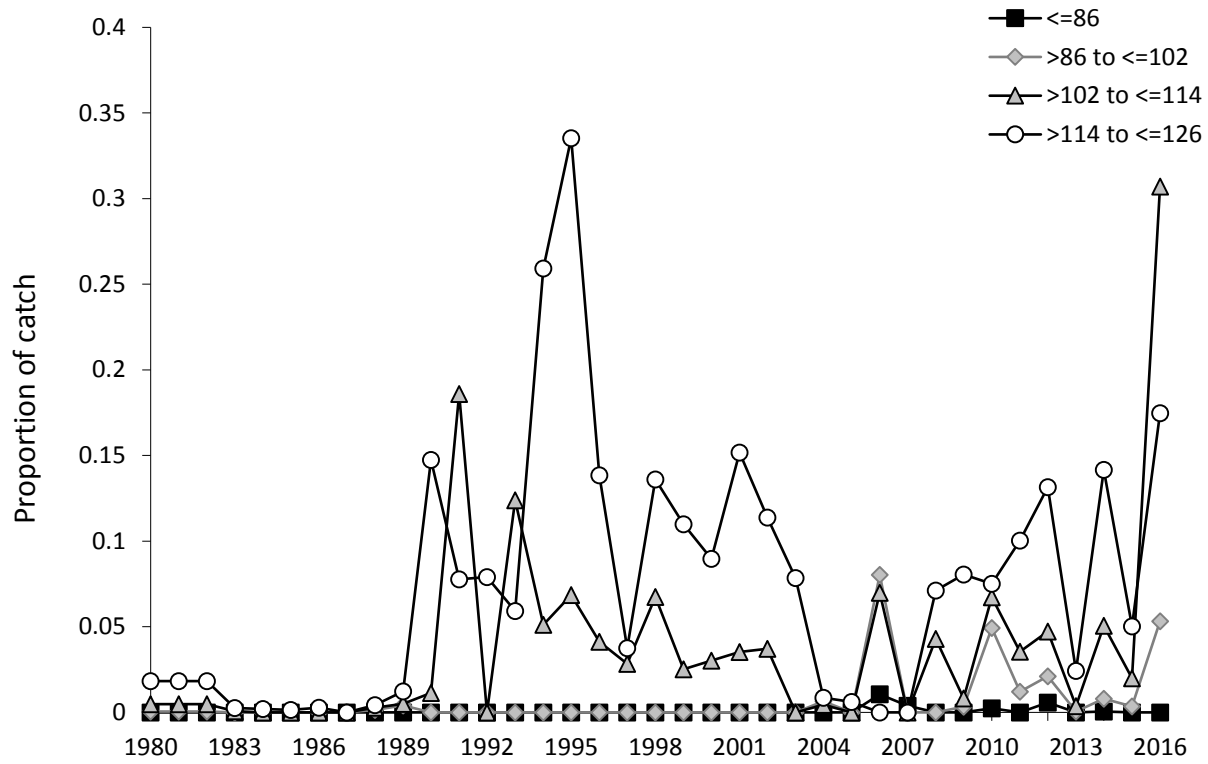


Fig. 4. Size composition of juvenile fish (< 6 years) for the NZ domestic longline fishery, where age $0-2 < 86$ cm, $86 < \text{age} 3 \leq 102$ cm, $102 < \text{age} 4 \leq 114$ cm, $114 < \text{age} 5 \leq 126$ cm.

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 data for the 2016–17 season and the age data for 2015–16 season were provided in 2017 (Farley et al. 2017).

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 (Fig. 1, Fig. 2; Farley et al. 2017). The mean size class decreased from 170 cm in 2011–12 to 162 cm in 2016–17.

There was also an increase in the catch of young SBT (7–10 years) in 2012–13 (Fig. 4; Farley et al. 2017). The mean age of SBT on the spawning ground decreased substantially from 16.8 years in 2011 to 13.8 years in 2016. The median age has also decreased from 17.5 years in 2011 to 12.5 in 2016.

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 collected 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.

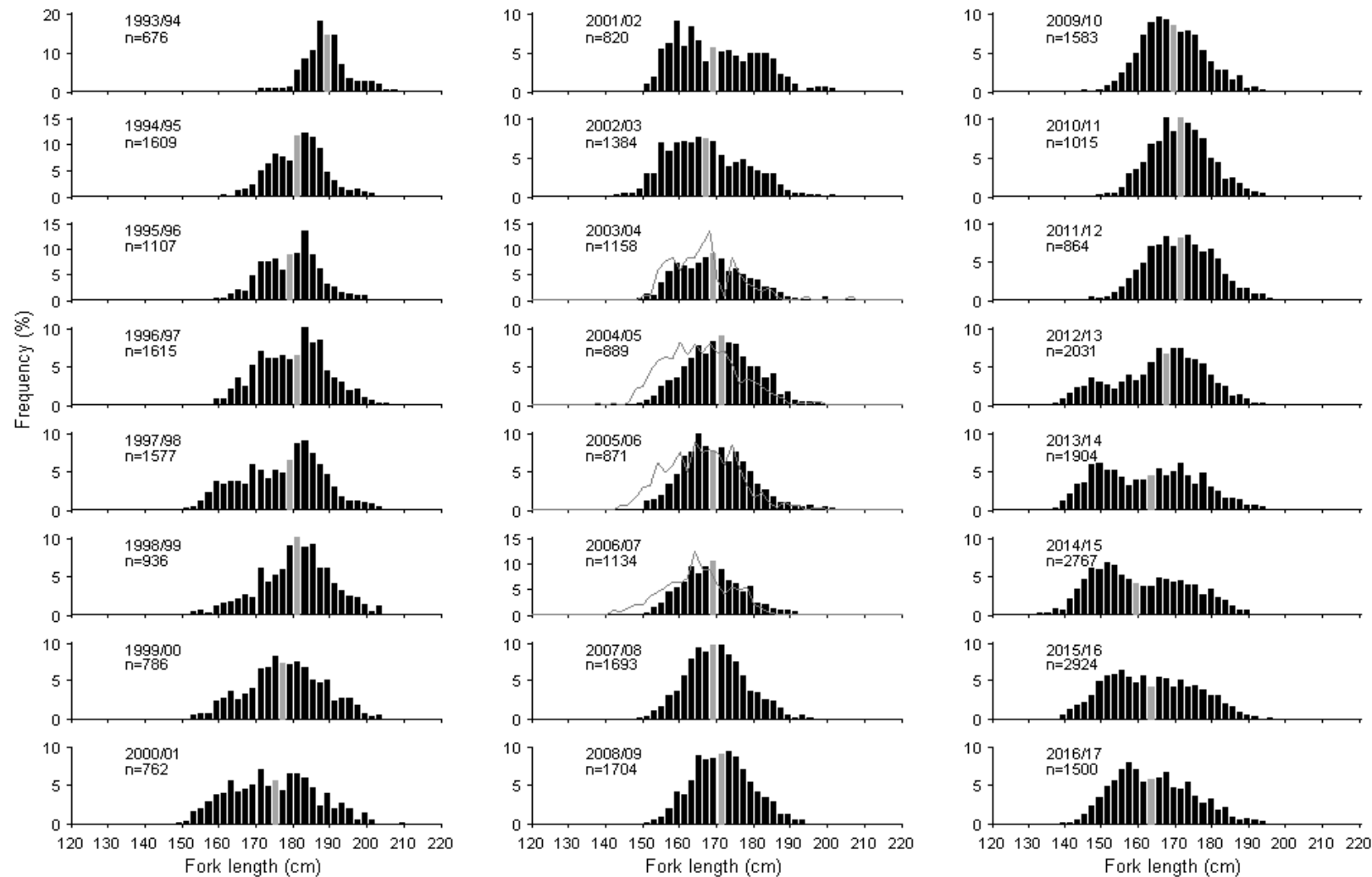


Fig. 5. Length frequency (2 cm intervals) of SBT caught on the spawning ground (bars) by spawning season (Farley et al. 2017). The grey bar shows the median size class. For comparison, the length distribution of SBT thought to be caught south of the spawning ground (Processor A) is shown for the 2003/04 (n=121), 2004/05 (n=685), 2005/06 (n=311) and 2006/07 (n=452) seasons (grey line) (see Farley et al. 2007). Note that 36 fish <120 cm are not show and the data for 2016/17 are preliminary.

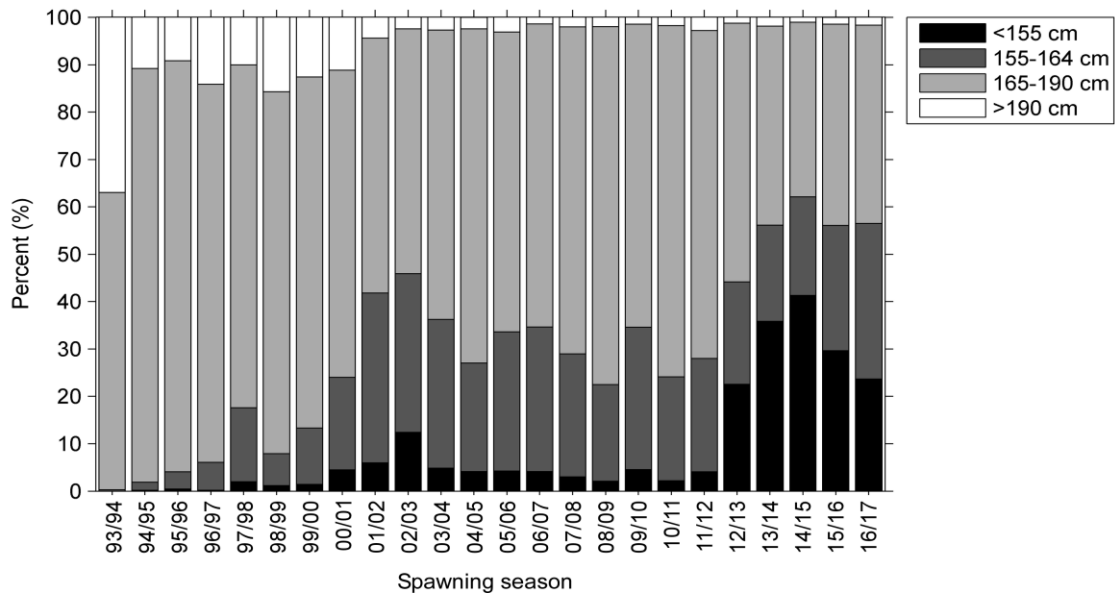


Fig. 6. Size composition of SBT caught on the spawning grounds by the Indonesian longline fishery by spawning season (from Farley et al. 2017). Data from Processor A are excluded.

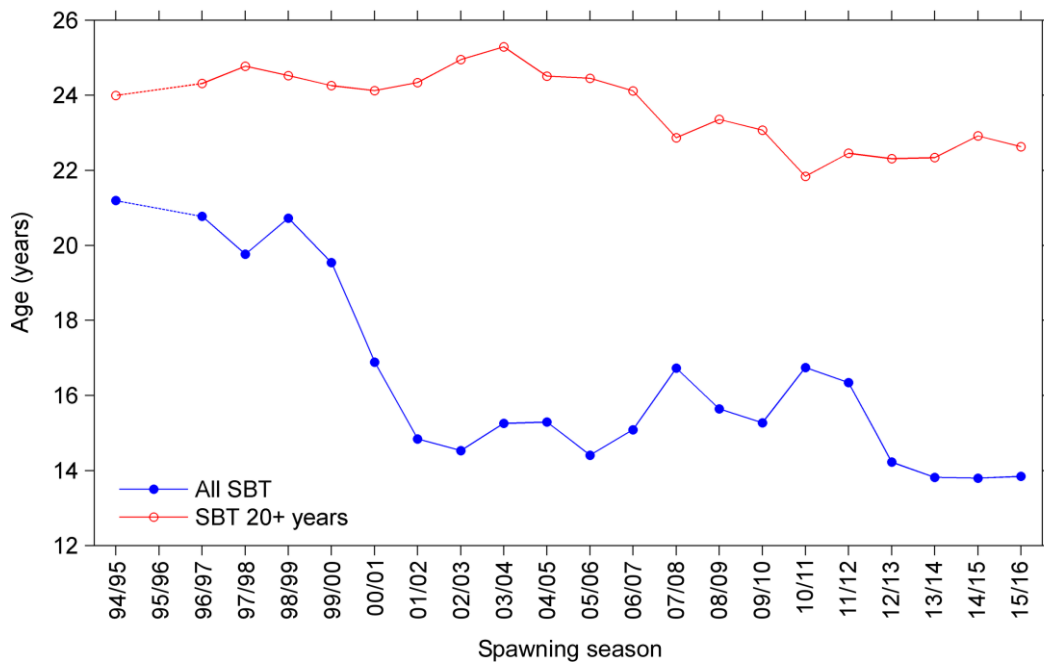


Fig. 7. Mean estimated age (years) of SBT caught on the spawning grounds by Indonesian longliners (from Farley et al. 2017). Data from Processor A are excluded. Note that there are no age data for the 1995–96 season.

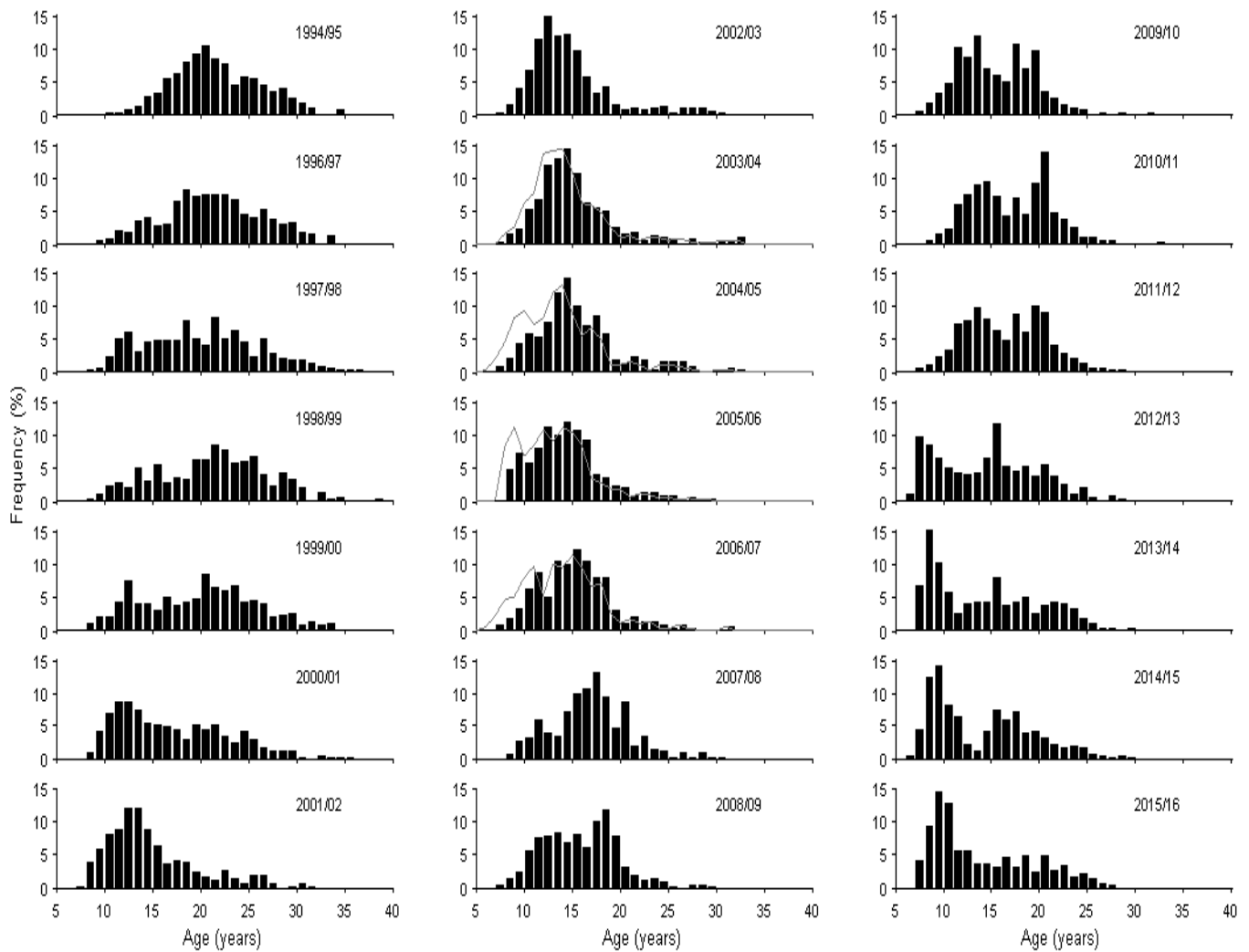


Fig. 8. Age frequency distribution of SBT in the Indonesian catch on the spawning ground by spawning season estimated using age-length keys from our sub-samples of direct aged fish and length frequency data obtained through the Indonesian monitoring program (Farley et al. 2017). There was no direct ageing 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 be 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 in 2017, but it is recommended that their interpretation be treated with caution. 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.

Catch per unit effort (CPUE)

Japanese longline CPUE

Nominal CPUE series for Japanese longliners was extracted from the CPUE input data provided in the CCSBT data exchange (SEC_CPUEInputs_65_16_revised). Other effort series (e.g. number of squares fished) were derived from the same data. Standardised CPUE series were obtained from updates provided by Japan (JP_CPUE_w05_08_for_monitoring_2017SC and JP_CorevesselCPUE_6916) 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). In addition, reductions in the Japanese total allowable catch (TAC) have been in place since 2006 and there have been increases in reported discarding. 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). The nominal CPUE in the most recent years (since 2006) is not likely to be affected by unreported catches because of new catch documentation methods. The standardised CPUE series are still potentially affected, and should be interpreted with caution.

The following updates for 2016 have been compiled:

- 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 2016 declined slightly but is above the recent 10 years (2007–16) mean (Fig. 9, horizontal line).
- Nominal CPUE for age 4–7, 8–11 and 12+ SBT. The nominal CPUE series in 2016 for ages 4–7 and 8–11 decreased slightly. The CPUE of age 12+ SBT has remained low with little variability since the early 1970s (Fig. 10).
- Nominal CPUE for age 0–2, 3, 4 and 5 SBT. In 2006 and 2007, the age composition of juvenile SBT became dominated by age 3 SBT, with an increase of a similar scale apparent in age 0–2. However, relative proportions of both age 0–2 and 3 dropped markedly in 2008. Age 4 and 5 SBT are the dominant year classes in the juveniles in 2016, with a decrease in both in 2016; age 3 increased slightly in 2016 (Fig. 11).

- Standardised CPUE. The standardised and normalised monitoring CPUE series from all vessels (W0.5, W0.8) exhibited decreases in 2016, as did the normalised series from the core vessels (Base W0.5 and Base W0.8) (Fig. 12).

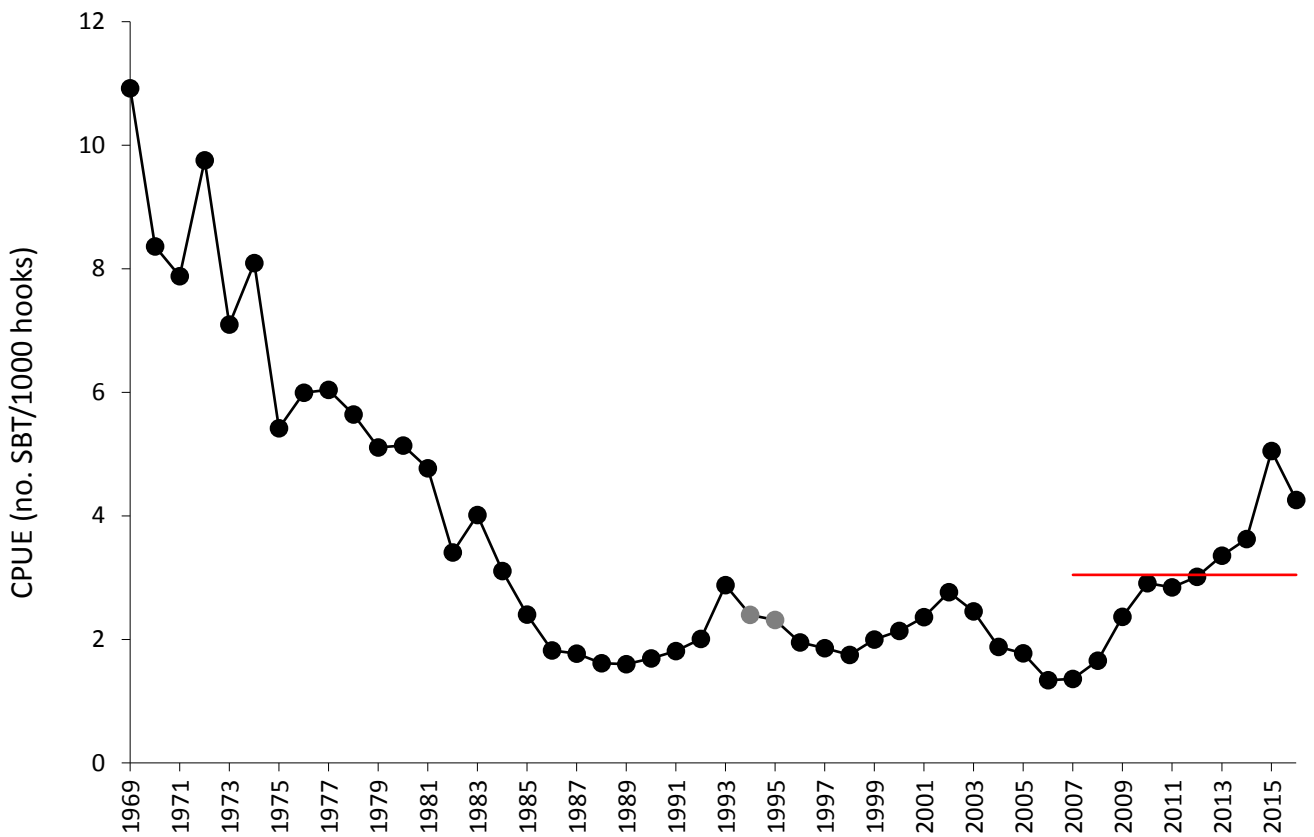


Fig. 9. Nominal CPUE of age 4+ SBT for Japanese longliners operating in statistical areas 4–9 in months 4–9. The 1995 and 1996 values are plotted as grey circles to indicate increased uncertainty about these points due to changes in retention policies for small fish in these two years, when a policy of releasing small fish applied. The horizontal line is the 2007–16 mean.

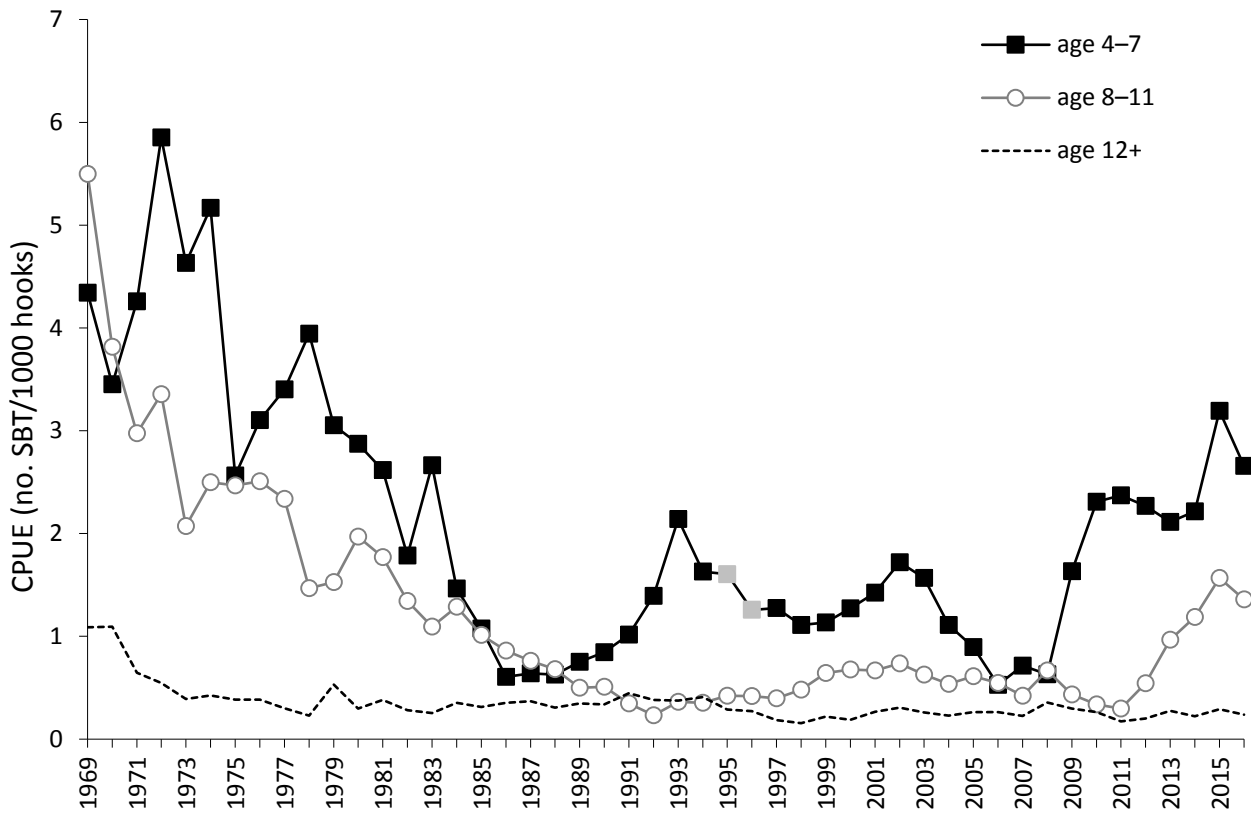


Fig. 10. Nominal CPUE of ages 4–7, 8–11 and 12+ SBT for Japanese longliners operating in statistical areas 4–9 in months 4–9. The 1995 and 1996 values for ages 4–7 are plotted as grey squares to indicate increased uncertainty about these points due to changes in retention policies for small fish in these two years.

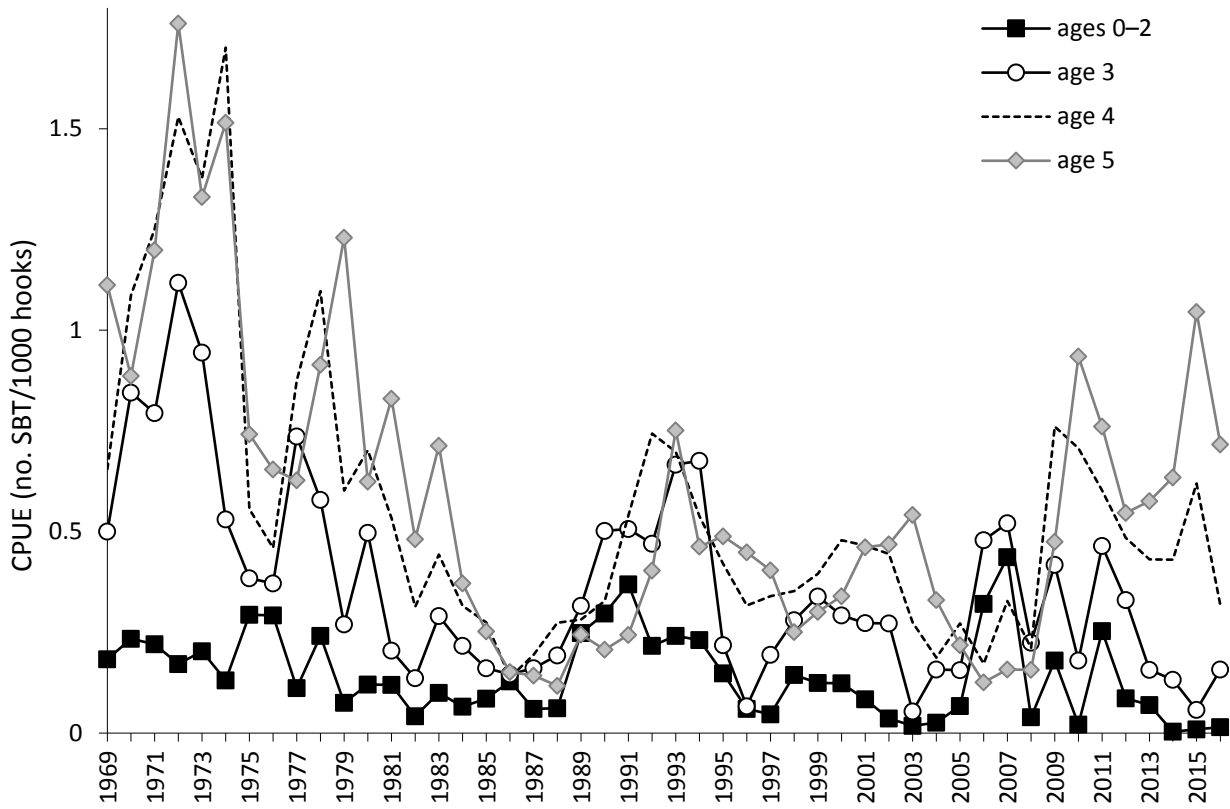


Fig. 11. Nominal CPUE of ages 0–2, 3, 4 and 5 SBT for Japanese longliners operating in statistical areas 4–9 in months 4–9.

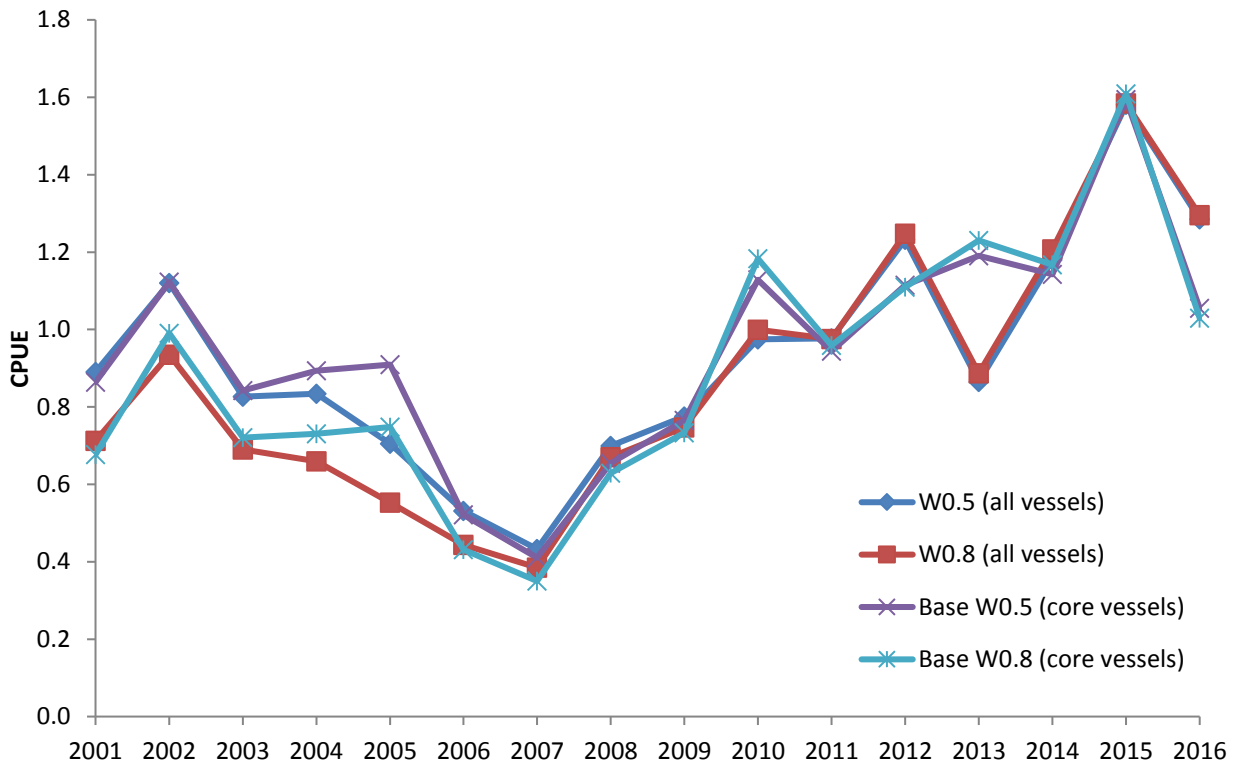


Fig. 12. Comparison of subsets of the standardised CPUE series. Each subset has been normalised by dividing by the mean.

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.

The Korean nominal CPUE has been reasonably stable since 1995, apart from very low catch rates in 2004 and 2005. The nominal CPUE decreased slightly in 2016 while the average CPUE increased slightly (Fig. 13). 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).

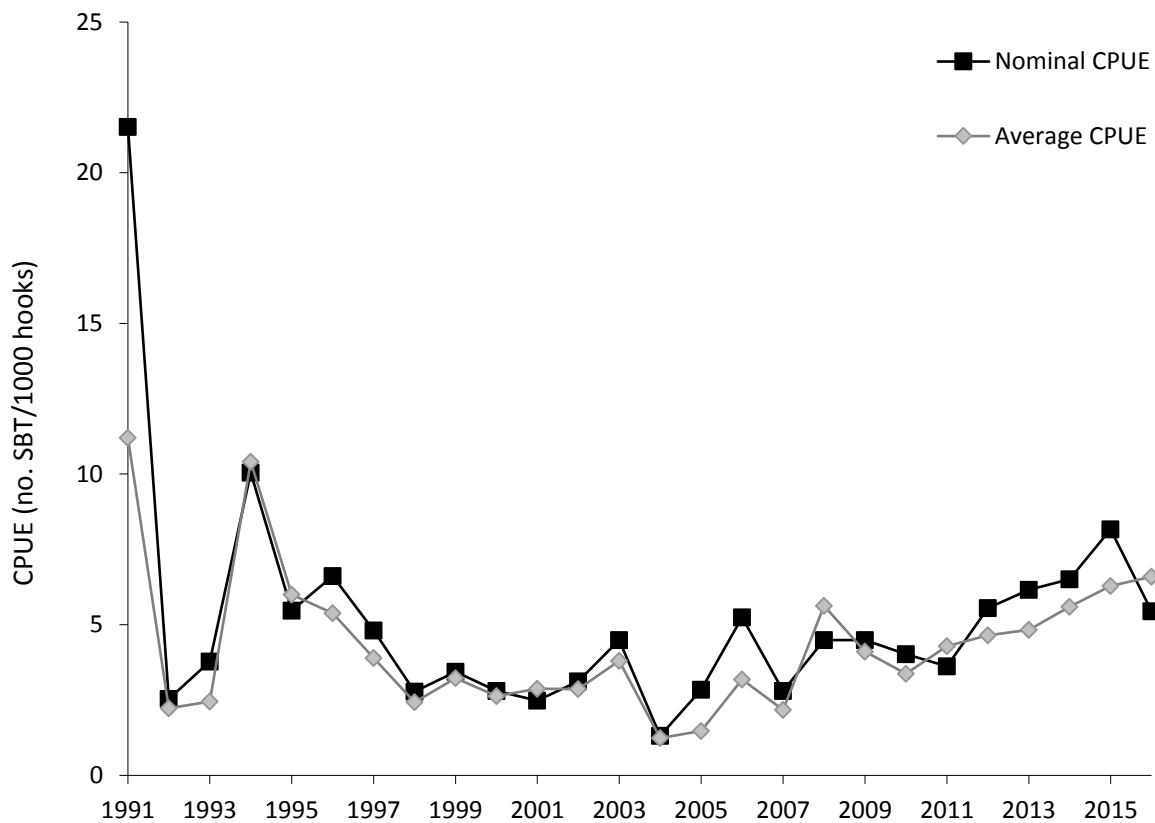


Fig. 13. Nominal and average CPUE of total SBT for Korean longliners operating in statistical areas 4–9 in months 4–9. Nominal CPUE is the total number of SBT over total effort (1000 hooks), while average CPUE is the mean of the nominal rate in each 5×5° grid square per month.

Taiwanese longline CPUE

Nominal CPUE series of Taiwanese longliners were obtained from aggregated catch and effort data provided in the 2015 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). Catches began to increase in the 1980s, then stabilised from the late 1980s, but have reduced in recent years. The Taiwanese fishery operates in both the northern fishery (areas 2, 14, 15), and the southern fishery (areas 8, 9) (Fig. 14, 15). 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 (Fig. 16).

Catch rates have fluctuated over time, with a substantial decrease in areas 2, 14 and 15 in 2015, to the lowest level since 2011 (Fig. 14). In contrast, there has been a substantial increase in the nominal catch rate in areas 8 and 9 to the highest recorded in 2015, although a decline followed in 2016 (Fig. 14). Catch rates in 2016 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. 15). 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. 14, 15; Anon 2009). Effort in areas 2, 14 and 15 in 2016 remained at levels similar to 2015, while effort in areas 8 and 9 increased (Fig 16).

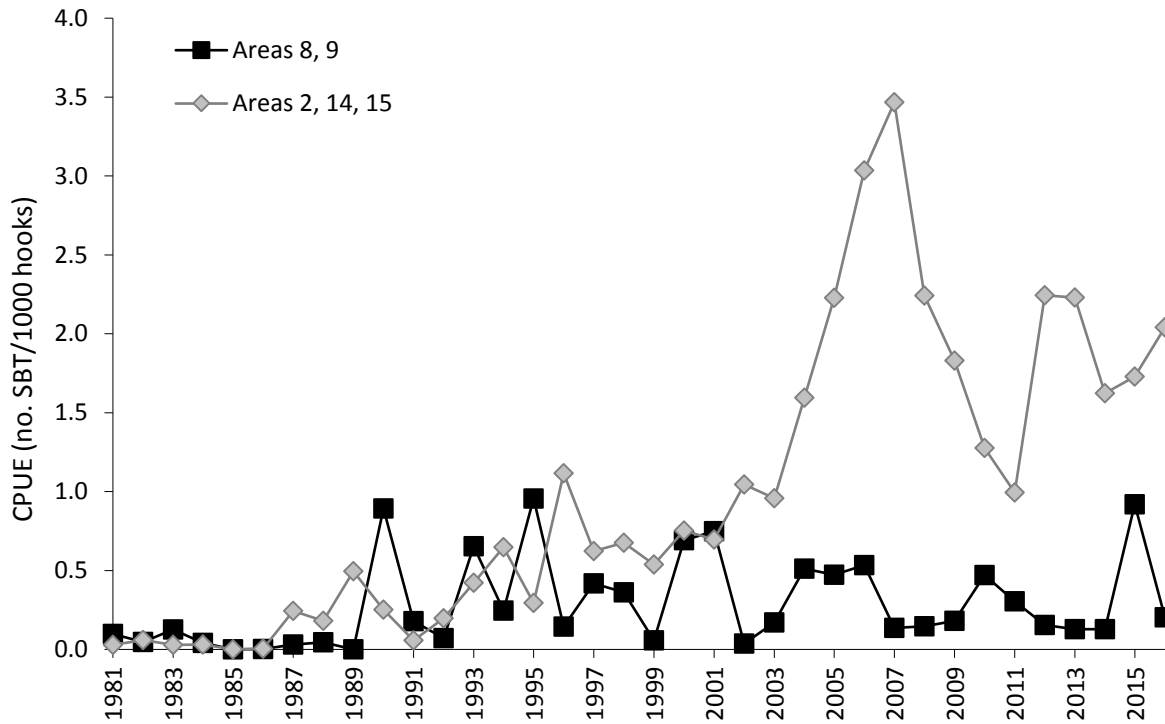


Fig. 14. Nominal CPUE of SBT for Taiwanese longliners operating in statistical areas 8 and 9 (pooled) and 2, 14 and 15 (pooled) in months 4–9.

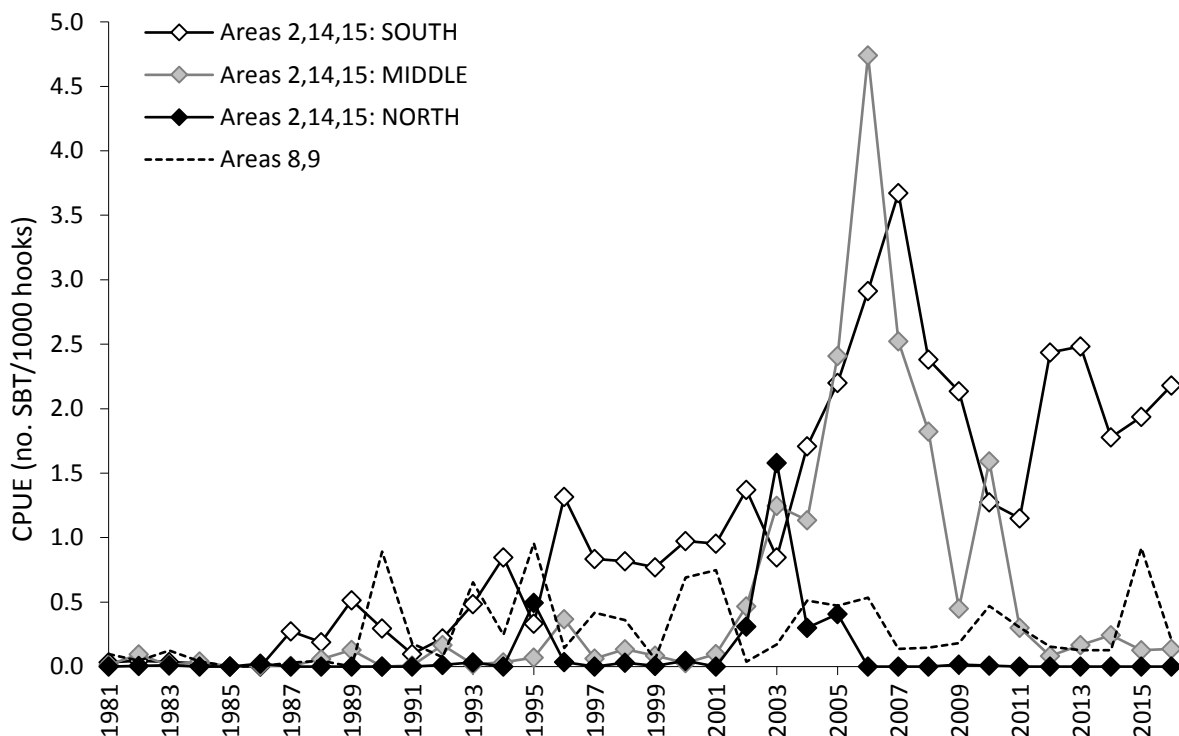


Fig. 15. Nominal CPUE of SBT for Taiwanese longliners operating in statistical areas 2, 14 and 15 (pooled) by 5° latitudinal strips: South = 30–35°S; Middle = 25–30°S; North = 20–25°S. Nominal CPUE in areas 8 and 9 (pooled) shown for comparison. Data are from months 4–9 only.

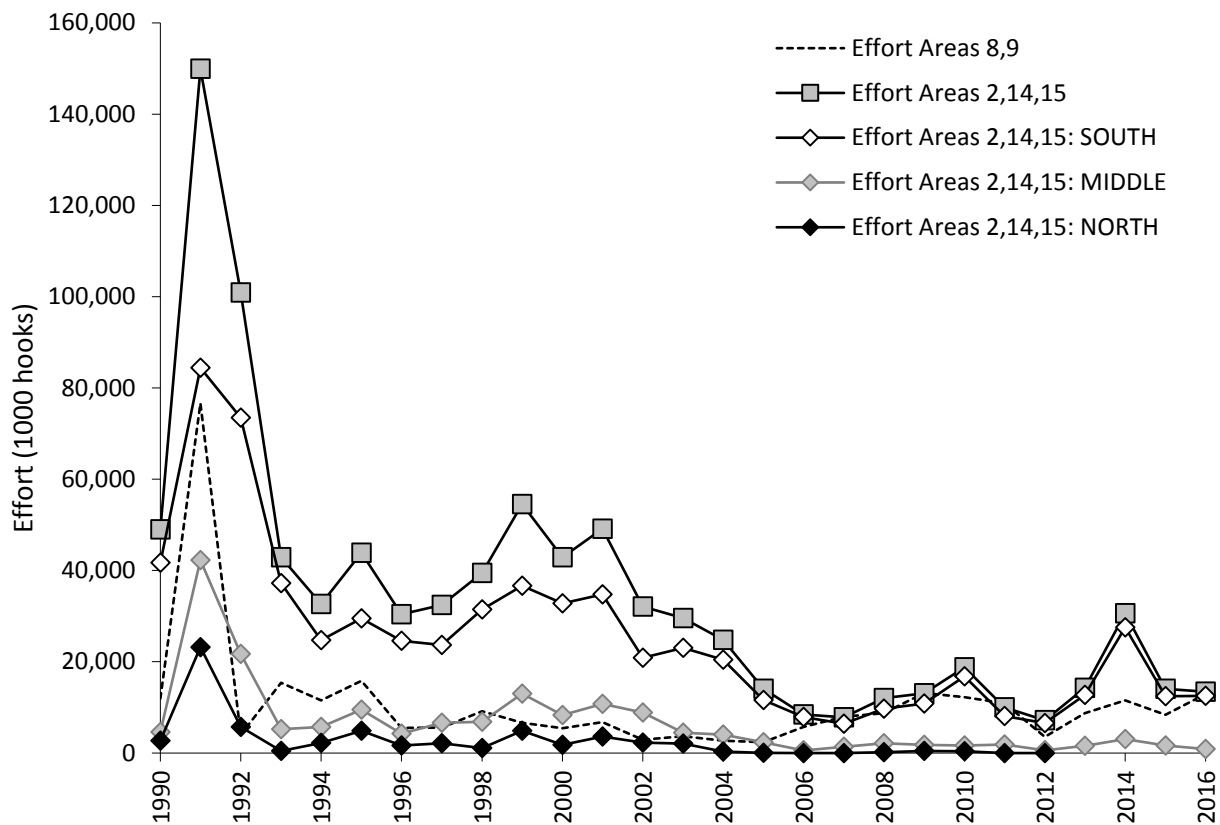


Fig. 16. Effort (1000 hooks) from Taiwanese longliners in statistical areas 8 & 9 (pooled) and 2, 14 and 15 (pooled). Areas 2, 14 and 15 are also separated into 5° latitudinal strips: South = 30–35°S; Middle = 25–30°S; North = 20–25°S. Data are from months 4–9 only.

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.

Japanese longline fishery size/age composition

Size composition data for SBT caught by Japanese longliners were obtained from the CCSBT data exchange in June 2017. These data are examined in detail below for trends for juvenile fish aged less than 6 years.

The age composition of SBT caught by the Japanese longline fishery has been highly variable over time. The relative proportion of the two older age classes examined here increased in 2015, while the two younger age classes declined, or in the case of the youngest age class remained near zero (Fig. 17). Observer coverage on vessels has been less than or around 10 per cent since 2003. Discarding of juveniles has been reported since 2009 but may have commenced earlier and would impact the size/age composition (Sakai & Itoh 2013).

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 calculations take into account the time through the year at which the fish was caught, and adjusts the upper and lower cut-points to account for growth through the year, whereas the size data are simply aggregated for the entire year.

Trends in size composition of < 126 cm indicate an increase in the proportion of the largest size class in 2015, with the second largest size class (>102 to ≤114 cm) declining (Fig. 18). The smallest size class has been relatively stable at very low levels since 2008 (Fig. 18).

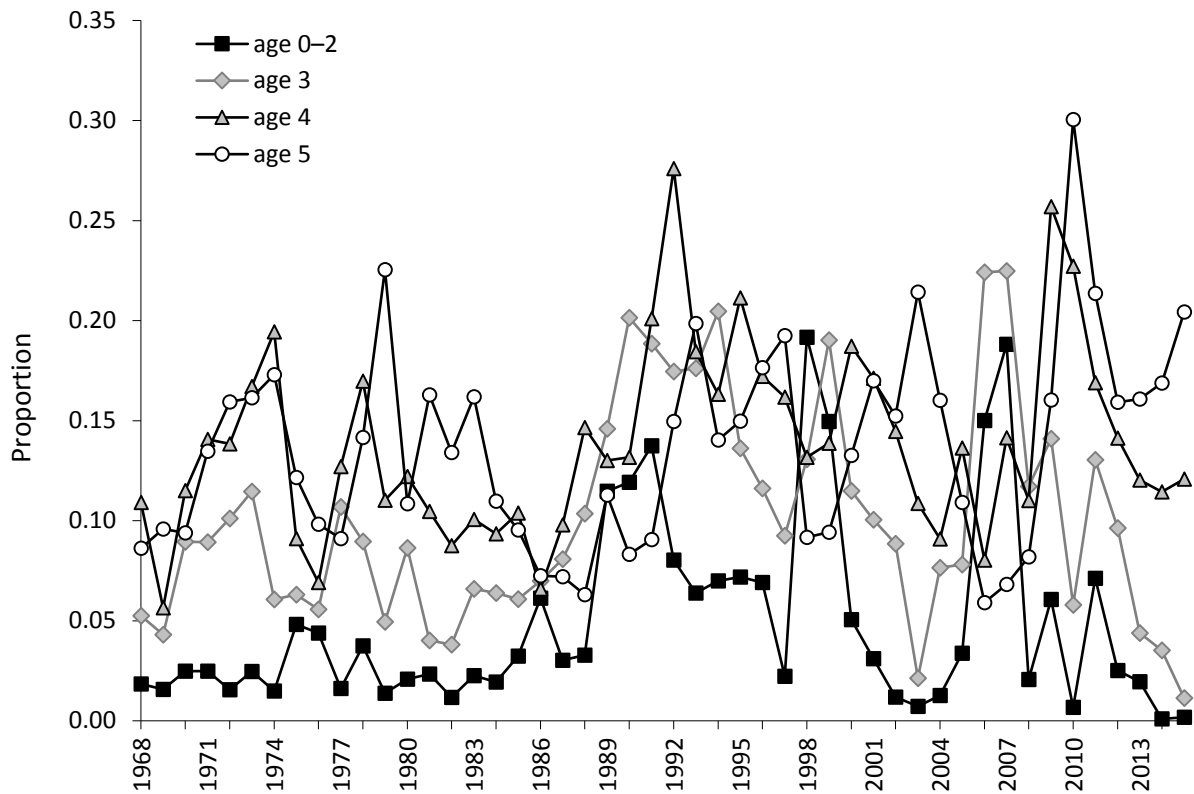


Fig. 17. Age composition (proportion of total catch) of ages 0–2, 3, 4 and 5 in the Japanese longline fishery in statistical areas 4–9, months 4–9.

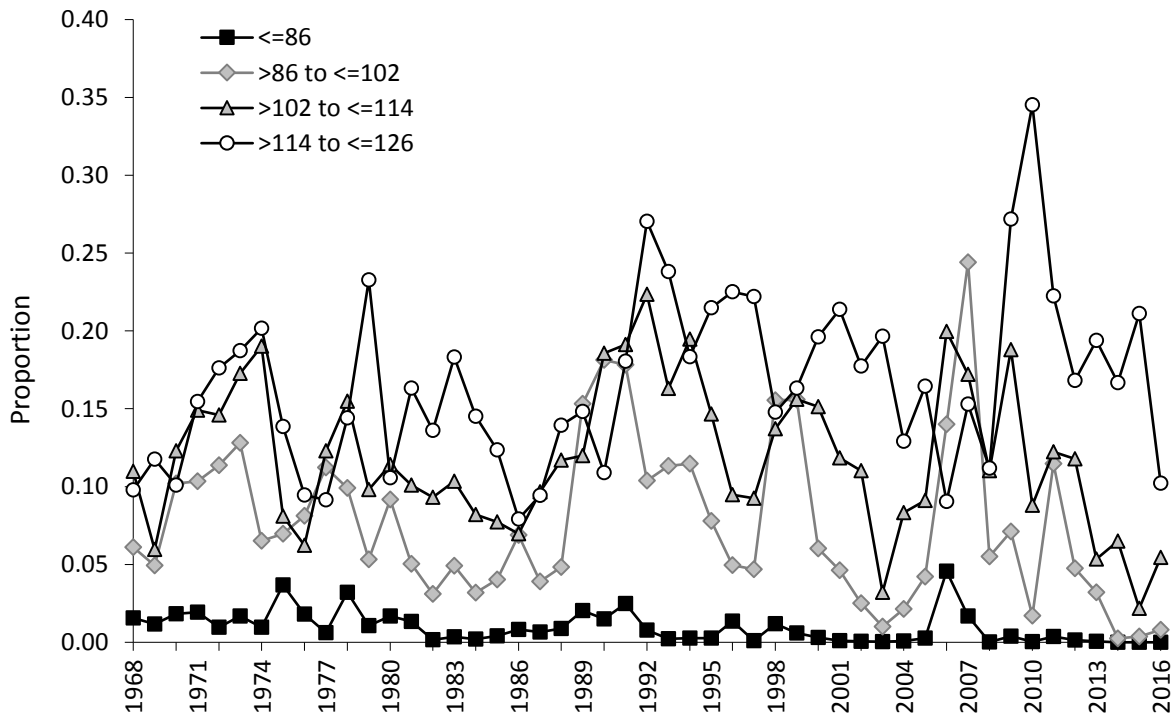


Fig. 18. Size composition (proportion of total catch) of juvenile SBT caught by Japanese longliners in statistical areas 4–9, months 4–9, where age 0–2≤86 cm, 86<age 3≤102 cm, 102<age 4≤114 cm, 114<age 5≤126 cm.

Taiwanese longline fishery size/age composition

Size composition data for SBT caught by Taiwanese longliners were obtained from the 2017 interim update of the CCSBT database (table MP_OM_CALCULATED_CATCH_AT_LENGTH). 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 (i.e. between 25–35°S, see ‘Taiwanese longline CPUE’), and generally catch higher proportions of juvenile SBT (Hartog & Preece 2008). In 2016, proportions of the two largest size classes increased slightly, while the two smallest remained stable (Fig. 19). Observer coverage on vessels has been less than 10 per cent in some past years, and discarding of juveniles cannot be discounted.

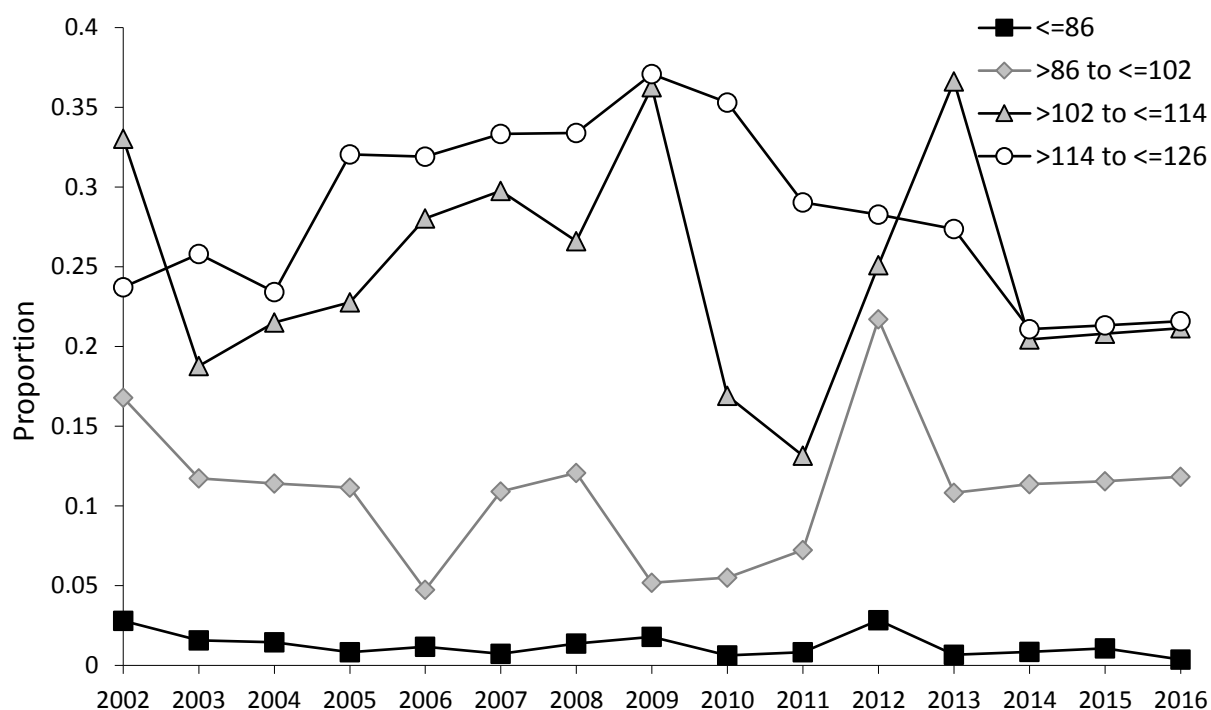


Fig. 19. Size composition (proportion of total catch) of juvenile SBT caught by Taiwanese longliners, where age 0–2≤86 cm, 86<age 3≤102 cm, 102<age 4≤114 cm, 114<age 5≤126 cm.

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_52_16). 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. 20). These two age classes have historically comprised around 90 per cent of the catch. In 2016, the age 2 and 3 age classes accounted for about 98 per cent of the catch.

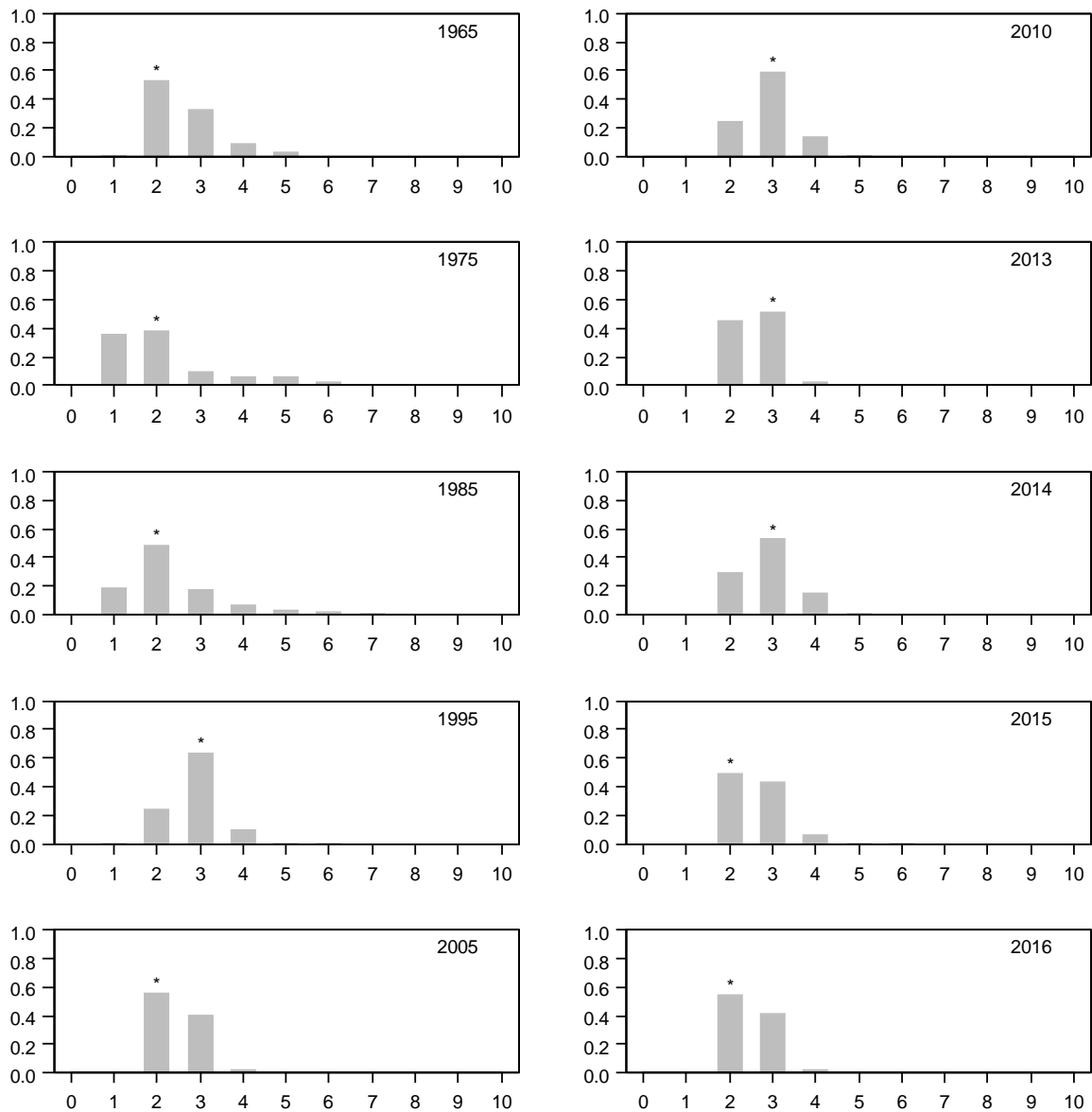


Fig. 20. Age composition in the Australian surface fishery. Median age classes are indicated with asterisks.

4 Summary

Recent trends in all indicators are summarised in Appendix 1. Overall, there were mixed results in the indicators.

Potential causes for the changes are discussed elsewhere, and therefore the indicators presented here should be interpreted with caution. In addition, some of the indicators may have been affected in the past by unreported catch, and historical trends must continue to be interpreted with caution. 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.

Trends in juvenile abundance

The two indices of juvenile (age 1 to 4) abundance that were updated for 2017—the scientific aerial survey index and trolling index—exhibited decreases from values observed in the previous year. The scientific aerial survey in particular exhibited a substantial decrease, although it is still above the 10 year average.

Trends in age 4+ SBT

Similar to previous years, the 2016 indicators of age 4+ SBT were mixed. The CPUE in the NZ domestic fishery increased in 2016 and all but the smallest age class increased in proportion in the NZ domestic fishery. There has been an increase in the proportion of small fish since 2012–13. The mean age of SBT on the spawning ground decreased substantially from 16.8 years in 2011 to 13.8 years in 2016. However, as discussed previously, determining the location where the smaller/younger fish have been caught is a priority for understanding these changes. In addition, although potentially affected by the overcatch, the nominal CPUE for the Japanese longline fishery for 4+ SBT decreased in 2016, but remains above the 10 year mean. The standardised Japanese CPUE series also all decreased.

References

- An, D, Hwang, S, Moon, D, Kim, S & Seok K 2008, *Review of Korean SBT fishery of 2006–07*, CCSBT-ESC/0809/SBT Fisheries—Korea, CCSBT, Rotorua, New Zealand.
- Anon 2008a, *Annual review of national SBT fisheries for the Scientific Committee: New Zealand*, CCSBT-ESC/0809/SBT Fisheries—New Zealand, CCSBT, Rotorua, New Zealand.
- Anon 2008b, *Review of Taiwanese SBT fishery of 2006–07*, CCSBT-ESC/0809/SBT Fisheries—Taiwan, Rotorua, New Zealand.
- Anon 2014, *Annual review of national SBT fisheries for the Scientific Committee: New Zealand*, CCSBT-ESC/1409/SBT Fisheries—New Zealand, CCSBT, Canberra, Australia.
- Anon 2013, *Review of Taiwan SBT Fishery of 2011/2012*, CCSBT-ESC/1309/SBT Fisheries—Taiwan, CCSBT, Canberra, Australia.
- Basson, M & Farley JH 2014, 'A standardised abundance index from commercial spotting data of southern bluefin tuna (*Thunnus maccoyii*): Random effects to the rescue', PLoS One vol. 9, e116245, doi: 10.1371/journal.pone.0116245.
- CCSBT-SC 2001, *Report of the Sixth Meeting of the Scientific Committee*, CCSBT, Tokyo, Japan.
- CCSBT-SC 2008, *Report of the Thirteenth Meeting of the Scientific Committee*, CCSBT, Rotorua, New Zealand.
- CCSBT-SC 2010, *Report of the Fifteenth Meeting of the Scientific Committee*, CCSBT, Taipei, Taiwan.
- Eveson P & Farley J 2017, *The aerial survey index of abundance: 2017 updated results*, CCSBT-ESC/1708/06, CCSBT, Yogyakarta, Indonesia
- Farley, J, Andamari, R & Proctor, C 2007, *Update on the length and age distribution of SBT in the Indonesian longline catch*, CCSBT-ESC/0709/10, CCSBT, Hobart, Australia.
- Farley, J, Eveson, P & Basson, M 2014, *Commercial spotting in the Australian surface fishery, updated to include the 2013–14 fishing season*, CCSBT-ESC/1409/17, CCSBT, Auckland, New Zealand.
- Farley, J, Sulistyarningsih, R, Proctor, C & Grewe, P, Davies C 2017, *Update on the length and age distribution of SBT in the Indonesian longline catch and close-kin tissue sampling and processing*, CCSBT-ESC/1708/09, CCSBT, Yogyakarta, Indonesia
- Fushimi, H, Yamakawa, T, O'Neil, T & Battaglione, S 2006, *Independent review of Australian SBT farming operations anomalies*, Report for the Commission for the Conservation of Southern Bluefin Tuna.
- Hartog, J, Preece, A, Basson, M & Kolody, D 2007, *Fishery indicators for the SBT stock 2006–07*, CCSBT-ESC/0709/14, CCSBT, Hobart, Australia.
- Hartog, J & Preece, A 2008, *Fishery indicators for the SBT stock 2007–08*, CCSBT-ESC/0809/16, CCSBT, Rotorua, New Zealand.

- Itoh, T 2006, *Possible effect on longline operation resulted from the 2006 changes in Japanese SBT fishery regulation*, CCSBT-ESC/0609/44, CCSBT, Tokyo, Japan.
- Itoh, T & Sakai, O 2009, *Report of the piston-line trolling survey in 2007/2008*, CCSBT-ESC/0909/32, CCSBT, Busan, Korea.
- Itoh, T, Sakai, O & Tokuda, D 2013, *Report of the piston-line trolling monitoring survey for the age-1 southern bluefin tuna recruitment index in 2012/2013*, CCSBT-ESC/1309/27, CCSBT, Canberra, Australia.
- Lou, X, Hidaka, T, Bergin & A, Kageyama, T 2006, *Independent review of Japanese southern bluefin tuna market data anomalies*, Report for the Commission for the Conservation of Southern Bluefin Tuna, Canberra.
- Patterson, H & Stobutzki, I 2014, *Fishery indicators for the SBT stock 2013–14*, CCSBT-ESC/1409/16, CCSBT, Auckland, New Zealand.
- Patterson, H & Stobutzki, I 2015, *Fishery indicators for the SBT stock 2014–15*, CCSBT-ESC/1509/11, CCSBT, Incheon, South Korea.
- Patterson, H, Preece, A & Hartog, J 2010, *Fishery indicators for the SBT stock 2009–10*, CCSBT-ESC/1009/09, CCSBT, Taipei, Taiwan.
- Patterson, H, Preece, A, & Hartog, J 2011, *Fishery indicators for the SBT stock 2010–11*, CCSBT-ESC/1107/08, CCSBT, Bali, Indonesia.
- Patterson, H, Preece, A & Hartog, J 2012, *Fishery indicators for the SBT stock 2011–12*, CCSBT-ESC/1208/14, CCSBT, Tokyo, Japan.
- Patterson, H, Preece, A & Hartog, J 2013, *Fishery indicators for the SBT stock 2012–13*, CCSBT-ESC/1309/08, CCSBT, Canberra, Australia.
- Patterson, H, Helidoniotis F & Stobutzki, I 2016, *Fishery indicators for the SBT stock 2015–16*, CCSBT-ESC/1609/16, CCSBT, Kaohsiung, Taiwan.
- Phillips, K 2009, *Fishery indicators for the SBT stock 2008–09*, CCSBT-ESC/0909/08, CCSBT, Busan, Korea.
- Polacheck, T, Preece, A, Hartog, J & Basson, M 2006, *Information and issue relevant to the plausibility of alternative CPUE time series for southern bluefin tuna stock assessments*, CCSBT-ESC/0609/24, CCSBT, Tokyo, Japan.
- Preece, A, Cooper, S & Hartog, J 2004, *Data post-processing for input to the 2004 stock assessments and comparisons of 2001 and 2004 assessment datasets*, CCSBT-ESC/0409/27, CCSBT, Jeju, Korea.
- Sakai, O & Itoh, T 2013, *Releases and discards of southern bluefin tuna from the Japanese longline vessels in 2012*, CCSBT-ESC/1309/33, CCSBT, Canberra, Australia.

Appendix 1. Recent trends in all indicators of the SBT stock

Table 1. Recent trends in all indicators of the SBT stock. Minimum and maximum values in the time series are also shown.

Indicator	Period	Min.	Max.	2013	2014	2015	2016	2017	12 month trend
Scientific aerial survey	1993–2000 2005–16	0.25 (1999)	4.85 (2016)	0.87	2.02	na	4.85	1.80	↓
Trolling index	1996–2003 2005–06 2006–16	1.62 (2012)	5.09 (2011)	3.70	2.86	na	3.94	1.70	↓
NZ domestic nominal CPUE	1989–2016	0.000 (1989)	8.78 (2016)	4.04	5.44	6.16	8.78		↑
NZ domestic age/size composition (proportion age 0–5 SBT)*	1980–2016	0.001 (1985)	0.404 (1995)	0.03	0.20	0.07	0.54		↑
Indonesian median size class**	1993–94 to 2014–15	162 (2012–13; 2013–14)	188 (1993–94)	164	162	160	163	163	-
Indonesian age composition:** mean age on spawning ground, all SBT	1994–95 to 2013–14	13.24 (2012–13)	21.2 (1994–95)	14.2	13.8	13.8	13.8		-
Indonesian age composition:** mean age on spawning ground 20+	1994–95 to 2013–14	21.8 (2010–11)	25.3 (2003–04)	22.3	22.3	22.9	22.6		↓
Indonesian age composition:** median age on spawning ground	1994–95 to 2013–14	13 (2001– 03; 2012– 13)	21 (1994–95; 1996–97; 1998–99)	15	14	14	13		↓

Table 1. (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.	2013	2014	2015	2016	12 month trend
Japanese nominal CPUE, age 4+	1969–2016	1.338 (2006)	22.123 (1965)	3.355	3.624	5.052	4.256	↓
Japanese standardised CPUE (W0.5, W0.8, Base w0.5, Base w0.8)	1969–2016	2007 (0.259–0.358)	1969 (2.284– 2.697)	0.583–0.901	0.754–1.179	1.011–1.495	0.666–1.206	↓
Korean nominal CPUE	1991–2016	1.312 (2004)	21.523 (1991)	6.163	6.512	8.169	5.451	↓
Taiwanese nominal CPUE, Areas 8+9	1981–2016	<0.001 (1985)	0.956 (1995)	0.128	0.127	0.920	0.203	↓
Taiwanese nominal CPUE, Areas 2+14+15	1981–2016	<0.001 (1985)	3.672 (2007)	2.230	1.624	1.728	2.042	↑
Japanese age comp, age 0–2*	1969–2016	0.004 (1966)	0.192 (1998)	0.020	0.001	0.002	0.003	↑
Japanese age comp, age 3*	1969–2016	0.011 (2015)	0.228 (2007)	0.044	0.035	0.011	0.036	↑
Japanese age comp, age 4*	1969–2016	0.091 (1967)	0.300 (2010)	0.120	0.114	0.121	0.072	↓
Japanese age comp, age 5*	1969–2016	0.072 (1986)	0.300 (2010)	0.161	0.169	0.204	0.162	↓
Taiwanese age/size comp, age 0–2*	1981–2016	<0.001 (1982)	0.251 (2001)	0.007	0.009	0.011	0.004	↓
Taiwanese age/size comp, age 3*	1981–2016	0.024 (1996)	0.349 (2001)	0.108	0.114	0.116	0.118	↑
Taiwanese age/size comp, age 4*	1981–2016	0.027 (1996)	0.502 (1999)	0.366	0.204	0.208	0.211	↑
Taiwanese age/size comp, age 5*	1981–2016	0.075 (1997)	0.371 (2009)	0.274	0.211	0.213	0.216	↑
Australia surface fishery median age composition	1964–2016	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; na = not available

