Australian Government
Bureau of Rural Sciences

Fishery indicators for the SBT stock 2008–09

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Executive Summary

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 SBT stock by the CCSBT Extended Scientific Committee (ESC) and its trilateral predecessor. At the ninth meeting of the Stock Assessment Group in 2008, it was agreed that the basis for management advice to the Commission in 2009 would be a reconditioned operating model in conjunction with an evaluation of current stock status and recent recruitment based on indicators; that conditioning of the operating model would be broadened to include some of the available indicators (notably the scientific aerial survey); and that a Management Procedure adopted by the Commission should incorporate indicators such as the scientific aerial survey.
The 2008–09 update	In 2001, it was agreed to monitor and review fishery indicators on an annual basis. The 2008–09 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.
Trends in juvenile SBT	Interpretation of indicators is limited to subset (1). Indicators of juvenile (age 1–4) SBT abundance in the Great Australian Bight exhibited declines over the past 12 months. This trend, evident in all three indicators, is of concern.
Trends in age 4+ SBT	In contrast to trends in the abundance of age 1–4 SBT, indicators of age 4+ SBT exhibited some upward trends.

Contents

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 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 (CCSBT-SC 2001).

Indicators can provide a broad perspective on recent changes in the status of the SBT stock and include 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 some of the only fisheries-independent data available to the ESC. At the ninth meeting of the Stock Assessment Group (SAG) in 2008, it was agreed that the basis for management advice to the Commission in 2009 would be a reconditioned operating model in conjunction with an evaluation of current stock status and recent recruitment based on indicators, and that conditioning of the operating model would be broadened to include some of the available indicators (notably the scientific aerial survey) (CCSBT-ESC13 2008). Furthermore, it was noted that a Management Procedure adopted by the Commission should incorporate fishery-independent indicators such as the scientific aerial survey.

Because some fisheries-dependent indicators are likely to 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 2008–09 update of fishery indicators for the SBT stock summarises indicators in the same groups presented in equivalent updates in 2007 and 2008 (Hartog et al. 2007, Hartog & Preece 2008):

1. Indicators unaffected by the unreported catch:
    - Aerial spotting data in the Great Australian Bight (scientific aerial survey; commercial spotting [SAPUE] index)
    - Trolling index
    - NZ CPUE (charter and domestic)
    - NZ longline fishery size composition
    - Indonesian longline fishery size/age composition
    - Indonesian catch on the spawning grounds (noting this fishery is now managed under an interim catch allocation)
2. Indicators that may be affected by the unreported catch
    - Reported global catch and retrospective estimates of unreported catch
    - Japanese, Korean and Taiwanese CPUE
    - Size/age composition in the Japanese, Korean and Taiwanese longline fisheries and age composition in the Australian surface fishery

In this paper, interpretation of indicators is restricted to the subset (1) considered to be unaffected by the unreported catch.

This paper updates the information provided by Hartog & Preece (2008) with the most recent data available through the CCSBT data exchange in July 2009.

Indicators unaffected by the unreported catch

Aerial spotting data in the Great Australian Bight

Scientific aerial survey

The scientific aerial survey index has been updated from data provided by Australia through the CCSBT data exchange (AU_AerialSurveyIndex_09).

A line-transect aerial survey conducted in the Great Australian Bight (GAB) between January and March provides a fisheries-independent estimate of the relative abundance of aggregated 2–4 year old SBT (Eveson et al. 2008). The survey was suspended in 2001 because of logistical problems, but re-established in 2005 after analyses had demonstrated that the survey provides a suitable indicator of relative juvenile abundance (Eveson et al. 2008).

The index of relative abundance in 2009 (the 2008–09 fishing season) is lower than the 2008 estimate (2007–08 fishing season), and the average 2005–09 median value (Fig. 1, dashed horizontal line), though slightly higher than the 2006 and 2007 estimates (2005–06 and 2006–07 fishing seasons, respectively). These differences are not significant because the 90% confidence intervals on the 2009 estimate overlap with the confidence intervals for the previous 4 years.

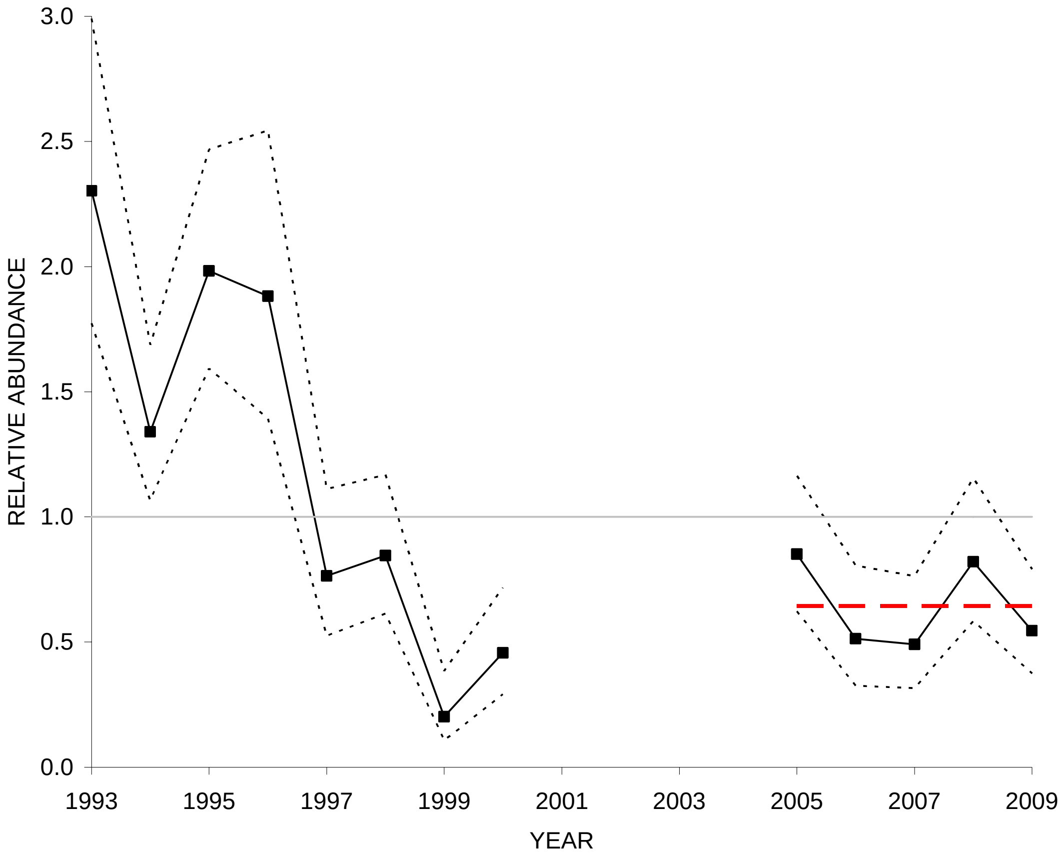


Fig. 1. Aerial survey index of relative abundance of juvenile SBT in the Great Australian Bight, Jan–Mar (hence the 2009 value represents the 2008–09 fishing season etc). Dotted lines are 90% confidence intervals. The horizontal line represents a relative abundance of 1.0; dashed horizontal line represents the average 2005–09 median value

Commercial spotting (SAPUE) index

The commercial spotting (SAPUE) index has been updated from data provided by Australia through the CCSBT data exchange (AU_SAPUE_02_09).

Data on sightings of SBT schools in the GAB were collected by experienced tuna spotters as part of commercial spotting operations over eight fishing seasons, 2001–02 to 2008–09. The data were used to produce standardised fishery-dependent indices of juvenile SBT relative abundance (surface abundance per unit effort; SAPUE). The SAPUE index reflects the aggregated abundance of age 2, 3 and 4 year old SBT. The lowest values in the series (2002–03 and 2003–04) therefore represent as age 2–4 year olds the 1999–01 and 2000–02 year classes.

Farley & Basson (2008) urge caution when directly comparing the last five years of the SAPUE with the overlapping period of the aerial survey index (2004–05 to 2008–09): the data were collected using different methods and commercial flights cover a much smaller area than the line transect aerial survey.

Median estimates have varied over the past eight years with no discernible trend (Fig. 2). The value in 2008–09 is significantly lower than the 2007–08 estimate, and is lower than the 2002–09 average median value (Fig. 2, horizontal line).

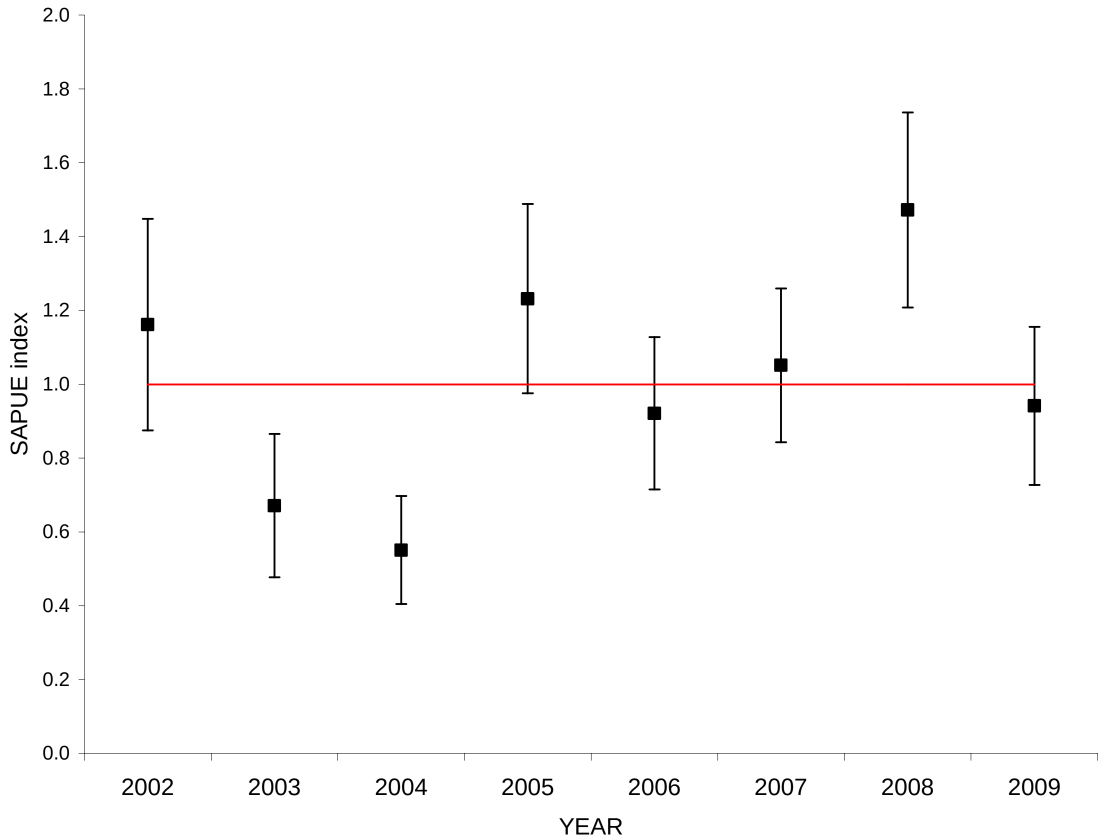


Fig. 2. SAPUE index of relative surface abundance of juvenile SBT in the Great Australian Bight, Jan–Mar. Estimates are median ± 2 standard errors, scaled by the mean over 2001–02 to 2008–09 (represented by the horizontal line). Data are for all months, December–March. 'Year' represents the second year in a split-year fishing season, i.e. '2009' is the 2008–09 fishing season

Trolling index

The trolling survey index has been updated from data provided by Japan through the CCSBT data exchange (JP_TrollingIndex_96_09).

The trolling survey is conducted by the Japanese National Research Institute of Far Seas Fisheries and is designed to provide a qualitative index (i.e. low, medium, high) of relative recruitment strength of age 1 SBT off the Western Australian coast (CCSBT-ESC13 2008, para 115). The ability of the index to measure abundance of age 1 SBT is still unknown (Itoh 2007). Three different series comprise the trolling index: (1) a piston-line trolling survey, 2006–09; (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. Methods used to obtain comparable data from these 3 sources are documented by Itoh (2007). However, the ESC has noted that data from the new piston line trolling survey (from 2006 onwards) give high estimates with larger variance compared with the acoustic survey data from earlier years (CCSBT-ESC13 2008, para 114). Other issues, such as limited temporal/spatial coverage of the survey, and analysis to address potential autocorrelation from multiple encounters of individual schools, require further consideration.

The index increased each year from 2000 to 2008 (excluding 2004, when no surveys were conducted), but fell in 2009 to below the average median value of the piston line survey over 2006–09 (Fig. 3, horizontal line). This decrease is not significant because the 90% confidence intervals on the 2009 estimate overlap with the confidence intervals for the previous 3 years.

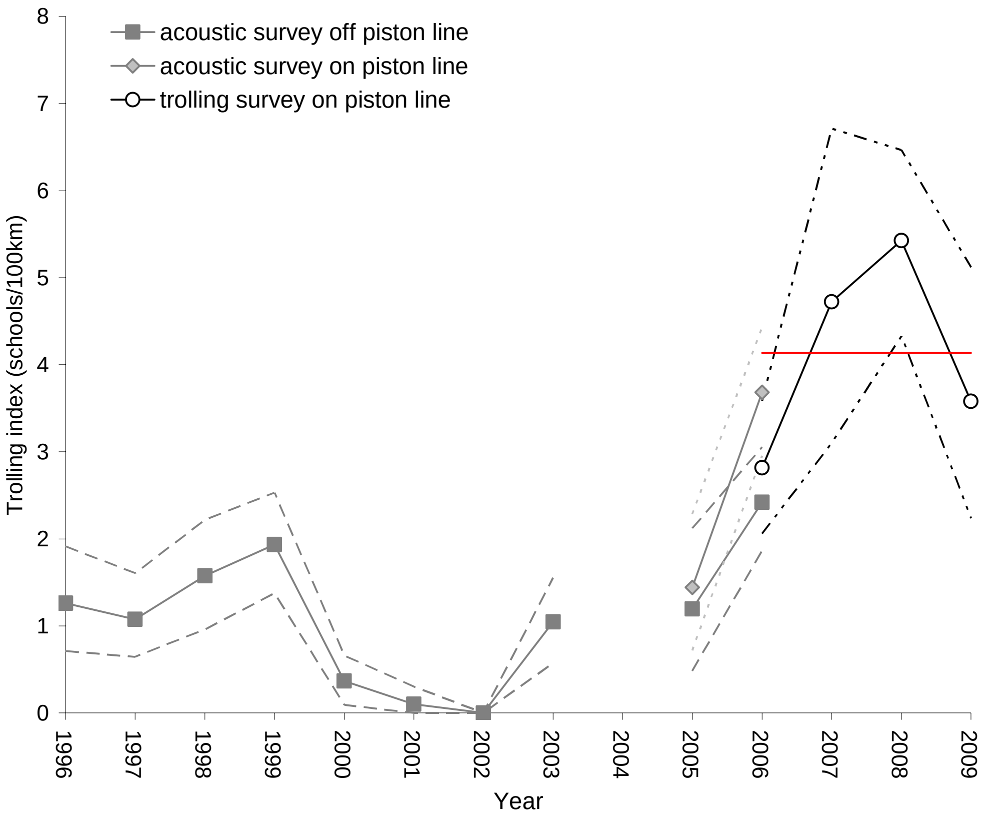


Fig. 3. Trolling index, showing number of schools per 100 km off the Western Australian coast in January. Dashed lines are 90% confidence intervals

Catch per unit effort

NZ joint venture (charter) longline CPUE

NZ joint venture (charter) longline CPUE for statistical areas 5 and 6 (aggregated age classes) was updated from CPUE input data provided in the May 2009 interim update of the CCSBT database.

The NZ joint venture (charter) fishery has 100% observer coverage and should remain unaffected by the unreported catches identified in the Japanese Market Review (Lou et al. 2006). The NZ fleets fish a small portion of the SBT stock, and interpretation of CPUE might be particularly sensitive to inter-annual variability in the spatial distribution of the stock. CPUE series have been compiled for longline vessels only, the handline/troll fishery virtually disappearing in the 1990s.

The CPUE in the southern fishery (statistical area 6) increased in 2008 to be the highest in the series (and higher than the 1997–2007 mean), following 5 years of low catch rates between 2003 and 2007. There was no effort in the northern fishery (statistical area 5) in 2008.

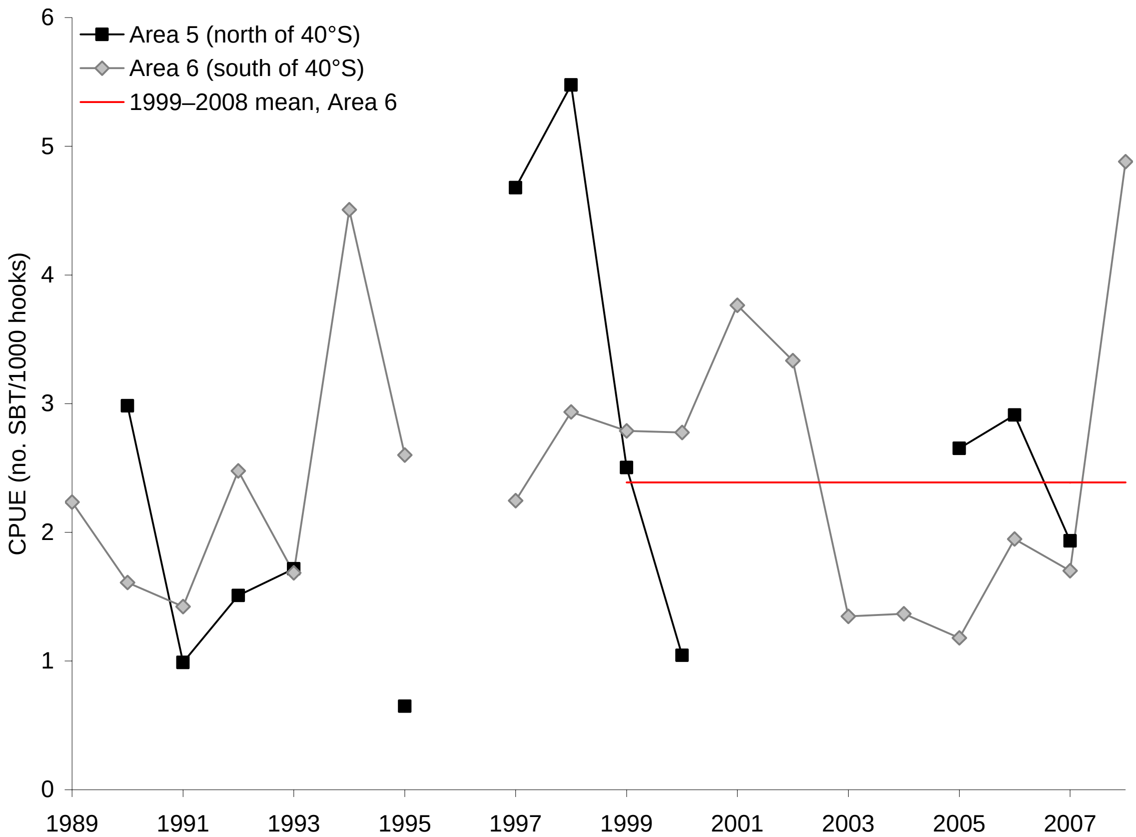


Fig. 4. Nominal CPUE (number per 1000 hooks) for the NZ charter longline fishery

NZ domestic longline CPUE

NZ domestic nominal CPUE was updated from aggregated catch and effort data provided in the May 2009 interim update of the CCSBT database.

Historically there has been lower levels of observer coverage in the NZ domestic fishery than in the NZ charter fishery (Anon 2008a). However, NZ domestic catches are landed fresh and exported as fresh product to Japan, and are thus assumed to be unaffected by results of the Japanese Market Review (which examined frozen product, see Lou et al. 2006).

Overall, catch rates in the NZ domestic fishery have increased over the last decade, increasing again in 2008.

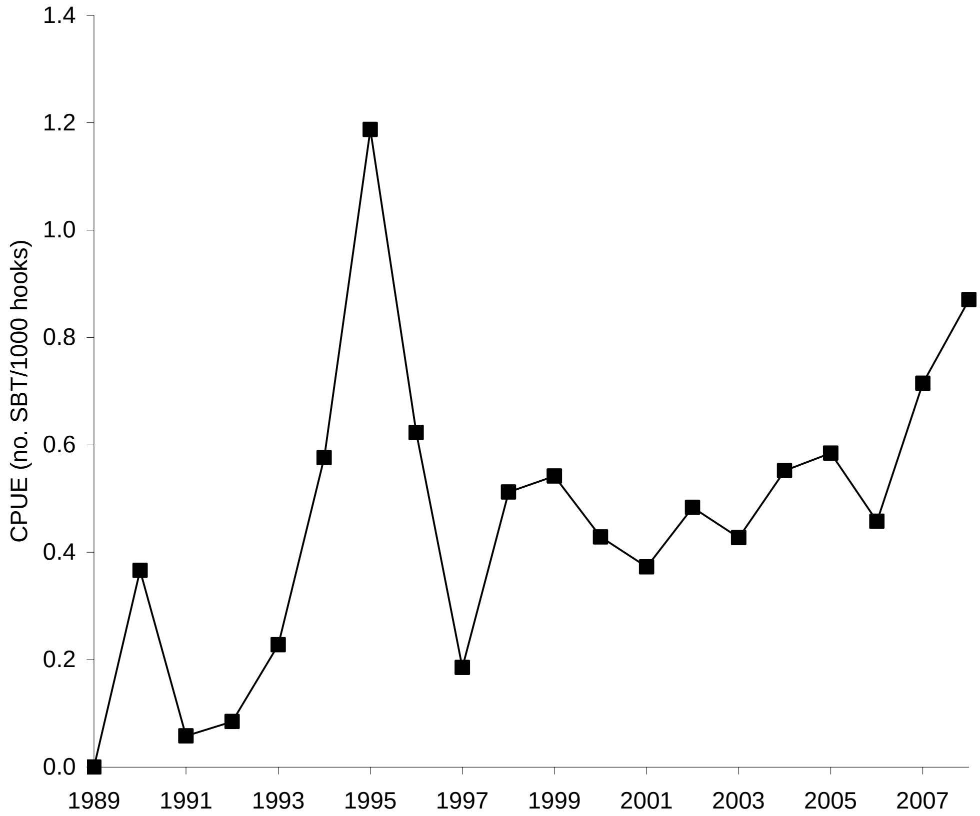


Fig. 5. Nominal CPUE (number per 1000 hooks) for the NZ domestic longline fishery

Catch size/age composition

New Zealand longline fishery size composition

Size composition data for SBT caught by the NZ charter and domestic longline fisheries were updated from data prepared for the operating model, available in the May 2009 interim update of the CCSBT database (table MP_OM_CALCULATED_CATCH_AT_LENGTH). All size composition data considered here derive from longline vessels, other methods (handline/troll) virtually disappearing from the fisheries in recent years.

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

Age 4 and 5 SBT all but disappeared from the NZ charter fishery in 2003 and 2004 respectively. Both age classes began to show some signs of re-emergence in 2006, a trend which continued into 2008. The proportional abundance of age 4 and 5 SBT is now similar to the levels observed in the late 1990s. The NZ charter fishery catches virtually no age 0–2, and continued to catch very small amounts of age 3 SBT in 2008, with no clear trends in the abundance of this size/age class apparent over the past decade. Given the 100% observer coverage in the NZ charter fishery, the small proportion of juveniles in the catch in recent years is not attributed to discarding.

Aside from a small spike in the abundance of age 3 SBT in 2005, the NZ domestic fishery has historically only landed age 4 and 5 juvenile SBT. The abundance of the juvenile age classes plummeted in 2004 (similar to the trend observed in the NZ charter fishery), though age 4 SBT reappeared in 2006 and 2008, and age 5 in 2008. Overall, however, the juvenile age classes have comprised a very small proportion of the NZ domestic catch since the late 1990s, and particularly since 2004. There is a low level of observer coverage in the NZ domestic fishery, and some discarding of juveniles may occur.

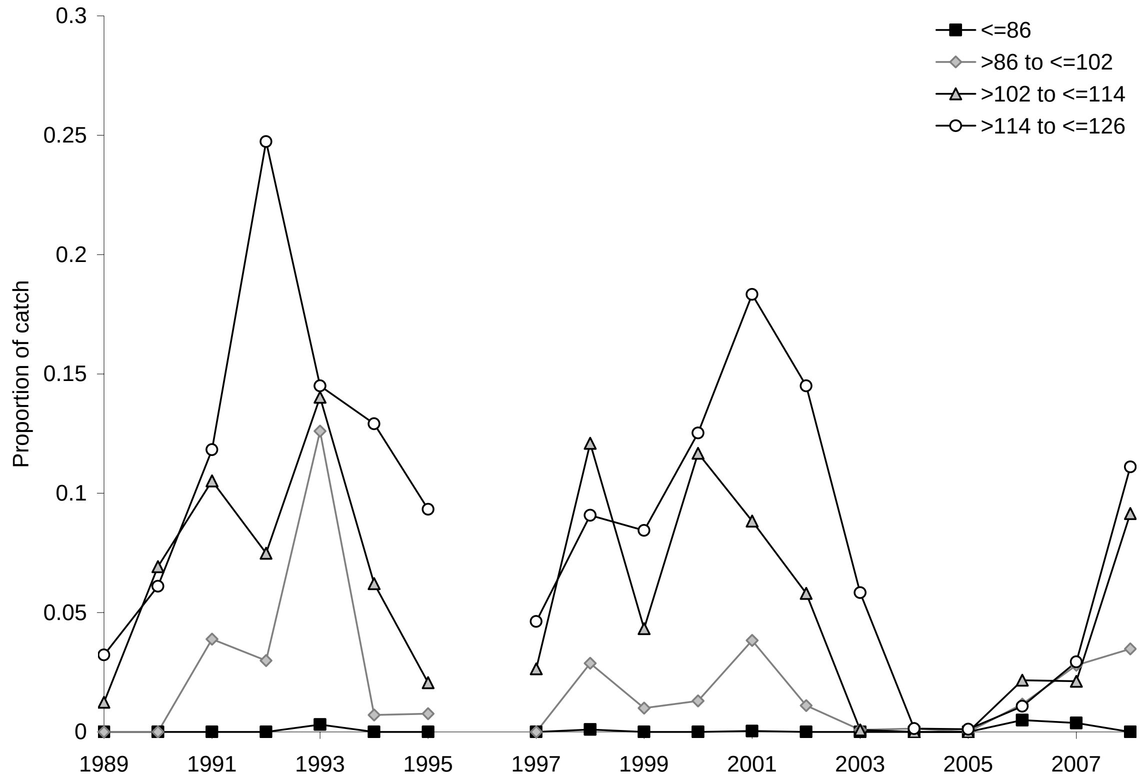


Fig. 6. Size composition for the NZ charter longline fishery, where age 0–2≤86 cm, 86<age 3≤102 cm, 102<age 4≤114 cm, 114<age 5≤126 cm

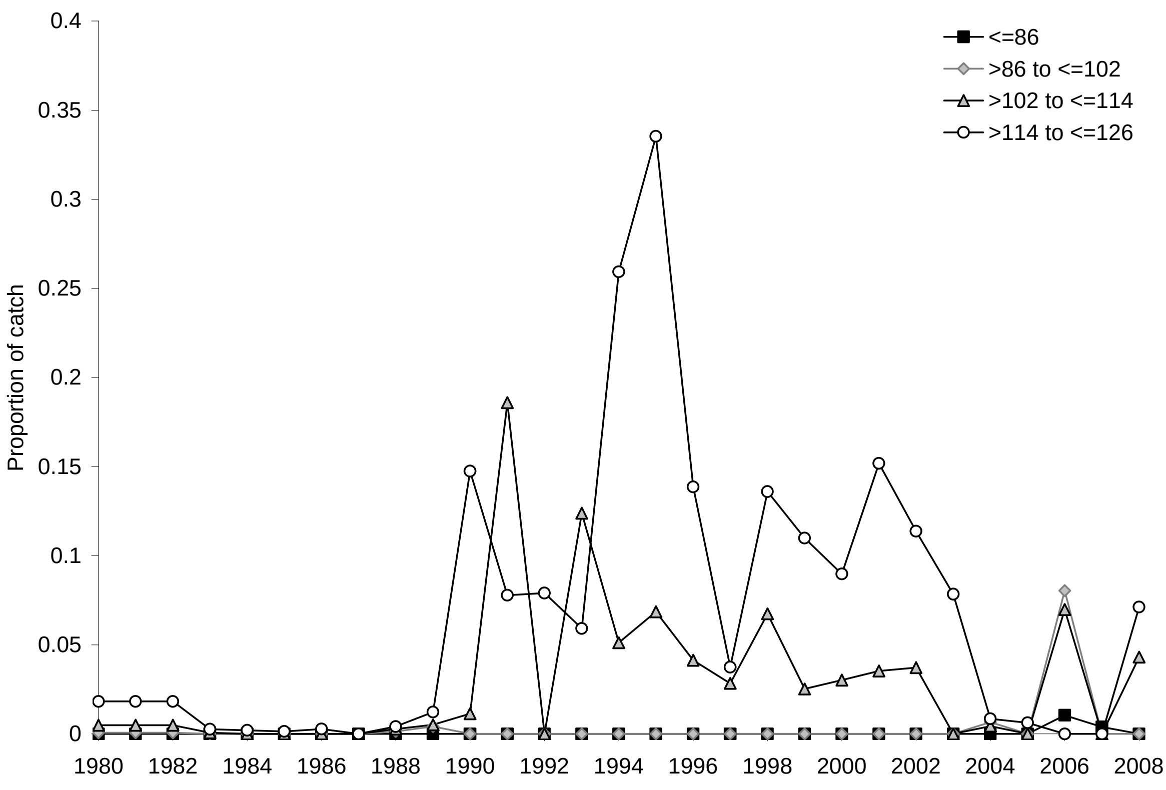


Fig. 7. Size composition for the NZ domestic longline fishery, where age 0–2≤86 cm, 86<age 3≤102 cm, 102<age 4≤114 cm, 114<age 5≤126 cm

Indonesian spawning ground size/age composition

The Indonesian catch data provide an important source of information about the spawning population, assuming that the selectivity of this fishery has been constant over time. Updates on mean age of SBT caught by Indonesian longliners on the spawning ground were obtained from direct age data available through the May 2009 interim update of the CCSBT database, while age frequency data were updated from data provided by Australia through the CCSBT data exchange (AU_IndonesianLLAgeandSizeComposition). Indonesian longline age composition provided by Australia (CSIRO) has been revised for the entire data set to account for minor rounding revisions.

No updates on size composition were available through the CCSBT data exchange in 2009. The proportional size composition on the spawning ground from the 1993–94 to 2007–08 spawning seasons has been reproduced from Hartog & Preece (2006) (Fig. 8). Previously, data from SBT caught south of the spawning ground (e.g. by Processor A; see Hartog & Preece 2006) have been compiled separately from Indonesian size/age data. However, no information on Processor A was available in the data exchange and all available data have thus been aggregated.

In the 2007–08 spawning season, mean age of SBT on the spawning grounds increased to 17 years, up from 15 years in 2006–07 (Fig. 9). Conversely, when considering only age 20+ SBT, mean age decreased slightly from 25 years in 2006–07 to 24 years in 2007–08. However, mean age of 20+ SBT has remained relatively stable over the past decade.

Direct age estimates in 2007–08 ranged from 6 to 40 years (n = 270), with a median age of 16 years (Fig. 10). Median age has continued to increase gradually over the past 5–6 spawning season, up from 13 years observed in 2001–02 and 2002–03.

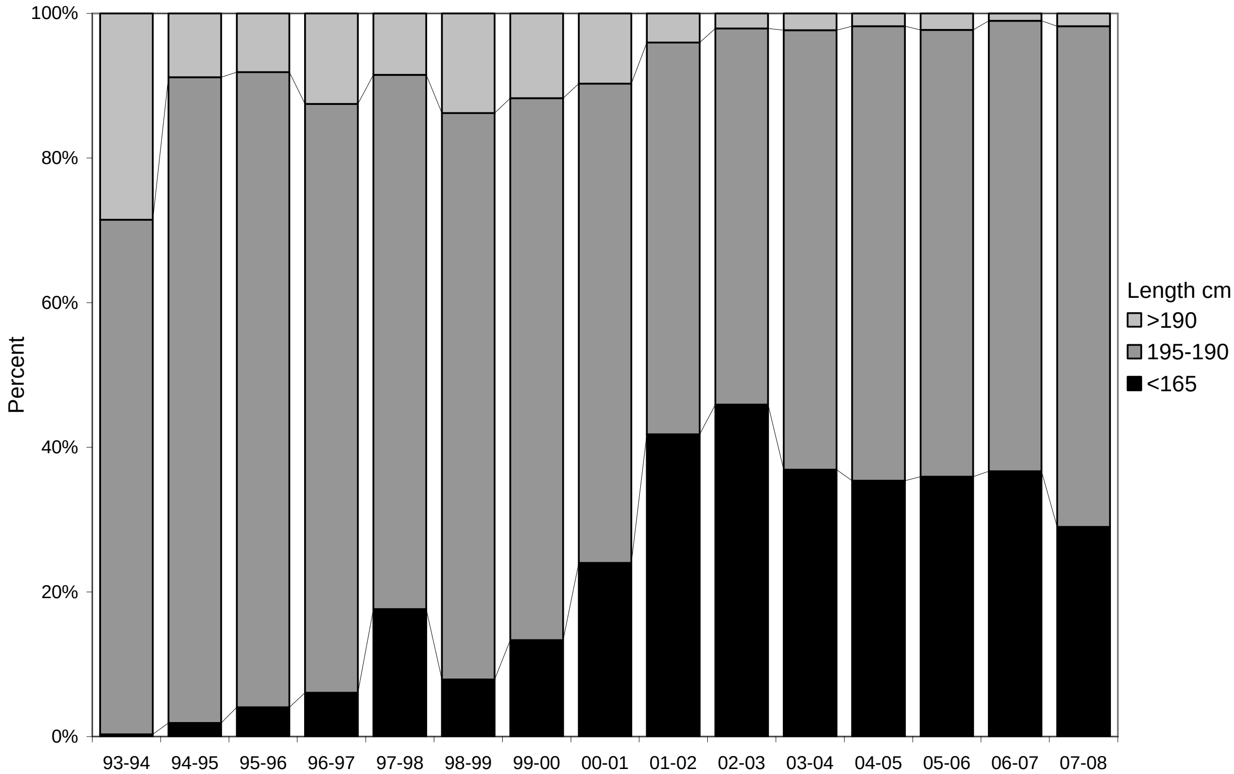


Fig. 8. Size composition of SBT caught on the spawning grounds by the Indonesian longline fishery by spawning season (no update available for 2008–09)

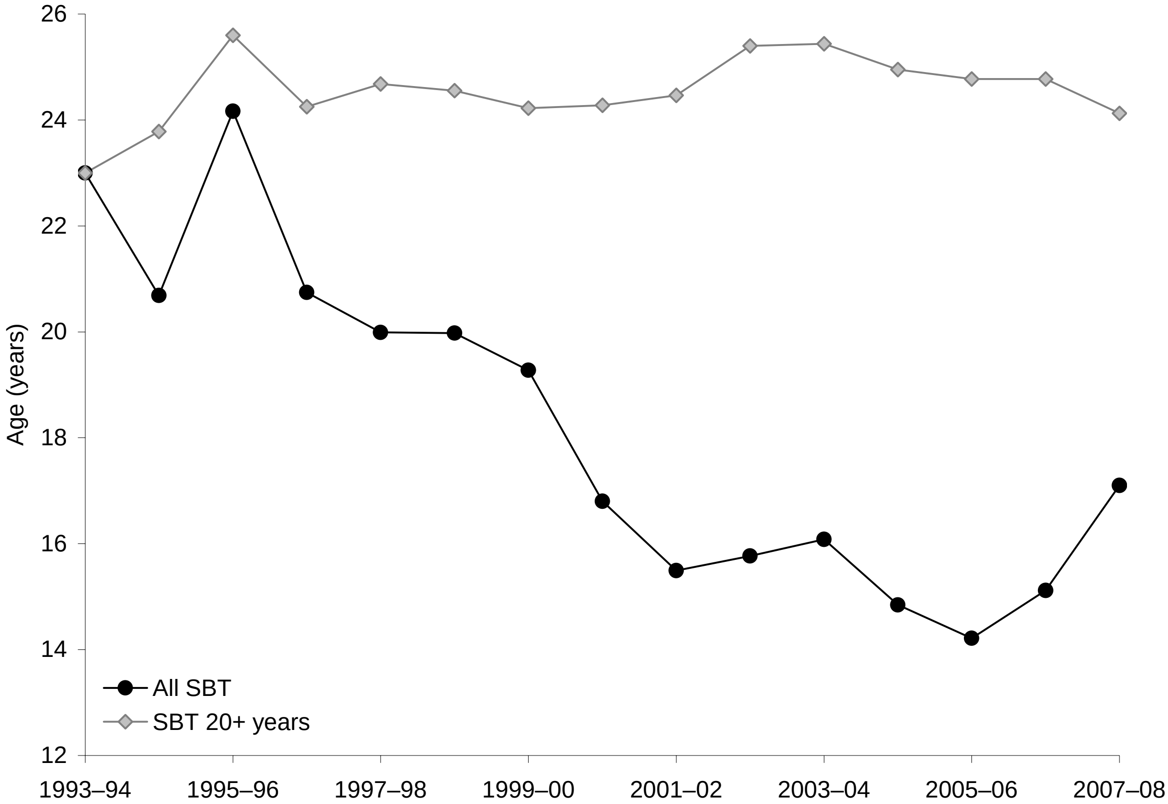


Fig. 9. Mean estimated age of SBT caught on the spawning grounds by Indonesian longliners

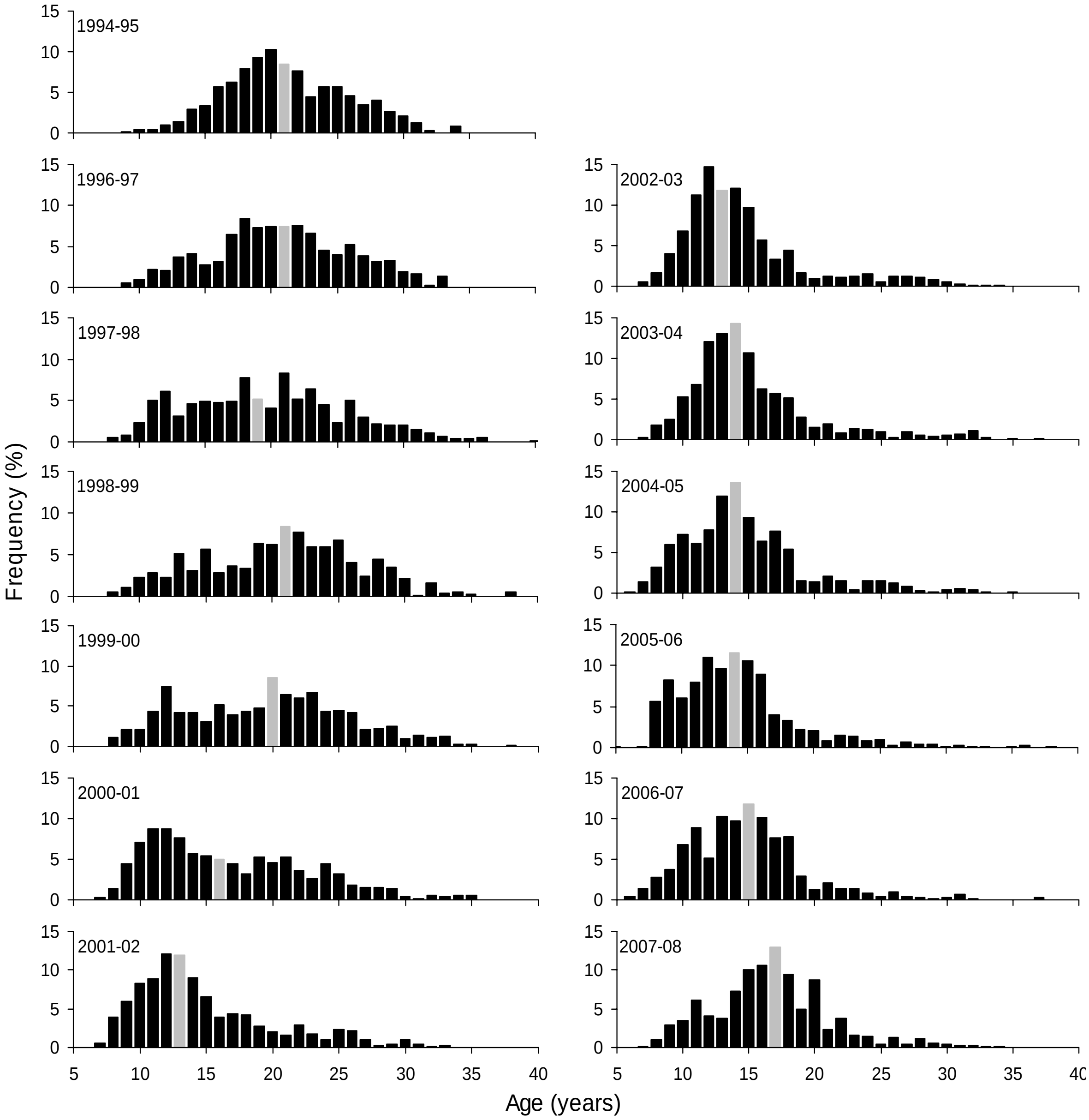


Fig. 10. Age frequency distribution of SBT caught on the spawning grounds by the Indonesian longline fishery. Grey bars show the median age class per spawning season

Indonesian spawning grounds total catch

The 2008 update of catch by Indonesian longliners on the spawning ground was obtained from official catch data provided in the May 2009 interim update of the CCSBT database.

Catches of SBT on the spawning grounds by Indonesian longliners have been previously interpreted as an index of relative abundance, subject to a number of assumptions, changes in fleet behaviour and difficulties in effort standardisation (Hartog & Preece 2006). However, since the introduction of an interim catch allocation of 750 t at CCSBT13 (2006), and Indonesia's subsequent accession as a full member of CCSBT in 2008, catches on the spawning grounds by Indonesian longliners may not be a useful indicator of stock status in the future.

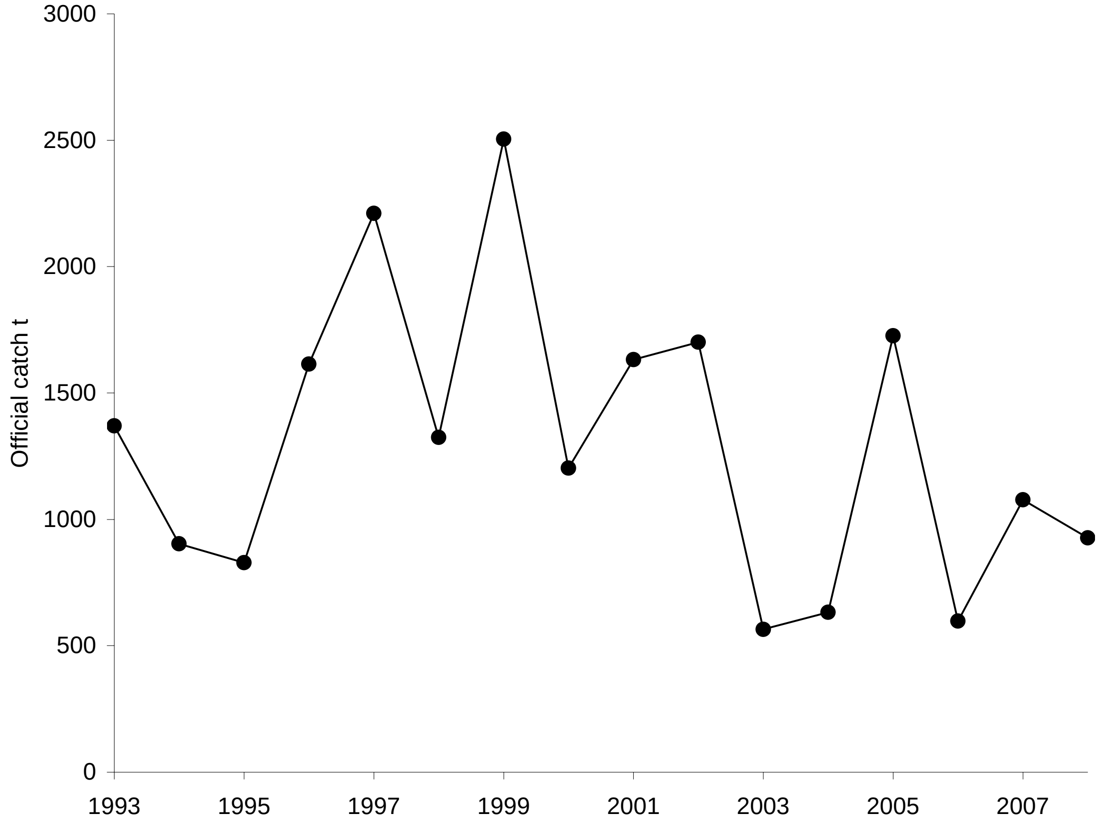


Fig. 11. Official catches of SBT by the Indonesian longline fleet

Indicators that may be affected by the unreported catch

The indicators included in this section may or may not be affected by unreported catches identified in the Japanese Market Review (Lou et al. 2006) or by potential bias in the 40-fish sampling program of the Australian surface fishery (discussed in further detail in the 2006 Australian Farm Review, Fushimi et al. 2006). These indicators have been updated with information provided through the CCSBT data exchange in 2009, but it is recommended that their interpretation be treated with considerable caution, and that any use of indicators to assess SBT stock status be focused on the previous indicator set.

Global catch

Reported global catch

Reported catch updates per country were obtained from official catch data provided in the May 2009 interim update of the CCSBT database.

Reported catches have declined by almost a third since 2005 (from ~16 000 t to ~11 400 t in 2008) (Fig. 12), largely due to a reduction in Japan's national allocation from 6065 t to 3000 t in 2006, and the introduction of an interim catch allocation of 750 t to Indonesia's SBT fishery in 2007. Australia reported the largest catches in 2006–08 of 5635 t, 4813 t and 5051 t, respectively, while Japan's reported catches over the same period were 4207 t, 2840 t and 2952 t. The Taiwanese catch has remained relatively stable over the past decade, particularly since its accession as a full member to CCSBT in 2002 and introduction of a national allocation. Korean catches have been lower and more variable since its accession as a full member to CCSBT in 2001, with little effort in the fishery in some recent years.

Reported global catch and retrospective unreported catch estimates

Reported catches per country and retrospective estimates of unreported catches (illegal, unregulated and unreported; IUU) were obtained from the OFFICIAL_SBT_CATCH table in the May 2009 interim update of the CCSBT database. Catches included in the IUU series derive from both illegal fishing and biased catch estimates; for further details, see page 18 of 'Description of the 2010 CCSBT Data CD' provided by the Secretariat in May 2009.

The effect of retrospective unreported catches (Fig. 13) on the interpretation of other indicators in this section should be considered carefully.

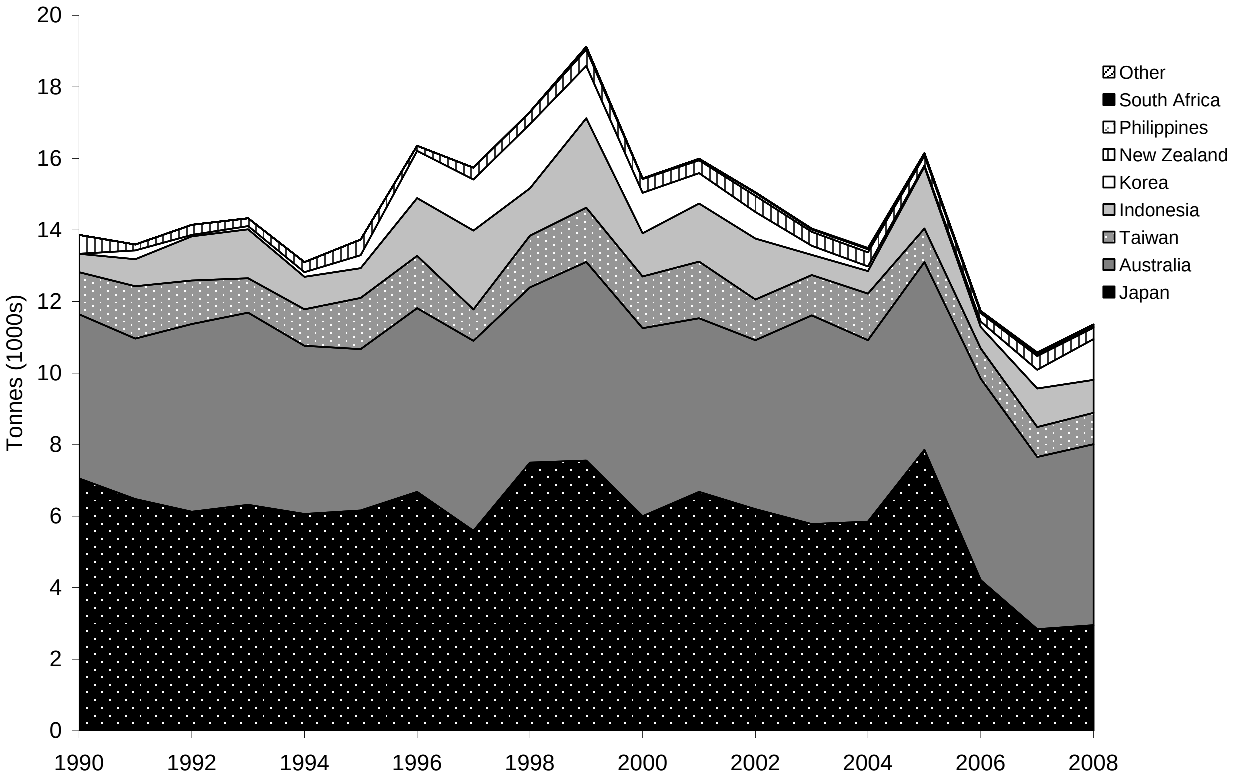


Fig. 12. Reported catches by country since 1990. Shaded areas are stacked so that *y*-axis values represent total catch (1000 t) reported by all members in a quota year

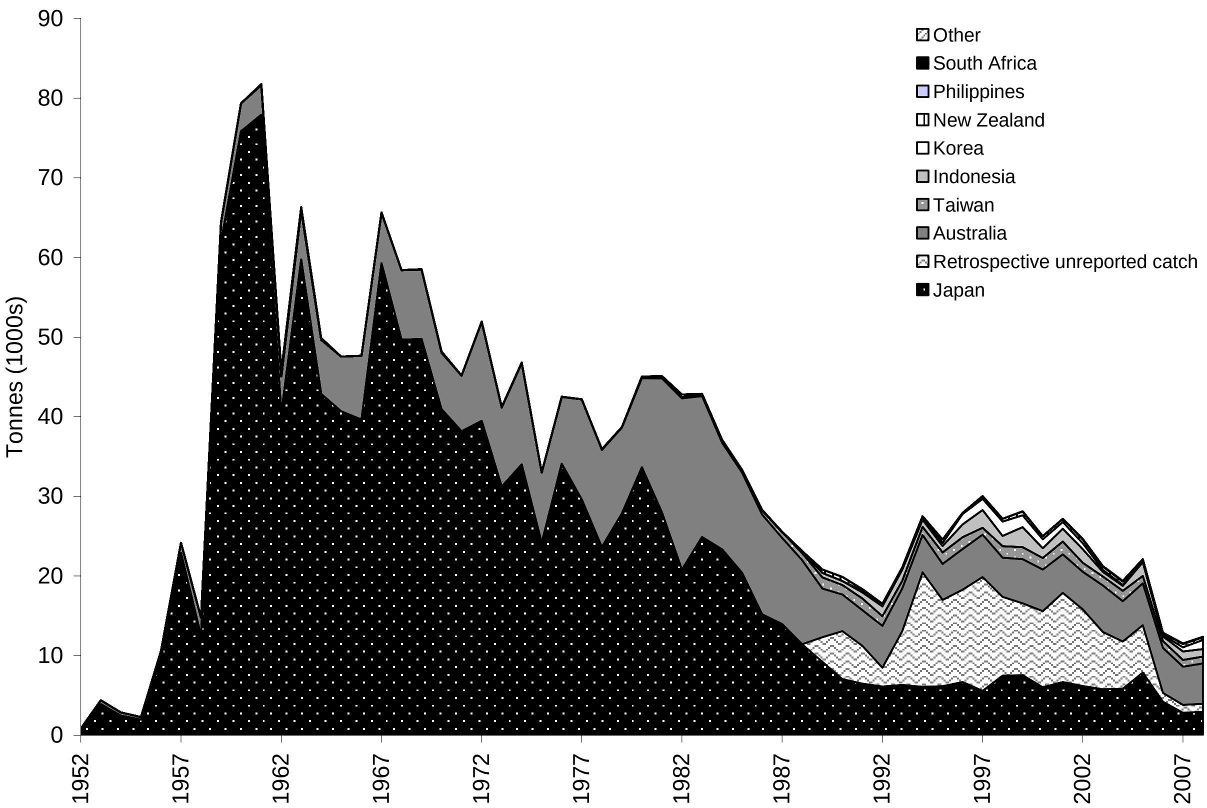


Fig. 13. Reported catches per country and estimates of retrospective unreported catches prepared by the Secretariat. Shaded areas are stacked so that *y*-axis values represent total estimated catch (1000 t) in a quota year

Catch per unit effort

Two possible sources of illegal, unreported catch (see Fig. 13, Lou et al. 2006) is non-Japanese longline catch entering Japanese markets as domestic SBT or as other tuna species. If either case is true, then CPUE from non-Japanese longline fleets may or may not have been affected by the unreported catches. Two further potential sources of illegal, unreported catch identified by Lou et al. (2006) are under-reported Japanese catches or Japanese SBT unloaded as other tunas. It is not known to what extent the Japanese longline CPUE series would be affected if either case were true.

Japanese longline CPUE

Nominal CPUE series for Japanese longliners was extracted from the CPUE input data provided in the May 2009 interim update of the CCSBT database. Other effort series (number of squares fished, Fig. 18) were derived from the same data. Standardised CPUE series were obtained from updates provided by Japan (w0.5, w0.8, ST Windows) and Australia (Laslett Core Area) through the CCSBT data exchange.

In recent years there have been several perturbations significantly affecting the continuity of the Japanese longline CPUE series. Of particular mention is the discovery of overcatch by the Japanese longline fleet in 2005 (confirmed late November 2005), and subsequent announcement by the Japan Fisheries Agency (JFA) that fishing operations would cease as of 11 December 2005, which saw a sudden spike in the submission of catch reports before the closure came into effect (Lou et al. 2006). This is not thought to have affected the CPUE series for months 4–9, which are the only months reported herein for Japanese, Korean and Taiwanese nominal CPUE. Furthermore, 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).

The following updates for 2008 have been compiled:

- Nominal aggregate CPUE for age 4+ SBT. The series showed an overall decline from 2002 until 2007, but increased in 2008 to a level above that recorded in 2004, slightly above the 2002–07 mean (Fig. 14, horizontal line)
- Nominal CPUE for age 4–7, 8–11 and 12+ SBT. The trend in aggregate 4+ CPUE since 2002 seems to be most closely related to a similar decline in the CPUE of age 4–7 SBT. A less marked decline can also be observed for age 8–11 SBT in 2002–07. The CPUE of age 4–7 has increased slightly since 2006, and that of age 8–11 since 2007. The CPUE of age 12+ SBT has remained low with relatively little variability since the early 1970s (Fig. 15)
- 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 the age 0–2 class. However, relative proportions of both age 0–2 and 3 dropped markedly in 2008; for age 0–2 SBT, the catch rate in 2008 was similar to the lowest yet observed (a little above the very low CPUE of age 0–2 in 2004). The catch rate of age 4 and age 5 SBT has remained at low levels for the past 4–5 years, similar to historic low levels observed in the late 1980s (Fig. 16)
- Age-specific nominal CPUE for SBT of ages 4, 5, 6, 7, 8 and 9. For ages 4 and 5 (and, to a lesser extent, age 6), catch rates increased in 2006, mostly as a result of increased CPUE in statistical areas 4–7. In general, CPUE of these age classes decreased slightly in statistical areas 8 and 9 in 2008. Catch rates of ages 7, 8 and 9 remained at low levels in all statistical areas, with the lowest catch rates observed in statistical areas 4–7 for ages 8 and 9 (Fig. 17)
- Total number of 5×5° grid squares with Japanese longline fishing effort in months 4–9 for statistical areas 4–9, 4–7, 8 and 9. The number of grid squares fished per month has shown a strong downward trend over time in all statistical areas considered, potentially leading to

over-optimism in the aggregate catch rates through a spatial hyperstability effect on the relationship between abundance and CPUE (Hartog & Preece 2008). The number of grid squares fished in 2008 declined slightly from 2007, possibly related to new management arrangements for the Japanese longline fleet brought into place in April 2006 (Fig. 18)

- Standardised CPUE. While standardised CPUE exhibited an overall declining trend from 2002 to 2007, all series except ST Windows increased in 2008 to levels similar to those observed in 2002–03. The ST Windows series increased slightly from the 2007 level but remains otherwise low (Fig. 19)

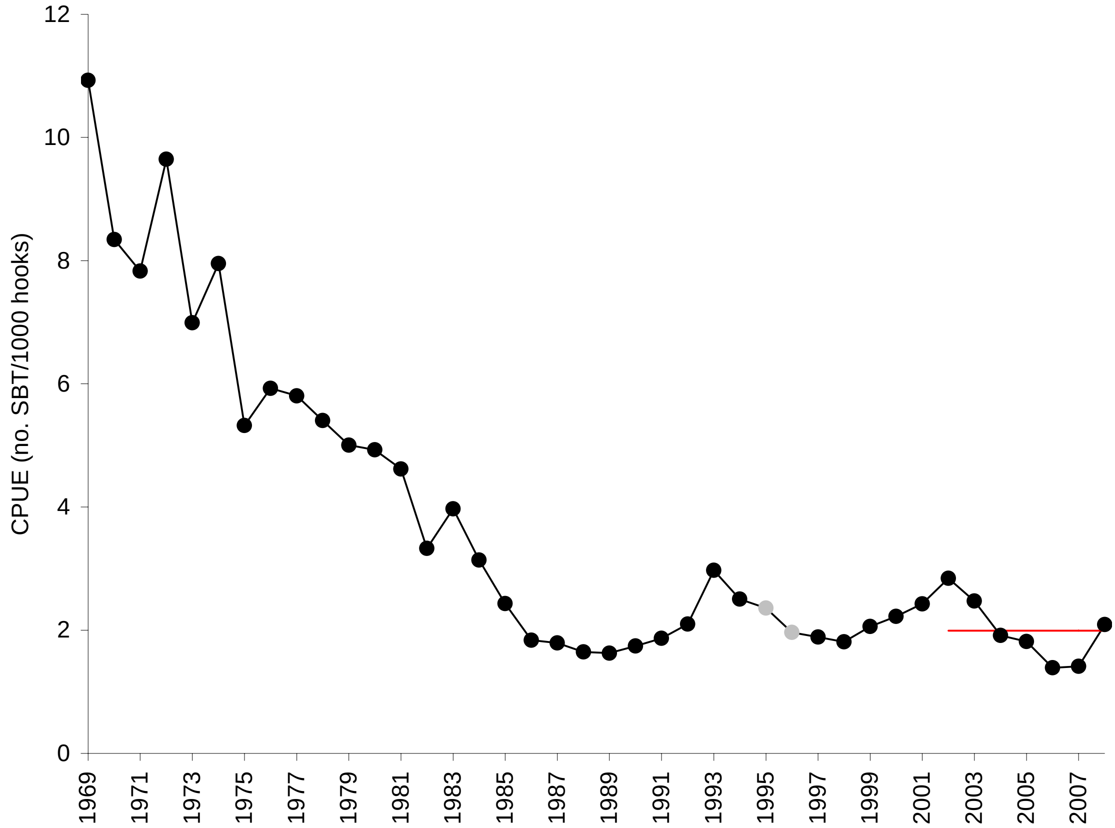


Fig. 14. Nominal CPUE of age 4+ SBT for Japanese longliners operating in statistical areas 4–9 in months 4–9. The 1995 and 1996 values are plotted as grey circles to indicate increased uncertainty about these points due to changes in retention policies for small fish in these two years. The horizontal line is the 2002–08 mean

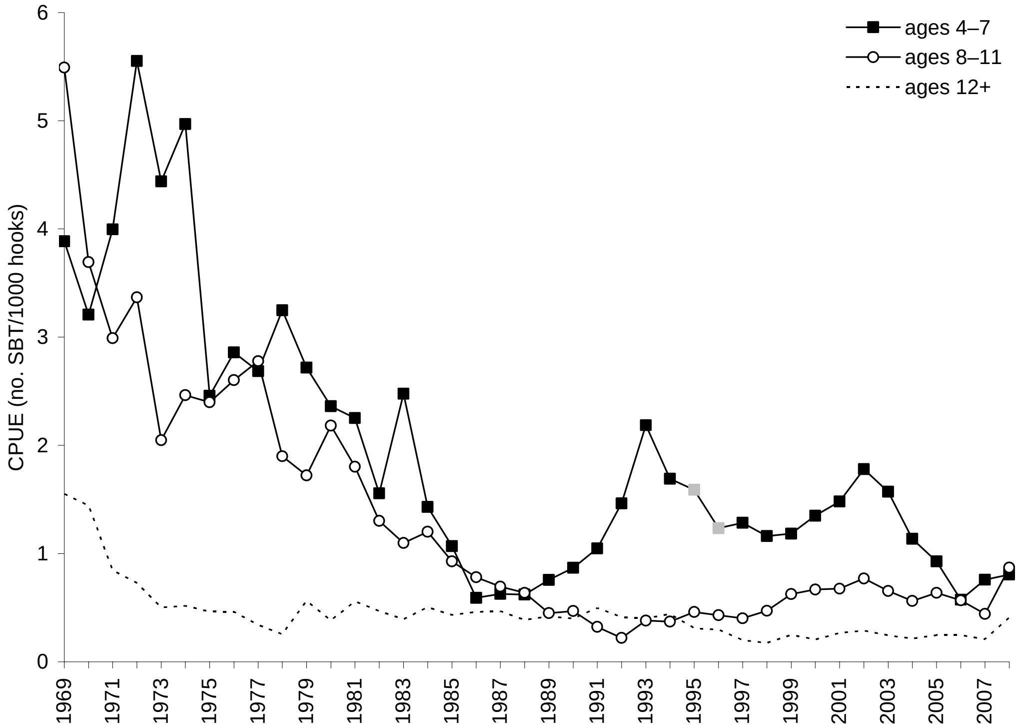


Fig. 15. Nominal CPUE of ages 4–7, 8–11 and 12+ SBT for Japanese longliners operating in statistical areas 4–9 in months 4–9. The 1995 and 1996 values for ages 4–7 are plotted as grey squares to indicate increased uncertainty about these points due to changes in retention policies for small fish in these two years

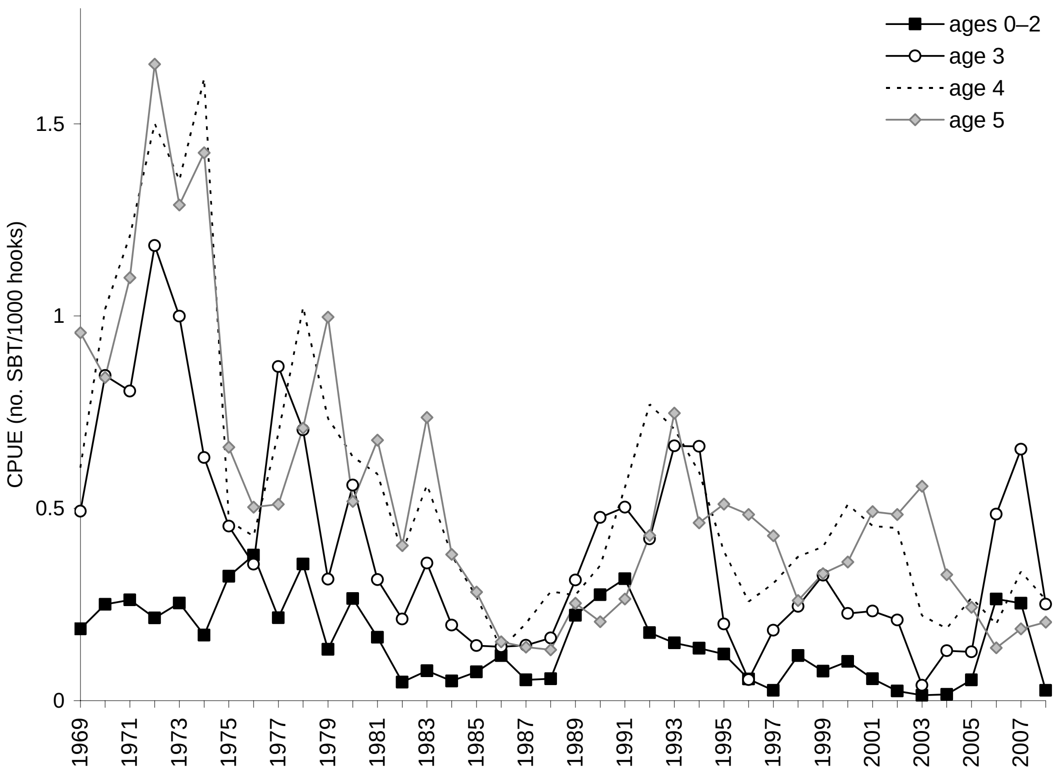


Fig. 16. Nominal CPUE of ages 0–2, 3, 4 and 5 SBT for Japanese longliners operating in statistical areas 4–9 in months 4–9

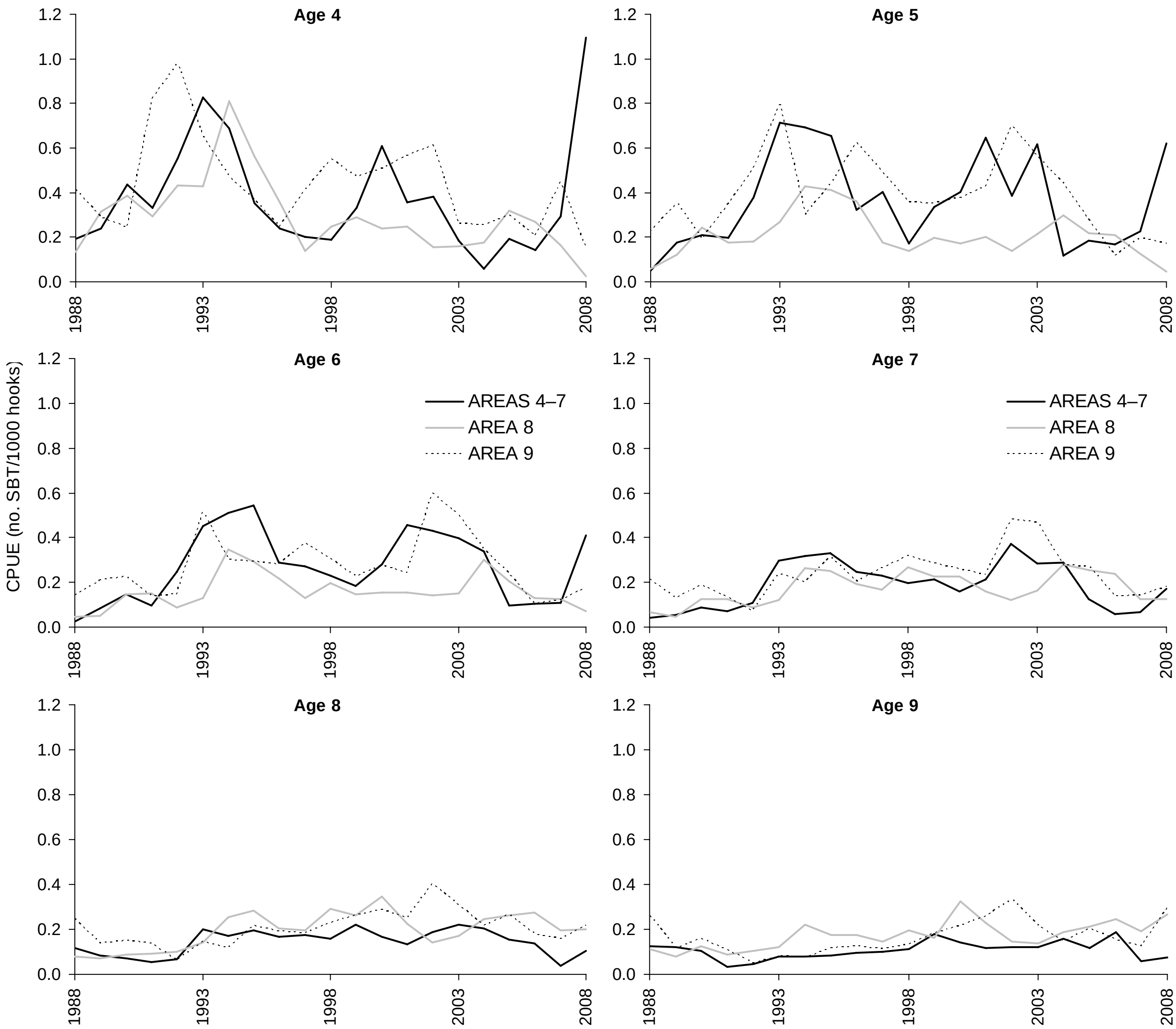


Fig. 17. Comparison of age-specific nominal CPUE for Japanese longliners in different statistical areas in months 4–9

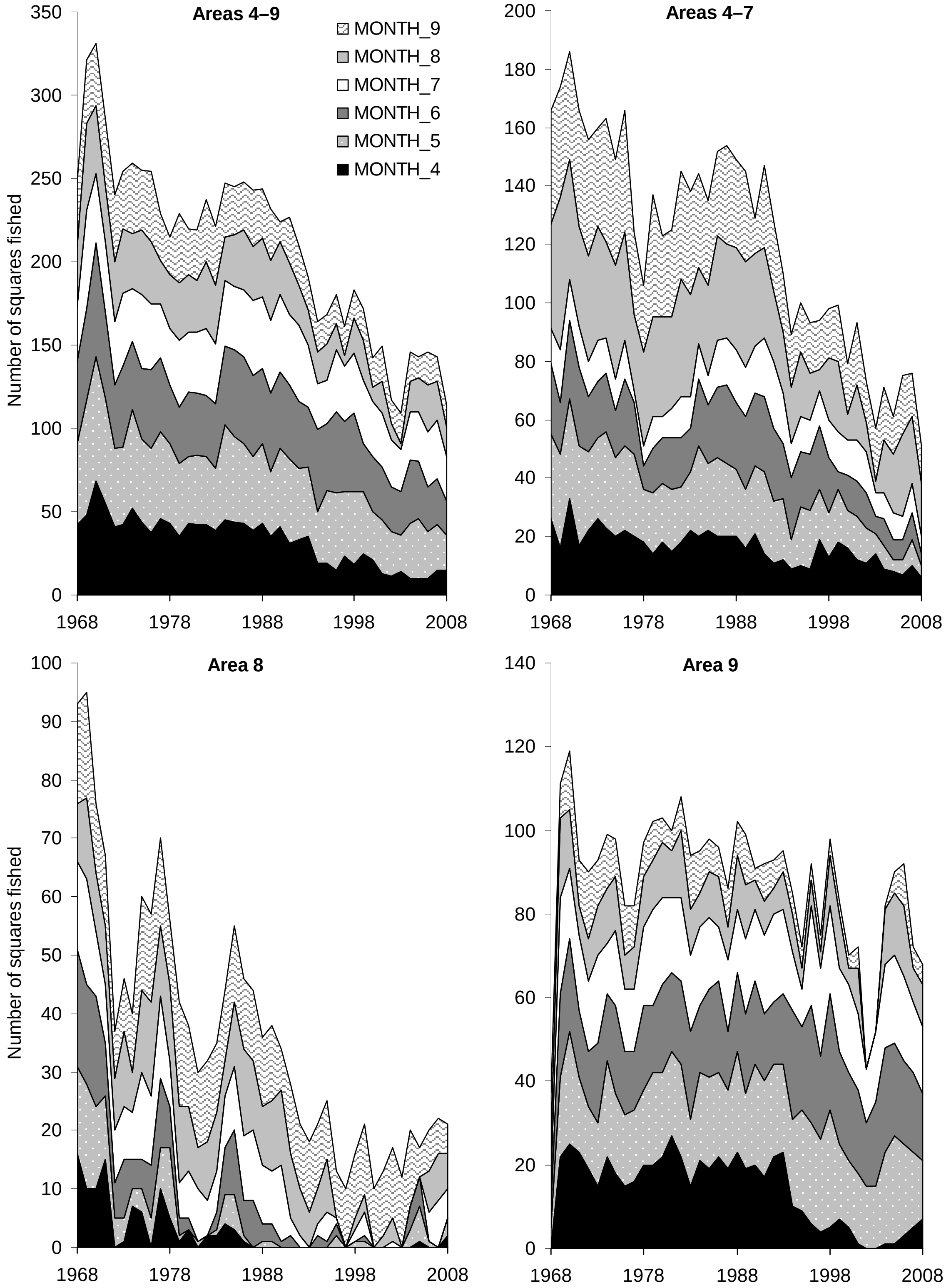


Fig. 18. Total number of 5×5° grid squares with Japanese longline fishing effort in months 4–9 for different statistical areas. Shaded series in each plot are stacked (i.e. y-axis values are cumulative), with the legend and shaded series being stacked in the same order

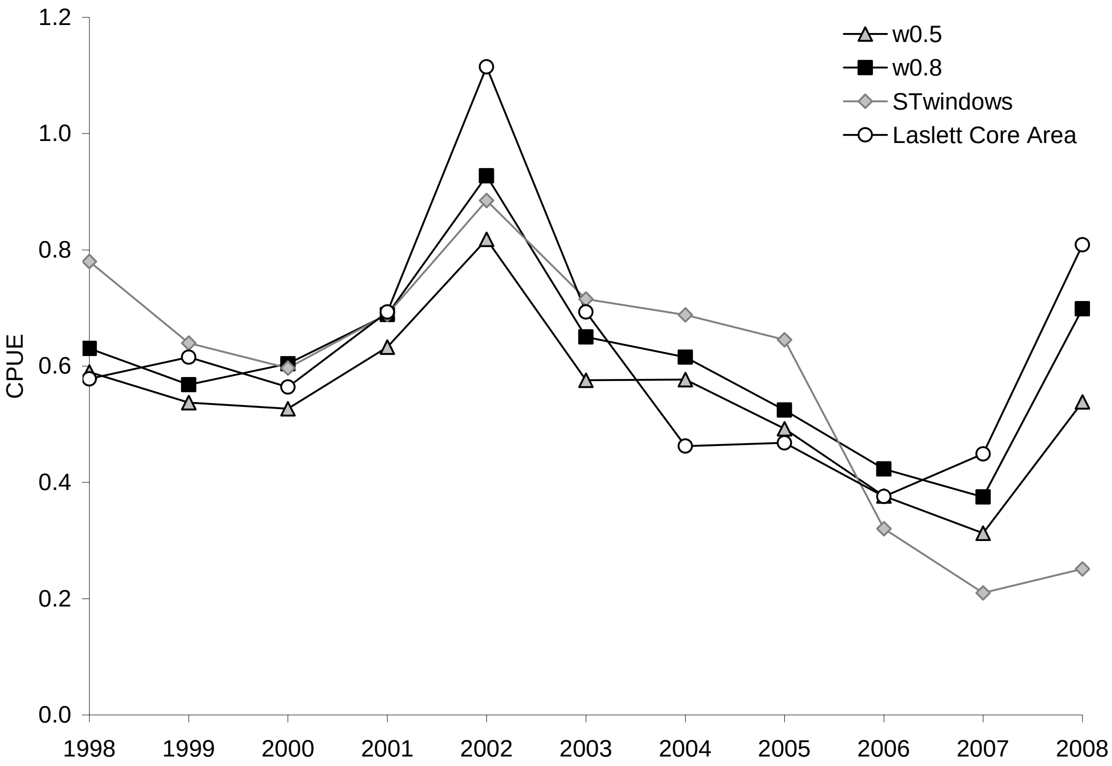


Fig. 19. Comparison of standardised CPUE series for the past 10 years

Korean longline CPUE

Nominal CPUE series for Korean longliners were obtained from aggregated catch and effort data provided in the May 2009 interim update of the CCSBT database.

Korean CPUE has generally declined since 1994, though increased again in recent years (2006–08) from very low catch rates in 2005, when little effort was deployed (Fig. 19). Catch rates in 2008 were slightly above those in 2007, and similar to rates observed in the late 1990s. Although the behaviour of the Korean longline fleet has been relatively stable since the early 1990s, in 2006 and 2007 the spatial distribution of the fleet shifted to take catches from western and central fishing grounds in the Indian Ocean (An et al. 2008).

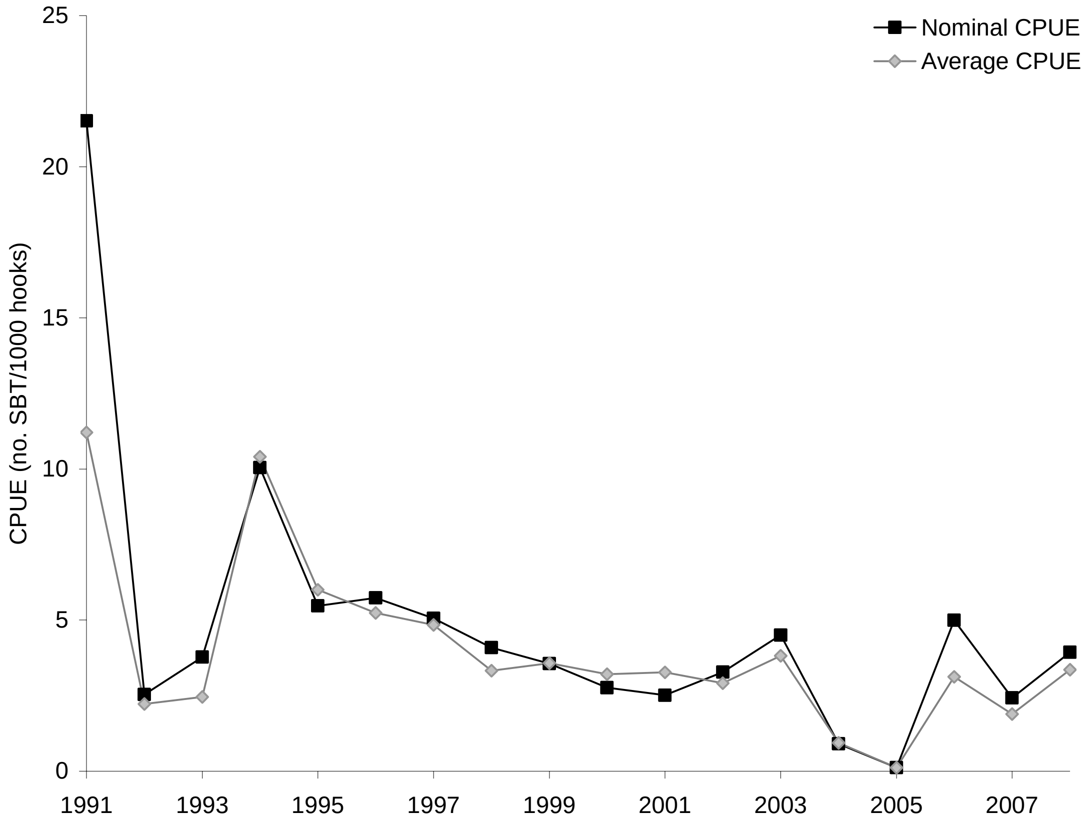


Fig. 20. Nominal and average CPUE of SBT for Korean longliners operating in statistical areas 4–9 in months 4–9. Nominal CPUE is the total number of SBT over total effort (1000 hooks), while average CPUE is the mean nominal rate in each 5×5° grid square per month

Taiwanese longline CPUE

Nominal CPUE series of Taiwanese longliners were obtained from aggregated catch and effort data provided in the May 2009 interim update of the CCSBT database.

Effort (vessel numbers) and spatial area fished by Taiwanese longliners began to increase in the 1980s. While SBT has previously been caught as bycatch of other Taiwanese tuna fisheries, in recent years vessels have began to target SBT on a seasonal basis (Anon 2008b). The main area of effort is the southern (30–35°S) and middle (25–30°S) 5° strips in statistical areas 2, 14 and 15, where vessels have historically targeted albacore. Highest catch rates were observed in the southern strip in 2008, though substantial catch rates were also observed in the middle strip during 2004–08 (Fig. 22). Catch rates in the northern (20–25°S) strip of statistical areas 2, 14 and 15, together with areas 8 and 9, remained low in 2008. Overall, CPUE declined in all statistical areas in 2008 (Figs. 21&22), though effort increased slightly from that observed in 2007 (Fig. 23). Notably, effort in areas 8 and 9 has increased substantially since 2005 to be similar to that in areas 2, 14 and 15 (where most effort is deployed in the southern strip); however, catch rates in these southern areas remained very low in 2008 (Figs. 21&22).

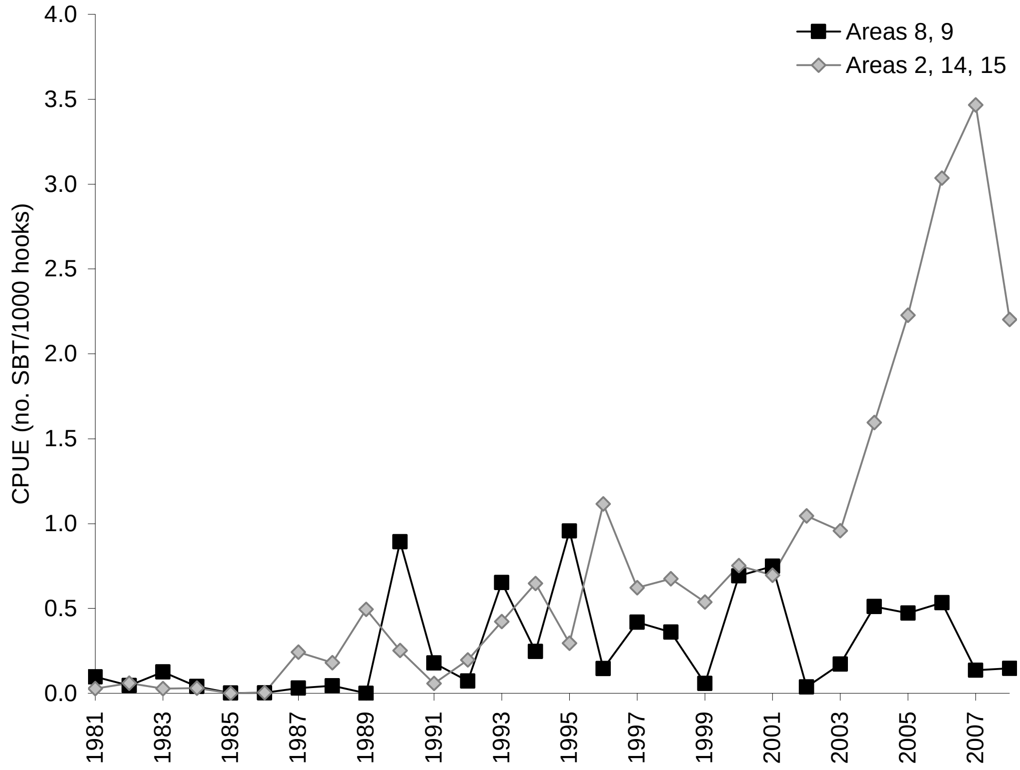


Fig. 21. Nominal CPUE of SBT for Taiwanese longliners operating in statistical areas 8 & 9 (pooled) and 2, 14 & 15 (pooled) in months 4–9

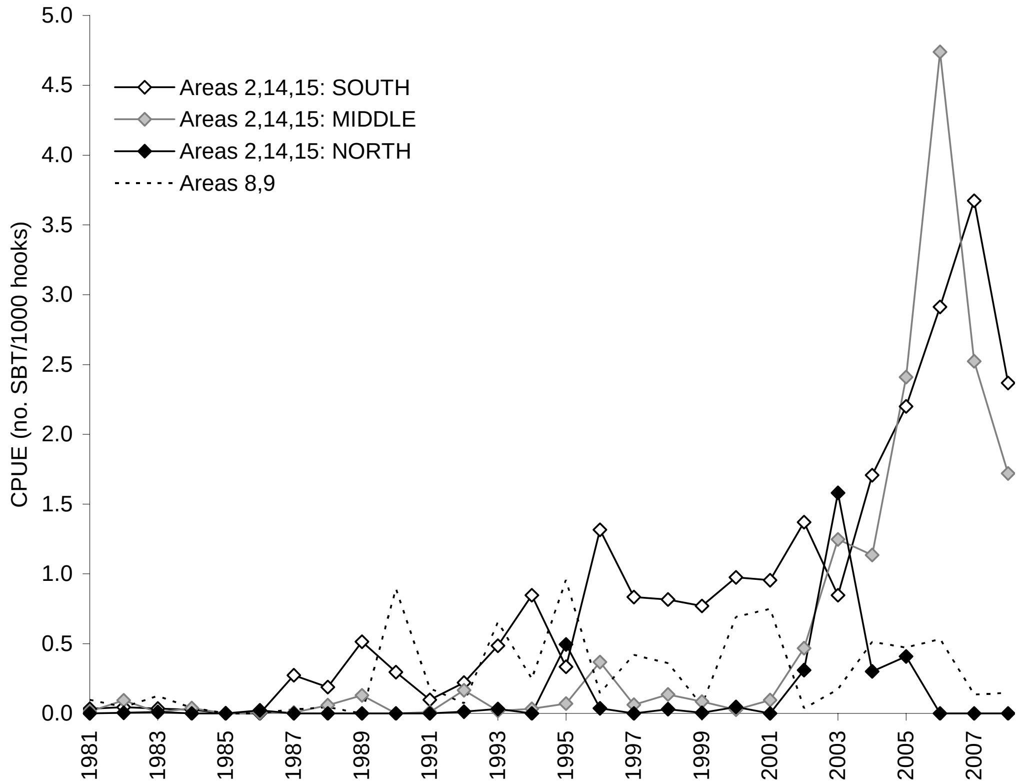


Fig. 22. Nominal CPUE of SBT for Taiwanese longliners operating in statistical areas 2, 14 & 15 (pooled) by 5° latitudinal strips: South = 30–35°S; Middle = 25–30°S; North = 20–25°S. Nominal CPUE in areas 8 & 9 (pooled) shown for comparison. Data are from months 4–9 only

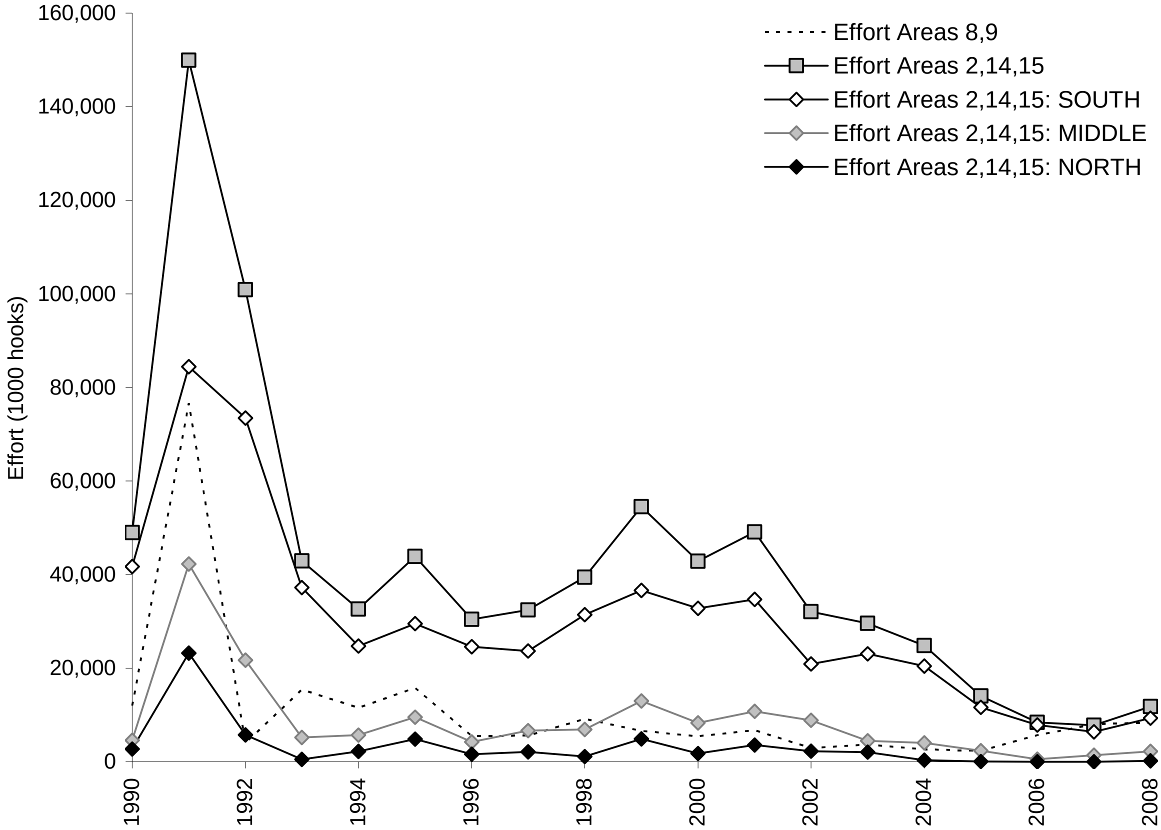


Fig. 23. Effort (1000 hooks) for the last 16 years from Taiwanese longliners in statistical areas 8 & 9 (pooled) and 2, 14 & 15 (pooled). Areas 2, 14 & 15 are also separated into 5° latitudinal strips: South = 30–35°S; Middle = 25–30°S; North = 20–25°S. Data are from months 4–9 only

Catch size/age composition

Analysis of indicators of trends in the juvenile portion of the SBT stock was prompted in 2005 because of very weak cohorts identified in the 2004 stock assessment (Hartog & Preece 2008). In the 2006 stock assessment (based on scenario modelling), the incidence of very small cohorts in the population seemed to have become reduced in latter years of the fishery (Hartog & Preece 2008, but see Basson et al. 2006).

Japanese longline fishery size/age composition

Size and age composition data for SBT caught by Japanese longliners were obtained from the May 2009 interim update of the CCSBT database (AGE_CAPTURE_DETAILS and AGE_FREQUENCY; SIZE_CAPTURE_DETAILS and SIZE_FREQUENCY).

The age composition of SBT caught by the Japanese longline fishery has been highly variable over time. The relative proportions of age 0–2 and age 3 SBT decreased in 2008, with the proportion of age 0–2 dropping to one of the lowest levels observed in the time series (Fig. 24). The proportion of age 4 decreased in 2008, while that of age 5 increased slightly. Overall, the proportions of all juvenile age classes in 2008 were similar to the low levels observed in the mid 1980s. Observer coverage on vessels has been less than 10% since 2003, and discarding of juveniles cannot be discounted.

For comparison with size/age composition in the NZ, Korean and Taiwanese longline fisheries, Japanese length data have also been compiled 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

Trends in size composition indicate that proportions of all juvenile size classes declined in 2008 (Fig. 25), with SBT ≤ 86 cm (~age 0–2) virtually disappearing from the fishery. Proportions of juvenile size classes in 2008 were again similar to levels observed in the mid 1980s.

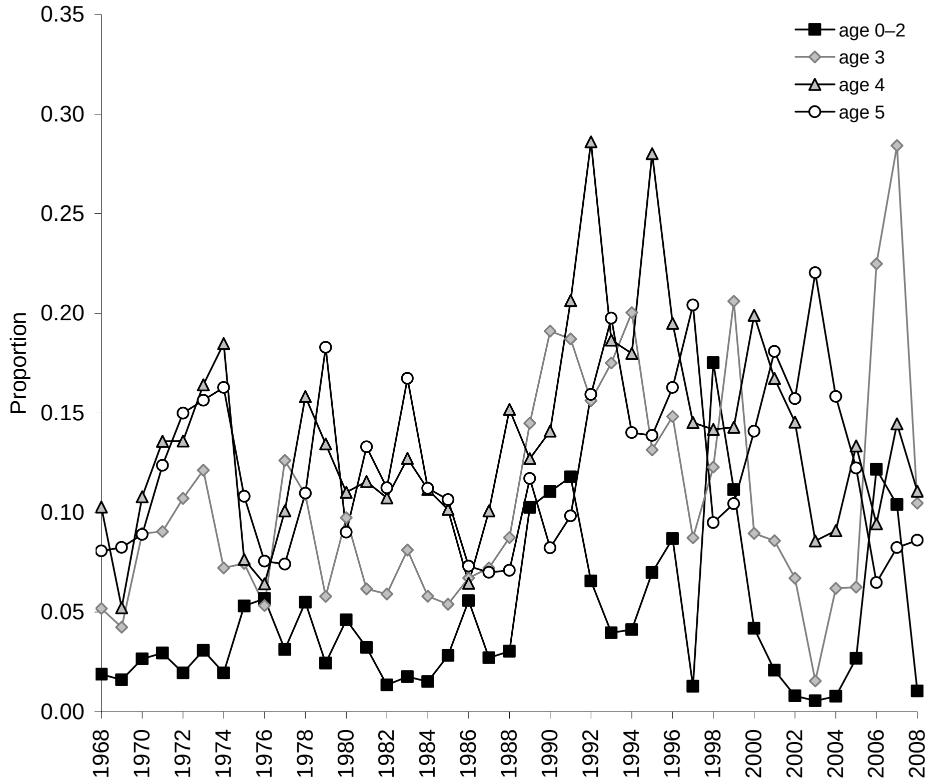


Fig. 24. Age composition (proportion of total catch) of ages 0–2, 3, 4 & 5 in the Japanese longline fishery in statistical areas 4–9, months 4–9

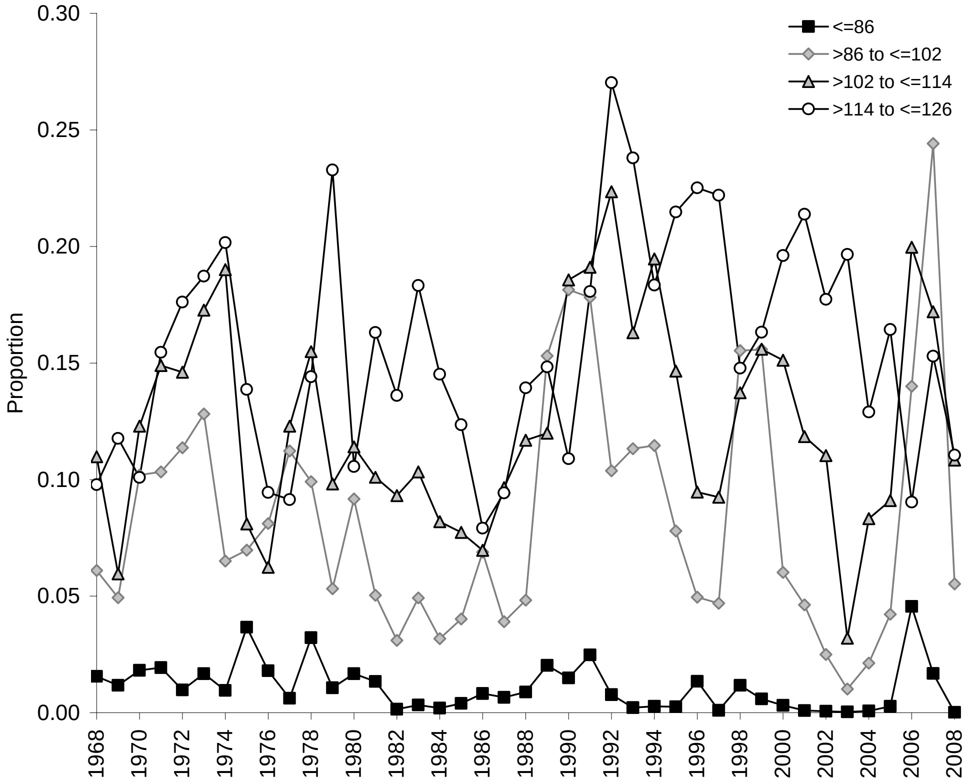


Fig. 25. Size composition (proportion of total catch) of juvenile SBT caught by Japanese longliners in statistical areas 4–9, months 4–9, where age 0–2≤86 cm, 86<age 3≤102 cm, 102<age 4≤114 cm, 114<age 5≤126 cm

Korean longline fishery size/age composition

Size composition data for SBT caught by Korean longliners were updated from data prepared for the operating model, available in the May 2009 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

The proportions of all juvenile size classes decreased in 2008 (Fig. 26), with the relative abundance of ages 3, 4 and 5 being considerably below the long-term (1991–2008) average. (Age 0–2: 2008 < 0.001, 1991–2008 = 0.007; Age 3: 2008 = 0.043, 1991–2008 = 0.086; Age 4: 2008 = 0.059, 1991–2008 = 0.123; Age 5: 2008 = 0.060, 1991–2008 = 0.163).

Given the variable but generally low effort in this fishery in recent years, the Korean data are not considered to be informative of relative cohort strength (Hartog & Preece 2008). Observer coverage on vessels has been less than 10% since 2004, and discarding of juveniles cannot be discounted.

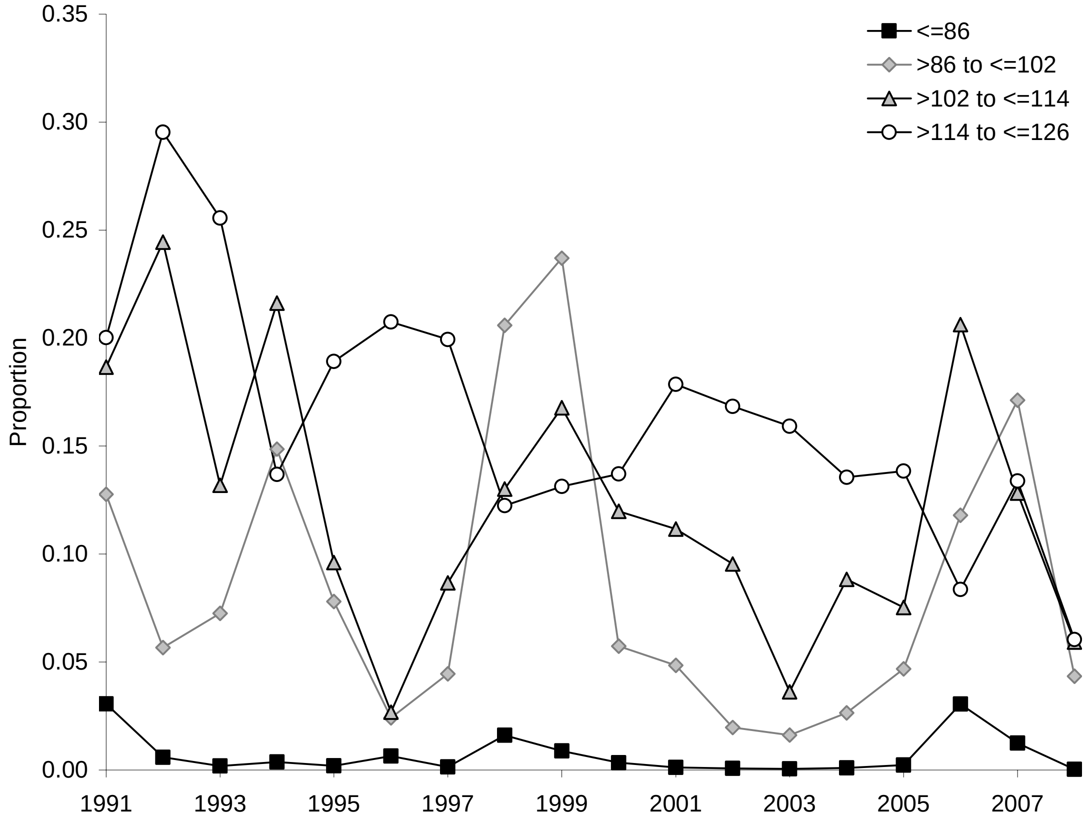


Fig. 26. Size composition (proportion of total catch) of juvenile SBT caught by Korean longliners, where age 0–2≤86 cm, 86<age 3≤102 cm, 102<age 4≤114 cm, 114<age 5≤126 cm

Taiwanese longline fishery size/age composition

Size composition data for SBT caught by Taiwanese longliners were updated from data prepared for the operating model, available in the May 2009 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 tuna 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 2008, proportions of juvenile size/age classes remained similar to levels observed in 2007, with ages 0–2 and 3 increasing slightly and age 4 decreasing. The proportion of age 5 SBT remained virtually unchanged from 2007. In 2008, the proportions of ages 3–5 were all above the long-term mean. (Age 0–2: 2008 < 0.013, 1981–2008 = 0.022; Age 3: 2008 = 0.121, 1998–2008 = 0.116; Age 4: 2008 = 0.266, 1981–2008 = 0.195; Age 5: 2008 = 0.334, 1981–2008 = 0.192). Observer coverage on vessels has been less than or around 10% since 2002, and discarding of juveniles cannot be discounted.

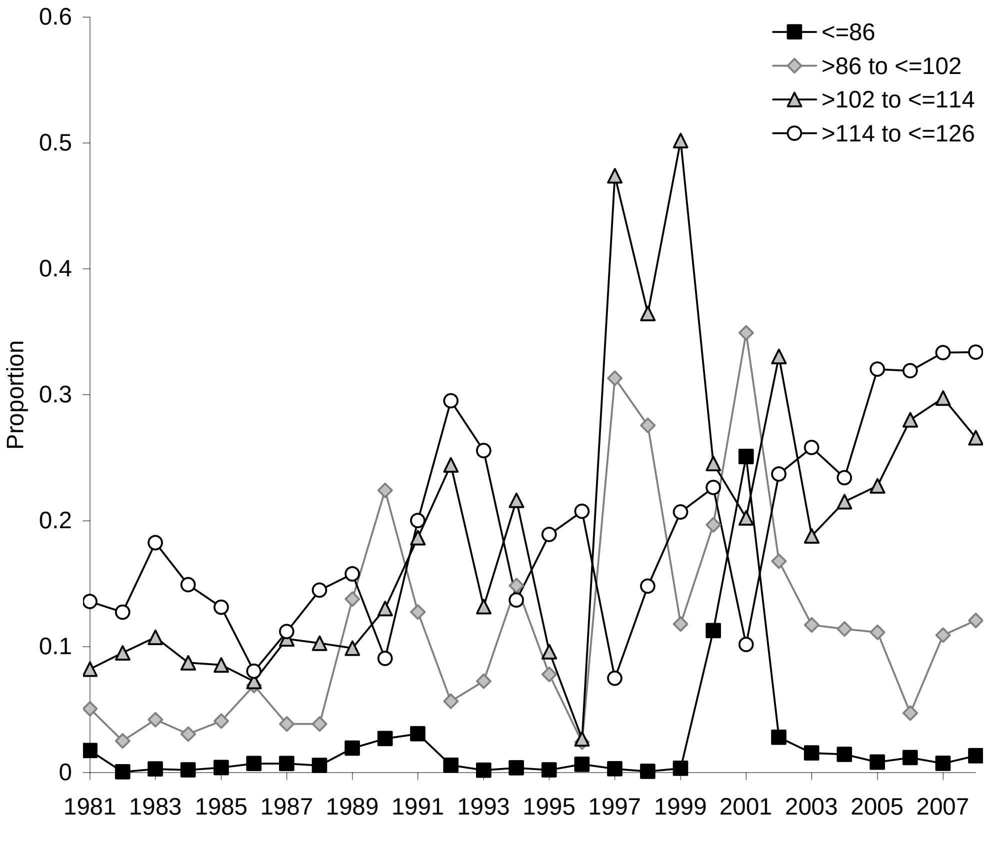


Fig. 27. Size composition (proportion of total catch) of juvenile SBT caught by Taiwanese longliners, where age 0–2≤86 cm, 86<age 3≤102 cm, 102<age 4≤114 cm, 114<age 5≤126 cm

Australian surface fishery age composition

The age composition of SBT caught by the Australian surface fishery was updated from data prepared by the Secretariat for the Management Procedure and provided through the CCSBT data exchange (SEC_ManagementProcedureData_52_08).

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 since 2004, and continues to be dominated by age 2 and 3 SBT. These two age classes have comprised around 90% of the catch in the surface fishery in recent years.

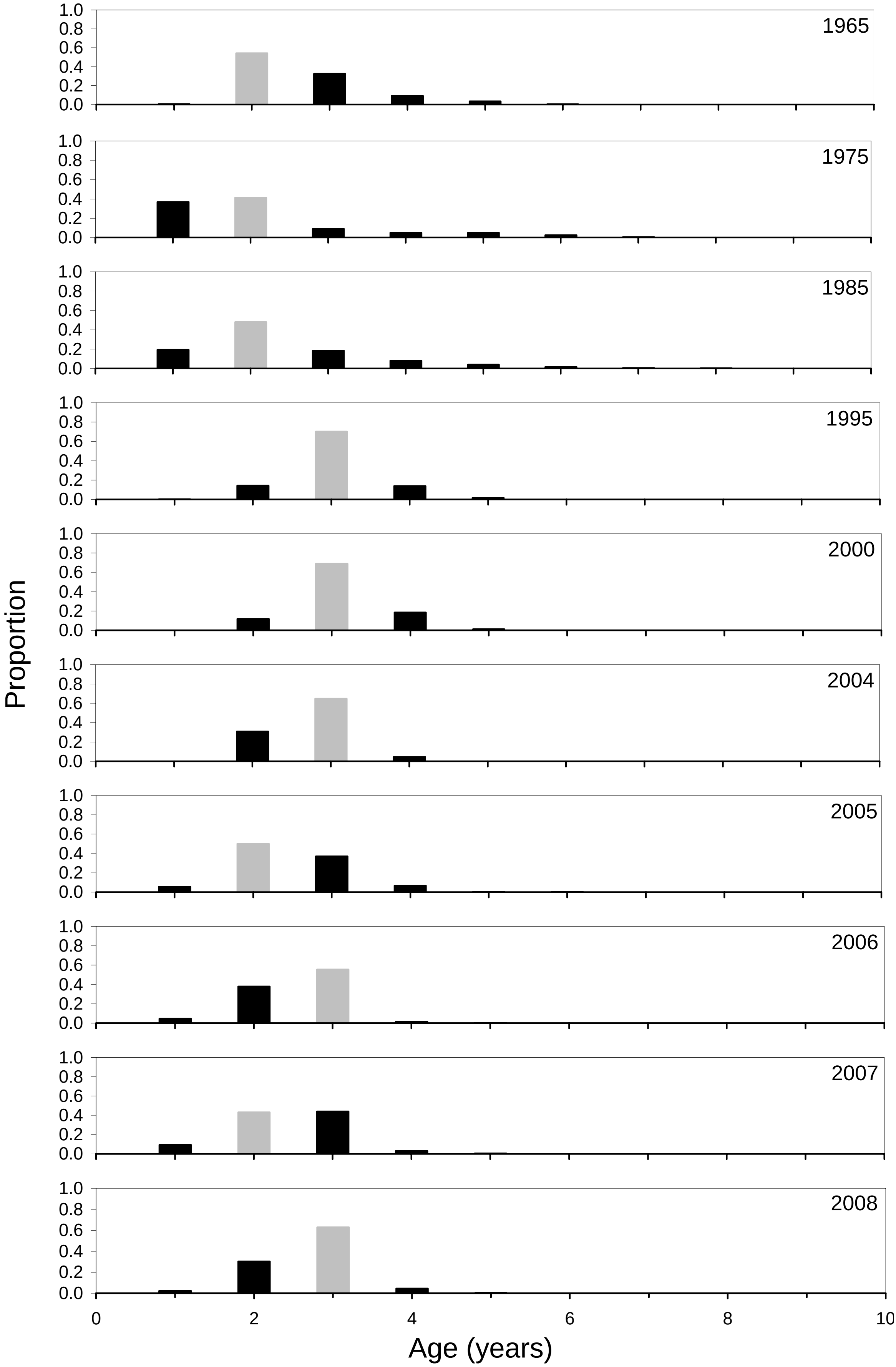


Fig. 28. Age composition in the Australian surface fishery. Grey bars show the median age class

Summary

Discussion of recent trends and apparent cohort strength is restricted to the subset of indicators thought to be unaffected by the unreported catch identified in the 2006 Japanese Market Review and Australian Farm Review. Further, Indonesian catch on the spawning ground was not considered in this summary because an interim catch allocation of 750 t has now been applied to the Indonesian fleet, and may is no longer provide a useful indicator of stock status.

Discussion is thus limited to the following indicators:

- Aerial spotting data in the GAB (scientific aerial survey; commercial spotting [SAPUE] index)
- Trolling index
- NZ CPUE (charter and domestic)
- NZ longline fishery size composition
- Indonesian longline fishery size/age composition

Trends in juvenile abundance

All three indices of juvenile (age 1 to 4) abundance in the GAB—the scientific aerial survey index, SAPUE index and trolling index—exhibited declines over the past 12 months from values observed in the 2007–08 fishing season (austral summer). Although only the decline in the SAPUE index was significant, this trend in all three indicators of juvenile abundance is of concern. The updated median of the scientific aerial survey was below the 2005–08 average, the median of the trolling index was below the 2006–08 average of the piston line survey, and the median of the SAPUE index was below the 2002–09 average.

Trends in age 4+ SBT

In contrast to trends in age 1–4 SBT, indicators of age 4+ SBT exhibited some upward trends. Catch per unit effort in both the NZ charter and domestic fisheries increased in 2008 compared with 2007, with age 4 and 5 SBT comprising a greater proportion of the catch. Both mean and median age of SBT caught on the Indonesian spawning grounds increased in 2008 compared with 2007, continuing the trend in this portion of the stock evident since around 2004/2005.

Recent trends in all indicators (excluding Indonesian catch on the spawning ground) are summarised in Table 1.

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.	2006	2007	2008	12 month trend
Unaffected by unreported catch							
Scientific aerial survey	1993–2000 2005–09	0.491 (2007)	0.851 (2005)	0.491	0.821	0.545	↓
SAPUE index	2002–09	0.55 (2004)	1.47 (2008)	1.05	1.47	0.94	↓
Trolling index	1996–2003 2005–06 2006–09	2.817 (2006)	5.426 (2008)	4.723	5.426	3.580	↓
NZ charter nominal CPUE (Areas 5+6)	1989–2008	1.339 (1991)	4.881 (2008)	2.011	1.746	4.881	↑
NZ domestic nominal CPUE	1989–2008	0.000 (1989)	1.187 (1995)	0.458	0.715	0.870	↑
NZ charter age/size composition (proportion age 0–5 SBT)	1989–2008	0.001 (2005)	0.414 (1993)	0.049	0.082	0.237	↑
NZ domestic age/size composition (proportion age 0–5 SBT)	1980–2008	0.001 (1985)	0.404 (1995)	0.161	0.004	0.114	↑
Indonesian age composition: mean age on spawning ground, all SBT	1993–94 to 2007–08	14 (2005–06)	24 (1995–96)	14	15	17	↑
Indonesian age composition: mean age on spawning ground, age 20+	1993–94 to 2007–08	23.000 (1993–94)	25.600 (1995–96)	24.770	24.770	24.122	↓
Indonesian age composition: median age on spawning ground	1994–95 to 2007–08	13 (2001–03)	21 (1994–97, 1998–99)	14	15	17	↑

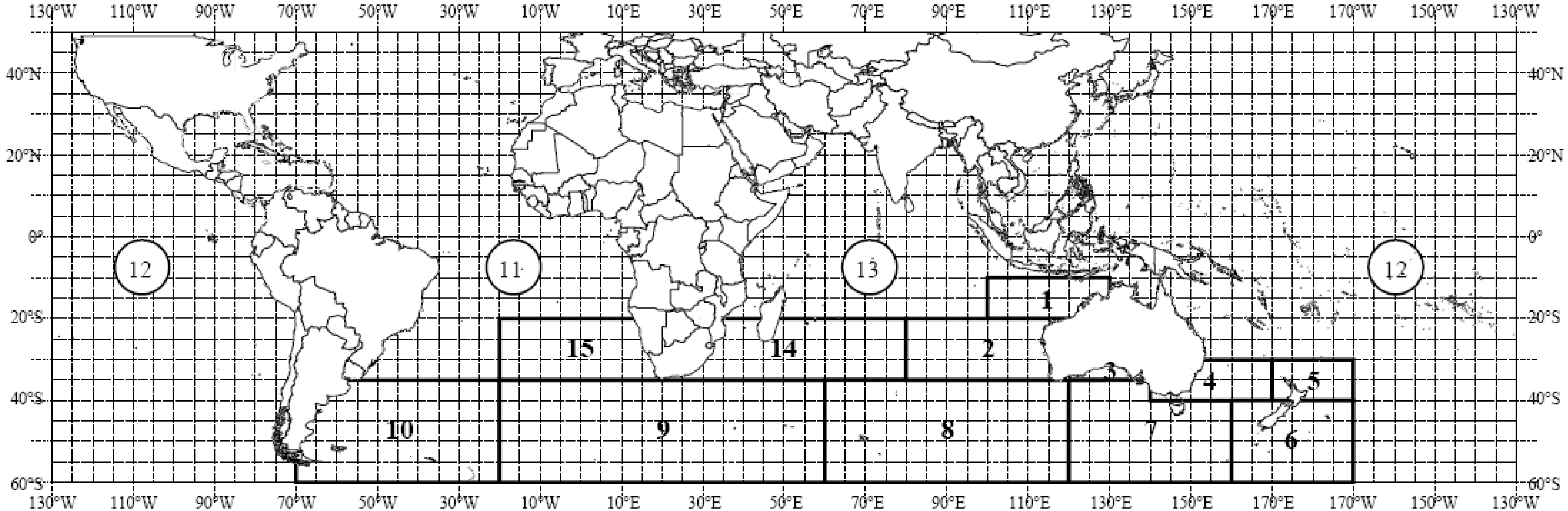
Table 1 (cont'd). Recent trends in all indicators of the SBT stock. Minimum and maximum values in the time series are also shown

Indicator	Period	Min.	Max.	2006	2007	2008	12 month trend
Affected by unreported catch							
Reported global catch	1952–2008	829 t (1952)	81 750 t (1961)	11 741 t	10 583 t	11 369 t	↑
Reported global catch + unreported catch estimates	1952–2008	829 t (1952)	81 750 t (1961)	12 867 t	11 545 t	12 374 t	↑
Japanese nominal CPUE, age 4+ SBT	1969–2008	1.390 (2006)	22.143 (1965)	1.390	1.412	2.090	↑
Japanese standardised CPUE (w0.5, w0.8, STwindows, Laslett)	1998–2008	observed 2006–07 (Fig. 19)	observed 2002 (Fig. 19)	0.321–0.423	0.210–0.450	0.251–0.809	↑
Korean nominal CPUE	1991–2008	0.118 (2005)	21.523 (1991)	4.995	2.429	3.931	↑
Taiwanese nominal CPUE, Areas 8+9	1981–2008	<0.001 (1985)	0.956 (1995)	0.533	0.136	0.147	↑
Taiwanese nominal CPUE, Areas 2+14+15		<0.001 (1985)	3.466 (2007)	3.035	3.466	2.203	↓

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

Indicator	Period	Min.	Max.	2006	2007	2008	12 month trend
Affected by unreported catch (cont'd)							
Japanese age composition, age 0–2	1969–2008	0.004 (1966)	0.175 (1998)	0.122	0.104	0.103	↓
Japanese age composition, age 3	1969–2008	0.015 (2003)	0.284 (2007)	0.225	0.284	0.105	↓
Japanese age composition, age 4	1969–2008	0.052 (1969)	0.286 (1992)	0.094	0.144	0.111	↓
Japanese age composition, age 5	1969–2008	0.065 (2006)	0.234 (1965)	0.065	0.082	0.086	↑
Korean age/size composition, age 0–2	1991–2008	<0.001 (2008)	0.031 (1991)	0.031	0.013	<0.001	↓
Korean age/size composition, age 3	1991–2008	0.016 (2003)	0.237 (1999)	0.118	0.171	0.043	↓
Korean age/size composition, age 4	1991–2008	0.027 (1996)	0.244 (1992)	0.206	0.128	0.059	↓
Korean age/size composition, age 5	1991–2008	0.060 (2008)	0.295 (1992)	0.084	0.134	0.060	↓
Taiwanese age/size composition, age 0–2	1981–2008	<0.001 (1982)	0.251 (2001)	0.012	0.007	0.013	↑
Taiwanese age/size composition, age 3	1981–2008	0.024 (1996)	0.349 (2001)	0.047	0.109	0.121	↑
Taiwanese age/size composition, age 4	1981–2008	0.027 (1996)	0.502 (1999)	0.280	0.297	0.266	↓
Taiwanese age/size composition, age 5	1981–2008	0.075 (1997)	0.334 (2008)	0.319	0.333	0.334	↑
Australia surface fishery median age composition	1964–2008	age 1 (1979–80)	age 3 (multiple years, see Fig. 28)	age 3	age 2	age 3	↑

Attachment 1. Map of CCSBT Statistical Areas



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