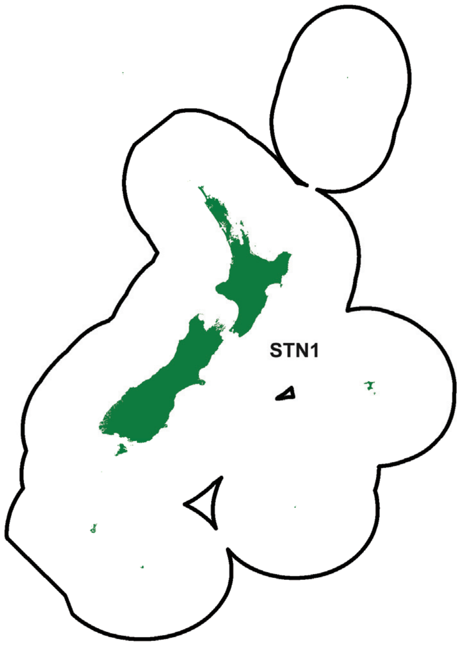
SOUTHERN BLUEFIN TUNA (STN)

(*Thunnus maccoyii)*



1. FISHERY SUMMARY

Southern bluefin tuna were introduced into the QMS on 1 October 2004 under a single QMA, STN 1, with allowances, TACC, and TAC in Table 1.

Table 1: Recreational and Customary non-commercial allowances, TACCS and TAC for southern bluefin tuna.

Fishstock	Recreational Allowance (t)	Customary non-commercial Allowance (t)	Other mortality (t)	TACC (t)	TAC (t)
STN 1	4	1	2	413	420

Southern bluefin tuna were added to the Third Schedule of the 1996 Fisheries Act with a TAC set under s14 because a national allocation of southern bluefin tuna for New Zealand has been determined as part of an international agreement. The TAC applies to all New Zealand fisheries waters, and all waters beyond the outer boundary of the exclusive economic zone.

Southern bluefin tuna were also added to the Sixth Schedule of the 1996 Fisheries Act with the provision that:

> "A person who is a New Zealand national fishing against New Zealand's national allocation of southern bluefin tuna may return any southern bluefin tuna to the waters from which it was taken from if –
> (a) that southern bluefin tuna is likely to survive on return; and
> (b) the return takes place as soon as practicable after the southern bluefin tuna is taken".

Management of southern bluefin tuna throughout its range is the responsibility of the Commission for Conservation of Southern Bluefin Tuna (CCSBT) of which New Zealand is a founding member. Current members of the CCSBT also include Australia, Japan, the Republic of Korea, the Fishing Entity of Taiwan and Indonesia. The Republic of South Africa, the European Community, and the Philippines have Cooperating Non-member status. Determination of the global TAC and provision of a national allocation to New Zealand is carried out by the CCSBT. The allocation for New Zealand for 2010 and 2011 agreed at the 16th meeting of CCSBT in October 2009 is 709 t (see Table 2). However, additional agreements reached by New Zealand have reduced the available catch limit to 570t for 2010 and 2011.

Table 2: Allocated catches for Members and Cooperating Non-members (2010 and 2011).

Member	Effective catch limit (t)
Australia	4015
Fishing Entity of Taiwan[#]	859
Japan	2261
New Zealand	709
Republic of Korea[#]	859
Indonesia	750
Cooperating Non-Member	
European Community	10
Philippines	45
South Africa	40

[#] Members catches are limited to an average of the amount listed in the table over the two-year period, but have some flexibility in the spread of catch over the two years.

In July 2006, the CCSBT Commission reviewed the results of two joint Australia / Japan reviews: the first was an assessment of the amount of southern bluefin tuna being sold through Japanese markets (referred to as the Market Review), and the second was an assessment of the potential for overcatch from the Australian surface fishery and associated farming operations (referred to as the Farming Review).

The Market Review reported that quantities of southern bluefin tuna sold through the Japanese markets (back to the mid-1980s) were well in excess of the amount reported by Japan as domestic catch or imported from other countries (measured through the Trade Documentation Scheme), i.e. there were large volumes of unreported catch. The Market Review could not determine where the catch came from.

The Farming Review reported that while the catch in numbers from the surface fishery were probably well reported there was scope for biases in reported catch in weight due to two factors: (1) changes in the weight of fish between the time of capture and when the weight sample is taken; and (2) the sample of fish taken to estimate the mean weight of fish in the catch may not be representative (causing either negative of positive biases in the mean weight estimate).

The Farming Review was inconclusive. To remove doubt Australia has agreed to undertake a research program to address some of the issues raised in the Farming Review.

While Japan does not accept the findings of the Market review they have acknowledged some illegal catch during the 2005 fishing season and recently changed how they manage their fishery and in 2006 accepted a cut in their allocated catch to 3000 t down from 6065 t. Current allocations are provided in Table 2 above, while previous allocations are provided in Table 3 below.

Table 3: Previous allocated catches for Members, Cooperating Non-members (2006-09).

	Allocated catch (t)
Australia	5265
Fishing Entity of Taiwan[#]	1140
Japan	3000
New Zealand	420
Republic of Korea[#]	1140
Indonesia	750
European Community	10
Philippines	45
South Africa	40

[#] The Fishing Entity of Taiwan and the Republic of Korea have both agreed to voluntarily limit their catches to 1000t.

The findings of the two reviews have resulted in considerable uncertainty in the southern bluefin tuna science process as even the most fundamental data (e.g. catch history) are not reliable and may be very different from reported catches. Further, many of the indicators of stock status previously relied upon are now under question as they may be biased due to illegal activity.

This working group report has not been updated to reflect the findings of these two reviews, but in some places the possible impact of the reviews are noted.

1.1 Commercial fisheries

The Japanese distant water longline fleet began fishing for southern bluefin tuna in the New Zealand region in the late 1950s and continued after the declaration of New Zealand's EEZ in 1979 under a series of bilateral access agreements until 1995 (Table 5).

The domestic southern bluefin tuna fishery began with exploratory fishing by Watties in 1966 and Ferons Seafoods in 1969. Most of the catch was used for crayfish bait (reported landings began in 1972). During the 1980s the fishery developed further when substantial quantities of southern bluefin tuna were air freighted to Japan. Throughout the 1980s, small vessels handlining and trolling for southern bluefin tuna dominated the domestic fishery. Southern bluefin tuna were landed to a dedicated freezer vessel serving as a mother ship, or, ashore for the fresh chilled market in Japan.

Longlining for southern bluefin tuna was introduced to the domestic fishery in the late 1980s under government encouragement and began in 1988 with the establishment of the New Zealand Japan Tuna Company Ltd. New Zealand owned and operated longliners, mostly smaller than 50 GRT, began fishing in 1991 for southern bluefin tuna (1 vessel). The number of domestic vessels targeting STN expanded throughout the 1990s and early 2000s prior to the introduction of STN into the QMS. Table 4 summarises southern bluefin landings in New Zealand waters since 1972. Figure 1 shows historical landings and TACC values as well as longline effort for domestic southern bluefin tuna.

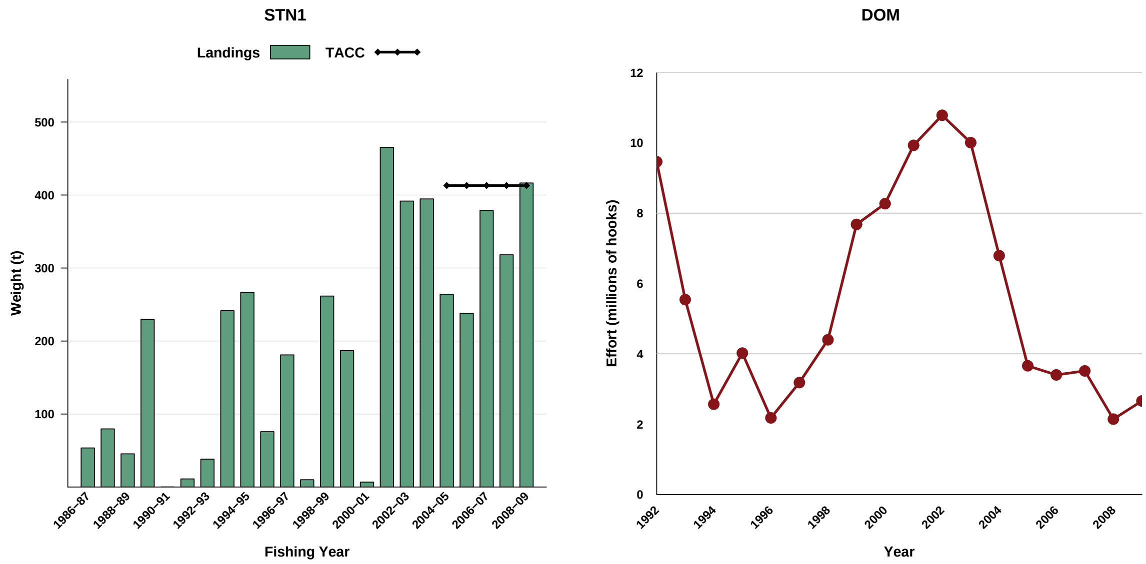


Figure 1: Commercial catch of southern bluefin tuna from 1986-87 to 2008-09 within NZ fishery waters (STN1), and fishing effort (number of hooks set) for all domestic surface longline vessels from 1992 to 2009.

Since 1991 surface longlines have been the predominant gear used to target southern bluefin tuna in the domestic fishery with 96% of all days fished using this method and only 4% using hand line (< 1% used trolling). This represents a major change from the 1980s when most fishing was by hand line.

In the few instances when the New Zealand allocation has been exceeded, the domestic catch limit has been reduced in the following year by an equivalent amount. Table 4 contrasts New Zealand STN catches with those from the entire stock. The low catches relative to other participants in the global fishery are due to New Zealand's limited involvement historically rather than to local availability. Table 5 indicates that throughout most of the 1980s catches of STN up to two thousand tonnes were taken within the New Zealand EEZ.

Data on reported catch of southern bluefin tuna are available from the early 1950s. By 1960 catches had peaked at nearly 80 000 t, most taken on longline by Japan. From the 1960s through the mid 1970s, when Australia was expanding their domestic surface fisheries for southern bluefin tuna, total catches were in the range 40 000 to 60 000 t. From the mid 1970s through the mid 1980s catches were in the range 35 000 to 45 000 t. Catches declined from 33 325 t in 1985 to 13 869 t in 1990 and have fluctuated about 15 000 t per year since that time (see Table 4). However, it should be noted that reported total catches are likely to be underestimates, at least after 1989, as they do not incorporate the findings from the Market and Farming Reviews. Despite this uncertainty the catches reported in 2008 (11 369 t) are the lowest estimated global catch for over 50 years.

Table 4: Reported domestic[1] and total[2] southern bluefin tuna landings (t) from 1972 to 2008 (calendar year).

Year	NZ Landings (t)	Total stock (t)	Year	NZ Landings (t)	Total stock (t)
1972	1	51 925	1991	164	13 691
1973	6	41 205	1992	279	14 217
1974	4	46 777	1993	217	14 344
1975	0	32 982	1994	277	13 154
1976	0	42 509	1995	436	13 637
1977	5	42 178	1996	139	16 356
1978	10	35 908	1997	334	16 076
1979	5	38 673	1998	337	17 776
1980	130	45 054	1999	461	19 529
1981	173	45 104	2000	380	15 475
1982	305	42 788	2001	358	16 027
1983	132	42 881	2002	450	15 240
1984	93	37 090	2003	390	14 060
1985	94	33 325	2004	393	13 623
1986	82	28 319	2005	264	16 146
1987	59	25 575	2006	238	11 850
1988	94	23 145	2007	379	11 540
1989	437	17 843	2008	319	11 369
1990	529	13 870			

[1] Domestic here includes catches from domestic vessels and Japanese vessels operating under charter agreement, i.e. all catch against the New Zealand allocation;
[2] These figures are likely underestimates as they do not incorporate the findings from the Market and Farming Reviews
Source: NZ data from Annual Reports on Fisheries, MAF data, NZ Fishing Industry Board Export data and LFRR data; Total stock from www.ccsbt.org.

Table 5: Reported catches or landings (t) of southern bluefin tuna by fleet and Fishing Year. NZ: New Zealand domestic and charter fleet, ET: catches by New Zealand flagged vessels outside these areas, JPNFL: Japanese foreign licensed vessels, KORFL: foreign licensed vessels from the Republic of Korea, LFRR: Estimated landings from Licensed Fish Receiver Returns, and MHR: Monthly Harvest Return Data.

Fish Yr	JPNFL	NZ	Total	LFRR/MHR	NZ ET
1979/80	7 374.7		7 374.7		
1980/81	5 910.8		5 910.8		
1981/82	3 146.6		3 146.6		
1982/83	1 854.7		1 854.7		
1983/84	1 734.7		1 734.7		
1984/85	1 974.9		1 974.9		
1985/86	1 535.7		1 535.7		
1986/87	1 863.1		1 863.1	59.9	
1987/88	1 059.0		1 059.0	94.0	
1988/89	751.1	284.3	1 035.5	437.0	
1989/90	812.4	379.1	1 191.5	529.3	
1990/91	780.5	93.4	873.9	164.6	
1991/92	549.1	248.9	798.1	279.1	
1992/93	232.9	126.6	359.5	216.4	
1993/94	0.0	287.3	287.3	277.0	
1994/95	37.3	358.0	395.2	435.3	
1995/96		141.8	141.8	140.5	
1996/97		331.8	331.8	333.5	
1997/98		330.8	330.8	331.5	
1998/99		438.1	438.1	457.9	
1999/00		378.3	378.3	381.3	
2000/01		366.0	366.0	366.4	
2001/02		468.3	468.3	452.3	
2002/03		405.7	405.7	391.7	0.0
2003/04		399.6	399.6	394.1	0.0
2004/05		272.1	272.1	263.3	0.0
2005/06		237.7	237.7	237.3	0.1
2006/07*		379.1	379.1	379.1	-
2007/08*		318.2	318.2	318.2	-
2008/09*		416.5	416.5	416.5	-

* - Southern bluefin tuna landings are not separated into within zone and ET since 2006/07

From 1960 to the 1990s catches by longline declined while surface fishery catches in Australian waters increased to reach its maximum level of 21 512 t in 1982 (equal to the longline catches of Japan). During the 1980s catches by both surface and longline fisheries declined but following dramatic TAC reductions in the late 1980s, catches stabilised. The main difference between gear types is that surface fisheries target juveniles (age-1 to age-3 year olds) while longline fisheries catch older juveniles and adults (age-4 year old up to age-40+). The surface fishery has comprised purse seine and pole-&-line vessels supported by aerial spotter planes that search out surface schools. The Australian surface fisheries that prior to 1990 were a mix of pole-&-line and purse seine vessels, have since the mid-1990s become almost exclusively a purse seine fishery. Whereas prior to 1990, surface fishery catches supplied canneries, since the mid-1990s these vessels catch juveniles for southern bluefin tuna farms where they are “on-grown” for the Japanese fresh fish market. In contrast to Australia, the fisheries of all other members, (including New Zealand) are based on longline. Historically New Zealand also supported handline and troll fisheries for STN, although these were small scale and targeted large adults.

Analysis of New Zealand catch data shows that most southern bluefin tuna are caught in FMA1, FMA2, FMA5 and FMA7. The northern FMAs (FMA1 and FMA2) that accounted for a small proportion of southern bluefin tuna before 1998 have in recent years accounted for about the same amount of southern bluefin tuna as the southern FMAs (FMA5 and FMA7).

This change in spatial distribution of catches can be attributed to the increase in domestic longline effort in the northern waters.

1.2 Recreational fisheries

Charter vessels based in Milford Sound are known to have targeted southern bluefin tuna historically and take it as bycatch in the newly developed Pacific bluefin tuna fishery. Estimates of catch based on voluntary charter boat reporting range from 4,025 kg (35 fish) in 2007 to 400 kg (3 fish) in 2008. A further 20 fish (2,171 kg) were released alive, probably after tagging.

1.3 Customary non-commercial fisheries

An estimate of the current customary catch is not available**.** Given that Maori knew of several oceanic fish species and missionaries reported that Maori regularly fished several miles from shore, it is possible that southern bluefin tuna were part of the catch of Maori prior to European settlement. It is clear that Maori trolled lures (for kahawai) that are very similar to those still used by Tahitian fishermen for small tunas and also used large baited hooks capable of catching large southern bluefin tuna. However, there is no Maori name for southern bluefin tuna, therefore it is uncertain if Maori caught southern bluefin tuna. An estimate of the current customary catch is not available.

1.4 Illegal catch

There is no known illegal catch of southern bluefin tuna by New Zealand vessels in the EEZ or from the high seas. The recent review of the Japanese Market suggests very large illegal catch from the broader stock historically.

Recent actions by individual CCSBT members to improve monitoring, control, and surveillance measures for southern bluefin tuna fisheries is intended to halt the occurrence of unreported catch.

1.5 Other sources of mortality

Incidental catches of southern bluefin tuna appear to be limited to occasional small catches in trawl fisheries. Small catches of southern bluefin tuna have been reported as non-target catch (< 0.5 t and 2 t respectively), in trawl fisheries for hoki (*Macruronus novaezelandiae*) and arrow squid (*Notodarus* spp.). In addition there have been occasional anecdotal reports of southern bluefin being caught in trawl fisheries for southern blue whiting (*Micromesistius australis*) and jack mackerel (*Trachurus* spp.) in sub-Antarctic waters.

In addition to the limited trawl bycatch there is some discarding and loss (usually as a result of shark damage) before fish are landed that occurs in the longline fishery. The estimated overall incidental mortality rate from observed longline effort is 0.54% of the catch. Discard rates are 0.86% on average from observer data of which approximately 50% are discarded dead. Fish are also lost at the surface in the longline fishery during hauling, 1.47% on average from observer data, of which 95% are thought to escape alive. An allowance of 2 t has been made for other sources of mortality.

2. BIOLOGY

The age at which 50% of southern bluefin are mature is uncertain because of limited sampling of fish on the spawning ground off Java. Recent sampling of the Indonesian catch suggests that 50% age-at-maturity may be as high as 12 years, while interpretations of available data since 1994 have used 8 years and older fish as representing the adult portion of the stock in the population models.

As the growth rate has changed over the course of the fishery (see following section & Table 6) the size at maturity depends on when the fish was alive (prior to the 1970s, during the 1970s, or in the period since 1980), as well as which maturity ogive is used. A simple linear interpolation is assumed for the 1970s. Table 5 shows the range of sizes (cm) for southern bluefin tuna aged 8 to 12 years for the two von Bertalanffy growth models used.

Table 6: Differences in southern bluefin tuna size at ages 8 – 12 between the 1960s and 1980s (lengths in cm).

Age	1960s	1980s
8	138.2	147.0
9	144.6	152.7
10	150.2	157.6
11	155.1	161.6
12	159.4	165.0

Radiocarbon dating of otoliths has been used to determine that southern bluefin tuna live beyond 30 years of age and that individuals reaching asymptotic length may be 20 years or older.

The sex ratio of southern bluefin caught by longline in the EEZ has been monitored since 1987. The ratio of males to females is 1.2:1.0, and is statistically significantly different than 1:1.

The parameters of length:weight relationships for southern bluefin tuna based on linear regressions of greenweight versus fork length are in Table 7.

Table 7: Parameters of length/ weight relationship for southern bluefin tuna. *l*n (Weight) = b_1 *l*n(length) – b_0 (Weight in kg, length in cm).

	b_0	B_1
Male	-10.94	3.02
Female	-10.91	3.01
All	-10.93	3.02

The data used include all longline observer data for the period 1987 to 2000 from all vessels in the EEZ (n = 18 994).

CCSBT scientists have used two stanza Von Bertalanffy growth models since 1994:

$$l_t = L_\infty(1 - e^{-k2(t-t0)})(1 + e^{-\beta(t-t0-\alpha)}) / (1 + e^{\beta\alpha})^{-(k2-k1)}$$, where t is age in years.

Table 8: von Bertalanffy growth parameters for southern bluefin tuna.

	L_∞	k_1	k_2	α	β	t_0
1960 von Bertalanffy	187.6	0.47	0.14	0.75	30	0.243
1980 von Bertalanffy	182	0.23	0.18	2.9	30	-0.35

While change in growth in the two periods (pre-1970 and post 1980) is significant and the impact of the change in growth on the results of population models substantial, the differences between the growth curves seem slight. The change in growth rate for juveniles and young adults has been attributed to a density dependent effect of over fishing.

No estimates of F and Z are presented because they are model dependent and because a range of models and modelling approaches are used. Prior to 1995 natural mortality rates were assumed to be constant and M = 0.2 was used. However, the results indicating that asymptotic size was reached at about 20 years and fish older than 30 years were still in the population, suggested that values of $M \geq 0.2$ were likely to be too high. Tagging results of juvenile's ages 1 to 3 years also suggests that M for these fish is high (possibly as high as M = 0.4), while M for fish of intermediate years is unknown. For these reasons M has been considered to be age-specific and represented by various M vectors. In the CCSBT stock assessments, a range of natural mortality vectors are now used.

A conversion factor of 1.15 is used for gilled and gutted southern bluefin tuna.

3. STOCKS AND AREAS

Southern bluefin tuna consist of a single stock primarily distributed between 30ºS and 45ºS, which is only known to spawn in the Indian Ocean south of Java.

Adults are broadly distributed in the South Atlantic, Indian and western South Pacific Oceans, especially in temperate latitudes while juveniles occur along the continental shelf of Western and South Australia and in high seas areas of the Indian Ocean. Southern bluefin tuna caught in the New Zealand EEZ appear to represent the easternmost extent of a stock whose centre is in the Indian Ocean.

A large-scale electronic tagging programme, involving most members of the Commission, has been undertaken to provide better information on stock structure. The goal has been to tag smaller fish across the range of the stock. New Zealand has participated in this programme, having deployed 19 implantable tags in small fish in 2007. Fifteen larger SBT were tagged with pop-off tags as well, with 12 tags having reported data thus far. Of note, one of the tagged fish moved to the spawning ground south of Indonesia.

Electronic tagging of juvenile STN in the Great Australian Bight showed that for a number of years tagged juveniles were not moving into the Tasman Sea. It was not known whether this was due to unfavourable environmental conditions or range contraction following the decline in the stock. However, in the last year more of these tagged juveniles have been reported in New Zealand catches.

Two sources of information suggest that there may be 'sub-structure' within the broader STN stock, in particular the Tasman Sea. Tagging of adult STN within the Australian east coast tuna and billfish fishery suggests that STN may spend most of the years within the broader Tasman Sea region. An analysis of the length and age composition of catches from the New Zealand JV fleet showed that cohorts that were initially strong or weak did not change over time, e.g. if a particular year class was weak (or strong) when it initially recruited to the New Zealand fishery it remained so over time.

4. STOCK ASSESSMENT

Determination of the status of the southern bluefin tuna stock is undertaken by the CCSBT Scientific Committee (CCSBT-SC). In recent years the stock assessment has been based on the results from the reconditioned CCSBT Operating Model. A workshop was held in Seattle in July 2009 to update this model (Anon. 2009a). In addition the Scientific Committee made further changes in September 2009 to the final grid used for the assessment (Anon. 2009b). There is no single agreed stock assessment base case, but an agreed range of values for key input parameters is run and the results averaged over the whole grid. In addition, in 2009 a set of six alternative models considered to be highly plausible were run to test the robustness of the results from the base grid.

4.1 Estimates of fishery parameters and abundance

As part of the stock assessment, a range of fishery indicators that were independent of any stock assessment model were considered to provide support and/or additional information important to aspects of current stock status. Indicators considered included those relating to recent recruitment, spawning biomass, and vulnerable biomass and were based on catch at age data, CPUE data, and information from various surveys (e.g. acoustic and aerial sightings).

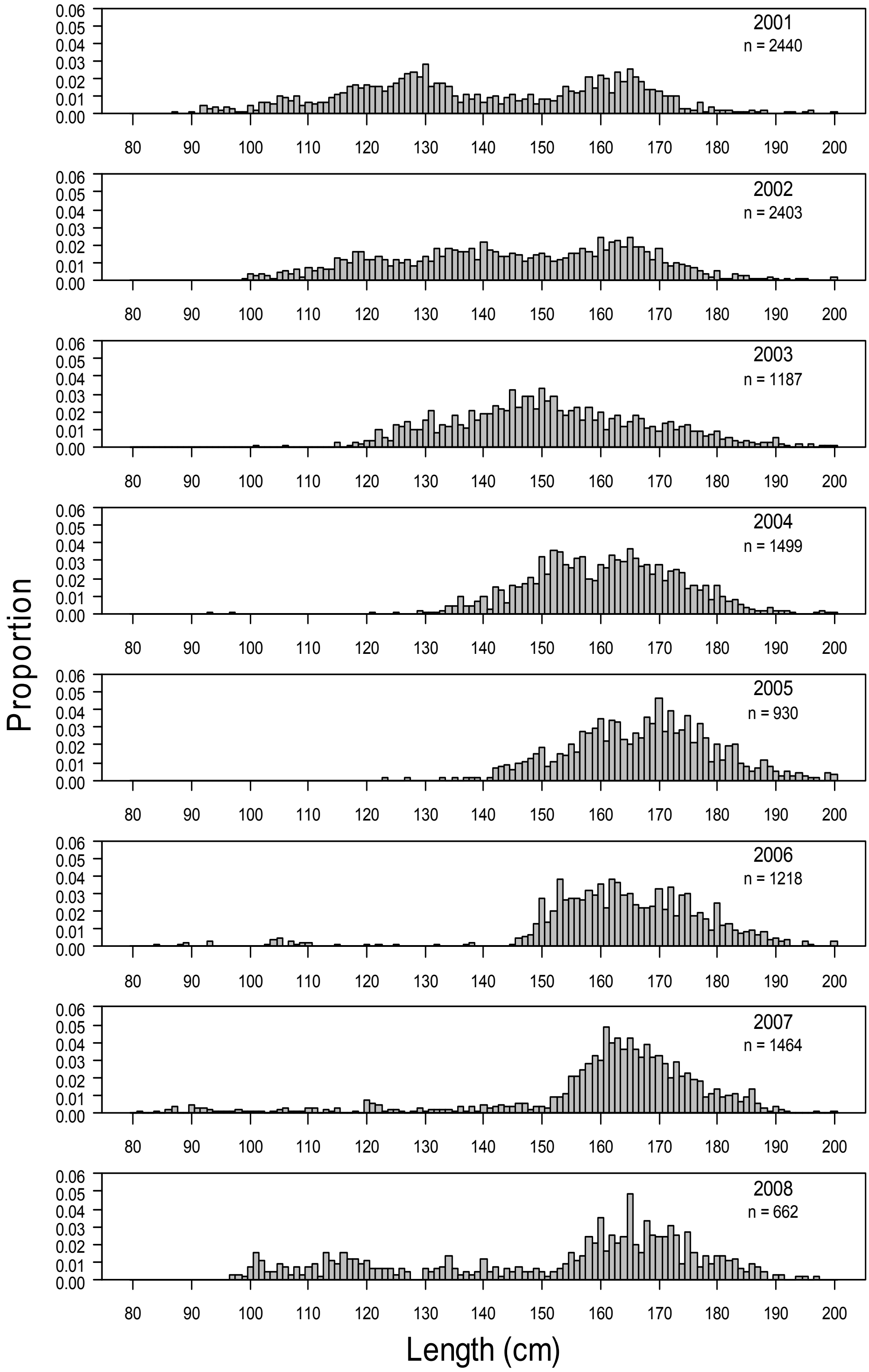


Figure 2: Proportion at length for the charter fleet for 2001 to 2008. Data for 2008 is preliminary.
Source: NZ Report to CCSBT (2008).

Trends in juvenile abundance

All three current indices of juvenile abundance—the scientific aerial survey index and SAPUE index for age 2 to 4 in the GAB and trolling index for age 1 in Western Australia—exhibited declines over the past 12 months from values observed in the 2007–08 fishing season (austral summer)The updated median of the scientific aerial survey was below the 2005–08 average, the median of the trolling index was below the 2006–09 average of the piston line survey, and the median of the SAPUE index was below the 2002–09 average.

However, the scientific aerial survey for ages 2-4 in the GAB has fluctuated with no clear trend over 2005-2009. The trolling index for the 2005-2008 year classes are higher than for the 1999-2002 year classes.

Trends in age 4+ SBT

Indicators of age 4+ SBT exhibited some upward trends:

- Catch per unit effort in both the New Zealand charter and domestic fisheries increased in 2008 compared with 2007, with ages 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.
- Standardised CPUE for age 4 and 5 show increasing trends in 2007-2008 for 2003-2004 year classes
- CPUE indices for the ages 5 to 7 age classes show steadily declining trends over the most recent seven years, except for some increases in the last two years.
- Other age classes (8-11, and 12+) show increases or remain the same after 2003 and also exhibited some upturns in the past two years.
- Current stock levels for these latter age groups, however, are still low, similar to levels observed in the past.

CPUE

For the New Zealand Charter fleet CPUE in the core part of the fishery (west coast South Island) averaged around 3 SBT per 1000 hooks over 1997-2002 (Figure 3). Associated with the lack of new recruitment, CPUE declined dramatically in 2003 and stayed at low levels until an increase in 2006.

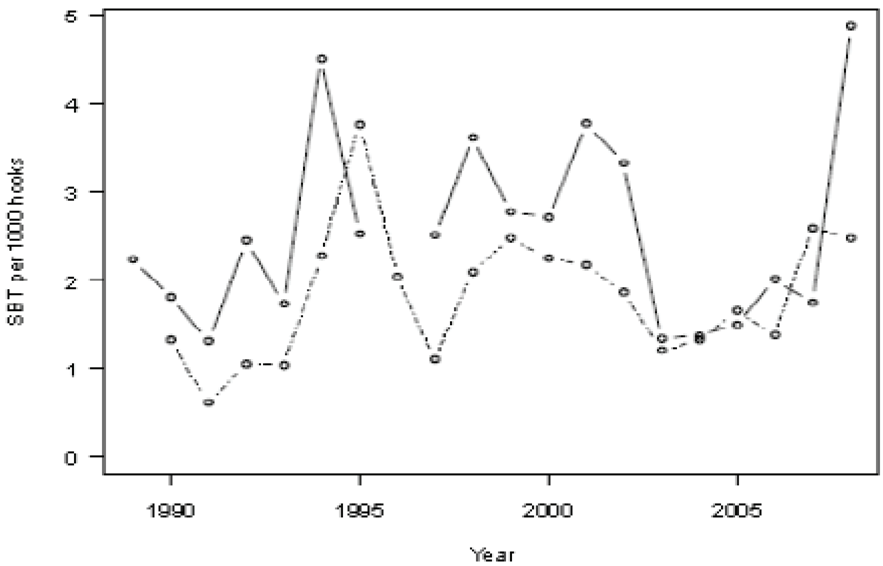


Figure 3: Nominal catch per unit effort (number of SBT per thousand hooks) by calendar year for the New Zealand Charter (solid line) and domestic (dashed line) longline fleets based only on effort from sets that either targeted or caught southern bluefin tuna. Source: NZ report to CCSBT (2009).

4.2 Biomass estimates

4.2.1 Spawning biomass

The results from the reconditioned OM indicate that the spawning stock biomass is at a very low level. For the base case, the spawning biomass is estimated to be at 4.6% of the unfished level (SSB0), with a 90% probability interval of 3% to 8%. This very low spawning stock biomass is consistent across all the plausible alternative scenarios (median range: 3.6-5.1%) and is a little more than 15% of the level at which MSY could be obtained.

These results differ from those reported in earlier reports. This difference reflects the revisions in the model structure and the incorporation of new data. It does not imply that the actual spawning stock biomass has approximately halved in the period between reporting of results. Results from the new base case indicate that spawning stock biomass has been very low, but relatively stable, over the recent period (Figure 4).

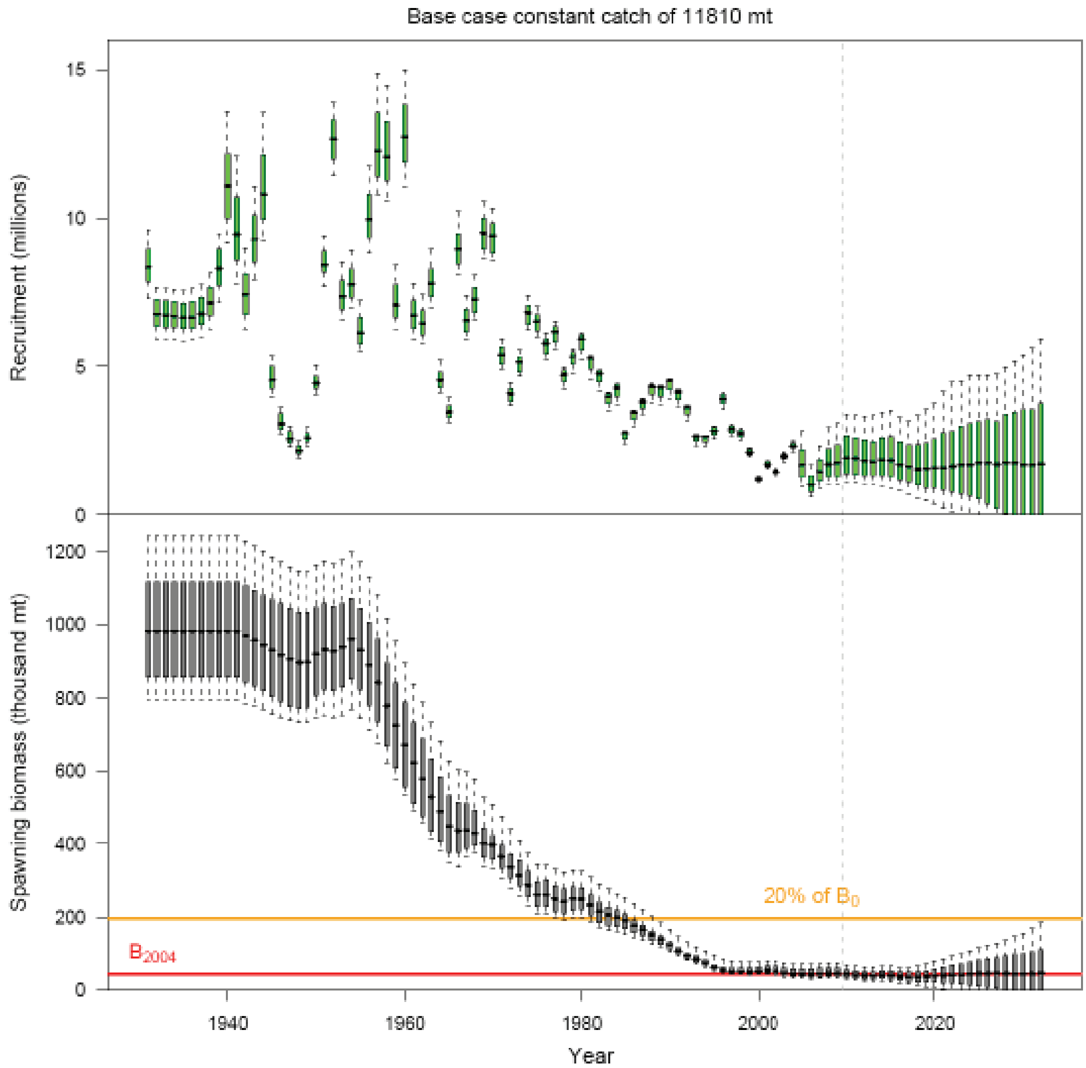


Figure 4: Recruitment and spawning stock biomass for the base case, showing the medians, quartiles and 90th percentiles, together with reference points of 20% of pre-exploitation spawning stock biomass and the spawning stock biomass in 2004 (B_{2004}). Projections of future spawning stock biomass and recruitments commence at the dashed vertical line assuming a constant catch equal to the previous TAC (11,810t). Source: Report of the ESC 2009.

The estimated trajectories of spawning stock biomass integrated over the grid for the base case over the full time series for the fishery are given in Figure 4. This shows a continuous decline from the late 1950s to the late 1970s, then a short period of stabilisation followed by a further decline from the early 1980s to mid 1990s to a very low level. The spawning stock biomass is estimated to have remained at this low level with relatively small annual variation until the early 2000s. For the more recent period, a decline in the median spawning stock biomass is evident from 2002. There is no current evidence of the spawning stock rebuilding.

4.2.2 Recruitment

Recruitments during the last two decades are estimated to be well below the levels over the 1950-1980 period. Recruitment in the 1990s fluctuated at a low level without any overall trend (Figure 4).

It is clearer, with the extra data now available since the last assessment, that the recruitments for 2000 to 2002 were poor (Figure 4). The two following year classes were somewhat stronger, though not as large as the average level evident during the 1990s. Recruitments from 2005 onwards cannot be estimated precisely, as yet: although some data give positive signals, it is also probable that at least some of these year classes were as weak as in 2000-2002. The weak year classes from 2000-2002 (Figure 4) are now evident as a gap in the size composition of the fish taken by longline fleets. As these year classes move into the spawning stock over the next 5 years, this will have a negative impact on the spawning stock. This negative impact is evident as a dip in the spawning stock biomass for the base case under the current TAC (11,810t).

4.3 Estimation of Maximum Constant Yield (MCY)

MCY has not been estimated.

4.4 Estimation of Current Annual Yield (CAY)

CAY has not been estimated.

4.5 Other yield estimates and stock assessment results

4.6 Other factors

Despite continuing low parental stock and low recruitment, the parental stock appears to have been relatively stable over much of the 1990s. However, the most recent assessment indicates that there is now very little chance that current catches will allow the stock to rebuild to the 1980 level by 2020 and evidence of recent poor recruitment, even if they continue for a few years, may mean that current catches will not be sustainable.

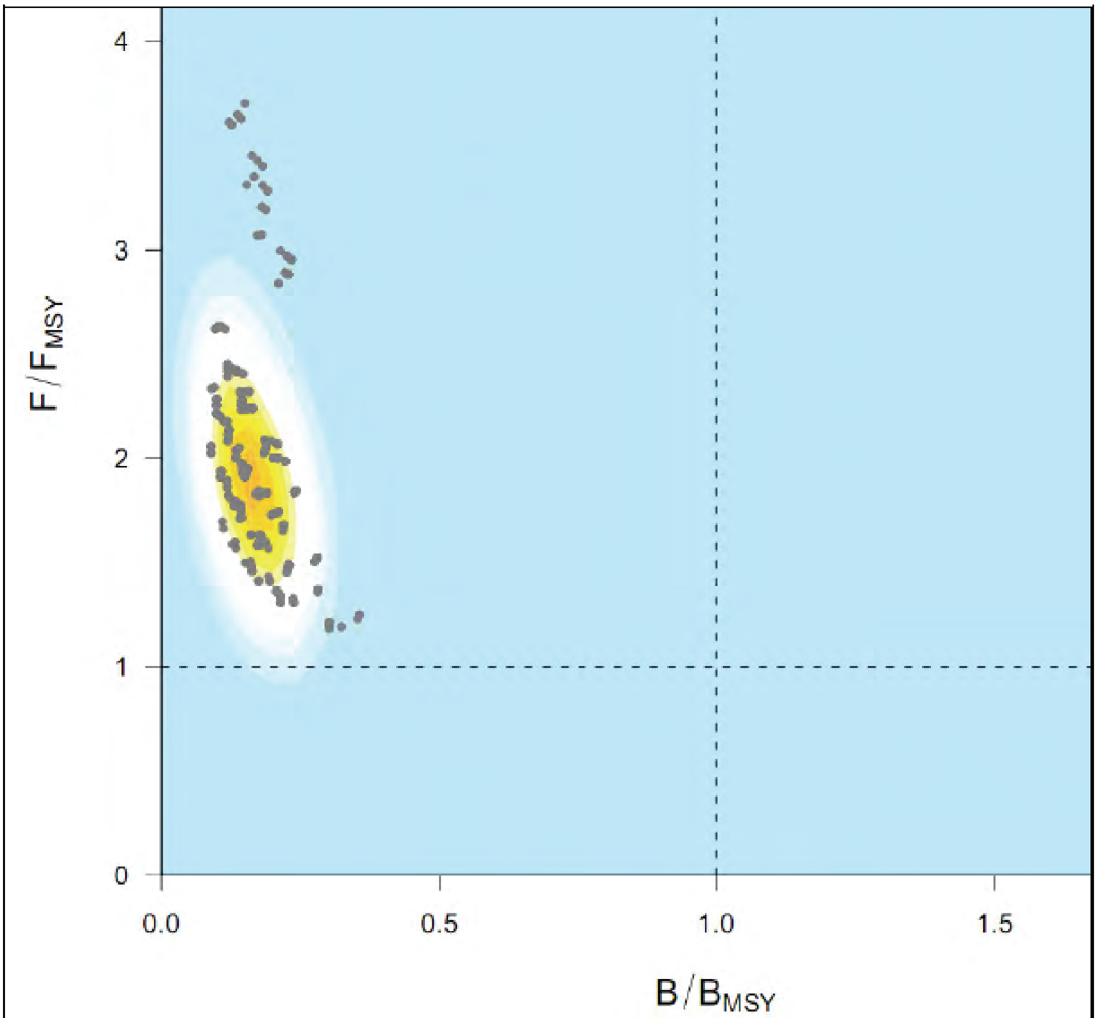
5. STATUS OF THE STOCK

The results from the reconditioned OM indicate that the spawning stock biomass is at a very low level. For the base case, the spawning biomass is estimated to be at 4.6% of the unfished level (SSB0), with a 90% probability interval of 3% to 8%. This very low spawning stock biomass is consistent across all the plausible alternative scenarios (median range: 3.6-5.1%) and is a little more than 15% of the level at which MSY could be obtained.

These results differ from those reported in earlier reports. This difference reflects the revisions in the model structure and the incorporation of new data. It does not imply that the actual spawning stock biomass has approximately halved in the period between reporting of results. Results from the new base case indicate that spawning stock biomass has been very low, but relatively stable, over the recent period (Figure 4).

The estimated trajectories of spawning stock biomass integrated over the grid for the base case over the full time series for the fishery are given in Figure 4. This shows a continuous decline from the late 1950s to the late 1970s, then a short period of stabilisation followed by a further decline from the early 1980s to mid 1990s to a very low level. The spawning stock biomass is estimated to have remained at this low level with relatively small annual variation until the early 2000s. For the more recent period, a decline in the median spawning stock biomass is evident from 2002. There is no current evidence of the spawning stock rebuilding.

Stock Status	
Year of Most Recent Assessment	2009
Assessment Runs Presented	Basecase grid plus six plausible scenarios
Reference Points	B_{MSY}
Status in relation to Target	Well below B_{MSY}. Spawning stock biomass estimated to be about 5%B_0.
Status in relation to Limits	
Historical Stock Status Trajectory and Current Status	



Estimated fishing mortality in 2008 compared to the estimates of *Fmsy* (vertical axis) versus spawning stock biomass in 2008 relative to estimates of *SSBmsy* (horizontal axis) for SBT. Each point represents the final year of one element of the grid. Contours represent density of values from the grid, based on likelihood weighting.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Flat trajectory of SSB.
Recent Trend in Fishing Mortality or Proxy	Reduced in last 3 years
Other Abundance Indices	
Trends in Other Relevant Indicators or Variables	Recent recruitments are estimated to be well below the levels from 1950-1980.

Projections and Prognosis		
Stock Projections or Prognosis	The stock is not projected to rebuild under current catch levels.	
Probability of Current Catch or TACC causing decline below Limits	Soft Limit: Hard Limit:	
Assessment Methodology		
Assessment Type	Level 1: Quantitative stock assessment	
Assessment Method	Basecase grid of reconditioned CCSBT Operating Model	
Main data inputs	CPUE, catch at age and length frequency data, tag recoveries, scientific aerial survey indices, commercial spotting indices, trolling indices	
Period of Assessment	Latest assessment: 2009	Next assessment: MPE 2010
Changes to Model Structure and Assumptions	Age specific M and senescent mortality included in 2009.	
Major Sources of Uncertainty	CPUE indices: • Historical indices have an unknown bias from misreporting • Fisheries management and operational changes since 2006 mean that 2007 and 2008 CPUE series may not be comparable with earlier years.	

Qualifying Comments

Fishery Interactions
The ERS working group noted the observed interactions reported by observers on seabirds, turtles and sharks but no estimates were made on total mortalities of these groups.

6. FOR FURTHER INFORMATION

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