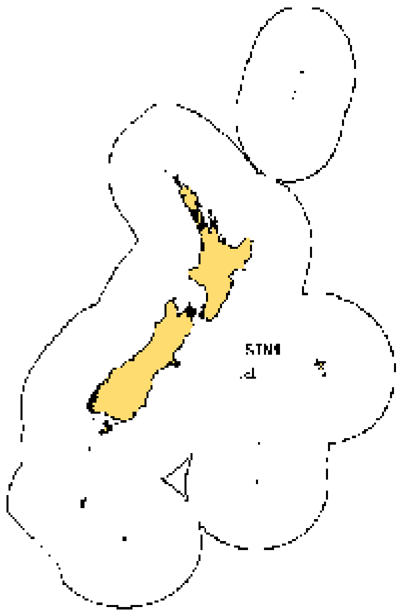
SOUTHERN BLUEFIN TUNA (STN)

(*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 as follows:

Fishstock	Recreational Allowance (t)	Maori customary 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, and the Fishing Entity of Taiwan. The Republics of South Africa and Indonesia have expressed interest in becoming members of the Commission. Determination of the global TAC and provision of a national allocation to New Zealand is done by the CCSBT. New Zealand was allocated a catch limit of 420 t (whole weight) at the 11th meeting of CCSBT in October 2004. This allocation has been at the same level since 1989.

(a) 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.

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 1 summarises southern bluefin landings in New Zealand waters since 1972.

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 handline (< 1% used trolling). This represents a major change from the 1980s when most fishing was by handline.

Table 1: Reported total domestic southern bluefin tuna landings (t) from 1972 to 2005 (calendar year).

Year	NZ Landings (t)	Total stock (t)	Year	NZ Landings (t)	Total stock (t)
1972	1	51 925	1990	529	13 870
1973	6	41 205	1991	164	13 691
1974	4	46 777	1992	279	14 217
1975	0	32 982	1993	217	14 344
1976	0	42 509	1994	277	13 154
1977	5	42 178	1995	436	13 637
1978	10	35 908	1996	139	16 356
1979	5	38 673	1997	334	16 076
1980	130	45 054	1998	337	17 776
1981	173	45 104	1999	461	19 529
1982	305	42 788	2000	380	15 472
1983	132	42 881	2001	358	16 026
1984	93	37 090	2002	450	15 212
1985	94	33 325	2003	389	14 024
1986	82	28 319	2004	393	13 490
1987	59	25 575	2005	264	Not available
1988	94	23 145			
1989	437	17 843			

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.

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 1 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 fisher's limited involvement historically rather than to local availability. Table 2 indicates that throughout most of the 1980s catches of STN exceeding several thousand tonnes were realised within the New Zealand EEZ.

Table 2. 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, and LFRR: Estimated landings from Licensed Fish Receiver Returns.

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

Reported catch of southern bluefin tuna by the parties and non-parties to the CCSBT is available since 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 been in the range 13 154 to 19 589 t (average of 15 242 t per year) since that time (see Table 1).

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 are effective for 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 been composed of purse seine and pole-&-line vessels supported by aerial spotter planes that search out surface schools. The Australian surface fisheries which prior to 1990 were a mix of pole-&-line and purse seine vessels, has 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) is based on longline. Historically New Zealand also supported handline and troll fisheries for STN, although these were small scale and like longline fisheries 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.

(b) Recreational fisheries

There is no estimate available for recreational catch of southern bluefin tuna, although charter vessels based in Milford Sound are known to target this species.

(c) Maori customary fisheries

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. It is therefore, uncertain if Maori caught southern bluefin tuna. An estimate of the current customary catch is not available.

(d) Illegal catch

There is no known illegal catch of southern bluefin tuna in the EEZ or from the high seas. Estimates of illegal catch are not available, but are probably insignificant.

(e) 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 (usually as a result of shark damage) and loss 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.

Since growth rate has changed over the course of the fishery (see following section) 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 3 shows the range of sizes (cm) for southern bluefin tuna aged 8 to 12 years for the two von Bertalanffy growth models used.

Table 3: 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 as follows:

$\ln(\text{Weight}) = b_1 \ln(\text{length}) - b_0$ (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.

	L_∞	k_1	k_2	a	b	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 dependant 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 with no agreement as to which model(s) is/are best. 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 ≥ 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 30º S and 45º S, 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, but unfortunately the lack of small fish in our fishery has meant that we have only had limited success deploying tags in our fishery.

4. STOCK ASSESSMENT

Determination of the status of the southern bluefin tuna stock in 2005 was based on the analysis on indicators undertaken by the CCSBT Stock Assessment Group (CCSBT-SAG) and Scientific Committee (CCSBT-SC). 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). There is no agreed stock assessment model, though results from ADAPT VPA population models and an operating model of the STN population and fishery were considered in 2004 and will be updated again in September 2006.

(a) 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. These include:

Recruitment

The indicators presented in 2005 reinforce the evidence available in 2004 that the 2000 and 2001 year classes were considerably smaller than previous years and the sum of the evidence is now convincing that there have been at least two very low recruitments. There are four primary data sources to indicate this poor recruitment: acoustic survey, size frequency, commercial spotting (SAPUE), and tagging data. The acoustic data indicated markedly low recruitment after 1999.

The size distribution data in the Japanese LL fishery show a marked reduction in the number of fish from the 2000 and 2001 year classes. The charter fishery in New Zealand also shows a near total absence of fish recruited since 1999. The Australian commercial aerial spotting data (CCSBT-ESC/0509/23 Figure 8) show lower abundance in 2003 and 2004. The tagging data show that the exploitation rates on the 2000 and 2001 year classes are high, and hence are consistent with estimates of low recruitments to these year classes.

In summary, the indicators of recruitment suggest markedly lower recruitment in at least 2000 and 2001 with some indication that recruitment in 1999 was also weak.

Spawning biomass

Catch rates of fish aged 12 and older in the Japanese LL indicate a drop in spawning stock biomass in about 1995. Recent Indonesian catch has remained low and the majority of the catch has been relatively young spawners. The data from the Indonesian fishery training schools from 2000 to 2005 is consistent with a declining spawning stock biomass.

In addition it was noted that the preliminary catch estimate for the first six months of 2005 suggests a substantial increase in exploitation of the spawning stock biomass.

Vulnerable biomass

Japanese LL CPUE of SBT for all ages combined suggests that the exploitable biomass for these gears has remained fairly constant during the past 10 years, though this level is low compared to historical values. Results indicate increases in the CPUE of ages 8-11 since about 1992, but there is a slight decline in 2003 which continued into 2004. CPUE of fish aged 4-7 has increased since the mid 1980s and remained broadly constant over the last 10 years.

In summary, these CPUE indicators generally suggest stable exploitable biomass over the last 10 years. However, recent low recruitments are likely to lead to declines in future exploitable biomass trends.

(b) Biomass estimates

Biomass estimates depend on the specific population model used; hence there is no agreed set of biomass estimates for southern bluefin tuna.

(c) Estimation of Maximum Constant Yield (MCY)

MCY has not been estimated.

(d) Estimation of Current Annual Yield (CAY)

CAY has not been estimated.

(e) Other yield estimates and stock assessment results

The following results of the CCSBT stock assessment in 2004 are comparable to those in 2001:

- at the time of the most recent round of quota reductions (1988), spawning stock size was well below levels in 1980 with trends since the late 1990s either upward or slightly downward with a slight upward trend more likely;
- the models consistently indicate a long-term decline in estimated recruitment with recruitments in the 1990s less than half of those in earlier years. Recruitment is estimated to increase somewhat in the late 1990's;
- the models consistently indicate the combination of high recruitment and high spawning stock in the period 1950-1970, with low recruitment and low spawning stock since then;
- quota reductions in all fisheries in 1988 (and earlier) and earlier changes in selectivity in the surface fishery (i.e. around 1984) initially reduced juvenile fishing mortality rates and hence led to an increase in escapement of younger fish. These increases in young fish escapement led to increases in estimates of abundance of intermediate ages and these fish are now of spawning age; and
- age structured models show strong autocorrelation in recruitment residuals: Better than expected recruitment tends to be followed by better than expected recruitment and lower than expected recruitment by lower than expected recruitment. This observation may be partially due to aging errors resulting from length-at-age assumptions, shifts in the environmental regime of SBT, and/or inappropriate stock recruitment curves.

(f) Other factors

It is generally agreed that there is strong evidence for a stock recruit relationship in southern bluefin tuna with high recruitment and high parental biomass in early years, low recruitment and low parental biomass in later years. 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 IUCN listed southern bluefin tuna as critically endangered in 1996 based on the rate of population decline. The three original Parties to the CCSBT (Australia, Japan and New Zealand) have met to assess stock status regularly and in nearly every case have agreed that the parental stock was at historically low levels and that the parental stock should be rebuilt to the level seen in the 1980s. This level of parental biomass coincided with a period when recruitment (on average) had been stable.

The CCSBT- Scientific Committee provided the following summary of the status of the stock:
"*The current assessments through the operating model (using data available from the 2004 SAG/ESC) suggest the SBT spawning biomass is at a low fraction of its original biomass and well below the 1980 level. The stock is estimated to be well below the level that could produce maximum sustainable yield. Rebuilding the spawning stock biomass would almost certainly increase sustainable yield and provide security against unforeseen environmental events. Recruitments in the last decade are estimated to be well below the levels in the period 1950-1980. Assessments estimate that recruitment in the 1990s fluctuated with no overall trend. Analysis of several independent data sources and the operating model indicate very low recruitments in 2000 and 2001. There is some evidence that the 1999 cohort is relatively weak and that the 2002 cohort is unlikely to be as strong as those estimated during the 1990s. Other indicators show that the Indonesia LL fishery on spawning fish catches fewer older individuals. One plausible interpretation is that the spawning stock has declined in average age and may have declined appreciably in abundance. The decline in average age may be due to the disappearance of older fish, a pulse of younger fish entering the spawning stock, or a combination of the two factors. A pulse of younger fish entering the spawning stock is consistent with the assessment model output which suggests that the spawning stock has been largely stable over the last decade and increased slightly over the last four years.*

Given all the evidence, it seems highly likely that current levels of catch will result in further declines in spawning stock and exploitable biomass, particularly because of recent low recruitments."

The most recent assessment was undertaken in 2005 and covered the entire stock. On a regional level there are concerns relating to the current status of this stock and the level of fishing effort. The stock is presently well below the level necessary to produce the maximum sustainable yield. Current catches from the stock are not sustainable and New Zealand catches represent less than 3% of the total catch in 2003. Current catches will not increase the stock towards a size that will support the maximum sustainable yield.

6. FOR FURTHER INFORMATION

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