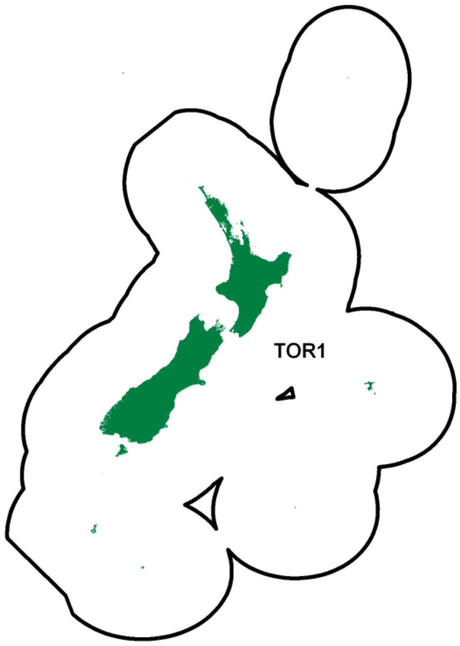
PACIFIC BLUEFIN TUNA (TOR)

(Thunnus orientalis)



1. FISHERY SUMMARY

Pacific bluefin tuna was introduced into the QMS on 1 October 2004 under a single QMA, TOR 1, with allowances, TACC, and TAC in Table 1.

Table 1: Recreational and Customary non-commercial allowances, TACCs and TACs (all in tonnes) for Pacific bluefin tuna.

Fishstock	Recreational Allowance	Customary non-commercial Allowance	Other mortality	TACC	TAC
TOR 1	25	0.50	3.5	116	145

Pacific bluefin tuna were added to the Third Schedule of the 1996 Fisheries Act with a TAC set under s14 because Pacific bluefin tuna is a highly migratory species and it is not possible to estimate MSY for the part of the stock that is found within New Zealand fisheries waters.

Pacific bluefin tuna is believed to be a single Pacific-wide stock and is covered by two regional fisheries management organisations, the Western and Central Pacific Fisheries Commission (WCPFC), and the Inter-American Tropical Tuna Commission (IATTC). They will cooperate in the management of the Pacific bluefin tuna stock throughout the Pacific Ocean. Under the WCPFC Convention, New Zealand is responsible for ensuring that the management measures applied within New Zealand fisheries waters are compatible with those of the Commissions.

1.1 Commercial fisheries

Pacific bluefin tuna was not widely recognised as a distinct species until the late 1990s. It was previously regarded as a sub-species of *Thunnus thynnus* (northern bluefin tuna, NTU). Prior to June 2001, catches of this species were either recorded as NTU or misidentified as southern bluefin tuna. Fishers have since become increasingly able to accurately identify TOR and, from June 2001, catch reports have rapidly increased. Catches of TOR may still be underreported to some degree as there is still some reporting against the NTU code. Recent genetic work suggests that true NTU (*Thunnus thynnus*) are not taken in the New Zealand fishery (see Biology section below for further details). Figure 1 shows the historical landings and domestic longline fishing effort for TOR 1.

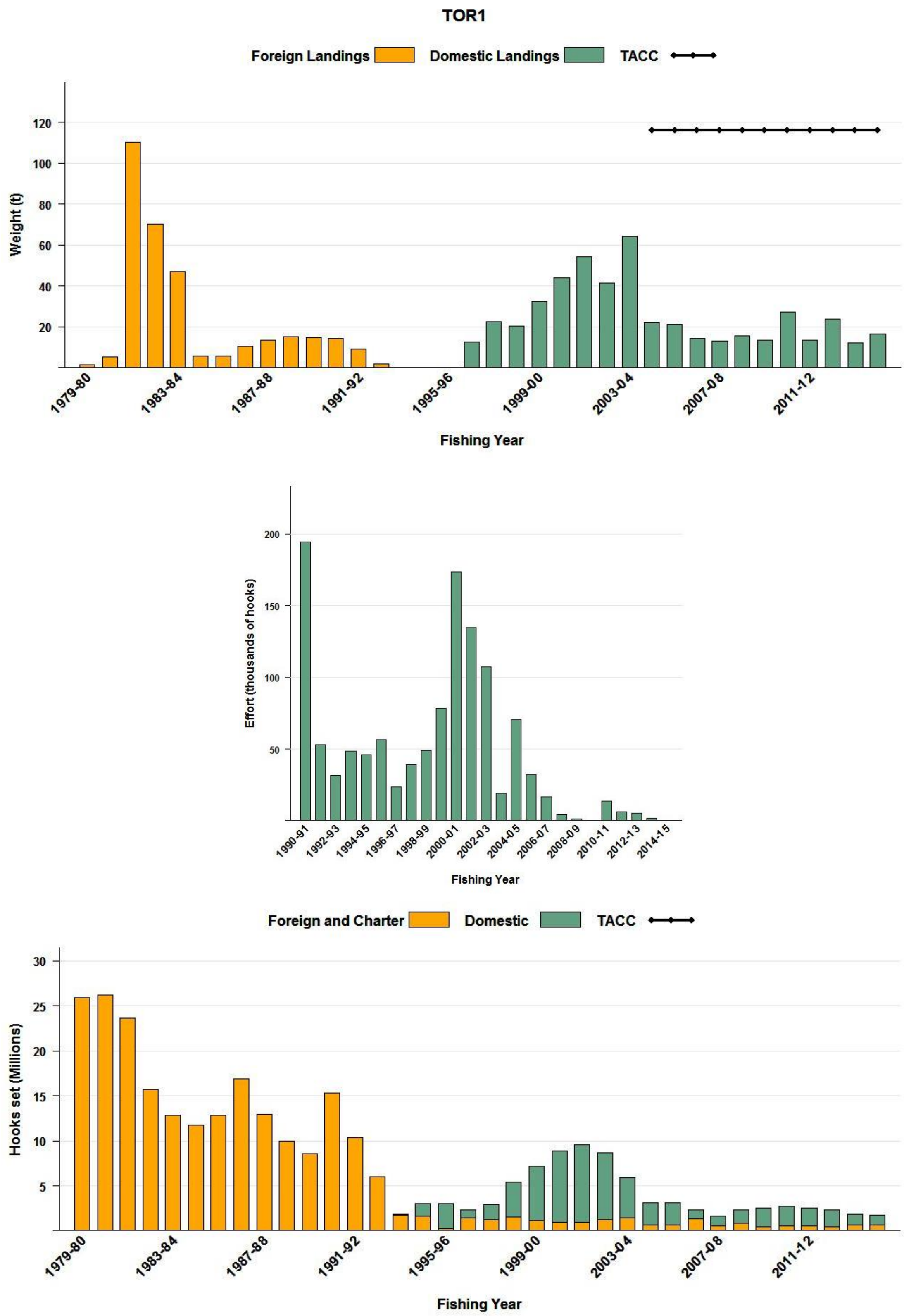


Figure 1: [Top] Commercial catch of pacific bluefin tuna by foreign licensed and New Zealand vessels from 1979–80 to 2014–15 within New Zealand waters (TOR 1). [Middle] Fishing effort (number of hooks set) for high seas New Zealand flagged surface longline vessels, from 1990–91 to 2014–15, and [Bottom] fishing effort (number of hooks set) for all domestic and foreign vessels (including effort by foreign vessels chartered by NZ fishing companies) from 1979–80 to 2014–15.

Table 2: Reported total New Zealand landings (t) of Pacific bluefin tuna (includes landings attributed to NTU), 1991 – present and total Pacific Ocean catches.

Year	NZ landings	Total stock (t)	Year	NZ	Total stock	Year	NZ	Total stock (t)
1991	1.5	15 781	2000	20.9	33 900	2009	16.0	19 928
1992	0.3	13 995	2001	49.8	18 712	2010	13.6	18 057
1993	5.6	10 811	2002	55.4	18 959	2011	27.4	17 651
1994	1.9	16 961	2003	40.8	18 419	2012	13.3	15 636
1995	1.8	29 225	2004	67.3	25 357	2013	23.9	12 124
1996	4.2	23 519	2005	20.1	28 988	2014	12.1	17 065
1997	14.3	24 632	2006	21.1	26 074	2015	16.5	6 732
1998	20.4	15 763	2007	14	21 189			
1999	21.2	29 153	2008	14.0	24 794			

Source: NZ landings, for 1991–2002 MPI Licensed Fish Receiver Returns data and Solander Fisheries Ltd. 2003–present MPI MHR data. Total Pacific landings for ISC members from http://isc.ac.affrc.go.jp/index.html. This covers most catches from this stock, but does not include South Pacific catches by coastal states in the South Pacific.

Pacific bluefin has been fished in the New Zealand EEZ since at least 1960, with some catch likely but undocumented prior to that time. New Zealand catches, are small compared to total stock removals (Table 2).

Table 3: Reported catches or landings (t) of Pacific bluefin tuna by fleet and Fishing Year. NZ: New Zealand domestic and charter fleet, MHR data from 2001–02 to present ET: catches from New Zealand flagged longline 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.

	TOR 1 (all FMAs)				
Fishing Year	JPNFL	NZ/MHR	Total	LFRR	NZ ET
1979–80	1.5		1.5		
1980–81	5.3		5.3		
1981–82	110.1		110.1		
1982–83	70.1		70.1		
1983–84	47		47		
1984–85	6		6		
1985–86	5.7		5.7		
1986–87	10.6		10.6	0.0	
1987–88	13.5		13.5	0.0	
1988–89	15.1		15.1	0.0	
1989–90	14.7		14.7	0.0	
1990–91	14.5		14.5	1.5	
1991–92	9.1		9.1	0.3	
1992–93	2.1		2.1	5.6	
1993–94	0.1		0.1	1.9	
1994–95			0	1.8	
1995–96			0	4.0	
1996–97		12.5	12.5	13.0	
1997–98		22.5	22.5	20.9	0.4
1998–99		20.6	20.6	17.9	0.1
1999–00		32.6	32.6	23.1	0.1
2000–01		43.9	43.9	51.8	1.0
2001–02		54.4	54.4	53.3	0.0
2002–03		41.6	41.6	39.8	0.0
2003–04		64.3	64.3	58.1	0.0
2004–05		22.9	22.9	22.9	0.0
2005–06		21.1	21.1	20.3	0.0
2006–07		14.3	14.3	14.5	0.0
2007–08		13.1	13.1	11.9	0.0
2008–09		15.7	15.7	15.5	0.0
2009–10		13.6	13.6	12.4	0.0
2010–11		27.4	27.4	26.7	0.0
2011–12		13.7	13.7	13.4	0.0
2012–13		23.9	23.9	23.9	0.0
2013–14		12.1	12.1	12.1	0.0
2014–15		16.5	16.5	16.5	0.0

Catches from within New Zealand fisheries waters are very small compared to those from the greater stock in the Pacific Ocean (0.14% average of the Pacific wide catch for 1999–2009). In contrast to New Zealand, where Pacific bluefin tuna are taken almost exclusively by longline, the majority of catches are taken in purse seine fisheries in the Western and Central Pacific Ocean (WCPO) (Japan and Korea) and Eastern Pacific Ocean EPO (Mexico). Much of the fish taken by the Mexican fleet are grown in sea pens.

Prior to the introduction into the QMS, the highest catches were made in FMA 1 and FMA 2. While it is possible to catch Pacific bluefin as far south as 48ºS, few catches are made in the colder southern FMAs. Although recent catches have occurred in FMA 7 fish have been in poor condition with little commercial value. Catches are almost exclusively by tuna longlines, typically as a bycatch of sets targeting bigeye tuna. Catches by fishing year and fleet are provided in Table 3.

The majority of Pacific bluefin tuna are caught in the bigeye tuna surface longline fishery (57%), with about 18% of the catch coming from the southern bluefin tuna surface longline fishery (Figure 2). There is no targeted commercial fishery for Pacific bluefin tuna in New Zealand. In New Zealand longline fisheries, Pacific bluefin tuna make up less than 1% of the commercial catch (Figure 3). Longline fishing effort is distributed along the east coast of the North Island and the south west coast of the South Island. The west coast South Island fishery predominantly targets southern bluefin tuna, whereas the east coast of the North Island targets a range of species including bigeye, swordfish, and southern bluefin tuna.

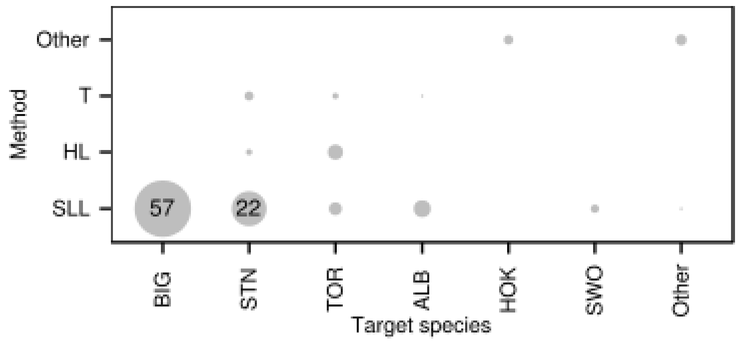


Figure 2: A summary of the proportion of landings of pacific bluefin tuna taken by each target fishery and fishing method. The area of each circle is proportional to the percentage of landings taken using each combination of fishing method and target species. The number in the bobble is the percentage. SLL = surface longline HL = hand line and T = trawl (Bentley et al 2013).

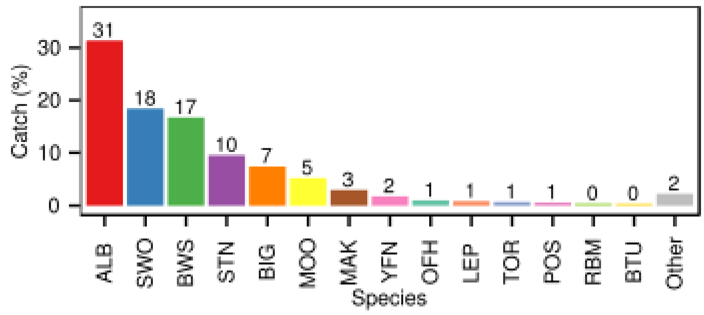


Figure 3: A summary of species composition of the reported surface longline catch. The percentage by weight of each species is calculated for all surface longline trips (Bentley et al 2013).

1.2 Recreational fisheries

Recreational fishers make occasional catches of Pacific bluefin tuna. In 2004 a target recreational fishery developed off the west coast of the South Island targeting large Pacific bluefin tuna that feed on spawning aggregations of hoki (*Macruronus novaezealandiae*). Fish taken in this fishery have been submitted for various world records for this species. Some information on charter vessel catch was collected by MPI through voluntary reporting and in 2011 recreational charter boats were required to register and report catch and effort in this fishery. A small number of private boats are also active in the fishery. The recreational allowance for Pacific bluefin was increased from 1 t to 25 t per year from 1 October 2011 to recognise the growth in this fishery. There is no information on the size of catch from the National Surveys of recreational fishers.

1.3 Customary non-commercial fisheries

There is no quantitative information available to allow the estimation of the harvest of Pacific bluefin tuna by customary fishers; however, the Maori customary catch of Pacific bluefin is probably negligible because of its seasonal and offshore distribution.

1.4 Illegal catch

There is no known illegal catch of Pacific bluefin tuna in New Zealand fisheries waters.

1.5 Other sources of mortality

There is likely to be a low level of shark damage and discard mortality of Pacific bluefin caught on tuna longlines that may be on the order of 1–2% assuming that all tuna species are subject to equivalent levels of incidental mortality. There have been reports that some fish hooked in the target recreational fishery have been lost due to entanglement of the fishing line with trawl warps. The survival of these lost fish is not known. An allowance of 3.5 t has been made for other sources of mortality.

2. BIOLOGY

Pacific bluefin tuna are epipelagic opportunistic predators of fish, crustaceans and cephalopods found within the upper few hundred metres of the water column. Individuals found in New Zealand fisheries waters are mostly adults. Adult Pacific bluefin occur broadly across the Pacific Ocean, especially the waters of the North Pacific Ocean.

There has been some uncertainty among fishers regarding bluefin tuna taken in New Zealand waters. Some fishers believe that three species of bluefin tuna are taken in New Zealand waters with some small catches of true "Northern" Atlantic tuna (*Thunnus thynnus*) in addition to Pacific and southern bluefin tuna. This belief is based on several factors including differences in morphology and the prices obtained for certain fish on the Japanese market.

To address this issue, muscle tissue samples were taken from 20 fish for which there was uncertainty as to whether the fish was a Pacific bluefin tuna (*Thunnus orientalis*) or an Atlantic bluefin tuna. A further sample from a fish thought to be a southern bluefin tuna was also included. The tissue samples were sequenced for the COI region of DNA, and the sequences compared with COI sequences for the three species of tuna held in GenBank. All of the DNA sequences, except one, matched with sequences for Pacific bluefin tuna. The final sample was confirmed as a southern bluefin tuna. Therefore, based on DNA analysis, there is presently no evidence that Atlantic bluefin tuna are taken in New Zealand waters. Further tissue samples from fish thought by fishers to be NTU will be collected by scientific observers.

Adult Pacific bluefin reach a maximum size of 550 kg and lengths of 300 cm. Maturity is reached at 3 to 5 years of age and individuals live to 15+ years old. Spawning takes place between Japan and the Philippines in April, May and June, spreading to the waters off southern Honshu in July and to the Sea of Japan in August. Pacific bluefin of 270 to 300 kg produce about 10 million eggs but there is no information on the frequency of spawning. Juveniles make extensive migrations north and eastwards across the Pacific Ocean as 1–2 year old fish. Pacific bluefin caught in the southern hemisphere, including those caught in New Zealand waters, are primarily adults.

Natural mortality is assumed to vary from about 0.1 to 0.4 and to be age specific in assessments undertaken by the IATTC. A range of von Bertalanffy growth parameters have been estimated for Pacific bluefin based on length frequency analysis, tagging and reading of hard parts (Table 4).

Table 4: von Bertalanffy growth parameters for Pacific bluefin tuna.

Method	L infinity	*k*	t_0
Length frequencies	300.0		
Scales	320.5	0.1035	- 0.7034
Scales	295.4		
Tagging	219.0	0.211	

The length weight relationship of Pacific bluefin based on observer data from New Zealand caught fish yields the following:

whole weight = 8.058 $e^{0.015\ \text{length}}$ R^2 = 0.895, n = 49 (weight is in kg and length is in cm).

Although the sample size of genetically confirmed Pacific bluefin that has been sexed by observers is small (50 fish), the sex ratio in New Zealand waters is not significantly different from 1:1.

3. STOCKS AND AREAS

Pacific bluefin tuna constitutes a single Pacific-wide stock that is primarily distributed in the northern hemisphere.

Between 2006 and 2008 42 Pacific bluefin were tagged from recreational charter vessels in New Zealand waters using Pop-off Satellite Archival Tags (PSATs), and all tags that have ‘reported’ indicate that these fish survived catch and release and spent several months within the New Zealand or Australian EEZs and adjacent waters over spring and summer. In addition 138 Pacific bluefin have been released with conventional tags. There have been four recaptures all from the West Coast recreational fishery. One fish was recaptured after 2 years 22 nautical miles from the release point and another after four years at liberty just 60 miles from where it was released. Both of these fish had carried PSAT tags.

4. ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

This summary is from the perspective of pacific bluefin tuna but there is no directed fishery for them and the incidental catch sections below reflect the New Zealand longline fishery as a whole and are not specific to this species; a more detailed summary from an issue-by-issue perspective is available in the Aquatic Environment and Biodiversity Annual Review where the consequences are also discussed (www.mpi.govt.nz/document-vault/11521) (Ministry for Primary Industries 2016).

4.1 Role in the ecosystem

Pacific bluefin tuna (*Thunnus thynnus orientalis,*) is one of the largest teleost fish species (Kitagawa et al 2004), comprising a single population that spawns only to the south of Japan and in the Sea of Japan (Sund et al 1981). Pacific bluefin tuna are large pelagic predators, so they are likely to have a ‘top down’ effect on the fish, crustaceans and squid they feed on.

4.2 Incidental fish bycatch

Observer records indicate that a wide range of species are landed by the longline fleets in New Zealand fishery waters. Blue sharks are the most commonly landed species (by number), followed by Ray’s bream (Table 5).

Table 5: Total estimated catch (numbers of fish) of common bycatch species in the New Zealand longline fishery as estimated from observer data from 2009 to 2015. Also provided is the percentage of these species retained (2015 data only) and the percentage of fish that were alive when discarded, N/A (none discarded).

Species	2012	2013	2014	2015	% retained (2015)	discards % alive (2015)
Blue shark	132 925	158 736	80 118	72 480	0.3	87.0
Rays bream	19 918	13 568	4 591	17 555	95.3	13.7
Lancetfish	7 866	19 172	21 002	12 962	0.2	44.6
Porbeagle shark	7 019	9 805	5 061	4 058	5.1	64.0
Moonfish	2 363	2 470	1 655	3 060	95.6	45.5
Mako shark	3 902	3 981	4 506	2 667	16.1	72.2
Butterfly tuna	713	1 030	699	1 309	86.9	11.1
Pelagic stingray	712	1 199	684	979	0.0	97.2
Dealfish	372	237	910	842	0.4	22.9
Sunfish	3 265	1 937	1 981	770	0.0	100.0
Escolar	2 181	2 088	656	653	82.5	71.4
Oilfish	509	386	518	584	46.7	83.3
Deepwater dogfish	647	743	600	545	2.3	88.3
Rudderfish	491	362	327	373	26.9	78.9
Thresher shark	246	256	261	177	0.0	53.3
Skipjack tuna	123	240	90	150	10.0	n/a
Striped marlin	124	182	151	120	10.0	55.6
School shark	477	21	119	88	43.5	76.9
Big scale pomfret	108	67	164	59	32.5	96.3

4.3 Benthic interactions
N/A

5. STOCK ASSESSMENT

No assessment is possible for Pacific bluefin tuna within the New Zealand fishery waters as the proportion of the greater stock found within these waters is unknown and is likely to vary from year to year. Pacific Bluefin tuna is assessed as one stock in the entire Pacific Ocean.

Stock status and trends

The latest assessment for Pacific bluefin tuna was completed in 2016. SC12 noted that ISC provided the following conclusions on the stock status of Pacific bluefin tuna in the Pacific Ocean in 2016 presented in SC12-SA-WP-07 (2016 Pacific Bluefin Tuna Stock Assessment).

The PBFWG conducted a benchmark assessment (base-case model) using the best available fisheries and biological information. The base-case model fits well the data that were considered to be more reliable and is internally consistent among most of the sources of data. The 2016 base-case model is a substantial improvement compared to the 2014 assessment and fits all reliable data well. The base-case model indicates: (1) spawning stock biomass (SSB) fluctuated throughout the assessment period (fishing years 1952–2014) and (2) the SSB steadily declined from 1996 to 2010; and (3) the decline appears to have ceased since 2010, although the stock remains near the historic low. The model diagnostics suggest that the estimated biomass trend for the last 30 years is considered robust although SSB prior to the 1980s is uncertain due to data limitations.

Using the base-case model, the 2014 (terminal year) SSB was estimated to be around 17 000 t (Figure 4), which is about 9000 t below the terminal year estimated in the 2014 assessment (26 000 in 2012). This is because of improvements to the input data and refinements to the assessment model scaled down the estimated value of SSB and not because the SSB declined from 2012 to 2014.

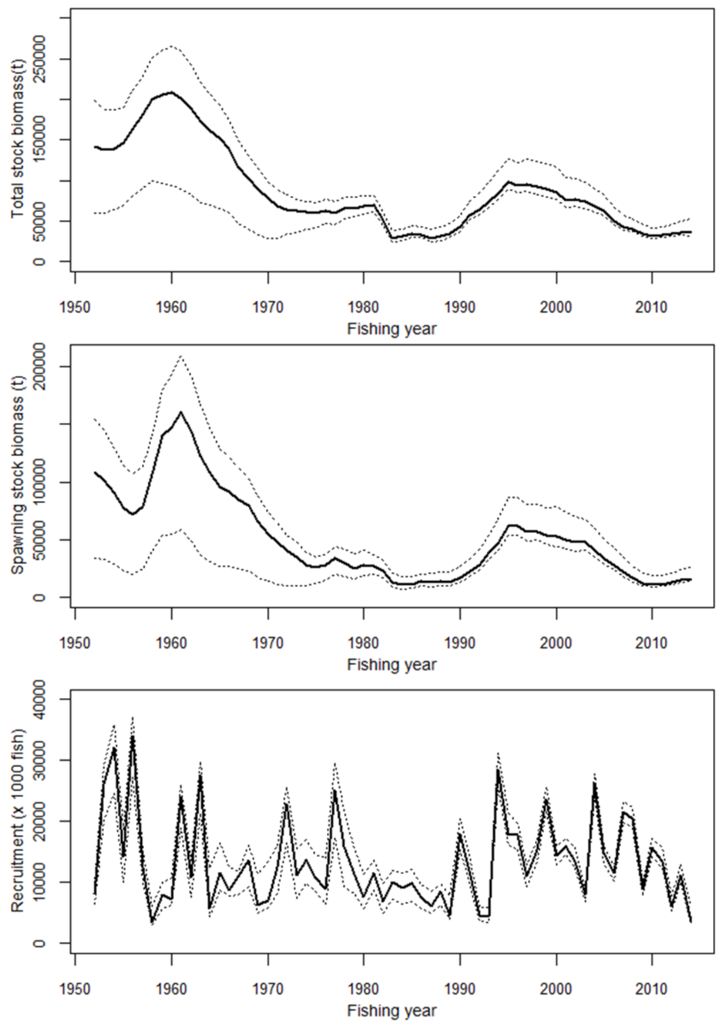


Figure 4. Total stock biomass (top), spawning stock biomass (middle) and recruitment (bottom) of PBF from the base-case model. The solid line indicates point estimate and dashed lines indicate the 90% confidence interval.

Recruitment estimates fluctuate widely without an apparent trend. The 2014 recruitment was relatively low, and the average recruitment for the last five years may have been below the historical average level (Figure 4). Note that recruitments in terminal years in an assessment are highly uncertain due to limited information on the cohorts. However, two of the last three data points from the Japanese troll CPUE-based index of recruitment, which was consistent with other data in the model, are at their lowest level since the start of the index (1980). Estimated age-specific fishing mortalities on the stock during 2011–2013 and 2002–2004 (the base period for WCPFC CMM 2015-04) are presented in Figure 5. Most age-specific fishing mortalities (F) for intermediate ages (2–10 years) are substantially above F2002-2004 while those for age 0 as well as ages 11 and above are lower (Table 6).

Table 6: Percent change of estimated age-specific fishing mortalities of PBF from 2002-2004 to 2011-2013.

Age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
change from F2002-2004 to F2011-2013	-28%	-1%	+96%	+4%	+86%	+43%	-9%	+81%	+21%	+23%	+5%	-5%	-7%	-8%	-9%	-10%	-10%	-10%	-11%	-11%	-11%

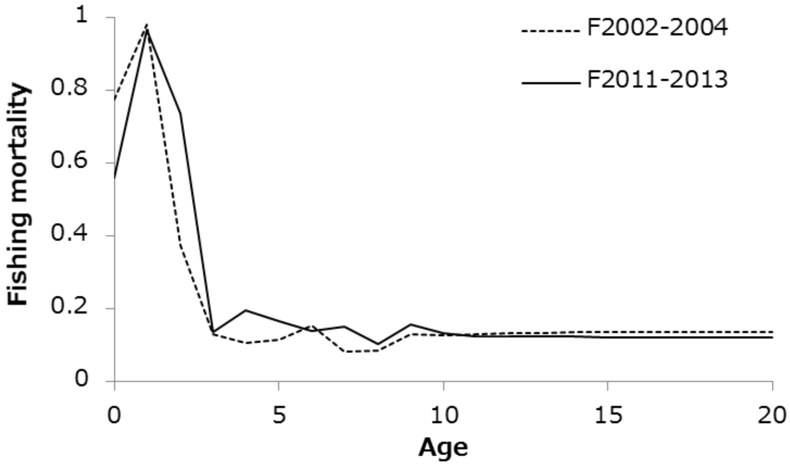


Figure 5: Geometric means of annual age-specific (years) fishing mortalities of PBF for 2002–2004 (dashed line) and 2011–2013 (solid line).

Although no limit reference points have been established for the PBF stock under the auspices of the WCPFC and IATTC, the $F_{2011-2013}$ exceeds all calculated biological reference points except for FMED and FLOSS despite slight reductions to F in recent years (Table 7). The ratio of SSB in 2014 relative to the theoretical unfished[1] SSB ($SSB_{2014}/SSB_{F=0}$, the depletion ratio) is 2.6%[2] and $SSB_{2012}/SSB_{F=0}$ is 2.1% indicating a slight increase from 2012 to 2014. Although the $SSB_{2014}/SSB_{F=0}$ for this assessment (2.6%) is lower than $SSB_{2012}/SSB_{F=0}$ from the 2014 assessment (4.2%), this difference is due to improvements to the input data and model structure (Figure 4) rather than a decline in SSB from 2012 to 2014. Note that potential effects on Fs as a result of the measures of the WCPFC and IATTC starting in 2015 or by other voluntary measures are not yet reflected in the data used in this assessment.

Since reference points for PBF have yet to be identified, two examples of Kobe plots (Figure 6: plot A based on SSBMED and FMED, plot B based on SSB20% and SPR20%) are presented. These versions of the Kobe plot represent two interpretations of stock status in an effort to prompt further discussion. In summary, if these were the reference points, overfishing would be occurring or just at the threshold in the case of FMED; and the stock would be considered overfished. Plot B shows that the stock has remained in an overfished and -overfishing status for the vast majority of the assessment period if F20% and SSB20% are the reference points. The ISC notes that the SSB estimates before 1980 are more uncertain and that the reason why the fishing mortality is estimated to be so high right after the WWII is not well understood. The low biomass level at the beginning of the assessment period (1952) could potentially be the result of relatively high catches prior to the assessment period of PBF.

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1 "Unfished" refers to what SSB would be had there been no fishing.

2 The unfished SSB is estimated based upon equilibrium assumptions of no environmental or density-dependent effects.

Table 7: Ratios of the estimated fishing mortalities F2002-2004, F2009-2011 and F2011-2013 relative to computed F- based biological reference points and SSB (t) and depletion ratio for the terminal year of the reference period for PBF.

	F_{max}	$F_{0.1}$	F_{med}	F_{loss}	$F_{10\%}$	$F_{20\%}$	$F_{30\%}$	$F_{40\%}$	Estimated SSB for terminal year of each reference period	Depletion ratio for terminal year of each reference period
2002–2004	1.86	2.59	1.09	0.80	1.31	1.89	2.54	3.34	41 069	0.064
2009–2011	1.99	2.78	1.17	0.85	1.41	2.03	2.72	3.58	11 860	0.018
2011–2013	1.63	2.28	0.96	0.70	1.15	1.66	2.23	2.94	15 703	0.024

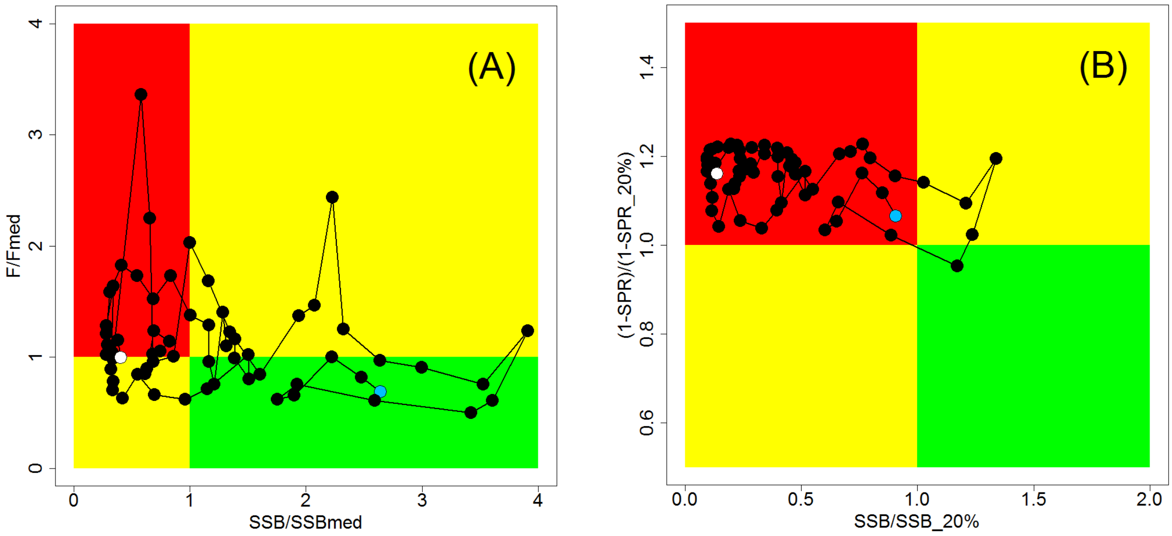

Figure 6: Kobe plots for PBF. (A) SSBMED and FMED; (B) SSB20% and SPR20% based. Note that SSBMED is estimated as the median of estimated SSB over whole assessment period (40 944 t) and FMED is calculated as an F to provide SSBMED in long-term, while the plots are points of estimates. The blue and white points on the plot show the start (1952) and end (2014) year of the period modelled in the stock assessment, respectively.

In the absence of any agreed definition of a drastic drop in stock recruitment referred to in CMM 2015-04, SC12 notes with concern that the 2012 and 2014 recruitments are at the lowest levels observed since 1980, noting that ISC noted that recruitment in the terminal years of any assessment is highly uncertain. SC12 also noted a comment from Japan that some indices of 2015 recruitment are above the 2014 level and early anecdotal information regarding the 2016 recruitment suggests it is not particularly low.

The provisional total Pacific Bluefin tuna catch in 2015 was 11 020 t in the North Pacific Ocean, which was a 36% decrease over 2014 and a 30% decrease over the average for 2010–2014.

SC12 noted that, based on the latest stock assessment carried out by ISC in 2016, SC12 noted that the Pacific bluefin tuna spawning stock biomass is depleted to 2.6% of the estimated unfished **spawning stock** biomass (SBF=0). SC12 emphasized that this depletion level is considerably below the biomass depletion-based Limit Reference Point of 20% of SBF=0 set by the Commission for all other WCPFC key tuna stocks (skipjack, yellowfin, bigeye, south Pacific albacore and north Pacific albacore). However, SC12 also notes that the Pacific bluefin tuna stock remained below 20% of SBF=0 for most of the time of assessment. SC12 also noted that the initial rebuilding target currently defined by the CMM 2015-04, the median of the SSB of the stock assessment period (42 582 t) corresponds to a spawning biomass of around 7% of estimated unfished spawning stock biomass.

Management advice and implications

SC12 noted the following conservation advice from ISC.

> The steady decline in SSB from 1996 to 2010 appears to have ceased, although SSB2014 is near the historic low and the stock is experiencing exploitation rates above all calculated biological reference points except for FMED and FLOSS.
>
> Under several harvest and recruitment scenarios examined, the initial goal of WCPFC, rebuilding to SSBMED by 2024 with at least 60% probability, is reached and the risk of SSB falling below SSBLOSS at least once in 10 years was low.
>
> The projection results indicate that the probability of SSB recovering to the initial WCPFC target (SSBMED by 2024, 38 000 t, calculated in the same manner as the previous assessment) is 69% or above the level prescribed in the WCPFC CMM if the low recruitment scenario is assumed and WCPFC CMM 2015-04 and IATTC Resolution C-14-06 continue in force and are fully implemented.

In view of the upcoming IATTC-WCPFC joint meeting on Pacific bluefin tuna management, SC12 expressed the need of urgent coordinated actions between WCPFC and IATTC in reviewing the current rebuilding plan, establishing the emergency rule as well as considering and developing reference points and HCRs for the long term management of PBF.

5.1 Estimates of fishery parameters and abundance

There are no fishery-independent indices of abundance for the pacific bluefin tuna stock. Relative abundance information is available from standardized indices of longline catch per unit effort data.

5.2 Biomass estimates

These estimates apply to the entire distribution of the stock in the Pacific Ocean. The ratio of SSB in 2014 relative to the theoretical unfished SSB (SSB2014/SSBF=0, the depletion ratio) is 2.6%. The base-case model indicates: (1) spawning stock biomass (SSB) fluctuated throughout the assessment period (fishing years 1952–2014) and (2) the SSB steadily declined from 1996 to 2010; and (3) the decline appears to have ceased since 2010, although the stock remains near the historic low.

5.3 Yield estimates and projections

No estimates of *MCY* and *CAY* are available.

6. STATUS OF THE STOCKS

Stock structure assumptions
Western and Central Pacific Ocean
All biomass in these tables refer to spawning biomass (SB).

Stock Status	
Year of Most Recent Assessment	2016
Assessment Runs Presented	Base case model
Reference Points	Target: Not established; default = B_{MSY} Soft Limit: Not established by WCPFC or IATTC; but evaluated using HSS default of 20% SB_0

	Hard Limit: Not established by WCPFC or IATTC; but evaluated using HSS default of 10% SB_0 Overfishing threshold: F_{MSY}
Status in relation to Target	Very Unlikely (< 10%) to be at or above B_{MSY} Very Unlikely (< 10%) that $F < F_{MSY}$
Status in relation to Limits	Very Likely (> 90%) to be below the Soft Limit Very Likely (> 90%) to be below the Hard Limit
Status in relation to Overfishing	Overfishing is Very Likely (> 90%) to be occurring
Historical Stock Status Trajectory and Current Status	

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Biomass is close to the lowest level ever experienced.
Recent Trend in Fishing Intensity or Proxy	F's on ages 0 and 1 have decreased, Fs on ages 2 to 4 have increased, and Fs on older ages have been variable between 2002–2004 and 2011–2013. The catch in weight is dominated by recruits and juveniles (ages 0–3).
Other Abundance Indices	-
Trends in Other Relevant Indicator or Variables	Recruitment has fluctuated without trend over the assessment period (1952–2014). Recent recruitment (2005–present) is highly uncertain, making short-term forecasting difficult.
Projections and Prognosis	
Stock Projections or Prognosis	Results of stock projections suggest that even under the low recruitment scenario, SB will increase.
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Very Likely (> 90%) Hard Limit: Very Likely (> 90%)
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Very Likely (> 90%)

Assessment Methodology and Evaluation		
Assessment Type	Level 1: Quantitative Stock assessment	
Assessment Method	Quantitative assessment in Stock Synthesis	
Assessment Dates	Latest assessment: 2016	Next assessment: Unknown
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- catch - size composition - catch-per-unit of effort (CPUE) from 1952 to 2011	1 – High Quality 1 – High Quality 2 – Medium or Mixed Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- Steepness (fixed at 0.999) - The assumed natural mortality rate	

Qualifying Comments
-

Fishery Interactions
-

7. FOR FURTHER INFORMATION

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