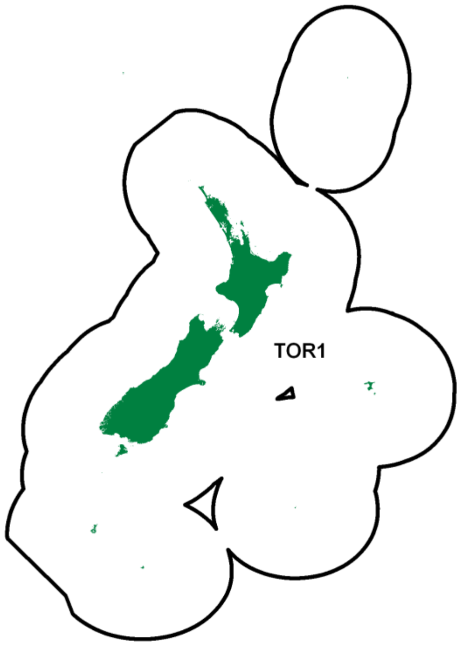
PACIFIC BLUEFIN TUNA (TOR)

(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 under reported 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.

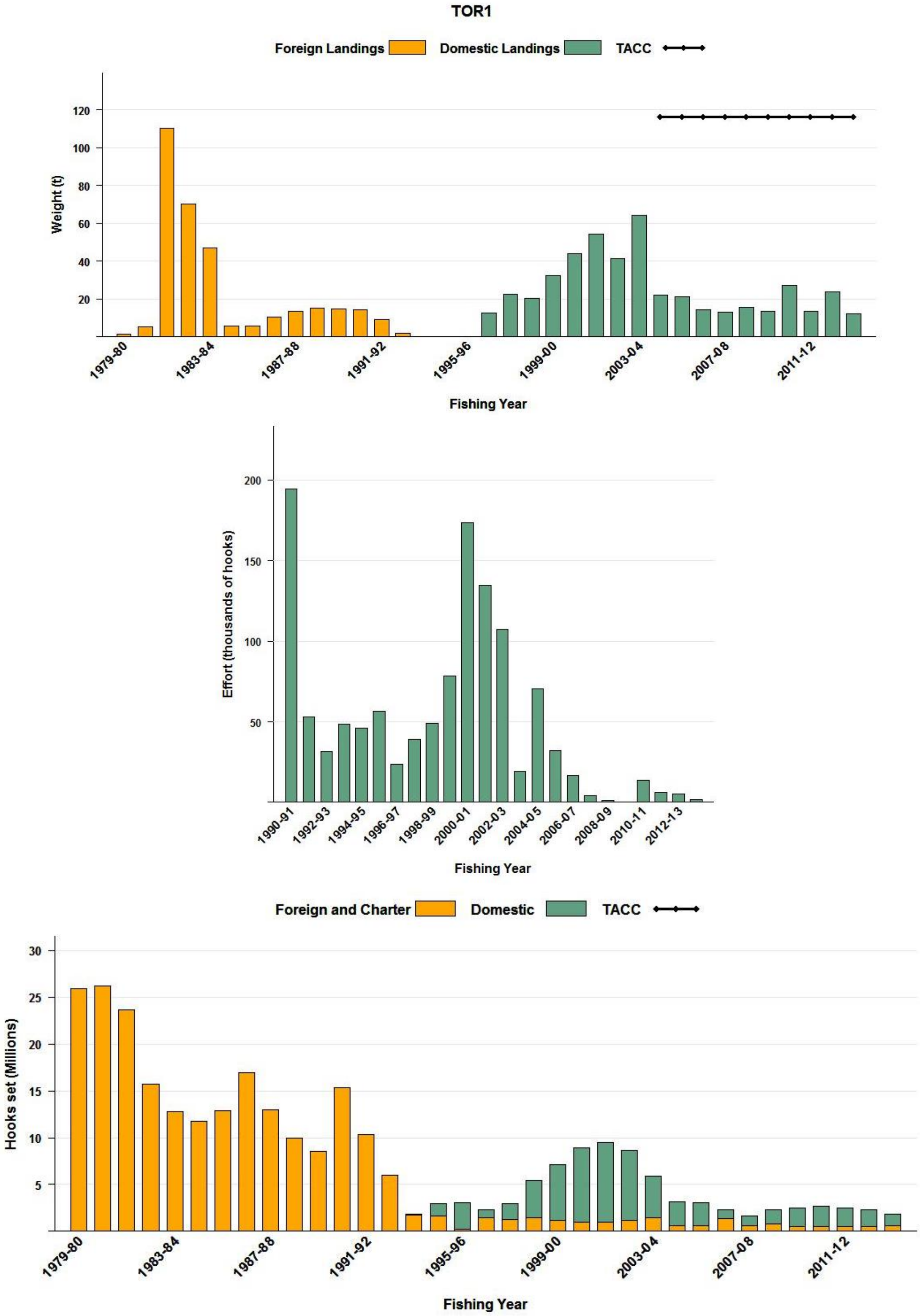


Figure 1: [Top] Commercial catch of pacific bluefin tuna by foreign licensed and New Zealand vessels from 1979–80 to 2013–14 within New Zealand waters (TOR 1). [Middle] Fishing effort (number of hooks set) for high seas New Zealand flagged surface longline vessels, from 1990–91 to 2012–13, and [Bottom] 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 2013–14.

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)	Ye	NZ landings	Total stock	Ye	NZ landings	Total stock (t)
1991	1.5	15 781	19	21.2	29 153	20	14	21 189
1992	0.3	13 995	20	20.9	33 900	20	14.0	24 794
1993	5.6	10 811	20	49.8	18 712	20	16.0	19 928
1994	1.9	16 961	20	55.4	18 959	20	13.6	18 057
1995	1.8	29 225	20	40.8	18 419	20	27.4	17 651
1996	4.2	23 519	20	67.3	25 357	20	13.3	15 636
1997	14.3	24 632	20	20.1	28 988	20	23.9	12 124
1998	20.4	15 763	20	21.1	26 074	20	12.1	17 065

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

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 to 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.

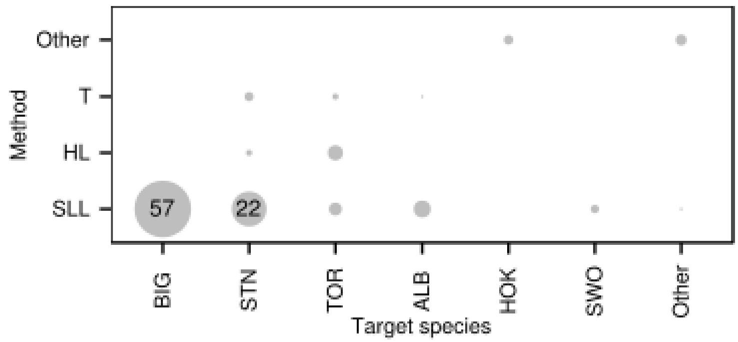


Figure 2: A summary of the proportion of landings of pacific bluefin tuna taken by each target fishery and fishing method. The area of each circle is proportional to the percentage of landings taken using each combination of fishing method and target species. The number in the bobble is the percentage.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

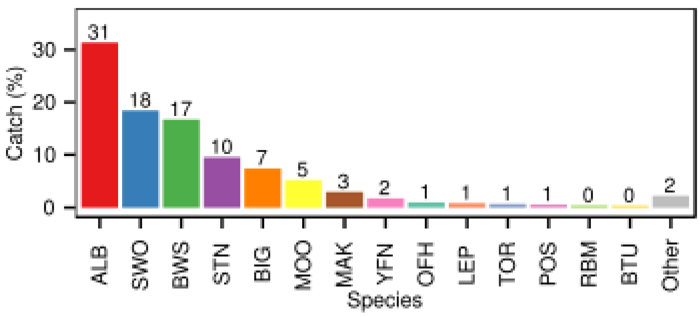


Figure 3: A summary of species composition of the reported surface longline catch. The percentage by weight of each species is calculated for all surface longline trips (Bentley et al 2013).

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 meters 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 section was updated for the November 2014 Fishery Assessment Plenary after review by the Aquatic Environment Working Group. 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/5008) (Ministry for Primary Industries 2014).

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 catch (seabirds, sea turtles and mammals)

The protected species capture estimates presented here include all animals recovered onto the deck (alive, injured or dead) of fishing vessels but do not include any cryptic mortality (e.g., seabirds caught on a hook but not brought onboard the vessel)[1].

4.2.1 Seabird bycatch

Between 2002–03 and 2013–14, there were zero observed captures of birds across other surface longline target fisheries (those not targeting albacore tuna, bigeye tuna, southern bluefin tuna, and swordfish). Seabird capture rates since 2003 are presented in Figures 5 and 6. Seabird captures were more frequent off the south west coast of the South Island (Figure 6). Bayesian models of varying complexity dependent on data quality have been used to estimate captures across a range of methods (Richard & Abraham 2014). Observed and estimated seabird captures in surface longline fisheries are provided in Table 6.

Through the 1990s the minimum seabird mitigation requirement for surface longline vessels was the use of a bird scaring device (tori line) but common practice was that vessels set surface longlines primarily at night. In 2007 a notice was implemented under s 11 of the Fisheries Act 1996 to formalise the requirement that surface longline vessels only set during the hours of darkness and use a tori line when setting. This notice was amended in 2008 to add the option of line weighting and tori line use if setting during the day. In 2011 the notices were combined and repromulgated under a new regulation (Regulation 58A of the Fisheries (Commercial Fishing) Regulations 2001) which provides a more flexible regulatory environment under which to set seabird mitigation requirements.

Risk posed by commercial fishing to seabirds has been assessed via a level 2 method which supports much of the NPOA-Seabirds 2013 risk assessment framework (MPI 2013b). The method used in the level 2 risk assessment arose initially from an expert workshop hosted by the Ministry of Fisheries in 2008. The overall framework is described in Sharp et al. (2011) and has been variously applied and improved in multiple iterations (Waugh et al. 2009, Richard et al. 2011, Richard and Abraham 2013, Richard et al. 2013 and Richard & Abraham in press). The method applies an "exposure-effects" approach where exposure refers to the number of fatalities is calculated from the overlap of seabirds with fishing effort compared with observed captures to estimate the species vulnerability (capture rates per encounter) to each fishery group. This is then compared to the population's productivity, based on population estimates and biological characteristics to yield estimates of population-level risk.

The 2014 iteration of the seabird risk assessment (Richard & Abraham in press) assessed other surface longline target fisheries (those not targeting albacore tuna, bigeye tuna, southern bluefin tuna, and swordfish) contribution to the total risk posed by New Zealand commercial fishing to seabirds (see Table 6). These target fisheries contribute 0.003 of PBR_1 to the risk to Southern Buller's albatross which was assessed to be at very high risk from New Zealand commercial fishing (Richard & Abraham in press).

[1] As part of its data reconciliation processes, MPI has identified that less than 2% of observed protected species captures between 2002 and 2015 were not recorded in COD. Steps are being taken to update the database and estimates of protected species captures and associated risks. Accordingly, some estimates of protected species captures or risk in this document may have a small negative bias. Neither Maui nor Hector's dolphins are affected. Updated estimates will be reviewed by the Aquatic Environment Working Group in the second quarter of 2016.

Table 5: Effort, observed and estimated seabird captures by fishing year for the New Zealand surface longline fishery within the EEZ. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures; the capture rate (captures per thousand hooks); and the mean number of estimated total captures (with 95% confidence interval). Estimates are based on methods described in Thompson et al (2013) and are available via http://www.fish.govt.nz/en-nz/Environmental/Seabirds/. Estimates from 2002–03 to 2013–14 are based on data version 2015003.

Fishing year			Fishing effort	Observed captures		Estimated captures	
	All hooks	Observed hooks	% observed	Number	Rate	Mean	95% c.i.
2002–2003	173 410	0	0	0	-	34	11–76
2003–2004	220 787	13 000	5.9	0	0	37	12–83
2004–2005	100 290	800	0.8	0	0	87	32–198
2005–2006	40 320	0	0	0	-	11	2–30
2006–2007	45 795	0	0	0	-	12	2–30
2007–2008	47 755	0	0	0	-	12	2–32
2008–2009	16 178	0	0	0	-	5	0–17
2009–2010	26 800	0	0	0	-	8	1–22
2010–2011	20 100	0	0	0	-	5	0–16
2011–2012	18 900	0	0	0	-	3	0–11
2012–2013	43 160	0	0	0	-	10	2–28
2013–2014	19 700	820	4.2	0	0	4	0–14

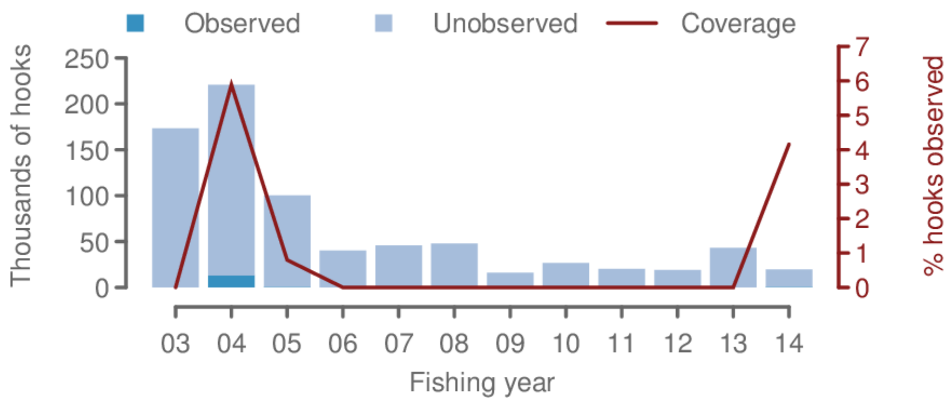


Figure 4: Observed captures of seabirds in the New Zealand surface longline fisheries from 2002–03 to 2013–14.

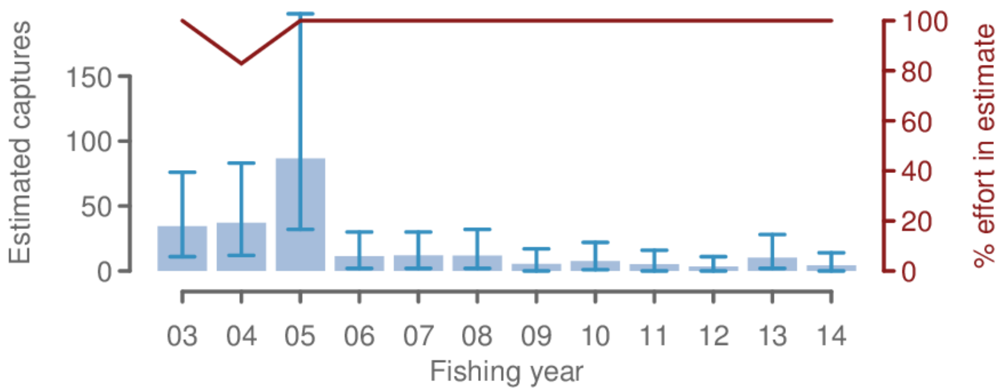


Figure 5: Estimated captures of seabirds in the New Zealand surface longline fisheries from 2002–03 to 2013–14.

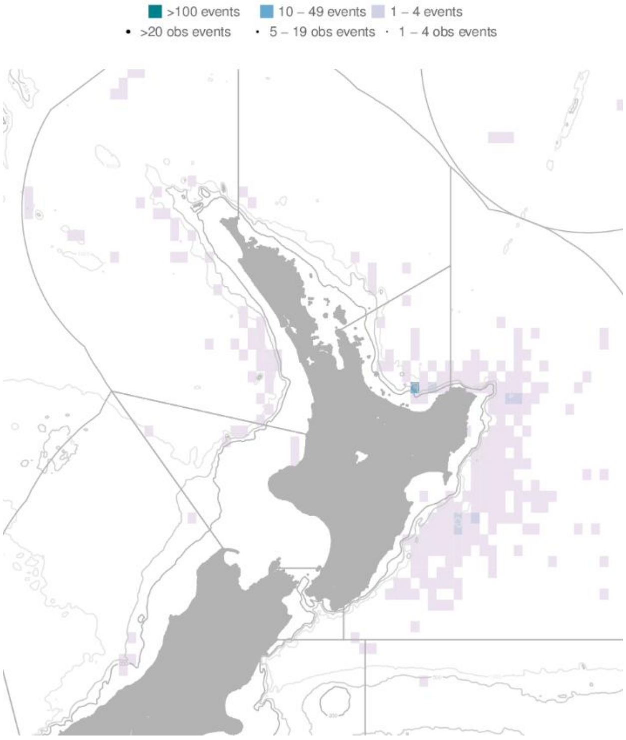


Figure 6: Distribution of fishing effort in the New Zealand surface longline fisheries and observed seabird captures, 2002–03 to 2013–14. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black dots, and observed captures are indicated by red dots. Fishing is only shown if the effort could be assigned a latitude and longitude, and if there were three or more vessels fishing within a cell. In this case, 89.4% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

Table 6: Risk ratio of seabirds predicted by the level two risk assessment for the other species target surface longline fisheries (those not targeting albacore tuna, bigeye tuna, southern bluefin tuna, pacific bluefin tuna and swordfish) and all fisheries included in the level two risk assessment, 2006–07 to 2012–13, showing seabird species with risk category of very high or high, or a medium risk category and risk ratio of at least 1% of the total risk. The risk ratio is an estimate of aggregate potential fatalities across trawl and longline fisheries relative to the Potential Biological Removals, PBR_1 (from Richard and Abraham 2014 where full details of the risk assessment approach can be found). PBR_1 applies a recovery factor of 1.0. Typically a recovery factor of 0.1 to 0.5 is applied (based on the state of the population) to allow for recovery from low population sizes as quickly as possible. This should be considered when interpreting these results. The New Zealand threat classifications are shown (Robertson et al 2013 at {http://www.doc.govt.nz/documents/science-and-technical/nztcs4entire.pdf}

	Risk ratio				
Species name	OTH target SLL	Total risk from NZ commercial fishing	% of total risk from NZ commercial fishing	Risk category	NZ Threat Classification
Black petrel	0.000	15.095	0.00	Very high	Threatened: Nationally Vulnerable
Salvin's albatross	0.000	3.543	0.00	Very high	Threatened: Nationally Critical
Southern Buller's albatross	0.003	2.823	0.10	Very high	At Risk: Naturally Uncommon
Flesh-footed shearwater	0.000	1.557	0.00	Very high	Threatened: Nationally Vulnerable
Gibson's albatross	0.000	1.245	0.00	Very high	Threatened: Nationally Critical
New Zealand white-capped albatross	0.000	1.096	0.01	Very high	At Risk: Declining
Chatham Island albatross	0.000	0.913	0.00	High	At Risk: Naturally Uncommon

Table 6 [Continued]

Species name	Risk ratio: OTH target SLL	Risk ratio: Total risk from NZ commercial fishing	Risk ratio: % of total risk from NZ commercial fishing	Risk category	NZ Threat Classification
Antipodean albatross	0.000	0.888	0.00	High	Threatened: Nationally Critical
Westland petrel	0.000	0.498	0.00	High	At Risk: Naturally Uncommon
Northern Buller's albatross	0.000	0.336	0.13	High	At Risk: Naturally Uncommon
Campbell black-browed albatross	0.000	0.304	0.00	High	At Risk: Naturally Uncommon
Stewart Island shag	0.000	0.301	0.00	High	Threatened: Nationally Vulnerable

4.2.2 Sea turtle bycatch

Between 2002–03 and 2013–14, there were 15 observed captures of sea turtles across all surface longline fisheries (Tables 7 and 8, Figure 7). Observer records documented all but one sea turtle as captured and released alive. Sea turtle capture distributions predominantly occur throughout the east coast of the North Island and Kermadec Island fisheries (Figure 9).

Table 7: Number of observed sea turtle captures in the New Zealand surface longline fisheries, 2002–03 to 2013–14, by species and area. Data from Thompson et al (2013), retrieved from http://data.dragonfly.co.nz/psc/. See glossary above for a description of the areas used for summarising the fishing effort and protected species captures.

Species	Bay of Plenty	East Coast North Island	Kermadec Islands	West Coast North Island	Total
Leatherback turtle	1	4	3	3	11
Green turtle	0	1	0	0	1
Unknown turtle	0	1	0	2	3
Total	1	6	3	5	15

Table 8: Effort and sea turtle captures in surface longline fisheries by fishing year. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures (both dead and alive); and the capture rate (captures per thousand hooks). For more information on the methods used to prepare the data see Thompson et al (2013).

Fishing year	Fishing effort: All hooks	Fishing effort: Observed hooks	Fishing effort: % observed	Observed captures: Number	Observed captures: Rate
2002–2003	10 770 488	2 195 152	20.4	0	0
2003–2004	7 386 484	1 607 304	21.8	1	0.001
2004–2005	3 679 765	783 812	21.3	2	0.003
2005–2006	3 690 869	705 945	19.1	1	0.001
2006–2007	3 739 912	1 040 948	27.8	2	0.002
2007–2008	2 246 139	421 900	18.8	1	0.002
2008–2009	3 115 633	937 496	30.1	2	0.002
2009–2010	2 995 264	665 883	22.2	0	0
2010–2011	3 188 179	674 572	21.2	4	0.006
2011–2012	3 100 177	728 190	23.5	0	0
2012–2013	2 876 932	560 333	19.6	2	0.004
2013-2014	2 546 764	773 527	30.4	0	0

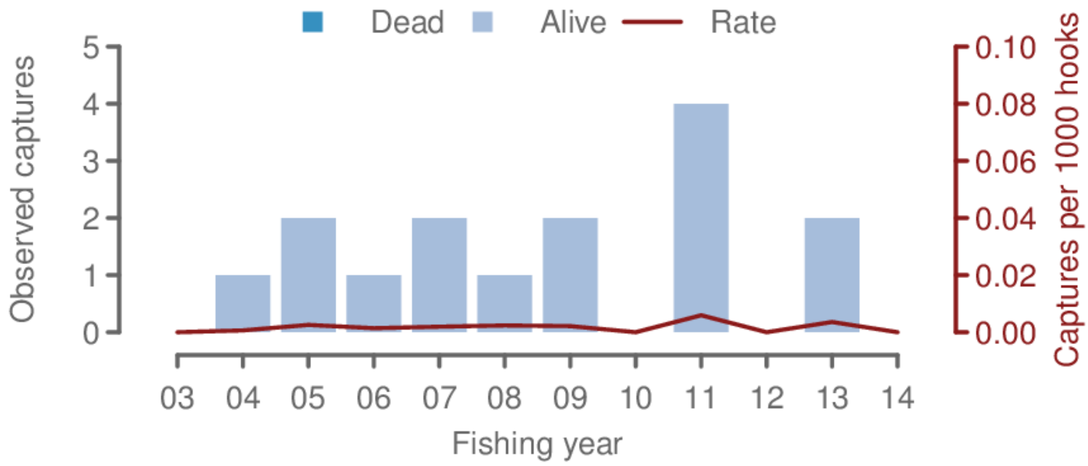


Figure 7: Observed captures of sea turtles in the New Zealand surface longline fisheries from 2002–03 to 2013–14.

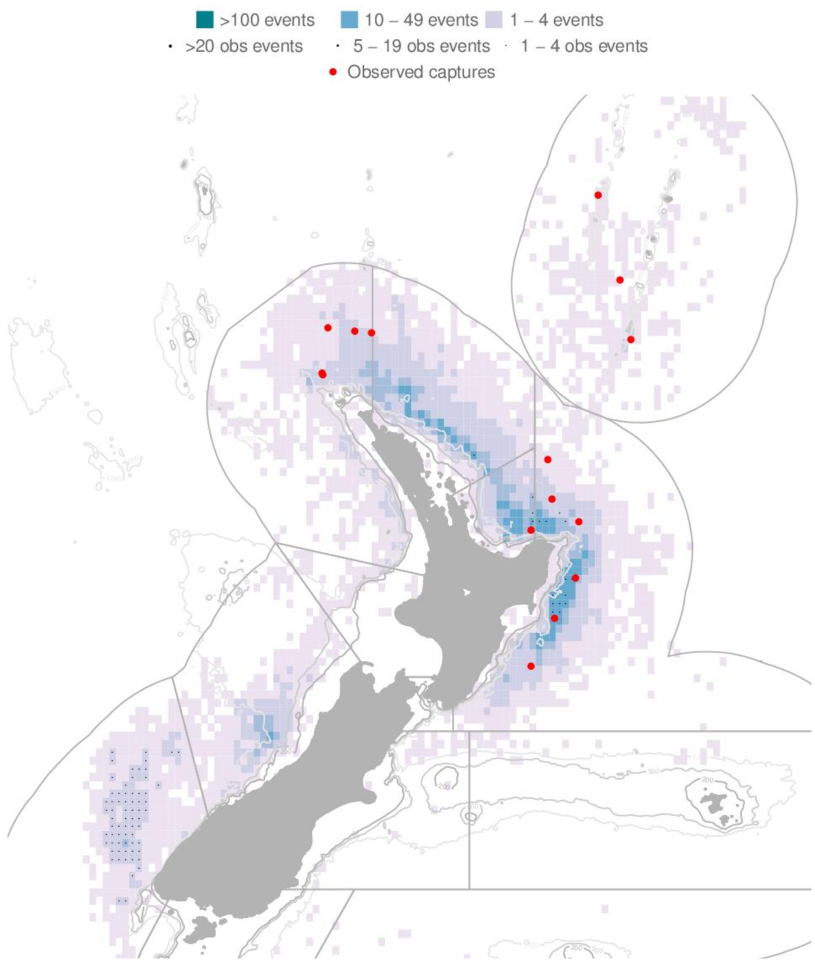


Figure 8: Distribution of fishing effort in the New Zealand surface longline fisheries and observed sea turtle captures, 2002–03 to 2013–14. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black dots, and observed captures are indicated by red dots. Fishing is only shown if the effort could be assigned a latitude and longitude, and if there were three or more vessels fishing within a cell. In this case, 89.4% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

4.2.3 Marine Mammals

4.2.3.1 Cetaceans

Cetaceans are dispersed throughout New Zealand waters (Perrin et al 2008). The spatial and temporal overlap of commercial fishing grounds and cetacean foraging areas has resulted in cetacean captures in fishing gear (Abraham & Thompson 2009, 2011).

Between 2002–03 and 2013–14, there were seven observed captures of whales and dolphins in surface longline fisheries. Observed captures included 5 unidentified cetaceans and 2 long-finned Pilot whales (Tables 9 and 10, Figure 10) (Thompson et al 2013). All captured animals recorded were documented as being caught and released alive (Thompson et al 2013). Cetacean capture distributions are more frequent off the east coast of the North Island (Figure 11).

Table 9: Number of observed cetacean captures in the New Zealand surface longline fisheries, 2002–03 to 2013–14, by species and area. Data from Thompson et al (2013), retrieved from http://data.dragonfly.co.nz/psc/. See glossary above for a description of the areas used for summarising the fishing effort and protected species captures.

Species	Bay of Plenty	East Coast North Island	Fiordland	Northland and Hauraki	West Coast North Island	West Coast South Island	Total
Long-finned pilot whale	0	1	0	0	0	1	2
Unidentified cetacean	1	1	1	1	1	0	5
Total	1	2	1	1	1	1	7

Table 10: Effort and captures of cetaceans in surface longline fisheries by fishing year. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures (both dead and alive); and the capture rate (captures per thousand hooks). For more information on the methods used to prepare the data, see Thompson et al (2013).

Fishing year	Fishing effort			Observed captures	
	All hooks	Observed hooks	% observed	Number	Rate
2002–2003	10 770 488	2 195 152	20.4	1	0
2003–2004	7 386 484	1 607 304	21.8	4	0.002
2004–2005	3 679 765	783 812	21.3	1	0.001
2005–2006	3 690 869	705 945	19.1	0	0
2006–2007	3 739 912	1 040 948	27.8	0	0
2007–2008	2 246 139	421 900	18.8	1	0.002
2008–2009	3 115 633	937 496	30.1	0	0
2009–2010	2 995 264	665 883	22.2	0	0
2010–2011	3 188 179	674 572	21.2	0	0
2011–2012	3 100 177	728 190	23.5	0	0
2012–2013	2 876 932	560 333	19.5	0	0
2013–2014	2 546 764	773 527	30.4	0	0

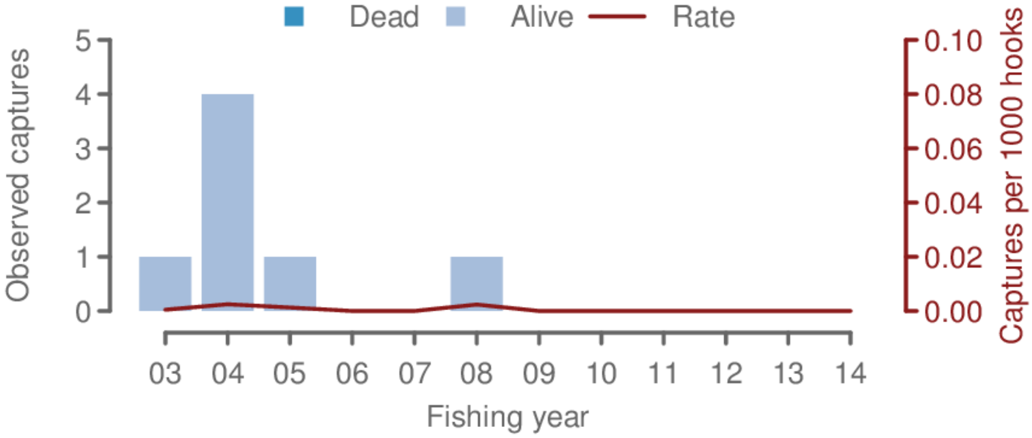


Figure 9: Observed captures of cetaceans in the New Zealand surface longline fisheries from 2002–03 to 2013–14.

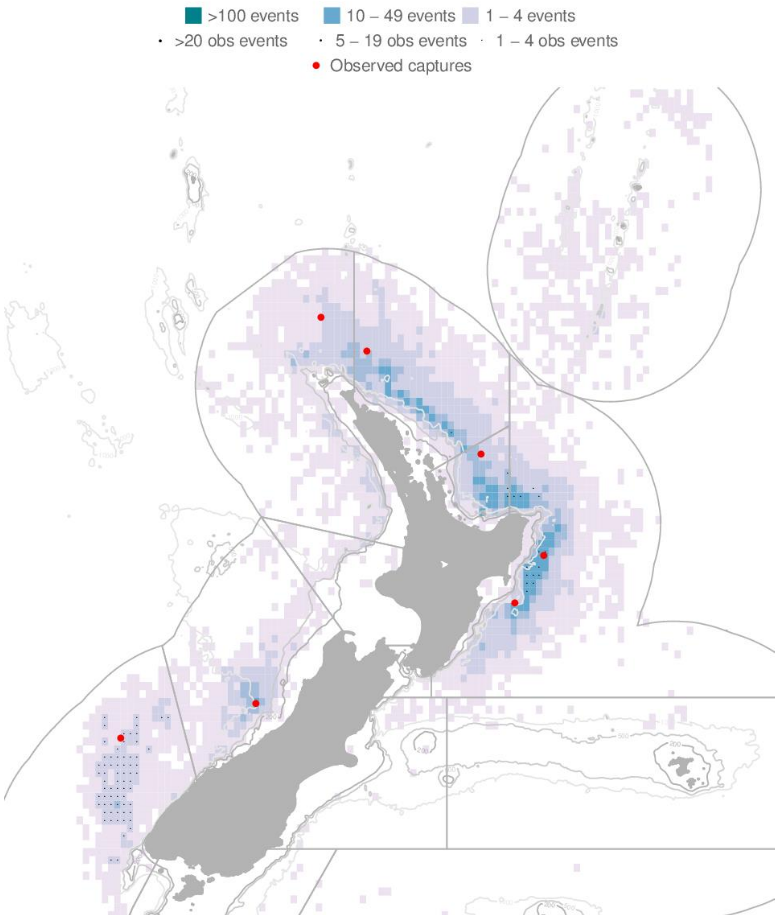


Figure 10: Distribution of fishing effort in the New Zealand surface longline fisheries and observed cetacean captures, 2002–03 to 2013–14. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black dots, and observed captures are indicated by red dots. Fishing is only shown if the effort could be assigned a latitude and longitude, and if there were three or more vessels fishing within a cell. In this case, 89.4% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

4.2.3.2 New Zealand fur seal bycatch

Currently, New Zealand fur seals are dispersed throughout New Zealand waters, especially in waters south of about 40º S to Macquarie Island. The spatial and temporal overlap of commercial fishing grounds and New Zealand fur seal foraging areas has resulted in New Zealand fur seal captures in fishing gear (Mattlin 1987, Rowe 2009). Most fisheries with observed captures occur in waters over or close to the continental shelf, which slopes steeply to deeper waters relatively close to shore, and thus rookeries and haulouts, around much of the South Island and offshore islands. Captures on longlines occur when the fur seals attempt to feed on the bait and fish catch during hauling. Most New Zealand fur seals are released alive, typically with a hook and short snood or trace still attached.

New Zealand fur seal captures in surface longline fisheries have been generally observed in waters south and west of Fiordland, but also in the Bay of Plenty-East Cape area when the animals have attempted to take bait or fish from the line as it is hauled. These capture rates include animals that are released alive (100% of observed surface longline capture in 2008–09; Thompson & Abraham 2010). Capture rates in 2011–12 and 2013-14 were higher than they were in the early 2000s (Figures 12 and 13). While fur seal captures have occurred throughout the range of this fishery most New Zealand captures have occurred off the Southwest coast of the South Island (Figure 12). Between 2002–03 and 2013–14, there were 323 observed captures of New Zealand fur seal in surface longline fisheries (Tables 11 and 12).

Table 11: Number of observed New Zealand fur seal captures in the New Zealand surface longline fisheries, 2002–03 to 2013–14, by species and area. Data from Thompson et al (2013), retrieved from http://data.dragonfly.co.nz/psc/. See glossary above for a description of the areas used for summarising the fishing effort and protected species captures.

	Bay of Plenty	East Coast North Island	Fiordland	Northland and Hauraki	Stewart Snares Shelf	West Coast North Island	West Coast South Island	Total
New Zealand fur seal	16	33	228	4	4	2	36	323

Table 12: Effort and captures of New Zealand fur seal in the New Zealand surface longline fisheries by fishing year. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures (both dead and alive); and the capture rate (captures per thousand hooks). Data from Thompson et al (2013), retrieved from http://data.dragonfly.co.nz/psc/. Estimates from 2002–03 to 2012–13 and preliminary estimates for 2013–14 are based on data version 2015003.

Fishing year	Fishing effort			Observed captures		Estimated captures	
	All hooks	Observed hooks	% observed	Number	Rate	Mean	95% c.i.
2002–2003	10 772 188	2 195 152	20.4	56	0.026	299	199–428
2003–2004	7 386 484	1 607 304	21.8	40	0.025	134	90–188
2004–2005	3 679 765	783 812	21.3	20	0.026	66	38–99
2005–2006	3 690 869	705 945	19.1	12	0.017	47	23–79
2006–2007	3 739 912	1 040 948	27.8	10	0.010	32	14–55
2007–2008	2 246 139	421 900	18.8	10	0.024	40	19–68
2008–2009	3 115 633	937 496	30.1	22	0.023	53	29–81
2009–2010	2 995 264	665 883	22.2	19	0.029	77	43–121
2010–2011	3 188 179	674 572	21.2	17	0.025	64	35–101
2011–2012	3 100 177	728 190	23.5	40	0.055	140	92–198
2012–2013	2 876 932	560 333	19.5	21	0.037	110	65–171
2013-2014	2 546 764	773 527	30.4	56	0.072	103	88-121

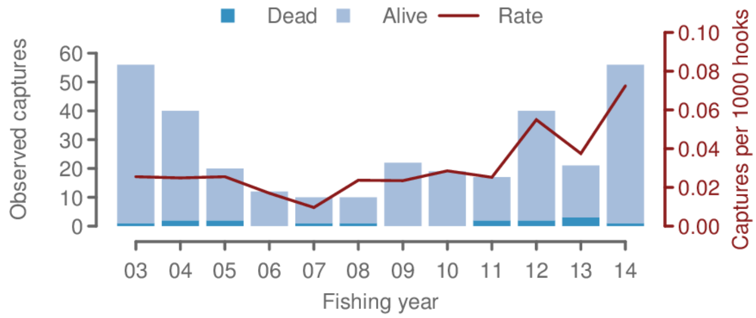


Figure 11: Observed captures of New Zealand fur seal in the New Zealand surface longline fisheries from 2002–03 to 2013–14.

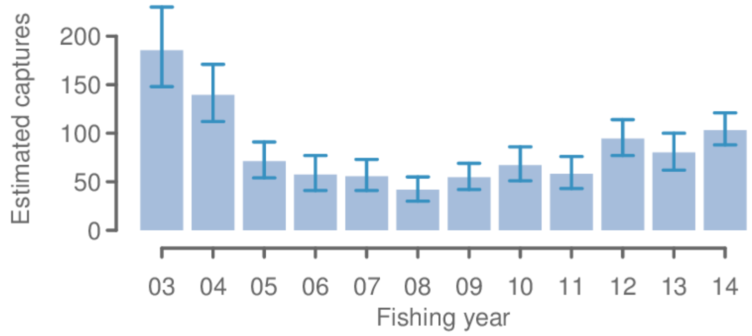


Figure 12: Estimated captures of New Zealand fur seal in the New Zealand surface longline fisheries from 2002–03 to 2013–14.

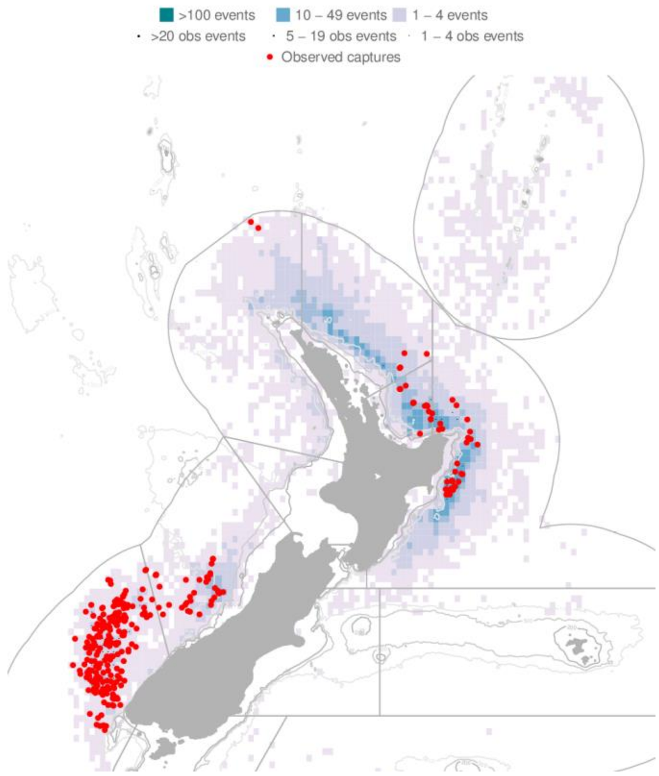


Figure 13: Distribution of fishing effort in the New Zealand surface longline fisheries and observed New Zealand fur seal captures, 2002–03 to 2013–14. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black dots, and observed captures are indicated by red dots. Fishing is only shown if the effort could be assigned a latitude and longitude, and if there were three or more vessels fishing within a cell. In this case, 89.4% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

4.3 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 13).

Table 13: Total estimated catch (numbers of fish) of common bycatch species in the New Zealand longline fishery as estimated from observer data from 2009 to 2013. Also provided is the percentage of these species retained (2013 data only) and the percentage of fish that were alive when discarded, N/A (none discarded).

Species	2011	2012	2013	2014	% retained (2014)	discards % alive (2014)
Blue shark	53 432	132 925	158 736	80 118	16.2	89.2
Lancetfish	37 305	7 866	19 172	21 002	0.3	24.4
Porbeagle shark	9 929	7 019	9 805	5 061	30.6	70.7
Rays bream	18 453	19 918	13 568	4 591	96.1	7.4
Mako shark	9 770	3 902	3 981	4 506	30.3	68.8
Sunfish	3 773	3 265	1 937	1 981	2.4	80.0
Moonfish	3 418	2 363	2 470	1 655	96.6	87.5
Dealfish	223	372	237	910	0.4	24.9
Butterfly tuna	909	713	1 030	699	77.3	3.4
Pelagic stingray	4 090	712	1 199	684	0.0	93.5
Escolar	6 602	2 181	2 088	656	88.6	0.0
Deepwater dogfish	548	647	743	600	1.2	80.9
Oilfish	1 747	509	386	518	82.1	40.0
Rudderfish	338	491	362	327	10.7	83.3
Thresher shark	349	246	256	261	28.6	80.0
Big scale pomfret	139	108	67	164	74.5	75.0
Striped marlin	175	124	182	151	0.0	94.3
School shark	49	477	21	119	72.0	78.6
Skipjack tuna	255	123	240	90	80.0	0.0

4.4 Benthic interactions

N/A

4.5 Key environmental and ecosystem information gaps

Cryptic mortality is unknown at present but developing a better understanding of this in future may be useful for reducing uncertainty of the seabird risk assessment and could be a useful input into risk assessments for other species groups.

The survival rates of released target and bycatch species is currently unknown.

Observer coverage in the New Zealand fleet is not spatially and temporally representative of the fishing effort.

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.

The latest assessment for Pacific bluefin tuna was completed in 2014. The update of the stock assessment of Pacific bluefin was outlined in WCPFC-SC10-2014/SA-WP-11. Results of the 2014 stock assessment are summarized as follows. The update of the stock assessment was completed in February 2014 at the SWSFC in La Jolla, USA through updates of fishery data up to June 2013 according to a request from the 2013 ISC Plenary. The fishery data (quarterly catch, size composition) from 1952 to 2010 (July 1952-June 2011) used in the 2012 stock assessment were not changed. In the case of CPUE time series, due to the nature of the CPUE standardizations method, the whole time series will need to be re-standardized with the additional two years of data. Stock Synthesis v3.23b was used as stock assessment model. Future projections were conducted under the 7 harvesting scenarios assigned by NC9. The software used for the future projections is distributed as an R-package named 'ssfuture'.

The current (2012) spawning stock biomass was 26,324 mt and slightly higher than that estimated for 2010 (25,476 mt). Mean recruitment for the last five years may have been below the historical average level. Although no target or LRPs have been established for the PBF stock, the current F average over 2009-2011 exceeds all target and limit biological reference points (BRPs) commonly used by fisheries managers except for F_{loss}, and the ratio of SSB in 2012 relative to unfished SSB (depletion ratio) is less than 6%. Based on reference point ratios, overfishing is occurring and the stock is overfished. Based on projection results, adopted WCPFC CMM (2013-09) and IATTC resolution for 2014 (C-13-02), if continued, are not expected to increase SSB if recent low recruitment continues. In relation to the projections "requested" by NC9, only Scenario 6, the strictest one, results in an increase in SSB even if the current low recruitment continues. If the low recruitment of recent years continues the risk of SSB falling below its historically lowest level observed would increase. This risk can be reduced with implementation of more conservative management measures.

SC10 noted that the ISC provided the following conclusions on the stock status of Pacific bluefin tuna in the Pacific Ocean in 2014:

- Using the updated stock assessment, the 2012 SSB was 26,324 mt and slightly higher than that estimated for 2010 (25,476 mt).

- Across sensitivity runs in the updated stock assessment, estimates of recruitment were considered robust. The recruitment level in 2012 was estimated to be relatively low (the 8th lowest in 61 years), and the average recruitment level for the last five years may have been below the historical average level (Figure 13). Estimated age-specific fishing mortalities on the stock in the period 2009-2011 relative to 2002-2004 (the base period for WCPFC Conservation and Management Measure 2010-04) increased by 19%, 4%, 12%, 31%, 60%, 51% and 21% for ages 0-6, respectively, and decreased by 35% for age 7+ (Figure 15).

- Although no target or LRPs have been established for the PBF stock under the auspices of the WCPFC and IATTC, the current *F* average over 2009-2011 exceeds all target and limit biological reference points (BRPs) commonly used by fisheries managers except for *Floss*, and the ratio of SSB in 2012 relative to unfished SSB (depletion ratio) is less than 6%. In summary, based on reference point ratios, overfishing is occurring and the stock is overfished (Table 14).

Table 14: Ratio of the estimated fishing mortalities $F_{2002\text{-}2004}$, $F_{2007\text{-}2009}$ and $F_{2009\text{-}2011}$ relative to computed *F*-based biological reference points for Pacific bluefin tuna (*Thunnus orientalis*) and depletion ratio (ratio of SSB in 2012 relative to unfished SSB), and estimated SSB (mt) in year 2012. Values in the first eight columns above 1.0 indicate overfishing.

	F_{Max}	$F_{0.1}$	F_{Med}	F_{loss}	$F_{10\%}$	$F_{20\%}$	$F_{30\%}$	$F_{40\%}$
$F_{2002\text{-}2004}$	1.70	2.44	1.09	0.84	1.16	1.68	2.26	2.98
$F_{2007\text{-}2009}$	2.09	2.96	1.40	1.08	1.48	2.14	2.87	3.79
$F_{2009\text{-}2011}$	1.79	2.54	1.25	0.97	1.32	1.90	2.55	3.36

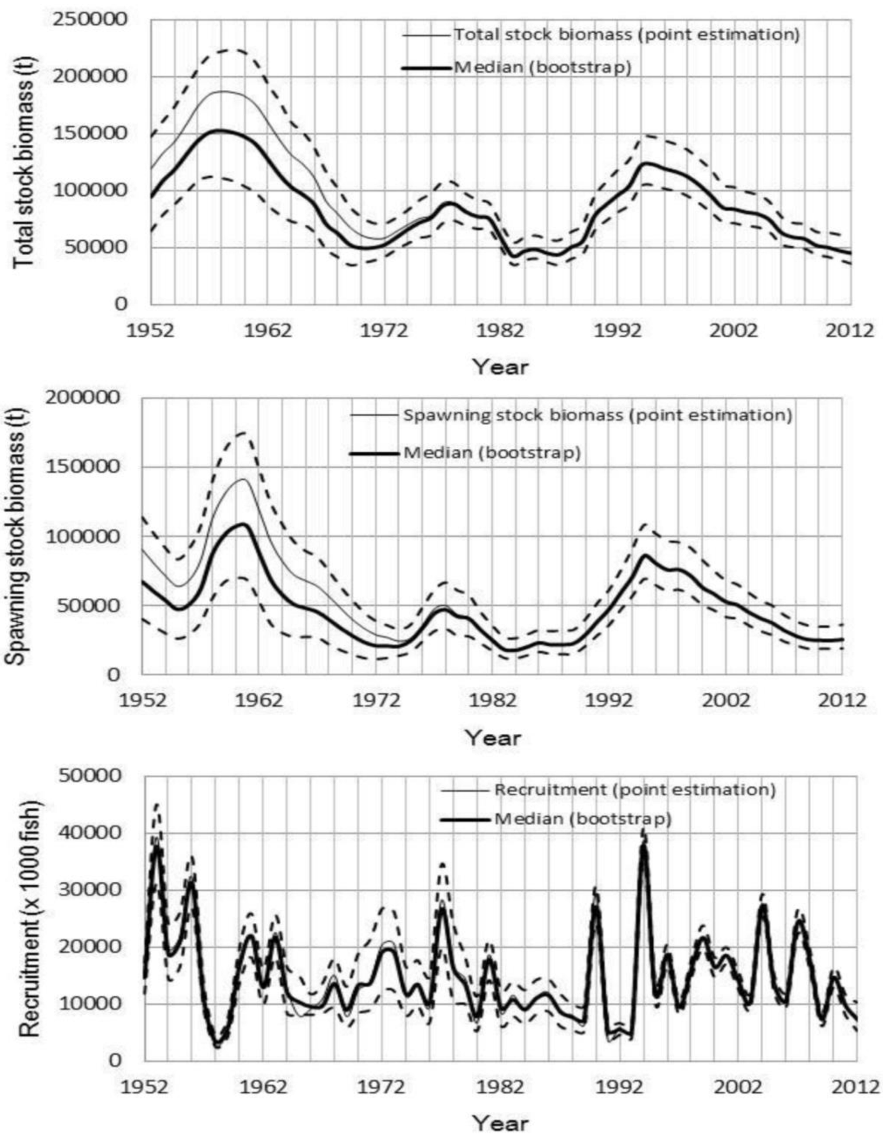


Figure 14. Total stock biomass, spawning stock biomass, and recruitment from 1952 to 2012.

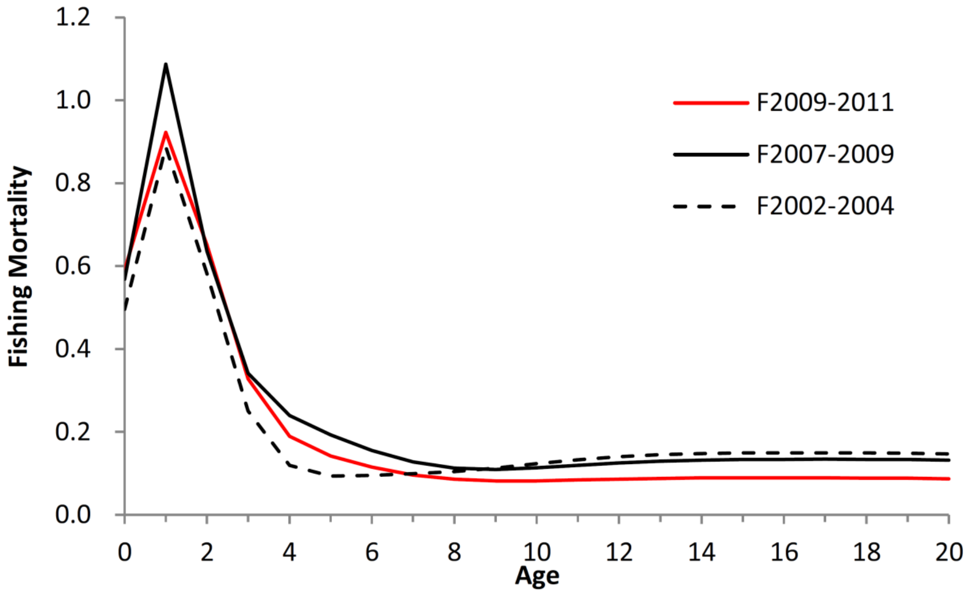


Figure 15. Geometric mean annual age-specific Pacific bluefin tuna (*Thunnus orientalis*) fishing mortalities for 2002-2004 (dashed line), 2007-2009 (solid line) and 2009-2011 (red line)

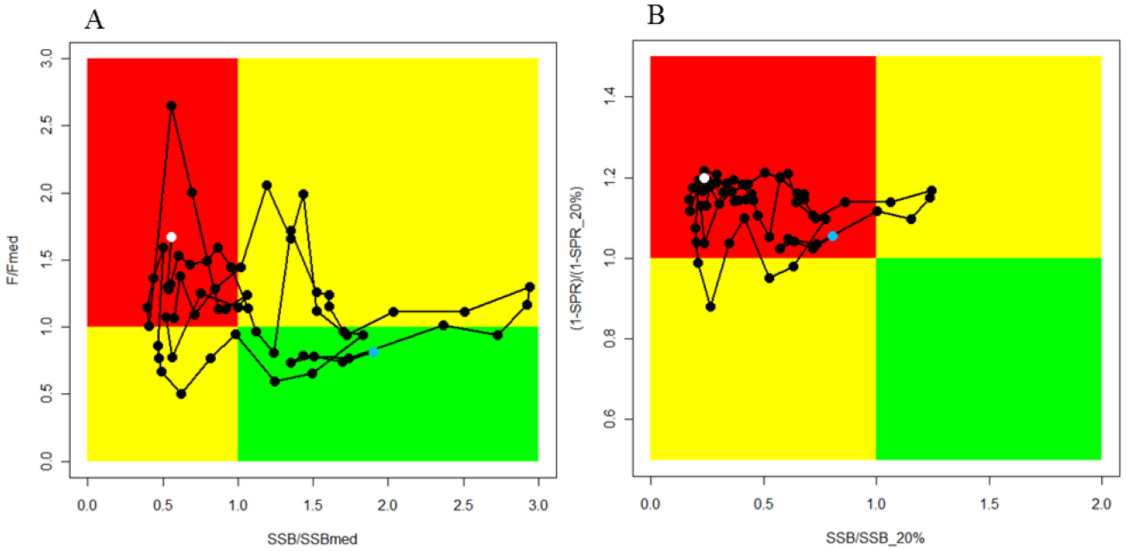


Figure 16. Alternative Kobe plots for Pacific bluefin tuna (*Thunnus orientalis*). A. *SSBMED* and *FMED*; B. *SSB20%* and *SPR20%.* Citation of these Kobe plots should include clarifying comments in the text. The blue and white points on the plot show the start (1952) and end (2012) year of the period modeled in the stock assessment, respectively.

Management advice and implications

SC10 noted that the ISC provided the following conservation advice from ISC:

- The current (2012) PBF biomass level is near historically low levels and experiencing high exploitation rates above all biological reference points except for F_{loss}. Based on projection results, the recently adopted WCPFC CMM (2013-09) and IATTC resolution for 2014 (C-13-02) if continued in to the future, are not expected to increase SSB if recent low recruitment continues.

- In relation to the projections requested by NC9, only Scenario 6, the strictest one, results in an increase in SSB even if the current low recruitment continues. Given the result of Scenario 6, further substantial reductions in fishing mortality and juvenile catch over the whole range of juvenile ages should be considered to reduce the risk of SSB falling below its historically lowest level.

- If the low recruitment of recent years continues the risk of SSB falling below its historically lowest level observed would increase. This risk can be reduced with implementation of more conservative management measures.

- Based on the results of future projections requested at NC9, unless the historical average level (1952-2011) of recruitment is realized, an increase of SSB cannot be expected under the current WCPFC and IATTC conservation and management measures, even under full implementation (Scenario 1).

- If the specifications of the harvest control rules used in the projections were modified to include a definition of juveniles that is more consistent with the maturity ogive used in the stock assessment, projection results could be different; for example, rebuilding may be faster. While no projection with a consistent definition of juvenile in any harvest scenario was conducted, any proposed reductions in juvenile catch should consider all non-mature individuals.

- Given the low level of SSB, uncertainty in future recruitment, and importance of recruitment in influencing stock biomass, monitoring of recruitment should be strengthened to allow the trend of recruitment to be understood in a timely manner.

5.1 Estimates of fishery parameters and abundance
None are available at present.

5.2 Biomass estimates
Estimates of current and reference biomass are not available.

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 this Table refer to spawning biomass (SB).

Stock Status	
Year of Most Recent Assessment	2014
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 recruits (age 0) and on juveniles (ages 1–3) have been generally increasing for more than a decade (1990–2011). 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 (1952–2011). Recent recruitment (2005–present) is highly uncertain, making short-term forecasting difficult.
Projections and Prognosis	
Stock Projections or Prognosis	Results of the future stock projection suggest that in the short-term (2009–2010) and under recent levels of F, SB will decline.
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: 2014	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 Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- Steepness (fixed at 0.99) - The assumed natural mortality rate	

Qualifying Comments
-

Fishery Interactions
Interactions with protected species are known to occur in the longline fisheries of the South Pacific, particularly south of 25°S. Seabird bycatch mitigation measures are required in the New Zealand and Australian EEZs and through the WCPFC Conservation and Management Measure CMM2007-04. Sea turtles also get incidentally captured in longline gear; the WCPFC is attempting to reduce sea turtle interactions through Conservation and Management Measure CMM2008-03. Shark bycatch is common in longline fisheries and largely unavoidable; this is being managed through New Zealand domestic legislation and to a limited extent through Conservation and Management Measure CMM2010-07.

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