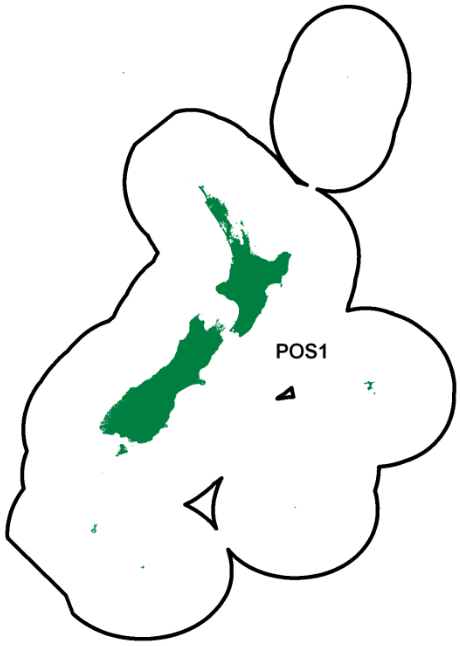
PORBEAGLE SHARK (POS)

(*Lamna nasus)*



1. FISHERY SUMMARY

Porbeagle shark were introduced into the QMS on 1 October 2004 under a single QMA, POS 1, with a TAC of 249 t, a TACC of 215 t and a recreational allowance of 10 t. The TAC was reviewed in 2012 with the reduced allocation and allowances applied from 1 October 2012 in Table 1. The decrease was in response to sustainability concerns surrounding porbeagle sharks which are slow growing and have low fecundity, making them particularly vulnerable to overexploitation.

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

Fishstock	Recreational Allowance	Customary non-commercial Allowance	Other mortality	TACC	TAC
POS 1	6	2	11	110	129

Porbeagle shark was added to the Third Schedule of the 1996 Fisheries Act with a TAC set under s14 because porbeagle shark 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.

Porbeagle shark was also added to the Sixth Schedule of the 1996 Fisheries Act with the provision that:

> "A commercial fisher may return any porbeagle shark to the waters from which it was taken from if –
> (a) that porbeagle shark is likely to survive on return; and
> (b) the return takes place as soon as practicable after the porbeagle shark is taken."

Management of the porbeagle shark throughout the western and central Pacific Ocean (WCPO) is the responsibility of the Western and Central Pacific Fisheries Commission (WCPFC). Under this regional convention New Zealand is responsible for ensuring that the management measures applied within New Zealand fisheries waters are compatible with those of the Commission.

1.1 Commercial fisheries

About half of the commercial catch of porbeagle shark is taken by tuna longliners, and most of the rest by mid-water and bottom trawlers. About 50% of porbeagle sharks caught by tuna longliners are processed, and the rest are discarded. Of the sharks that are processed, about 80% are finned only, and 20% are processed for their flesh and fins. Figure 1 shows historical landings and longline fishing effort for POS 1.

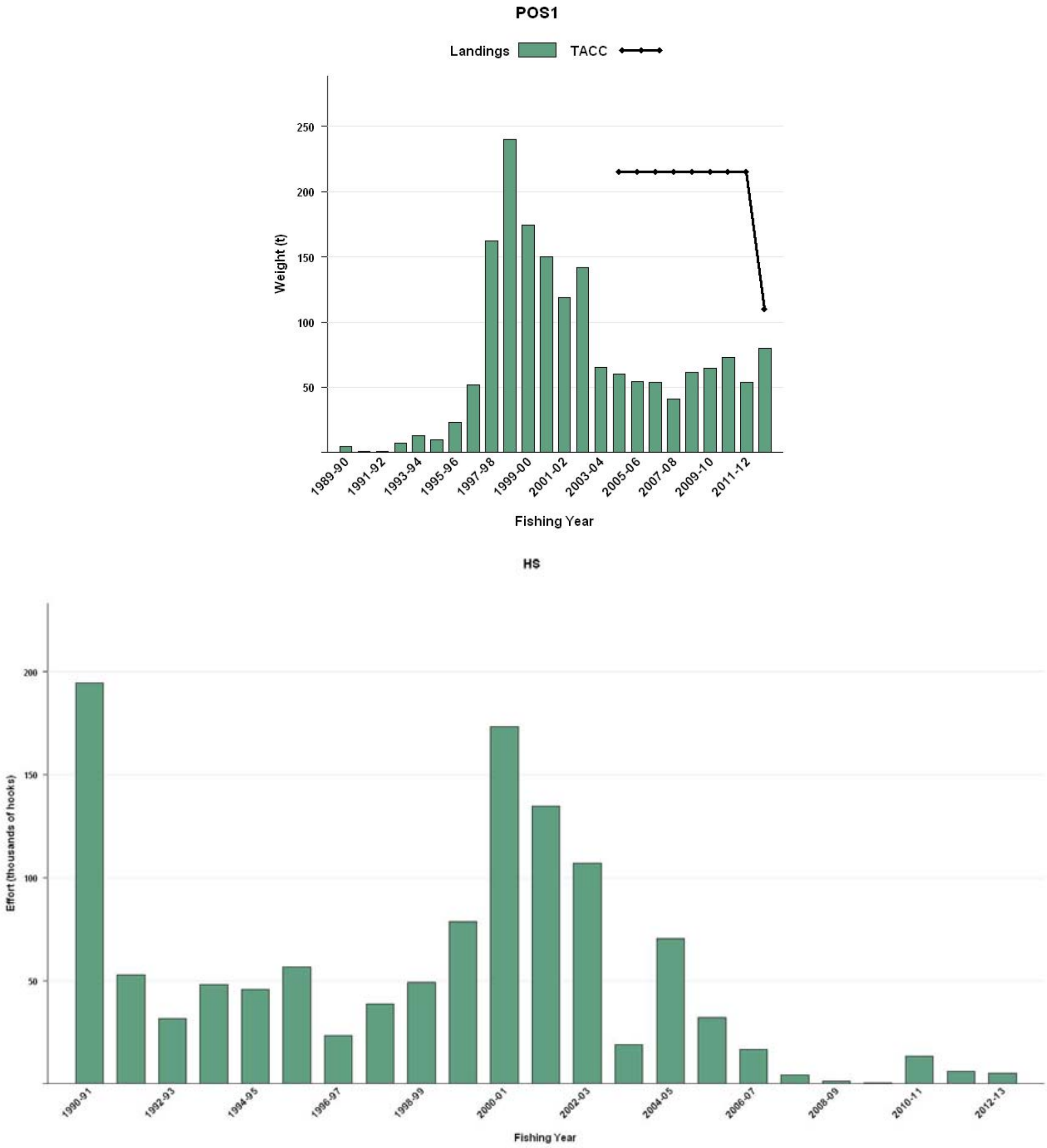


Figure 1: [Top] Catch of porbeagle sharks from 1989–90 to 2012–13 within NZ waters (POS 1). [Bottom] Fishing effort (number of hooks set) for high seas New Zealand flagged surface longline vessels from 1990–91 to 2012–13. [Figure continued on next page].

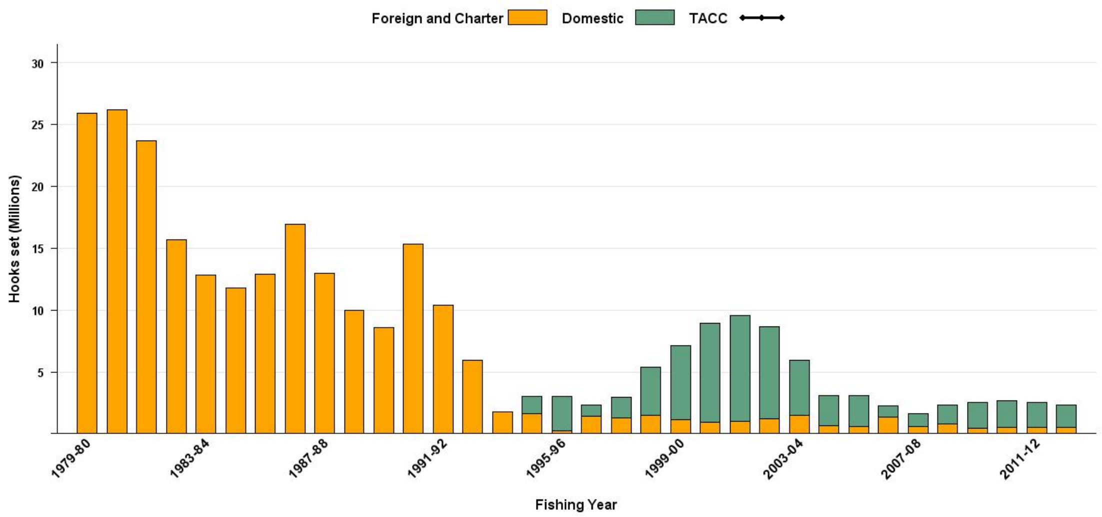


Figure 1 [Continued]: Fishing effort for all domestic vessels (including effort by foreign vessels chartered by NZ fishing companies), from 1979–80 to 2012–13.

Landings of porbeagle sharks reported on CELR (landed), CLR, and LFRR forms are shown in Table 2. The total weights reported by fishers were 152–301 t during 1997–98 to 2002–03. Processors reported 119–240 t on LFRRs during the same period. There has been an 86% decline in the total weight of porbeagle shark reported since 1998–99, to a low of 41 t in 2007–08. This decline began during a period of rapidly increasing domestic fishing effort in the tuna longline fishery, but has accelerated since tuna longline effort dropped in the 2003–04 fishing year. Estimates of the catch of porbeagle sharks aboard tuna longliners, based on scaled-up scientific observer records, were lower than reported by either fishers or processors in the most recent years for which comparable data are available (2000–01 and 2001–02). However, the observer-based estimates are imprecise, and possibly biased, because the observer coverage of the domestic fleet (which accounts for most of the fishing effort) has been low (just below 10% in 2007–2010). Some porbeagle catch is mistakenly reported by fishers as porae (species code POR), and is not included in Table 2; however, the amount is likely to be small (annual reported landings of porae are about 60–70 t).

Catches of porbeagle sharks reported by scientific observers aboard tuna longliners are concentrated off the west and southwest coast of the South Island, and the northeast coast of North Island. However, these apparent distributions are biased by the spatial distribution of observer coverage. Porbeagle sharks are taken by tuna longliners around most of mainland New Zealand where these fisheries occur. The target species for this fishery are mainly southern bluefin, bigeye and albacore tuna. Most of the porbeagle landings reported on CELR and CLR forms were taken in FMA 7, with significant amounts also coming from trawl fisheries in FMAs 3, 5 and 6.

Table 2: New Zealand commercial landings (t) of porbeagle sharks reported by fishers (CELRs and CLRs) and processors (LFRRs) by fishing year. Also shown for some years are the estimated quantities of porbeagles caught by tuna longliners, based on scaled-up scientific observer records (– no data available).

Year	Total reported	LFRR/MHR	Estimated catch by tuna longliners
1989–90	–	5	–
1990–91	1	1	–
1991–92	1	1	–
1992–93	7	7	–
1993–94	10	13	–
1994–95	16	10	–
1995–96	26	23	–
1996–97	39	52	–
1997–98	205	162	–
1998–99	301	240	–
1999–00	215	174	–
2000–01	188	150	–
2001–02	161	119	–
2002–03*	152	142	–
2003–04*	84	65	–
2004–05*	62	60	–
2005–06*	54	55	2 817
2006–07*	53	54	2 743
2007–08*	43	41	–
2008–09*	64	61	–
2009–10*	–	65	–
2010–11*	–	73	–
2011–12*	–	54	–
2012–13*	–	80	–

*MHR rather than LFRR data.

The majority of porbeagle shark are caught in the southern bluefin tuna target surface longline fishery (34%), followed by bigeye tuna (19%) and a small proportion (11%) are landed in the hoki target mid-water trawl fishery (Figure 2). Across all surface longline fisheries albacore make up the bulk of the catch (33%) (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 4).

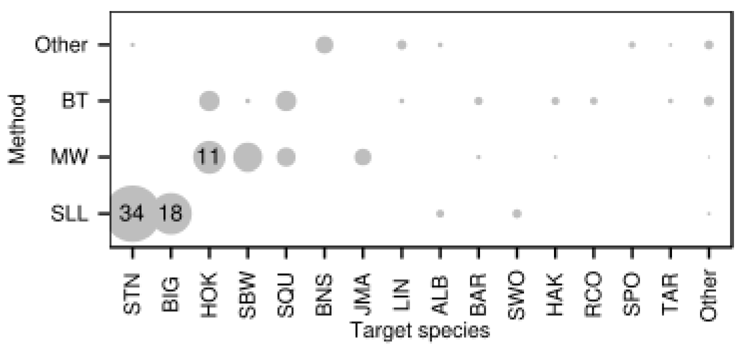


Figure 2: A summary of the proportion of landings of porbeagle shark taken by each target fishery and fishing method. The area of each circle is proportional to the percentage of landings taken using each combination of fishing method and target species. The number in the circle is the percentage (Bentley et al 2013).

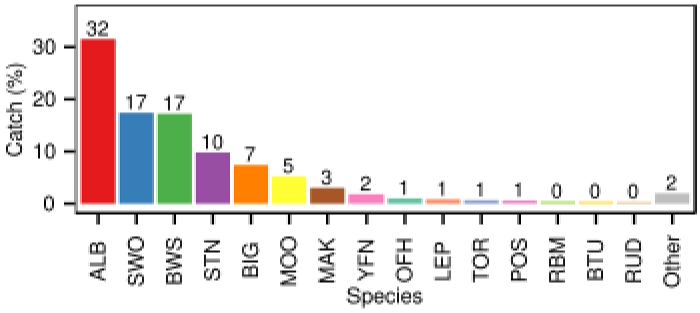


Figure 3: A summary of species composition of the reported surface longline fishery catch. The percentage by weight of each species is calculated for all trips classified under the activity (Bentley et al 2013).

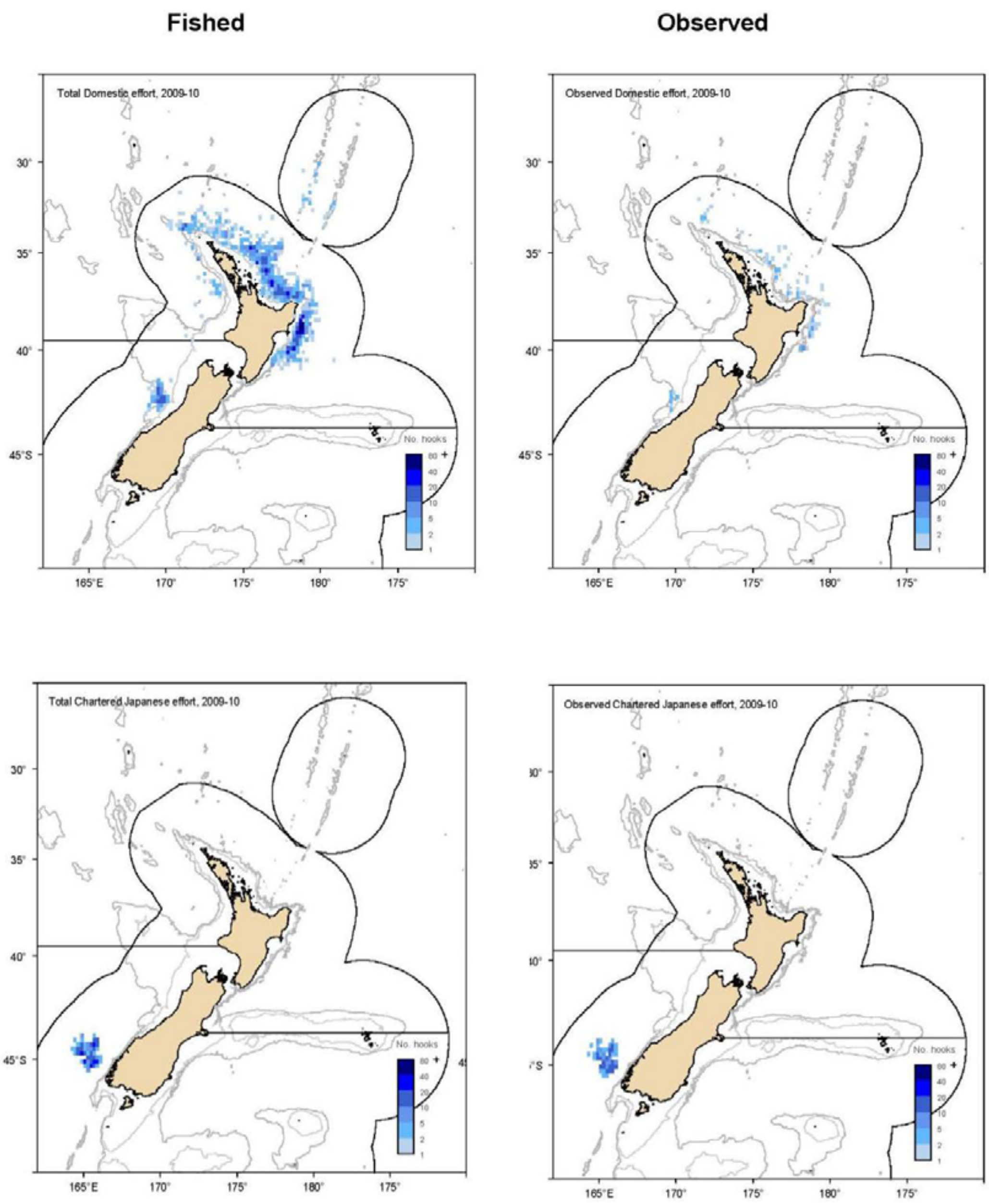


Figure 4: Distribution of fishing positions for domestic (top two panels) and charter (bottom two panels) vessels, for the 2009–10 fishing year, displaying both fishing effort (left) and observer effort (right).

Across all fleets in the longline fishery, 64.2% of the porbeagle sharks were alive when brought to the side of the vessel (Table 3). The domestic fleets retain around 35–47% of their porbeagle shark catch, mostly for the fins, while the foreign charter fleet retain most of the porbeagle sharks (79–92%) (mostly for fins; Table 4).

Table 3: Percentage of porbeagle shark (including discards) that were alive or dead when arriving at the longline vessel and observed during 2006–07 to 2009–10, by fishing year, fleet and region. Small sample sizes (number observed < 20) were omitted (Griggs & Baird 2013).

Year	Fleet	Area	% alive	% dead	Number
2006–07	Charter	North	60.5	39.5	223
		South	87.3	12.7	370
	Domestic	North	44.8	55.2	134
	Total		**71.3**	**28.7**	**727**
2007–08	Charter	South	77.6	22.4	49
	Domestic	North	59.6	40.4	488
	Total		**61.3**	**38.7**	**537**
2008–09	Charter	North	91.0	9.0	78
		South	85.4	14.6	158
	Domestic	North	57.9	42.1	254
	Total		**71.5**	**28.5**	**494**
2009–10	Charter	South	82.4	17.6	68
	Domestic	North	40.4	59.6	322
		South	30.0	70.0	20
	Total		**46.8**	**53.2**	**410**
Total all strata			**64.2**	**35.8**	**2 168**

Table 4: Percentage of porbeagle shark that were retained, or discarded or lost, when observed on a longline vessel during 2006–07 to 2009–10, by fishing year and fleet. Small sample sizes (number observed < 20) omitted (Griggs & Baird 2013).

Year	Fleet	% retained or finned	% discarded or lost	Number
2006–07	Charter	86.6	13.4	628
	Domestic	38.1	61.9	134
	Total	**78.1**	**21.9**	**762**
2007–08	Charter	89.8	10.2	49
	Domestic	35.7	64.3	488
	Total	**40.6**	**59.4**	**537**
2008–09	Charter	91.1	8.9	257
	Domestic	46.9	53.1	258
	Total	**68.9**	**31.1**	**515**
2009–10	Charter	79.2	20.8	72
	Domestic	46.0	54.0	348
	Total	**51.7**	**48.3**	**420**
Total all strata		**62.0**	**38.0**	**2 234**

1.2 Recreational fisheries

An estimate of the recreational harvest is not available. The recreational catch of porbeagle sharks is probably negligible, because they usually occur over the outer continental shelf or beyond. They are occasionally caught by gamefishers but most are tagged and released. In 2001, 40 porbeagle sharks were tagged by recreational fishers but numbers have dwindled from this peak to one or two per year.

1.3 Customary non-commercial fisheries

An estimate of the current customary catch is not available. The Maori customary catch of porbeagle sharks is probably negligible, because they usually occur over the outer continental shelf or beyond.

1.4 Illegal catch

There is no known illegal catch of porbeagle sharks.

1.5 Other sources of mortality

Many of the porbeagle sharks caught by tuna longliners (about 64%) are alive when the vessel retrieves the line, but it is not known how many of the released, discarded sharks survive.

2. BIOLOGY

Porbeagles live mainly in the latitudinal bands 30–50°S and 30–70°N. They occur in the North Atlantic Ocean, and in a circumglobal band in the Southern Hemisphere. Porbeagles are absent from the North Pacific Ocean, where the closely related salmon shark, *Lamna ditropis*, fills their niche. In the South Pacific Ocean, porbeagles are caught north of 30°S in winter–spring only; in summer they are not found north of about 35°S. They appear to penetrate further south during summer and autumn, and are found near many of the sub-Antarctic islands in the Indian and South-west Pacific Oceans. Porbeagle sharks are not found in the equatorial tropics.

Porbeagles are live-bearers (aplacental viviparous), and the length at birth is 58–67 cm fork length (FL) in the South-west Pacific. Females mature at around 170–180 cm FL and males at about 140–150 cm FL. The gestation period is about 8–9 months. In the North-west Atlantic, all females sampled in winter were pregnant, suggesting that there is no extended resting period between pregnancies, and that the female reproductive cycle lasts for one year. Litter size is usually four embryos, with a mean litter size in the South-west Pacific of 3.75. If the reproductive cycle lasts one year, annual fecundity would be about 3.75 pups per female.

A study of the age and growth of New Zealand porbeagles produced growth curves and estimates of the natural mortality rate (Table 5). However, attempts to validate ages using bomb radiocarbon analysis were unsuccessful, but suggested that the ages of porbeagles older than about 20 years were progressively under-estimated; for the oldest sharks the age under-estimation may have been as much as 50%. Consequently, the growth parameters provided in Table 5 are probably only accurate for ages up to about 20 years. Males mature at 8–11 years, and females mature at 15–18 years. Longevity is unknown but may be about 65 years.

In New Zealand, porbeagle sharks recruit to commercial fisheries during their first year at about 70 cm FL, and much of the commercial catch is immature. Most sharks caught by tuna longliners are 70–170 cm FL. The size and sex distribution of both sexes is similar up to about 150 cm, but larger individuals are predominantly male; few mature females are caught. Regional differences in length composition suggest segregation by size. The size and sex composition of sharks caught by trawlers are unknown.

Porbeagles are active pelagic predators of fish and cephalopods. Pelagic fish dominate the diet but squid are also commonly eaten, especially by the small sharks.

Table 5: Estimates of biological parameters.

Fishstock	Estimate			Source
1. Natural mortality (M)				
POS 1	0.05–0.10			Francis (unpub. data)
2. Weight = a (length)^b (Weight in kg, length in cm fork length)				
		a	*b*	
POS 1, both sexes		2.143×10^{-5}	2.924	Ayers et al (2004)
3. Von Bertalanffy model parameter estimates				
	k	t_0	L_∞	
POS 1 males	0.112	-4.75	182.2	Francis et al (2007)
POS 1 females	0.060	-6.86	233.0	Francis et al (2007)

3. STOCKS AND AREAS

In the North-west Atlantic, most tagged sharks moved short to moderate distances (up to 1500 km) along continental shelves, although one moved about 1800 km off the shelf into the mid-Atlantic Ocean. Sharks tagged off southern England were mainly recaptured between Denmark and France, with one shark moving 2370 km to northern Norway. Only one tagged shark has crossed the Atlantic: it travelled 4260 km from South-west Eire to 52°W off eastern Canada. Thus porbeagles from the northwest and northeast Atlantic appear to form two distinct stocks. There have been no genetic studies to determine the number of porbeagle stocks, but based on the disjunct (antitropical) geographical distribution and differences in biological parameters, North Atlantic porbeagles are probably reproductively isolated from Southern Hemisphere porbeagles.

The stock structure of porbeagle sharks in the Southern Hemisphere is unknown. However, given the scale of movements of tagged sharks, it seems likely that sharks in the South-west Pacific comprise a single stock. There is no evidence to indicate whether this stock extends to the eastern South Pacific or Indian Ocean.

4. ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

This section was updated for the November 2013 Fishery Assessment Plenary after review by the Aquatic Environment Working Group. This summary is from the perspective of the porbeagle shark 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 (http://www.mpi.govt.nz/Default.aspx?TabId=126&id=1644) (Ministry for Primary Industries 2012).

4.1 Role in the ecosystem

4.1.1 Diet

Porbeagle shark (*Lamna nasus*) are active pelagic predators of fish and cephalopods. Porbeagle sharks less than 75 cm feed mostly on squid but their diet changes to fish as they grow, with fish comprising more than 60% of the diet for porbeagle sharks 75 cm and over (Figure 5) (Griggs et al 2007).

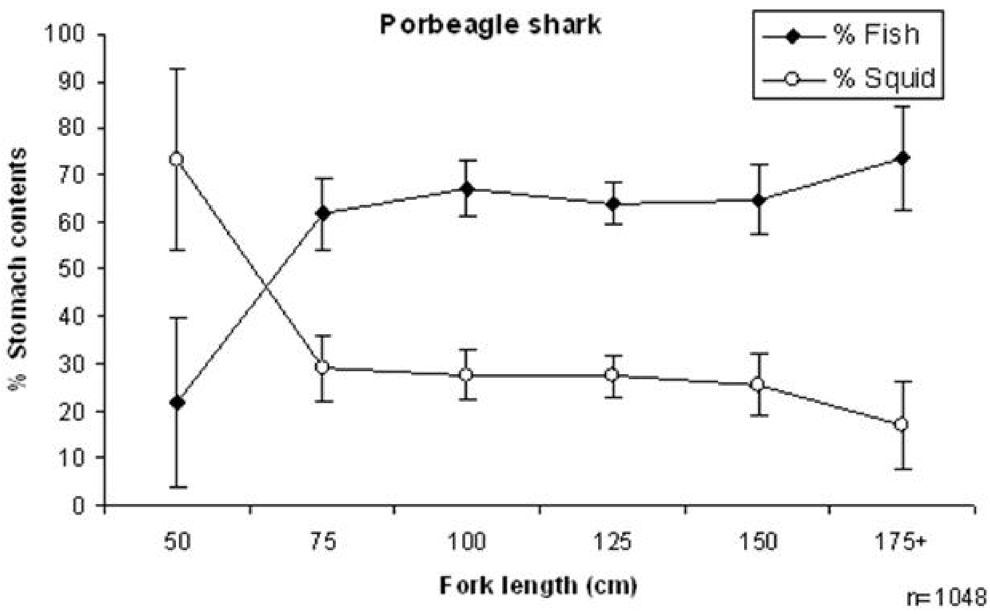


Figure 5: Changes in percentage of fish and squid in stomachs of porbeagle sharks as a function of fork length.

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).

4.2.1 Seabird bycatch

Between 2002–03 and 2011–12, there were 731 observed captures of birds across all surface longline fisheries. Seabird capture rates since 2003 are presented in Table 6 and Figures 6 and 7. While the seabird capture distributions largely coincide with fishing effort they are more frequent off the south west coast of the South Island (Figure 8). The analytical methods used to estimate capture numbers across the commercial fisheries have depended on the quantity and quality of the data, in terms of the numbers observed captured and the representativeness of the observer coverage. Ratio estimation was historically used to calculate total captures in longline fisheries by target fishery fleet and area (Baird 2008) and by all fishing methods but recent estimates are either ratio or model based as specified in the tables below (Abraham et al 2010).

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.

Table 6: Number of observed seabird captures in the New Zealand surface longline fisheries, 2002–03 to 2011–12, by species and area. See glossary above for a description of the areas used for summarising the fishing effort and protected species captures. The risk ratio is an estimate of aggregate potential fatalities across trawl and longline fisheries relative to the Potential Biological Removals, PBR (from Richard and Abraham (2013) where full details of the risk assessment approach can be found). It is not an estimate of the risk posed by fishing for porbeagle shark using longline gear but rather the total risk for each seabird species. Other data, version 20130305.

Albatross Species	Risk Ratio	Kermadec Islands	Northland and Hauraki	Bay of Plenty	East Coast North Island	Stewart Snares Shelf	Fiordland	West Coast South Island	West Coast North Island	Total
Salvin's	Very high	0	1	2	6	0	0	0	0	9
Southern Buller's	Very high	0	3	2	27	0	278	33	0	343
NZ white-capped	Very high	0	2	0	3	10	60	27	0	102
Northern Buller's	High	0	0	0	1	0	0	0	0	1
Gibson's	High	4	16	0	17	0	6	2	1	46
Antipodean	High	12	9	1	8	0	0	0	1	31
Northern royal	Medium	0	0	1	0	0	0	0	0	1
Southern royal	Medium	0	1	0	0	0	4	0	0	5
Campbell black-browed	Medium	2	9	2	29	0	3	3	1	49
Light-mantled sooty	Very low	0	0	0	0	0	0	1	0	1
Unidentified	N/A	38	2	0	2	0	0	0	1	43
Total	**N/A**	**56**	**43**	**8**	**93**	**10**	**351**	**66**	**4**	**631**
Other seabirds										
Black petrel	Very high	1	10	1	0	0	0	0	1	13
Flesh-footed shearwater	Very high	0	0	0	10	0	0	0	2	12
Cape petrel	High	0	0	0	2	0	0	0	0	2
Westland petrel	Medium	0	0	0	2	0	1	6	0	9
White-chinned petrel	Medium	2	3	3	3	1	19	3	3	37
Grey petrel	Medium	3	4	3	38	0	0	0	0	48
Grey-faced petrel	Very low	12	5	1	2	0	0	0	0	20
Sooty shearwater	Very low	1	0	0	8	3	1	0	0	13
Southern giant petrel	-	0	0	2	0	0	0	0	2	0
White-headed petrel	-	2	0	0	0	0	0	0	0	2
Unidentified	N/A	0	1	0	0	0	1	0	0	2
Total	**N/A**	**21**	**23**	**10**	**65**	**4**	**22**	**9**	**8**	**158**

Table 7: 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 2010–11 are based on data version 20120531 and preliminary estimates for 2011–12 are based on data version 20130305.

			Fishing effort	Observed captures		Estimated captures	
Fishing year	All hooks	Observed hooks	% observed	Number	Rate	Mean	95% c.i.
2002–2003	10 764 588	2 195 152	20.4	115	0.052	2 033	1 577–2 737
2003–2004	7 380 779	1 607 304	21.8	71	0.044	1 345	1 044–1 798
2004–2005	3 676 365	783 812	21.3	41	0.052	601	472–780
2005–2006	3 687 339	705 945	19.1	37	0.052	790	585–1 137
2006–2007	3 738 362	1 040 948	27.8	187	0.18	936	720–1 344
2007–2008	2 244 339	426 310	19	41	0.088	513	408–664
2008–2009	3 115 633	937 233	30.1	57	0.061	593	477–746
2009–2010	2 992 285	665 883	22.3	135	0.203	921	732–1 201
2010–2011	3 185 779	674 572	21.2	47	0.07	696	524–948
2011–2012†	3 069 707	728 190	23.7	64	0.088	808	596–1 168

†Provisional data, model estimates not finalised.

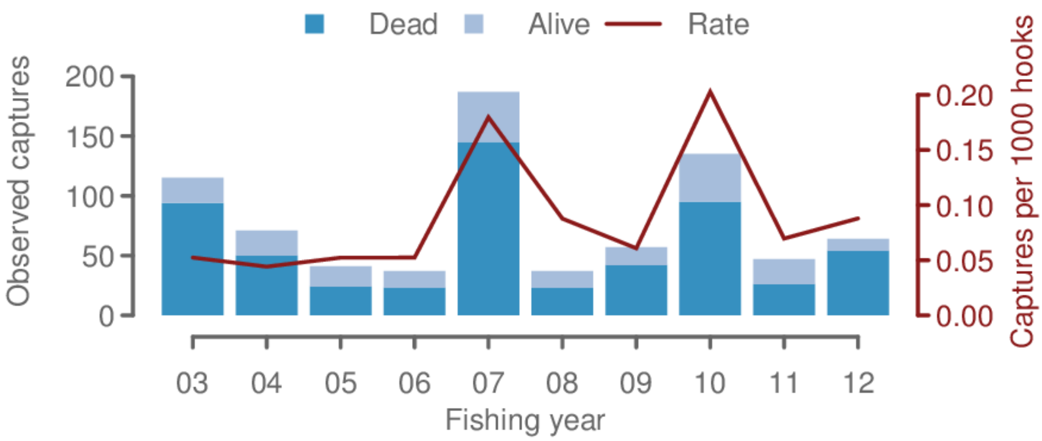


Figure 6: Observed captures of seabirds in the New Zealand surface longline fisheries from 2002–03 to 2011–12.

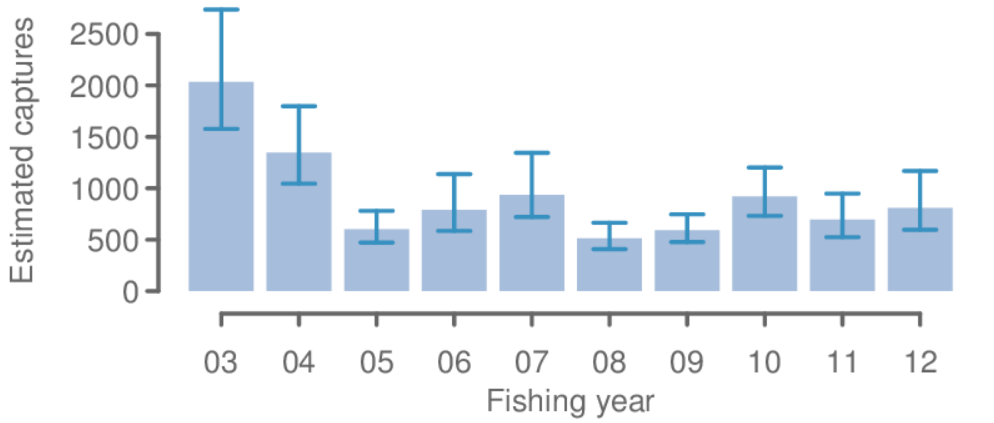


Figure 7: Estimated captures of seabirds in the New Zealand surface longline fisheries from 2002–03 to 2011–12.

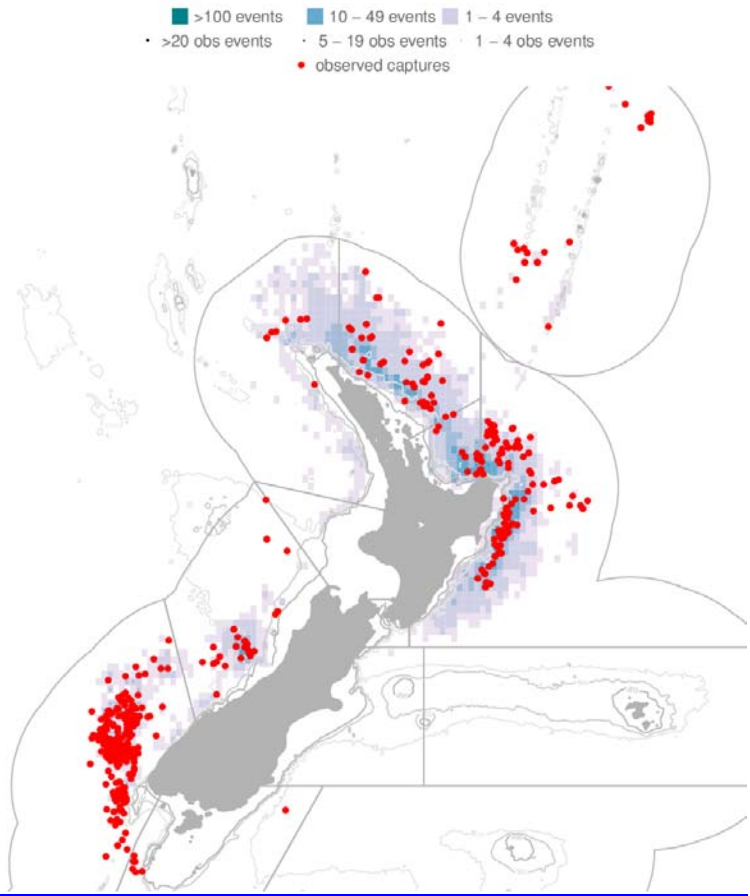


Figure 8: Distribution of fishing effort in the New Zealand surface longline fisheries and observed seabird captures, 2002–03 to 2011–12. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black 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, 94.1% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

4.2.2 Sea turtle bycatch

Between 2002–03 and 2011–12, there were 13 observed captures of sea turtles across all surface longline fisheries (Tables 8 and 9, Figure 9). 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 10).

Table 8: Number of observed sea turtle captures in the New Zealand surface longline fisheries, 2002–03 to 2011–12, 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	0	1
Total	1	6	3	3	13

Table 9: 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 effort			Observed captures	
Fishing year	All hooks	Observed hooks	% observed	Number	Rate
2002–2003	10 764 588	2 195 152	20.4	0	0
2003–2004	7 380 779	1 607 304	21.8	1	0.001
2004–2005	3 676 365	783 812	21.3	2	0.003
2005–2006	3 687 362	705 945	19.1	1	0.001
2006–2007	3 738 362	1 040 948	27.8	2	0.002
2007–2008	2 244 339	421 900	18.8	1	0.002
2008–2009	3 115 633	937 496	30.1	2	0.002
2009–2010	2 992 285	665 883	22.3	0	0
2010–2011	3 185 779	674 572	21.3	4	0.006
2011–2012	3 069 707	728 190	23.7	0	0

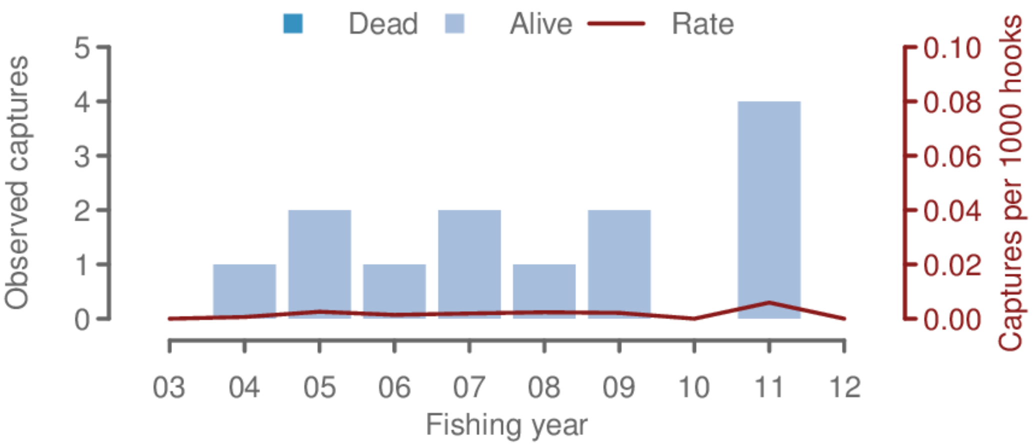


Figure 9: Observed captures of sea turtles in the New Zealand surface longline fisheries from 2002–03 to 2011–12.

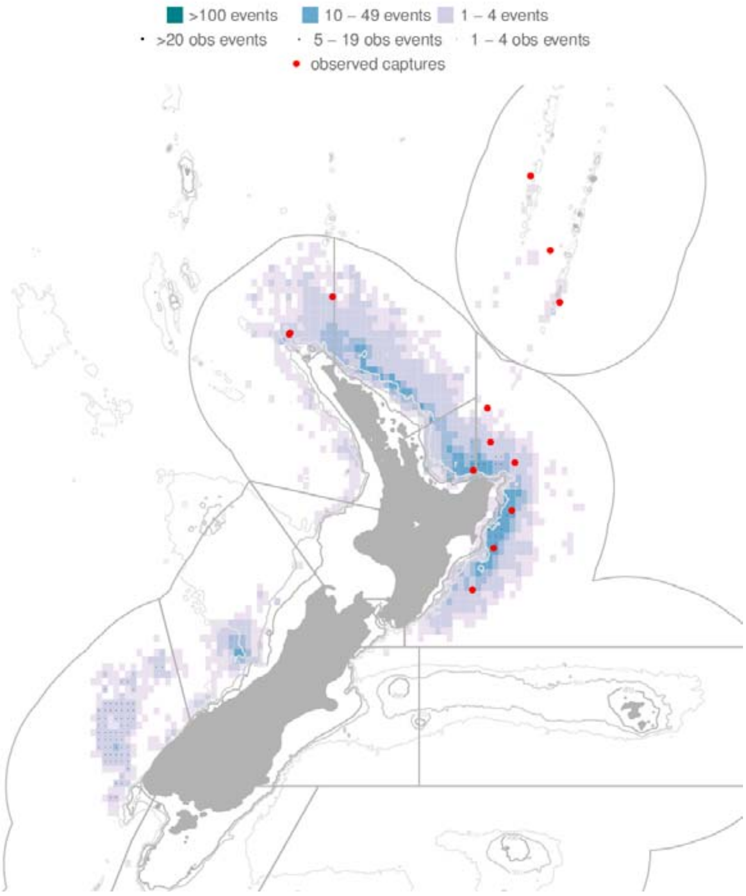


Figure 10: Distribution of fishing effort in the New Zealand surface longline fisheries and observed sea turtle captures, 2002–03 to 2011–12. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black 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, 94.1% 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 2011–12, 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 10 and 11, Figure 11) (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 12).

Table 10: Number of observed cetacean captures in the New Zealand surface longline fisheries, 2002–03 to 2011–12, 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 11: 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 effort			Observed captures	
Fishing year	All hooks	Observed hooks	% observed	Number	Rate
2002–2003	10 764 588	2 195 152	20.4	1	0.0005
2003–2004	7 380 779	1 607 304	21.8	4	0.002
2004–2005	3 676 365	783 812	21.3	1	0.001
2005–2006	3 687 339	705 945	19.1	0	0
2006–2007	3 738 362	1 040 948	27.8	0	0
2007–2008	2 244 339	421 900	18.8	1	0.002
2008–2009	3 115 633	937 496	30.1	0	0
2009–2010	2 992 285	665 883	22.3	0	0
2010–2011	3 185 779	674 572	21.2	0	0
2011–2012	3 069 707	728 190	23.7	0	0

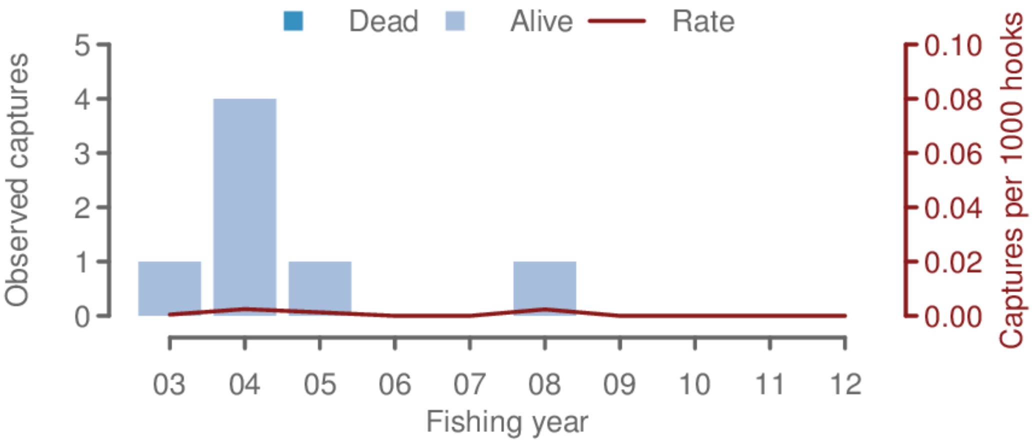


Figure 11: Observed captures of cetaceans in the New Zealand surface longline fisheries from 2002–03 to 2011–12.

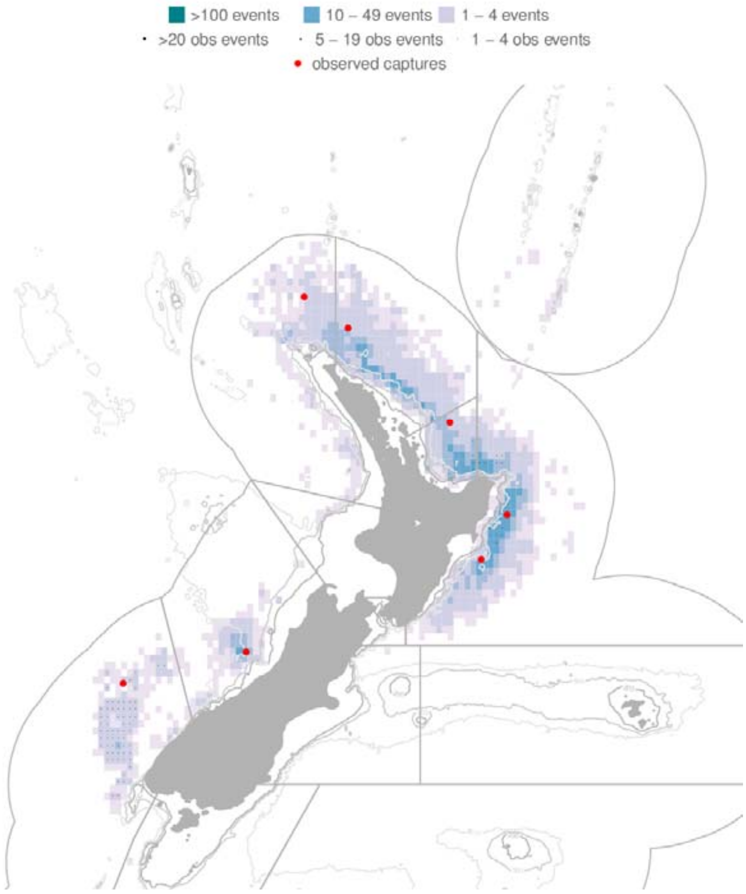


Figure 12: Distribution of fishing effort in the New Zealand surface longline fisheries and observed cetacean captures, 2002–03 to 2011–12. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black 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, 94.1% 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 around much of the South Island and offshore islands slopes steeply to deeper waters relatively close to shore, and thus rookeries and haulouts. Captures on longlines occur when the seals attempt to feed on bait or fish from the line 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). Bycatch rates in 2011–12 were, low and lower than they were in the early 2000s (Figures 13 and 14). 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 15). Between 2002–03 and 2011–12, there were 246 observed captures of New Zealand fur seal in surface longline fisheries (Tables 12 and 13).

Table 12: Number of observed New Zealand fur seal captures in the New Zealand surface longline fisheries, 2002–03 to 2011–12, 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	10	16	139	3	4	2	32	206

Table 13: 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). Estimates are based on methods described in Thompson et al (2013) are available via http://www.fish.govt.nz/en-nz/Environmental/Seabirds/. Estimates from 2002–03 to 2010–11 are based on data version 20120531 and preliminary estimates for 2011–12 are based on data version 20130305.

	Fishing effort			Observed captures		Estimated captures	
Fishing year	All hooks	Observed hooks	% observed	Number	Rate	Mean	95% c.i.
2002–2003	10 764 588	2 195 152	20.4	56	0.026	157	138-178
2003–2004	7 380 779	1 607 304	21.8	40	0.025	116	99-133
2004–2005	3 676 365	783 812	21.3	20	0.026	77	63-93
2005–2006	3 687 339	705 945	19.1	12	0.017	70	55-85
2006–2007	3 738 362	1 040 948	27.8	10	0.010	52	40-66
2007–2008	2 244 339	426 310	19.0	10	0.023	45	34-56
2008–2009	3 115 633	937 233	30.1	22	0.023	57	46-69
2009–2010	2 992 285	665 883	22.3	19	0.029	78	64-94
2010–2011	3 164 159	674 522	21.3	17	0.025	57	45-69
2011–2012†	3 069 707	728 190	23.7	40	0.055	96	81-111

†Provisional data, model estimates not finalised.

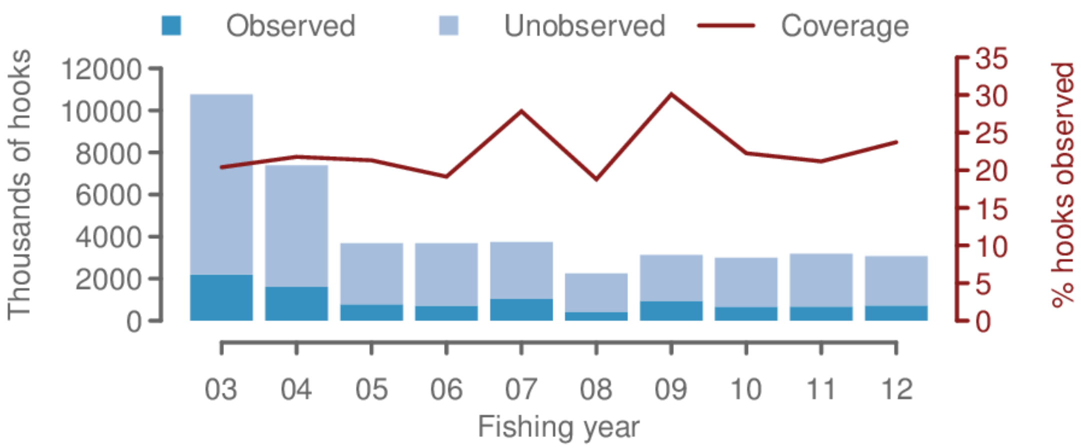


Figure 13: Observed captures of New Zealand fur seal in the New Zealand surface longline fisheries from 2002–03 to 2011–12.

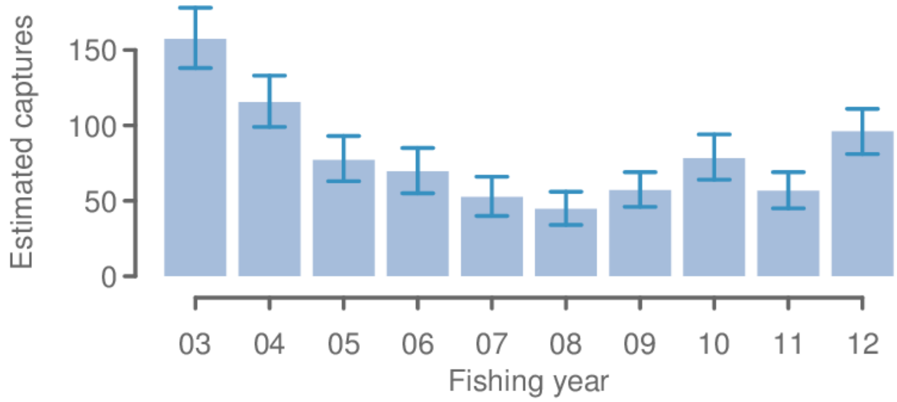


Figure 14: Estimated captures of New Zealand fur seal in the New Zealand surface longline fisheries from 2002–03 to 2011–12.

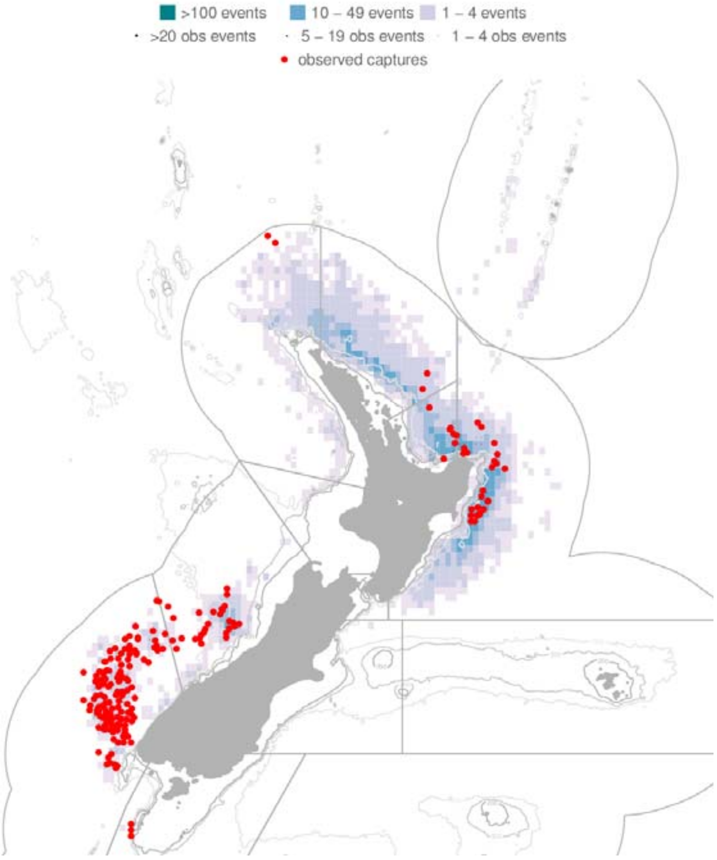


Figure 15: Distribution of fishing effort in the New Zealand surface longline fisheries and observed New Zealand fur seal captures, 2002–03 to 2011–12. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated 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, 94.1% 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 14). Southern bluefin tuna and albacore tuna are the only target species that occur in the top five of the frequency of occurrence.

Table 14: Numbers of the most common fish species observed in the New Zealand longline fisheries during 2009–10 by fleet and area. Species are shown in descending order of total abundance (Griggs & Baird 2013).

	Charter	Domestic		Total
Species	South	North	South	number
Blue shark	2 024	4 650	882	7 556
Ray's bream	3 295	326	88	3 709
Southern bluefin tuna	3 244	211	179	3 634
Lancetfish	3	2 139	1	2 143
Albacore tuna	90	1 772	42	1 904
Dealfish	882	0	7	889
Swordfish	3	452	2	457
Moonfish	76	339	6	421
Porbeagle shark	72	328	20	420
Mako shark	11	343	7	361
Big scale pomfret	349	4	0	353
Deepwater dogfish	305	0	0	305
Sunfish	7	283	5	295
Bigeye tuna	0	191	0	191
Escolar	0	129	0	129
Butterfly tuna	15	100	3	118
Pelagic stingray	0	96	0	96
Oilfish	2	75	0	77
Rudderfish	39	20	2	61
Flathead pomfret	56	0	0	56
Dolphinfish	0	47	0	47
School shark	34	0	2	36
Striped marlin	0	24	0	24
Thresher shark	7	17	0	24
Cubehead	13	0	1	14
Kingfish	0	10	0	10
Yellowfin tuna	0	9	0	9
Hake	8	0	0	8
Hapuku bass	1	6	0	7
Pacific bluefin tuna	0	5	0	5
Black barracouta	0	4	0	4
Skipjack tuna	0	4	0	4
Shortbill spearfish	0	4	0	4
Gemfish	0	3	0	3
Bigeye thresher shark	0	2	0	2
Snipe eel	2	0	0	2
Slender tuna	2	0	0	2
Wingfish	2	0	0	2
Bronze whaler shark	0	1	0	1
Hammerhead shark	0	1	0	1
Hoki	0	0	1	1
Louvar	0	1	0	1
Marlin, unspecified	0	1	0	1
Scissortail	0	1	0	1
Broadnose seven gill shark	1	0	0	1
Shark, unspecified	0	1	0	1
Unidentified fish	2	30	8	40
Total	10 545	11 629	1 256	23 430

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

With the establishment of the WCPFC in 2004, future stock assessments of porbeagle shark in the western and central Pacific Ocean stock will be reviewed by the WCPFC. There is currently a shark research plan that has been developed within the context of the Western and Central Pacific Fisheries Commission but porbeagle sharks will not be a focus of that plan in the near future.

There have been no stock assessments of porbeagle sharks in New Zealand. No estimates of yield are possible with the currently available data.

CPUE estimates were calculated for each fleet and area stratum in which eight or more sets were observed and at least 2% of the hooks were observed. CPUE estimates were calculated for porbeagle sharks for each fleet and area in 2006–07 to 2009–10 and added to the time series for 1988–89 to 2005–06 (Griggs et al 2008) and these are shown in Figure 16 (Griggs & Baird 2013). The CPUE results from the Domestic fleet should be interpreted with caution due to the lower observer coverage of this fleet. CPUE estimates for the Charter fleet can be considered reliable from 1992–93 onwards (Griggs et al 2007). Porbeagle CPUE was higher in the South than the North, but porbeagle CPUE has been very low for the past nine years in the South, and there has been a recent increase in the North.

Relative to a wide range of shark species, the productivity of porbeagle sharks is very low. Females have a high age-at-maturity, high longevity (and therefore low natural mortality rate) and low annual fecundity. The low fecundity is cause for strong concern, as the ability of the stock to replace sharks removed by fishing is very limited.

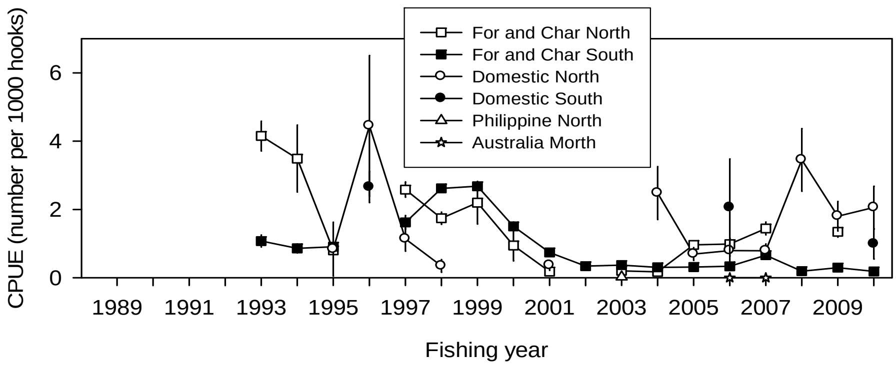


Figure 16: Annual variation in CPUE by fleet and area. Plotted values are the mean estimates with 95% confidence limits. Fishing year 1989 = October 1988 to September 1989 (Griggs & Baird 2013).

Observed length frequency distributions of porbeagle sharks by area and sex are shown in Figure 17 for fish measured in 2006–07 to 2009–10 (Griggs & Baird 2013). The proportion of porbeagles caught in the South was less than the North, and the fish were smaller than seen previously (Francis et al 2004, Ayers et al 2004, Griggs et al, 2007, 2008). In this four year period there is a mode at about 75–100 cm each year in both sexes and few larger fish (Figure 15), while in previous years there had been a bimodal distribution with a dominant mode between 110–140 cm (Francis et al 2004, Ayers et al 2004). This larger mode has been less predominant in the previous five years, 2002–03 to 2005–06 (Griggs et al 2007, 2008). Based on length-frequencies and mean lengths at maturity of 145 cm FL for males and 175 cm fork length for females (Francis & Duffy 2005), most porbeagle sharks were immature (86.4% of males and 97.4% of females, overall). Sex ratios were similar (Griggs & Baird 2013) (Figure 15).

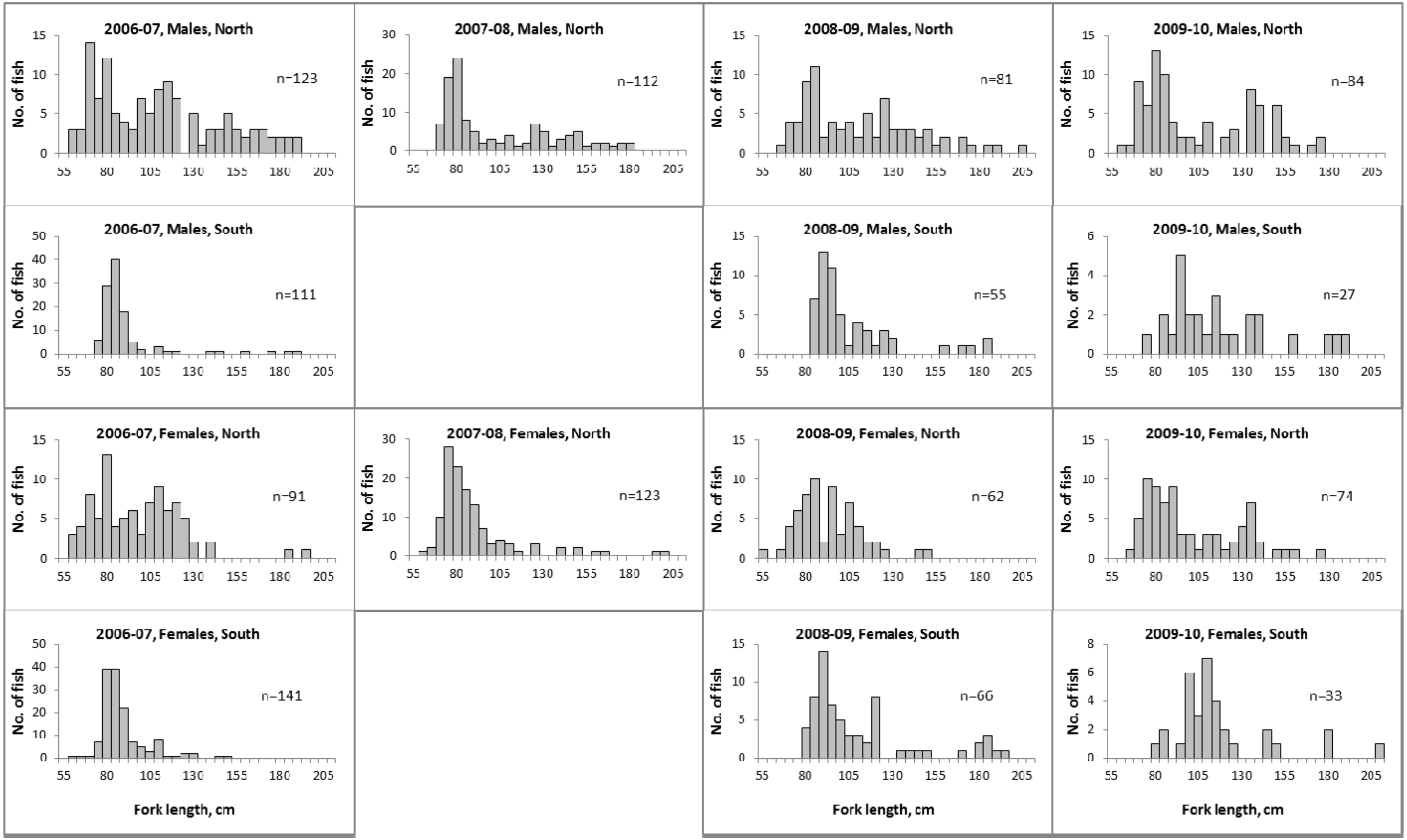


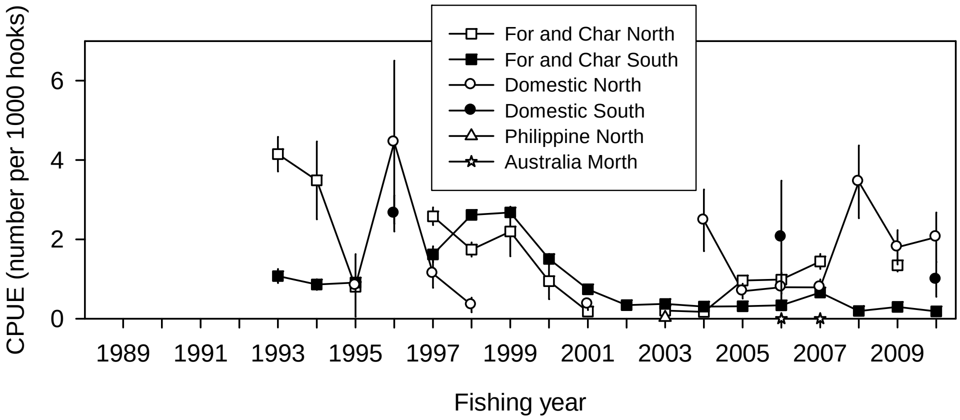
Figure 17: Length-frequency distributions of porbeagle shark by fishing year, sex, and region. Sample sizes of less than 20 fish not shown (Griggs & Baird 2013).

6. STATUS OF THE STOCK

Stock structure assumptions
POS 1 is assumed to be part of the wider South Western Pacific Ocean stock.

Stock Status	
Year of Most Recent Assessment	2008
Assessment Runs Presented	Base case model only
Reference Points	Target: Not established; but B_{MSY} assumed Soft Limit: Not established by WCPFC; but HSS default of 20% SB_0 assumed Hard Limit: Not established by WCPFC; but HSS default of 10% SB_0 assumed Overfishing threshold: F_{MSY}
Status in relation to Target	Unlikely (< 40%) to be at or above B_{MSY} Unlikely (< 40%) that $F < F_{MSY}$
Status in relation to Limits	Unknown
Status in relation to Overfishing	Overfishing is Likely (> 60%) to be occurring

Historical Stock Status Trajectory and Current Status



Annual variation in CPUE by fleet and area. Plotted values are the mean estimates with 95% confidence limits. Fishing year 1989 = October 1988 to September 1989 (Griggs & Baird 2013).

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Unknown
Recent Trend in Fishing Intensity or Proxy	Unknown
Other Abundance Indices	CPUE analyses have been undertaken in New Zealand but are not considered to have generated reliable estimates of abundance.
Trends in Other Relevant Indicator or Variables	Catches in New Zealand increased from the late 1980s to a peak in 1998/99 of 301 t and then declined to 41 t in 2007-08. This decline in catch coincides with a decline in longline fishing effort.

Projections and Prognosis	
Stock Projections or Prognosis	Unknown
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown Hard Limit: Unknown

Probability of Current Catch or TACC causing Overfishing to continue or to commence	Likely (> 60%)	
Assessment Methodology and Evaluation		
Assessment Type	Level 3: Qualitative Evaluation: Fishery characterization with evaluation of fishery trends (e.g. catch, effort and nominal CPUE) - there is no agreed index of abundance.	
Assessment Method	CPUE analysis	
Assessment Dates	Latest assessment: 2008	Next assessment: Unknown
Overall assessment quality rank	2 – Medium or Mixed Quality: information has been subjected to peer review and has been found to have some shortcomings.	
Main data inputs (rank)	- Commercial reported catch and effort	1 - High quality for the charter fleet but low for all the other fleets.
Data not used (rank)	-	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	Historical catch recording may not be accurate.	

Qualifying Comments
Relative to a wide range of shark species, the productivity of porbeagle sharks is very low. Females have a high age-at-maturity, high longevity (and therefore low natural mortality rate) and low annual fecundity. The low fecundity and high longevity are cause for strong concern, as the ability of the stock to replace sharks removed by fishing is very limited; as a result, this stock is Likely to be below B_{MSY}.
Fishery Interactions
Interactions with protected species are known to occur in the longline fisheries of the South Pacific, particularly south of 30°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.

7. FOR FURTHER INFORMATION

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