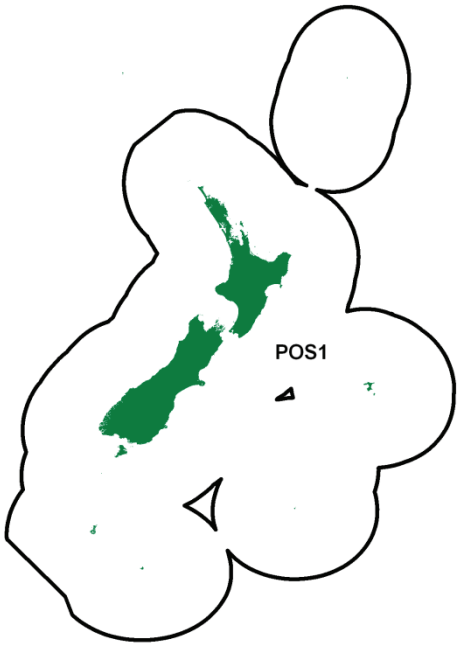
PORBEAGLE SHARK (POS)

(*Lamna nasus)*



1. FISHERY SUMMARY

Porbeagle shark were introduced into the QMS on 1 October 2004 under a single QMA, POS 1, with allowances, TACC, and TAC in Table 1.

Table 1: Recreational and Customary non-commercial allowances, TACCs and TACs for porbeagle shark.

Fishstock	Recreational Allowance (t)	Customary non-commercial Allowance (t)	Other mortality (t)	TACC (t)	TAC (t)
POS 1	10	2	22	215	249

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 sharks is taken by tuna longliners, and most of the rest by mid-water and bottom trawlers. About 80% 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 POS1.

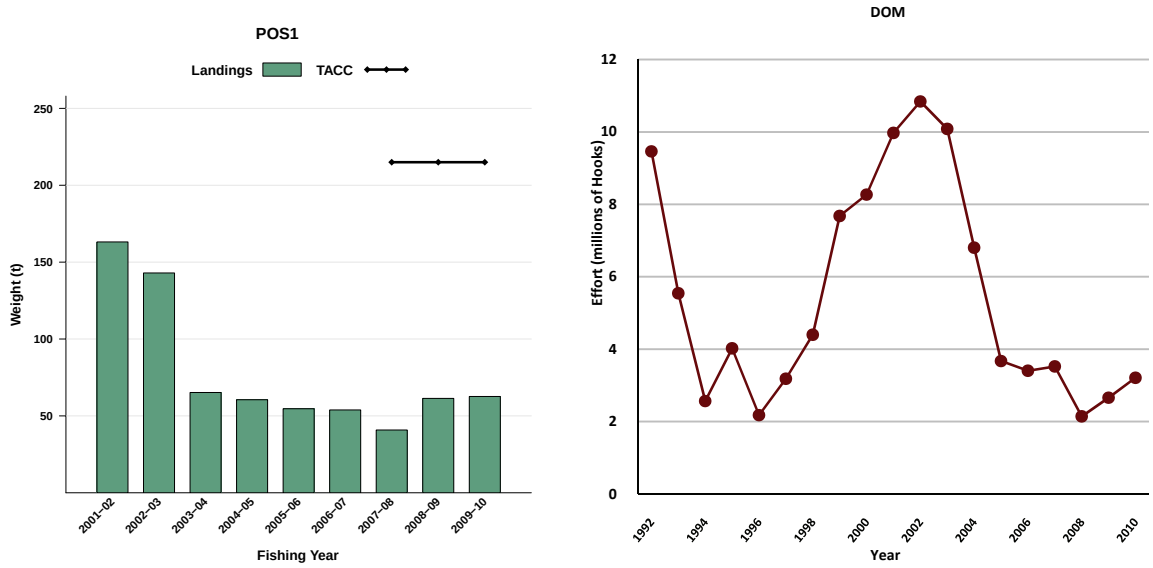


Figure 1: Catch of porbeagle sharks from 2001-02 to 20009-10 within NZ waters (POS1), and fishing effort (number of hooks set) for all domestic (including effort by foreign vessels chartered by NZ fishing companies) New Zealand flagged surface longline vessels 1992 to 2010.

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 a 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 during the last four years. 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 2007-2009). 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).

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		63	

*MHR rather than LFRR data.

Catches of porbeagle sharks reported by scientific observers aboard tuna longliners are concentrated off the west and southwest coast of 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 probably taken by tuna longliners around most of mainland New Zealand. 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 FMAs 3, 5, and 6.

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.

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 60%) are alive when the vessel retrieves the line, but it is not known how many of the unprocessed, 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.

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 3). However, attempts to validate ages using bomb radiocarbon analysis were unsuccessful, and 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 3 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, porbeagles 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 comparable 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 small sharks.

Table 3: 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, though 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^{o}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. STOCK ASSESSMENT

With the establishment of WCPFC in 2004, future stock assessments of porbeagle shark in the western and central Pacific Ocean stock will be reviewed by the WCPFC. Unlike the major tuna stocks, in the short-term, development of a regional assessment for porbeagle shark is likely to be done by collaboration among interested members.

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

Unstandardised CPUE analysis of tuna longline catches recorded by observers show considerable variability, particularly, for the domestic fleet. Values in the southern foreign and charter fleet for the most recent four years are the lowest recorded (Figure 2). These indices may not reflect stock abundance because they do not take into account variation in many influencing factors (e.g., vessel, gear, location and time of year), and indices for the domestic fleet are based on low observer coverage.

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.

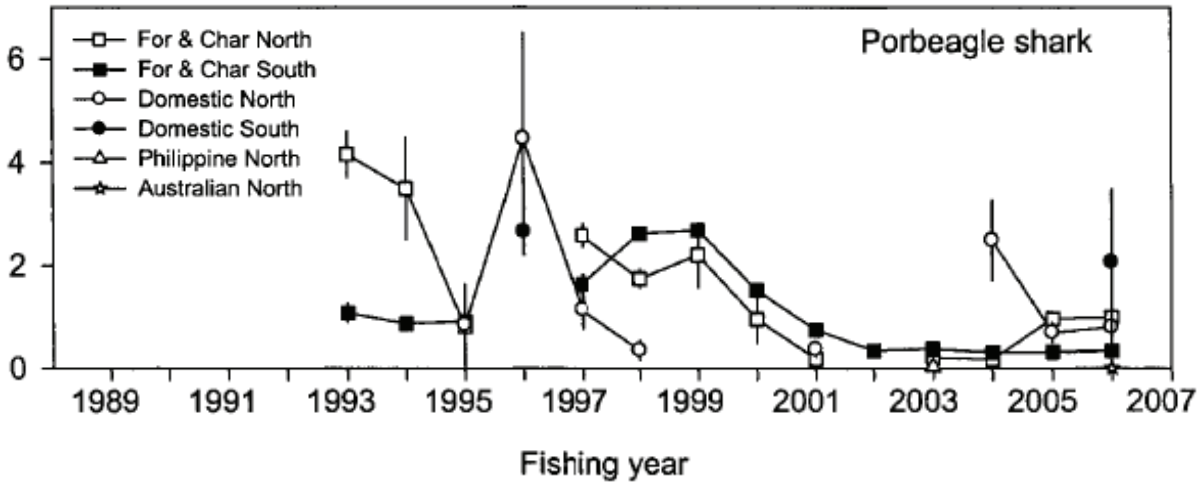


Figure 2: Unstandardised CPUE indices (number of sharks per 1000 hooks) for the New Zealand domestic tuna longline fishery based on observer reports. Years are fishing years (1993 = October 1992 to September 1993). Confidence intervals are from bootstrapped data. Source: Griggs et al. (2008).

5. STATUS OF THE STOCK

Stock structure assumptions
POS1 is assumed to be part of the wider South Western Pacific Ocean stock but the assessment below relates only to the New Zealand component of that stock.

Stock Status	
Year of Most Recent Assessment	2008
Reference Points	Target: Not established Soft Limit: Not established by WCPFC; but evaluated using HSS default of 20%SB_0. Hard Limit: Not established by WCPFC; but evaluated using HSS default of 10%SB_0.
Status in relation to Target	Unknown but see the qualifying comments below
Status in relation to Limits	Unknown

Fishery and Stock Trends	
Trend in Biomass or Proxy	Unknown
Trend in Fishing Mortality 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 the 1998/99 of 301t to 41t in 2007-08.

Projections and Prognosis	
Stock Projections or Prognosis	Unknown
Probability of Current Catch causing decline below limits	Soft Limit: Unknown Hard Limit: Unknown

Assessment Methodology		
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	
Main data inputs	Catch and effort	
Period of Assessment	Latest assessment: 2008	Next assessment: ?
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, Australian EEZ's 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).

6. FOR FURTHER INFORMATION

Ayers, D.; Francis, M.P.; Griggs, L.H.; Baird, S.J. (2004). Fish bycatch in New Zealand tuna longline fisheries, 2000-01 and 2001-02. *New Zealand Fisheries Assessment Report 2004/46*. 47 p.

Francis, M.P.; Campana, S.E.; Jones, C.M. (2007). Age under-estimation in New Zealand porbeagle sharks (*Lamna nasus*): is there an upper limit to ages that can be determined from shark vertebrae? *Marine and Freshwater Research 58*: 10-23.

Francis, M. P.; Duffy, C. (2005). Length at maturity in three pelagic sharks *(Lamna nasus, Isurus oxyrinchus*, and *Prionace glauca*) from New Zealand. *Fishery bulletin 103*: 489-500.

Francis, M.P.; Griggs, L.H.; Baird, S.J. (2001). Pelagic shark bycatch in the New Zealand tuna longline fishery. *Marine and Freshwater Research 52*: 165-178.

Francis, M.P.; Griggs, L.H.; Baird, S.J. (2004). Fish bycatch in New Zealand tuna longline fisheries, 1998-99 to 1999-2000. *New Zealand Fisheries Assessment Report 2004/22*. 62 p.

Francis, M.P.; Stevens, J.D. (2000). Reproduction, embryonic development and growth of the porbeagle shark, *Lamna nasus*, in the south-west Pacific Ocean. *Fishery Bulletin 98*: 41-63.

Griggs, L. H.; Baird, S. J.; Francis, M. P. (2007). Fish bycatch in New Zealand tuna longline fisheries 2002–03 to 2004–05. *New Zealand Fisheries Assessment Report* 2007/18. 58 p.

Griggs, L.H., Baird, S.J., Francis, M.P. (2008). Fish bycatch in New Zealand tuna longline fisheries in 2005-06. *New Zealand Fisheries Assessment Report* 2008/27. 47p.

Jensen, C.F.; Natanson, L.J.; Pratt, H.L.; Kohler, N.E.; Campana, S.E. (2002). The reproductive biology of the porbeagle shark, *Lamna nasus*, in the western North Atlantic Ocean. *Fishery Bulletin 100*: 727-738.

Natanson, L.J.; Mello, J.J.; Campana, S.E. (2002). Validated age and growth of the porbeagle shark (*Lamna nasus*) in the western North Atlantic Ocean. *Fishery Bulletin 100*: 266-278.