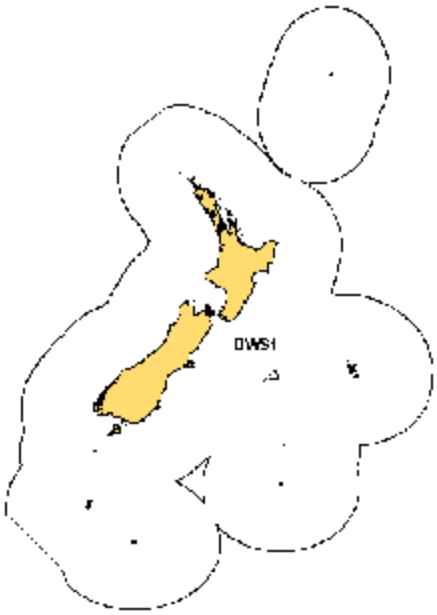
BLUE SHARK (BWS)

(*Prionace glauca*)



1. FISHERY SUMMARY

Blue shark were introduced into the QMS on 1 October 2004 under a single QMA, BWS 1, with allowances, TACC, and TAC as follows:

Fishstock	Recreational Allowance	Maori customary Allowance	Other mortality	TACC	TAC
BWS 1	20	10	190	1 860	2 080

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

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

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

Management of the blue shark throughout the western and central Pacific Ocean (WCPO) will be the responsibility of the Western and Central Pacific Fisheries Commission (WCPFC). Under this regional convention New Zealand will be responsible for ensuring that the management measures applied within New Zealand fisheries waters are compatible with those of the Commission. However, it is not expected that WCPFC will attempt to actively manage blue shark in the first years of the Commission.

(a) Commercial fisheries

Most of the blue shark catch in the New Zealand EEZ (NZ EEZ) is caught in the tuna surface longline fishery. Relatively little blue shark is caught by other methods. Data collected by the Ministry of Fisheries Observer Programme (MFish OP) from the tuna longline fishery suggest that most of the blue shark catch is processed (72% of the observed catch), although usually only the fins are retained and the rest of the carcass is dumped (> 99% of the processed, observed catch).

Landings of blue sharks reported on Catch Effort Landing Returns (CELRs), Catch Landing Returns (CLRs), and Licensed Fish Receiver Returns (LFRRs) are given in Table 1. Total weights reported by fishers (CELR and CLRs) were 551–1167 t per annum during 1997–98 to 2002–03. Processors (LFRRs) reported 525–1415 t per annum during the same period. As with mako (*Isurus oxyrinchus*) and porbeagle (*Lamna nasus*) sharks, there has been a marked decline in reported landings of blue sharks since 2000-01 to about 700 t. This is thought to result from a decrease in domestic tuna longline fishing effort. Estimated catches in the tuna longline fishery calculated by scaling-up observed catches to the entire fleet are considerably higher than reported landings in all fishing years for which these estimates are available. However, these estimates are imprecise and probably biased, as MFish OP coverage of the domestic fleet (which accounts for most of the fishing effort) has been low (less than 3% in the years 1997-98 to 2001-02) and has not adequately covered the spatial and temporal distribution of the fishery.

Table 1: New Zealand commercial landings and discards (t) of blue sharks reported by fishers (CELRs and CLRs) and processors (LFRRs) by fishing year. Also shown for some years are the estimated quantities of blue sharks caught by tuna longliners, based on scaled up scientific observer records. –, no data available. [1]

	Reported by fishers			Processed	Estimated catch by
	CELR and CLR		Total	LFRR	tuna longliners
Year	Landed	Discarded	reported		
1989–90	12	0	12	5	–
1990–91	2	0	2	3	–
1991–92	18	0	18	13	–
1992–93	39	0	39	33	–
1993–94	370	1	371	118	–
1994–95	251	2	254	140	–
1995–96	145	6	152	166	–
1996–97	131	31	161	303	800
1997–98	518	32	551	537	1 369
1998–99	528	48	576	525	–
1999–00	629	12	641	1 031	–
2000–01	1 119	48	1 167	1 415	1 478
2001–02	1 019	57	1 076	1 105	1 969
2002-03*	907	61	968	914	–
2003-04*				649	–
2004-05*				734	

[1] Note that there may be some misreporting of blue shark catches (MFish species code "BWS") as bluenose (*Hyperoglyphe antarctica*; MFish species code "BNS") and vice versa.
*MHR data.

Catches of blue sharks observed by the MFish OP aboard tuna longline vessels are concentrated off the west and south-west coasts of the South Island, and the north-east coast of the North Island, extending northwards to the Kermadec Islands. However, these apparent distributions are biased by the spatial distribution of MFish OP coverage; blue sharks are probably caught by tuna longline vessels throughout most of the NZ EEZ. Most of the blue shark landings reported by fishers (CELR and CLR forms) are concentrated in Fisheries Management Areas (FMAs) 1 and 2.

(b) Recreational fisheries

Blue sharks are caught in relatively large numbers by recreational fishers in the NZ EEZ. Although not as highly regarded as other large, pelagic sharks such as mako in northern New Zealand, blue sharks are the primary target gamefish in southern New Zealand. Several hundred blue sharks are routinely tagged and released each year by the New Zealand Cooperative Gamefish Tagging Programme, an ongoing tag and release programme that operates in New Zealand's recreational gamefish fisheries. The total recreational catch is unknown but likely to be considerably higher.

(c) Maori customary fisheries

Prior to European settlement, Maori caught large numbers of cartilaginous fishes, including blue sharks. However, there are no estimates of current Maori customary catch.

(d) Illegal catch

There is no known illegal catch of blue sharks.

(e) Other sources of mortality

About 90% of all observed blue sharks are retrieved alive. About 28% of all observed blue sharks are discarded. The proportion of sharks discarded dead is unknown. Mortality rates of blue sharks tagged and released by the New Zealand Cooperative Gamefish Tagging Programme are also unknown.

2. BIOLOGY

Blue sharks (*Prionace glauca*) are large, highly migratory, pelagic carcharhinids found throughout the world's oceans in all tropical and temperate waters from about 50° N to 50° S. They are slender in build, rarely exceeding 3 m in total length and 200 kg in weight. They feed opportunistically on a range of living and dead prey, including bony fishes, smaller sharks, squids, and carrion.

In New Zealand waters, male blue sharks are sexually mature at about 190–195 cm fork length (FL), and female blue sharks at about 170–190 cm FL. Internationally, gestation in female blue sharks lasts between 9–12 months and between 4–135 pups (averaging 26–56) are born alive, probably during the spring. Pups are probably born at about 50 cm FL. The few embryos from New Zealand fisheries waters examined to date consisted of mid-term pups 21–37 cm FL collected in July and a full-term pup 54 cm FL collected in February. Blue sharks 50–70 cm FL are caught year-round in New Zealand fisheries waters but only in small numbers.

Age and growth estimates are available for blue sharks in New Zealand waters. These estimates were derived from counts of opaque growth zones in X-radiographs of sectioned vertebrae and assumed that one opaque zone is formed per year. This assumption is untested. Female blue sharks appear to approach a lower mean asymptotic maximum length and grow at a faster rate than males. This contradicts studies on the age and growth of blue shark from other oceans, where females typically approach a larger mean asymptotic maximum length than males.

This is thought to result from the presence of relatively few large (> 250 cm FL), old female blue sharks in length-at-age dataset analysed. The MFish OP data suggest that large (> 250 cm FL) female blue sharks are missing from the catch, despite reliable personal observations to the contrary from commercial and recreational fishers. There is evidence of size and sex segregation in the distributions of blue sharks in the North Pacific, with large, pregnant female blue sharks tending to be found nearer the equator than male or smaller female blue sharks. Given the biases in MFish Observer Programme coverage, it is possible that large female blue sharks in the NZ EEZ have not been adequately sampled, despite the probable presence of these sharks in the catch.

Growth rates estimated for New Zealand blue sharks are broadly comparable with overseas studies. Males and females appear to grow at similar rates until about seven years of age, when their growth appears to diverge. Age at maturity is estimated at 8 years for males and 7-9 years for females. The maximum recorded ages of male and female blue sharks in New Zealand waters are 22 and 19 years, respectively. Blue sharks appear to be fully recruited to the commercial longline fishery by the end of their second year. The commercial catch sampled by the MFish OP contains both mature and immature fish.

Estimates of biological parameters for blue sharks in New Zealand waters are given in Table 3.

Table 3: Estimates of biological parameters.

Fishstock	Estimate					Source
1. Natural mortality (M)						
BWS 1	0.19–0.21					Manning & Francis (2005)
2. Weight = a (length)^b (Weight in kg, length in cm fork length)						
	a	b				
BWS 1 males	1.578×10^{-6}	3.282				Ayers et al. (2004)
BWS 1 females	6.368×10^{-7}	3.485				
3. Von Bertalanffy model parameter estimates						
	k	t_0	L_∞			
BWS 1 males	0.0668	-1.7185	390.92			Manning & Francis (2005)
BWS 1 females	0.1106	-1.2427	282.76			
4. Schnute model (case 1) parameter estimates (are provided for comparison with the von Bertalanffy estimates above)						
	L_1	L_2	k	g	L_∞	
BWS 1 males	65.21	217.48	0.1650	0.1632	297.18	Manning & Francis (2005)
BWS 1 females	63.50	200.60	0.2297	0.0775	235.05	

3. STOCKS AND AREAS

The New Zealand Cooperative Gamefish Tagging Programme tagged and released 3501 blue sharks between 1 July 1975 and 30 June 2004 in the NZ EEZ. Most tagged sharks were captured and released off the east coast of the South Island in recent years. A total of 58 tagged sharks have been recaptured since the start of the tagging programme. The recapture data show dispersal of tagged sharks away from their release point, although the relationship between time at liberty and dispersal is unclear. While some tagged sharks have been recaptured with little apparent movement away from their release point, others have been recaptured off Australia, Fiji, and French Polynesia. The most distant recapture to date was a blue shark caught off Chile.

Although the data are relatively sparse, an overview of tagging data from Australia, New Zealand, the Central Pacific, and California suggest population exchange between not only the eastern and western South Pacific, but also between the South Pacific, south Indian, and even South Atlantic oceans. This suggests that blue sharks in the South Pacific constitute a single biological stock, although whether this is part of a single, larger Southern Hemisphere stock is unclear.

No other data are available on blue shark stock structure in the South Pacific.

4. STOCK ASSESSMENT

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

Quantitative stock assessments of blue sharks outside the NZ EEZ have been mostly limited to standardised CPUE analyses, although quantitative assessment models have been developed using conventional age-structured and MULTIFAN-CL methods. There have been no quantitative stock assessments of blue sharks in New Zealand waters and no quantitative stock assessments are possible with the currently available data.

Unstandardised CPUE indices computed from tuna longline catches recorded by the MFish OP in the NZ EEZ are highly variable (Figure 1). These indices are not thought to reflect stock abundance as they do not consider confounding factors such as inward and outward migration of blue sharks through the NZ EEZ, vessel gear parameters other than the number of hooks set, and the location and time and date the gear was set.

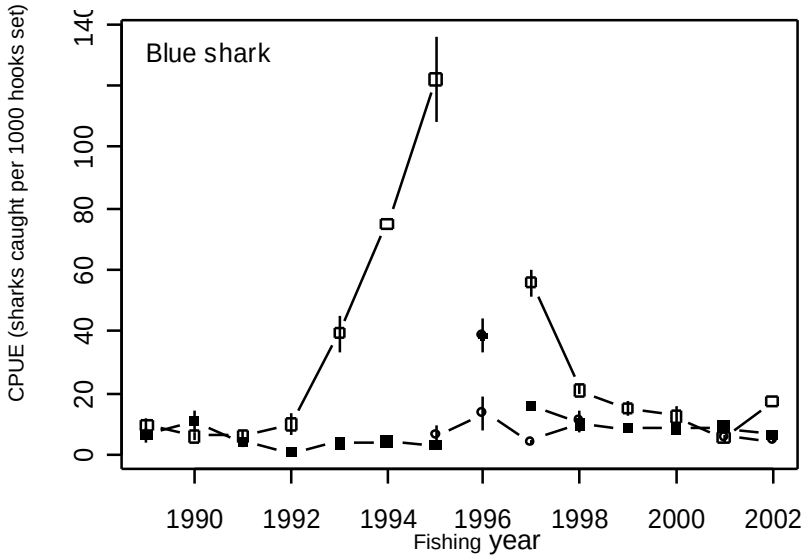


Figure 1 Unstandardised CPUE indices for the tuna longline fishery based on observer reports. Years are fishing years (1994 = October 1993 to September 1994). Confidence intervals are from bootstrapped data. -■- foreign and charter fleet, southern New Zealand; -□- foreign and charter fleet, northern New Zealand; -●- domestic fleet, southern New Zealand; -○- domestic fleet, northern New Zealand. Source: Ayers et al. (2004).

Blue sharks are the most heavily fished of the three large pelagic shark species (blue, mako, and porbeagle sharks) commonly caught in the tuna longline fishery. Compared to mako and porbeagle sharks, however, blue sharks are relatively fecund, fast growing, and widely distributed. Nevertheless, there is some concern about the impact of a rapid increase in domestic fishing effort in the late 1990s and the early 2000s. This has now been ameliorated by a substantial decline in tuna longline fishing effort during the last three years. The status of the stock is uncertain.

5. STATUS OF THE STOCK

There is no assessment for this stock so it is not known if the stock is at or above a level capable of producing the maximum sustainable yield. Furthermore, it is not known whether current catches or the TAC are at levels that will allow the stock to move towards the biomass that would support the maximum sustainable yield. Due to its biological characteristics, blue shark is possibly less vulnerable to overexploitation than mako or porbeagle sharks.

6. FOR FURTHER INFORMATION

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