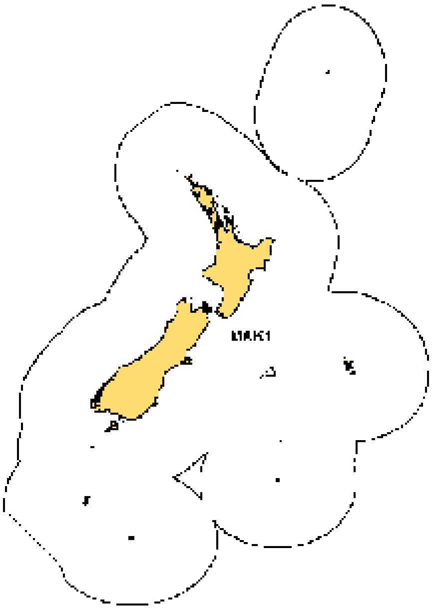
MAKO SHARK (MAK)

(*Isurus oxyrinchus*)



1. FISHERY SUMMARY

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

Fishstock	Recreational Allowance	Maori customary Allowance	Other mortality	TACC	TAC
MAK 1	50	10	46	406	512

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

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

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

Management of the mako 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 mako shark in the first years of the Commission.

(a) Commercial fisheries

Most of the commercial catch of mako sharks is taken by tuna longliners, but bottom longliners and bottom and midwater trawlers also take some. About three-quarters of mako sharks caught by tuna longliners are processed, and the rest are discarded.

Landings of mako sharks reported on CELR (landed), CLR, and LFRR forms are shown in Table 1. The total weights reported by fishers were 86–295 t during 1997–98 to 2002–03. Processors reported 76–319 t on LFRRs during the same period. There was a steady increase in the weight of mako shark landed between 1997–98 and 2000–01, resulting from a large increase in domestic fishing effort in the tuna longline fishery, and probably also improved reporting. Landings have since declined to one-third of the peak landings. Nevertheless, reported landings almost certainly underestimate catches. Estimates of the catch of mako sharks aboard tuna longliners, based on scaled up scientific observer records, are considerably higher than reported by either fishers or processors in the years for which comparable data are available. 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 (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 mako sharks reported by fishers (CELRs and CLRs) and processors (LFRRs) by fishing year. Also shown for some years are the estimated quantities of makos caught by tuna longliners, based on scaled-up scientific observer records. –, no data available.

	Reported by fishers			Processed	Estimated catch by tuna longliners
	CELR and CLR		Total	LFRR	
Year	Landed	Discarded	reported		
1989/90	11	0	11	15	–
1990/91	15	0	15	21	–
1991/92	17	0	17	16	–
1992/93	24	1	24	29	–
1993/94	44	0	44	50	–
1994/95	62	1	63	69	–
1995/96	64	3	67	66	–
1996/97	37	14	51	55	113
1997/98	80	6	86	76	188
1998/99	83	9	93	98	–
1999/00	131	17	148	196	–
2000/01	274	21	295	319	694
2001/02	223	19	242	245	340
2002/03*	218	15	233	216	–
2003/04*				100	–
2004/05*				107	

*MHR data.

Catches of mako 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. Mako 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 mako landings reported on CELR and CLR forms were taken in FMAs 1 and 2.

(b) Recreational fisheries

There is a significant recreational catch of mako sharks and they are highly prized as a game fish. Several hundred makos per year are reported landed by big game fishing clubs, and many others are tagged and released, or caught by fishers not belonging to one of these clubs.

(c) Maori customary fisheries

There are no estimates of Maori customary catch of mako sharks. Traditionally, makos were highly regarded by Maori for their teeth, which were used for jewellery. Target fishing trips were made, with sharks being caught by flax rope nooses to avoid damaging the precious teeth.

(d) Illegal catch

There is no known illegal catch of mako sharks.

(e) Other sources of mortality

Many of the mako sharks caught by tuna longliners (about 70%) are alive when the vessel retrieves the line. It is not known how many of the unprocessed, discarded sharks survive.

2. BIOLOGY

Makos occur worldwide in tropical and warm temperate waters, mainly between latitudes 50 ^{o}N and 50^{o}S. In the South Pacific, makos are rarely caught south of 40 ^{o}S in winter–spring (August–November) but in summer–autumn (December–April) they penetrate at least as far as 55 ^{o}S. Makos occur throughout the New Zealand EEZ (to at least 49 ^{o}S), but are most abundant in the north, especially during the colder months.

Mako sharks produce live young around 57–69 cm fork length (FL). In New Zealand, female makos mature at about 275–285 cm FL and males at about 180–185 cm FL. The length of the gestation period is uncertain, but is thought to be 18 months with a resting period between pregnancies leading to a two- or three-year cycle. Only one pregnant female has been recorded from New Zealand, but newborn young are relatively common. Litter size is 4–18 embryos. If the reproductive cycle lasts three years, and mean litter size is 12, mean annual fecundity would be 4 young.

Estimates of mako shark age and growth in New Zealand were derived by counting vertebral growth bands, and assuming that one band is formed each year (this assumption requires validation). Males and females grow at similar rates until age 7–9 years, after which the relative growth of males declines. In New Zealand, males mature at about 7–9 years and females at 19–21 years. The maximum ages recorded are 29 and 28 years for males and females respectively.

The longest reliably measured mako appears to be a 351 cm FL female from the Indian Ocean, but it is likely that they reach or exceed 366 cm FL. In New Zealand, makos recruit to commercial fisheries during their first year at about 70 cm FL, and much of the commercial catch is immature. Sharks less than 150 cm FL are rarely caught south of Cook Strait, where most of the catch by tuna longliners consists of subadult and adult males.

Makos are active pelagic predators of other sharks and bony fishes, and to a lesser extent squids. As top predators, makos probably associate with their main prey, but little is known of their relationships with other species.

Estimates of biological parameters are given in Table 3.

Table 3: Estimates of biological parameters.

Fishstock	Estimate				Source
1. Natural mortality (M)					
MAK 1	0.10–0.15				Bishop et al. (2006)
2. Weight = a (length)^{b} (Weight in kg, length in cm fork length)					
Both sexes combined					
MAK 1	a = 2.388 x 10^{-5}	b = 2.847			Ayers et al. (2004)
3. Schnute growth parameters					
	L_1	L_{10}	κ	γ	
MAK 1 males	100.0	192.1	–	3.40	Bishop et al. (2006)
MAK 1 females	99.9	202.9	–0.07	3.67	Bishop et al. (2006)

3. STOCKS AND AREAS

Up to June 2004, 10871makos had been tagged in New Zealand waters and 307 recaptured. Most of the tagged makos were small to medium sharks with estimated total lengths of 120–200 cm, and weights of 5–50 kg, and they were mainly tagged off east Northland. Most movements were less than 500 km, with sharks remaining around east Northland or travelling to the Bay of Plenty and the west coast of North Island. However, long distance movements out of the New Zealand EEZ were frequent, with makos travelling to Australia or the western Tasman Sea (1500–2000 km), the tropical islands north of New Zealand (New Caledonia, Fiji, Tonga, Solomon Islands; 1500–2400 km) and to the Marquesas Islands in French Polynesia (4600 km).

DNA analysis of mako sharks collected in the North-east Pacific, South-west Pacific (Australia), North Atlantic and South-west Atlantic oceans showed that North Atlantic makos were genetically isolated from those found elsewhere, but there was no significant difference among the remaining sites.

The stock structure of mako 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 also extends to the eastern South Pacific or the North Pacific.

4. STOCK ASSESSMENT

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

There have been no stock assessments of mako sharks in New Zealand, or elsewhere in the world. No estimates of yield are possible with the currently available data.

Unstandardised CPUE analysis of tuna longline catches recorded by observers show no long-term trends over the period 1992–93 to 2001–02. These indices may not reflect stock abundance because they do not take into account variation in the numbers of mako sharks migrating into the New Zealand EEZ each year, and variation in many other influencing factors (e.g., vessel, gear, location and time of year).

Compared with a wide range of shark species, the productivity of mako sharks is low. Females have a high age at maturity, moderately 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 population to replace sharks removed by fishing is very limited.

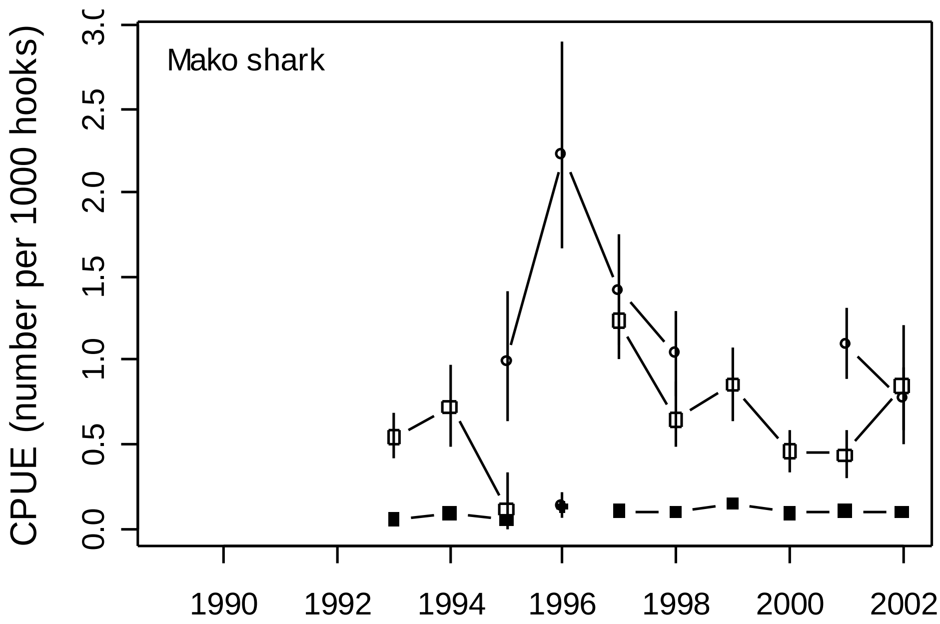


Figure 1. Unstandardised CPUE indices for the tuna longline fishery based on observer reports. Years are fishing years (1993 = October 1992 to September 1993). Confidence intervals are from bootstrapped data. -■- foreign and charter fleet, southern New Zealand; -□- foreign and charter fleet, northern New Zealand; -●- domestic fleet, southern New Zealand; -○- domestic fleet, northern New Zealand. Source: Ayers et al. (2004).

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, mako shark is vulnerable to overexploitation.

6. FOR FURTHER INFORMATION

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