

MAKO SHARK (MAK)

(Isurus oxyrinchus)



1. FISHERY SUMMARY

Mako sharks were introduced into the Quota Management System (QMS) on 1 October 2004 under a single Quota Management Area, MAK 1, with a Total Allowable Catch (TAC) of 542 t, a Total Allowable Commercial Catch (TACC) of 406 t, and a recreational allowance of 50 t. The TAC was reviewed in 2012 and the reduced allocation and allowances applied from 1 October 2012 are given in Table 1. The decrease was in response to sustainability concerns that mako sharks are considered to be at risk of overfishing internationally because of their low productivity.

Table 1: Recreational and customary non-commercial allowances, TACC, and TAC (t) for mako sharks.

Fishstock	Recreational allowance	Customary non-commercial allowance	Other mortality	TACC	TAC
MAK 1	30	10	36	200	276

Mako sharks were added to the Third Schedule of the 1996 Fisheries Act with a TAC set under s14 because mako sharks are 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.

The conditions of Schedule 6 releases have been amended for mako, porbeagle, and blue sharks. From 1 October 2014, fishers have been allowed to return these three species to the sea both alive and dead, although the status must be reported accurately. Those returned to the sea dead are counted against a fisher's Annual Catch Entitlement and the total allowable catch limit for that species. On 1 October 2014 a ban on shark finning was introduced; after this time any mako sharks for which the fins are retained are required to be landed with the fins attached (artificial attachment such as tying or securing the fins to the trunk is permitted).

Management of the mako 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

Most of the commercial catch of mako sharks is taken by tuna longliners, bottom longliners and as incidental bycatch of bottom and midwater trawlers. Between 2019–20 and 2021–22 surface longline accounted for 62.7%, mid-water trawl accounted for 19% and bottom longline attributed 9.5% of the total commercial captures of mako. The TACC was reduced from 400 t to 200 t for the 2012–13 fishing year and in 2015 a shark finning ban was put in place. Since the ban on shark finning in 2015, most mako catches are now discarded or actively released alive. In the three-year period from 2019–20 to 2021–22, 93.5% of the annual commercial catch by weight was disposed of (Moore & Finucci 2024).

Landings of mako sharks reported on CELR (landed), CLR, LFRR, and MHR forms are shown in Figure 1 and Table 2. There was a steady increase in the weight of mako sharks landed in the late 1990s, reaching a peak of 319 t in 2000–01, resulting from a large increase in domestic fishing effort in the tuna longline fishery, and probably also improved reporting. Landings then declined to between 70 and 100 t between 2003–04 and 2011–12 and have declined further to between about 10 and 40 t since 2016–17.

In addition to catch taken within New Zealand fisheries waters, a small amount (less than 1 t in recent years) is taken by New Zealand longline vessels fishing on the high seas.

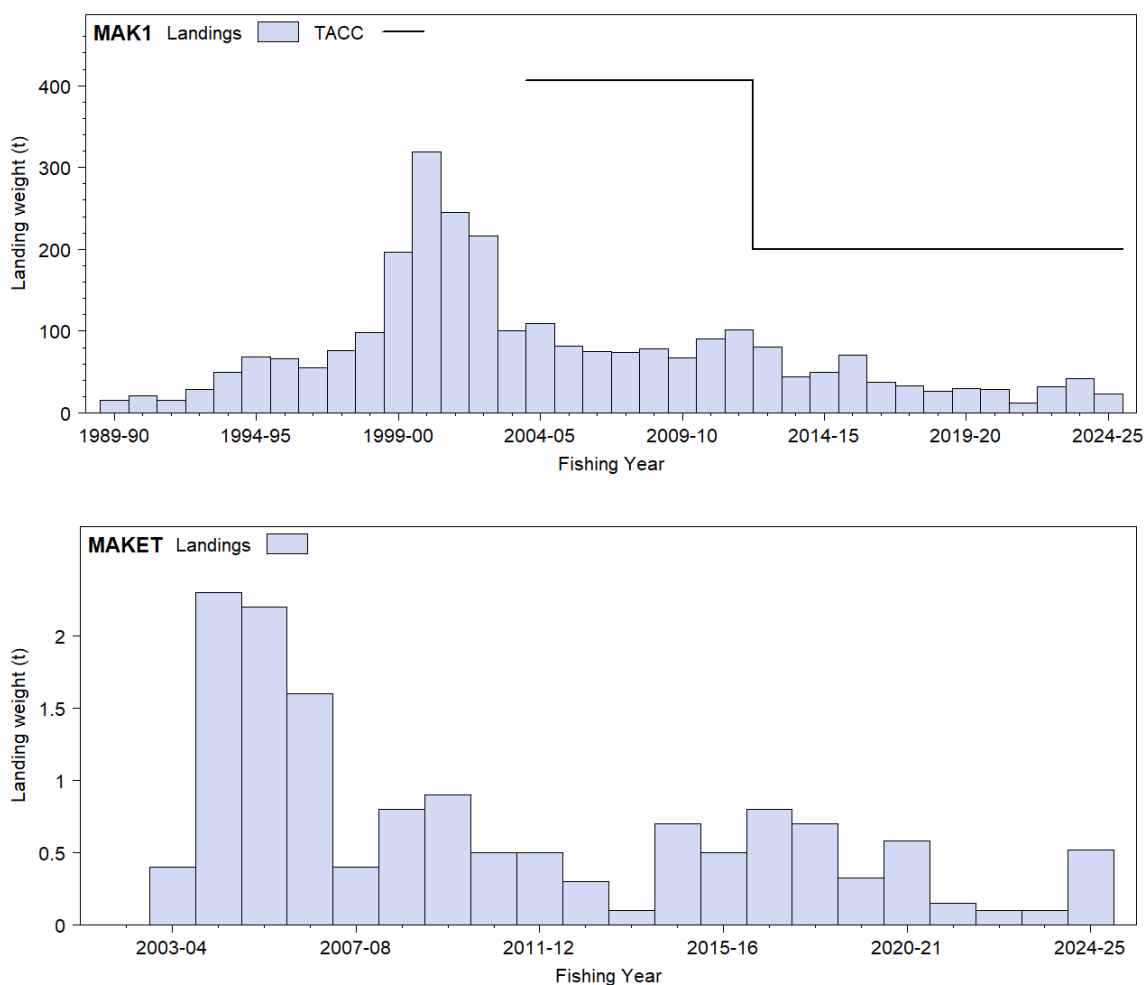


Figure 1: [Top] Mako shark catch from 1989–90 to present within New Zealand waters (MAK 1) and [bottom] 2002–03 to present on the high seas (MAK ET).

Most of the mako catch and disposals by surface longline between the 2019–20 and 2021–22 fishing years was taken off the east coast of the North Island in sets targeting southern bluefin tuna, swordfish, and bigeye tuna (Figure 2). Most of the mako catch and disposals by trawl between the 2019–20 to

2021–22 fishing years was taken off the west coast of the South Island (Figure 3), in tows targeting jack mackerel and hoki (Moore and Finucci 2024).

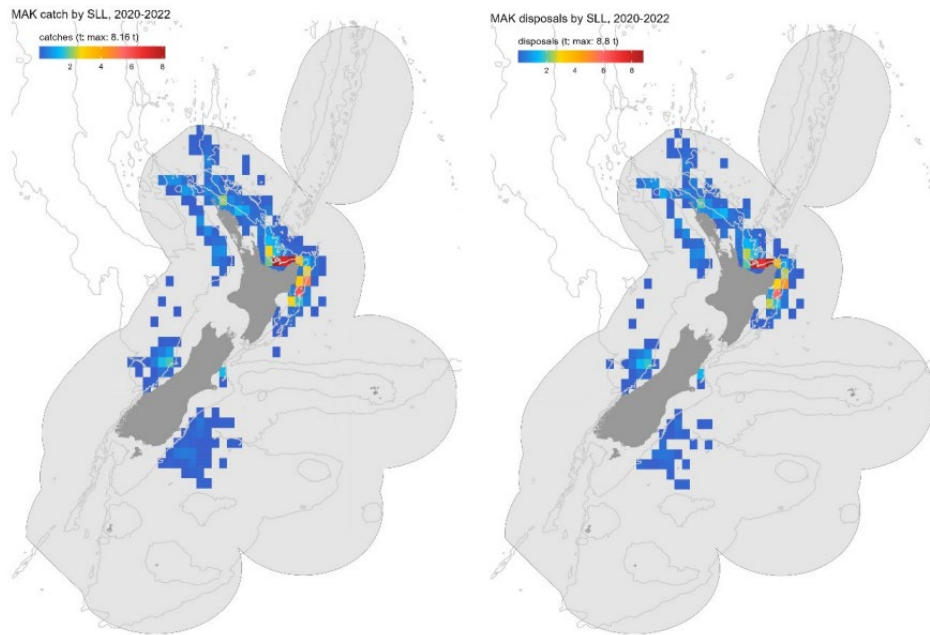


Figure 2: Total catches (including disposals; left) and disposals (right) of mako (MAK) by surface longline (SLL) in New Zealand’s Exclusive Economic Zone, aggregated at the 0.5° resolution for 2019–20 to 2021–22 (Moore & Finucci 2024).

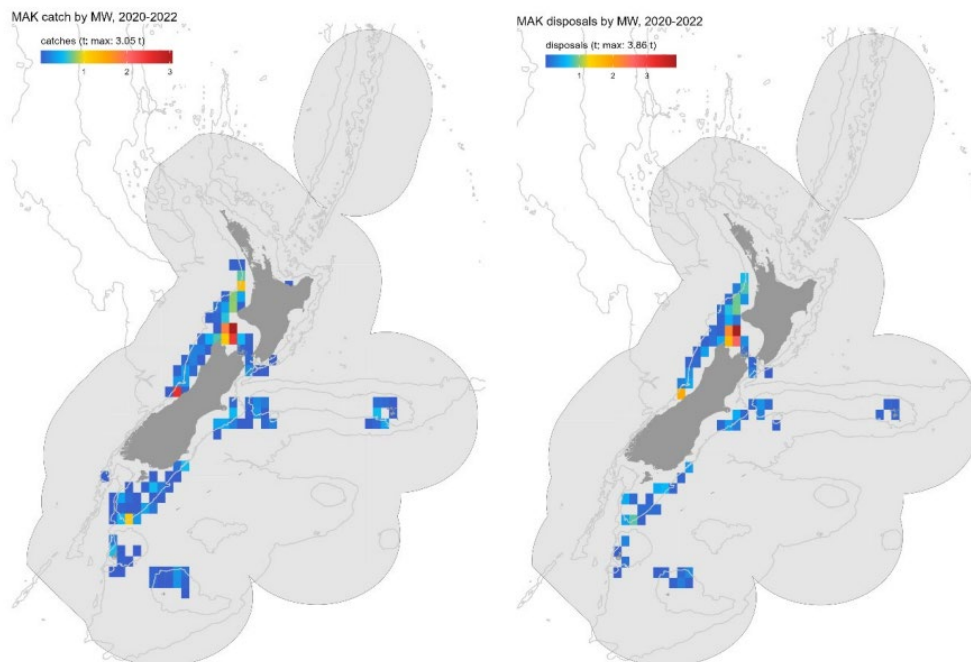


Figure 3: Total catches (including disposals; left) and disposals (right) of mako (MAK) by mid-water trawl (MW) in New Zealand’s Exclusive Economic Zone, aggregated at the 0.5° resolution for 2019–20 to 2021–22 (Moore & Finucci 2024).

In 2024–25, for all longline fisheries, mako were in the top ten species by weight but made up < 1% of reported catches (Figure 4). The south-west coast South Island fishery predominantly targets southern bluefin tuna (*T. maccoyii*), whereas the fishery off the east coast of the North Island targets a range of species including bigeye, swordfish (*Xiphias gladius*), and southern bluefin tuna.

Across all fleets in the longline fishery in 2017–18, 72% of the mako sharks were alive when brought to the side of the vessel (Table 3). The percentage of mako shark catches retained has decreased over time, decreasing to 2.2% in 2017–18 (Table 4).

Table 2: New Zealand commercial landings (t) of mako sharks reported by fishers (CELRs and CLRs) and processors (LFRRs or MHRs) by fishing year. * MHR rather than LFRR data

Year	Fishers	Processors	Year	Fishers	Processors
1989–90	11	15	2007–08*	72	74
1990–91	15	21	2008–09*	82	78
1991–92	17	16	2009–10*		67
1992–93	24	29	2010–11*		91
1993–94	44	50	2011–12*		102
1994–95	63	69	2012–13*		81
1995–96	67	66	2013–14*		44
1996–97	51	55	2014–15*		50
1997–98	86	76	2015–16*		71
1998–99	93	98	2016–17*		38
1999–00	148	196	2017–18*		33
2000–01	295	319	2018–19*		27
2001–02	242	245	2019–20*		30
2002–03*	233	216	2020–21*		29
2003–04*	100	100	2021–22*		12
2004–05*	107	112	2022–23*		32
2005–06*	83	84	2023–24*		42
2006–07*	76	75	2024–25*		23

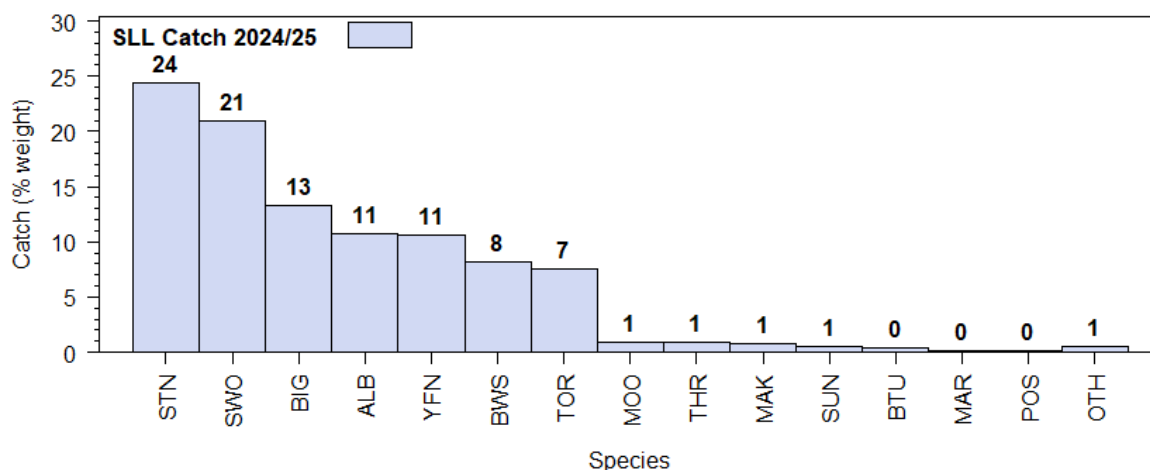


Figure 4: A summary of species composition of the surface longline estimated catch for the most recent fishing year. The percentage by weight of each species is calculated for all surface longline trips.

Table 3: Percentage of mako sharks (including discards) that were alive or dead when hauled to the longline vessel and observed during 2006–07 to 2020–21, by fishing year, fleet, and region. Small sample sizes (number observed < 20) were omitted (Griggs & Baird 2013, Griggs et al. 2018, 2021, 2024). Only the New Zealand domestic fleet operated after 2014–15. [Continued on next page]

Year	Fleet	Area	% alive	% dead	Number
2006–07	Australia	North	82.1	17.9	28
	Charter	North	83.0	17.0	276
		South		93.1	6.9
	Domestic	North	67.6	32.4	262
Total		76.6	23.4	595	
2007–08	Domestic	North	63.8	36.2	304
	Total		64.7	35.3	320
2008–09	Charter	North	88.6	11.4	44
		South	100.0	0.0	31
	Domestic	North	69.6	30.4	289
		Total		74.4	25.6
2009–10	Domestic	North	76.1	23.9	330
	Total		75.9	24.1	348
2010–11	Domestic	North	73.0	27.0	515
	Total		73.8	26.2	530

Table 3: [Continued]

Year	Fleet	Area	% alive	% dead	Number
2011–12		South	86.4	13.6	22
	Domestic	North	67.6	32.4	296
	Total		68.9	31.1	328
2012–13	Charter	North	80.8	19.2	26
		South	79.6	20.4	49
	Domestic	North	79.0	21.0	119
	Total		78.7	21.3	197
2013–14	Domestic	North	68.6	31.4	188
		South	64.1	35.9	39
	Total		68.7	31.3	246
2014–15	Charter	South	88.9	11.1	27
	Domestic	North	76.7	23.3	163
		South	69.6	30.4	23
	Total	Total	77.5	22.5	213
2015–16	Domestic	North	63.2	36.8	427
		South	68.5	31.5	54
	Total		63.8	36.2	481
2016–17	Domestic	North	68.3	31.7	183
		South	58.3	41.7	36
	Total		66.7	33.3	219
2017–18	Domestic	North	71.1	28.9	284
		South	75.0	25.0	36
	Total		71.6	28.4	320
2018–19	Domestic	North	78.5	21.5	65
		South	55.9	44.1	34
	Total		70.7	29.3	99
2019–20	Domestic	North	71.1	28.9	76
	Total		70.0	30.0	80
2020–21	Domestic	North	62.6	37.4	91
	Total		63.6	36.4	99

Table 4: Percentage of mako sharks that were retained, or discarded or lost, when observed on a longline vessel during 2006–07 to 2020–21, by fishing year and fleet. Small sample sizes (number observed < 20) omitted (Griggs & Baird 2013, Griggs et al. 2018, 2021, 2024). Only the New Zealand domestic fleet operated after 2014–15.

Year	Fleet	% retained or finned	% discarded or lost	Number
2006–07	Australia	17.9	82.1	28
	Charter	93.8	6.2	323
	Domestic	37.0	63.0	262
	Total	66.1	33.9	613
2007–08	Domestic	66.6	33.4	305
	Total	68.2	31.8	321
2008–09	Charter	100.0	0.0	85
	Domestic	58.7	41.3	293
	Total	68.0	32.0	378
2009–10	Domestic	19.1	80.9	350
	Total	21.6	78.4	361
2010–11	Domestic	27.9	72.1	580
	Total	30.1	69.9	598
2011–12	Charter	96.0	4.0	25
	Domestic	47.1	52.9	314
	Total	50.7	49.3	339
2012–13	Charter	80.0	20.0	75
	Domestic	13.2	86.8	129
	Total	37.7	62.3	204
2013–14	Charter	95.2	4.8	21
	Domestic	24.0	76.0	258
	Total	29.4	70.6	279
2014–15	Charter	59.3	40.7	27
	Domestic	6.8	93.2	190
	Total	13.4	86.6	217
2015–16	Domestic	2.5	97.5	483
2016–17	Domestic	7.3	92.7	219
2017–18	Domestic	2.2	97.8	320
2018–19	Domestic	5.0	95.0	100
2019–20	Domestic	0.0	100.0	84
2020–21	Domestic	1.0	99.0	99

1.2 Recreational fisheries

Historically there was a recreational target fishery for mako sharks and they were highly prized as a sport fish. Most mako sharks are now taken as a bycatch when targeting other species. Reported catch has declined since the mid-1990s. Fishing clubs affiliated to the New Zealand Sports Fishing Council reported landing 2 mako sharks in 2020–21. In addition, recreational fishers tagged and released 200 to 500 mako sharks per season up until 2019, however, the number of tagged and released mako sharks in New Zealand waters has decreased significantly with the lowest numbers recorded in the last 40 year between 2021 and 2024. In the 2023–24 fishing year 31 mako sharks were tagged and released and no mako sharks were recaptured in 2022–23 or 2023–24 (Holdsworth & Curtis 2025). Using New Zealand Sports Fishing Council records only, it is estimated that 97% of mako sharks caught by recreational fishers associated with sport fishing clubs were tagged and released in recent years.

Recreational catch estimates are available from three national panel surveys (see below). They are caught around the upper North Island, with harvest by area in 2017–18 being: FMA 1 (4.2%), FMA 2 (73.0%), and FMA 9 (22.8%). In 2022–23 all harvest was reported from FMA 1.

1.2.2 Estimates of recreational harvest

Recreational catch estimates are available from comparable national panel surveys conducted in the 2011–12, 2017–18 and 2022–23 fishing years (Wynne-Jones et al. 2014, 2019, Heinemann & Gray in 2024). The panel survey used face-to-face interviews of a random sample of New Zealand households to recruit a panel of fishers and non-fishers for a full year. The panel members were contacted regularly about their fishing activities and catch information was collected in standardised phone interviews. Although the national panel survey estimates include harvest taken on recreational charter vessels, the survey is unlikely to estimate this proportion of the mako shark catch well. Note that national panel survey estimates do not include recreational harvest taken on charter vessel trips or under s111 general approvals.

The national panel survey harvest estimates are 529 fish (CV 0.51), 1048 fish (CV 0.77) and 1458 fish (CV 0.94) for the 2011–12, 2017–18 and 2022–23 fishing years, respectively. These estimates were derived from landings of mako by very small numbers of panellists.

1.3 Customary non-commercial fisheries

There are no estimates of Māori customary catch of mako sharks. Traditionally, mako were highly regarded by Māori 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.

1.4 Unreported catch

There is no known unreported catch of mako sharks.

1.5 Other sources of mortality

Many of the mako sharks caught by tuna longliners (about 75%) are alive when the vessel retrieves the line. It is not known how many of the sharks that are returned to the sea alive under the provisions of Schedule 6 of the Fisheries Act survive. A research study to estimate survival rates of returned mako sharks using pop-up tags has been conducted by NIWA for WCPFC. Estimates of post-release mortality for mako after 60 days were estimated to be 20%. Recommendations that came out of the subsequent workshop included collection of data to further enable evaluation of shark mitigation effectiveness, such as: handling practices and release methods, condition at haulback and condition at release, shark length, length of trailing gear, ganglion materials, hooking location, and hook type. Dead discards are now allowed under Schedule 6 of the Fisheries Act, and these may be under-reported.

2. BIOLOGY

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

Mako sharks produce live young around 57–69 cm (average 61 cm) fork length (FL). In New Zealand, male mako sharks mature at about 180–185 cm FL and female mako mature at about 275–285 cm FL (Francis & Duffy 2005). The length of the gestation period is uncertain, but it is thought to be 18 months with a resting period between pregnancies leading to a two- or three-year pupping 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 pups per year.

Estimates of mako shark age and growth in New Zealand were derived by counting vertebral growth bands, assuming that one band pair (one opaque and one translucent band) is formed each year. This assumption has been validated for North Atlantic mako sharks but there is evidence that fast-growing juveniles in California waters deposit two band pairs per year, and length frequency modes suggest the same is true for New Zealand juveniles (Francis 2016). Males and females grow at similar rates until age 16 years, after which the relative growth of males probably declines. In New Zealand, males mature at about 9–10 years and females at 20–21 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, mako recruit to commercial fisheries during their first year at about 70 cm FL, and much of the commercial catch is immature and less than 6 years old. Sharks less than 150 cm FL are rarely caught south of Cook Strait, where most of the catch by tuna longliners consists of sub-adult and adult males.

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

Estimates of biological parameters are given in Table 5.

Table 5: Estimates of biological parameters.

Fishstock	Estimate				Source
1. Natural mortality (M)					
MAK 1	0.10–0.15				Bishop et al. (2006)
2. Weight = $a(\text{length})^b$ (Weight in kg, length in cm fork length)					
Both sexes combined	a	b			
MAK 1	2.388×10^{-5}	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)
MAK 1 males less than 16 years	100.4	184.9	-0.13	5.16	Francis (2016)
MAK 1 females less than 16 years	97.6	180.1	-0.20	5.17	Francis (2016)

3. STOCKS AND AREAS

There were 16 678 mako sharks tagged and released in New Zealand waters between the 1974–75 and 2023–24 fishing years, with 374 of these recaptured (Holdsworth & Curtis 2025). Most of the tagged fish in recent years were small to medium sharks with estimated total weights at 90 kg or less, with a

mode at 40 to 50 kg, and they were mainly tagged off east Northland and the west coast of the North Island. Holdsworth & Curtis (2025) have reported that mako sharks tagged in New Zealand seldom travel into equatorial waters, however, long distance movements out of the New Zealand EEZ are frequent, and a high portion of recaptures have been reported in the Fijian region, New Caledonia and New South Wales (Figure 5).

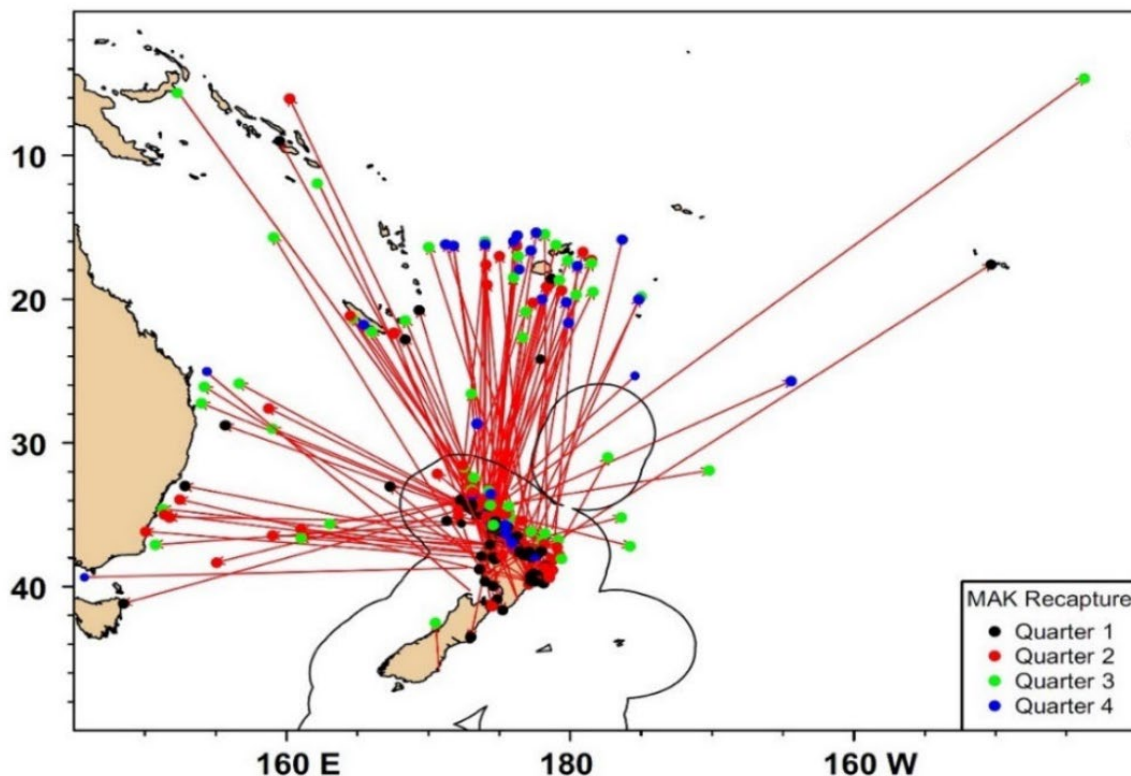


Figure 5: All released and recaptured locations of make sharks (MAK) in the NZGTP, with recapture locations colour coded by quarter (Quarter 1 = Jan-Mar).

Electronic tagging of juvenile mako sharks, and adult males, showed relatively high site fidelity, with all 14 sharks remaining in the New Zealand EEZ for many months (Francis et al. 2019). Most of the sharks showed an offshore movement in winter, with some travelling up the Kermadec Ridge or to Fiji, New Caledonia, and the Coral Sea. Several of the sharks subsequently returned to New Zealand. This indicates that juvenile mako sharks may undergo seasonal migrations but that they spend much of their life in New Zealand coastal waters. Little is known about the movements of adults, but they appear to travel further afield than juveniles.

Several DNA analyses of mako sharks worldwide have shown that there are distinct stocks in the North Atlantic, South Atlantic, North Pacific, Southwest Pacific, and Southeast Pacific (Clarke et al. 2015, Corrigan et al. 2018). This is consistent with tagging data that have shown no movements of New Zealand sharks beyond the Southwest Pacific.

4. ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

There is no directed fishery for mako; they are exposed to incidental capture, so there is no information on bycatch of other species in target mako shark fisheries.

4.1 Non-target fish catch

Mako shark is a non-target catch in the tuna and swordfish surface longline fishery in the New Zealand EEZ. Observer records indicate that a wide range of species are landed by the surface longline fleets in New Zealand fishery waters. Blue sharks are the most commonly landed species (by number), followed by lancetfish and Ray's bream.

4.2 Benthic interactions

There are no known interactions with benthic habitats for this fishery.

4.3 Key environmental and ecosystem information gaps

Cryptic mortality is unknown at present.

Historically, observer coverage in the New Zealand fleet has not been spatially or temporally representative of the fishing effort. However, in 2013 the observer effort was restructured to rectify this by planning observer deployment to correspond with recent spatial and temporal trends in fishing effort.

5. STOCK ASSESSMENT

Since the establishment of the WCPFC in 2004, stock assessments of the western and central Pacific Ocean stock of mako sharks are reviewed by the WCPFC. As such, mako sharks are included in the WCPFC 2021-2030 shark research plan, which was reviewed at WCPFC SC21 (Brouwer & Hamer 2025).

5.1 Southwest Pacific Ocean

SC18-SA-WP-02 (Large et al. 2022a & Large et al. 2022b) provided an assessment of southwest Pacific shortfin mako shark stock in the WCPO (referred to as the southwest Pacific stock). Shortfin mako sharks in the South Pacific are thought to consist of two stocks, a southwest and southeastern stock which are both separated from those in the north Pacific at the Equator. Shortfin mako sharks in the north Pacific have been assessed and that stock is currently considered not to be overfished. This is the first attempt at undertaking an assessment of the southwest Pacific stock.

The stock assessment was set up in Stock Synthesis as a two-fleet model. The model was run for a 26-year period (1995 to 2020), given highly uncertain catches prior to 1995. The catches were reconstructed from observer data, producing relatively high catches between the mid-1990s and early 2000s, with relatively strong reductions in catch since about 2010. The catch reconstruction model also produced high uncertainties in catch between the mid-1990s and early 2000s, and in the early to mid-2010s.

Two CPUE series, one from New Zealand, representing high latitude fisheries capturing young-of-year and juvenile fish, and one from Japan representing low latitude fisheries on juvenile (mainly age 1+ but sub-mature) individuals, were used as indices of abundance. The high latitude index suggested a decline in the late 1990s, with subsequent increase since the early 2000s, and relatively variable, yet over-all flat trends in recent years. The low latitude index suggested a time-lagged decline compared to the New Zealand high latitude index in the later 1990s and early 2000s, but did not show a subsequent increase. Corresponding length frequencies appeared relatively consistent with indices: a decline and subsequent recovery in mean lengths for high latitude mean lengths, and relatively stable mean lengths for low latitude fisheries.

Despite numerous attempts, very few of the attempted models yielded plausible outcomes. The assessment was unstable, with high estimation uncertainty and sensitivity to a range of inputs. It was considered that the assessment model, while delivering information on stock biomass and fishing mortality trends, is not robust enough to provide management advice.

5.1.1 Stock status and trends

The assessment models had high estimation uncertainty and were sensitive to a range of inputs.

Assessment results were deemed preliminary and were not recommended for providing management advice; alternative assessment approaches should be explored. Therefore, SC18 found it was unable to provide stock status or trends information on Southwest Pacific mako shark to the Commission, as the status remains unknown.

5.1.2 Management advice and implications

SC18 does not regard the South Pacific mako shark assessment to be robust enough to provide management advice. SC18 notes that a large number of CCMs currently release (cut sharks free) shortfin mako sharks. This practice may result in a reduction in fishing mortality and SC18 encourages CCMs to continue to maintain this practice as a precautionary measure for a slow growing, unproductive species with unknown stock status.

5.2 New Zealand waters

There have been several attempts to assess the status of mako sharks in New Zealand waters, all of which have however been inconclusive:

- 2014 – indicator analysis (Francis & Large 2017)
- 2019 – updated indicator analysis (Francis & Finucci 2019)
- 2017 – qualitative risk assessment (Ford et al. 2018)
- 2025 – spatial risk assessment (Edwards et al. 2025)

Indicator analyses

There have been no stock assessments of mako sharks in New Zealand waters and no estimates of yield are possible given local sharks are part of the wider south-western Pacific Ocean stock. Indicator analyses reported in 2014 (Figure 5 & Figure 6, Francis et al. 2014) suggest that mako shark populations in the New Zealand EEZ have not been declining under recent fishing pressure and may have been increasing since 2005 (Table 6, Francis et al. 2014). These changes are presumably in response to a decline in SLL fishing effort since 2002 and declines in annual landings since a peak in 2000–01 for mako sharks (Figure 1). Observer data from 1995 suggest that mako sharks may have undergone a down-then-up trajectory. The quality of observer data and model fits means that these interpretations are uncertain. The stock status of mako sharks may be recovering. Conclusive determinations of stock status will require regional (i.e., South Pacific) stock assessments.

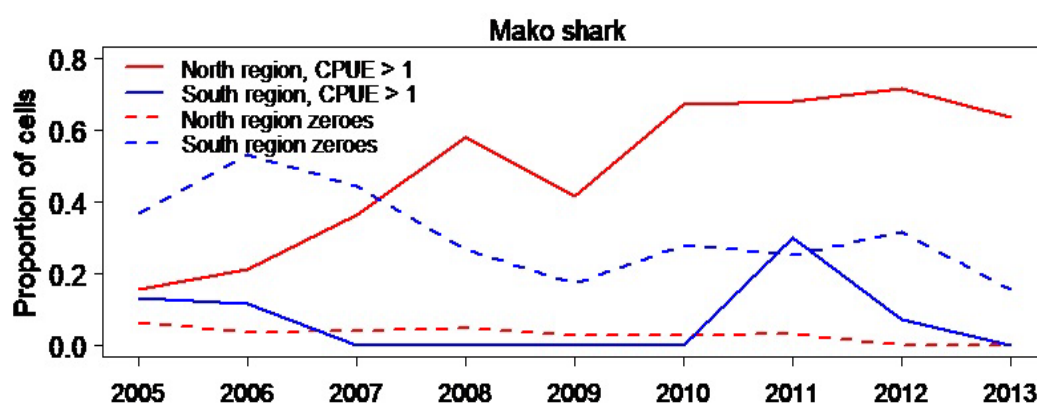


Figure 6: Mako shark distribution indicators. Proportions of 0.5 degree cells having CPUE greater than 1 per 1000 hooks, and proportions of cells having zero catches, for North and South regions by fishing year, based on estimated catches (processed and discarded combined) reported on TLCERs (Francis et al. 2014). North region comprises Fisheries Management Areas (FMAs) 1, 2, 8, and 9, and South region comprises FMAs 5 and 7.

The indicator analyses were updated in 2019 (Francis & Finucci 2019). The authors updated the same indicators with five more years of data (to 2018), during which time there have been major changes in the SLL fishery, which takes most of the New Zealand catch of these species. Most of the abundance indicator series presented showed declining trends in recent years, particularly in North region in 2017–

2018, suggesting a reversal of the previous increasing trends. Taken at face value, these changes suggest there has been a decline in the abundance of pelagic sharks in New Zealand’s EEZ. However, the authors described a number of reasons why the indicators may not accurately index shark abundance. The abundance indicators have been compromised by changes in the fisheries they monitor, under-reporting by commercial fishers, and reduced collection of data by observers. They may also have been invalidated by avoidance of sharks by surface longliners and changes in shark availability resulting from shark movement. These factors combine to make interpretation of the stock status of the three species (blue, mako, and porbeagle sharks) problematic.

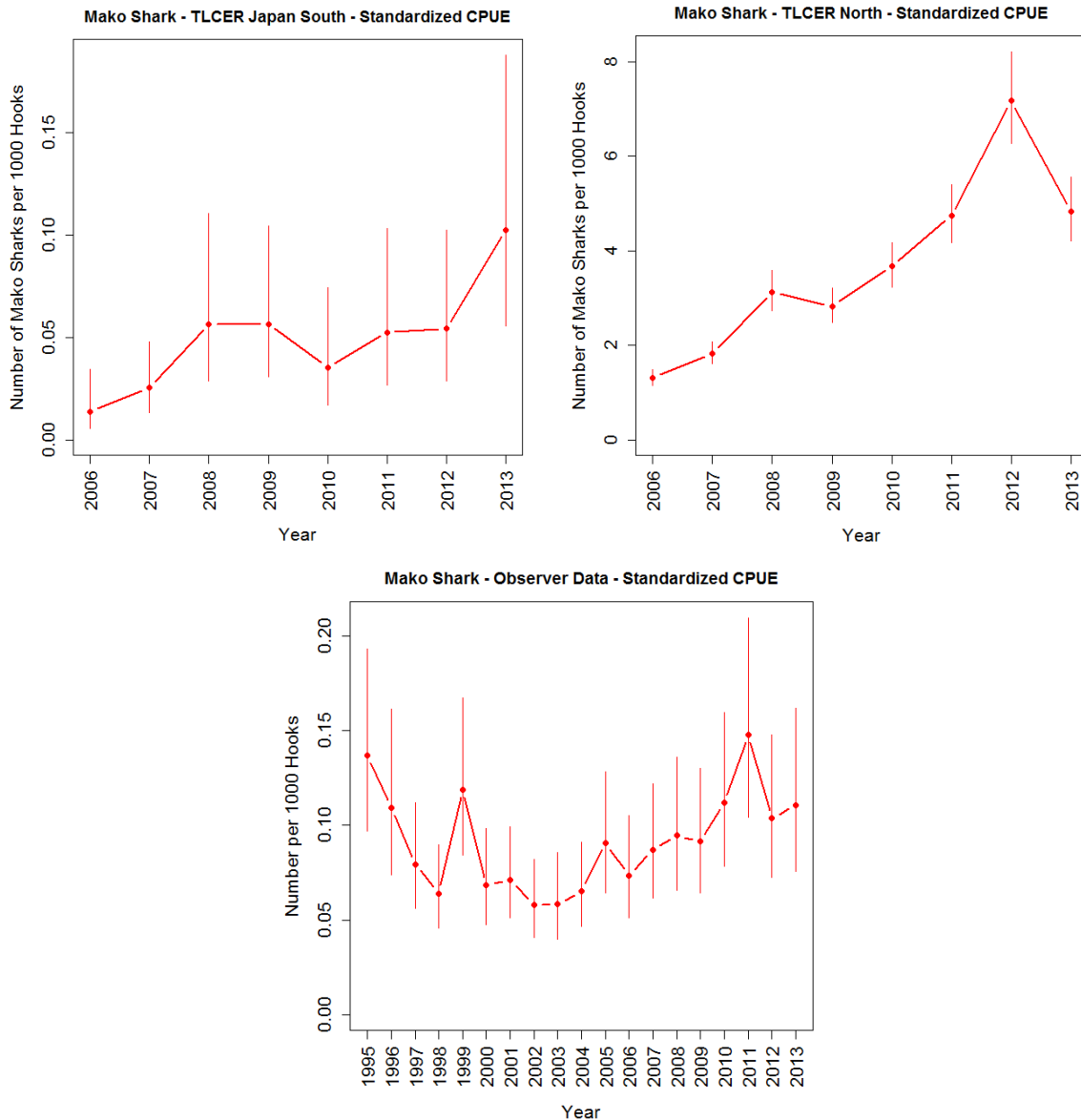


Figure 7: Standardised CPUE indices for commercial TLCER (Japan South and North), and observer datasets (all New Zealand).

Blue, porbeagle, and mako sharks are generally regarded as wide-ranging, mobile oceanic species. Although this may be true of blue sharks, recent electronic tagging of porbeagle and mako sharks in New Zealand waters has shown that juveniles (which make up a high proportion of the catch of each species) are partly residential in the New Zealand EEZ. Thus, abundance indices for the New Zealand EEZ may not index the entire southwest Pacific populations of those species. To understand trends in the wider pelagic shark stocks of the South Pacific, and to quantify their status in relation to management reference points, quantitative regional stock assessments are now required.

Table 6: Summary of trends identified in abundance indicators since the 2005 fishing year based on both TLCER and observer data sets. The CPUE-Obs indicator was calculated for both North and South regions combined. North region comprises Fisheries Management Areas (FMAs) 1, 2, 8, and 9, and South region comprises FMAs 5 and 7. For the CPUE-TLCER indicator in South region, only the Japan dataset indicator is shown (the TLCER Domestic South dataset was small and probably unrepresentative). Green cells show indicators that suggest positive trends in stock size. Note that a downward trend in ‘proportion-zeroes’ is considered a positive stock trend. NA = indicator not applicable because of small sample size (Francis et al. 2014).

Indicator class	Indicator	North region			South region		
		Blue	Porbeagle	Mako	Blue	Porbeagle	Mako
Distribution	High-CPUE	Up	Up	Up	Up	Up	NA
Distribution	Proportion-zeroes	Nil	Down	Down	Nil	Nil	Down
Catch composition	GM index total catch - TLCER	Up (all species)			Up (all species)		
Catch composition	GM index total catch - Obs	Up (all species)			Nil (all species)		
Catch composition	GM index HMS shark catch - TLCER	Up (all species)			Up (all species)		
Catch composition	GM index HMS shark catch - Obs	Up (all species)			Nil (all species)		
Standardised CPUE	CPUE - TLCER	Up	Nil	Up	Up	Nil	Nil
Standardised CPUE	CPUE - Obs	Up	Nil	Nil	Up	Nil	Nil
Sex ratio	Proportion males	Nil	Nil	Nil	Nil	Nil	NA
Size composition	Median length - Males	Nil	Nil	Nil	Nil	Nil	NA
Size composition	Median length - Females	Nil	Nil	Nil	Nil	Nil	NA

Compared with a wide range of shark species, the productivity of mako sharks is very 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 serious concern, because the ability of the population to replace sharks removed by fishing is very limited.

Risk assessments

A data-informed qualitative risk assessment was completed on all chondrichthyans (sharks, skates, rays, and chimaeras) at the New Zealand scale in 2017 (Ford et al. 2018). Mako sharks had a risk score of 15 and were ranked second equal lowest risk of the eleven QMS chondrichthyan species. Data were described as ‘exist and sound’ for the purposes of the assessment and the risk score was achieved by consensus of the expert panel, but with low confidence. This low confidence was due to the fact that no data were available on adult stock size.

In 2025 a spatial risk assessment for selected shark species in New Zealand, including mako sharks, was completed (Edwards et al. 2025). Catch and effort data were obtained for all methods that caught each of these species. From these data, the catchability per fishing gear type was co-estimated with the species spatial density distribution (in numbers) using Bayesian methods. The estimation model had a hierarchical structure, first predicting the density and spatial limit of the population as a function of environmental covariates, and then predicting the catch as the product of the density and catchability.

Exploitation rate was estimated from model parameters as the weighted sum of catchabilities across all fishing events, with weights provided by the spatial distribution of the population relative to each event. This was compared to an exploitation rate reference point (the impact sustainability threshold or IST), which is a function of the maximum intrinsic growth rate (r_{max}). Comparison of the exploitation rate with the IST yielded the risk ratio. Risk for a particular species was calculated as the posterior probability that the risk ratio was greater than one. Since the IST is a measure of the equilibrium exploitation rate at a desirable population status, the risk is the probability that this management objective will not be reached under current levels of fishing pressure.

The model was shown to provide a good fit to the catch data and produce well-defined posterior estimates of the risk for each species. However, risk estimates were highly sensitive to assumptions of post-capture survivorship (Ψ_l), and the proportion of the population outside of the spatial assessment domain (Υ) at any given time. Neither of these could be estimated, and sensitivity testing was therefore needed to explore the credibility of the results (Figure 10).

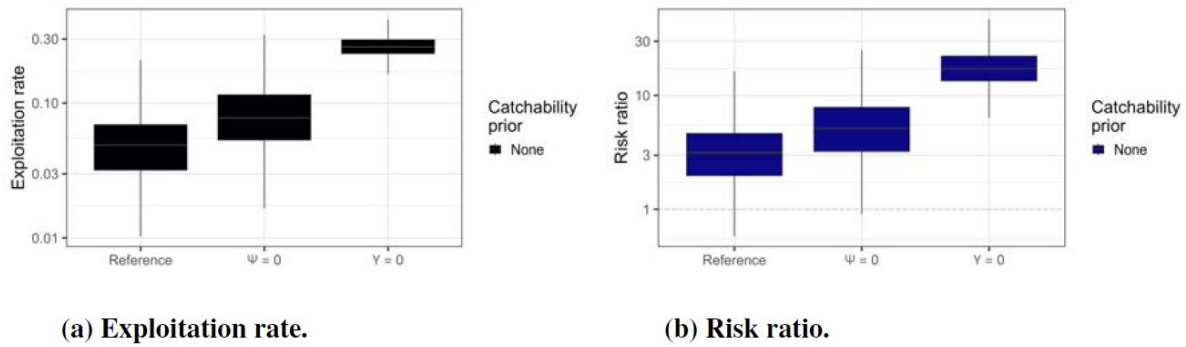


Figure 10. Posterior estimates of the recent (2021 to 2023 inclusive) total exploitation rate (as a proportion of the exploitable population, summed across all fishing methods) and the associated risk ratio, for mako shark (MAK). The reference case, and sensitivity to $\Psi = 0$ and $Y = 0$ are shown (Edwards et al. 2025).

Sensitivity runs showed that if the total population were inside the New Zealand Exclusive Economic Zone (EEZ), then the risk would be close to one for all species (i.e., eventual depletion of the population would be almost certain). The reference case assumed that most of the population was outside of the EEZ and not exposed to any fishing pressure. Under this scenario mako shark was still estimated to have a risk close to one (the probability that the risk ratio was greater than one was >90%) with an exploitation rate of $\geq 5\%$.

5.3 Research recommendations

WCPFC SC18 agreed on the following research priorities for the Southwest Pacific mako stock:

- Future assessments should spend increased effort to reconstruct spatio-temporal abundance patterns for shortfin mako and develop a better understanding of how these patterns drive regional abundance indices.
- Increased effort should be made to re-construct catch histories for sharks (and other bycatch species) from a range of sources. Additional data sources, such as log-sheet reported captures from reliably reporting vessels, may be incorporated into integrated catch-reconstruction models to fill gaps in observer coverage.
- Additional tagging should be carried out using satellite tags in a range of locations, especially known nursery grounds off southeast Australia and New Zealand, as well as high seas areas to the north and east of New Zealand, where catch rates are high. Such tagging may help to resolve questions about the degree of natal homing and mixing of the stock.
- Tagging may also help to obtain better estimates of natural mortality, if carried out in sufficient numbers.
- Additional growth studies and validation of ageing methods from a range of locations could help build a better understanding of typical growth, as well as regional growth differences. Current growth data are conflicting, despite evidence that populations at locations of current tagging studies are likely connected or represent individuals from the same population.
- Genetic/genomic studies could be undertaken to augment the tagging work to help resolve the stock/sub-stock structure patterns. To support this work, a strategic tissue sampling programme for sharks is recommended.
- Aggregated data are currently submitted as annual totals for the WCPFC area only, making them uninformative for a stock specific assessment. Therefore, shortfin mako shark aggregated data should be reported by ocean area not simply as WCPO and, where possible, these data should be retrospectively corrected.

WCPFC SC21 discussed a joint bycatch-billfish and sharks-assessment methods workshop, to review and recommend potential assessment methods for data-limited billfish and shark stock assessments. SC21 noted that the next Southwest Pacific mako shark assessment should not start until the workshop has made recommendations on a suggested way forward. In the meantime, it was suggested to progress

a general characterisation of low information sharks stocks as well as epigenetic and stock structure analysis of Southwest Pacific mako sharks.

6. STATUS OF THE STOCK

Stock structure assumptions

MAK 1 is assumed to be part of the wider south-western Pacific Ocean stock. However, there is no stock assessment for this wider stock since the WCPFC SC18 assessment presented in 2022 was inconclusive. The results below are from indicator analyses of the New Zealand component of that stock only.

Stock Status			
Most Recent Assessment Plenary Publication Year	2022 Southwest Pacific stock assessment (inconclusive)		
Intrinsic productivity level	Low		
Catch in most recent year of assessment	Year: <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td> </td></tr></table> Catch: <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td> </td></tr></table>		
Assessment Runs Presented	Southwest Pacific Ocean: Stock Synthesis two-fleet model (low latitude high seas & high latitude fleet)		
Reference Points	Target: Not established Soft Limit: Not established but HSS default of 20% SB_0 assumed. Hard Limit: Not established but HSS default of 10% SB_0 assumed. Overfishing threshold: F_{MSY}		
Status in relation to Target	Unknown		
Status in relation to Limits	Unknown		
Status in relation to Overfishing	Unknown		

Historical Stock Status Trajectory and Current Status

WCPFC SC18 was unable to provide stock status or trends information on Southwest Pacific mako shark as the status remains unknown.

The model was run for a 26-year period (1995 to 2020), given highly uncertain catches prior to 1995. The catches were reconstructed from observer data, producing relatively high catches between the mid-1990s and early 2000s, with relatively strong reductions in catch since about 2010.

The catch reconstruction model produced high uncertainties in catch between the mid-1990s and early 2000s, and in the early to mid-2010s.

Despite numerous attempts, very few of the attempted models yielded plausible outcomes. The assessment was unstable, with high estimation uncertainty and sensitivity to a range of inputs.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Uncertain
Recent Trend in Fishing Intensity or Proxy	Uncertain
Other Abundance Indices	-
Trends in Other Relevant Indicator or Variables	Catches in New Zealand increased from the early 1980s to a peak in the early 2000s but have declined from highs of 319 t to 12–42 t between 2016–17 and 2024–25.

Projections and Prognosis	
Stock Projections or Prognosis	Unknown, although the 2022 Southwest Pacific stock assessment provided preliminary indications that recent fishing mortality may have declined below critical (i.e., F_{crash}) levels.
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	Unknown

Assessment Methodology and Evaluation		
Assessment Type	Level 2 – Partial Quantitative Stock Assessment: Standardised CPUE indices and other fishery indicators	
Assessment Method	Indicator analyses	
Assessment Dates	Latest assessment Plenary publication year: 2022	Next assessment: 2027-2028 (two-year assessment; dates to be confirmed pending WCPFC billfish / shark assessment methodologies workshop outcomes)
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Longline catch and effort across the WCPO - WCPO observer data (gear, fate, condition, length, sex) - Logsheet based CPUE series: New Zealand and Japan	1 – All High Quality
Data not used (rank)	- Australian CPUE series - Fijian and Combined Distant Water CPUE	1 – High Quality data (but poor residual patterns suggested model fit was not satisfactory)
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	2022 Southwest Pacific stock assessment attempt: - information on life-history parameters - uncertain estimated catch inputs - variable CPUE trends - estimates of initial fishing mortality - absence of mature females in input data - conflicting signals in regional trends - unknown degree of stock connectivity - sparse length composition data	

Qualifying Comments
-

7. 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.
- Bentley, N; Langley, A D; Middleton, D A J; Lallemand, P (2013) Fisheries of New Zealand, 1989/90-2011/12. Retrieved from <http://fonz.tridentsystems.co.nz>. Accessed 11 November 2013.
- Bishop, S D; Francis, M P; Duffy, C (2006) Age, growth, maturity, longevity and natural mortality of the shortfin mako shark (*Isurus oxyrinchus*) in New Zealand waters. *Marine and Freshwater Research* 57: 143–154.
- Brouwer, S; Hamer, P (2025) Progress against the 2021-2030 Shark Research Plan - 2025. WCPFC-SC21-2025/SA-IP-19 REV. 17 p.
- Clarke, S; Coelho, R; Francis, M; Kai, M; Kohin, S; Liu, K-M; Simpfendorfer, C; Tovar-Avila, J; Rigby, C; Smart, J (2015) Report of the Pacific Shark Life History Expert Panel Workshop, 28–30 April 2015. Western Central Pacific Fisheries Commission Scientific Committee eleventh regular session WCPFC-SC11-2015/EB-IP-13. 111 p.
- Clarke, S; Harley, S; Hoyle, S; Rice, J (2011) An indicator-based analysis of key shark species based on data held by SPC-OFP. Western Central Pacific Fisheries Commission Scientific Committee seventh regular session WCPFC SC7-EB-WP-01. 88 p.
- CMM2008-03 (2008) Conservation and Management measure for sea turtles, for the Western and Central Pacific Ocean. CMM2008-03 of the Western and Central Pacific Fisheries Commission.
- Corrigan, S; Lowther, A D; Beheregaray, L B; Bruce, B D; Cliff, G; Duffy, C A; Foulis, A; Francis, M P; Goldsworthy, S D; Hyde, J R; Jabado, R W; Kacev, D; Marshall, L; Mucientes, G R; Naylor, G J P; Pepperell, J G; Queiroz, N; White, W T; Wintner, S P; Rogers, P J (2018) Population connectivity of the highly migratory shortfin mako (*Isurus oxyrinchus* Rafinesque 1810) and implications for management in the Southern Hemisphere. *Frontiers in Ecology and Evolution* 6: 187. doi: 10.3389/fevo.2018.00187.
- Duffy, C; Francis, M P (2001) Evidence of summer parturition in shortfin mako (*Isurus oxyrinchus*) sharks from New Zealand waters. *New Zealand Journal of Marine and Freshwater Research* 35: 319–324.
- Edwards, C T T; Pinkerton M H; Dunn M (2025) Spatial risk assessment for selected shark species in New Zealand – Part I: pelagic bycatch. *New Zealand Aquatic Environment and Biodiversity Report No. 354*. 129.
- Fisheries New Zealand (2020) Aquatic Environment and Biodiversity Annual Review 2019–20. Compiled by the Aquatic Environment Team, Fisheries Science and Information, Fisheries New Zealand, Wellington New Zealand. 765 p.
- Ford, R B; Francis, M P; Holland, L; Clark, M R; Duffy, C A J; Dunn, M R; Jones, E; Wells, R (2018) Qualitative (Level 1) risk assessment of the impact of commercial fishing on New Zealand chondrichthyans: an update for 2017. *New Zealand Aquatic Environment and Biodiversity Report No. 201*. 103 p.
- Francis, M P (2013) Commercial catch composition of highly migratory elasmobranchs. *New Zealand Fisheries Assessment Report 2013/68*. 79 p.
- Francis, M P (2016) Size, maturity and age composition of mako sharks observed in New Zealand tuna longline fisheries. *New Zealand Fisheries Assessment Report 2016/22*. 34 p.
- Francis, M P; Clarke, S C; Griggs, L H; Hoyle, S D (2014) Indicator based analysis of the status of New Zealand blue, mako and porbeagle sharks. *New Zealand Fisheries Assessment Report 2014/69*. 115 p.
- 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; Finucci, B (2019) Indicator based analysis of the status of New Zealand blue, mako and porbeagle sharks in 2018. *New Zealand Fisheries Assessment Report 2019/51*. 105 p.
- 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; Shivji, M S; Duffy, C A; Rogers, P J; Byrne, M E; Wetherbee, B M; Tindale, S C; Lyon, W S; Meyers, M M (2019) Oceanic nomad or coastal resident? Behavioural switching in the shortfin mako shark (*Isurus oxyrinchus*). *Marine Biology* 166(1): 5.
- Griggs, L H; Baird, S J (2013) Fish bycatch in New Zealand tuna longline fisheries 2006–07 to 2009–10. *New Zealand Fisheries Assessment Report 2013/13*. 71 p.
- 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*. 47 p.
- Griggs, L H; Baird, S J; Francis, M P (2018) Fish bycatch in New Zealand tuna longline fisheries 2010–11 to 2014–15. *New Zealand Fisheries Assessment Report 2018/29*. 91 p.
- Griggs, L H; Datta, S; Finucci, B; Baird, S J (2021) Fish bycatch in New Zealand tuna longline fisheries 2015–16 to 2017–18. *New Zealand Fisheries Assessment Report 2021/20*. 68 p.
- Griggs, L H; Datta, S; Finucci, B (2024) Fish bycatch in New Zealand tuna longline fisheries 2018–19 to 2020–21. *New Zealand Fisheries Assessment Report 2024/59* 78 p.
- Heinemann A; Gray, A. (2024) National Panel Survey of Recreational Marine Fishers 2022-23. *New Zealand Fisheries Assessment Report 2024/51*. 116 p.
- Heist, E J; Musick, J A; Graves, J E (1996) Genetic population structure of the shortfin mako (*Isurus oxyrinchus*) inferred from restriction fragment length polymorphism analysis of mitochondrial DNA. *Canadian Journal of Fisheries and Aquatic Sciences* 53: 583–588.
- Holdsworth, J C; Curtis, S (2025) New Zealand billfish and gamefish tagging, 2022–23 to 2023–24. *New Zealand Fisheries Assessment Report 2025/12*. 32 p.
- Holdsworth, J; Saul, P (2014) New Zealand billfish and gamefish tagging, 2012–13. *New Zealand Fisheries Assessment Report 2014/11*. 26 p.
- Holdsworth, J C; Saul, P J; Boyle, T; Sippel, T (2016) Synthesis of New Zealand gamefish tagging data, 1975 to 2014. *New Zealand Fisheries Assessment Report 2016/24*. 63 p.
- Horn, P L; Ballara, S L; Sutton, P J H; Griggs, L H (2013) Evaluation of the diets of highly migratory species in New Zealand waters. *New Zealand Aquatic Environment and Biodiversity Report No. 116*. 140 p.
- Large, K; Neubauer, P; Brouwer, S (2022a) Stock assessment of Southwest Pacific mako shark – 2022. WCPFC-SC18-2022/SA-WP-02. 40 p.
- Large, K; Neubauer, P; Brouwer, S; Mikihiko K (2022b) Inputs to the Stock assessment of Southwest Pacific Shortfin mako shark. WCPFC-SC18-2022/SA-IP-13. 155 p.

- Mollet, H F; Cliff, G; Pratt, H L; Stevens, J D (2000) Reproductive biology of the female shortfin mako, *Isurus oxyrinchus* Rafinesque, 1810, with comments on the embryonic development of lamnoids. *Fishery Bulletin* 98: 299–318.
- Moore, B R; Finucci B (2024) Estimation of release survival of pelagic sharks and fish in New Zealand commercial fisheries. *New Zealand Fisheries Assessment Report 2024/07* 133p.
- Rowe, S J (2009) Conservation Services Programme observer report: 1 July 2004 to 30 June 2007. *DOC Marine Conservation Services Series 1*. 93 p.
- Schrey, A; Heist, E (2003) Microsatellite analysis of population structure in the shortfin mako (*Isurus oxyrinchus*). *Canadian Journal of Fisheries and Aquatic Sciences* 60: 670–675.
- Wynne-Jones, J; Gray, A; Heinemann, A; Hill, L; Walton, L (2019) National Panel Survey of Marine Recreational Fishers 2017–18. *New Zealand Fisheries Assessment Report 2019/24*. 104 p.
- Wynne-Jones, J; Gray, A; Hill, L; Heinemann, A (2014) National Panel Survey of Marine Recreational Fishers 2011–12: Harvest Estimates. *New Zealand Fisheries Assessment Report 2014/67*. 139 p.