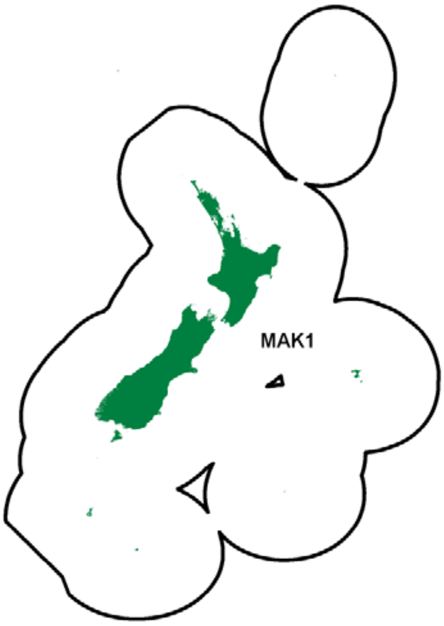
MAKO SHARK (MAK)

(*Isurus oxyrinchus)*
Mako



1. FISHERY SUMMARY

Mako shark were introduced into the QMS on 1 October 2004 under a single QMA, MAK 1, with a TAC of 542 t, a TACC of 406 t and a recreational allowance of 50 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 that mako shark is considered to be at risk of overfishing internationally because of its low productivity.

Table 1: Recreational and Customary non-commercial allowances, TACC and TAC (all in tonnes) for mako shark.

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

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.

The conditions of Schedule 6 releases have been amended for mako, porbeagle, and blue shark. 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 ACE and the total allowable catch limit for that species.

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 and bottom longliners and they are also incidental bycatch of bottom and mid-water trawlers. Before the introduction of a ban on shark finning that took effect on 1 October 2014, about 25% of mako sharks caught by tuna longliners were processed and the rest were discarded. The TACC was reduced from 400 t to 200 t for the 2012–13 fishing year.

Landings of mako sharks reported on CELR (landed), CLR, LFRR, and MHR forms are shown in Table 2 and Figure 1. Processors reported 44–319 t on LFRRs during the period 1997–98 to 2014–15. There was a steady increase in the weight of mako shark landed in the late 1990s, reaching a peak 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 about one-quarter of the peak landings between 2003–04 and 2014–15.

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.

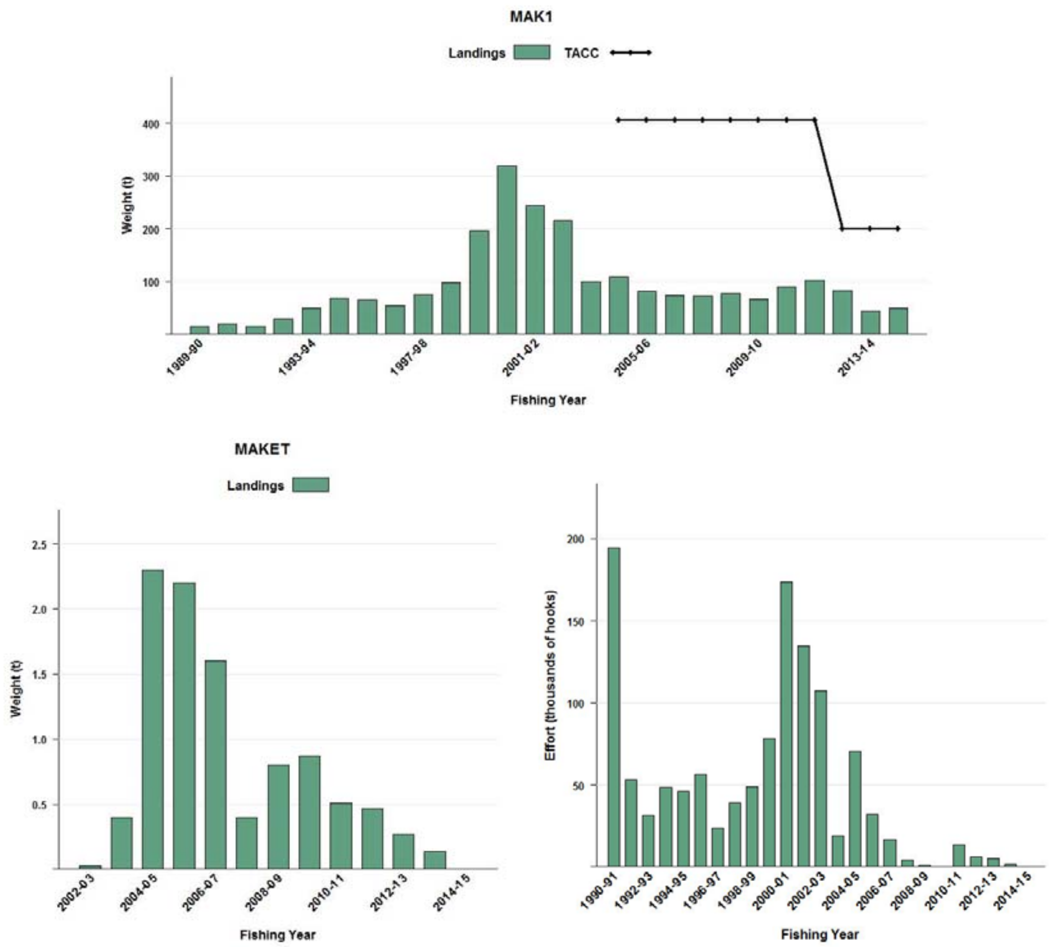


Figure 1: [Top] Mako Shark catch from 1989–90 to 2014–15 within New Zealand waters (MAK 1) and 2002–03 to 2014–15 on the high seas (MAK ET). [Bottom] Fishing effort (number of hooks set) for high seas New Zealand flagged surface longline vessels, from 1990–91 to 2014–15. [Continued on next page].

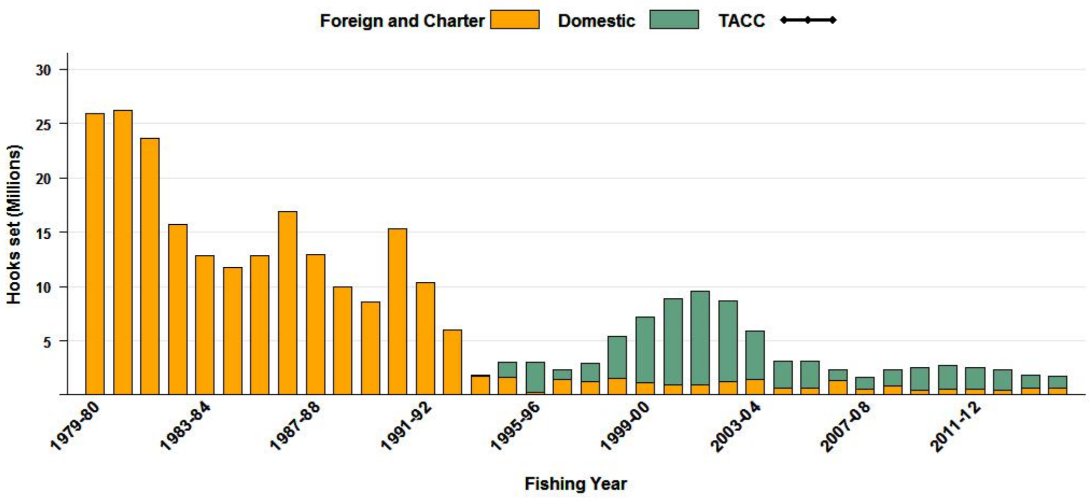


Figure 1 [Continued]: Fishing effort (number of hooks set) for all foreign (including effort by foreign vessels chartered by New Zealand fishing companies) and domestic vessels, from 1979–80 to 2014–15.

Table 2: New Zealand commercial landings (t) of mako sharks reported by fishers (CELRs and CLRs) and processors (LFRRs) by fishing year.

Year	Total Reported	LFRR/MHR
1989–90	11	15
1990–91	15	21
1991–92	17	16
1992–93	24	29
1993–94	44	50
1994–95	63	69
1995–96	67	66
1996–97	51	55
1997–98	86	76
1998–99	93	98
1999–00	148	196
2000–01	295	319
2001–02	242	245
2002–03*	233	216
2003–04*	100	100
2004–05*	107	112
2005–06*	83	84
2006–07*	76	75
2007–08*	72	74
2008–09*	82	78
2009–10*		67
2010–11*		91
2011–12*		103
2012–13*		84
2013–14*		44
2014–15*		50

*MHR rather than LFRR data.

Catches of mako sharks aboard tuna longliners are concentrated off the west and southwest coast of the South Island, and the northeast coast of the North Island (Figure 2). Most of the mako landings were taken in FMAs 1 and 2.

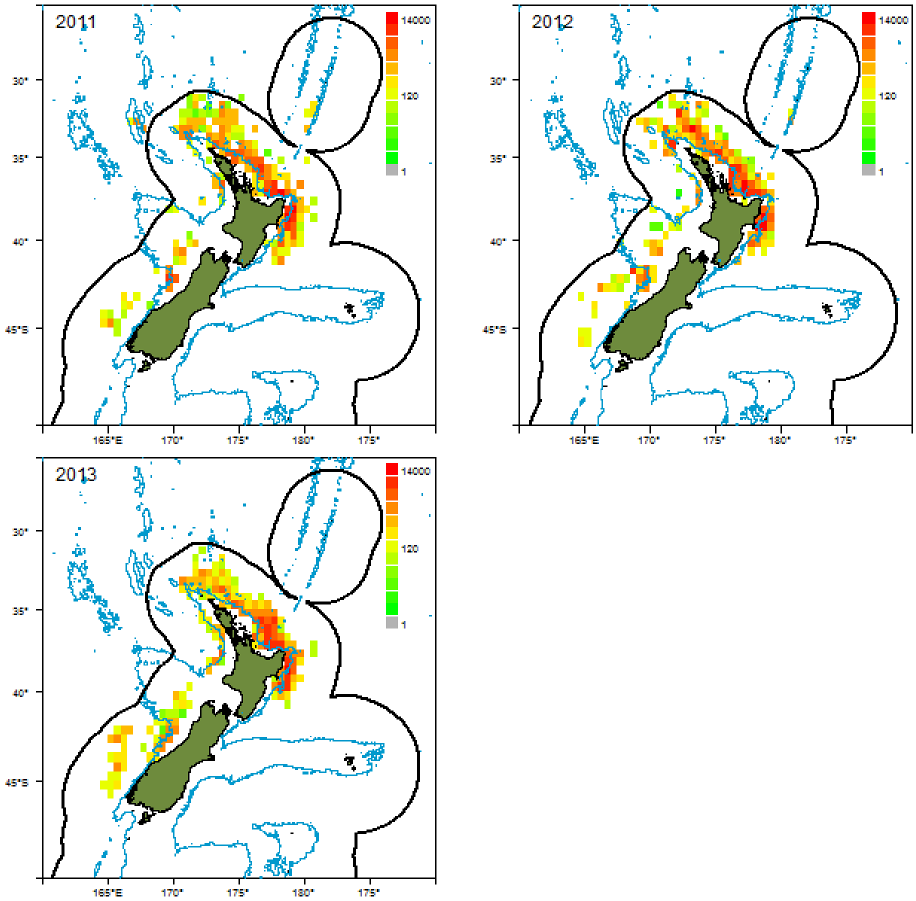


Figure 2: Mako shark catches (kg) by the surface longline fishery in 0.5 degree rectangles by fishing year. Note the log scale used for the colour palette. Depth contour = 1000 m.

The majority of mako shark (55%) are caught in the bigeye tuna target surface longline fishery (Figure 3). Across all longline fisheries mako are in the top ten species by weight (3% of reported catches) (Figure 4). 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 fishery off the east coast of the North Island targets a range of species including bigeye, swordfish, and southern bluefin tuna.

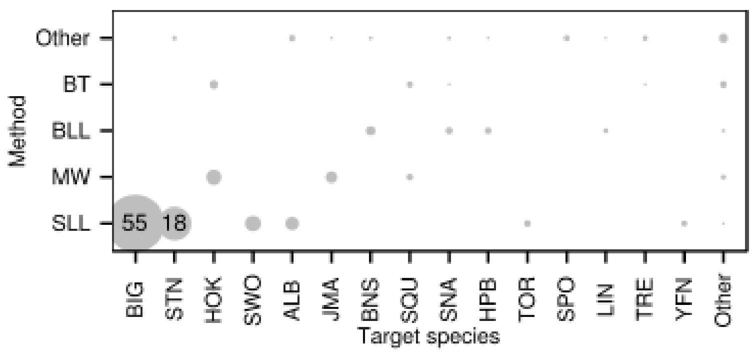


Figure 3: A summary of the proportion of landings of mako shark taken by each target fishery and fishing method for the 2012–13 fishing year. The area of each circle is proportional to the percentage of landings taken using each combination of fishing method and target species. The number in the circle is the percentage. SLL = surface longline, MW = mid-water trawl, BLL = bottom longline, BT = bottom trawl (Bentley et al 2013).

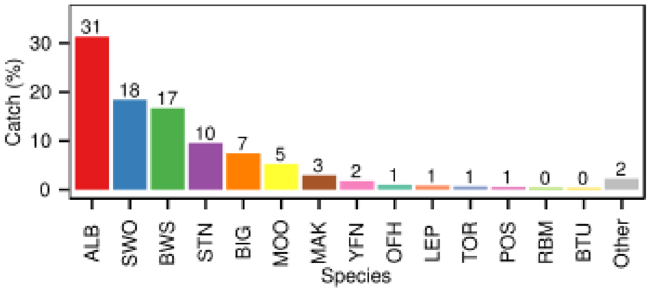


Figure 4: A summary of species composition of the reported surface longline catch for the 2012–13 fishing year. . The percentage by weight of each species is calculated for all surface longline trips (Bentley et al 2013).

Across all fleets in the longline fishery between 2006–07 and 2009–10, 73.6% of the mako sharks were alive when brought to the side of the vessel (Table 3). Between 2006–07 and 2009–10 the domestic fleet retained around 19–67% of their mako shark catch, mostly for the fins, while the foreign charter fleet retained most of the mako sharks (94–100%) (mostly for fins) (Table 4).

Table 3: Percentage of mako 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	Australia	North	82.1	17.9	28
	Charter	North	83.0	17.0	276
		South	93.1	6.9	29
	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**	**367**
2009–10	Domestic	North	76.1	23.9	330
	Total		**75.9**	**24.1**	**348**
Total all strata			73.6	26.4	1 630

Table 4: Percentage of mako 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	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**

Table 4 [Continued]

Year	Fleet	% retained or finned	% discarded or lost	Number
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
Total all strata		57.3	42.7	1 673

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 while targeting other species. Reported catch has declined since the mid 1990s. Fishing clubs affiliated to the New Zealand Sports Fishing Council have reported landing 24 mako sharks in 2015–16. In addition recreational fishers tag and release 300 to 550 mako sharks per season. Using NZ Sports Fishing Council records only, it is estimated that 96% of mako sharks caught by recreational fishers associated with sport fishing clubs were tagged and released in 2015–16.

1.3 Customary non-commercial fisheries

There are no estimates of Maori customary catch of mako sharks. Traditionally, mako 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.

1.4 Illegal catch

There is no known illegal 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. 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 fork length (Figure 5) and female mako mature at about 275–285 cm FL (Figure 6) (Francis & Duffy 2005). 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 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, and 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. 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.

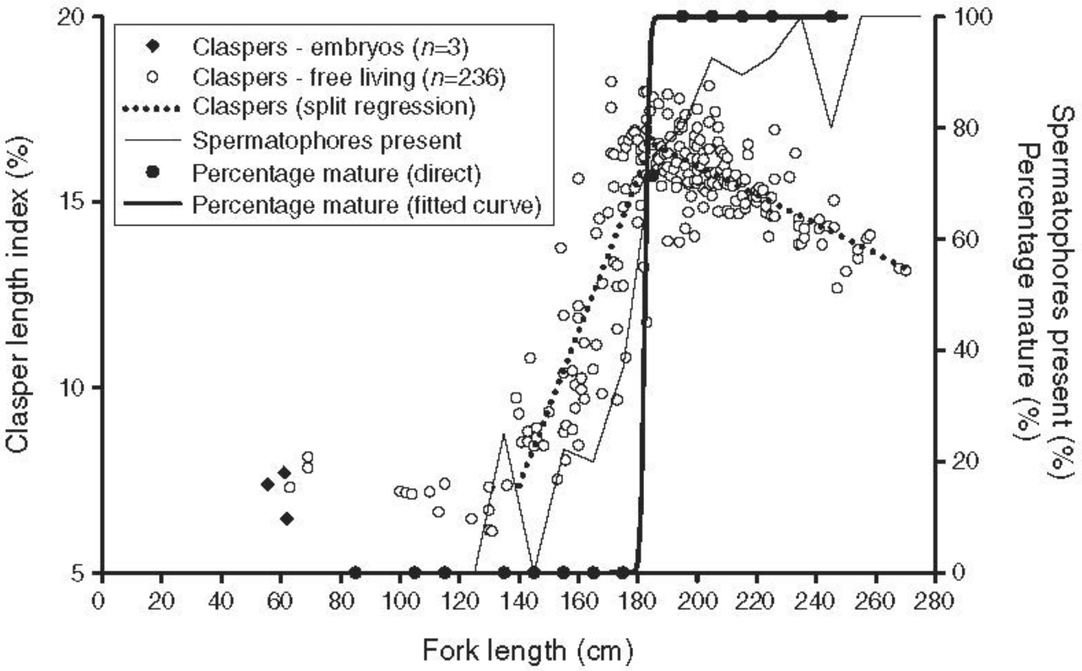


Figure 5: Maturation of male shortfin mako sharks (*Isurus oxyrinchus*): variation in clasper development, presence of spermatophores in the reproductive tract, and direct maturity estimation determined from a suite of maturity indicators (Francis & Duffy 2005).

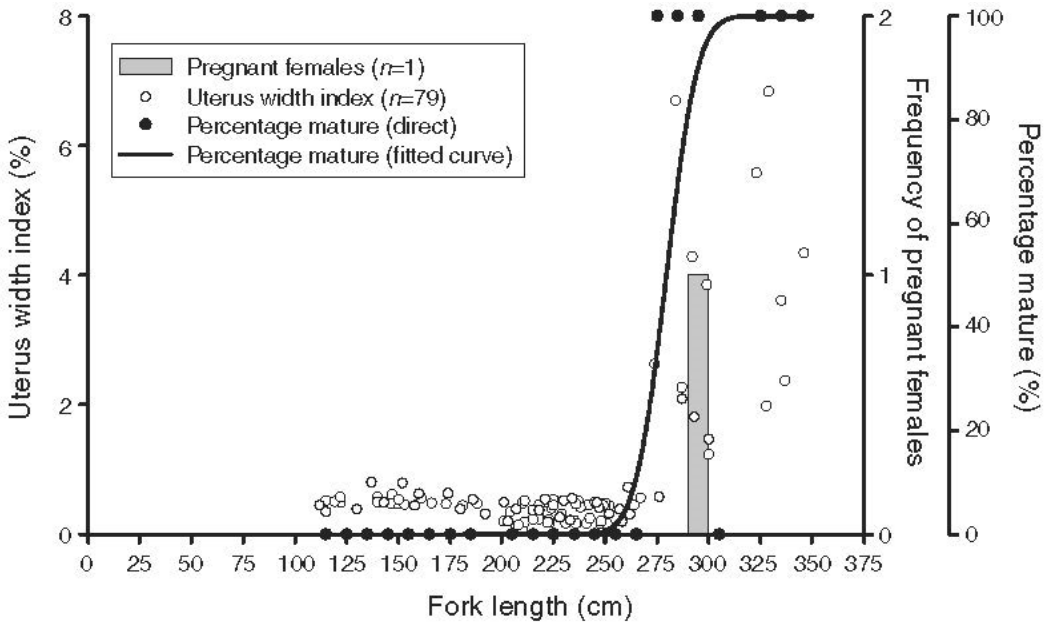


Figure 6: Maturation of female shortfin mako sharks (*Isurus oxyrinchus*): variation in uterus width index, and direct maturity estimation from a suite of maturity indicators. The only pregnant female recorded from New Zealand waters is also indicated (Francis & Duffy 2005).

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(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

Up to June 2015, 14 831 mako sharks had been tagged and released in New Zealand waters and 370 recaptured. 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. Most recaptures have been within 500 km of the release site, 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 are frequent, with mako sharks travelling to eastern 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). Electronic tagging of five juvenile mako sharks aged about 4−8 years showed relatively high site fidelity, with all five sharks remaining in the NZ EEZ for many months. Four of the five sharks showed an offshore movement in winter, with three sharks travelling up the Kermadec Ridge and one to Fiji before all 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). 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 hammerhead fisheries.

4.1 Role in the ecosystem

Mako sharks (*Isurus oxyrinchus*) are active pelagic predators of other sharks and bony fishes, and to a lesser extent squid (Griggs et al 2007).

4.2 Benthic interactions
N/A

4.3 Key environmental and ecosystem information gaps
Cryptic mortality is unknown at present.

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

5. STOCK ASSESSMENT

With the establishment of the WCPFC in 2004, future stock assessments of the western and central Pacific Ocean stock of mako shark 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 mako sharks will not be a focus of that plan in the near future.

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. Indicator analyses (Figure 7 and 8) 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 (Griggs & Baird 2013), and declines in annual landings since a peak in 2000–01 for mako sharks. 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.

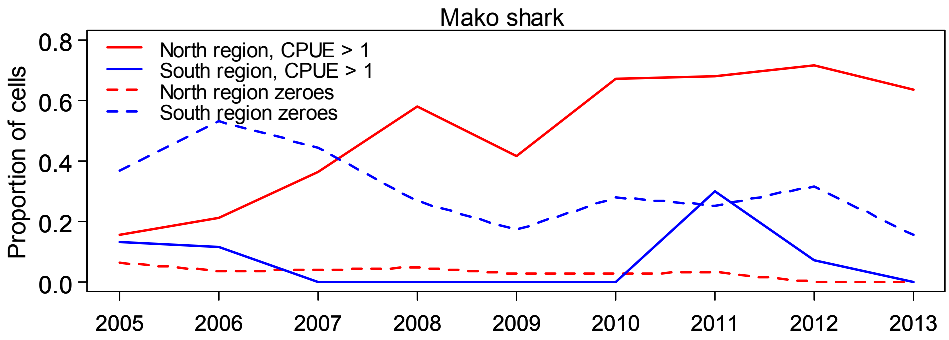


Figure 7: Mako shark distribution indicators. Proportions of 0.5 degree rectangles having CPUE greater than 1 per 1000 hooks, and proportions of rectangles having zero catches, for North and South regions by fishing year, based on estimated catches (processed and discarded combined) reported on TLCERs.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

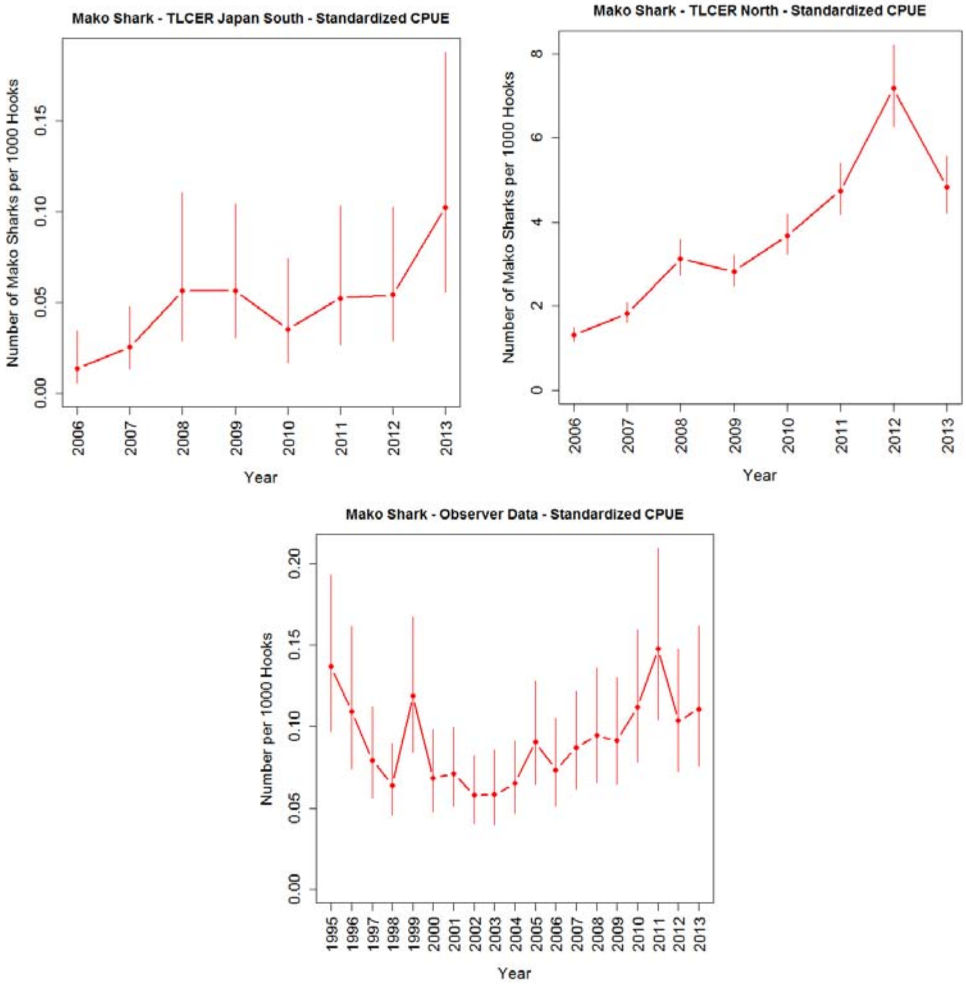


Figure 8: Standardised CPUE indices for commercial TLCER (Japan South and North) and observer datasets (all New Zealand).

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. Source: Francis et al (2014).

		North region			South region		
Indicator class	Indicator	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, as the ability of the population to replace sharks removed by fishing is very limited.

Observer records show that few mako sharks were observed in the South and there were no discernible difference between males and females (Figure 9). There were more males than females, especially in South region (FMAs 5 and 7). With mean length of maturity of 182.5 cm FL for males and 280 cm fork length for females (Francis & Duffy 2005), most mako sharks were immature (85.1% of males and 100.0% of females, overall) (Griggs & Baird 2013).

A data informed qualitative risk assessment was completed on all chondrichthyans (sharks, skates, rays and chimaeras) at the New Zealand scale in 2014 (Ford et al 2015). 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 was available on adult stock size.

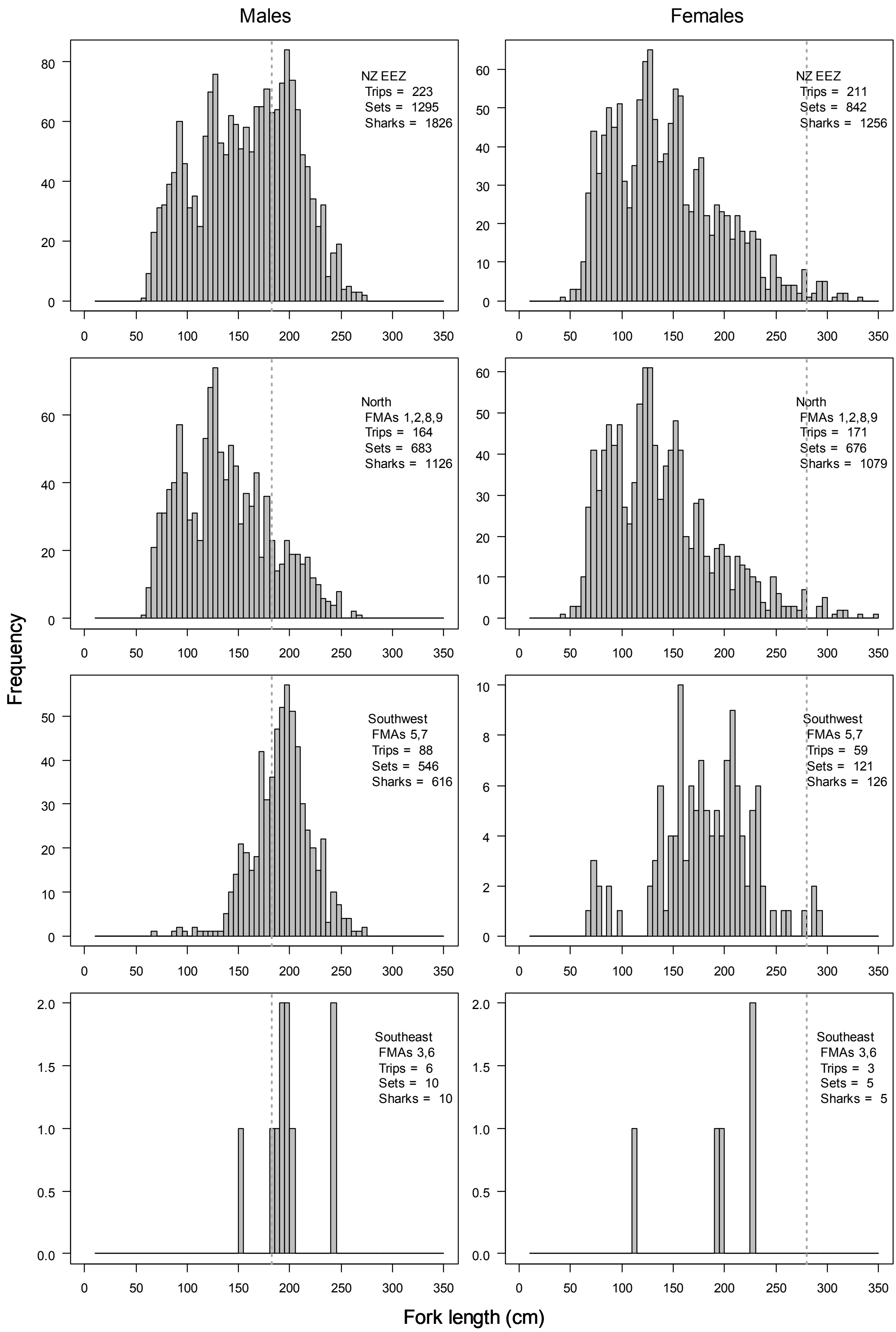


Figure 9: Length-frequency distributions of male and female mako sharks measured by observers aboard surface longline vessels between 1993 and 2012 for the New Zealand EEZ, and North, Southwest and Southeast regions. The dashed vertical lines indicate the median length at maturity. Francis (2013).

6. STATUS OF THE STOCK

Stock structure assumptions

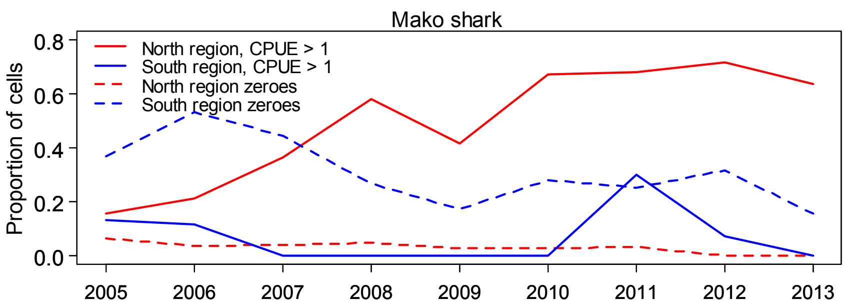
MAK 1 is assumed to be part of the wider South Western Pacific Ocean stock. However, there is no stock assessment for this wider stock. The results below are from indicator analyses of the New Zealand component of that stock only.

Stock Status	
Year of Most Recent Assessment	2014
Assessment Runs Presented	Indicator analyses for NZ EEZ only
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

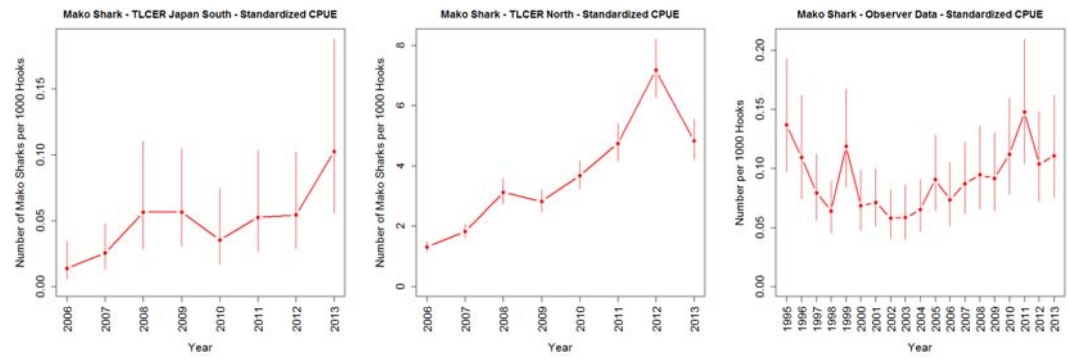
Historical Stock Status Trajectory and Current Status

Summary of trends identified in abundance indicators since the 2005 fishing year based on both TLCER and observer data sets. North region comprises Fisheries Management Areas (FMAs) 1, 2, 8, and 9, and South region comprises FMAs 5 and 7.

		North region			South region		
Indicator class	Indicator	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



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



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

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Appears to be increasing
Recent Trend in Fishing Intensity or Proxy	Appears to be decreasing
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 44–103 t between 2005–06 and 2014–15,

Projections and Prognosis		
Stock Projections or Prognosis	The stock is likely to increase if effort remains at current 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: 2014	Next assessment: Unknown
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Distribution - Species composition - Size and sex ratio - Catch per unit effort	1 – High quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	Catch recording before 2005 may not be accurate	
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, 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.

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 No. 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.

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.

Ford, R; Galland, A; Clark, M; Crozier, P; Duffy, C A; Dunn, M; Francis, M; Wells, R (2015) Qualitative (Level 1) Risk Assessment of the impact of commercial fishing on New Zealand Chondrichthyans. *New Zealand Aquatic Environment and Biodiversity Report No. 157***.** 111 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 (2013) Commercial catch composition of highly migratory elasmobranchs. *New Zealand Fisheries Assessment Report 2013/68*. 79 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* 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; 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.

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.

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.; Saul, P. (2014) New Zealand billfish and gamefish tagging, 2012–13. *New Zealand Fisheries Assessment Report 2014/11***.** 26 p.

Ministry for Primary Industries (2014). Aquatic Environment and Biodiversity Annual Review 2014. Compiled by the Fisheries Management Science Team, Ministry for Primary Industries, Wellington, New Zealand. 560 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.

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.

.