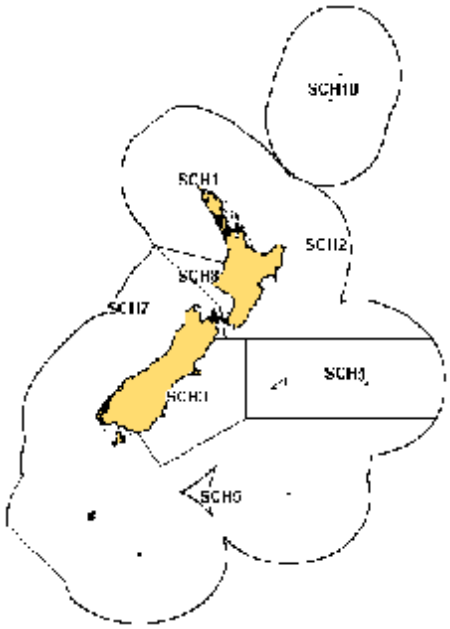
SCHOOL SHARK (SCH)

(*Galeorhinus galeus*)



1. FISHERY SUMMARY

(a) Commercial fisheries

This moderate-sized shark has supported a variety of fisheries around New Zealand from the early 1940s onwards. Landings rose steeply from the late 1970s until 1983 (Table 1), with the intensification of setnetting for this and other species, and a general decline in availability of other, previously more desirable, coastal species. However, because of the earlier discarding and under-reporting, this recorded rise in landings does not reflect an equal rise in catches. After a small decline in 1984–85, catches decreased by about 50% from 1986 onwards because of reduced quotas within the QMS (Table 2). From 1987–88 to 1991–92 total reported landings were around 2200–2500 t. In 1995–96 total landings increased markedly to 3387 t and the total TACC (3107 t) was exceeded for the first time. Landings have remained around the TACC level since 1995–96. TACCs for SCH 3, 5, 7 & 8 were increased by between 5% (SCH 5) and 20% (the remainder) under AMP management in October 2004.

Table 1: Reported domestic landings (t) of school shark from 1948 to 1983.

Year	Landings	Year	Landings	Year	Landings	Year	Landings
1948	75	1957	301	1966	316	1975	518
1949	124	1958	323	1967	376	1976	914
1950	147	1959	304	1968	360	1977	1 231
1951	157	1960	308	1969	390	1978	161
1952	179	1961	362	1970	450	1979	481
1953	142	1962	354	1971	597	1980	1 788
1954	185	1963	380	1972	335	1981	2 716
1955	180	1964	342	1973	400	1982	2 965
1956	164	1965	359	1974	459	1983	3 918

Source: MAF data.

During the period of high landings in the mid 1980s set netting was the main method, providing about half the total catch, with lining one-third, and trawling the remainder. There were large regional variations.

Earlier data on landings by method are not available. Data since the introduction of CELRs in 1988–89 are generally incomplete, biased and the catch-by-method of bycatch species (including school shark in many fisheries) is not fully recorded – however, these data have been analysed to provide a characterisation of the school shark fisheries (Paul and Saunders, 2000).

School shark are also caught by the foreign licensed fleet of tuna longliners fishing offshore in the EEZ to well beyond the shelf edge and above 4000 m bottom depths. The catch is probably small but cannot be quantified.

Table 2: Reported landings (t) of school shark by Fishstock from 1983–84 to 2004–05 and actual TACCs (t) from 1986–87 to 2004–05.

Fishstock	SCH 1		SCH 2		SCH 3		SCH 4		SCH 5	
FMA (s)	1 & 9		2		3		4		5 & 6	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1983–84*	1087	–	298	–	630	–	8	–	792	–
1984–85*	861	–	237	–	505	–	12	–	995	–
1985–86*	787	–	214	–	370	–	23	–	647	–
1986–87†	418	560	137	160	283	270	19	200	382	610
1987–88†	530	604	123	168	320	289	22	200	529	613
1988–89†	483	624	134	188	222	294	25	200	494	615
1989–90†	585	652	154	197	272	305	27	235	450	635
1990–91†	559	664	139	198	227	318	21	239	480	649
1991–92†	596	664	161	198	264	318	34	239	612	686
1992–93†	820	664	202	199	220	320	38	239	593	686
1993–94†	658	667	156	199	202	322	41	239	624	686
1994–95†	658	668	159	199	237	322	86	239	656	694
1995–96†	804	668	212	199	296	322	229	239	690	694
1996–97†	793	668	228	199	290	322	179	239	662	694
1997–98†	764	668	214	199	270	322	127	239	623	694
1998–99†	783	668	275	199	331	322	100	239	714	694
1999–00†	820	668	250	199	341	322	97	239	706	694
2000–01†	799	668	178	199	364	322	100	239	724	694
2001–02†	691	668	208	199	324	322	93	239	673	708
2002–03†	689	668	225	199	410	322	130	239	746	708
2003–04†	758	668	187	199	323	322	149	239	727	708
2004–05†	694	668	202	199	424	387	206	239	743	743

Fishstock	SCH 7		SCH 8		SCH 10			
FMA (s)	7		8		10		Total	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings§	TACC
1983–84*	1 039	–	694	–	0	–	4 776	–
1984–85*	1 030	–	698	–	0	–	4 501	–
1985–86*	851	–	652	–	0	–	3 717	–
1986–87†	454	470	229	310	0	10	1 946	2 590
1987–88†	515	500	374	345	0	10	2 367	2 729
1988–89†	532	522	419	433	0	10	2 309	2 886
1989–90†	516	524	371	438	0	10	2 377	2 996
1990–91†	420	531	369	441	0	10	2 215	3 050
1991–92†	431	531	409	441	0	10	2 508	3 086
1992–93†	482	531	484	441	0	10	2 839	3 089
1993–94†	473	531	448	441	0	10	2 603	3 093
1994–95†	370	534	417	441	0	10	2 583	3 105
1995–96†	635	534	521	441	0	10	3 387	3 107
1995–96†	542	534	459	441	0	10	3 153	3 107
1997–98†	471	534	447	441	0	10	2 917	3 107
1998–99†	681	534	533	441	0	10	3 421	3 107
1999–00†	639	534	469	441	0	10	3 324	3 107
2000–01†	576	534	453	441	0	10	3 193	3 107
2001–02†	501	534	449	441	0	10	2 913	3 121
2002–03†	512	534	448	441	0	10	3 161	3 121
2003–04†	574	534	405	441	0	10	3 124	3 121
2004–05†	546	641	554	529	0	10	3 369	3 416

* FSU data.
† QMS data.
§ Includes landings from unknown areas before 1986–87.

(b) Recreational fisheries

Although the school shark is a listed gamefish and is regularly caught by recreational fishers, it is not considered to be a particularly desirable target species at the present time. Recreational catch records have been obtained from diary surveys undertaken in 1991–94, 1996 and 1999/2000 (Tables 3 and 4). The most recent nationwide recreational survey was undertaken in 2001, but the results are still under review and are not currently available.

A key component of the estimating recreational harvest from diary surveys is determining the proportion of the population that fish. The Recreational Working Group has concluded that the methodological framework used for telephone interviews produced incorrect eligibility figures for the 1996 and previous surveys. Consequently the harvest estimates derived from these surveys are considered to be considerably underestimated and not reliable. However relative comparisons can be made between stocks within these surveys. The Recreational Working Group considered that the 2000 survey using face-to-face interviews better estimated eligibility and that the derived recreational harvest estimates are believed to be more accurate. FMA2 catches are nevertheless considered to be over-estimate, probably because of an unrepresentative diarist sample. The 1999/2000 Harvest estimates for each Fishstock should be evaluated with reference to the coefficient of variation.

Recreational harvest estimates obtained for school shark stocks during the 1999/2000 survey ranged from <1% to 14% of the commercial catch in the respective QMAs over the same period. Disproportionately low numbers of tag returns from recreational fishers confirm that they are a minor source of school shark fishing mortality.

Table 3: Estimated number and weight of school sharks harvested by recreational fishers relative to Fishstock and survey. Surveys were carried out in different years in the Ministry of Fisheries regions: South in 1991–92, Central in 1992–93 and North in 1993–94 (Teirney et al., 1997).

			Total	
Fishstock	**Survey**	**Number**	**c.v.(%)**	**Survey harvest (t)**
SCH 1	North	17 000	24	10–170
SCH 1	Central	1 000	–	0–10
SCH 2	Central	13 000	27	25–45
SCH 3	South	6 000	33	15–35
SCH 5	South	1 000	–	0–10
SCH 7	Central	9 000	84	10–35
SCH 7	South	3 000	–	5–15
SCH 8	Central	7 000	45	10–30

Table 4: Estimates of annual number and weight of school shark harvested by recreational fishers from national diary surveys in 1996 (Bradford, 1998) and Dec1999-Nov 2000 (Boyd and Reilly 2005). The mean weights used to convert numbers to catch weight are considered the best available estimates. Estimated harvest is also presented as a range to reflect the uncertainty in the point estimates.

Fishstock	**Number caught**	**c.v. (%)**	**Estimated harvest range(t)**	**Point estimate (t)**
1996				
SCH 1	23 000	17	35–55	46
SCH 2	5 000	–	–	–
SCH 3	3 000	–	–	–
SCH 5	1 000	–	–	–
SCH 7	8 000	24	5–25	16
SCH 8	11 000	22	15–25	21
1999/2000				
SCH 1	27 000	42	38-93	66
SCH 2	7 000	30	13-24	18
SCH 3	19 000	46	26-70	48
SCH 5	3 000	66	2-11	7
SCH 7	23 000	56	26-91	58
SCH 8	3 000	55	4-13	8

(c) Maori customary fisheries

Maori fishers made extensive use of school shark in pre-European times for food, oil, and skin. There is no quantitative information on the current level of Maori customary take.

(d) Illegal catch

There is no quantifiable information on the level of illegal catch. There is an unknown amount of unreported offshore trawl and pelagic longline catch of school shark, either landed (under another name, or in "mixed") or discarded.

(e) Other sources of mortality

There is an unknown discarded bycatch of juvenile, mainly first-year, school shark taken in harbour and bay setnets. Quantitative information is not available on the level of other sources of mortality.

2. BIOLOGY

School sharks are distributed across the shelf, generally being inshore in summer and offshore in winter. They extend in smaller numbers near the seafloor down the upper continental slope, to at least 600 m. The capture of school sharks by tuna longliners shows that their distribution extends well offshore, up to 180 nm off the South Island, and 400 nm off northern New Zealand towards the Kermadec Islands. They feed predominantly on small fish and cephalopods (octopus and squid).

Growth rates have not been estimated for New Zealand fish, but in Australia and South America school sharks are slow growing and long-lived (Grant et al., 1979; Olsen, 1984; Peres and Vooren, 1991). They are difficult to age by conventional methods, but up to 45 vertebral rings can be counted. Growth is fastest for the first few years, slows appreciably between 5 and 15 years, and is negligible at older ages, particularly after 20. Results from an Australian long-term tag recovery suggest a maximum age of at least 50 years. Age at maturity has been estimated at 12–17 years for males and 13 to 15 years for females (Francis and Mulligan, 1998). The size range of commercially caught maturing and adult school shark is 90–170 cm total length (TL), with a broad mode at 110–130 cm TL, which varies with area, season and depth.

Breeding is not annual; it has generally been assumed to be biennial, but recent work on a Brazilian stock suggests that females have a 3-year cycle (Peres and Vooren, 1991). Fecundity (pup number) increases from 5–10 in small females to over 40 in the largest. Mating is believed to occur in deep water, probably in winter. Release of pups occurs during spring and early summer (November-January), apparently earlier in the north of the country than in the south. Nursery grounds include harbours, shallow bays and sheltered coasts. The pups remain in the shallow nursery grounds during their first one or two years and subsequently disperse across the shelf. The geographic location of the most important pupping and nursery grounds in New Zealand is not known.

The combination of late maturity, slow growth, and low fecundity gives a low overall productivity. In Australia, M has been estimated as 0.1.

New Zealand tagging studies have shown that school shark may move considerable distances, including trans-Tasman migrations (for details see the 1995 Plenary Report).

Biological parameters relevant to stock assessment are shown in Table 5.

Table 5: Estimates of biological parameters for school shark.

Fishstock	Estimate		Source
1. Weight = a (length)^b (Weight in g, length in cm fork length)			
	Both sexes combined		
SCH 1	a = 0.0003	b = 3.58	McGregor (unpubl.)
SCH 3	a = 0.0035	b = 3.08	McGregor (unpubl.)
SCH 5	a = 0.0181	b = 2.72	McGregor (unpubl.)
SCH 5	a = 0.0068	b = 2.94	Hurst et al. 1990
SCH 7	a = 0.0061	b = 2.94	Blackwell (unpubl.)
SCH 8	a = 0.0104	b = 2.84	Blackwell (unpubl.)
2. Estimate of M for Australia			
	M = 0.1		Grant et al. (1979), Olsen (1984)

3. STOCKS AND AREAS

Although tagged fish movements suggest that there is a single biological stock, there are no definitive data on which to base changes to the stock boundaries used in previous assessment documents. The majority of recaptures have been within the same QMA. Stock boundaries are based on these QMAs, and are essentially in place to prevent localised depletion.

4. STOCK ASSESSMENT

There are no new data which would alter the yield estimates given in the 1996 Plenary Report. The yield estimates are based on commercial landings data.

(a) Estimates of fishery parameters and abundance

Standardization of by-catch (trawl, set-net and line, Ayers *et al.* 2004) and target (set-net, see section on AMP analysis) school shark CPUE produced indices that were flat or declining around the North Island and flat or increasing around the South Island. Although abundance of South Island fish stocks appears to have increased, this could have been to due to southward displacement of North Island fish.

(b) Biomass estimates

Estimates of current and reference biomass are not available.

(c) Estimation of Maximum Constant Yield (MCY)

(i) North and South Islands (all areas except SCH 4 and SCH 5)

MCY was estimated using the equation, MCY = cY_{av} (Method 4). Y_{av} was the average of reported domestic catches from 1955 to 1975 (360 t). This represents a relatively stable period of landings and (to a lesser extent) effort, when the fishery was probably largely under-developed. The species was landed by both line and trawl. The proportion of the fish taken as bycatch by the latter method being landed probably increased with time as its value increased. The fishery increased in size, and effort by lines and nets increased substantially, during the period from 1980 to 1983.

The value of c was set at 0.9, based on an Australian estimate of M = 0.1, and because variability in year class strength is probably low because of low fecundity.

MCY = 0.9 * 360 t = 324 t (rounded to 325 t)

The estimate of MCY has not changed since the 1989 Plenary Report.

The level of risk to the stock of harvesting at the MCY value cannot be determined.

(ii) Chatham Rise (SCH 4)

Because the fishery has been largely unexploited, MCY cannot be estimated.

(iii) Southland+Subantarctic area (SCH 5)

MCY was not estimated because the pattern of exploitation on the stock is not known and catches have been constrained by the TACC.

(d) Estimation of Current Annual Yield (CAY)

Current biomass cannot be estimated, so CAY cannot be determined.

Yield estimates are summarised in Table 6.

Table 6: Yield estimates (t).

Parameter	Fishstock	Estimate
MCY	All except SCH 4 and 5	325
CAY	All	Cannot be determined

(e) Other yield estimates and stock assessment results

No information is available.

(f) Other factors

In Australia, recruitment overfishing has occurred to such an extent that the stock is considered seriously threatened and harsh management measures are being imposed. The Australian modelling work indicates that the cumulative removal of the largest, highly fecund females has produced a situation where, although the faster-growing young adults are still being caught in moderate (but declining) numbers, a stock collapse is very probable. A long period (decades) at a very low fishing level seems necessary for stock rebuilding.

The most important conclusion from this for New Zealand is that fishing pressure on large mature females should be minimised to maintain the productivity of this species.

5. ANALYSIS OF ADAPTIVE MANAGEMENT PROGRAMMES (AMP)

The Ministry of Fisheries revised the AMP framework in December 2000. The AMP framework is intended to apply to all proposals for a TAC or TACC increase, with the exception of fisheries for which there is a robust stock assessment. In March 2002, the first meeting of the new Adaptive Management Programme Working Group was held. Two changes to the AMP were adopted:

- a new checklist was implemented with more attention being made to the environmental impacts of any new proposal
- the annual review process was replaced with an annual review of the monitoring requirements only. Full analysis of information is required a minimum of twice during the 5 year AMP.

SCH 3

The SCH 3 TACC was increased from 322t to 387t under an AMP on 1 October 2004.

Annual Review of SCH 3 AMP in 2006

In 2006 the AMP FAWG reviewed the performance of the logbook monitoring programme (Lydon et al. 2006a) after one year of the current 5-year term. The WG noted:

- Approximately 38% of the SCH 3 annual catch is taken by set-net, with most of the remainder caught by bottom trawl.
- About 16% of the setnet catch in 2004/05 was covered by logbook returns.
- Despite the fact that 903 tows were covered by logbooks in 2004/05, only 34 SCH were measured. The main reason for this is that most of the trawled SCH are caught by vessels targeting RCO and BAR, while the trawlers currently participating in the logbook programme primarily target FLA.
- If this AMP is to succeed it is imperative that vessels targeting RCO and BAR participate in the programme.

SCH 5

The SCH 5 TACC was increased from 708t to 743t under an AMP on 1 October 2004.

Annual Review of SCH 5 AMP in 2006

In 2006 the AMP FAWG reviewed the performance of the logbook monitoring programme (Lydon et al. 2006a) after one year of the current 5-year term. The WG noted:

- Approximately 88% of the SCH 5 annual catch is taken by set-net, with most of the remainder caught by bottom trawl.
- About 10% of the setnet catch in 2004/05 was covered by logbook returns.
- Despite the fact that 38 tows were covered by logbooks in 2004/05, no SCH were measured. As with SCH 3, the reason for this is that vessels targeting RCO and BAR are not currently participating in the logbook programme.
- Logbook coverage by both setnet and bottom trawl fisheries should be substantially improved.

SCH 7

The SCH 7 TACC was increased from 534t to 641t under an AMP on 1 October 2004.

Annual Review of SCH 7 AMP in 2006

In 2006 the AMP FAWG reviewed the performance of the logbook monitoring programme (Lydon et al. 2006b) after one year of the current 5-year term. The WG noted:

- A total 21 vessels participated in the SCH 7 logbook programme.
- Target levels of logbook coverage are based on effort i.e. 30% of all trawls in the trawl fishery and 30% of sets in the setnet fishery.
- Given the extent of the analysis required to estimate levels of effort coverage this would only be required at medium term and full-term reviews.
- Proportion of catch covered by the programme could be used as a surrogate during annual reviews. 19% of the SCH 7 catch was sampled in 2004/05, but this is likely to be an underestimate since the logbook catch is an estimated quantity while the total catch is green weight reported to the MHR.
- Sampling appears to be adequate.

SCH 8

The SCH 8 TACC was increased from 441t to 529t under an AMP on 1 October 2004.

Annual Review of SCH 8 AMP in 2006

In 2006 the AMP FAWG reviewed the performance of the logbook monitoring programme (Lydon et al. 2006b) after one year of the current 5-year term. The WG noted:

- A total 10 vessels participated in the SCH 7 logbook programme
- Target levels of logbook coverage are based on effort i.e. 30% of all shots in the linefishery and 30% of sets in the setnet fishery.
- Given the extent of the analysis required to estimate levels of effort coverage this would only be required at medium term and full-term reviews.
- Proportion of catch covered by the programme would be used as a surrogate during annual reviews. 31% of the SCH 8 catch was sampled in 2004/05, but this is likely to be an underestimate since the logbook catch is an estimated quantity while the total catch is green weight reported to the MHR.
- Sampling appears to be adequate.

6. STATUS OF THE STOCKS

Estimates of current absolute biomass are not available.

School shark TACs were originally set at half the 1983 catch because of apparently declining catch rates and concern about the undoubtedly low productivity of the species. However, catches and actual TACCs have steadily increased since 1986–87. It is not known whether recent catch levels or the

current TACCs are sustainable, or if they are at levels that will allow the stocks to move towards a size that will support the maximum sustainable yield.

Summary of yield estimates (t), TACCs (t) and reported landings (t) of school shark for the most recent fishing year.

Fishstock	QMA		MCY Estimates	2004–05 Actual TACC	2004–05 Reported Landings
SCH 1	Auckland (East) (West)	1 & 9		668	694
SCH 2	Central (East)	2		199	202
SCH 3	South-east (Coast)	3		387	424
SCH 4	South-east (Chatham)	4		239	206
SCH 5	Southland and Subantarctic	5 & 6		743	743
SCH 7	Challenger	7		641	546
SCH 8	Central (West)	8		529	554
SCH 10	Kermadec	10		10	0
Total				3 416	3 369

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