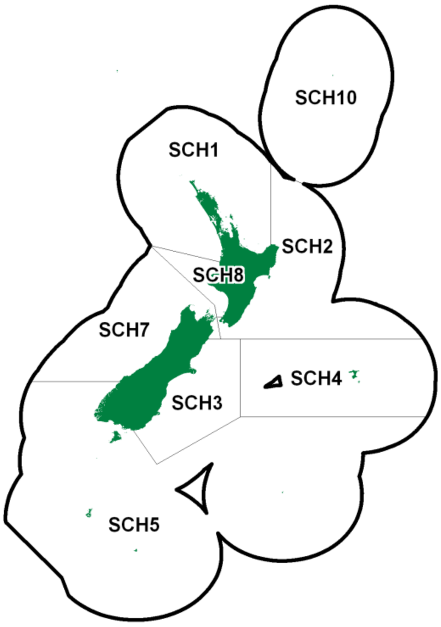
SCHOOL SHARK (SCH)

(*Galeorhinus galeus*)
Tupere, Tope, Makohuarau



1. FISHERY SUMMARY

School shark was introduced into the QMS on 1 October 1986. The recreational, customary, and other mortality allowances as well as TACCs and TACs applicable from the fishing year 2018–19 are shown in Table 1.

Table 1: Recreational and Customary non-commercial allowances, TACCs, and TACs for school shark by Fishstock.

Fish Stock	Recreational allowance	Customary non-commercial allowance	Other sources of mortality	TACC	TAC
SCH 1	68	102	34	689.0	893.0
SCH 2	–	–	–	198.6	198.6
SCH 3	48	48	19	387.0	502.0
SCH 4	–	–	–	238.5	238.5
SCH 5	7	7	37	743.0	794.0
SCH 7	58	58	32	641.0	789.0
SCH 8	21	21	26	529.0	597.0
SCH 10	–	–	–	10.0	10.0

1.1 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 2), with the intensification of setnets targeting this and other shark species, and a general decline in availability of other, previously more desirable, coastal species. However, because of earlier discarding and under-reporting, this recorded rise in landings did not reflect an equivalent rise in catches. Landings decreased by about 50% from 1986 onwards because quotas were set below previous catch levels when this species was introduced into the QMS (Table 3). From 1987–88 to 1991–92 total reported landings were around 2200–2500 t annually. In 1995–96, total landings increased to above the level of the TACC (3106 t) to 3412 t, exceeding the TACC for the first time. Total landings remained near the level of the TACC from 1995–96 to 2012–13, decreasing slightly thereafter with 2613 t landed in 2019–20.

TACCs were increased by 5% for SCH 5, and 20% for SCH 3, 7, & 8 under AMP management in October 2004. From 1 October 2007, the TACC for SCH 1 was increased to 689 t, also setting a TAC for the first time at 893 t with 102 t, 68 t, and 34 t allocated to customary, recreational, and other sources of mortality respectively. In 2004, SCH 3, 5, 7, & 8 were allocated recreational and customary non-commercial allowances of 48 t, 7 t, 58 t, and 21 t, respectively, and other sources of mortality were allocated 19 t, 37 t, 32 t, and 26 t, respectively. All AMP programmes ended on 30th September 2009. School shark was added to the 6th schedule on the 1st of January 2013 which allows school shark that are alive when caught, and likely to survive, to be released. Table 2 shows total New Zealand historical (pre-1984) SCH landings by calendar year; TACCs and landings by fishing year are provided by Fishstock in Table 3 and Figure 1.

Table 2: 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: Fisheries New Zealand data.

During the period of high landings in the mid-1980s, setnetting was the main fishing method, providing about half the total catch, with lining accounting for one-third of the catch, and trawling the remainder. There were large regional variations. These proportions have shifted somewhat in more recent years, with setnets still accounting for just under 50% of the landings, and bottom longline and bottom trawl approximately splitting the remaining 50%. Small amounts of school shark are also caught by the foreign charter tuna longliners fishing offshore in the EEZ to well beyond the shelf edge.

The Banks Peninsula Marine Mammal Sanctuary was established in 1988 by the Department of Conservation under the Marine Mammal Protection Act 1978, for the purpose of protecting Hector’s dolphins. The sanctuary extends 4 nautical miles from the coast from Sumner Head in the north to the Rakaia River mouth in the south. Before 1 October 2008, no setnets were allowed within the sanctuary between 1 November and the end of February. For the remainder of the year, setnets were allowed but could only be set from an hour after sunrise to an hour before sunset, be no more than 30 metres long, with only one net per boat, and the boat was required to remain tied to the net while it was set.

Voluntary setnet closures were implemented by the Southeast Finfish Management Company (SEFMC) from 1 October 2000 to protect nursery grounds for rig and elephant fish and to reduce interactions between commercial setnets and Hector’s dolphins in shallow waters. The closed area extended from the southernmost end of the Banks Peninsula Marine Mammal Sanctuary to the northern bank of the mouth of the Waitaki River. This area was closed permanently for a distance of 1 nautical mile offshore and for 4 nautical miles offshore for the period 1 October to 31 January.

From 1 October 2008, a new suite of regulations intended to protect Māui and Hector’s dolphins was implemented for all New Zealand by the Minister of Fisheries.

For SCH 1, setnet fishing was closed from Maunganui Bluff to Pariokariwa Point for a distance of 4 nautical miles on 1 October 2003. This closure was extended by the Minister to 7 nautical miles on 1 October 2008. An appeal was made by affected fishers who were granted interim relief by the High Court, allowing setnet fishing beyond 4 nautical miles during daylight hours between 1 October and 24 December during three consecutive years: 2008–2010.

For SCH 3, commercial and recreational setnetting was banned in most areas from 1 October 2008 to 4 nautical miles off the east coast of the South Island, extending from Cape Jackson in the Marlborough Sounds to Slope Point in the Catlins. Some exceptions were allowed, including an exemption for commercial and recreational setnetting to only 1 nautical mile offshore around the Kaikōura Canyon, and permitting setnetting in most harbours, estuaries, river mouths, lagoons, and inlets except for the Avon-Heathcote Estuary, Lyttelton Harbour, Akaroa Harbour, and Timaru Harbour. In addition, trawl gear within 2 nautical miles of shore was restricted to flatfish nets with defined low headline heights.

For SCH 5, commercial and recreational setnetting was banned in most areas from 1 October 2008 to 4 nautical miles offshore, extending from Slope Point in the Catlins to Sandhill Point east of Fiordland

and in Te Waewae Bay. An exemption which permitted setnetting in harbours, estuaries, and inlets was allowed. In addition, trawl gear within 2 nautical miles of shore was restricted to flatfish nets with defined low headline heights.

For SCH 7, both commercial and recreational setnetting were banned to 2 nautical miles offshore from 1 October 2008, with the recreational closure effective for the entire year and the commercial closure restricted to 1 December to the end of February. The closed area extends from Awarua Point north of Fiordland to the tip of Cape Farewell at the top of the South Island. There is no equivalent closure in SCH 8, with the southern limit of the Māui dolphin closure beginning north of New Plymouth at Pariokariwa Point.

Table 3: Reported landings (t) of school shark by Fishstock from 1931–32 to present and actual TACCs (t) from 1986–87 to present. QMS data from 1986 to present.

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
1931–32	0	–	0	–	0	–	0	–	0	–
1932–33	0	–	0	–	0	–	0	–	0	–
1933–34	0	–	0	–	0	–	0	–	0	–
1934–35	0	–	0	–	0	–	0	–	0	–
1935–36	0	–	0	–	0	–	0	–	0	–
1936–37	0	–	0	–	0	–	0	–	0	–
1937–38	0	–	0	–	0	–	0	–	0	–
1938–39	0	–	0	–	0	–	0	–	0	–
1939–40	0	–	0	–	0	–	0	–	0	–
1940–41	0	–	0	–	0	–	0	–	0	–
1941–42	0	–	0	–	0	–	0	–	0	–
1942–43	0	–	0	–	0	–	0	–	0	–
1943–44	0	–	0	–	0	–	0	–	0	–
1944–45	0	–	0	–	0	–	0	–	0	–
1945–46	53	–	2	–	0	–	0	–	0	–
1946–47	73	–	3	–	7	–	0	–	3	–
1947–48	40	–	2	–	0	–	0	–	0	–
1948–49	48	–	3	–	0	–	0	–	0	–
1949–50	92	–	4	–	1	–	0	–	0	–
1950–51	105	–	6	–	1	–	0	–	0	–
1951–52	131	–	5	–	4	–	0	–	0	–
1952–53	144	–	7	–	5	–	0	–	0	–
1953–54	108	–	4	–	10	–	0	–	0	–
1954–55	121	–	10	–	8	–	0	–	0	–
1955–56	124	–	12	–	8	–	0	–	0	–
1956–57	92	–	19	–	5	–	0	–	0	–
1957–58	197	–	28	–	11	–	0	–	0	–
1958–59	211	–	24	–	17	–	0	–	1	–
1959–60	203	–	21	–	18	–	0	–	1	–
1960–61	219	–	19	–	23	–	0	–	1	–
1961–62	268	–	21	–	25	–	1	–	4	–
1962–63	252	–	23	–	29	–	0	–	2	–
1963–64	249	–	42	–	23	–	1	–	3	–
1964–65	186	–	51	–	30	–	1	–	1	–
1965–66	229	–	36	–	37	–	0	–	1	–
1966–67	189	–	31	–	36	–	0	–	1	–
1967–68	211	–	56	–	33	–	0	–	2	–
1968–69	195	–	57	–	41	–	0	–	4	–
1969–70	179	–	46	–	110	–	0	–	7	–
1970–71	157	–	82	–	99	–	0	–	13	–
1971–72	163	–	112	–	109	–	0	–	6	–
1972–73	136	–	59	–	30	–	0	–	3	–
1973–74	103	–	73	–	52	–	0	–	9	–
1974–75	120	–	75	–	98	–	0	–	18	–
1975–76	121	–	64	–	62	–	1	–	29	–
1976–77	389	–	88	–	54	–	0	–	70	–
1977–78	508	–	99	–	68	–	0	–	118	–
1978–79	52	–	28	–	13	–	0	–	6	–
1979–80	197	–	53	–	89	–	0	–	42	–
1980–81	690	–	127	–	295	–	2	–	229	–
1981–82	686	–	199	–	461	–	0	–	497	–
1982–83	598	–	245	–	544	–	1	–	264	–

Table 3 [continued]

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*	1 087	–	298	–	630	–	8	–	792	–
1984–85*	861	–	237	–	505	–	12	–	995	–
1985–86*	787	–	214	–	370	–	23	–	647	–
1986–87	416	560	123	162	283	270	19	120	382	610
1987–88	528	668	123	199	320	322	22	239	531	694
1988–89	477	668	136	199	220	322	26	239	501	694
1989–90	585	668	156	199	272	322	27	239	460	694
1990–91	554	668	139	199	227	322	20	239	480	694
1991–92	596	668	161	199	255	322	34	239	622	694
1992–93	819	668	202	199	216	322	38	239	594	694
1993–94	657	668	157	199	202	322	41	239	624	694
1994–95	640	668	161	199	238	322	86	239	656	694
1995–96	802	668	214	199	296	322	229	239	714	694
1996–97	791	668	228	199	290	322	179	239	662	694
1997–98	764	668	214	199	270	322	126	239	623	694
1998–99	784	668	275	199	335	322	106	239	714	694
1999–00	820	668	250	199	343	322	97	239	706	694
2000–01	799	668	178	199	364	322	100	239	724	694
2001–02	694	668	208	199	324	322	93	239	676	708
2002–03	689	668	225	199	410	322	130	239	746	708
2003–04	758	668	187	199	323	322	149	239	729	708
2004–05	695	668	201	199	424	387	206	239	743	743
2005–06	634	668	175	199	325	387	183	239	712	743
2006–07	661	668	200	199	376	387	88	239	738	743
2007–08	708	689	227	199	345	387	133	239	781	743
2008–09	713	689	232	199	364	387	145	239	741	743
2009–10	589	689	213	199	426	387	191	239	784	743
2010–11	777	689	187	199	366	387	174	239	701	743
2011–12	689	689	188	199	351	387	201	239	729	743
2012–13	602	689	200	199	320	387	127	239	748	743
2013–14	659	689	183	199	363	387	126	239	725	743
2014–15	595	689	157	199	362	387	218	239	646	743
2015–16	497	689	152	199	434	387	206	239	623	743
2016–17	530	689	138	199	339	387	238	239	696	743
2017–18	633	689	165	199	357	387	180	239	710	743
2018–19	557	689	168	199	389	387	202	238	608	743
2019–20	537	689	131	199	375	387	168	238	656	743

Fishstock	SCH 7		SCH 8		SCH 10			
FMA (s)	7		8		10		Total	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings§	TACC
1931–32	0	–	0	–	–	–	0	–
1932–33	0	–	0	–	–	–	0	–
1933–34	0	–	0	–	–	–	0	–
1934–35	0	–	0	–	–	–	0	–
1935–36	0	–	0	–	–	–	0	–
1936–37	0	–	0	–	–	–	0	–
1937–38	0	–	0	–	–	–	0	–
1938–39	0	–	0	–	–	–	0	–
1939–40	0	–	0	–	–	–	0	–
1940–41	0	–	0	–	–	–	0	–
1941–42	0	–	0	–	–	–	0	–
1942–43	0	–	0	–	–	–	0	–
1943–44	0	–	0	–	–	–	0	–
1944–45	0	–	0	–	–	–	0	–
1945–46	8	–	3	–	–	–	66	–
1946–47	16	–	3	–	–	–	105	–
1947–48	13	–	3	–	–	–	58	–
1948–49	18	–	5	–	–	–	74	–
1949–50	24	–	4	–	–	–	125	–
1950–51	29	–	6	–	–	–	147	–
1951–52	14	–	4	–	–	–	158	–
1952–53	17	–	5	–	–	–	178	–
1953–54	16	–	4	–	–	–	142	–
1954–55	36	–	10	–	–	–	185	–
1955–56	26	–	10	–	–	–	180	–
1956–57	34	–	14	–	–	–	164	–
1957–58	42	–	23	–	–	–	301	–
1958–59	41	–	29	–	–	–	323	–
1959–60	32	–	29	–	–	–	304	–
1960–61	**24**	**–**	**21**	**–**	**–**	**–**	**307**	–

Table 3 [continued]

Fishstock	SCH 7		SCH 8		SCH 10			
FMA (s)	7		8		10		Total	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings§	TACC
1961–62	26	–	15	–	–	–	360	–
1962–63	21	–	26	–	–	–	353	–
1963–64	29	–	34	–	–	–	381	–
1964–65	31	–	41	–	–	–	341	–
1965–66	26	–	30	–	–	–	359	–
1966–67	25	–	22	–	–	–	304	–
1967–68	51	–	23	–	–	–	376	–
1968–69	35	–	26	–	–	–	358	–
1969–70	28	–	20	–	–	–	390	–
1970–71	69	–	30	–	–	–	450	–
1971–72	159	–	48	–	–	–	597	–
1972–73	77	–	30	–	–	–	335	–
1973–74	75	–	42	–	–	–	354	–
1974–75	144	–	94	–	–	–	549	–
1975–76	153	–	90	–	–	–	520	–
1976–77	220	–	102	–	–	–	923	–
1977–78	280	–	164	–	–	–	1 237	–
1978–79	22	–	44	–	–	–	165	–
1979–80	94	–	44	–	–	–	519	–
1980–81	350	–	106	–	–	–	1 799	–
1981–82	480	–	393	–	–	–	2 716	–
1982–83	947	–	367	–	–	–	2 966	–
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	224	310	0	10	1 902	2 513
1987–88	516	534	374	441	0	10	2 413	3 106
1988–89	540	534	419	441	0	10	2 319	3 106
1989–90	516	534	371	441	0	10	2 387	3 106
1990–91	420	534	369	441	0	10	2 209	3 106
1991–92	431	534	409	441	0	10	2 508	3 106
1992–93	482	534	484	441	0	10	2 835	3 106
1993–94	473	534	451	441	0	10	2 605	3 106
1994–95	369	534	417	441	0	10	2 567	3 106
1995–96	636	534	521	441	0	10	3 412	3 106
1996–97	543	534	459	441	0	10	3 152	3 106
1997–98	473	534	446	441	0	10	2 917	3 106
1998–99	682	534	533	441	0	10	3 429	3 106
1999–00	639	534	469	441	0	10	3 324	3 106
2000–01	576	534	453	441	0	10	3 193	3 106
2001–02	501	534	449	441	0	10	2 946	3 120
2002–03	512	534	448	441	0	10	3 161	3 120
2003–04	574	534	405	441	0	10	3 126	3 120
2004–05	546	641	554	529	0	10	3 369	3 416
2005–06	569	641	503	529	0	10	3 100	3 416
2006–07	583	641	534	529	0	10	3 180	3 416
2007–08	606	641	497	529	0	10	3 297	3 436
2008–09	694	641	588	529	0	10	3 478	3 436
2009–10	606	641	460	529	0	10	3 269	3 436
2010–11	677	641	587	529	0	10	3 469	3 436
2011–12	612	641	506	529	0	10	3 276	3 436
2012–13	656	641	512	529	0	10	3 165	3 436
2013–14	620	641	459	529	0	10	3 135	3 436
2014–15	610	641	523	529	0	10	3 110	3 436
2015–16	552	641	458	529	0	10	2 920	3 436
2016–17	559	641	352	529	0	10	2 852	3 436
2017–18	596	641	373	529	0	10	3 014	3 436
2018–19	534	641	277	529	0	10	2 734	3 436
2019–20	510	641	236	529	0	10	2 613	3 436

* FSU data.
§ Includes landings from unknown areas before 1986–87.
Note: Data from 1931 to 1982 are based on reported landings by harbour and are likely to be underestimated as a result of under-reporting and discarding practices. Data include both foreign and domestic landings. Data were aggregated to FMA using methods and assumptions described by Francis & Paul (2013).

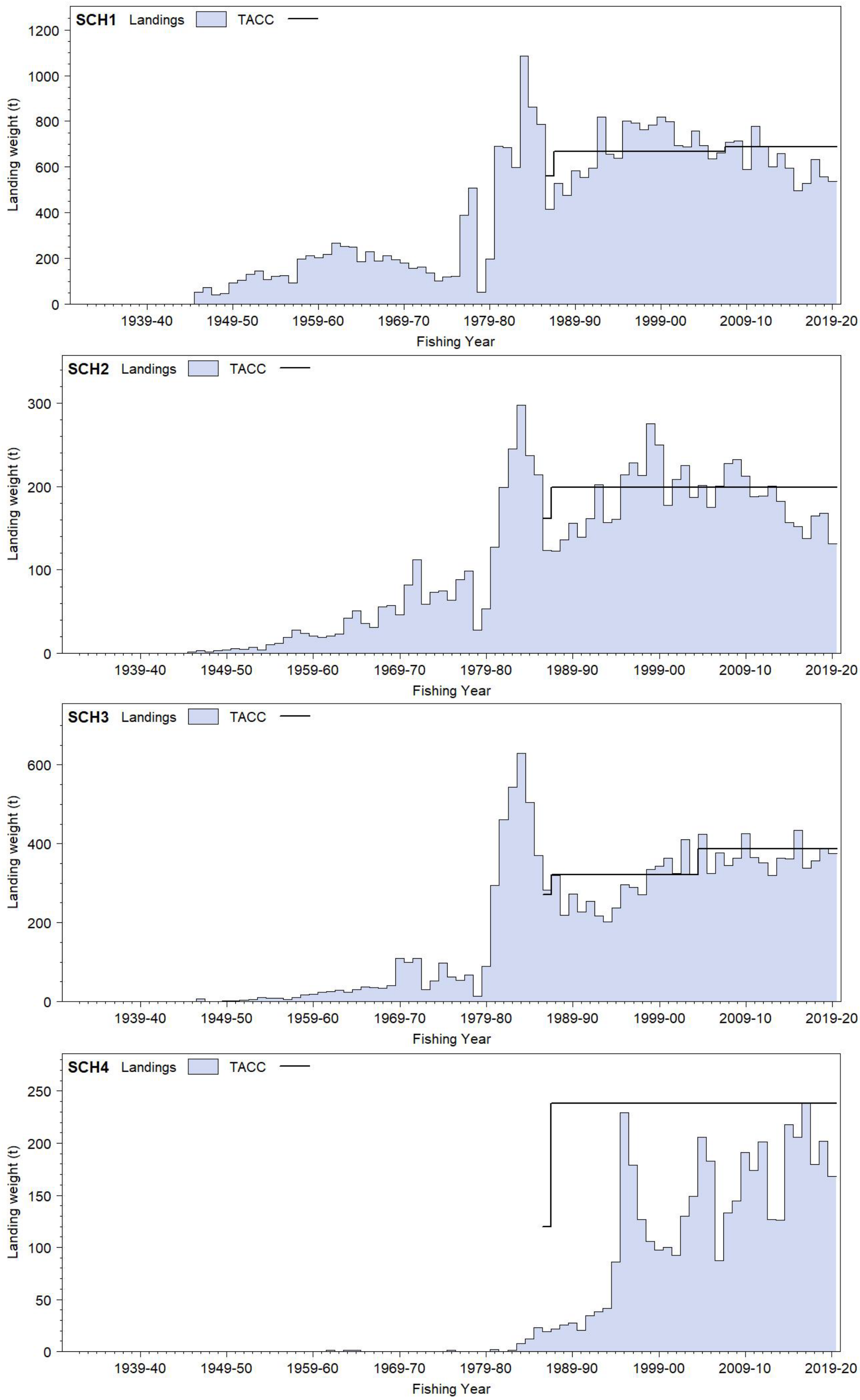


Figure 1: Reported commercial landings and TACC for the seven main SCH stocks. Above: SCH 1 (Auckland East), SCH 2 (Central East), SCH 3 (South East coast), and SCH 4 (South East Chatham Rise). [Continued on next page]

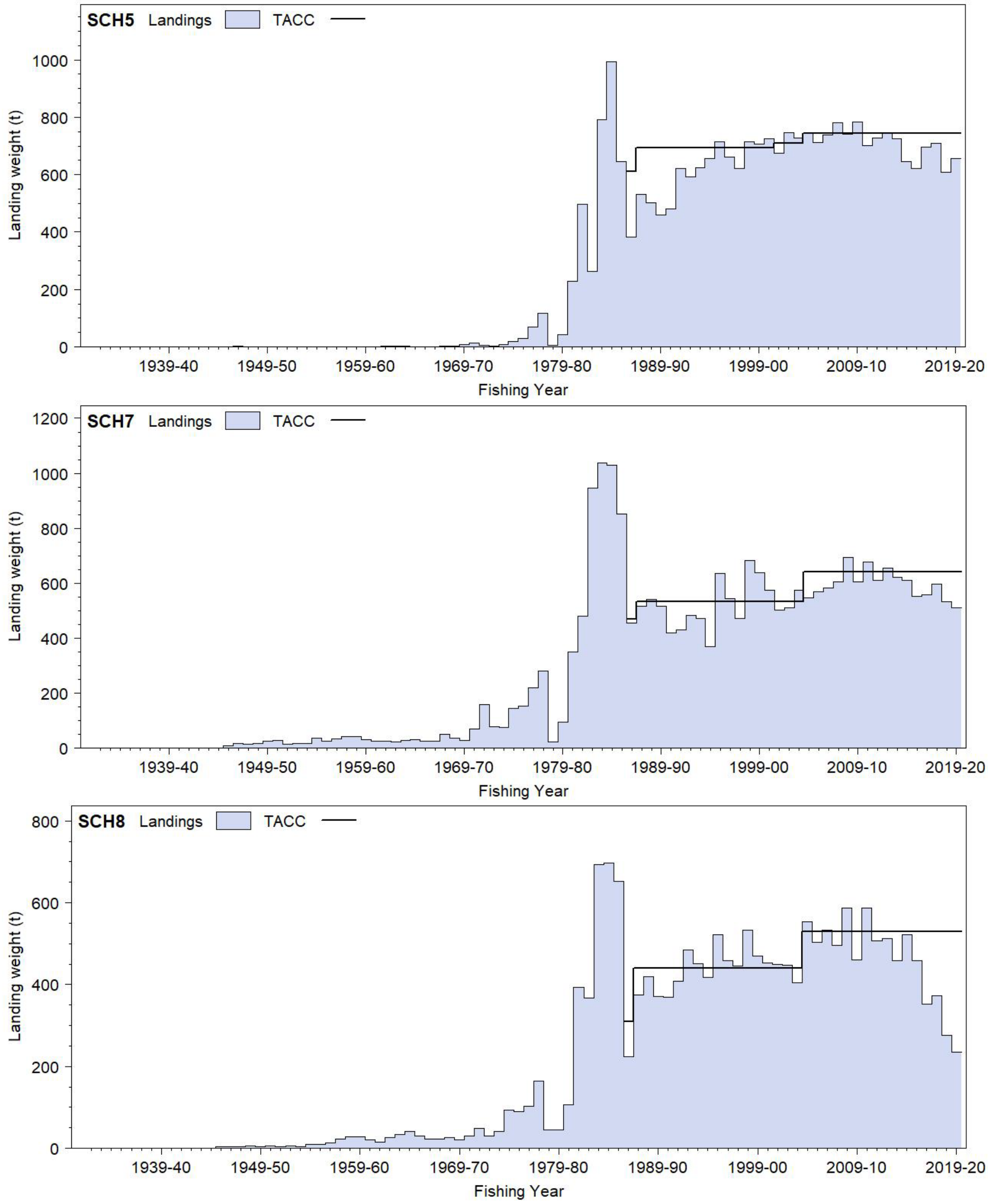


Figure 1: [Continued] Reported commercial landings and TACC for the seven main SCH stocks. From top to bottom: SCH4 (South East Chatham Rise), SCH 5 (Southland), SCH 7 (Challenger), and SCH 8 (Central Egmont).

1.2 Recreational fisheries

Although school shark is a listed gamefish and is regularly caught by recreational fishers, it is not considered to be a particularly desirable target species.

1.2.1 Management controls

The main method used to manage recreational harvests of school shark is daily bag limits. Fishers can take up to 20 school sharks as part of their combined daily bag limit in the Auckland and Kermadec, Central, and Challenger Fishery Management Areas. Fishers can take up to 5 school sharks as part of their combined daily bag limit in the Southland and South-East Fishery Management Areas.

1.2.2 Estimates of recreational harvest

There are two broad approaches to estimating recreational fisheries harvest: the use of onsite or access point methods where fishers are surveyed or counted at the point of fishing or access to their fishing activity; and, offsite methods where some form of post-event interview and/or diary is used to collect data from fishers.

The first estimates of recreational harvest for school shark were calculated using an offsite approach, the offsite regional telephone and diary survey approach. Estimates for 1996 came from a national telephone and diary survey (Bradford 1998). Another national telephone and diary survey was carried out in 2000 (Boyd & Reilly 2002). The harvest estimates provided by these telephone diary surveys (Table 4) are no longer considered reliable.

In response to the cost and scale challenges associated with onsite methods, in particular the difficulties in sampling other than trailer boat fisheries, offsite approaches to estimating recreational fisheries harvest have been revisited. This led to the development and implementation of a national panel survey for the 2011–12 fishing year (Wynne-Jones et al 2014). 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 collected in standardised phone interviews. The national panel survey was repeated during the 2017–18 fishing year using very similar methods to produce directly comparable results (Wynne-Jones et al 2019). Recreational catch estimates from the two national panel surveys (in numbers of fish, no mean weights being available from concurrent boat ramp surveys) are given in Table 4. Note that national panel survey estimates do not include recreational harvest taken under s111 general approvals.

Table 4: Recreational harvest estimates for school shark stocks. The telephone/diary surveys ran from December to November and are denoted by the January calendar year. National panel surveys ran throughout the October to September fishing year and is denoted by the January calendar year.

Stock	Year	Method	Number of fish	Total weight (t)	CV
SCH 1	1996	Telephone/diary	23 000	46	0.17
	2000	Telephone/diary	27 000	66	0.42
	2012	Panel survey	9 788	–	0.24
	2018	Panel survey	1 198	–	0.51
SCH 2	1996	Telephone/diary	5 000	–	–
	2000	Telephone/diary	7 000	18	0.30
	2012	Panel survey	2 739	–	0.54
	2018	Panel survey	1 804	–	0.79
SCH 3	1996	Telephone/diary	3 000	–	–
	2000	Telephone/diary	19 000	48	0.46
	2012	Panel survey	5 381	–	0.37
	2018	Panel survey	627	–	0.43
SCH 5	1996	Telephone/diary	1 000	–	–
	2000	Telephone/diary	3 000	7	0.66
	2012	Panel survey	443	–	0.60
	2018	Panel survey	349	–	1.00
SCH 7	1996	Telephone/diary	8 000	16	0.24
	2000	Telephone/diary	23 000	58	0.56
	2012	Panel survey	10 311	–	0.36
	2018	Panel survey	2 001	–	0.31
SCH 8	1996	Telephone/diary	11 000	21	0.22
	2000	Telephone/diary	3 000	8	0.55
	2012	Panel survey	1 892	–	0.32
	2018	Panel survey	847	–	0.39

1.3 Customary non-commercial fisheries

Māori 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 customary non-commercial take.

1.4 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.

1.5 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 nautical miles off the South Island, and 400 nautical miles 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 & 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 & 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 work on a Brazilian stock suggests that females have a 3-year cycle in the South Atlantic (Peres & Vooren 1991). Fecundity (pup number) increases from 5–10 in small females to over 40 in the largest females. 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.

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		
	a	*b*	
SCH 1	0.0003	3.58	McGregor (unpub.)
SCH 3	0.0035	3.08	McGregor (unpub.)
SCH 5	0.0181	2.72	McGregor (unpub.)
SCH 5	0.0068	2.94	Hurst et al (1990)
SCH 7	0.0061	2.94	Blackwell (unpub.)
SCH 8	0.0104	2.84	Blackwell (unpub.)
2. Estimate of *M* for Australia			
	0.1		Grant et al (1979), Olsen (1984)

The combination of late maturity, slow growth, and low fecundity gives a relatively 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 Hurst et al 1999).

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

3. STOCKS AND AREAS

Information relevant to determining school shark stock structure in New Zealand was reviewed in 2009 (Smith 2009, Blackwell & Francis 2010, Francis 2010). Primarily based on the tagging evidence, there is probably a single biological stock in the New Zealand EEZ. Genetic, biological, fishery, and tagging data were all considered, but the evidence for the existence of distinct biological stocks is poor. Some differences were found in CPUE trends between QMAs, but stock separation at the QMA level seems unlikely, and the CPUE differences may have resulted from processes acting below the stock level, such as localised exploitation of different sexes or different size classes of sharks. An apparent lack of juvenile school shark nursery areas in SCH 4 and SCH 5 suggests that these Fishstocks are not distinct, but are instead maintained by recruitment from other QMAs.

The most useful source of information was an opportunistic tagging programme undertaken mainly on research trawlers since 1985 (Hurst et al 1999). However, most tag releases were made around the South Island and little information is provided for North Island school sharks. Female school sharks were slightly more mobile than males, with higher proportions of the former moving to non-adjacent QMAs and to Australia. About 30% of school shark recaptures were reported from outside the release QMA within a year of release, and this was maintained in the second year after release. After 2–5 years at liberty about 60% of recaptured school sharks (both sexes) were reported from outside the release QMA. After more than 5 years at liberty, 8% of males and 19% of females were recaptured from Australia. A large proportion of tagged school sharks moved outside the QMA of release within 5 years, and a significant proportion eventually moved to Australia. These trends in apparent movement are consistent across two decades of tagging. The relative importance of various breeding grounds around New Zealand (e.g., aggregations of breeding females in Kaipara Harbour) and whether females return to the area in which they were born are unknown.

The current stock management units are a precautionary measure to spread fishing effort; amalgamation of all QMAs into one QMA for the whole EEZ could create local depletion or sustainability risks for sub-stock components.

4. STOCK ASSESSMENT

4.1 Estimates of fishery parameters and abundance

Fishery characterisations and CPUE analyses for SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7, and SCH 8 were updated in 2021 following a previous 2017–18 update and a full review in 2014. The 2014 review noted that, for many fisheries, the fishery definitions were constructs of administrative boundaries and often created artificially divided fisheries that should be linked. The result of this review was the creation of revised fishery definitions for monitoring school shark, with boundaries between fisheries drawn in areas where there were gaps in catches, and, as much as possible, the same area definitions were used to define setnet and bottom longline fisheries for monitoring purposes. Table 6 lists the definitions of the fisheries selected for monitoring school shark. The fisheries were selected on the basis of fine scale positional data but use general statistical areas to apply these definitions to the period before fine scale positional data became available. This approach also assumes that the fine scale positional information from 2007 to the present is representative of the distribution of fishing before that year.

Table 6: List of fisheries selected to monitor NZ school shark. Core statistical areas are shown as well as any additional statistical areas needed to complete the fishery definition by capture method. There is no recorded fishing for school shark using setnets (SN) around the Chatham Islands (SCH 4). BLL, bottom longline.

Region	Code	Core Statistical Areas	SN	BLL
Far North & SCH 1E	N/1E	043–010	same as core	same as core
SCH 2 & top of SCH 3	2/3N	011–015	add 018, 020	same as core
Chatham Rise (SCH 4)	SCH4	049–051, 401–412	NA	add 019, 020, 021
lower SCH 3 & SCH 5	3S/5	022–033	same as core	same as core
SCH 7, SCH 8 & lower SCH 1W	7/8/1W	034–042, 801	add 016, 017	add 016, 017, 018

The main difficulty in finalising these definitions was how to deal with Cook Strait. The decision was made to assign all Cook Strait catches, even those from the eastern end of Cook Strait, to the central west coast fishery (SCH 7, SCH 8, and lower SCH 1W). Setnet landings from Kaikōura and Pegasus Bay were assigned to the northern east coast fishery and bottom longline landings from the western end of the Chatham Rise were assigned to SCH 4.

Characterisation comments by SCH QMA

Statistics and trends in target species reported here refer to the 2016–17 to 2018–19 fishing years.

SCH 1
About 48% of the SCH 1 landings were taken by bottom trawl when targeting tarakihi, with smaller catches reported when targeting snapper and trevally. The bottom longline SCH 1 fishery caught about 27% of the total landings and was primarily directed at snapper and hāpuku and bass, with tarakihi and school shark being other important targets. The setnet fishery, which took about 8% of the landings following a long-term decline in setnet effort in this region, was mainly targeted at school shark, with some additional targeting of rig, trevally, red gurnard, and snapper.

SCH 2
SCH 2 were caught primarily in the bottom trawl fishery (41%) targeting tarakihi, red gurnard, hoki, and gemfish and the bottom longline fishery (36%) targeting school shark, hāpuku/bass, ling, and bluenose. About 7% of the catch was taken in setnets targeting rig, school shark, blue moki, and butterfish.

SCH 3
School shark in SCH 3 were predominantly caught in the setnet fishery (53%) targeting school shark and rig, with some targeting of tarakihi and hāpuku/bass; and in the bottom trawl fishery (31%) with mixed targeting of tarakihi, barracouta, elephant fish, and red cod. Mixed target bottom longlines took about 11% of the catch.

SCH 4
SCH 4 catches were primarily (92%) from a bottom longline fishery targeting school shark, hāpuku/bass and ling. There was also a small bottom trawl fishery (8% of catches) which targeted a range of species including tarakihi, barracouta, stargazer, hoki, and scampi. The setnet fishery has been small (under 1% of the catch) and cannot be used to monitor the Fishstock.

SCH 5
School shark in SCH 5 were mostly caught in the setnet fishery that targeted school shark (81%), with some minor targeting of rig. About 10% was taken by bottom longline primarily targeting school shark, hāpuku/bass, and ling, and 8% by bottom trawl primarily targeting squid, stargazer, and ling.

SCH 7
SCH 7 were caught in bottom trawl (44%) targeting tarakihi, red gurnard, John dory, flatfish, and others, and in bottom longline (41%) targeting school shark, hāpuku/bass, and ling. There were some catches by the setnet fishery (13%) targeting school shark, rig, and butterfish.

SCH 8
School shark catches in SCH 8 were mainly caught by setnets that targeted school shark and rig (44%) and by bottom longlines (37%) targeting school shark and hāpuku/bass. About 16% was caught by bottom trawl targeting tarakihi, school shark, red gurnard, and John dory.

4.1 Biomass estimates

WCNI
The west coast North Island (WCNI) inshore trawl survey core area spans the area extending along the northern west coast of the North Island from Scott Point to Airedale Reef in the 10–200 m depth range. It is primarily aimed at estimating relative abundance and distribution for snapper, tarakihi, red gurnard,

and John dory. There were five surveys between 1989 and 1999, and the series was recently resumed with surveys in 2018, 2019, and 2020.

The lack of a continuous time series for the west coast North Island prevents the detection of a long-term trend, but recent biomass estimates are lower than historical ones (Figure 2).

WCSI

The west coast South Island (WCSI) inshore trawl survey covered depths of 20–200 m off the west coast of the South Island from Cape Farewell to Karamea; 25–400 m from Karamea to Cape Foulwind; 20–400 m from Cape Foulwind to the Haast River mouth; and 10–70 m within Tasman Bay and Golden Bay inside a line drawn between Farewell Spit and Stephens Island.

Survey biomass for school shark in the WCSI survey was considered separately for the west coast area (Cape Farewell to the Haast River mouth) and the Tasman / Golden bays area. For the west coast area, biomass in the core strata has been variable, but relatively low in 2003 (a year when catchability was low for most species (Stevenson & MacGibbon 2018), and relatively high around 1997 and 2011 (Figure 2). Estimated school shark biomass in the Tasman / Golden bays area has been stable over time.

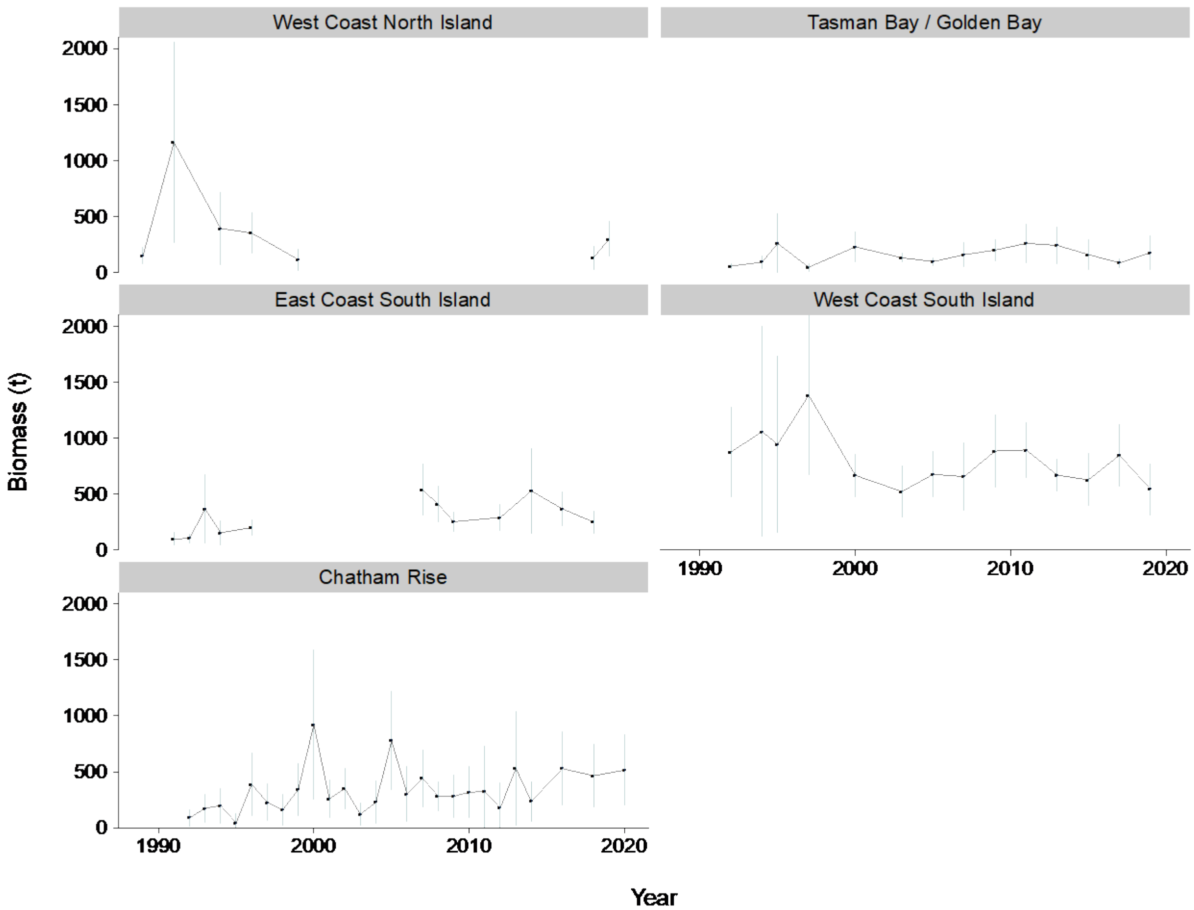


Figure 2: School shark total biomass and 95% confidence intervals for the east coast South Island (ECSI) winter, Chatham Rise, and west coast South Island (WCSI) surveys in core strata. Results for the WCSI survey are presented separately for the Tasman and Golden bays and the west coast portions. Surveys separated by three years or less are connected by a solid line.

ECSI

The east coast South Island (ECSI) winter trawl surveys from 1991 to 1996 in 30–400 m were replaced by summer trawl surveys (1996–97 to 2000–01) which also included the 10–30 m depth range, but these were discontinued after the fifth survey in the annual time series because of the extreme fluctuations in catchability between surveys (Francis et al 2001). The winter surveys were reinstated in 2007 and this time included additional 10–30 m strata in an attempt to index elephant fish and red gurnard which were included in the list of target species. Only the 2007, 2012, 2014, 2016, and 2018 surveys provide full coverage of the 10–30 m depth range.

Biomass in the core strata (30–400 m) for the ECSI surveys has been variable but was generally higher in years 2007 onward compared with the 1990s (Figure 2, Table 7). The additional biomass captured in the 10–30 m depth range accounted for only about 3% to 6% of the biomass in the core plus shallow strata (10–400 m) for the 2007, 2012, 2014, and 2016 surveys, and hence the shallow strata (10–30 m) are probably not essential for monitoring school shark biomass.

Chatham Rise

The main survey area for this survey includes strata spread over 200–800 m depths on the Chatham Rise. School sharks were only observed in the shallower strata. The estimated school shark biomass has been increasing over time.

Table 7: Relative total biomass indices (t) and coefficients of variation (CV) for school shark for the west coast North Island inshore trawl survey, the Tasman and Golden bays (TBGB) inshore trawl survey, the east coast South Island (ECSI) winter trawl survey, the west coast South Island (WCSI) autumn trawl survey, and the Chatham Rise trawl survey. Estimates are shown for the core strata only, as defined within each survey design.

Region	Year	Trip number	Core strata biomass estimate	CV (%)	Region	Year	Trip number	Core strata biomass estimate	CV (%)
WCNI	1989	KAH8918	149	26	WCSI (autumn)	1992	KAH9204	878	23
	1991	KAH9111	1162	39		1994	KAH9404	1058	44
	1994	KAH9410	392	41		1995	KAH9504	945	42
	1996	KAH9615	352	26		1997	KAH9701	1385	26
	1999	KAH9915	114	44		2000	KAH0004	668	15
	2018	KAH1806	131	41		2003	KAH0304	523	22
	2019	KAH1906	299	27		2005	KAH0503	677	15
TBGB (winter)	1992	KAH9204	56	26		2007	KAH0704	657	23
	1994	KAH9404	93	32		2009	KAH0904	885	18
	1995	KAH9504	259	52		2011	KAH1104	895	14
	1997	KAH9701	47	41		2013	KAH1305	670	11
	2000	KAH0004	228	31		2015	KAH1503	628	19
	2003	KAH0304	131	17		2017	KAH1703	848	16
	2005	KAH0503	97	19		2019	KAH1902	544	21
	2007	KAH0704	159	36	Chatham Rise (summer)	1992	TAN9106	89	44
	2009	KAH0904	199	25		1993	TAN9212	175	37
	2011	KAH1104	260	34		1994	TAN9401	198	41
	2013	KAH1305	242	34		1995	TAN9501	43	100
	2015	KAH1503	160	43		1996	TAN9601	389	37
	2017	KAH1703	85	25		1997	TAN9701	226	37
	2019	KAH1902	176	44		1998	TAN9801	159	44
ECSI (winter)	1991	KAH9105	100	30		1999	TAN9901	344	34
	1992	KAH9205	104	21		2000	TAN0001	923	36
	1993	KAH9306	369	42		2001	TAN0101	258	34
	1994	KAH9406	155	36		2002	TAN0201	351	27
	1996	KAH9606	202	18		2003	TAN0301	121	43
	2007	KAH0705	538	22		2004	TAN0401	228	43
	2008	KAH0806	411	20		2005	TAN0501	778	28
	2009	KAH0905	254	18		2006	TAN0601	304	41
	2012	KAH1207	292	20		2007	TAN0701	442	29
	2014	KAH1402	529	36		2008	TAN0801	283	23
	2016	KAH1605	369	21		2009	TAN0901	281	34
	2018	KAH1803	251	20		2010	TAN1001	317	36
						2011	TAN1101	325	63
						2012	TAN1201	176	65
						2013	TAN1301	531	48
						2014	TAN1401	236	39
						2016	TAN1601	529	31
						2018	TAN1801	465	31
						2020	TAN2001	515	31

CPUE trends by SCH Region (Table 6)

School shark is considered to be a New Zealand-wide stock, but B_{MSY}–based reference points are not currently able to be established for the stock as a whole.

Far North & SCH 1E

Bottom longline and bottom trawl fisheries in Far North & SCH 1E catch a range of sizes including juveniles, pre-adult, and mature individuals according to commercial samples (Tremblay-Boyer 2021). There were no setnet or Adaptive Management Programme (AMP) samples available for this region. The North Island west coast trawl survey caught mostly juveniles and sub-adults, with modes corresponding to ages 0+, 1+, and 2+.

Standardised CPUE series were developed for setnet at the daily resolution, bottom longline at the daily resolution, and bottom trawl at the trip resolution. The combined setnet series shows a shallow increasing trend to 2008–09, followed by variable but flat-overall CPUE up to 2014–15 and a sharp increase to a higher plateau since (Figure 16). The overall increasing trend is mirrored by the combined bottom longline series, although this series reaches a higher biomass plateau in 2002–03 and a slow increase in biomass since, with some variability. The combined bottom trawl series shows a similar trend to the combined setnet series, with increasing biomass since 2015–16.

Establishing interim B_{MSY}-compatible reference points

In 2020, the Working Group accepted the setnet combined series, the bottom longline combined series, and the combined bottom trawl series as valid measures of biomass. Because the trends were similar, a mean of the three series was adopted as the biomass index, and a mean CPUE for the period 2008–09 to 2015–16 was adopted as an interim B_{MSY}-compatible proxy for Far North & SCH 1E. The Working Group considered that the stock was rebuilding slowly from a low level following larger (largely unreported) historical catches prior to the introduction of the QMS. The Working Group adopted the default Harvest Strategy Standard definitions for the Soft and Hard Limits of one half and one quarter the target, respectively.

SCH 2 & top of SCH 3

Commercial observer samples for SCH 2 & top of SCH 3 were from setnet, bottom longline, and bottom trawl methods (Tremblay-Boyer 2021). All three gears captured a wide range of sizes, including pre-recruits and mature individuals. Bottom trawls appeared to catch smaller individuals than setnet and bottom longline but there were few observations per year. Bottom longlines sampled larger individuals but there were also few observations per year. Samples from the setnet Adaptive Management Programme also included a range of sizes, with a high proportion of mature individuals in some years. The east coast South Island survey (spanning Pegasus Bay and Canterbury Bight) sampled almost exclusively juveniles and pre-recruits, with few individuals over 100 cm.

A new bottom trawl index was developed in SCH 2 & top of SCH 3 to attempt to resolve the previous conflict in trends in the bottom longline and setnet capture methods in this region observed in the 2018 analysis. The results revealed a setnet series that was increasing and longline series that was decreasing (Figure 17). The bottom trawl series increased until 2000 and then declined—thereby matching the setnet series initially and the bottom trawl series latterly. The reason for the contradiction in trends between gear types is unknown.

Establishing interim B_{MSY}-compatible reference points

Because of the unexplained contradictory trends in the CPUE series, in 2020 the Working Group rejected CPUE as a biomass index for this region.

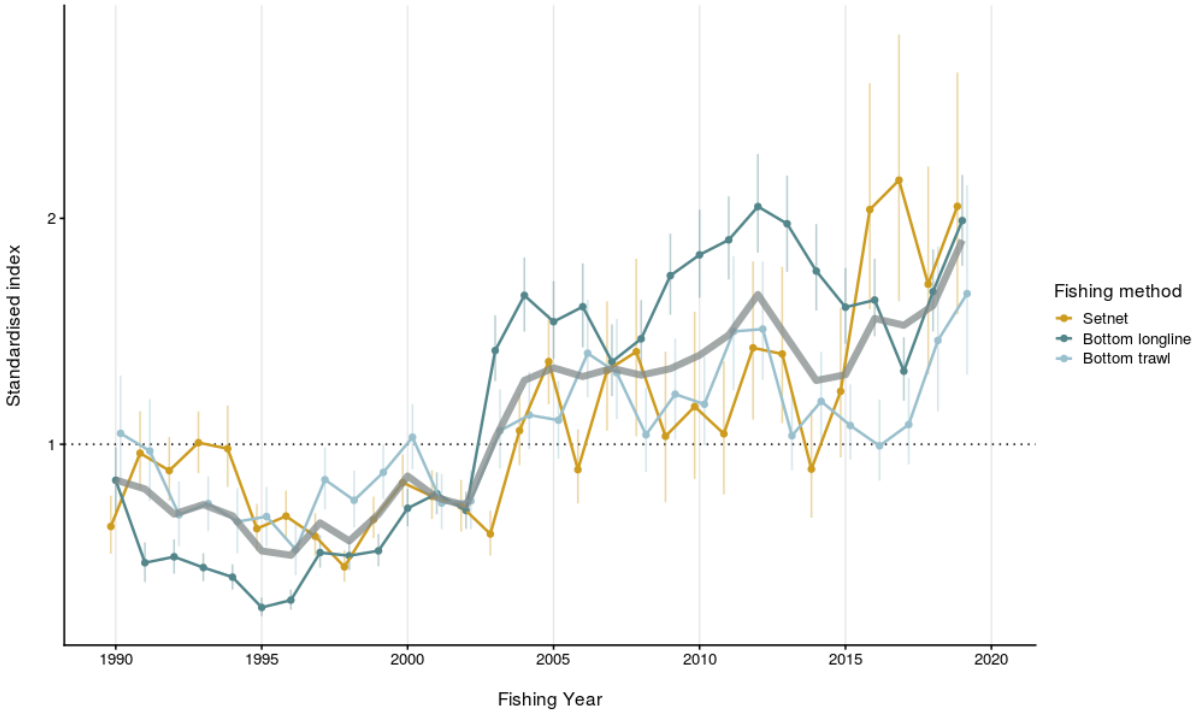


Figure 3: Far North/SCH 1E region (see Table 6): comparison of the combined SN series, the combined BLL series, and the combined BT (bottom trawl) series. All combined series use the delta-lognormal method. The bold grey line shows the average of the series for all three methods. The points show the point estimates for each year and the vertical lines span the 95% confidence intervals.

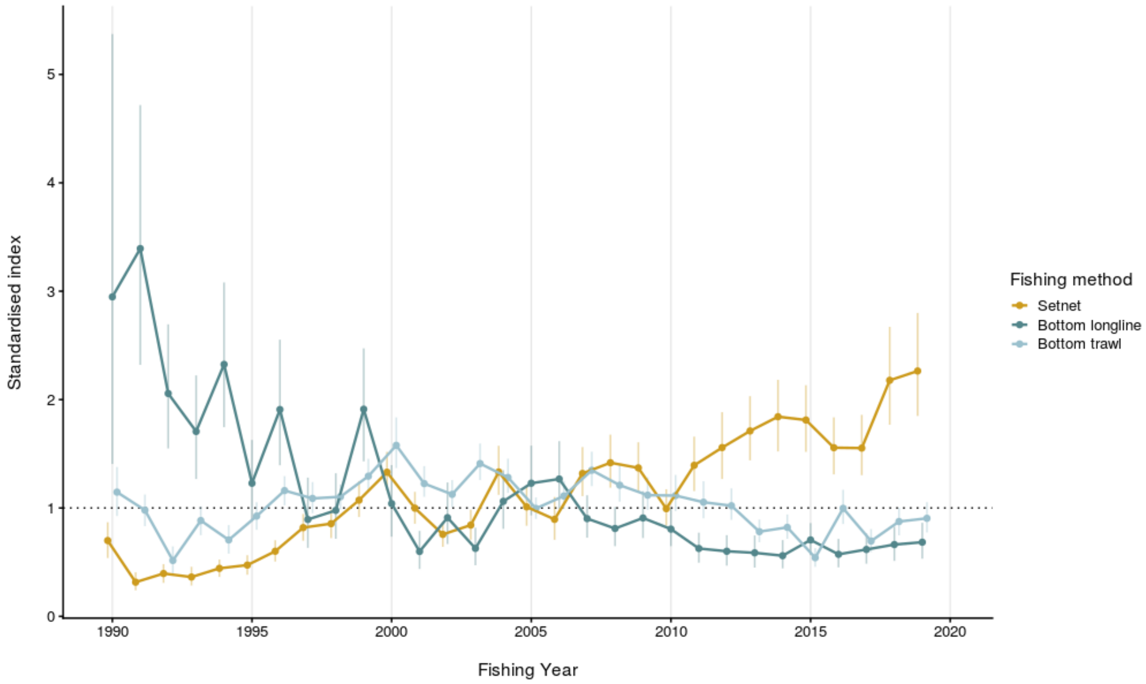


Figure 4: SCH 2 & top of SCH 3 region (see Table 6): comparison of the combined SN series, the combined BLL series, and the combined BT series. All combined series use the delta-lognormal method. The points show the point estimates for each year and the vertical lines span the 95% confidence intervals.

Chatham Rise (SCH 4)

There is no available setnet or bottom trawl series to contribute to the monitoring of the Chatham Rise region. Commercial samples for both bottom longline and bottom trawl predominantly catch mature individuals in most years; the Chatham Rise trawl survey also mostly catches large, mature individuals (Tremblay-Boyer 2021). A standardised CPUE series was constructed from the recent (since 2003–04) bottom longline catch and effort data (Figure 18). This series shows no overall trend over the 16 years.

Although earlier data are available, there was a fleet change in 2003–04 and data prior to this period were sparse.

Establishing interim B_{MSY}-compatible reference points

In 2021, the Working Group adopted CPUE from the bottom longline combined model as a biomass index for this region. However, because the CPUE series was relatively short and without trend, no reference period or reference points were adopted.

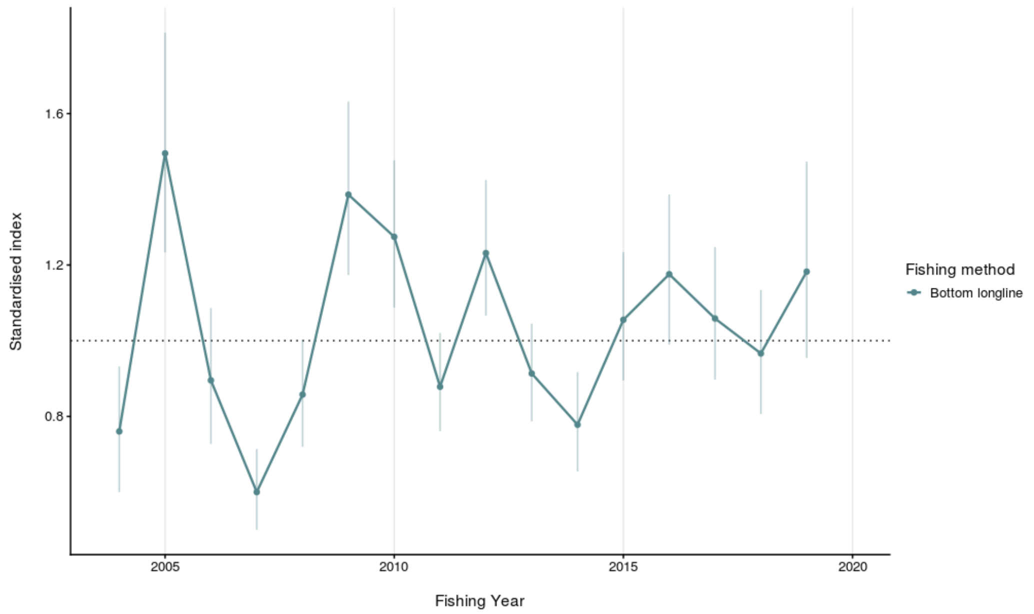


Figure 5: Chatham Rise (SCH 4) region (see Table 6): Combined series for bottom longline using the delta-lognormal method. The points show the point estimates for each year and the vertical lines span the 95% confidence intervals.

Lower SCH 3 & SCH 5

Commercial observer samples for school shark in Lower SCH 3 & SCH 5 showed a wide range of sizes captured, with pre-recruit and mature individuals observed on most years for all gears (but with sparse bottom longline samples, Tremblay-Boyer 2021). Bottom trawls caught a length range comparable with, or wider than, those caught by bottom longline or setnet. The AMP setnet samples included a high proportion of mature individuals, with median size 110 cm TL or higher for most years. The east coast South Island survey (spanning Pegasus Bay and Canterbury Bight) sampled almost exclusively juveniles and pre-recruits, with few individuals over 100 cm.

The combined setnet series for lower SCH 3 & SCH 5 showed a long and gradual declining trend (Figure 19). There was high variability, and therefore no clear trends, in the combined bottom longline series. The combined bottom trawl index declined gradually from 2000 to 2014 but subsequently increased. The setnet fishery is known to target large mature fish, but there is no known nearby spawning or nursery ground (Francis 2010 and Section 3 above). The inconclusive bottom longline series is likely to be the result of small amounts of available data, leading to low reliability.

Establishing interim B_{MSY}-compatible reference points

In 2021, the Plenary accepted the setnet combined series as a valid measure of relative biomass and rejected the bottom longline series due to the large fluctuations in CPUE which are unlikely to reflect abundance. The combined setnet index was favoured over the bottom trawl index because it covers a broad spatial area whereas the bottom trawl index only includes shallow waters off the east coast below Banks Peninsula and around Foveaux Strait. Mean setnet CPUE for t1989–90 to 1998–99 was adopted as an interim B_{MSY}-compatible proxy for Lower SCH 3 & SCH 5. This period was chosen because CPUE was stable, followed by a decline in CPUE as catches increased after 1999. Based on the catch history prior to the reference period, it was assumed the stock was not in a depleted state at the start of the time series of relative abundance. The Plenary adopted the default Harvest Strategy Standard definitions for the Soft and Hard Limits of one half and one quarter the target, respectively.

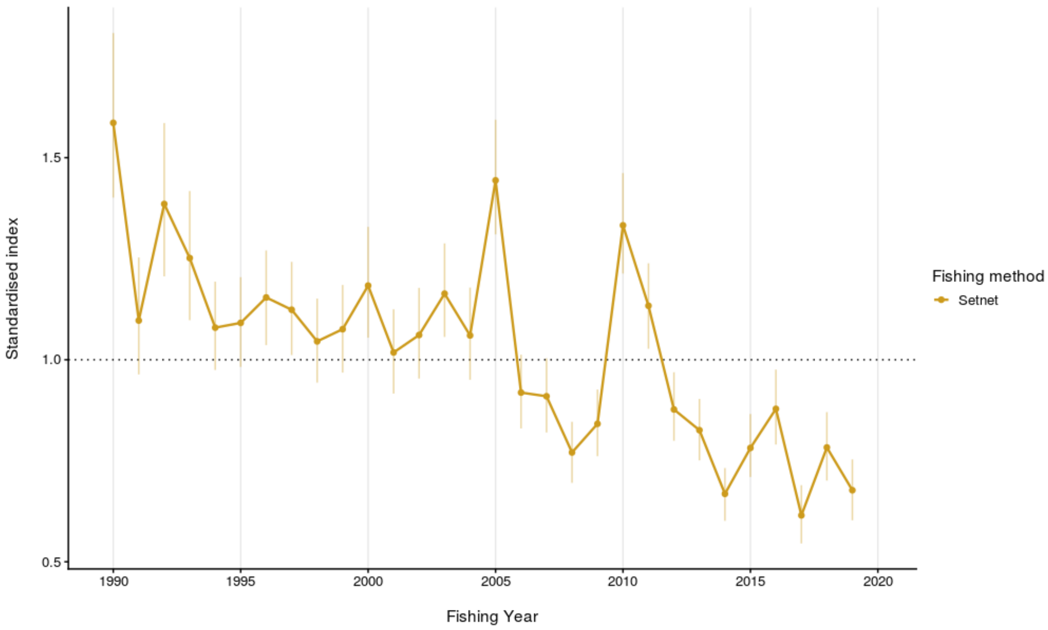


Figure 6: Lower SCH 3 & SCH 5 region (see Table 6): combined index for the setnet fishery. The combined index uses the delta-lognormal method. The points show the point estimates for each year and the vertical lines span the 95% confidence intervals.

SCH 7, SCH 8, & lower SCH 1W

School shark observer samples for SCH 7, SCH 8, & lower SCH 1W were available for setnet, bottom longline, and bottom trawl (Tremblay-Boyer 2021). Both bottom trawl and setnet samples included pre-recruits and mature individuals in most years, with some variability. The Tasman/Golden bays component of the west coast South Island trawl survey sampled juveniles and pre-adults only; no mature individuals were caught in any of the surveys. The west coast component caught a higher proportion of pre-adults in comparison, with mature individuals often present.

The combined setnet series is variable with a gradual increase since 1998–99, because of a decrease in the proportion of fishing days with zero catch of school shark (Figure 20). This series has been compromised by extensive dolphin closures implemented in 2008, 2019, and 2020. The combined bottom longline index includes a pronounced biomass peak in 2001–02 that the standardisation was unable to account for; this biomass peak is unlikely to be representative of true biomass trends. The bottom trawl index shows variable but stable biomass trends since 1997–98. A research trawl survey time series is available for the west coast South Island and shows stable population abundance since 2000 following an earlier decline.

Establishing interim B_{MSY}-compatible reference points

In 2021, the Working Group accepted biomass estimates from the west coast South Island research trawl survey (excluding TBGB) as a valid measure of biomass. The survey estimates were favoured over the fishery biomass indices because of the high sample size and the wide range of school shark sizes. Issues with spatial management measures might have also impacted the validity of the setnet combined index. The period 2005 to 2017 was adopted to set the interim B_{MSY}-compatible proxy for SCH 7, SCH 8, & lower SCH 1W. This period was chosen because abundance fluctuated without trend, and catch was high and relatively stable. The Plenary adopted the default Harvest Strategy Standard definitions for the Soft and Hard Limits of one half and one quarter the target, respectively.

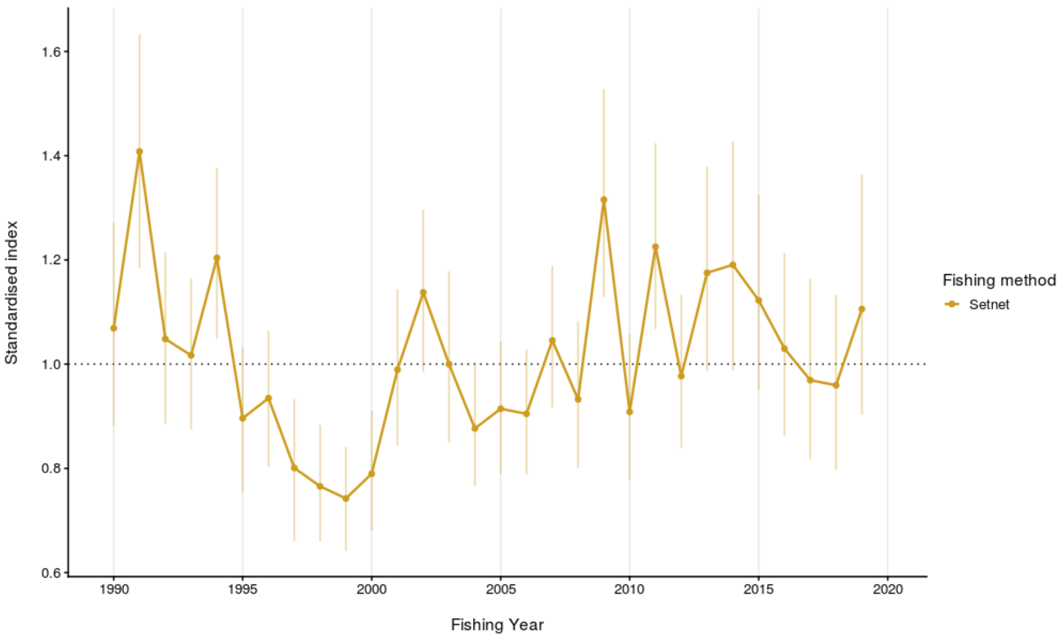


Figure 7: SCH 7, SCH 8, & lower SCH 1W region (see Table 6): combined series for the setnet fishery. The combined index uses the delta-lognormal method. The points show the point estimates for each year and the vertical lines span the 95% confidence intervals.

4.2 Other factors

In Australia, recruitment overfishing occurred to such an extent that the stock was considered seriously threatened and a series of conservative management measures (TAC reductions) were progressively imposed between 1996 and 2007 (Wilson et al 2008). Wilson et al (2008) noted that the stock had been in an overfished state and overfishing was occurring from 1992 to 2004. A 2009 assessment estimated that the stock was at 12% B_0 (Thomson & Punt 2009). An assessment update, in 2012, concluded that the school shark stock remained below 20% B_0, but was recovering (Thomson 2012). A stock recovery has been supported by recent survey work (McAlister et al 2015), but the latest assessment still lists school shark as overfished with uncertainty as to whether overfishing is ongoing. A recent close-kin study found the Australian school shark biomass to be much lower than that estimated in the previous stock assessment by Thomson & Punt (2009) (Thomson et al 2020). They suggested there might be multiple school shark stocks such that the DNA samples informing the close-kin analysis might not be representative of all assessed stocks. The New Zealand stock is known to mix with the Australian stock (Hurst et al 1999), but the degree of mixing is unlikely to be large.

4.3 Future research considerations

- Further investigate the conflicts in SCH 2 & 3N in a dedicated study that includes examination of whether conflicts are due to spatial or temporal structuring and augment this analysis through discussions with stakeholders. Similar analyses may be needed for other areas.
- Conduct further work to better understand stock structure and movements of stocks.
  - Collect more comprehensive information on the length and sex composition of school shark around New Zealand to obtain a clearer picture of the size and sex structuring of the population(s) by area.
  - Commercial length samples should be analysed under a modelling framework to identify environmental and operational covariates likely to influence length distributions and spatial structuring.
  - Conduct a feasibility study on the use of tags to determine more about stock movements and stock structure.
- Investigate the utility of conducting adequate ageing to determine the age structure in different areas.
- Improve information and analysis on the size-at-maturity based on trawl survey data. This will likely require more staging data, particularly for females.
- Seek out observer data from setnet vessels.

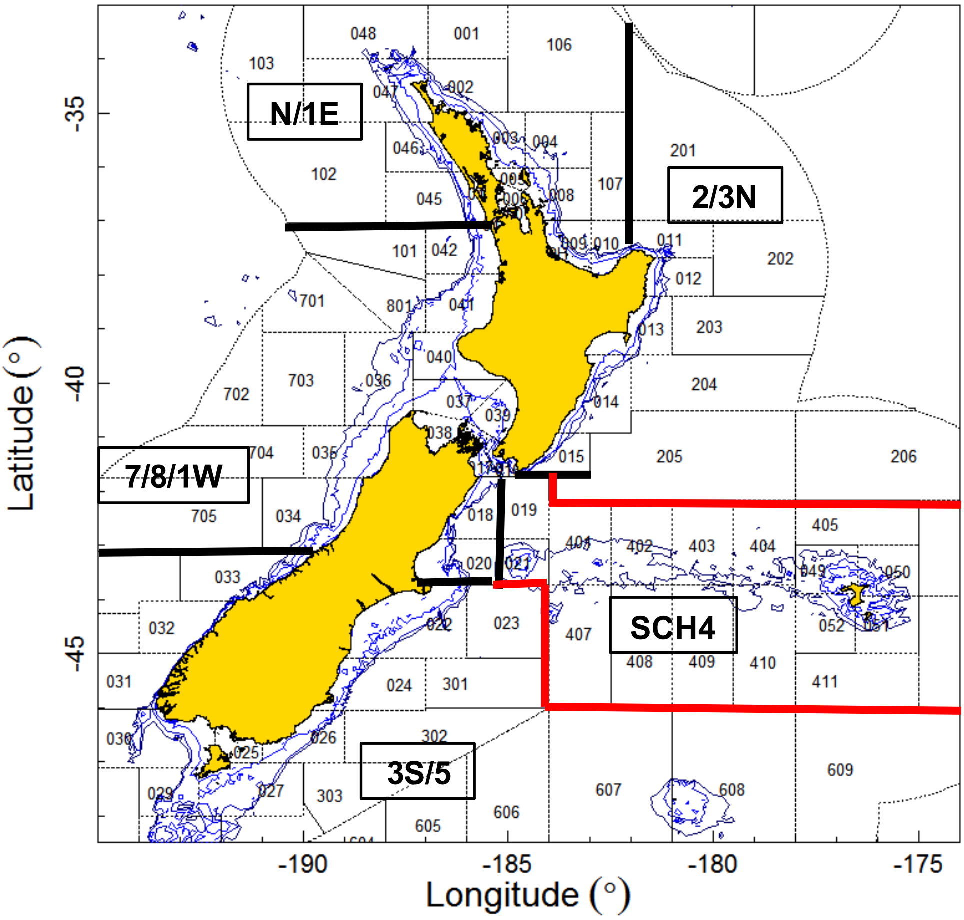
- Investigate BP/HG survey data from recent trawl surveys with a view to determining the amount of school shark information.
- Derive a total length to fork length relationship for converting lengths.
- Compile and examine information on the perceived or potential status of various components of the stock at the time of its introduction to the QMS, with a view to revisiting reference points; this should be completed before the next stock assessment.

5. STATUS OF THE STOCKS

Stock Structure Assumptions

SCH are known from tagging studies to be highly mobile, moving between the North Island and South Island, and as far as Australia. From the tagging evidence, there is probably a single biological SCH stock in the New Zealand EEZ. However, differences in average modal length and CPUE trends between FMAs indicate that movement between areas may be variable, with components of the stock aggregating in different areas. Therefore, the current stock management units are a precautionary measure to spread fishing effort and mortality across components of the stock. Conclusions about the assessment units (see map below) have also been formulated under the assumption that there is some level of persistence in the spatial population structure.

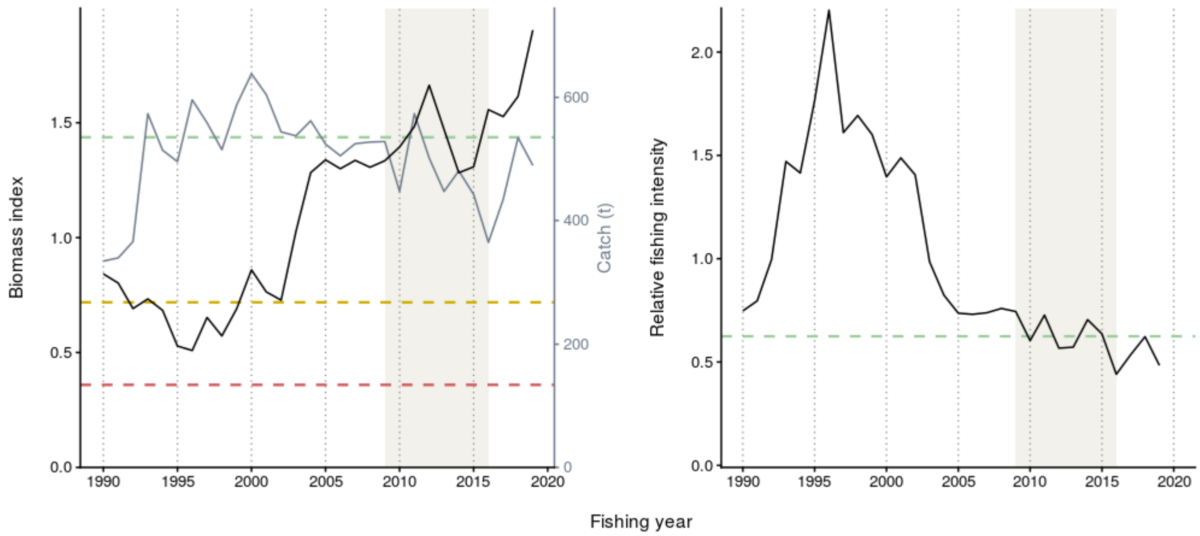
In the 2014 assessment, five proposed New Zealand school shark regions were used, as shown in the map below and described in Table 6. These boundaries follow existing statistical area boundaries so that the regions can be defined before the availability of fine scale positional data. The Cook Strait boundaries differ by method of capture as defined in Table 6. These school shark regions were also used for the 2018 and 2021 assessments.



- **Far North & SCH 1E (N/1E on the map)**

Stock Status	
Year of Most Recent Assessment	2021
Assessment Runs Presented	Standardised CPUE based on the average of the combined setnet, bottom longline, and trip-based bottom trawl series
Reference Points	Target: Interim B_{MSY}-compatible proxy based on the mean CPUE from 2008–09 to 2015–16 for the average of the lognormal setnet and combined bottom longline series Soft Limit: 50% of target Hard Limit: 25% of target Overfishing threshold: Interim F_{MSY}-compatible proxy based on the mean relative exploitation rate for the period: 2008–09 to 2015–16
Status in relation to Target	Likely (> 60%) to be at or above B_{MSY}
Status in relation to Limits	Soft Limit: Unlikely (< 40%) to be below Hard Limit: Very Unlikely (< 10%) to be below
Status in relation to Overfishing	About as Likely as Not (40–60%) to be occurring

Historical Stock Status Trajectory and Current Status



Left panel: Biomass index for school shark in SCH N/1E as the average of the standardised CPUE from the combined setnet, bottom longline, and bottom trawl series (solid line). Also shown is the trajectory of total landed SCH by all methods from the sub-stock area (grey line). Horizontal lines represent the target (green dashed line), the soft limit (yellow dashed line), and hard limit (red dashed line). The reference period is shown in beige. Right panel: Annual relative exploitation rate for school shark in SCH N/1E from the averaged setnet, bottom longline, and trawl CPUE series. The interim F_{MSY}-compatible target is shown by the green dashed line.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	CPUE trebled since 1995
Recent Trend in Intensity or Proxy	Relative fishing intensity declined by 75% since 1995
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	The stock is Unlikely (< 40%) to decline at current catch
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unlikely (< 40%) for current catch Hard Limit: Very Unlikely (< 10%) for current catch
Probability of Current Catch or TACC causing Overfishing to continue or to commence	About as Likely as Not (40–60%) at current catch

Assessment Methodology		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE	
Assessment Dates	Latest assessment: 2021	Next assessment: 2024
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Changes to Model Structure and Assumptions	The average of the combined setnet, bottom longline, and bottom trawl CPUE series was used to index stock status.	

Major Sources of Uncertainty	- The components of the population fished by each gear type - Relationship between stock monitoring areas

Qualifying Comments
-

Fishery Interactions
Region Far North/SCH 1E catches are primarily taken by bottom trawl while targeting tarakihi and snapper, with smaller catches when targeting trevally and red gurnard. The bottom longline Far North/SCH 1E fishery is primarily directed at school shark, with hāpuku, snapper, and bluenose being other important targets. The setnet fishery is also primarily targeted at school shark, with some targeting of rig, trevally, red gurnard, and snapper.

- **SCH 2 & top of SCH 3 (Kaikōura and Pegasus Bay); (2/3N on the map)**

Stock Status	
Year of Most Recent Assessment	2021
Assessment Runs Presented	None
Reference Points	Target: Not established Soft Limit: 50% of target Hard Limit: 25% of target Overfishing threshold: Not established
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unlikely
Status in relation to Overfishing	Unknown

Historical Stock Status Trajectory and Current Status
-

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	-
Recent Trend in Fishing Intensity or Proxy	-
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	None of the CPUE series were accepted as indices of abundance.

Projections and Prognosis	
Stock Projections or Prognosis	Unknown
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown Hard Limit: Unlikely (< 40%)
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unknown

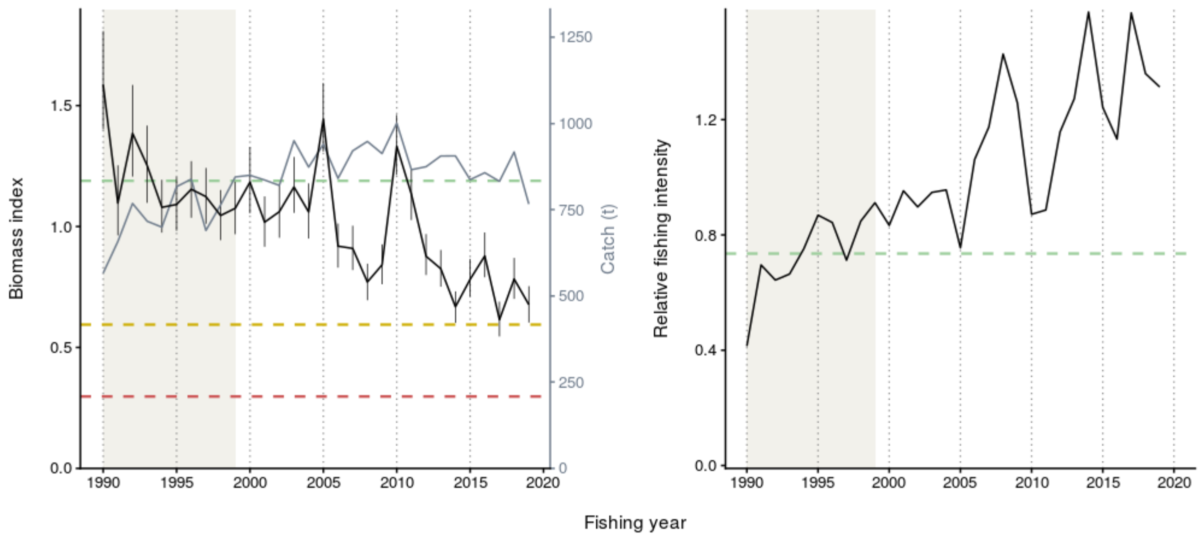
Assessment Methodology		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE	
Assessment Dates	Latest assessment: 2021	Next assessment: 2024
Overall assessment quality rank	3 – Low Quality: contradictory CPUE indices	
Main data inputs (rank)	N/A	
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	None	
Major Sources of Uncertainty	- The components of the population fished by each gear type - Relationship between stock monitoring areas	

Qualifying Comments
-

Fishery Interactions
Region SCH 2/SCH 3 North school shark are caught primarily in the bottom trawl fishery targeting tarakihi, red cod, gemfish, and red gurnard, and the setnet fishery targeting school shark, rig, tarakihi, blue warehou, and blue moki. About one fifth of the catch is taken by the bottom longline fishery targeting school shark, hāpuku/bass, ling, and bluenose.

- **Lower SCH 3 (Canterbury Bight) & SCH 5 (3S/5 on the map)**

Stock Status	
Year of Most Recent Assessment	2021
Assessment Runs Presented	Standardised CPUE based on the combined setnet series
Reference Points	Target: Interim B_{MSY}-compatible proxy based on the mean CPUE from 1989–90 to 1998–99 for the setnet combined series Soft Limit: 50% of target Hard Limit: 25% of target Overfishing threshold: Interim F_{MSY}-compatible proxy based on the mean relative exploitation rate for the period: 1989–90 to 1998–99
Status in relation to Target	Unlikely (< 40%) to be at or above the target
Status in relation to Limits	Soft Limit: About as Likely as Not (40–60%) to be below Hard Limit: Unlikely (< 40%) to be below
Status in relation to Overfishing	Overfishing is Very Likely (> 90%) to be occurring

Historical Stock Status Trajectory and Current Status

Left panel: Standardised CPUE for school shark in SCH 3S/5 from the combined setnet series (solid line). Also shown is the trajectory of total landed SCH from the sub-stock area (grey line). Horizontal lines represent the target (green dashed line), the soft limit (yellow dashed line), and hard limit (red dash line). The reference period is shown in beige. Right panel: Annual relative exploitation rate for school shark in SCH 3S/5. The interim *FMSY*-compatible target is shown by the green dashed line.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	CPUE has declined by at least 50% since 2005.
Recent Trend in Fishing Mortality or Proxy	Fishing mortality has doubled since 1990 and has been above the fishing mortality proxy since 1998.
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	- The east coast South Island trawl survey biomass index has been relatively stable, but it monitors sub-adult fish and does not cover the southern end of the South Island.

Projections and Prognosis	
Stock Projections or Prognosis	The stock is Very Likely (> 90%) to remain below the target at current catch levels.
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: About as Likely as Not (40–60%) for current catch Hard Limit: Unlikely (< 40%) for current catch
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Very Likely (> 90%) for current catch

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE	
Assessment Dates	Latest assessment: 2021	Next assessment: 2024
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	- Relationship between stock monitoring areas	

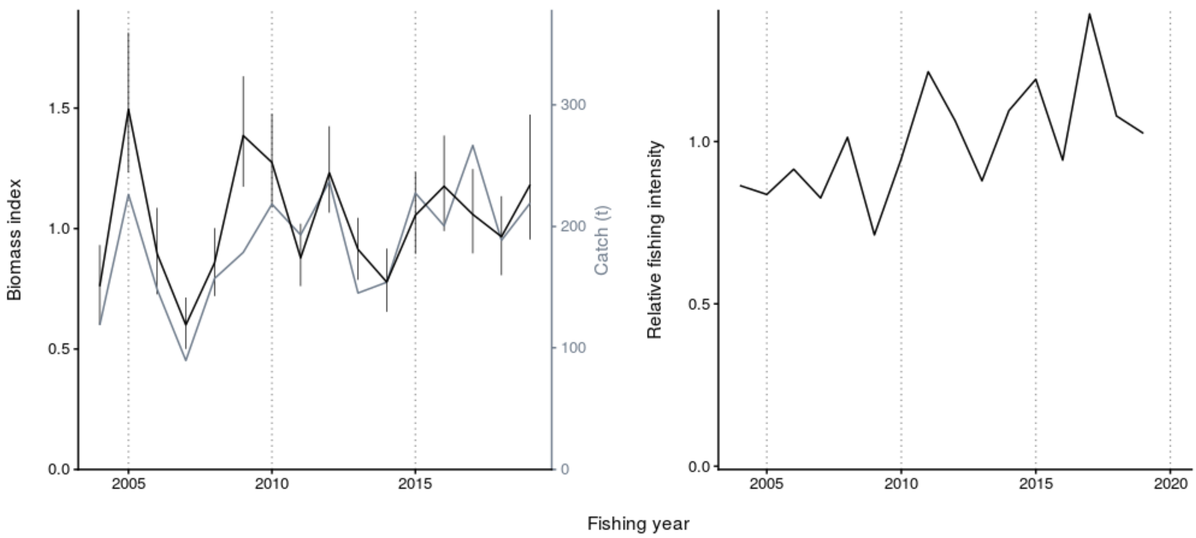
Qualifying Comments
There is a possibility that the stock may have already been in a depleted state at the beginning of the time series. Catches from this fishery include the highest proportions of large school sharks in New Zealand.

Fishery Interactions
Region SCH 3S/5 is predominantly a setnet fishery targeting school shark and small amounts of rig, with other species being very minor; and in the bottom trawl fishery targeting red cod, flatfish, barracouta, and stargazer. Mixed targeted bottom longline takes only a small part of the catch.

- **SCH 4**

Stock Status	
Year of Most Recent Assessment	2021
Assessment Runs Presented	Standardised CPUE based on the combined bottom longline series
Reference Points	Target: Not established Soft Limit: 50% of target Hard Limit: 25% of target Overfishing threshold: Not established
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unlikely
Status in relation to Overfishing	Unknown

Historical Stock Status Trajectory and Current Status



Left panel: Standardised CPUE for school shark in SCH 4 from model of catch rate in bottom longline trips (solid line). Also shown is the trajectory of total landed SCH from the sub-stock area (grey line). Right panel: Annual relative exploitation rate for school shark in SCH 4.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The bottom longline CPUE series has fluctuated without trend. The series is short due to a fleet change and sparse data in the earlier period.
Recent Trend in Fishing Intensity or Proxy	Fishing intensity has been increasing since about 2010.
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	Biomass estimates from the Chatham Rise research trawl survey have been increasing over time but few school shark observations are made. Only large individuals are sampled due to the depth span of this survey.

Projections and Prognosis	
Stock Projections or Prognosis	-
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown Hard Limit: Unlikely
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unknown

Assessment Methodology		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE	
Assessment Dates	Latest assessment: 2021	Next assessment: 2024
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Catch and effort data	1 – High Quality
Data not used (rank)		
Changes to Model Structure and Assumptions	None	

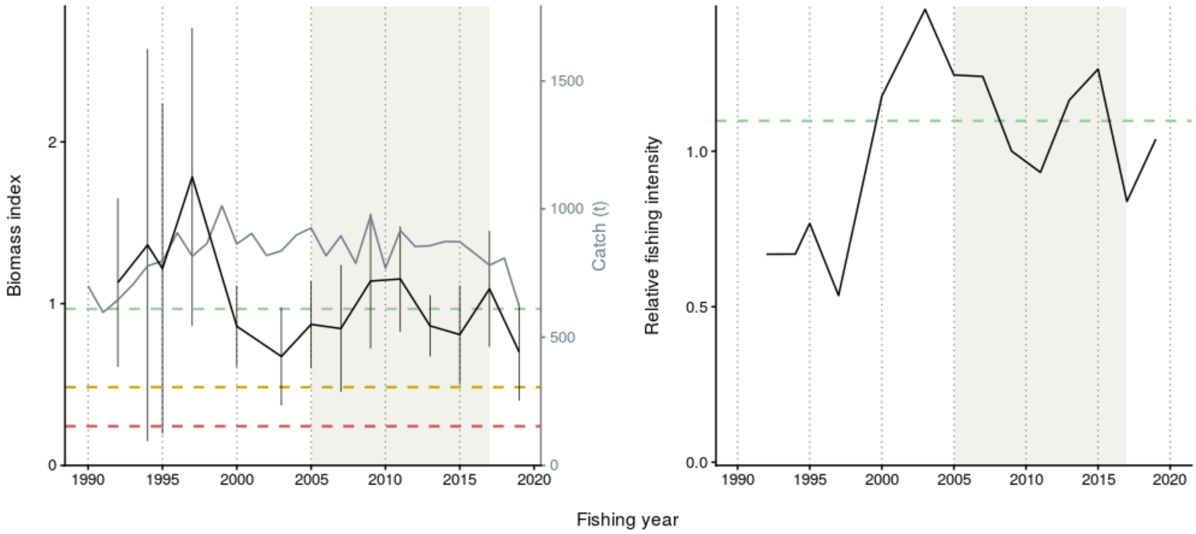
Major Sources of Uncertainty	- Relationship between stock monitoring areas
Qualifying Comments	
-	

Fishery Interactions
Region SCH 4 (Chatham Rise) catches are caught primarily in the bottom longline fishery targeting school shark, ling, hapuku/bass and bluenose.

- **SCH 7, SCH 8 & lower SCH 1W (7/8/1W on the map)**

Stock Status	
Year of Most Recent Assessment	2021
Assessment Runs Presented	Biomass estimates based on the west coast South Island research trawl survey
Reference Points	Target: Interim B_{MSY}-compatible proxy based on the mean biomass from 2005 to 2015 for west coast South Island research trawl survey Soft Limit: 50% of target Hard Limit: 25% of target Overfishing threshold: Interim F_{MSY}-compatible proxy based on the mean relative exploitation rate for the period: 2004–05 to 2015
Status in relation to Target	About as Likely as Not (40–60%) to be at or above B_{MSY}
Status in relation to Limits	Soft Limit: Unlikely (< 40%) Hard Limit: Very Unlikely (< 10%)
Status in relation to Overfishing	Overfishing is Unlikely (< 40%) to be occurring

Historical Stock Status Trajectory and Current Status



Left panel: Biomass index for school shark in 7/8/1W from the West Coast South Island research trawl survey (solid line). Also shown is the trajectory of total landed SCH by all methods from the substock area (grey line). Horizontal lines represent the target (green dashed line), the soft limit (yellow dashed line), and hard limit (red dashed line). The reference period is shown in beige. Right panel: Annual relative exploitation rate for school shark in 7/8/1W from the combined setnet CPUE series. The interim F_{MSY}-compatible target is shown by the green dashed line.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The west coast South Island trawl survey biomass has been fluctuating without trend since 2005 after declining from an initial high in the 1990s, with no substantive change in catch-at-length.
Recent Trend in Fishing Intensity or Proxy	Fishing mortality has been near target levels since 2007.
Other Abundance Indices	- The combined setnet CPUE has been increasing slowly since 1998–99, with some variability. However, this series is being compromised due to area closures.
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	-
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unlikely (< 40%) Hard Limit: Very Unlikely (< 10%)
Probability of Current Catch or TACC causing Overfishing to continue or to commence	About as Likely as Not (40–60%)

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Research trawl survey biomass	
Assessment Dates	Latest assessment: 2021	Next assessment: 2024
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Estimated biomass from trawl survey	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	- Research trawl survey biomass was used instead of the average of the combined setnet and combined longline CPUE series that was previously accepted to monitor stock status.	

	- The setnet combined index could be used as an auxiliary index, but it has probably been impacted by spatial management measures aimed at the conservation of Māui and Hector's dolphins.
Major Sources of Uncertainty	- Relationship between stock monitoring areas

Qualifying Comments
-

Fishery Interactions
Region SCH 7/8/1W are caught by setnet targeting school shark and rig; bottom longline targeting school shark and hāpuku/bass; and bottom trawl targeting tarakihi, barracouta, red gurnard, flatfish, hoki, and others.

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