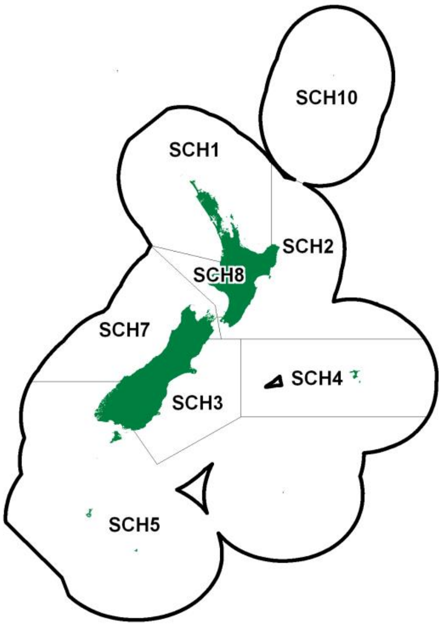
SCHOOL SHARK (SCH)

(*Galeorhinus galeus*)
Tupere, Tope, Makohuarau



1. FISHERY SUMMARY

School shark was introduced into the QMS on 1 October 1986, with allowances, TACCs and TACs 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	893
SCH 2	-	-	-	161.9	198.6
SCH 3	48	48	19	387	502
SCH 4	-	-	-	120	238
SCH 5	7	7	37	743	794
SCH 7	58	58	32	641	789
SCH 8	21	21	26	529	597
SCH 10	-	-	-	10	10

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. Catches 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/year. In 1995–96, total landings increased to above the level of the TACC (3107 t) to 3387 t, exceeding the TACC for the first time. Landings have remained near the level of the TACC since 1995–96. TACCs for SCH 3, 5, 7 & 8 were increased by 5% (SCH 5) and 20% (the remainder) 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, while 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 were added to the 6th schedule on the 1st of January 2013, which allows school shark that are alive 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 Table3 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: MPI 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 setnet still accounting for just under 50% of the landings, while 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 which was required to remain tied to the net while it was set.

Voluntary setnet closures were implemented by the SEFMC from 1 October 2000 to protect nursery grounds for rig and elephantfish 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 Maui's and Hector's dolphins was implemented for all of 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 set netting was banned in most areas from 1 October 2008 to 4 nautical miles offshore of 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 set netting to only one nautical mile offshore around the Kaikoura 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 all of 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 the period 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 Maui's dolphin closure beginning north of New Plymouth at Pariokariwa Point.

Table 3: Reported landings (t) of school shark by Fishstock from 1931–32 to 2015–16 and actual TACCs (t) from 1986–87 to 2012–13. QMS data from 1986-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	-

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
1982–83	598	-	245	-	544	-	1	-	264	-
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
201213	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	496	689	152	199	434	387	206	239	623	743

Fishstock	SCH 7		SCH 8		SCH 10		Total	
FMA (s)	7		8		10			
	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	-
1961–62	26	-	15	-	-	-	360	-
1962–63	21	-	26	-	-	-	353	-

Table 3 [continued]

Fishstock	SCH 7		SCH 8		SCH 10		Total	
FMA (s)	7		8		10			
	Landings	TACC	Landings	TACC	Landings	TACC	Landings§	TACC
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
1995–96	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

*FSU data. § Includes landings from unknown areas before 1986-87.

Note: Data for the period 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 includes both foreign and domestic landings. Data were aggregated to FMA using methods and assumptions described by Francis & Paul (2013).

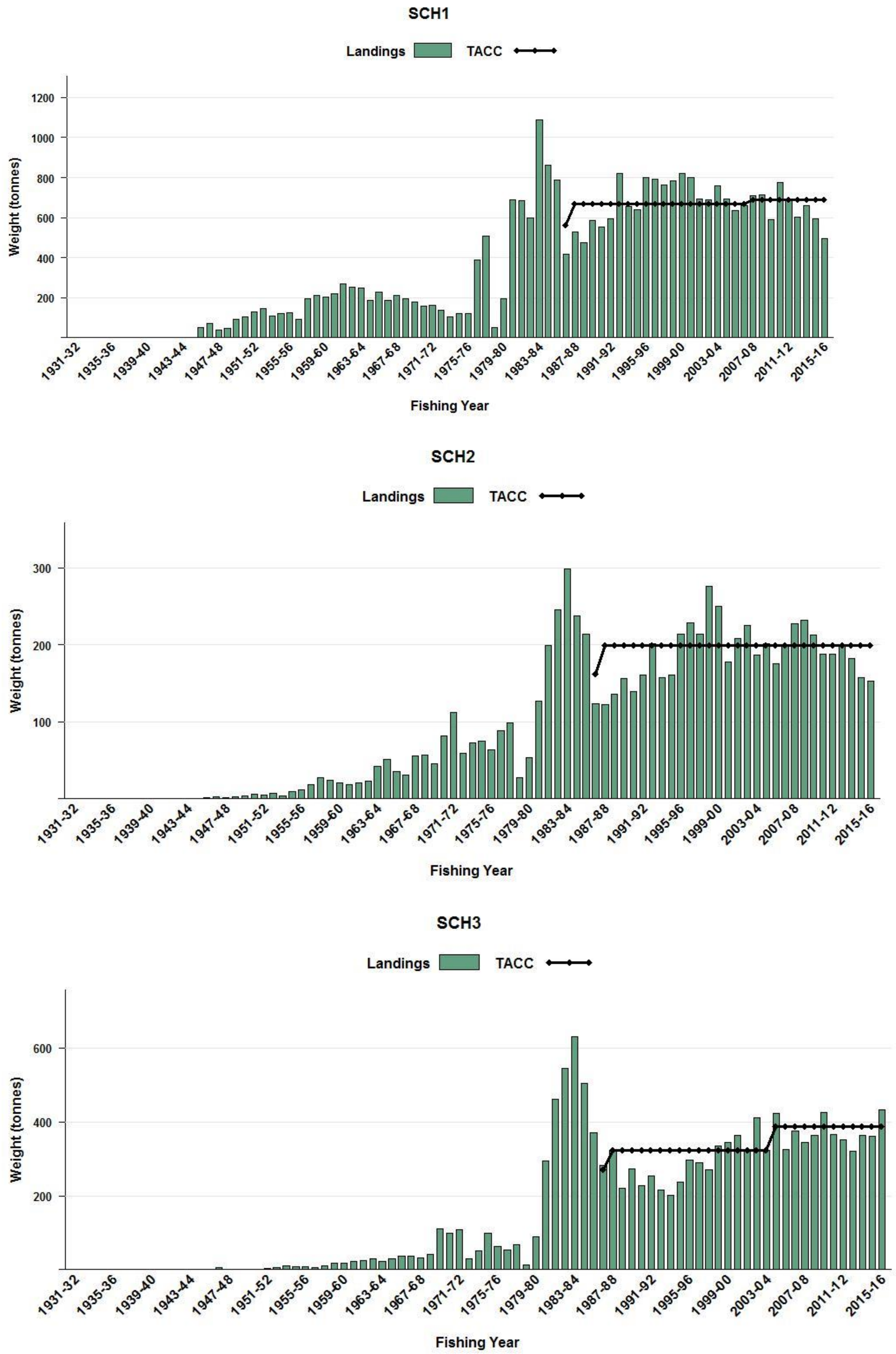
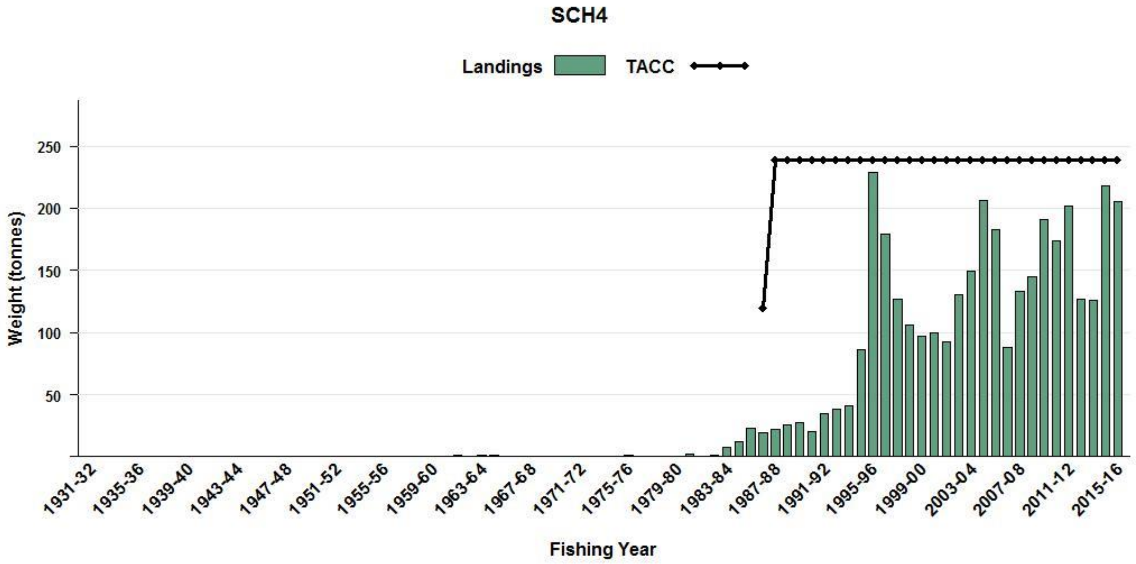
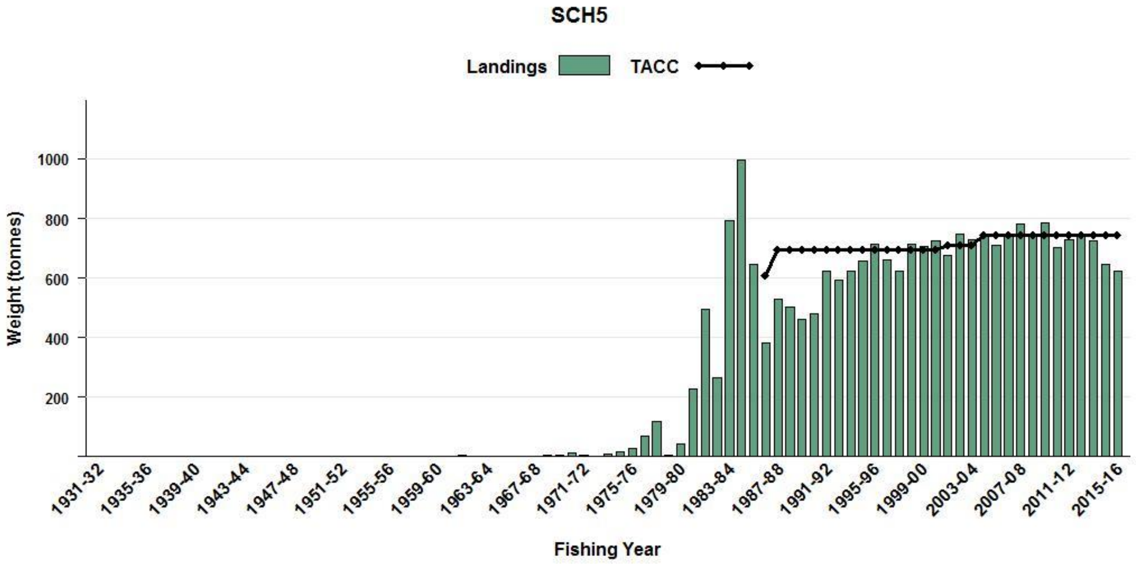


Figure 1: Reported commercial landings and TACC for the seven main SCH stocks. Above: SCH1 (Auckland East), SCH 2 (Central East), and SCH 3 (South East coast). Continued on next page)





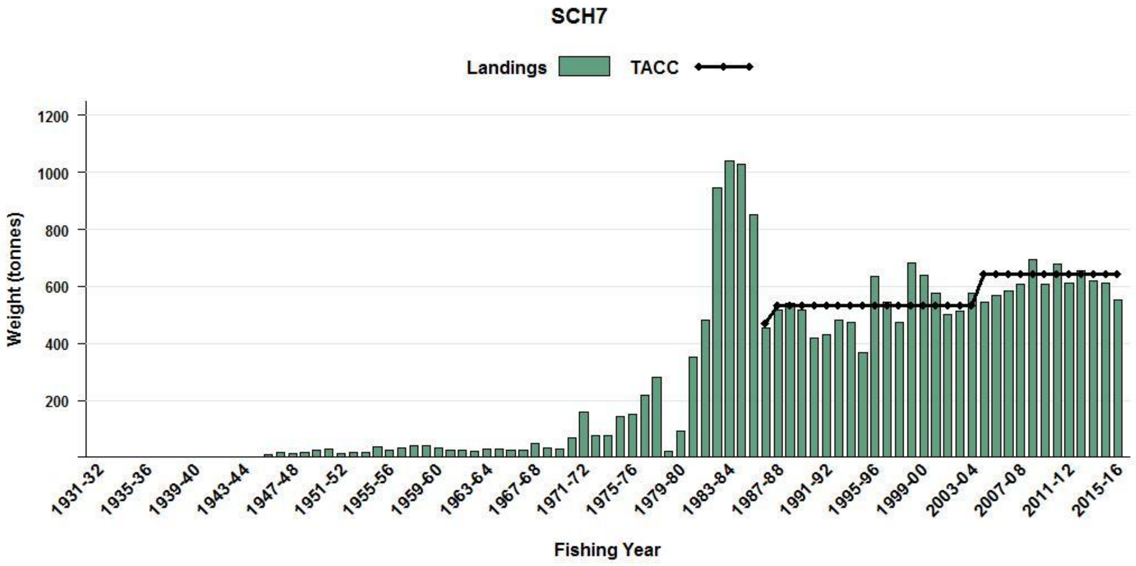


Figure 1 [Continued]: Reported commercial landings and TACC for the seven main SCH stocks. From top to bottom: SCH4 (South East Chatham Rise), SCH 5 (Southland), and SCH 7 (Challenger). Continued on next page.

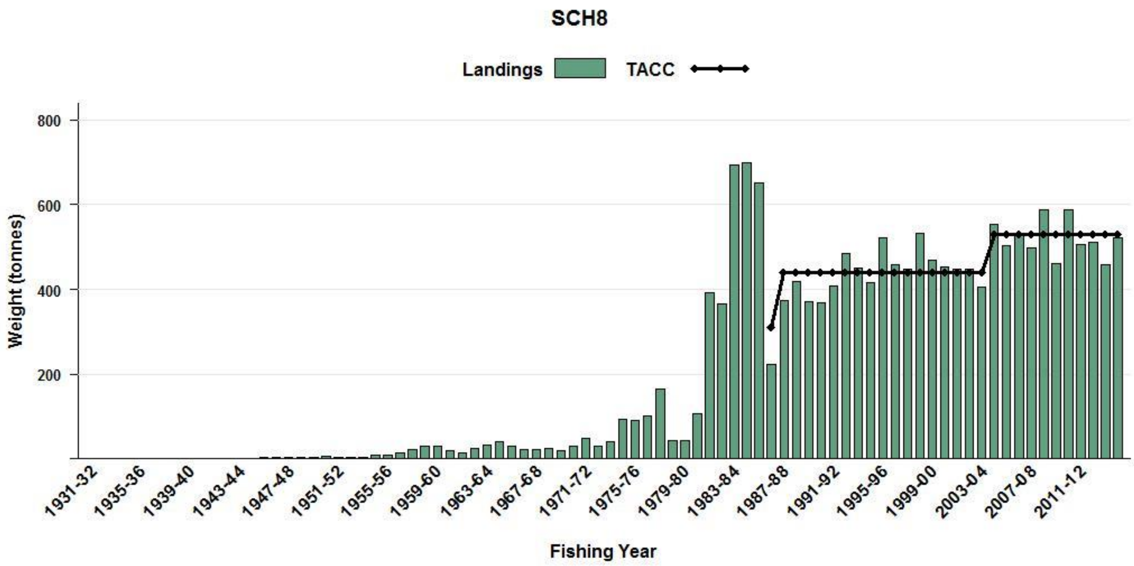


Figure 1[Continued]: Reported commercial landings and TACC for the seven main SCH stocks. SCH8 (Central Egmont).

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 at the present time.

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 shark as part of their combined daily bag limit in the 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 shark as part of their combined daily bag limit in the 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 are 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 2005. 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. 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. Note that the national panel survey estimate does not include harvest taken on recreational charter vessels, or recreational harvest taken under s111 general approvals. Recreational catch estimates from the national panel survey are given in Table 4.

Table 4: Recreational harvest estimates for school shark stocks. The telephone/diary surveys ran from December to November but are denoted by the January calendar year. The national panel survey ran through the October to September fishing year but 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	9 448	-	0.26
SCH 2	1996	Telephone/diary	5 000	-	-
	2000	Telephone/diary	7 000	18	0.30
	2012	Panel survey	1 425	-	0.79
SCH 3	1996	Telephone/diary	3 000	-	-
	2000	Telephone/diary	19 000	48	0.46
	2012	Panel survey	5 381	-	0.37
SCH 5	1996	Telephone/diary	1 000	-	-
	2000	Telephone/diary	3 000	7	0.66
	2012	Panel survey	443	-	0.60
SCH 7	1996	Telephone/diary	8 000	16	0.24
	2000	Telephone/diary	23 000	58	0.56
	2012	Panel survey	9 693	-	0.38
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

1.3 Customary non-commercial 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 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. 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 the 1995 Plenary Report).

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 so little information is provided for North Island school shark. Female school shark 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 have been updated in 2014 as part of a full review of these Fishstocks. As part of this review, the fine scale location data from the QMA-specific CPUE series used to monitor this species were inspected for continuity and consistency. It was noted that, in many cases, these fishery definitions were constructs of administrative boundaries and often 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 9 fisheries selected for monitoring school shark. The fisheries were selected on the basis of fine scale positional data but use MPI statistical areas to make the definitions in order 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 representation of the distribution of fishing before that year.

The main difficulty in finalising these definitions was how to deal with Cook Strait, with the decision made to place 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 Kaikoura 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.

Table 6: List of 9 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 setnet on the Chatham Islands (SCH 4).

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

Characterisation comments by SCH QMA

SCH 1

About 1/3 of the SCH 1 landings are taken by bottom trawl while targeting tarakihi and snapper, with smaller catches when targeting trevally and red gurnard. The bottom longline SCH 1 fishery, taking about 30% of the total landings, is primarily directed at school shark, with hapuku and snapper being other important targets. The setnet fishery, which takes about ¼ of the landings, is mainly targeted at school shark, with some additional targeting of rig, trevally, gurnard and snapper.

SCH 2

SCH 2 are caught primarily in the bottom trawl fishery (44%) targeting tarakihi, hoki, gemfish and gurnard; and the bottom longline fishery (32%) targeting school shark, ling, hapuku/bass and bluenose. Sixteen per cent of the catch is taken in setnet targeting school shark, blue warehou and blue moki.

SCH 3

SCH 3 is predominantly caught in the setnet fishery (56%) targeting school shark and rig, with some targeting of spiny dogfish and tarakihi; and in the bottom trawl fishery (35%) targeting red cod, with some targeting of flatfish, barracouta and tarakihi. Mixed targeted bottom longline takes 8% of the catch.

SCH 4

SCH 4 is primarily (78%) a bottom longline fishery targeted at bluenose, hapuku/bass, ling and a few school shark. There also exists a small bottom trawl fishery (16% of landings) which targets a range of species including tarakihi, barracouta, stargazer, hoki and scampi. The setnet fishery is very small (3%) and cannot be used to monitor the Fishstock.

SCH 5
SCH 5 is almost entirely caught in the school shark targeted setnet fishery (86%), with some minor targeting of rig. Seven percent is taken by bottom trawl primarily targeting stargazer and squid, and 5% by bottom longline primarily targeting hapuku/bass and ling.

SCH 7
SCH 7 are caught by the setnet fishery (28%) targeting school shark, rig and spiny dogfish; bottom longline (31%) targeting school shark, hapuku/bass and ling; and bottom trawl (39%) targeting barracouta, tarakihi, flatfish, hoki, red cod and others.

SCH 8
SCH 8 are caught mainly (66%) by setnet targeting school shark and rig; and by bottom longline (22%) targeting school shark and hapuku/bass. Ten percent is caught by bottom trawl targeting gurnard, tarakihi and trevally.

4.1 Biomass estimates

ECSI

The ECSI winter 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 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 elephantfish and red gurnard which were included in the list of target species. Only 2007, 2012, and 2014 surveys provide full coverage of the 10–30 m depth range.

Biomass in the core strata (30–400 m) for the east coast South Island winter trawl surveys is 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 and 2014 surveys, and hence the shallow strata (10–30 m) are probably not essential for monitoring school shark biomass

4.2 Length frequency distributions

ECSI
School shark are most common in 30–100 m with a tendency for the youngest cohorts to be in the shallower depth ranges (Figure 3). The three modes at 35, 50, and 60 cm are all pre-recruited school shark and correspond to ages of 0+, 1+, and 2+. The survey appears to be monitoring pre-recruited cohorts 0+, 1+, 2+ (and possibly a few more older cohorts) reasonably well, but not the recruited school shark size distribution. Plots of time series length frequency distributions are spiky because of the low numbers caught, but the size range is reasonably consistent among surveys. The addition of the 10–30 m depth range has changed the shape of the length frequency distribution only slightly.

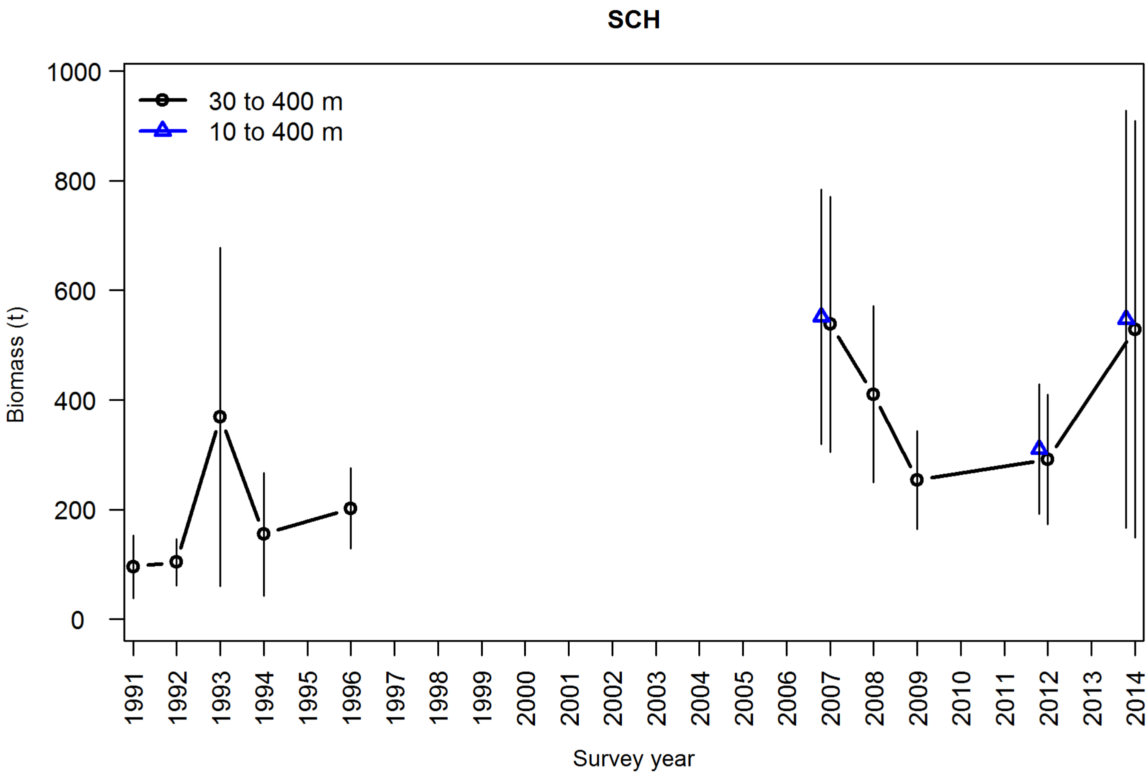


Figure 2: School shark total biomass and 95% confidence intervals for the all ECSI winter surveys in core strata (30–400 m), and core plus shallow strata (10–400 m) in 2007, 2012 and 2014.

Table 7: Relative biomass indices (t) and coefficients of variation (CV) for school shark for the east coast South Island (ECSI) – winter, survey area*. Biomass estimates for ECSI in 1991 have been adjusted to allow for non-sampled strata (7 & 9 equivalent to current strata 13, 16 and 17). – , not measured; NA, not applicable.

Region	Fishstock	Year	Trip number	Total Biomass estimate	CV (%)	Total Biomass estimate	CV (%)
ECSI (winter)	SCH				30–400m		10–400m
		1991	KAH9105	100	30	-	-
		1992	KAH9205	104	21	-	-
		1993	KAH9306	369	42	-	-
		1994	KAH9406	155	36	-	-
		1996	KAH9608	202	18	-	-
		2007	KAH0705	538	22	552	21
		2008	KAH0806	411	20	-	-
		2009	KAH0905	254	18	-	-
		2012	KAH1207	292	20	310	19
		2014	KAH1402	529	36	547	35

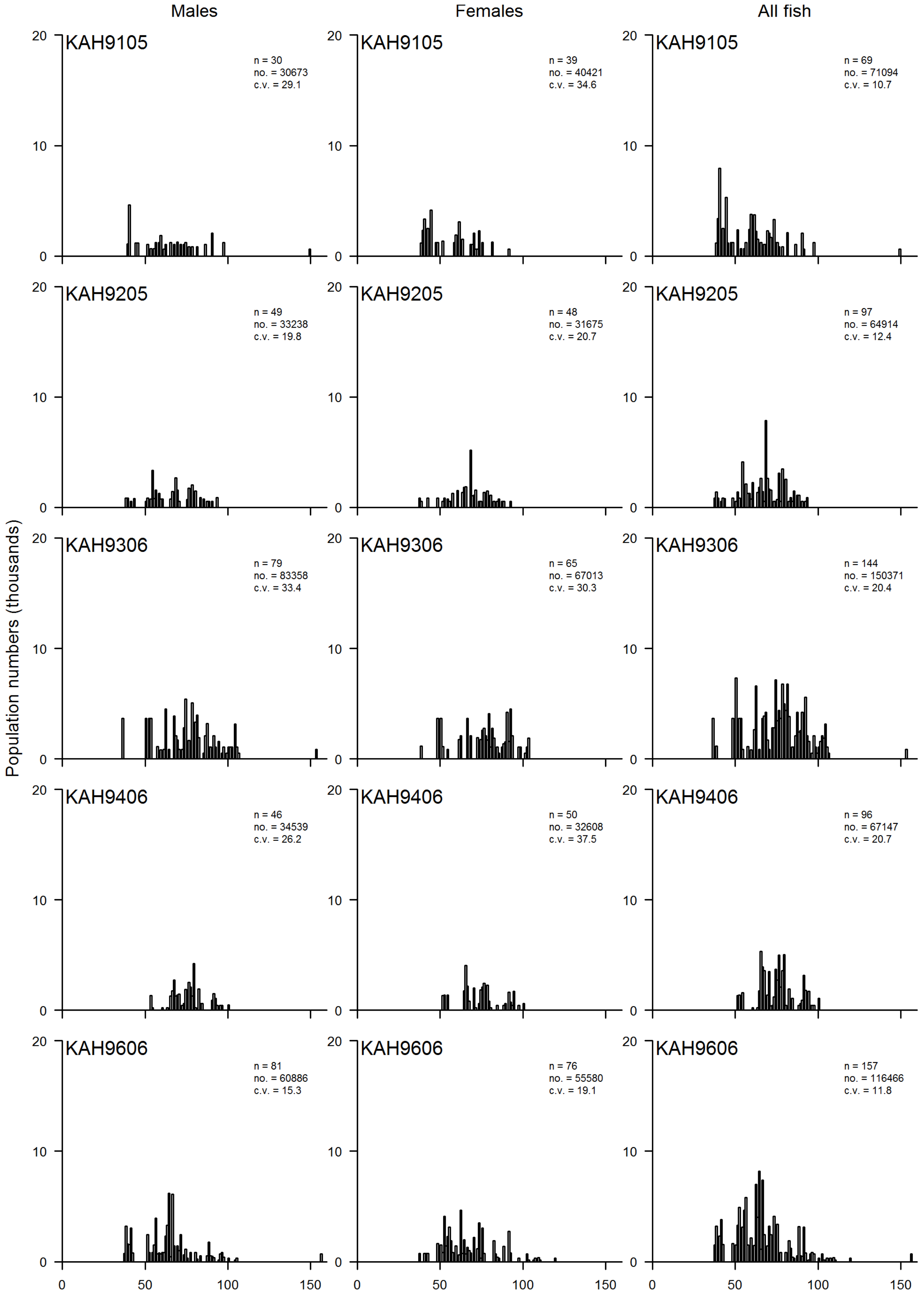


Figure 3:Scaled length frequency distributions for school shark in core strata (30–400 m) for all ten ECSI winter surveys. The length distribution is also shown in the 10–30 m depth strata for the 2007, 2012, and 2014 surveys overlaid in red. Population estimates are for the core strata only. n, number of fish measured; no., population number; c.v., coefficient of variation [Continued on next page].

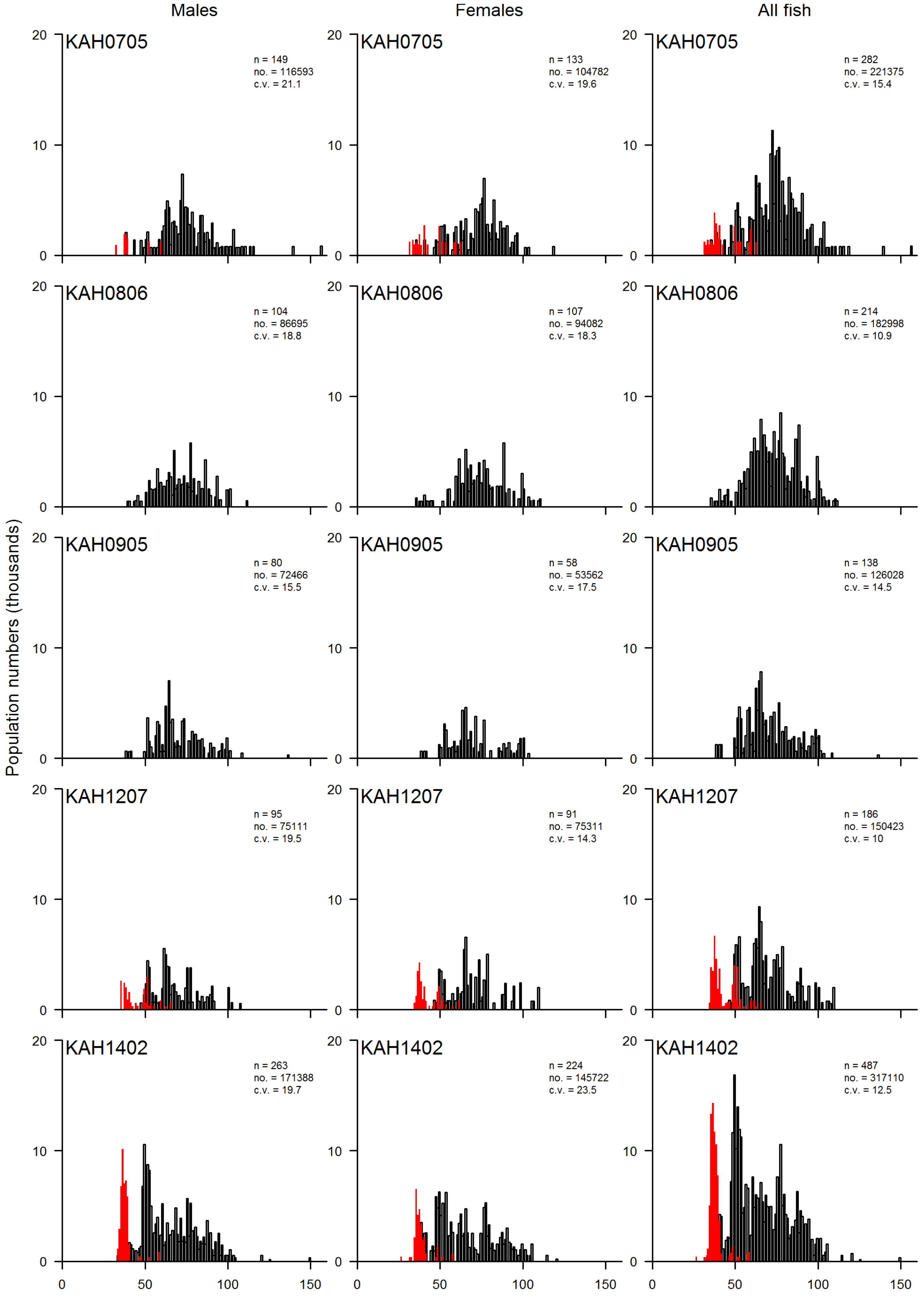


Figure 3: [Continued]: Scaled length frequency distributions for school shark in core strata (30–400 m) for all ten ECSI winter surveys. The length distribution is also shown in the 10–30 m depth strata for the 2007, 2012, and 2014 surveys overlaid in red. Population estimates are for the core strata only. n, number of fish measured; no., population number; c.v., coefficient of variation.

CPUE trends by SCH Region (see Table 6)

Far North & SCH 1E

The lognormal setnet series shows a shallow increasing trend with a sharp upturn in 2011/12 and 2012/13 (Figure 4). This upturn is seen in the areaXyear implied residual plots for each of the major statistical areas (047, 002 and 007). The increasing trend is also mirrored by the lognormal bottom longline series but that increasing trend is exaggerated from the early 2000s in the combined binomial/lognormal model (Figure 6).

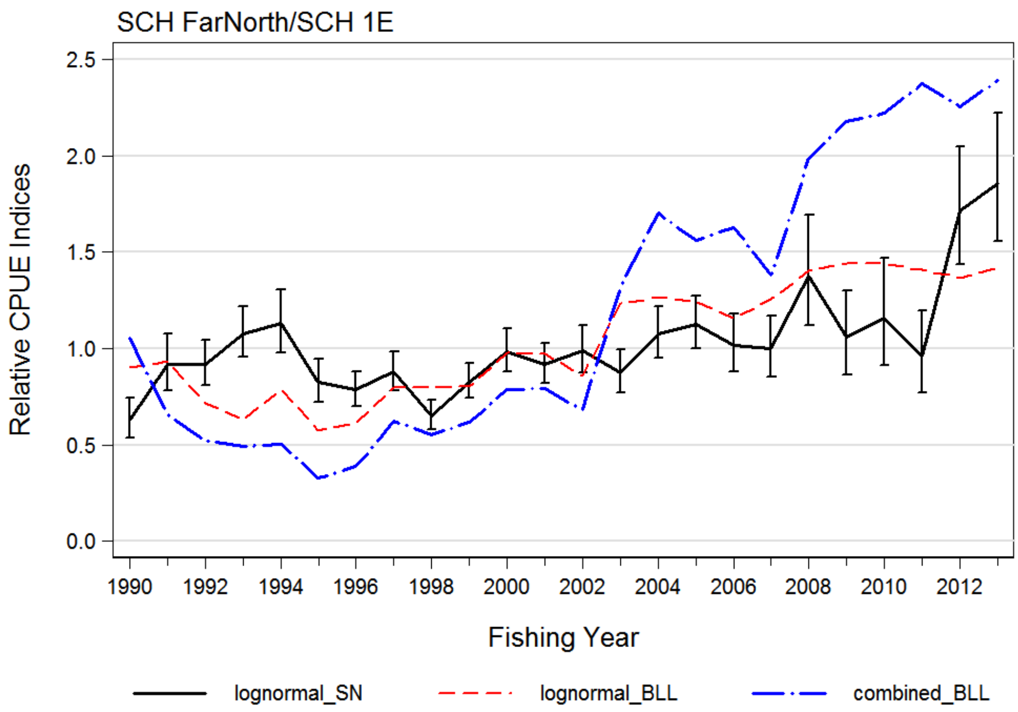


Figure 4: Far North/SCH 1E region (see Table 5): comparison of the lognormal SN series, the lognormal BLL series and the combined (using the delta-lognormal method) BLL series.

SCH 2 & top of SCH 3

The bottom longline and setnet capture methods provide contradictory trends in this Region, with the setnet series increasing and both the lognormal and combined series decreasing (Figure 5). The reason for this contradiction is unknown. It is possible that the relatively small amount of catch and effort data available from this region is partially responsible for this result.

Chatham Rise (SCH 4)

There is no available setnet series to contribute to the monitoring this Chatham Rise region. A standardised CPUE series was constructed from the recent (since 2003/04) bottom longline catch and effort data (Figure 6). This latter series shows no trend over the ten years of indices. Although earlier data are available, it is apparent from their analysis, that there was a substantial change in reporting behaviour between 2002/03 and 2003/04.

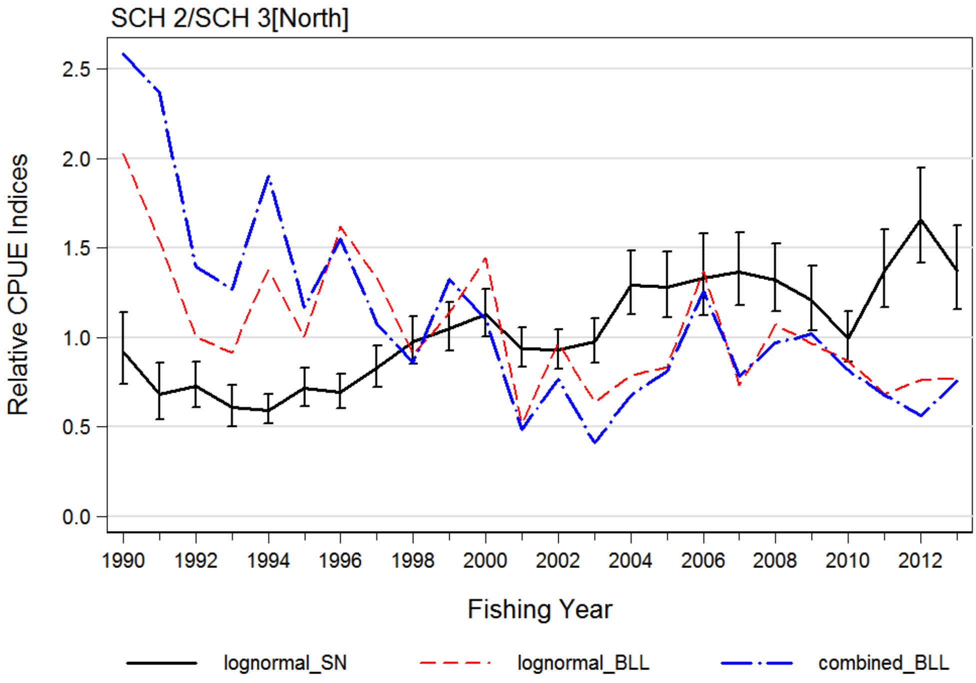


Figure 5: SCH 2 & top of SCH 3 region (see Table 6): comparison of the lognormal SN series, the lognormal BLL series and the combined (using the delta-lognormal method) BLL series.

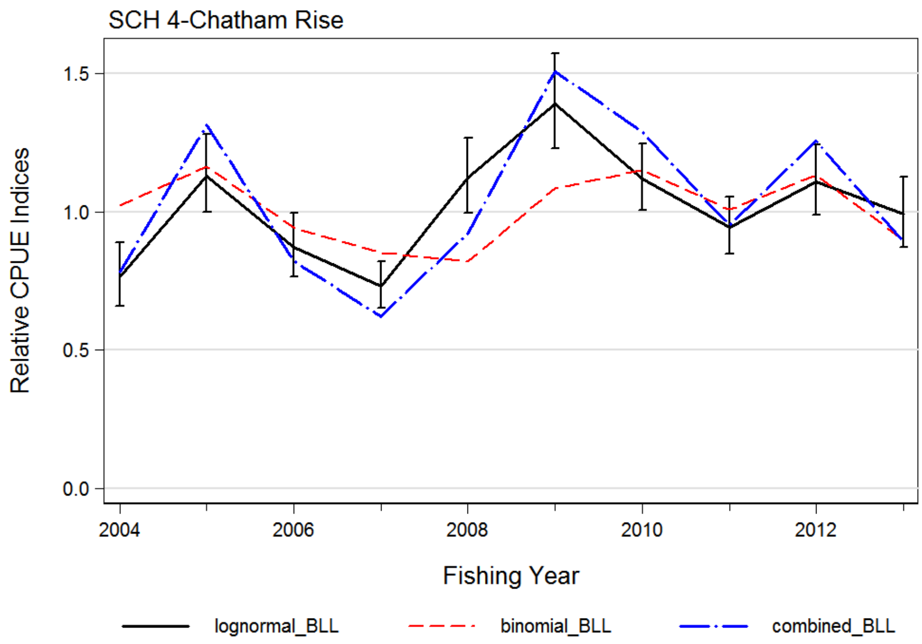


Figure 6: Chatham Rise (SCH 4) region (see Table 6): comparison of the lognormal SN series, the lognormal BLL series and the combined (using the delta-lognormal method) BLL series.

Lower SCH 3 & SCH 5

The lognormal setnet series showed a long and gradual declining trend while there was no trend in either the lognormal or combined bottom longline series (Figure 7). The setnet fishery is known to target large mature fish, but there is no nearby spawning or nursery ground (Francis 2010 and Section 3 above). The inconclusive bottom longline series is likely the result of small amounts of available data, leading to low reliability.

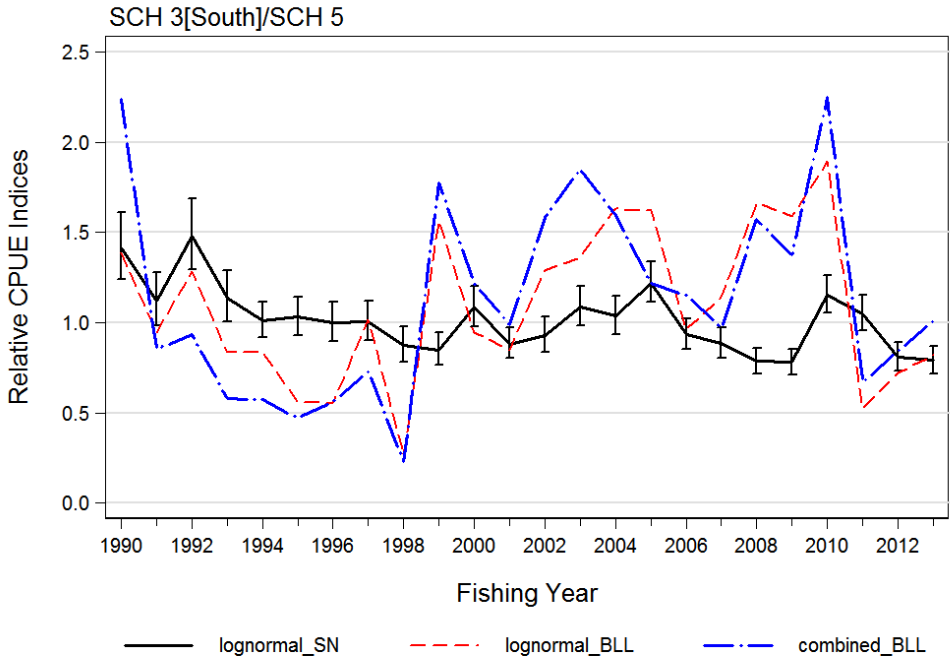


Figure 7: lower SCH 3 & SCH 5 region (see Table 6): comparison of the lognormal SN series, the lognormal BLL series and the combined (using the delta-lognormal method) BLL series.

SCH 7, SCH 8 & lower SCH 1W

As seen for the series based mainly in Foveaux Strait and Stewart Island, the lognormal setnet series shows a long and gradual declining trend (Figure 8). However, unlike for the Foveaux Strait series, both of the bottom longline series show a gradually increasing trend, with considerable year-to-year variability.

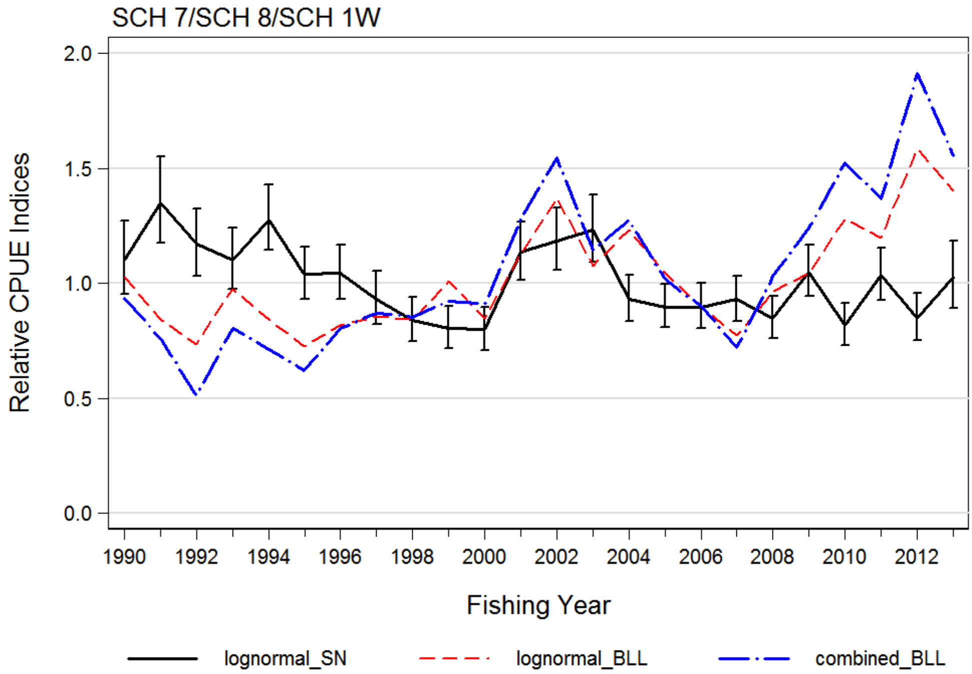


Figure 8: SCH 7, SCH 8 & lower SCH 1W region (see Table 6): comparison of the lognormal SN series, the lognormal BLL series and the combined (using the delta-lognormal method) BLL series.

SCH overview

SCH are mainly caught in setnet fisheries targeting sharks (school shark, rig, elephantfish and spiny dogfish, depending on the Region); in bottom trawl fisheries targeting red cod, tarakihi, gurnard and snapper and others; and in bottom longline fisheries targeting school shark, hapuku/bass and ling. A large proportion of the school shark catch in the setnet and bottom longline fisheries is taken by targeted effort.

There are similarities in the CPUE time series between regions. For instance, there is good agreement between the increasing trends seen in the setnet fisheries in the Far North, the Bay of Plenty and the east coast of the North Island (Figure 9). Moving around the South Island, there is also good agreement between the decreasing trends seen in Foveaux Strait and Stewart Island and from the central west coast of the North and South Islands (Figure 10).

Similarly, the bottom longline CPUE series show similarities, but these are different from the setnet fishery. The bottom longline fishery operating in the central west coast of the North and South Islands shows an increasing trend, unlike the related series developed from setnet data (Figure 11). The strong downward trend seen in the east coast North Island bottom longline series is not corroborated by other series in nearby regions (Figure 12), although the comparison is compromised by the lack of index values before 2003/04 for the Chatham Islands series.

These contradictory trends are difficult to interpret for a highly mobile species such as this one. In general, it seems that the North and East Coast regions are doing well, showing increasing trends in CPUE. The Southern and West Coast regions have been fluctuating without trend since 2000 after a period of decline of about 30% from 1989 to 1999. The Working Group noted that the setnet fisheries in SCH 5 and SCH 7 have accounted for 26% of the total SCH catch over the past 24 years and that these are the fisheries which have a high proportion of mature fish in the catch. The lack of similarity between the bottom longline and setnet CPUE series within a region may point to these fisheries tending to operate in different areas and depths, and potentially catching different components of the population.

Recent setnet closures have potentially compromised the continuity of setnet indices for SCH 1W, 3, 5 and 7.

4.2 Yield estimates and projections

The estimates of *MCY* are no longer considered valid.

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

4.3 Other factors

In Australia, recruitment overfishing has occurred to such an extent that the stock is considered seriously threatened and a series of conservative management measures (TAC reductions) have been progressively imposed between 1996 and 2007 (Wilson et al. 2008). The Australian modelling work indicates that the stock is overfished. Wilson et al. (2008) noted that the stock had been in an overfished state and overfishing was occurring from 1992 to 2004. While the stock was still listed as overfished since then, they are uncertain as to whether overfishing is still occurring.

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.

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). School shark was ranked 6th highest in terms of risk of the eleven QMS chondrichthyan species. Data were described as existing and sound for the purposes of the assessment and consensus over this risk score was achieved by the expert panel. This risk assessment does not replace a stock assessment for this species but may influence research priorities across species.

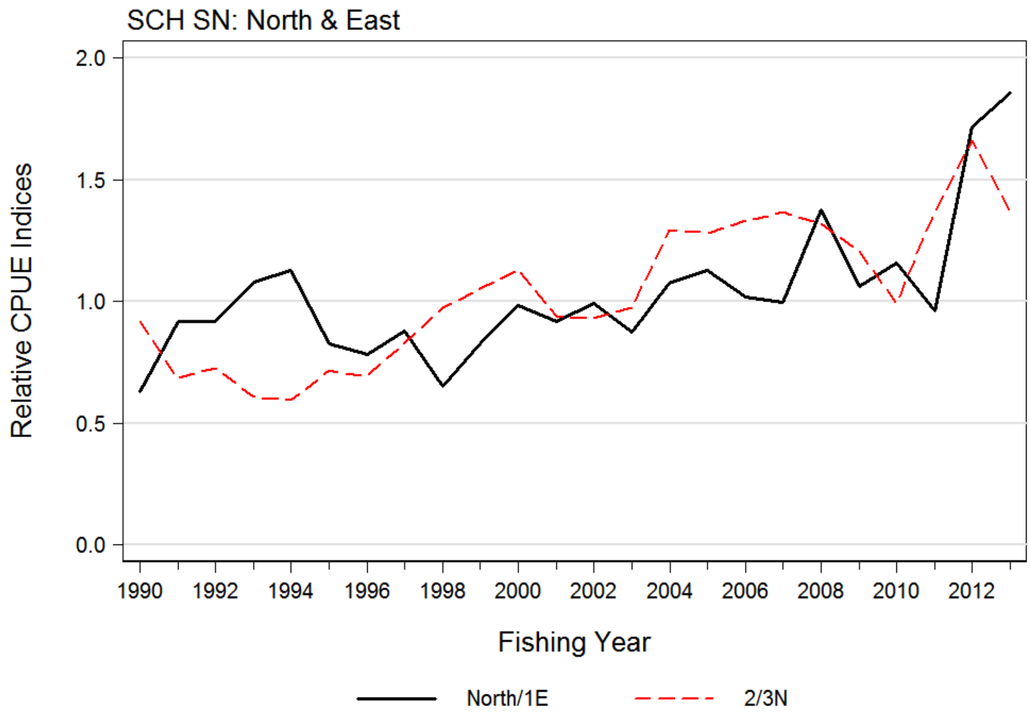


Figure 9: Comparison of lognormal setnet series for the North and East sides of New Zealand (Regions N/1E and 2/3N – see Table 6).

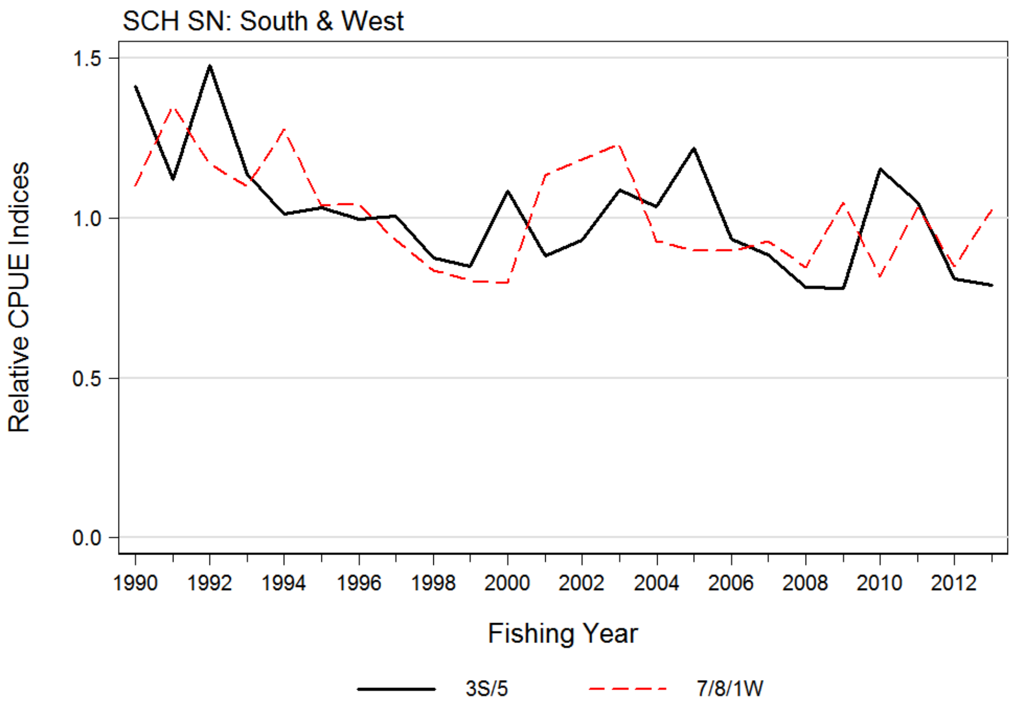


Figure 10: Comparison of lognormal setnet series for the Southern and Western sides of New Zealand (Regions 3S/5 and 7/8/1W – see Table 6).

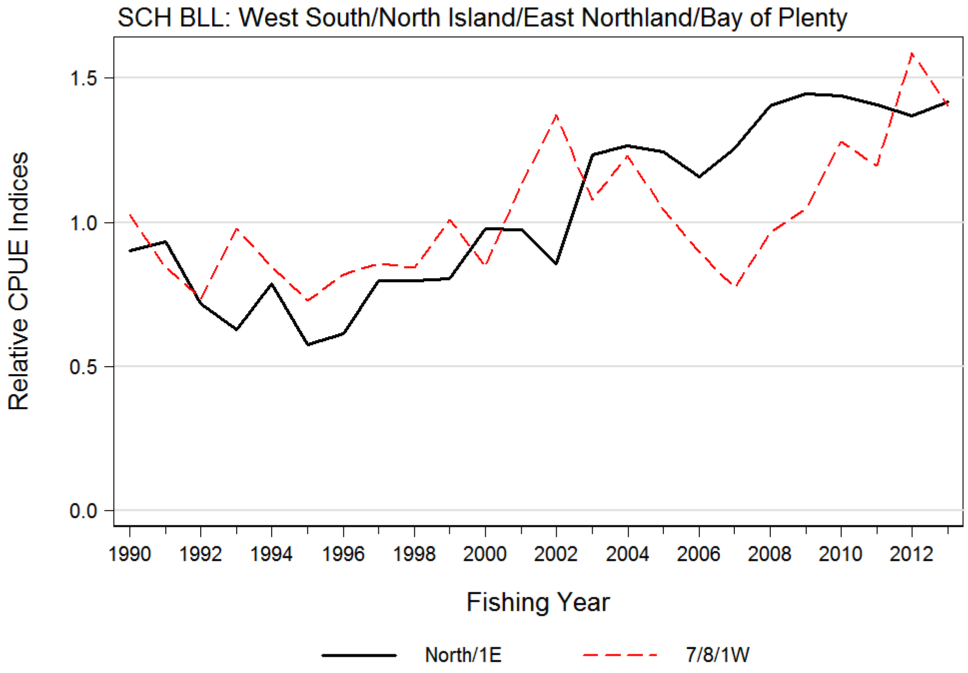


Figure 11: Comparison of lognormal bottom longline series for the Far North and West sides of New Zealand (Regions N/1E and 7/8/1W – see Table 6).

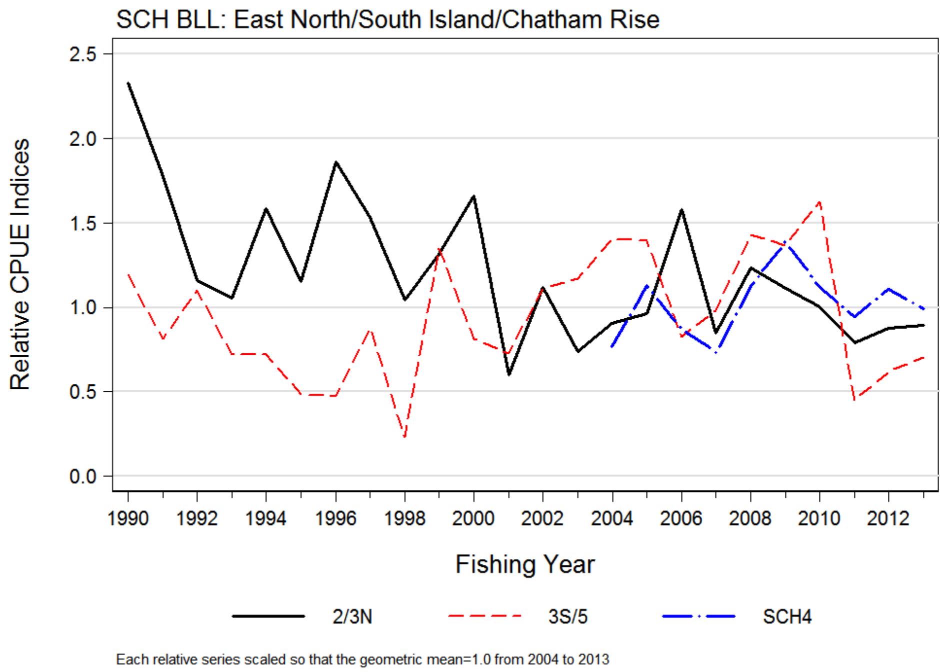


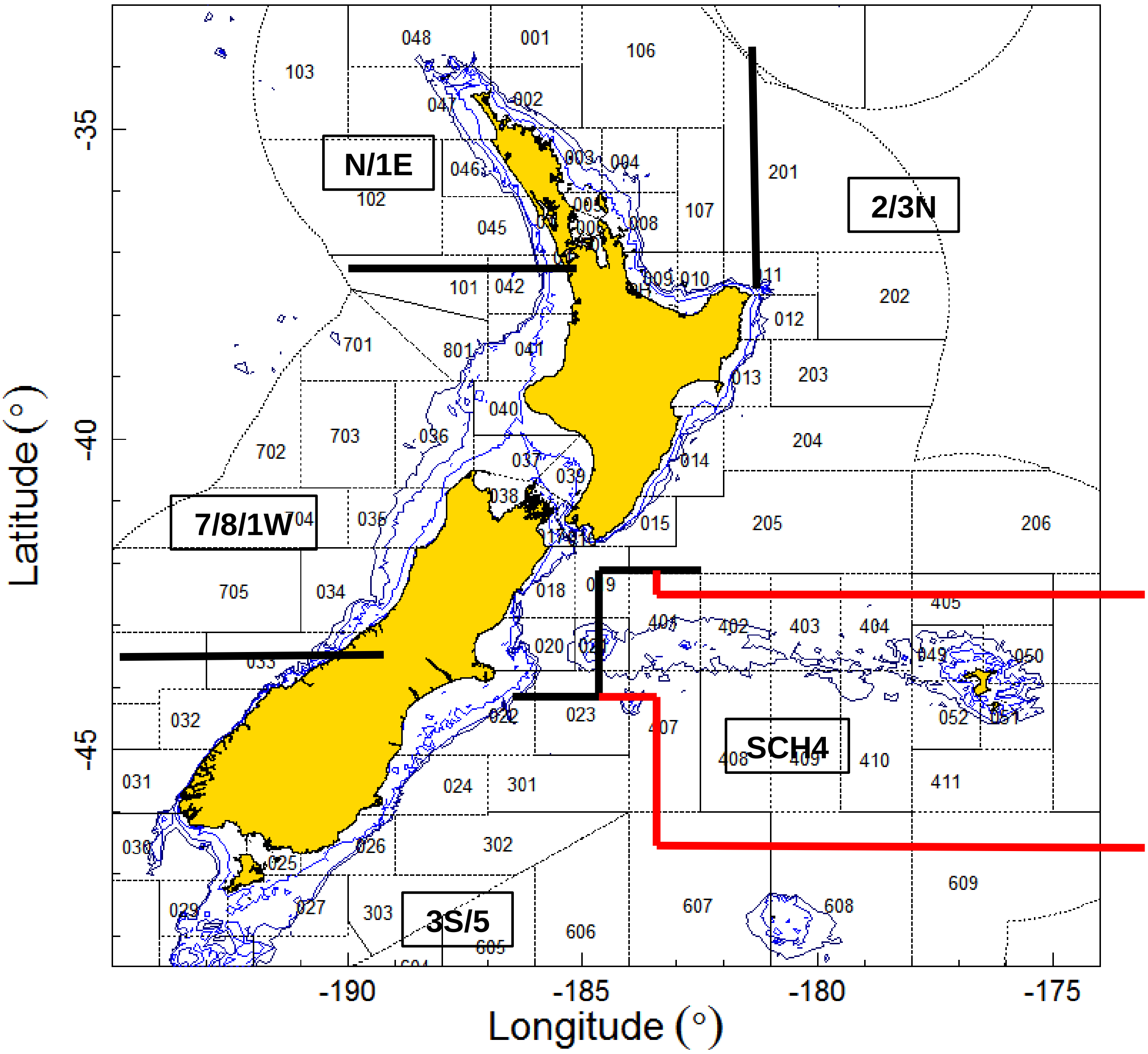
Figure 12: Comparison of lognormal setnet series for the East and South coasts of New Zealand and the Chatham Islands (Regions 2/3N, 3S/5 and SCH3 – see Table 6).

5. STATUS OF THE STOCKS

Stock Structure Assumptions

SCH are known from tagging studies to be highly mobile, moving between the North and South Islands, 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. Larger females predominate in catches around Southland and the west coast of the South Island. Therefore, the current stock management units are a precautionary measure to spread fishing effort and mortality across components of the stock.

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.

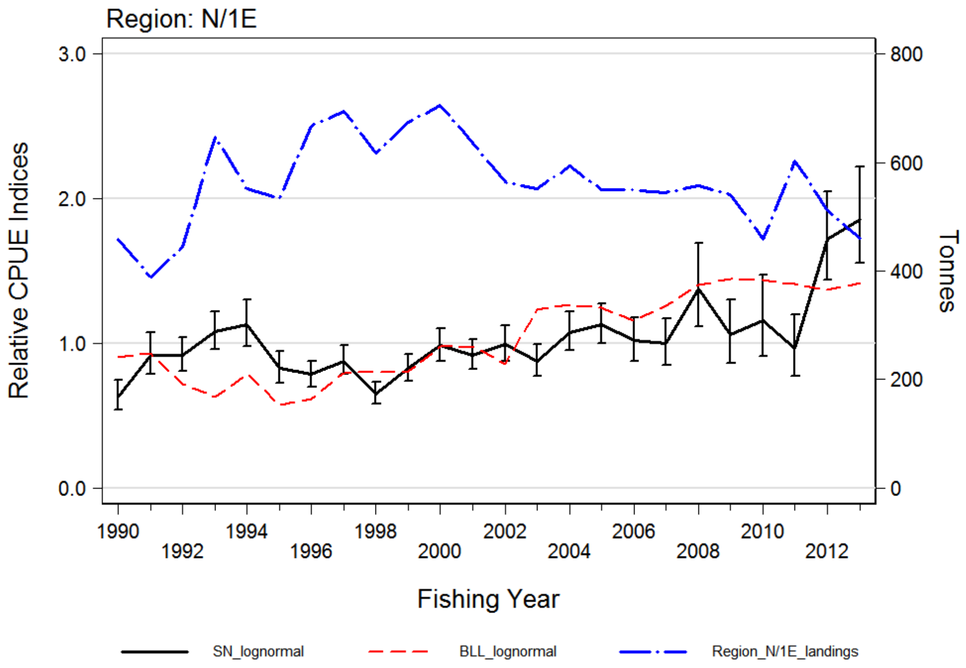


Far North & SCH 1E (N/1E on the map)

Stock Status	
Year of Most Recent Assessment	2014 (Fishery characterisation and CPUE standardisation)
Assessment Runs Presented	Far North & SCH 1E: setnet Far North & SCH 1E : bottom longline
Reference Points	Target: Not established but B_{MSY} assumed Soft Limit: 20% B_0 Hard Limit: 10% B_0
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unlikely (< 40%)

Status in relation to Overfishing	Unknown

Historical Stock Status Trajectory and Current Status



Comparison of the setnet and bottom longline CPUE series for the N/1E school shark Region. Also shown are the total annual catches (tonnes) for the Region.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The lognormal setnet and bottom longline CPUE series have both increased steadily from the beginning of the series, with the setnet series showing a sharp increase in 2011/12 and 2012/13.
Recent Trend in Intensity or Proxy	Fishing mortality appears to have been declining because CPUE has increased while catches have remained constant or declined.
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

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%) for current catch	
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	Evaluation of standardised CPUE indices	
Assessment Dates	Latest assessment: 2014	Next assessment: 2017
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 previously accepted indices were based on bottom longline and setnet which were divided at North Cape. This assessment redefined the monitored fishery to be more consistent with the fine scale pattern of fishing.	

Major Sources of Uncertainty	-The components of the population fished by each gear type -Interactions with other areas

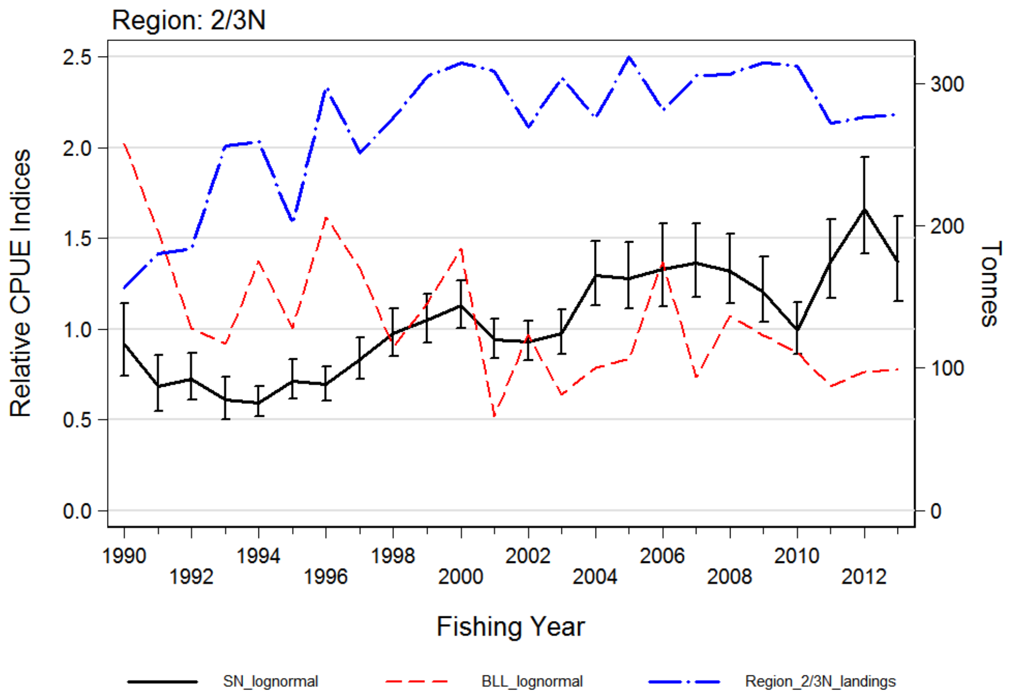
Qualifying Comments
Other available data from trawl surveys, observer records and bottom trawl CPUE indices should be analysed for comparison with the setnet and longline indices. A single New Zealand-wide CPUE index should be developed.

Fishery Interactions
Region Far North/SCH 1E catches are primarily taken by bottom trawl (37%) while targeting tarakihi and snapper, with smaller catches when targeting trevally and red gurnard. The bottom longline Far North/SCH 1E fishery (also 37%) is primarily directed at school shark, with hapuku, snapper and bluenose being other important targets. The setnet fishery (19%) is also primarily targeted at school shark, with some targeting of rig, trevally, gurnard and snapper. The bottom pair trawl fishery (only 3%) is almost entirely directed at snapper and trevally, with tarakihi becoming more important in recent years. In the setnet fisheries there is a risk of incidental capture of seabirds, Maui's dolphins on the west coast, other dolphins and New Zealand fur seals.

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

Stock Status	
Year of Most Recent Assessment	2014 (Fishery characterisation and CPUE standardisation)
Assessment Runs Presented	SCH 2 & top of SCH 3: setnet SCH 2 & top of SCH 3 : bottom longline
Reference Points	Target: Not established but B_{MSY} assumed Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: -
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unlikely (< 40%)
Status in relation to Overfishing	Unknown

Historical Stock Status Trajectory and Current Status



Comparison of the setnet and bottom longline CPUE series for the 2/3N school shark Region. Also shown are the total annual catches for the Region.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The lognormal setnet CPUE series has been increasing steadily from the mid-1990s, while the longline series has been steadily decreasing since the beginning of the series.
Recent Trend in Fishing Intensity or Proxy	Unknown
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	CPUE trends in this Region are contradictory, with the setnet series increasing while the bottom longline series has been decreasing. It is not known which series (if any) reflect the true underlying abundance.
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	Evaluation of standardised CPUE indices	
Assessment Dates	Latest assessment: 2014	Next assessment: 2017
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	-The previously accepted CPUE series was based on setnet data using mixed target species. This assessment redefined the monitoring fishery to be more consistent with the fine scale pattern of fishing.
Major Sources of Uncertainty	-The components of the population fished by each gear type -Interactions with other areas

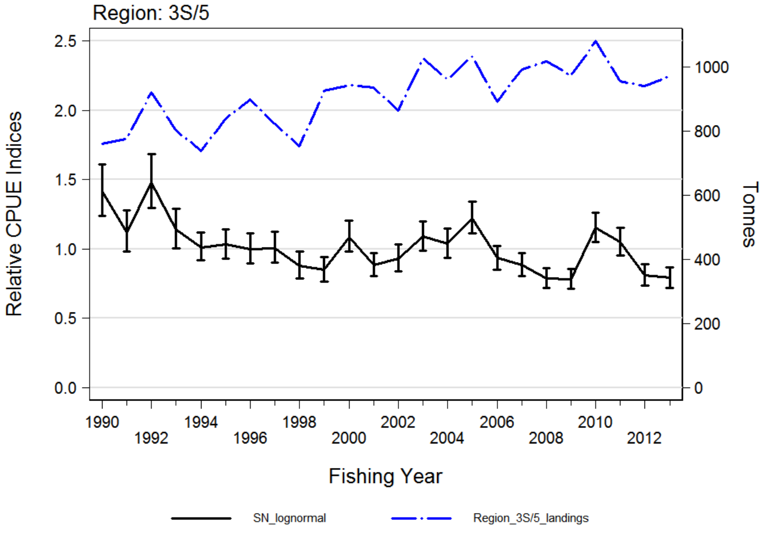
Qualifying Comments
Other available data from trawl surveys, observer records and bottom trawl CPUE indices should be analysed for comparison with the setnet and longline indices. A single New Zealand-wide CPUE index should be developed.

Fishery Interactions
Region SCH 2/SCH 3 North catches are caught primarily in the bottom trawl fishery (45%) targeting tarakihi, hoki, gemfish and gurnard; and the bottom longline fishery (18%) targeting school shark, ling, hapuku/bass and bluenose. 35% of the catch is taken in setnet targeting school shark, blue warehou and blue moki. In the setnet fisheries there is a risk of incidental capture of seabirds, and Hector's dolphins in northern section of SCH 3 (east coast South Island north of Banks Peninsula).

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

Stock Status	
Year of Most Recent Assessment	2014 (Fishery characterisation and CPUE standardisation)
Assessment Runs Presented	Lower SCH 3 & SCH 5: setnet
Reference Points	Target: Not established but B_{MSY} assumed Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: -
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unlikely (< 40%)
Status in relation to Overfishing	Unknown

Historical Stock Status Trajectory and Current Status



The setnet CPUE series for the 3N/5 school shark Region. Also shown are the total annual catches for the Region.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The lognormal setnet CPUE index has been fluctuating without trend since 2000 after a period of decline of about 30% from 1989 to 1999.
Recent Trend in Fishing Mortality or Proxy	Catch has been increasing while set-net CPUE has been fluctuating without trend, indicating that fishing intensity is increasing.
Other Abundance Indices	-
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: Unknown for current catch Hard Limit: Unknown for current catch
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unknown: catch levels have increased in this Region while stock abundance has been fluctuating without trend.

Assessment Methodology and Evaluation		
Assessment Type	Level 2: Partial Quantitative Stock Assessment	
Assessment Method	Evaluation of standardised CPUE index series	
Assessment Dates	Latest assessment: 2014	Next assessment: 2017
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	-The previously accepted CPUE series was based on setnet data using mixed target species. This assessment redefined the monitoring fishery to be more consistent with the fine scale pattern of fishing.	
Major Sources of Uncertainty	-The components of the population fished by each gear type -Interactions with other areas	

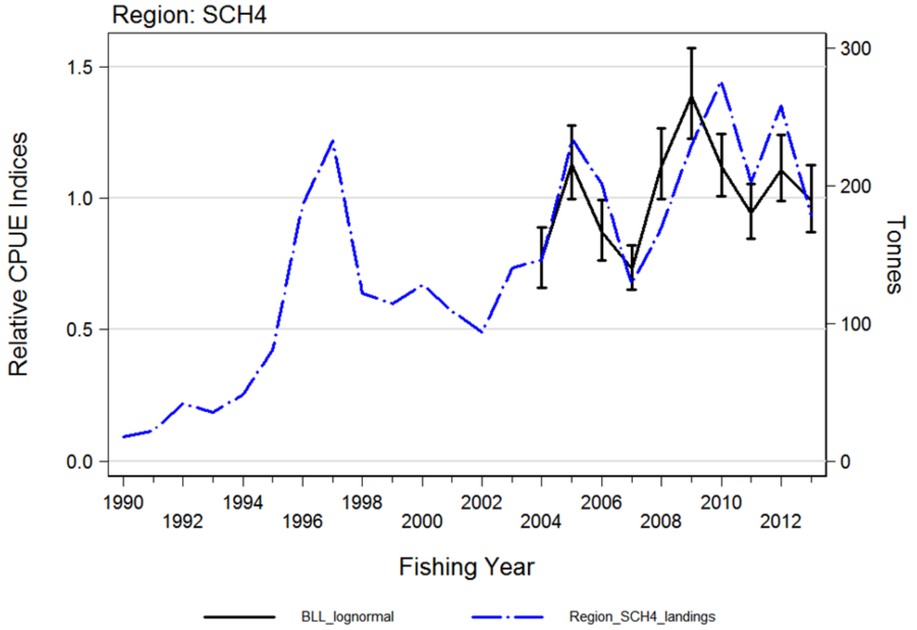
Qualifying Comments
Other available data from trawl surveys, observer records and bottom trawl CPUE indices should be analysed for comparison with the setnet and longline indices. A single New Zealand-wide CPUE index should be developed.

Fishery Interactions
Region SCH 3S/5 is predominantly a setnet fishery (76%) targeting school shark and small amounts of rig, with other species being very minor; and in the bottom trawl fishery (16%) targeting red cod, flatfish, barracouta and stargazer. Mixed targeted bottom longline takes 6% of the catch. In the setnet fisheries there is a risk of incidental capture of seabirds, Hectors dolphins, other dolphins and New Zealand fur seals. There is a risk of incidental capture of sea lions from Otago Peninsula south.

SCH 4

Stock Status	
Year of Most Recent Assessment	2014 (Fishery characterisation and CPUE standardisation)
Assessment Runs Presented	SCH 4 (Chatham Rise): bottom longline
Reference Points	Target: Not established but B_{MSY} assumed Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: -
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown

	Hard Limit: Unlikely (< 40%) to be below
Status in relation to Overfishing	Unknown

Historical Stock Status Trajectory and Current Status	
	
Bottom longline CPUE series for the SCH4 school shark Region. Also shown are the total annual catches for the Region.	
Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The bottom longline CPUE series is too short to enable conclusions, with the earlier data having been compromised by a reporting change.
Recent Trend in Fishing Intensity or Proxy	Unknown
Other Abundance Indices	-
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: Unknown Hard Limit: Unknown
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	Evaluation of standardised CPUE indices	
Assessment Dates	Latest assessment: 2014	Next assessment: 2017
Overall assessment quality rank	2 – Medium or Mixed Quality: short time series	
Main data inputs (rank)	-Catch and effort data	2 – Medium or Mixed Quality: short time series
Data not used (rank)	-	
Changes to Model Structure and Assumptions	This is the first time this Region has been monitored.	
Major Sources of Uncertainty	-The components of the population fished by each gear type	

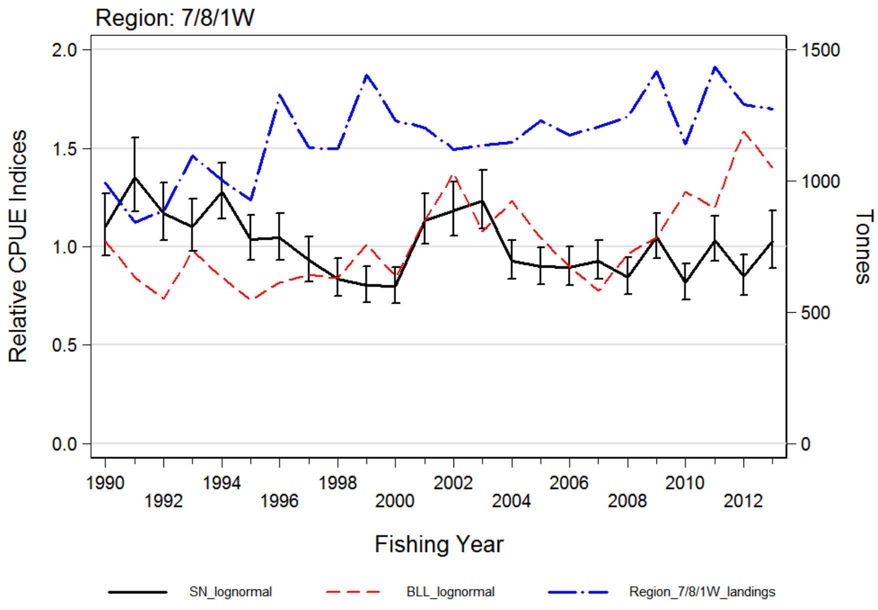
	-Interactions with other areas
Qualifying Comments	
Other available data from trawl surveys, observer records and bottom trawl CPUE indices should be analysed for comparison with the setnet and longline indices. A single New Zealand-wide CPUE index should be developed.	

Fishery Interactions
Region SCH 4 (Chatham Rise) catches are caught primarily in the bottom longline fishery (81%) targeting school shark, ling, hapuku/bass and bluenose. In the bottom longline fishery there is a risk of incidental capture of seabirds.

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

Stock Status	
Year of Most Recent Assessment	2014
Assessment Runs Presented	SCH 7, SCH 8 & lower SCH 1W: setnet SCH 7, SCH 8 & lower SCH 1W: bottom longline
Reference Points	Target: Not established but B_{MSY} assumed Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: -
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unlikely (< 40%) to be below
Status in relation to Overfishing	Unknown

Historical Stock Status Trajectory and Current Status



Lognormal indices from the setnet target shark CPUE series and the bottom longline fishery targeted at Hapuku, Bluenose, School Shark and Ling. Also shown are the landings for the Region.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The lognormal setnet CPUE index has been fluctuating without trend since 2004 after a period of decline of about 33% from 1989 to 2000. The bottom longline index has increased in recent years.

Recent Trend in Fishing Intensity or Proxy	Unknown
Other Abundance Indices	-
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: Unknown for current catches Hard Limit: Unlikely (< 40%) for current catches
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	
Assessment Method	Evaluation of standardised CPUE index series	
Assessment Dates	Latest assessment: 2014	Next assessment: 2017
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	-The previously accepted CPUE series was based on setnet and bottom longline data using mixed target species. This assessment redefined the monitoring fishery to be more consistent with the fine scale pattern of fishing	
Major Sources of Uncertainty	-The components of the population fished by each gear type -Interactions with other areas	

Qualifying Comments
Other available data from trawl surveys, observer records and bottom trawl CPUE indices should be analysed for comparison with the setnet and longline indices. A single New Zealand-wide CPUE index should be developed.
Fishery Interactions
Region SCH 7/8/1W are caught by setnet (43%) targeting school shark and rig ; bottom longline (30%) targeting school shark and hapuku/bass; and bottom trawl (24%) targeting barracuda, tarakihi, flatfish, hoki, red cod and others. In the setnet fisheries there is a risk of incidental capture of seabirds, dolphins and New Zealand fur seals.

6. POTENTIAL FUTURE RESEARCH

1. A single New Zealand-wide CPUE index should be developed by weighting each index by the landings from each set of statistical areas.
2. Other available data from trawl surveys, observer records and bottom trawl CPUE indices should be analysed for comparison with the setnet and longline indices.
3. Length and age data should be examined to determine which components of the population are fished by each gear type.

7. FOR FURTHER INFORMATION

Anon (1990) Management meets industry. Papers from the Southern Shark Fishery seminars held in Victor Harbour, Phillip Island and Hobart, October 1989. Australia. Bureau of Rural Resources and Australian Fisheries Service, Australian Fisheries Services, Canberra.

Ayers, D; Paul, L J; Sanders, B M (2004) Estimation of catch per unit effort analyses for school shark (*Galeorhinus galeus*) from bycatch and target fisheries in New Zealand, 1989–90 to 2001–02. *New Zealand Fisheries Assessment Report 2006/26.* 121 p.

Beentjes, M P; MacGibbon, D J (2013) Review of QMS species for inclusion in the east coast South Island winter trawl survey reports. *New Zealand Fisheries Assessment Report 2013/35*. 102 p.

Beentjes, M P; MacGibbon, D; Lyon, W S (2015) Inshore trawl survey of Canterbury Bight and Pegasus Bay, April–June 2014 (KAH1402). *New Zealand Fisheries Assessment Report 2015/14*.

Blackwell, R G; Francis, M P (2010) Review of life-history and fishery characteristics of New Zealand rig and school shark. *New Zealand Fisheries Assessment Report 2010/02*. 38 p.

Boyd, R O; Reilly, J L (2005) 1999–2000 national marine recreational fishing survey: harvest estimates. Draft New Zealand Fisheries Assessment Report. (Unpublished report held by Ministry for Primary Industries, Wellington.)

Bradford, E (1998) Harvest estimates from the 1996 national recreational fishing surveys. New Zealand Fisheries Assessment Research Document. 1998/16. 27 p. (Unpublished report held by NIWA library, Wellington.)

Bradford, E (2001) Standardised catch rate indices for New Zealand school shark, *Galeorhinus galeus,* in New Zealand, 1989–90 to 1998–99. *New Zealand Fisheries Assessment Report 2001/33*. 75 p.

Campbell, D; Battaglene, T; Pascoe, S (1991) Management options for the Southern Shark Fishery - an economic analysis. Australian Bureau of Agricultural and Resource Economics Discussion Paper 91.12. 43 p.

Coutin, P; Bruce, B; Paul, L (1992) New Zealand school sharks cross the Tasman Sea. *Australian Fisheries* 51(3): 24–25.

Ford, R B; Galland, A; Clark, M R; Crozier, P; Duffy, C AJ; Dunn, M R; Francis, M P, 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 (1998) New Zealand shark fisheries: development, size and management. *Marine and Freshwater Research* 49: 579–591.

Francis, M P (2010) Movement of tagged rig and school shark among QMAs, and implications for stock management boundaries. *New Zealand Fisheries Assessment Report No.* 2010/3. 22 p.

Francis, M P; Mulligan, K P (1998) Age and growth of New Zealand school shark, *Galeorhinus galeus*. *New Zealand Journal of Marine and Freshwater Research* 32(3): 427–440.

Francis, M.P.; Paul, L.J. (2013). New Zealand inshore finfish and shellfish commercial landings, 1931–82. *New Zealand Fisheries Assessment Report 2013/55.* 136 p.

Grant, C J; Sandland, R L; Olsen, A M (1979) Estimation of growth, mortality and yield per recruit of the Australian school shark, *Galeorhinus australis* (Macleay), from tag recoveries. *Australian Journal of Marine and Freshwater Research* 30(5): 625–637.

Hurst, R J; Bagley, N W; McGregor, G A; Francis, M P (1999) Movements of the New Zealand school shark, *Galeorhinus galeus*, from tag returns. *New Zealand Journal of Marine and Freshwater Research* 33(1): 29–48.

Hurst, R J; Bagley, N W; Uozumi, Y (1990) New Zealand-Japan trawl survey of shelf and upper slope species off southern New Zealand, June 1986. *New Zealand Fisheries Technical Report* No. 18. 50 p.

Livingston, M E; Uozumi, Y; Berben, P H (1991) Abundance, distribution, and spawning condition of hoki and other mid-slope fish on the Chatham Rise, July 1986. *New Zealand Fisheries Technical Report* No. 25. 47 p.

Lydon, G J; Middleton, D A J; Starr, P J (2006) Performance of the SCH 7 and SCH 8 Logbook Programmes. AMP-WG-06-06. (Unpublished manuscript available from the NZ Seafood Industry Council, Wellington).

Olsen, A M (1984) Synopsis of biological data on the school shark, *Galeorhinus australis* (Macleay 1881). *FAO Fisheries Synopsis* No. *139*. 42 p.

Paul, L J (1988) School shark. New Zealand Fisheries Assessment Research Document 1988/27. 32 p. (Unpublished report held by NIWA library, Wellington.)

Paul, L J (1991) Overseas travel report: "Sharks Down Under" conference, Taronga Zoo, Sydney, February 1991. MAF Fisheries Greta Point Internal Report No. 176. 137 p. (Unpublished report held in NIWA library, Wellington).

Paul, L J; Saunders, B (2001) A description of the commercial fishery for school shark, *Galeorhinus galeus,* in New Zealand, 1945 to 1999. *New Zealand Fisheries Assessment Report 2001/32*. 63 p.

Peres, M B; Vooren, C M (1991) Sexual development, reproductive cycle, and fecundity of the school shark *Galeorhinus galeus* off southern Brazil. *Fishery Bulletin*. 89(4): 655–667.

Seafood Industry Council (SeaFIC) (2003a) SCH 3 Adaptive Management Programme Proposal for the 2004–05 Fishing year. 50 p. (Unpublished report held at the Seafood Industry Council, Wellington).

Seafood Industry Council (SeaFIC) (2003b) SCH 5 Adaptive Management Programme Proposal for the 2004–05 Fishing year. 49 p. (Unpublished report held at the Seafood Industry Council, Wellington).

Seafood Industry Council (SeaFIC) (2003c) SCH 7 Adaptive Management Programme Proposal for the 2004–05 Fishing year. 42 p. (Unpublished report held at the Seafood Industry Council, Wellington).

Seafood Industry Council (SeaFIC) (2003d) SCH 8 Adaptive Management Programme Proposal for the 2004–05 Fishing year. 42 p. (Unpublished report held at the Seafood Industry Council, Wellington).

Smith, P J (2009) Review of genetic studies of rig and school shark. Final Research Report for Ministry of Fisheries research project No. INS200803. 16 p. (Unpublished report held by Ministry for Primary Industries, Wellington.)

Starr, P J (2005) CPUE indices for groper, *Polyprion* spp., when targeted and as a bycatch in four New Zealand fisheries, 1990–2003. *New Zealand Fisheries Assessment Report 2005/51*. 29 p.

Starr, P J; Kendrick, T H (2010a) Report to the Adaptive Management Programme Fishery Assessment Working Group: Characterisation and CPUE analysis for SCH 1. Document 2010/05-v3, 85 p. (Unpublished document held by the Ministry for Primary Industries, Wellington.) (http://cs.fish.govt.nz/forums/thread/3872.aspx)

Starr, P J; Kendrick, T H (2010b) Report to the Adaptive Management Programme Fishery Assessment Working Group: Characterisation and CPUE analysis for SCH 2. Document 2010/06-v2, 64 p. (Unpublished document held by the Ministry for Primary Industries, Wellington.) (http://cs.fish.govt.nz/forums/thread/3873.aspx)

Starr, P J; Kendrick, T H; Bentley, N (2010a) Report to the Adaptive Management Programme Fishery Assessment Working Group: Characterisation, CPUE analysis and logbook data for BYX 1. Document 2010/04-v3, 86 p. (Unpublished document held by the Ministry for Primary Industries.) (http://cs.fish.govt.nz/forums/thread/3871.aspx)

Starr, P J; Kendrick, T H; Bentley, N (2010b) Report to the Adaptive Management Programme Fishery Assessment Working Group: Characterisation, CPUE analysis and logbook data for SCH 3. Document 2010/07-v2, 62 p. (Unpublished document held by the Ministry for Primary Industries, Wellington.) (http://cs.fish.govt.nz/forums/thread/3874.aspx)

Starr, P J; Kendrick, T H; Bentley, N (2010c) Report to the Adaptive Management Programme Fishery Assessment Working Group: Characterisation, CPUE analysis and logbook data for SCH 5. Document 2010/08-v2, 65 p. (Unpublished document held by the Ministry for Primary Industries, Wellington.) (http://cs.fish.govt.nz/forums/thread/3875.aspx)

Starr, P J; Kendrick, T H; Bentley, N (2010d) Report to the Adaptive Management Programme Fishery Assessment Working Group: Characterisation, CPUE analysis and logbook data for SCH 7 and SCH 8. Document 2010/09-v2, 149 p. (Unpublished document held by the Ministry for Primary Industries, Wellington.) (http://cs.fish.govt.nz/forums/thread/3876.aspx)

Starr, P J; Kendrick, T H; Lydon, G J; Bentley, N (2007a) Report to the Adaptive Management Programme Fishery Assessment Working Group: Two year review of the SCH 3 Adaptive Management Programme. AMP-WG-07-08. (Unpublished manuscript available from the NZ Seafood Industry Council, Wellington).

Starr, P J; Kendrick, T H; Lydon, G J; Bentley, N (2007b) Report to the Adaptive Management Programme Fishery Assessment Working Group: Two year review of the SCH 5 Adaptive Management Programme. AMP-WG-07-09. (Unpublished manuscript available from the NZ Seafood Industry Council, Wellington.).

Starr, P J; Kendrick, T H; Lydon, G J; Bentley, N (2007c) Report to the Adaptive Management Programme Fishery Assessment Working Group: Two year review of the SCH 7 Adaptive Management Programme. AMP-WG-07-15. (Unpublished manuscript available from the NZ Seafood Industry Council, Wellington.).
Starr, P J; Kendrick, T H; Lydon, G J; Bentley, N (2007d) Report to the Adaptive Management Programme Fishery Assessment Working Group: Two year review of the SCH 8 Adaptive Management Programme. AMP-WG-07-16. (Unpublished manuscript available from the NZ Seafood Industry Council, Wellington.).
Teirney, L D; Kilner, A R; Millar, R E; Bradford, E; Bell, J D (1997) Estimation of recreational catch from 1991–92 to 1993–94. New Zealand Fisheries Assessment Research Document 1997/15. 43 p. (Unpublished report held by NIWA library, Wellington.)
Wilson, D; Curtotti, R; Begg, G; Phillips, K (Eds.) (2008) Fishery Status Reports, 2008: status of fish stocks and fisheries managed by the Australian Government, Bureau of Rural Sciences & Australian Bureau of Agricultural and Resource Economics, Canberra. 395 p.