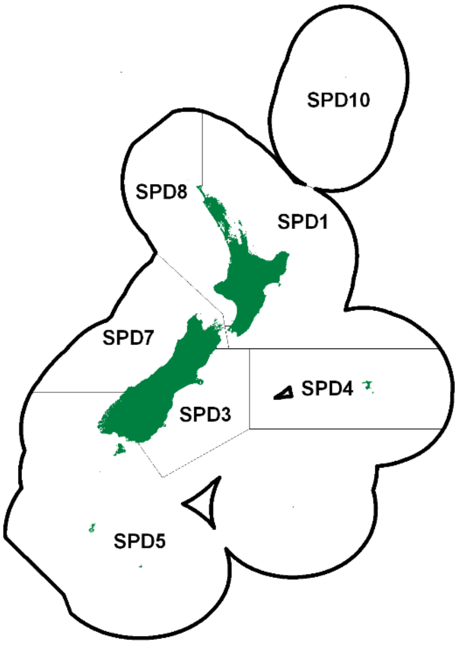
SPINY DOGFISH (SPD)

(*Squalus acanthias*)
Makohuarau, Pioke, Kāraerae



1. FISHERY SUMMARY

Allowances, TACCs, and TACs are shown in Table 1.

Table 1: Recreational and Customary non-commercial allowances, other mortality, TACCs, and TACs (t) for spiny dogfish by Fishstock.

Fishstock	Recreational allowance	Customary non-commercial allowance	Other sources of mortality	TACC	TAC
SPD 1	39	39	4	331	413
SPD 3	115	115	51	4 794	5 075
SPD 4	10	10	16	1 626	1 662
SPD 5	8	8	37	3 700	3 753
SPD 7	31	31	19	1 902	1 983
SPD 8	41	41	3	307	392
SPD 10	1	1	0	0	2

1.1 Commercial fisheries

Spiny dogfish are found throughout the southern half of New Zealand, extending to East Cape and Manakau Harbour on the east and west coasts of the North Island respectively. A related species, the northern spiny dogfish (*Squalus mitsukurii*), is mainly restricted to North Island waters, overlapping with its conspecific in the central west coast area and around the Chatham Islands. Although they have different species codes for reporting purposes it is probable that some misidentification and misreporting occurs—particularly in FMAs 1, 8, and 9.

The best estimate of reported catch from the fishery is shown in the final column in Table 2. For the period 1980–81 to 1986–87 the best estimate of landings is the sum of the FSU data. For the period 1987–88 to 1996–97 it is the sum of the LFRR and the discards from the CELR and CLR. It has been assumed here that all the fish which have been caught and discarded will die, and that all the discarded fish have been recorded. Although neither assumption is likely to be true, and the biases they produce will at least partially cancel each other out, it is likely that the true level of discards is considerably higher. However, these figures are currently the best estimates of total removals from the fishery from 1980–81 to 1996–97.

Before 1980–81 landings of rig and both *Squalus* species were included together and catches of the latter were probably small. Since then the reported landings of spiny dogfish has fluctuated between about

3000 and 7000 t in most years, averaging about 5600 t from 2010–11 to 2018–19. The reported catch by the deepwater fleet has remained fairly constant during most of the period, averaging 2000–4000 t, with a slight decrease in recent years. The reported catch by the inshore fleet has shown a steady increase throughout the period and is now at a similar level to the catch from the deepwater fleet.

Most of the spiny dogfish caught by the deepwater fleet are taken as a bycatch in the jack mackerel, barracouta, hoki, red cod, and arrow squid fisheries, in depths from 100 to 500 m. Some are packed whole but most are trunked and exported to markets in Asia and Europe.

Table 2: Reported catches of spiny dogfish (t) by fishing year. FSU (Fisheries Statistics Unit), LFRR (Licensed Fish Receiver Return). Discards reported from CELR (Catch Effort Landing Return), and CLR (Catch Landing Return). Numbers in brackets are probably underestimates. (no data).

	FSU				Best
	Inshore	Deepwater	LFRR	Discards	Estimate
1980–81	–	(196)	–	–	196
1981–82	–	1 881	–	–	1 881
1982–83	(107)	2 568	–	–	2 675
1983–84	309	2 949	–	–	3 258
1984–85	303	3 266	–	–	3 569
1985–86	311	2 802	–	–	3 113
1986–87	870	2 277	2 608	–	3 147
1987–88	834	3 877	4 823	–	4 823
1988–89	(351)	(500)	3 573	(16)	3 589
1989–90	(14)	0	2 952	321	3 273
1990–91	–	–	5 983	333	6 316
1991–92	–	–	3 274	521	3 795
1992–93	–	–	4 157	616	4 773
1993–94	–	–	6 150	1 063	7 213
1994–95	–	–	4 793	628	5 421
1995–96	–	–	6 230	1 920	8 150
1996–97	–	–	4 887	2 572	7 459

Spiny dogfish are also taken as bycatch by inshore trawlers, setnetters, and longliners targeting flatfish, snapper, tarakihi, and gurnard. Because of processing problems due to their spines, sandpaper-like skin, and short shelf life, and their low economic value, many inshore fishers are not interested in processing and landing them. Furthermore, because of their sheer abundance they can at times severely hamper fishing operations for other commercial species and they are regarded by many fishers as a major nuisance. Trawlers working off Otago during the summer months often reduce towing times and headline heights, and at times leave the area altogether to avoid having to spend hours pulling hundreds of meshed dogfish out of trawl nets. Setnetters and longliners off the Otago coast, and in Tasman Bay and the south Taranaki Bight, have also complained about spiny dogfish taking longline baits, attacking commercial fish caught in the nets or lines, and rolling up nets.

Table 3 gives available historical landings data for 1978 to 1982. The catch by FMA from the FSU, CELR, and CLR databases is shown in Table 4. Substantial landings have been reported from FMAs 3, 5, 6, and 7 since 1982–83; landings from FMA 4 have increased substantially since the mid-1990s. In the early 1980s landings were highest in FMAs 5 and 6, with 1000–2000 t taken annually by factory trawlers. By the 1990s landings from FMA 3 and, to a lesser extent, FMA 7 became more important. The catch in both these areas was taken equally by factory trawlers and inshore fleets. Since the fishing year 2013–14 the highest landings have been reported from SPD 3, 4, and 5, which together contributed 82% of total spiny dogfish landings in 2019–20. The catch in FMA 1 is unlikely to be spiny dogfish which is considered to be virtually absent from the area, and so these catches should probably be attributed to *S. mitsukurii*.

Competitive quotas of 4075 t for FMA 3, and of 3600 t for FMAs 5 and 6, were introduced for the first time in the 1992–93 fishing year. These quotas were based on yields derived from trawl surveys using a method that is now considered obsolete, and harvest levels which are now considered unreliable. The reported catches exceeded the FMA 3 quota in 1997–98, 2000–01, and 2001–02 and the FMAs 5 and 6 quota in 2001–02.

Table 3: Reported landings (t) for the main QMAs from 1978 to 1982. For SPD, there are no data available for 1931 to 1977 years.

Year	SPD 1	SPD 3	SPD 4	SPD 5	SPD 7	SPD 8
1978	1	20	0	38	124	41
1979	2	130	67	74	128	40
1980	0	39	13	149	11	31
1981	2	123	92	203	73	150
1982	20	291	31	2 228	113	84

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).

Prior to their introduction into the QMS, spiny dogfish were legally discarded at sea (provided that total catch was reported). Although discard rates increased dramatically through the 1990s (Table 6), this is believed to reflect a change in reporting practice rather than an increase in the proportion of catch discarded. Spiny dogfish were placed on Schedule 6 when they were introduced to the QMS.

Table 4: Reported landings (t) of spiny dogfish by FMA. Proportions by area have been taken from CELR and CLR and prorated to the best estimate from Table 2. Competitive quotas of 4075 t for FMA 3, and of 3600 t for FMAs 5 and 6, were introduced for the first time in the 1992–93 fishing year.

Year	FMA 1	FMA 2	FMA 3	FMA 4	FMA 5	FMA 6	FMA 7	FMA 8	FMA 9	FMA 10	Other	Total
1982–83	4	0	151	131	2 089	81	145	66	7			2 675
1983–84	22	18	409	347	565	1 700	119	63	16			3 258
1984–85	21	12	557	481	451	1 899	90	48	10			3 569
1985–86	13	11	892	411	537	1 017	120	92	20			3 113
1986–87	64	18	1 048	162	1 002	29	501	296	27			3 147
1987–88	50	9	1 664	172	642	16	1 402	841	27			4 823
1988–89	341	16	1 510	168	771	7	633	132	11			3 589
1989–90	36	14	2 243	136	241	2	521	80	0			3 273
1990–91	129	14	2 987	513	1 708	14	883	67	0			6 316
1991–92	54	23	1 801	66	538	33	1 031	249	0			3 795
1992–93	50	9	2 128	218	817	22	1 163	366	0			4 773
1993–94	51	34	3 165	358	1 158	21	2 212	214	0			7 213
1994–95	84	47	2 883	363	606	37	1 205	196	0			5 421
1995–96	68	177	2 558	969	1 147	152	1 205	186	15			7 052
1996–97	30	159	2 428	1 287	764	120	1 517	235	7	1	1	6 555
1997–98	52	165	5 042	917	428	223	2 389	1 172	34	0	11	10 433
1998–99	45	488	3 148	1 048	1 996	154	1 902	74	< 1	0	< 1	8 424
1999–00	15	328	3 309	994	1 163	189	1 505	25	7	0	5	7 540
2000–01	38	336	4 355	1 075	1 389	212	1 310	54	16	0	28	8 811
2001–02	12	222	4 249	1 788	3 734	487	961	71	12	0	–	11 530
2002–03	10	245	3 553	1 010	2 621	413	772	85	19	0	0	8 727
2003–04	12	91	2 077	516	1 032	302	423	20	5	0	0	4 477

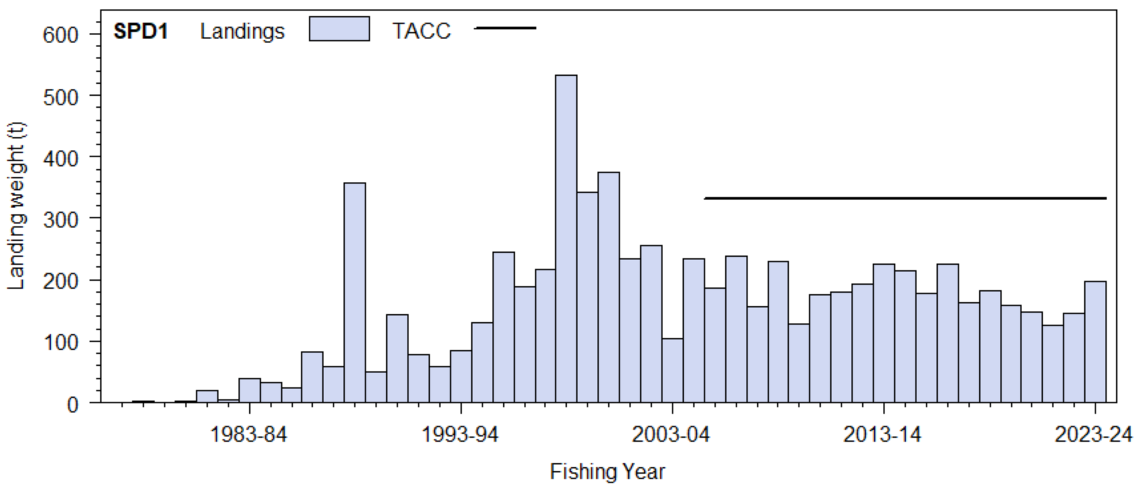
Table 5: Reported domestic landings (t) of spiny dogfish by Fishstock and TACC from 2004–05. [Continued on next page]

Fishstock	SPD 1		SPD 3		SPD 4		SPD 5		SPD 7	
FMA	1&2		3		4		5&6		7	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landing	TACC
2004–05	234	331	2 707	4 794	839	1 626	2 479	3 700	842	1 902
2005–06	186	331	3 831	4 794	1 055	1 626	2 298	3 700	832	1 902
2006–07	239	331	2 712	4 794	822	1 626	2 165	3 700	1 125	1 902
2007–08	156	331	2 082	4 794	1 397	1 626	1 501	3 700	928	1 902
2008–09	229	331	1 981	4 794	866	1 626	2 071	3 700	929	1 902
2009–10	128	331	1 855	4 794	667	1 626	2 205	3 700	1 116	1 902
2010–11	176	331	1 976	4 794	825	1 626	1 443	3 700	1 436	1 902
2011–12	187	331	1 607	4 794	740	1 626	1 390	3 700	1 704	1 902
2012–13	193	331	1 302	4 794	442	1 626	1 547	3 700	1 298	1 902
2013–14	226	331	1 411	4 794	1 090	1 626	2 068	3 700	914	1 902
2014–15	212	331	1 860	4 794	1 380	1 626	1 715	3 700	1 022	1 902
2015–16	178	331	1 284	4 794	1 002	1 626	1 092	3 700	858	1 902
2016–17	225	331	1 725	4 794	1 377	1 626	1 604	3 700	897	1 902
2017–18	163	331	2 007	4 794	1 756	1 626	1 534	3 700	920	1 902
2018–19	183	331	1 970	4 794	1 149	1 626	1 268	3 700	610	1 902
2019–20	158	331	1 750	4 794	907	1 626	1 062	3 700	645	1 902
2020–21	147	331	2 169	4 794	854	1 626	1 602	3 700	636	1 902
2021–22	125	331	2 272	4 794	1 140	1 626	984	3 700	722	1 902
2022–23	146	331	2 394	4 794	965	1 626	1 091	3 700	578	1 902
2023–24	196	331	2 596	4 794	1 199	1 626	1 064	3 700	538	1 902

Table 5 [Continued]: Reported domestic landings (t) of spiny dogfish by Fishstock and TACC from 2004–05.

Fishstock	SPD 8			
FMA	8&9		Total	
	Landings	TACC	Landings	TACC
2004–05	121	307	7 222	12 660
2005–06	108	307	8 311	12 660
2006–07	118	307	7 181	12 660
2007–08	124	307	6 188	12 660
2008–09	150	307	6 226	12 660
2009–10	194	307	6 166	12 660
2010–11	221	307	6 077	12 660
2011–12	252	307	5 880	12 660
2012–13	182	307	4 965	12 660
2013–14	122	307	5 831	12 660
2014–15	123	307	6 312	12 660
2015–16	148	307	4 525	12 660
2016–17	181	307	5 112	12 660
2017–18	149	307	6 528	12 660
2018–19	162	307	5 342	12 660
2019–20	149	307	4 671	12 660
2020–21	145	307	5 552	12 660
2021–22	114	307	5 356	12 660
2022–23	97	307	5 270	12 600
2023–24	110	307	5 704	12 600

Spiny dogfish was introduced into the QMS in October 2004. Catches and TACCs are shown in Table 5, and Figure 1 depicts historical landings and TACC values for the main SPD stocks. Landings for all Fishstocks have generally remained well below the TACC limits.



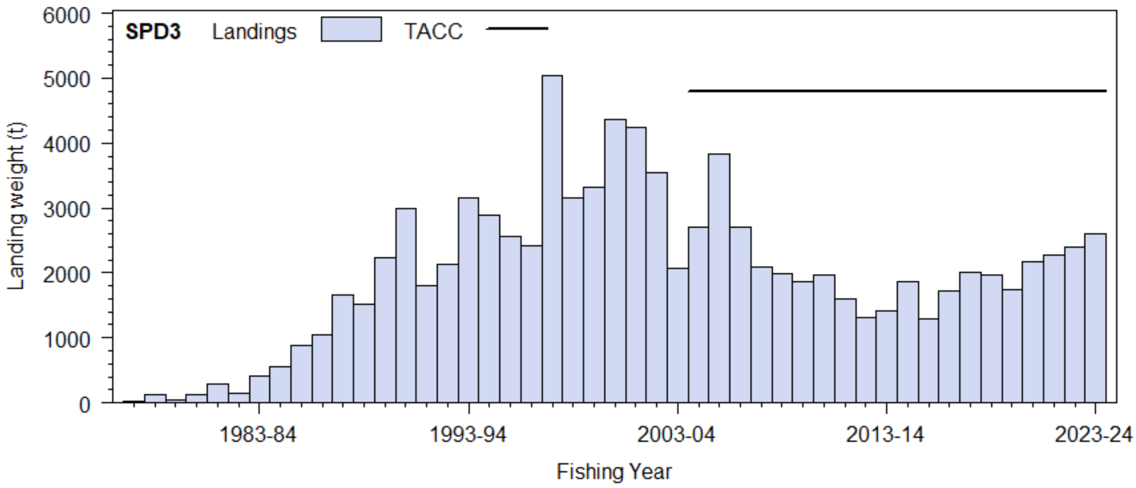
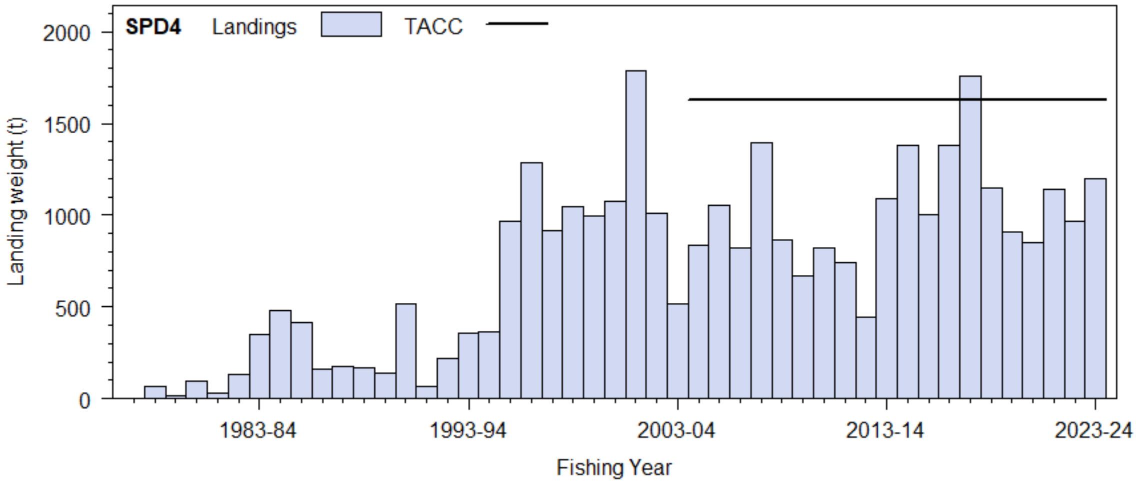
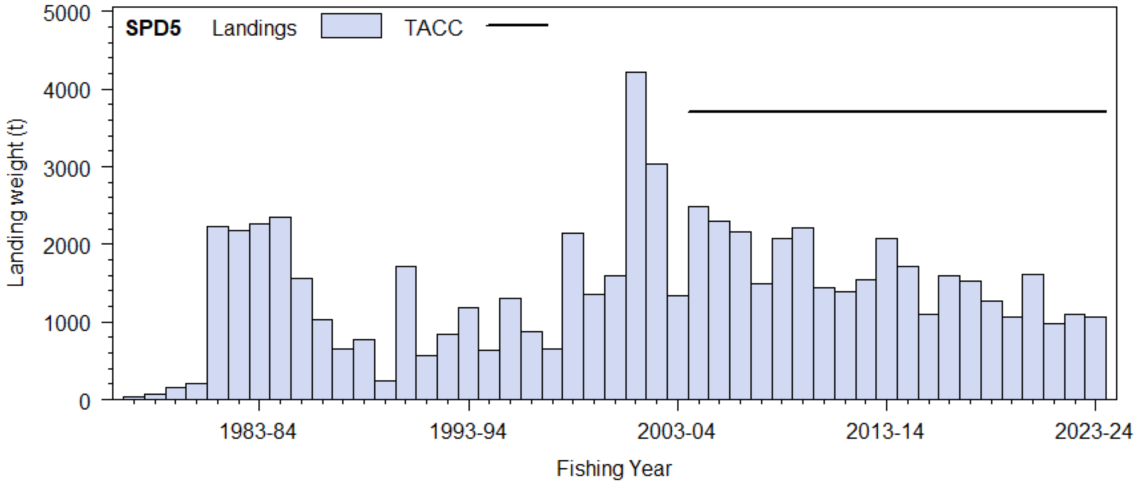


Figure 1: Reported commercial landings and TACCs for the six main SPD stocks: SPD 1 (Auckland East, Central East) and SPD 3 (South East Coast). [Continued on next two pages]





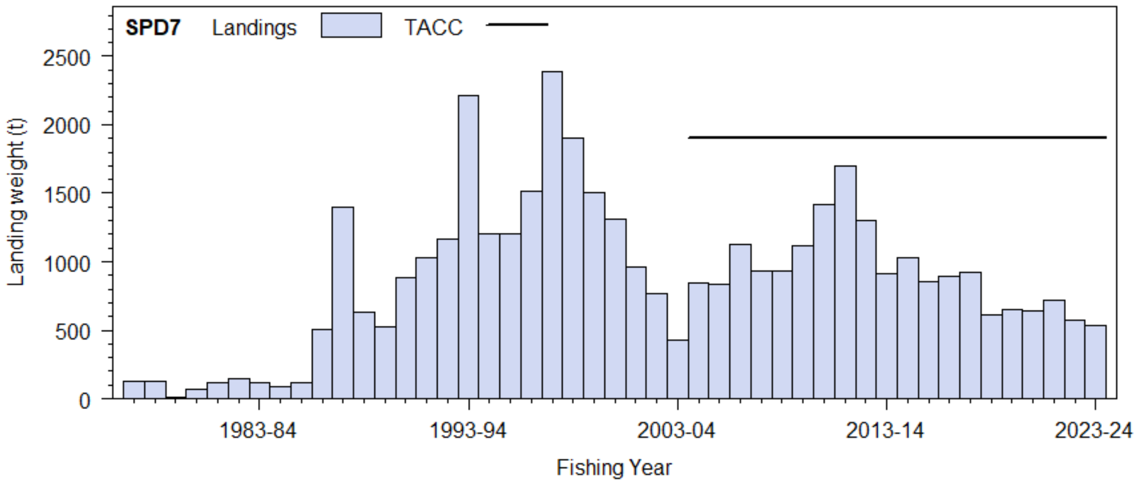


Figure 1 [Continued]: Reported commercial landings and TACCs for the six main SPD stocks: SPD 4 (South East Chatham Rise), SPD 5 (Sub-Antarctic, Southland) and SPD 7 (Challenger). **[Continued on next page]**

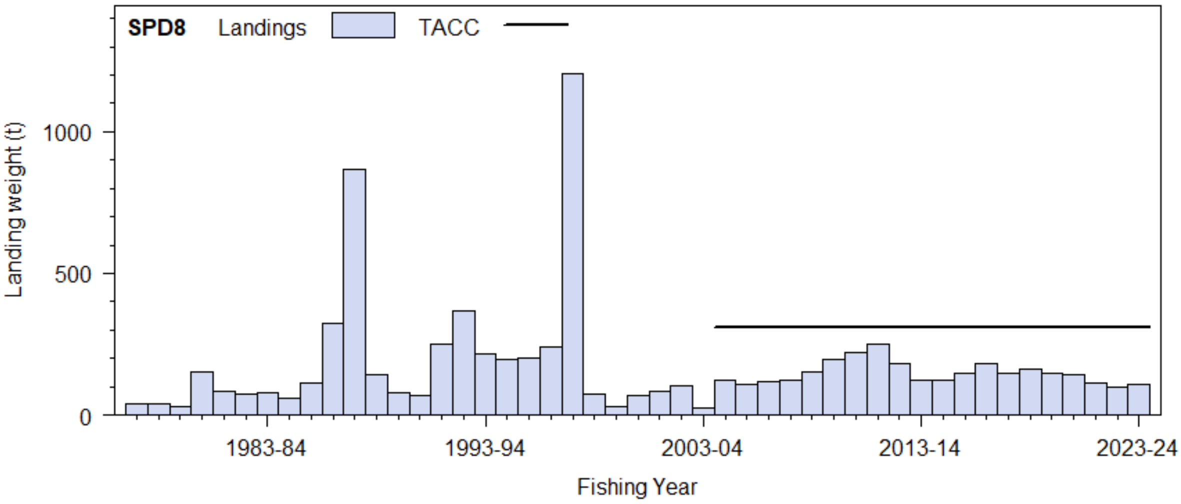


Figure 1 [Continued]: Reported commercial landings and TACCs for the six main SPD stocks: SPD 8 (Central Egmont, Auckland West).

Table 6: Discard rates (% of catch) by FMA and fishing year (after Manning et al 2004).

									FMA			
FMA	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Other**	**Average**
Fishing year												
1989–90	11	17	18	4	46	100	13	34	0	0	0	18
1990–91	7	0	6	2	29	11	21	24	0	0	0	11
1991–92	9	3	8	13	34	90	42	18	0	0	0	20
1992–93	13	47	5	51	39	43	20	80	0	0	0	21
1993–94	5	65	13	42	21	34	29	66	0	0	0	23
1994–95	2	52	8	31	20	74	29	64	98	0	5	19
1995–96	7	39	18	55	39	94	45	72	100	0	11	36
1996–97	15	61	26	40	70	68	59	89	93	0	16	44
1997–98	53	83	51	53	72	86	81	92	100	0	16	64
1998–99	20	92	57	60	29	78	82	63	0	0	16	58
1999–00	9	86	60	55	39	68	81	84	35	0	0	62
2000–01	37	70	60	77	57	77	72	56	29	0	87	64
Average	15	74	35	53	42	78	54	68	78	0	16	45

1.2 Recreational fisheries

Spiny dogfish are caught by recreational fishers throughout their geographical range in New Zealand. They are mainly taken as bycatch when targeting other more valued species using rod and line and setnet. In many parts of New Zealand, spiny dogfish are regarded by recreational anglers as a pest, often clogging nets and taking baits from hooks.

The first recreational harvest estimates were provided by offsite telephone-diary surveys conducted between 1991 and 2001 (Bradford et al 1998, Boyd & Reilly 2004, Teirney et al 1997). These estimates are no longer considered to be reliable by the Marine Amateur Fishing Working Group (MAFWG), because the method was prone to 'soft refusal' bias during recruitment of potential participants and overstated catches during reporting. The recreational harvest estimates provided by the 2000 and 2001 telephone-diary surveys were also thought to be implausibly high for many species by the MAFWG.

In response to these problems and the cost and scale challenges associated with onsite methods, a national panel survey was conducted for the first time throughout the 2011–12 fishing year. The panel survey used face-to-face interviews of a random sample of 30 390 New Zealand households to recruit a panel of fishers and non-fishers for a full year (Wynne-Jones et al 2014). The panel members were contacted regularly about their fishing activities and harvest information in standardised phone interviews. The national panel survey was repeated during the 2017–18 and 2022–23 fishing years using very similar methods to produce directly comparable results (Wynne-Jones et al 2019; Heinemann & Gray 2024). Recreational catch estimates from the three national panel surveys are given in Table 7.

Note that national panel survey estimates do not include recreational harvest taken on charter vessel trips or under s111 general approvals.

Table 7: Recreational harvest estimates for spiny dogfish stocks from national panel surveys (Wynne-Jones et al 2014, 2019, Heinemann & Gray 2024). Mean weights from boat ramp surveys (Hartill & Davey 2015, Davey et al 2019; Davey et al 2024).

Stock	Year	Method	Number of fish	Total weight (t)	CV
SPD 1	2011–12	Panel survey	6679	6.8	0.27
	2017–18	Panel survey	3566	5.5	0.36
	2022–23	Panel survey	1297	0.8	0.55
SPD 3	2011–12	Panel survey	4130	4.2	0.29
	2017–18	Panel survey	2912	4.5	0.46
	2022–23	Panel survey	2945	1.9	0.71
SPD 5	2011–12	Panel survey	466	0.5	0.81
	2017–18	Panel survey	1462	2.2	0.72
	2022–23	Panel survey	99	0.1	1.01
SPD 7	2011–12	Panel survey	5872	6.0	0.56
	2017–18	Panel survey	5019	7.7	0.34
	2022–23	Panel survey	2384	1.5	0.44
SPD 8	2011–12	Panel survey	3882	4.0	0.29
	2017–18	Panel survey	984	1.5	0.60
	2022–23	Panel survey	181	0.1	0.74

1.3 Customary non-commercial fisheries

Māori fishers traditionally caught large numbers of 'dogfish' and this included rig, school shark, and spiny dogfish. Quantitative information on the current level of customary non-commercial fisheries take is not available.

1.4 Illegal catch

It is unlikely that there is an illegal catch of spiny dogfish because the quota for this species has never been reached, and it has low commercial value.

2. BIOLOGY

Spiny dogfish are widely distributed around the South Island and extend as far north as Manukau Harbour and East Cape on the west and east coasts of the North Island, respectively. They are most abundant off the east coast of the South Island and the Stewart-Snares shelf. They are found on the continental shelf and upper slope down to a depth of at least 500 m but are most common in depths of 50–150 m. Schools are strongly segregated by size and sex. The size of fish in the commercial fishery is not known but will depend to a large extent on the method of capture and the area fished.

Spiny dogfish are born at a size of 18–30 cm total length (TL). They have been aged using fin spines, and early growth has been validated by following modes in length frequency and eye lens weight frequency data. Males mature at 58 cm TL at age 6, and females mature at 73 cm TL at age 10. The maximum ages and lengths in a study of east coast South Island dogfish were 21 years and 90 cm TL for males, and 26 years and 111 cm TL for females.

M was estimated using the equation $\log_e 100$/maximum age, where maximum age is the age to which 1% of the population survive in an unexploited stock. Using a maximum age of 26 gave an estimate of *M* of 0.18. This has been revised up to 0.2 to reflect the imprecision with which this estimate is known. A similar estimate of *M* was obtained using a survivorship table approach (Hanchet 1986). At an instantaneous mortality rate of 0.2 y^{-1} an initial population of 1000 females would replace themselves over their lifespan (given their length-at-age, length-at-maturity, and fecundity-length relationships). The Intrinsic Productivity Level is categorised as Medium for this species.

Female spiny dogfish give birth to young over an extended period between April and September, mainly on the shelf edge in depths of 200–300 m. Mating also occurs in deeper water (coincident with a movement of mature males offshore), after which females with young 'candled' embryos move into shallower waters of 100 m or less. They remain there for 12 months until the embryos are 15 cm long after which they return to deeper water. Parturition occurs after a gestation period approaching 24 months, and this is closely followed by mating and ovulation and the biennial cycle is repeated. Both the number and the size of the young increase linearly with the length of the mother. The number of young per litter ranges from 1 to 19.

Young of the year move inshore into shallower waters shortly after birth. Over the next few years they move steadily into deeper water but remain in size segregated schools comprising up to 2 or 3 age classes. Once maturity is reached both males and females undergo inshore/offshore migrations associated with reproductive activity. A north/south migration along the east coast South Island during autumn/spring has also been postulated, but the full extent of this migration is unknown.

Spiny dogfish are found both on the bottom and in midwater and feed on a very wide range of species, including *Munida*, krill, fish, squid, and crabs.

Biological parameters relevant to the stock assessment are shown in Table 8.

Table 8: Estimates of biological parameters of spiny dogfish for QMA 3 (Hanchet 1986).

1. Natural mortality (M)

0.2

2. Weight = a (length)^b (Weight in g, length in cm fork length)

Males		Females	
a	b	a	b
0.00275	3.05	0.00139	3.25

3. von Bertalanffy growth parameters

Males			Females		
K	t_0	L_∞	K	t_0	L_∞
0.116	-2.88	89.5	0.069	-3.45	120.1

4. Maturity ogive

Age (years)	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**> 12**
Males	0.00	0.02	0.21	0.68	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Females	0.00	0.00	0.00	0.00	0.04	0.04	0.23	0.52	0.75	1.00	1.00

3. STOCKS AND AREAS

No specific research on the stock structure of spiny dogfish has been carried out. Limited tagging has been conducted, so the only available data come from seasonal trawl surveys and fisheries landings data.

The analysis of *W.J. Scott* and *James Cook* surveys carried out from 1978 to 1983 clearly showed seasonal migrations of spiny dogfish along the east coast of South Island (ECSI). Spiny dogfish were most abundant in the southern part of the coast from October to April, and more abundant to the north in May to September. It is also clear from summer trawl surveys of the area that there is a resident part of the population of spiny dogfish on the Stewart-Snares shelf over the summer months. However, there have been no comparable series of seasonal surveys there and so it is presently unclear whether the east coast South Island fish migrate south as far as the Stewart-Snares shelf. Until more data become available fish from the two areas should be treated as separate stocks.

Seasonal trawl surveys were also carried out off west coast South Island (WCSI) between June 1981 and April 1983 using the *W.J. Scott.* The catches showed a strong seasonal component being highest in summer and autumn and lowest in winter and spring. It is likely that some fish migrate north in winter, perhaps to the northern and southern Taranaki Bights, and Tasman Bay and Golden Bay. However, it is also clear from summer trawl surveys of the areas that there is a resident part of the population of spiny dogfish in the Taranaki Bights over the summer months. It may therefore be appropriate to treat fish from FMAs 7 and 8 as a single stock.

There is little commercial catch in FMAs 1, 2, 4, and 9, and little data on movement in or between the areas. Until more data have been obtained it would seem appropriate to manage spiny dogfish with the following five fishstocks:

- SPD 1: FMAs 1 & 2
- SPD 3: FMA 3
- SPD 4: FMA 4
- SPD 5: FMAs 5 & 6
- SPD 7 and SPD 8: FMAs 7, 8, & 9

4. STOCK ASSESSMENT

There are no estimates of current or virgin biomass.

4.1 Estimates of fishery parameters and abundance

Biomass indices of spiny dogfish from recent trawl surveys using *Tangaroa* and *Kaharoa* are summarised in Figures 2–5 and Table 9. Based on a combination of CVs, variability in biomass indices, and the time span of each series, it is concluded that surveys provide reliable indices of dogfish abundance off the west coast of the South Island, the east coast of the South Island, and on the Chatham Rise. Relative biomass indices suggest that spiny dogfish became more abundant on the Chatham Rise during the early to mid-1990s. Apart from a temporary increase during the mid-1990s, the abundance of spiny dogfish off the west coast South Island appears to have been fairly stable. Off the east coast of the South Island spiny dogfish biomass increased in the early 1990s and since 2007 when these surveys were reinstated, has been generally been declining.

West coast South Island inshore trawl survey

Biomass fluctuated between 3919 and 10 270 t from 1992 to 2011 (Table 9, Figure 2). Biomass in 2013 was the highest in the series, but this was influenced by a single large catch, reflected in the large CV. Biomass has generally declined since then to the lowest estimate of the series in 2021 at 2226 t. While there was a slight increase in 2023 to 3043 t, the last four estimates of the series were the lowest. The increase in biomass came from Tasman Bay and Golden Bay and the west coast (MacGibbon et al 2024). Throughout the time series, more biomass has come from the west coast, but biomass has been more stable in Tasman Bay and Golden Bay. This decline in abundance was also present in other surveys, including the more offshore west coast South Island trawl survey carried out on RV *Tangaroa* (Devine et al 2022) and the winter inshore east coast South Island survey (MacGibbon et al 2019, Beentjes et al 2022).

The length frequency has shown a fairly broad distribution for spiny dogfish from the west coast over time, usually between about 30 cm and 80 cm (MacGibbon et al 2024). The length frequency distribution for Tasman Bay and Golden Bay has been narrower in comparison with the west coast, mainly from about 50–70 cm, and comprised mostly of males. From about 2013, both the left- and right-hand tails of the west coast distribution have been truncated. This was not so apparent in the Tasman Bay and Golden Bay distribution.

In most years, adult fish have made up most of the biomass, with exceptions in 2019 and 2023 (MacGibbon et al 2024). The juvenile contribution to biomass was still a significant proportion, especially when compared with most other species monitored by the survey. The small increase in biomass in 2023 came from both juvenile and adult fish but mainly from juveniles.

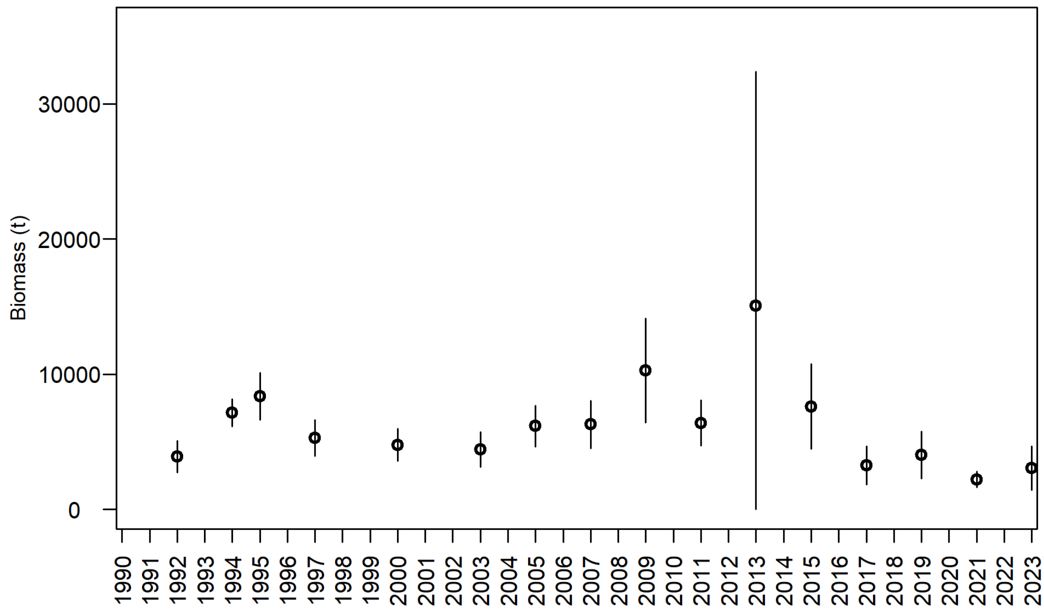


Figure 2: Spiny dogfish biomass for the west coast South Island inshore trawl survey time series (error bars are ± two standard deviations).

Chatham Rise trawl survey

The Chatham Rise trawl survey was designed primarily for hoki and, for spiny dogfish, covers the relevant depth range 200–400 m. It therefore excludes a small portion of SPD habitat at depths less than 200 m around the Mernoo Bank and Chatham Islands. The survey biomass estimates for SPD increased from 1992 to 1997 and have cycled around the series mean since then (Figure 3). The Chatham Rise SPD survey catch is dominated by mature females (60–100 cm), whereas that of the ECSI survey consists mostly of males and females < 60 cm (Beentjes et al 2016, Stevens et al 2015).

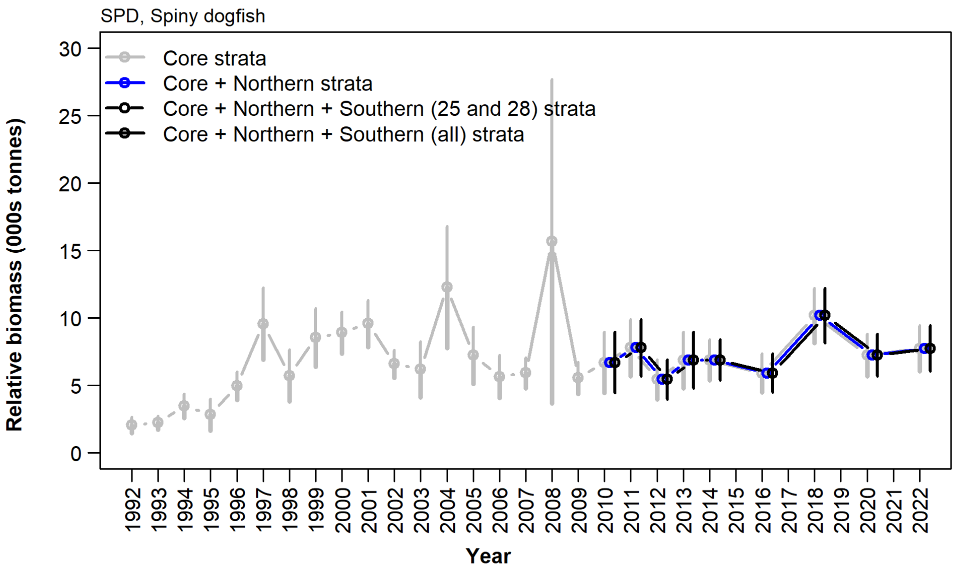


Figure 3: Spiny dogfish biomass for the Chatham Rise inshore trawl survey time series (error bars are ± two standard deviations).

East coast South Island inshore trawl survey

The east coast South Island winter surveys from 1991 to 1996 (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 were expanded to include the 10–30 m depth range, to monitor elephantfish and red gurnard which were officially included in the list of target species in 2012. The 2007 survey and all surveys from 2012 onwards provide full coverage of the 10–30 m depth range.

Spiny dogfish biomass in the core survey area increased markedly in 1996 and has fluctuated over the last eight surveys with a clear declining trend. The lowest and second lowest estimates in the time series were in 2021 and 2024 (Table 9, Figure 4) (MacGibbon et al 2024). Pre-recruited biomass was a small component of the total biomass estimate in the 1992 to 1994 surveys at 1–3% of total biomass, but since 1996 it has ranged from 7 to 52%. In 2024, it was 18%, similar to the post-1994 average of 19% (Table 9, Figure 4). This is also reflected in the biomass of juvenile spiny dogfish (based on the length-at-50% maturity), which increased markedly from about 14% of total biomass before 1996 to between 32 and 63% in the last eleven surveys, and in 2024 it was 38%.

The additional spiny dogfish biomass captured in the 10–30 m depth range accounted for, on average, 10% of the biomass in the core plus shallow strata (10–400 m) with a range of 5–13%, until 2024 when it increased to 24% indicating that it is useful to monitor the shallow strata for spiny dogfish biomass (Table 9, Figure 4). The addition of the 10–30 m depth range had little effect on the shape of the spiny dogfish length frequency distributions with the exception of 2022 and 2024, when the smallest fish were caught in less than 30 m. The spatial distribution of spiny dogfish aggregations varied, geographically over the core strata time series, but overall this species was consistently well represented over the entire survey area, most commonly from 30 m to about 350 m. Spiny dogfish are consistently the most commonly caught species on the ECSI trawl survey and occurred in 94–100% of core strata tows with no trend (97% in 2024). Spiny dogfish comprised 10–46% of the total catch on the surveys with a downward trend until 2021, before increasing again to 27% in 2022, and 26% in 2024.

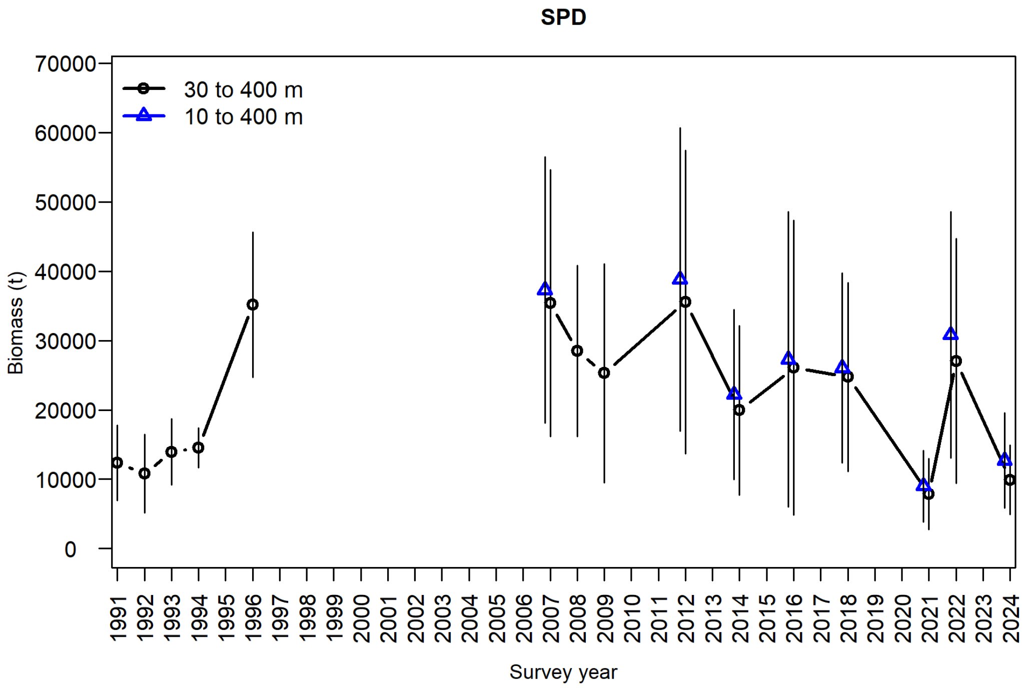


Figure 4: Spiny dogfish total biomass for ECSI winter surveys in core strata (30–400 m), and core plus shallow strata (10–400 m). Error bars are ± two standard deviations.

Table 9: Relative biomass indices (t) and coefficients of variation (CV) for spiny dogfish for east coast North Island (ECNI), east coast South Island (ECSI) - summer and winter, Chatham Rise, Stewart-Snares shelf, Sub-Antarctic, west coast South Island (WCSI) and west coast North Island (WCNI) survey areas*. 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). The sum of pre-recruit and recruited biomass values do not always match the total biomass for the earlier surveys because at several stations length frequencies were not measured, affecting the biomass calculations for length intervals. – , not measured; NA, not applicable. Recruited is defined as the size-at-recruitment to the fishery (50 cm). [Continued on next two pages]

Region	Fishstock	Year	Trip number	Biomass estimate	CV (%)	Biomass estimate	CV (%)	Pre-recruit	CV (%)	Recruited	CV (%)
ECNI	SPD 2	1993	KAH9304	963	78	–	–	–	–	–	–
		1994	KAH9402	988	47	–	–	–	–	–	–
		1995	KAH9502	658	25	–	–	–	–	–	–
		1996	KAH9602	1 026	51	–	–	–	–	–	–
ECSI (winter)	SPD 3			30–400 m		10–400 m		30–400 m		30–400 m	
		1991	KAH9105	12 873	22	–	–	–	–	–	–
		1992	KAH9205	10 787	26	–	–	266	27	9 212	31
		1993	KAH9306	13 949	17	–	–	343	72	13 122	17
		1994	KAH9406	14 530	10	–	–	205	49	14 325	10
		1996	KAH9606	35 169	15	–	–	3 412	23	31 757	16
		2007	KAH0705	35 386	24	37 299	26	5 831	46	29 554	27
		2008	KAH0806	28 476	22	–	–	1 886	50	26 590	22
		2009	KAH0905	25 311	31	–	–	2 398	30	22 913	32
		2012	KAH1207	35 546	31	38 821	28	3 804	58	31 742	34
		2014	KAH1402	19 949	31	22 188	28	5 683	34	14 266	36
		2016	KAH1605	26 063	41	27 300	39	2 639	34	18 299	50
		2018	KAH1803	24 758	28	26 049	26	7 423	55	17 336	29
		2021	KAH2104	7 857	32	9 010	29	4 099	54	3 758	33
		2022	KAH2204	27 030	33	30 819	29	3 121	34	23 909	36
		2024	KAH2402	9 910	25	12 720	27	1 796	40	8 114	26
ECSI (summer)	SPD 3	1996–97	KAH9618	35 776	28	–	–	–	–	–	–
		1997–98	KAH9704	29 765	25	–	–	–	–	–	–
		1998–99	KAH9809	22 842	16	–	–	–	–	–	–
		1999–00	KAH9917	49 832	37	–	–	–	–	–	–
		2000–01	KAH0014	30 508	34	–	–	–	–	–	–
Chatham Rise	SPD 4	1991	TAN9106	2 390	14	–	–	–	–	–	–
		1992	TAN9212	2 220	11	–	–	–	–	–	–
		1994	TAN9401	3 449	13	–	–	–	–	–	–
		1995	TAN9501	2 841	21	–	–	–	–	–	–
		1996	TAN9601	4 969	11	–	–	–	–	–	–
		1997	TAN9701	8 905	9	–	–	–	–	–	–
		1998	TAN9801	9 586	9	–	–	–	–	–	–
		1999	TAN9901	6 334	8						
		1999–00	TAN0001	6 191	17	–	–	–	–	–	–
		2000–01	TAN0101	12 289	18	–	–	–	–	–	–
		2001–02	TAN0201	2 390	14	–	–	–	–	–	–

Table 10 [Continued]: Relative biomass indices (t) and coefficients of variation (CV) for spiny dogfish for east coast North Island (ECNI), east coast South Island (ECSI) - summer and winter, Chatham Rise, Stewart-Snares shelf, Sub-Antarctic, west coast South Island (WCSI) and west coast North Island (WCNI) survey areas*. 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). The sum of pre-recruit and recruited biomass values do not always match the total biomass for the earlier surveys because at several stations length frequencies were not measured, affecting the biomass calculations for length intervals. – , not measured; NA, not applicable. Recruited is defined as the size-at-recruitment to the fishery (50 cm).

Region	Fishstock	Year	Trip number	Total Biomass estimate	CV (%)	Total Biomass estimate	CV (%)	Pre-recruit	CV (%)	Pre-recruit	CV (%)	Recruited	CV (%)	Recruited	CV (%)
Chatham Rise	SPD 4	2002–03	TAN0301	2 220	11	–	–	–	–	–	–	–	–	–	–
		2004	TAN0401	3 449	13	–	–	–	–	–	–	–	–	–	–
		2005	TAN0501	7 227	15	–	–	–	–	–	–	–	–	–	–
		2006	TAN0601	5 650	14	–	–	–	–	–	–	–	–	–	–
		2007	TAN0701	5 906	10	–	–	–	–	–	–	–	–	–	–
		2008	TAN0801	15 674	38	–	–	–	–	–	–	–	–	–	–
		2009	TAN0901	5 548	11	–	–	–	–	–	–	–	–	–	–
		2010	TAN1001	6 698	17	–	–	–	–	–	–	–	–	–	–
		2011	TAN1101	7 794	14	–	–	–	–	–	–	–	–	–	–
		2012	TAN1201	5 438	14	–	–	–	–	–	–	–	–	–	–
		2013	TAN1301	6 884	15	–	–	–	–	–	–	–	–	–	–
		2014	TAN1401	6 886	11	–	–	–	–	–	–	–	–	–	–
		2016	TAN1601	5 908	12	–	–	–	–	–	–	–	–	–	–
		2018	TAN1801	10 175	10	–	–	–	–	–	–	–	–	–	–
		2020	TAN2001	7 238	11	–	–	–	–	–	–	–	–	–	–
		2022	TAN2201	7 740	11	–	–	–	–	–	–	–	–	–	–
Stewart-Snares shelf	SPD 5	1993	TAN9301	35 776	28	–	–	–	–	–	–	–	–	–	–
		1994	TAN9402	29 765	25	–	–	–	–	–	–	–	–	–	–
		1995	TAN9502	22 842	16	–	–	–	–	–	–	–	–	–	–
		1996	TAN9604	49 832	37	–	–	–	–	–	–	–	–	–	–
Sub-Antarctic (*Spring*)	SPD 5	1991	TAN9105	8 502	55	–	–	–	–	–	–	–	–	–	–
		1992	TAN9211	1 150	15	–	–	–	–	–	–	–	–	–	–
		1993	TAN9310	1 585	21	–	–	–	–	–	–	–	–	–	–
		2000	TAN0012	4 173	12	–	–	–	–	–	–	–	–	–	–
		2001	TAN0118	8 528	31	–	–	–	–	–	–	–	–	–	–
		2002	TAN0219	3 505	19	–	–	–	–	–	–	–	–	–	–
		2003	TAN0317	2 317	17	–	–	–	–	–	–	–	–	–	–
		2004	TAN0414	3 378	27										
		2005	TAN0515	4 344	19	–	–	–	–	–	–	–	–	–	–
		2006	TAN0617	3 039	19	–	–	–	–	–	–	–	–	–	–
Sub-Antarctic (*Autumn*)	SPD 5	1992	TAN9204	926	30	–	–	–	–	–	–	–	–	–	–
		1993	TAN9304	440	38	–	–	–	–	–	–	–	–	–	–
		1996	TAN9605	207	56	–	–	–	–	–	–	–	–	–	–
		1998	TAN9805	1 532	36	–	–	–	–	–	–	–	–	–	–

Table 10 [Continued]: Relative biomass indices (t) and coefficients of variation (CV) for spiny dogfish for east coast North Island (ECNI), east coast South Island (ECSI) - summer and winter, Chatham Rise, Stewart-Snares shelf, Sub-Antarctic, west coast South Island (WCSI) and west coast North Island (WCNI) survey areas*. 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). The sum of pre-recruit and recruited biomass values do not always match the total biomass for the earlier surveys because at several stations length frequencies were not measured, affecting the biomass calculations for length intervals. – , not measured; NA, not applicable. Recruited is defined as the size-at-recruitment to the fishery (50 cm).

Region	Fishstock	Year	Trip number	Total Biomass estimate	CV (%)	Total Biomass estimate	CV (%)	Pre-recruit	CV (%)	Pre-recruit	CV (%)	Recruited	CV (%)	Recruited	CV (%)
WCSI	SPD 7	1992	KAH9204	3 919	15	–	–	–	–	–	–	–	–	–	–
		1994	KAH9404	7 145	7	–	–	–	–	–	–	–	–	–	–
		1995	KAH9504	8 370	10	–	–	–	–	–	–	–	–	–	–
		1997	KAH9701	5 275	13	–	–	–	–	–	–	–	–	–	–
		2000	KAH0004	4 777	12	–	–	–	–	–	–	–	–	–	–
		2003	KAH0304	4 446	15	–	–	–	–	–	–	–	–	–	–
		2005	KAH0503	6 175	12	–	–	–	–	–	–	–	–	–	–
		2007	KAH0704	6 219	14	–	–	–	–	–	–	–	–	–	–
		2009	KAH0904	10 270	19	–	–	–	–	–	–	–	–	–	–
		2011	KAH1104	6 402	13	–	–	–	–	–	–	–	–	–	–
		2013	KAH1305	15 087	57	–	–	–	–	–	–	–	–	–	–
		2015	KAH1503	7 613	21	–	–	–	–	–	–	–	–	–	–
		2017	KAH1703	3 255	22	–	–	–	–	–	–	–	–	–	–
		2019	KAH1902	4 031	22	–	–	–	–	–	–	–	–	–	–
		2021	KAH2103	2 226	14	–	–	–	–	–	–	–	–	–	–
		2023	KAH2302	3 043	27	–	–	–	–	–	–	–	–	–	–
WCNI	SPD 9	1991	KAH9111	443*	34	–	–	–	–	–	–	–	–	–	–
		1994	KAH9410	381*	30	–	–	–	–	–	–	–	–	–	–
		1996	KAH9615	634*	68	–	–	–	–	–	–	–	–	–	–
		1999	KAH9915	106*	15	–	–	–	–	–	–	–	–	–	–

*Assuming areal availability, vertical availability, and vulnerability equal 1.0. Biomass is only estimated outside 10 m depth except for COM9901 and CMP0001. Note: because trawl survey biomass estimates are indices, comparisons between different seasons (e.g., summer and winter ECSI) are not strictly valid.

The size distributions of spiny dogfish in the 1992 to 1994 surveys were similar and generally bimodal for males, but less defined for females which are less numerous than males with more females over 80 cm, throughout the core strata time series. From 1996 onwards, smaller fish were more abundant, and there were many more larger fish in the population. The large increase in biomass observed post-1996 is in part a result of the change in the population size composition. In contrast, in 2021 the time series biomass low is associated with a marked drop-off in numbers of larger fish over about 50 cm, which subsequently reappeared in 2022, concurrent with the three-fold biomass increase. Aside from a modest increase in small fish centred around 40 cm in the 10–30 m strata, the length frequency distribution in 2024 shows a marked decline in numbers across all size ranges, consistent with the decrease in biomass. Spiny dogfish on the ECSI sampled on these surveys were considerably smaller than those from the Chatham Rise, Southland, and the sub-Antarctic surveys (Bagley & Hurst 1996, O'Driscoll & Bagley 2001, Stevens et al 2021, 2022), suggesting that this area may be an important nursery ground for juvenile spiny dogfish. It also indicates that there may be movement in and out of the ECSI survey areaand that the ECSI inshore time series may not be monitoring the entire population.

Manning et al (2004) evaluated the usefulness of commercial CPUE, commercial length composition, trawl survey relative biomass estimates and trawl-survey-catch length composition for monitoring all major SPD stocks (Table 10).

Table 10: Catch and effort data sets and analyses evaluated as monitoring tools for major SPD stocks.

QMA	Data set and analysis
SPD 3 - East coast South Island	1. Standardised setnet CPUE for core vessels targeting SPD.
	2. Standardised setnet CPUE for core vessels targeting all species.
	3. Standardised bottom trawl CPUE for core vessels targeting all species.
	4. Relative abundance indices from east coast South Island trawl surveys (discontinued after 2001).
SPD 4 - Chatham Rise	5. Standardised bottom trawl CPUE for core Korean vessels.
	6. Standardised bottom trawl CPUE for core domestic vessels.
	7. Standardised bottom longline CPUE for core domestic vessels.
	8. Relative abundance indices from Chatham Rise trawl surveys.
SPD 5 - Stewart-Snares shelf	9. Standardised bottom trawl CPUE.
	10. Relative abundance indices from Stewart-Snares shelf surveys (discontinued after 1996).
SPD 7 - West coast South Island	11. Standardised bottom trawl CPUE for core vessels.
	12. Relative abundance indices from west coast South Island trawl surveys.

Based on the results of the analyses listed in Table 10, the following methods were recommended for monitoring SPD:

QMA	Recommended Monitoring Tools
SPD 3 - East coast South Island	Standardised setnet CPUE using model 2 (core vessels targeting all species)
SPD 4 - Chatham Rise	Chatham Rise trawl survey and length composition of commercial catch
SPD 5 – Stewart-Snares shelf	*Standardised bottom trawl CPUE and length composition of commercial catch
SPD 7 - West coast South Island	West coast South Island trawl survey and length composition of commercial catch

* Information on historical changes in reporting rates is required before this index can be used.

4.2 Biomass estimates

Lack of suitable information has precluded estimation of virgin and current biomass for spiny dogfish. Although most of the necessary biological parameters (Hanchet 1986, 1988, Hanchet & Ingerson 1997), relative indices of abundance and data required to estimate fishing selectivity for most important fisheries (with the exception of FMA 4 bottom longline and FMA 3 setnet fisheries) are now available, robust stock assessments will also require estimates of historical, unreported discarding and discard mortality so that an accurate history of fishery related removals can be constructed.

4.3 Yield estimates and projections

MCY cannot be estimated.

CAY cannot be determined.

4.4 Other factors

The ability to withstand harvesting depends on the strength of a number of compensatory mechanisms. For example, under exploitation individuals may grow faster, show increased fecundity, or suffer reduced natural mortality. In elasmobranchs the number of young born is related directly to the number of adult females, and, because of the relatively large size and hence good survival of the young at birth, it is presumed that there is a strong stock recruit relationship for these species.

Several methods of estimating *MCY* involve the multiplication of a harvest level by an estimate of B_0 or B_{av}. Francis & Francis (1992) used Monte Carlo simulation to estimate harvest levels for calculating *MCY* for a rig stock. No stock-recruitment data were available for elasmobranchs at the time and so they used values for the Beverton & Holt steepness parameter ranging from 0.35 to 0.50, and recruitment variability of 0.4. These values were all at the low range of values used for teleost species and which they considered appropriate for rig. The results of their simulation studies showed that the estimates of *MCY* obtained using the harvest levels given in the equations in the Guide to Biological Reference Points were overly optimistic for rig. Given that spiny dogfish have a slower growth rate and are less fecund than rig, it seems reasonable to assume that those harvest levels are also unsuitable for spiny dogfish.

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). Spiny dogfish was ranked seventh 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.

5. STATUS OF THE STOCKS

No estimates of current or reference biomass are available, but trawl survey estimates of abundance have been calculated for a number of years (Table 9).

Although reported commercial catches of spiny dogfish were observed to increase in all major FMAs during the 1990s, the extent to which these increases can be attributed to changes in reporting practice (i.e., more accurate reporting of discards in recent times) is uncertain. Trawl surveys, on the other hand, indicate that there was a general increase in the abundance of spiny dogfish, particularly around the South Island, in the mid-1990s.

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