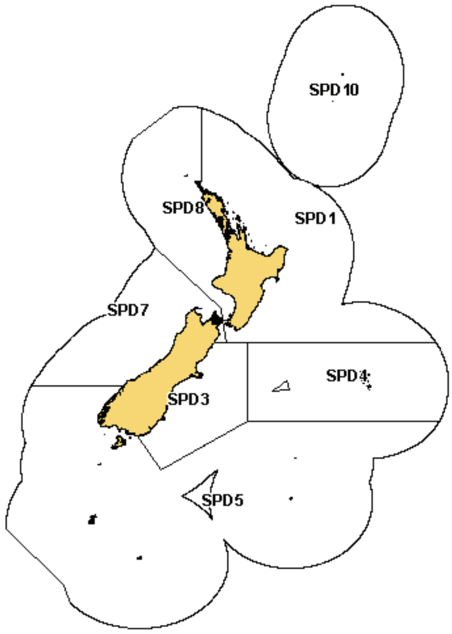
SPINY DOGFISH (SPD)

(*Squalus acanthias*)
Makohuarau, Pioke, Kāraerae



1. FISHERY SUMMARY

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 1. 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 this 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.

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 catch of spiny dogfish has fluctuated between about 3000 and 7000 t. 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. 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 1: 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
80–81	–	(196)	–	–	196
81–82	–	1 881	–	–	1 881
82–83	(107)	2 568	–	–	2 675
83–84	309	2 949	–	–	3 258
84–85	303	3 266	–	–	3 569
85–86	311	2 802	–	–	3 113
86–87	870	2 277	2 608	–	3 147
87–88	834	3 877	4 823	–	4 823
88–89	(351)	(500)	3 573	(16)	3 589
89–90	(14)	0	2 952	321	3 273
90–91	–	–	5 983	333	6 316
91–92	–	–	3 274	521	3 795
92–93	–	–	4 157	616	4 773
93–94	–	–	6 150	1 063	7 213
94–95	–	–	4 793	628	5 421
95–96	–	–	6 230	1 920	8 150
96–97	–	–	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.

The catch by FMA from the FSU, CELR and CLR databases is shown in Table 2. Large catches have been made from FMAs 3, 5, 6, and 7 since 1982–83. Catches from FMA 4 have increased substantially since the mid-1990s. Landings from FMA 5 and 6 were most important in the early 1980s, with 1000-2000 t taken annually by factory trawlers. In more recent years FMA 3, and to a lesser extent, FMA 7 have become more important. The catch in both these areas is taken equally by factory trawlers and inshore fleets. 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 FMA 5/6 quota in 2002–02.

Spiny dogfish was introduced into the QMS in October 2004. Catches and TACCs are shown in Table 3, while Figure 1 depicts historical landings and TACC values for the main SPD stocks.

Table 2: Reported landings of spiny dogfish by proposed Fishstock. Proportions by area have been taken from CELR and CLR and pro-rated to the best estimate from Table 1. 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	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	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 3: Reported domestic landings (t) of spiny dogfish by Fishstock and TACC from 2004–05 to 2007–08.

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	Landings	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	2 164	3 700	1 125	1 902
2007–08	165	331	2 095	4 794	1 422	1 626	1 527	3 700	960	1 902

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	7 180	12 660
2007–08	124	307	6 293	12 660

Prior to their introduction into the QMS spiny dogfish were legally discarded at sea (provided that total catch is reported). Although discard rates increased dramatically through the 1990s (Table 4), this is believed to reflect a change in reporting practise rather than an increase in the proportion of catch discarded.

Table 4: Discard rates (% of catch) by QMA and fishing year (after Manning *et al*., 2004).

Fishing year	QMA											
	1	2	3	4	5	6	7	8	9	10	Other	Total
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
Total	15	74	35	53	42	78	54	68	78	0	16	45

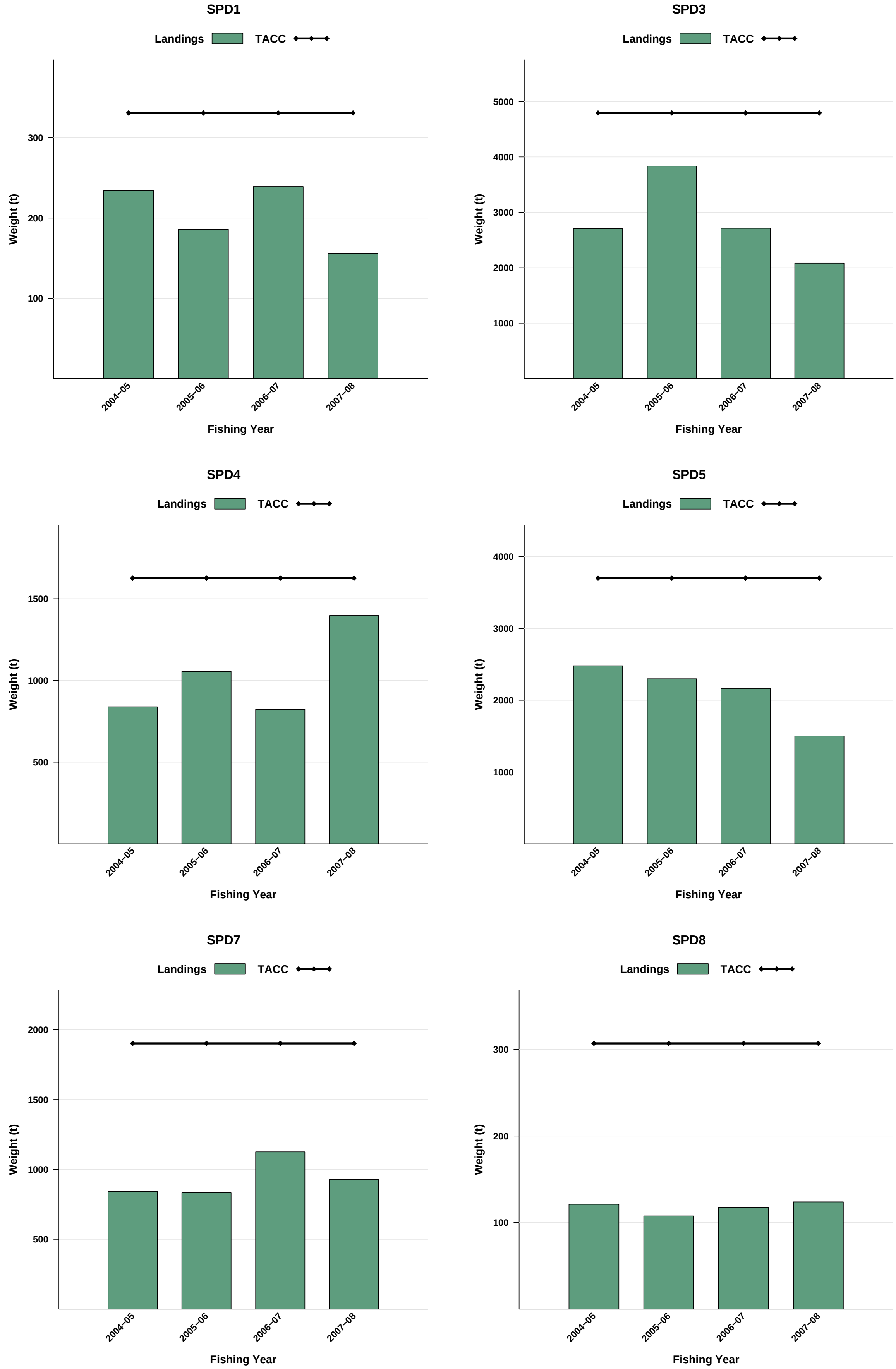


Figure 1: Historical landings and TACC for the six main SPD stocks. From top left to bottom right: SPD1 (Auckland East, Central East), SPD3 (South East Coast), SPD4 (South East Chatham Rise), SPD5 (Sub Antarctic, Southland), SPD7 (Challenger), and SPD8 (Central Egmont, Auckland West). Note that these figures do not show data prior to entry into the QMS.

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. Estimates of recreational landings obtained from three surveys in 1991–92 to 1993–94, 1996 and 1999-00 are given in Table 5. Overall, recreational landings probably comprise only a small proportion (< 10 %) of the total spiny dogfish catch.

Table 5: Estimated number and weight of spiny dogfish harvested by recreational fishers by Fishstock and survey. Surveys were carried out in different years in the Ministry of Fisheries regions: South in 1991–92, Central in 1992–93, North in 1993–94 (Teirney *et al.* 1997) and nationally in 1996 (Bradford 1998) and 1999-00 (Boyd & Reilly 2005). Survey harvests are presented as a range to reflect the uncertainty in the estimates.

Fishstock	Survey	Number	CV%	Harvest Range (t)	Point estimate (t)
1991–92					
QMA 3	South		23		120
QMA 5	South		-		2
QMA 7	South		92		11
1992–93					
QMA 2	Central		42		133
QMA 7	Central		35		46
QMA 8	Central		45		143
1993–94					
QMA 1,9	North		-		<10
1996					
QMA 1	National	1 000	–	–	–
QMA 2	National	5 000	–	–	–
QMA 3	National	21 000	17	25–40	33
QMA 5	National	9 000	–	–	–
QMA 7	National	24 000	21	30–45	37
QMA 9	National	15 000	–	–	–
1999–00					
QMA 1	National	9 000	61	4.4-17.9	11
QMA 2	National	22 000	37	17.3-37.8	28
QMA 3	National	93 000	27	83.2-145.9	115
QMA 5	National	7 000	47	4.4-12.3	8
QMA 7	National	25 000	35	20.4-41.9	31
QMA 8	National	21 000	52	12.7-40.3	27
QMA 9	National	12 000	82	2.7-26.2	14

The Recreational Technical Working Group concluded that the harvest estimates from the diary surveys should be used only with the following qualifications: a) they may be very inaccurate; b) the 1996 and earlier surveys contain a methodological error; and, c) the 2000 and 2001 estimates are implausibly high for many important fisheries.

1.3 Customary non-commercial fisheries

Maori fishers traditionally caught large numbers of "dogfish" during the last century 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 as the quota for this species has never been reached, and it has low commercial value.

1.5 Other sources of mortality

It is likely that there is a large amount of spiny dogfish discarded by fishers which is never reported on the returns. The level of mortality and any temporal trends from non-reported discards have not been estimated. The introduction of cost recovery charges in 1994–95 may account for the decline in reported discards in that year.

2. BIOLOGY

Spiny dogfish are widely distributed around the South Island and extend as far north as Manakau Harbour and East Cape on the west and east coasts of the North Island respectively. They are most abundant on 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 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 $year^{-1}$ an initial population of 1 000 females would replace themselves over their lifespan (given their length-at-age, length–at-maturity and fecundity-length relationships).

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 is closely followed by mating and ovulation and the biennial cycle is repeated. Both the number and the size of 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 mid-water 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 6.

Table 6: Estimates of biological parameters of spiny dogfish for QMA3 (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 (ECSI) 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 on 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 QMA 7 and 8 as a single stock.

There is little commercial catch in QMAs 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 5 Fishstocks:

SPD 1: QMA 1 & 2
SPD 3: QMA 3
SPD 4: QMA 4
SPD 5: QMA 5 & 6
SPD 7: QMA 7, 8 & 9.

4. STOCK ASSESSMENT

There are no estimates of current or virgin biomass. This is the first stock assessment for spiny dogfish.

4.1 Estimates of fishery parameters and abundance

Biomass indices of spiny dogfish from recent trawl surveys using *Tangaroa* and *Kaharoa* are summarised in Table 7 and Figure 2. Based on a combination of CVs, variability in biomass indices and the time span of each series, it is concluded that surveys only provide reliable indices of dogfish abundance off the west 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 dogfish off the west coast of South Island appears to have been fairly stable between 1991 and 2003. Although the relevant surveys were discontinued, spiny dogfish appear also to have increased substantially in abundance off the east coast of the South Island and on the Stewart-Snares shelf in the mid 1990s.

Table 7: Biomass indices (t) and coefficients of variation (CV) from trawl surveys assuming vulnerability, spatial availability and vertical availability equal 1. Note: because trawl survey biomass estimates are indices, comparisons between different seasons (e.g., summer and winter ECSI) are not strictly valid.

QMA	Area	Vessel	Trip code	Date	Fishing year	Biomass (t)	CV (%)
2	East coast North Island	KAH	KAH9304	Feb–Mar 1993	1992–93	963	78
			KAH9402	Feb–Mar 1994	1992–94	988	47
			KAH9502	Feb–Mar 1995	1994–95	658	25
			KAH9602	Feb–Mar 1996	1995–96	1 026	51
3	East coast South Island (*Winter*)	KAH	KAH9105	May–Jun 1991	1990–91	12 873	22
			KAH9205	May–Jun 1992	1991–92	10 787	26
			KAH9306	May–Jun 1993	1992–93	13 949	17
			KAH9406	May–Jun 1994	1993–94	14 530	10
			KAH9606	May–Jun 1996	1995–96	35 169	15
			KAH0705	May–Jun 2007	2006-07	35 386	24
			KAH0806	May–Jun 2008	2007-08	28 476	22
	East coast South Island (*Summer*)	KAH	KAH9618	Dec–Jan 1996–97	1996–97	35 776	28
			KAH9704	Dec–Jan 1997–98	1997–98	29 765	25
			KAH9809	Dec–Jan 1998–99	1998–99	22 842	16
			KAH9917	Dec–Jan 1999–00	1999–00	49 832	37
			KAH0014	Dec–Jan 2000–01	2000–01	30 508	34
4	Chatham Rise	TAN	TAN9106	Dec–Feb 1991–92	1991–92	2 390	14
			TAN9212	Dec–Feb 1992–93	1992–93	2 220	11
			TAN9401	Jan–Feb 1994	1993–94	3 449	13
			TAN9501	Jan–Feb 1995	1994–95	2 841	21
			TAN9601	Dec–Jan 1995–96	1995–96	4 969	11
			TAN9701	Jan 1997	1996–97	9 570	14
			TAN9801	Jan 1998	1997–98	5 724	17
			TAN9901	Jan 1999	1998–99	8 551	13
			TAN0001	Dec–Jan 1999–00	1999–00	8 905	9
			TAN0101	Dec–Jan 2000–01	2000–01	9 586	9
			TAN0201	Dec–Jan 2001–02	2001–02	6 334	8
			TAN0301	Dec–Jan 2002–03	2002–03	6 191	17
			TAN0401	Jan 2004	2003–04	12 289	18
			TAN0501	Jan 2005	2004–05	7 227	15
			TAN0601	Jan 2006	2005–06	5 650	14
			TAN0701	Jan 2007	2006–07	5 906	10
			TAN0801	Jan 2008	2007-08	15674	38
			TAB0901	Jan 2009	2008-09	5548	11
5	Stewart–Snares Shelf	TAN	TAN9301	Feb–Mar 1993	1992–93	36 023	13
			TAN9402	Feb–Mar 1994	1993–94	36 328	17
			TAN9502	Feb–Mar 1995	1994–95	91 364	29
			TAN9604	Feb–Mar 1996	1995–96	89 818	29
6	Sub–Antarctic (*Spring*)	TAN	TAN9105	Nov–Dec 1991	1991–92	8 502	55
			TAN9211	Nov–Dec 1992	1992–93	1 150	15
			TAN9310	Nov–Dec 1993	1993–94	1 585	21
			TAN0012	Nov–Dec 2000	2000–01	4 173	12
			TAN0118	Nov–Dec 2001	2001–02	8 528	31
			TAN0219	Nov–Dec 2002	2002–03	3 505	19
			TAN0317	Nov–Dec 2003	2003–04	2 317	17
			TAN0414	Nov–Dec 2004	2004–05	3 378	27
			TAN0515	Nov–Dec 2005	2005–06	4 344	19
			TAN0617	Nov–Dec 2006	2006–07	3 039	19
QMA	Area	Vessel	Trip code	Date	Fishing Year	Biomass (t)	CV (%)
6	Sub-Antarctic (*Autumn*)	TAN	TAN9204	Apr–May 1992	1991–92	0 926	30
			TAN9304	May–Jun 1993	1992–93	0 440	38
			TAN9605	Mar–Apr 1996	1995–96	0 207	56
			TAN9805	Apr–May 1998	1997–98	1 532	36
7	West coast South Island	KAH	KAH9204	Mar–Apr 1992	1991–92	3 919	15
			KAH9404	Mar–Apr 1994	1993–94	7 145	7
			KAH9504	Mar–Apr 1995	1994–95	8 370	10
			KAH9701	Mar–Apr 1997	1996–97	5 275	13
			KAH0004	Mar–Apr 2000	1999–00	4 777	12
			KAH0304	Mar–Apr 2003	2002–03	4 446	15
			KAH0503	Mar–Apr 2005	2004–05	6 175	12
			KAH0704	Mar–Apr 2007	2006-07	6 219	14
			KAH09	Mar-Apr 2009	2008-09	9 518	19
9	West coast North Island	KAH	KAH9111	Oct 1991	1991–92	443*	34
			KAH9410	Oct 1994	1994–95	381*	30
			KAH9615	Oct 1996	1996–97	634*	68
			KAH9915	Nov 1999	1999–00	106*	15

Manning *et al*. (2004) recently 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 8).

Table 8: 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 8, 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 FMA 4 bottom longline and QMA 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 Estimation of Maximum Constant Yield (MCY)

MCY cannot be estimated.

4.4 Estimation of Current Annual Yield (CAY)

CAY cannot be determined.

4.5 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 Annala & Sullivan (1996) 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.

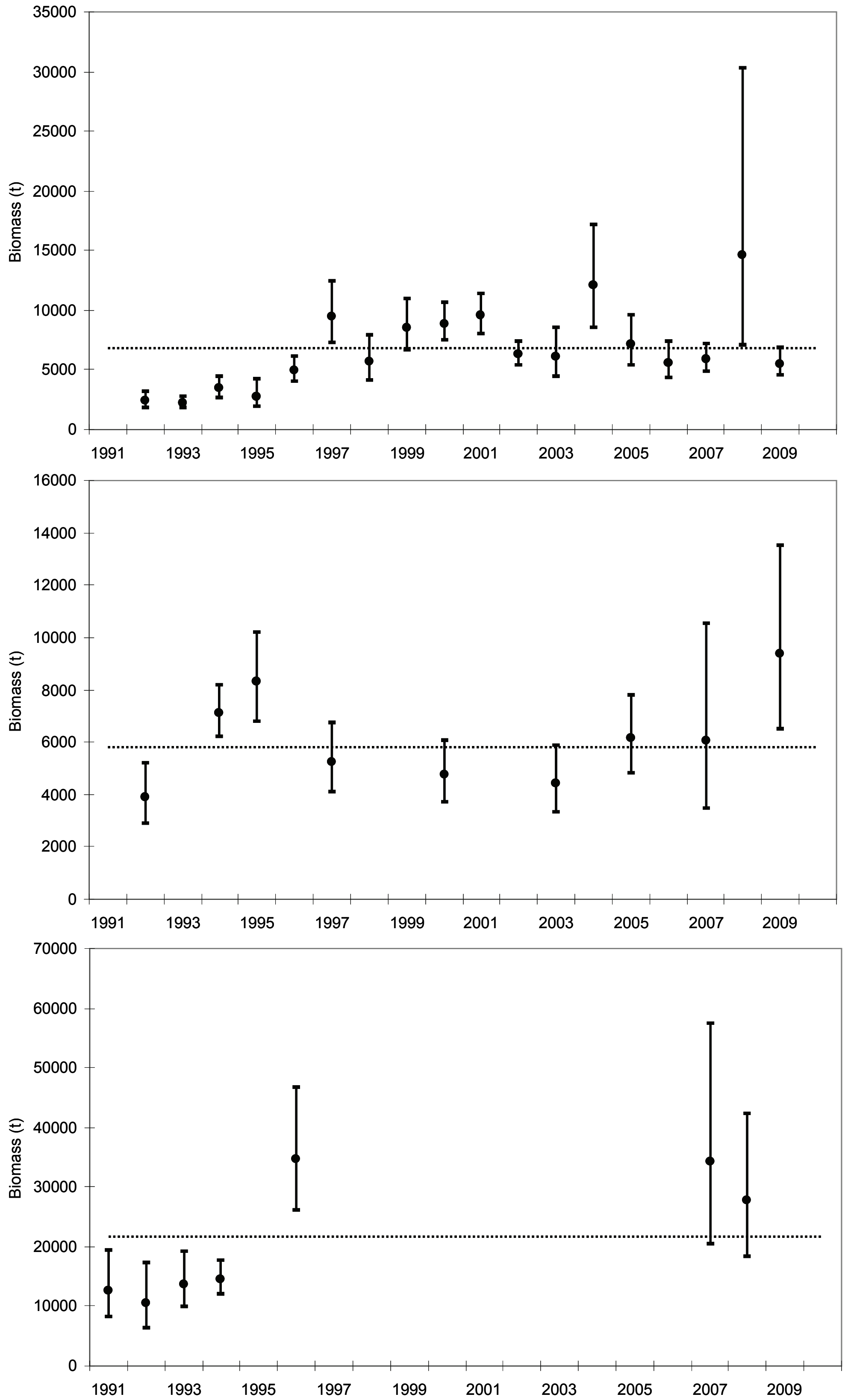


Figure 2: Spiny dogfish biomass ±95% CI (estimated from survey CV's assuming a lognormal distribution) and the time series mean (dotted line) estimated from the Chatham Rise (Top), West (Middle) and East (bottom) Coast South Island trawl survey.

5. STATUS OF THE STOCKS

No estimates of current or reference biomass are available.

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. It is unknown whether current catch limits are sustainable.

Reported landings and TACCs for the 2007–08 fishing year are summarised in Table 9.

Table 9: Summary of TACCs (t) and reported landings (t) of spiny dogfish for the most recent fishing year.

Fishstock		FMA	2007–08 Actual TACC	2007–08 Reported landings
SPD 1	Auckland (East), Central (East)	1&2	331	165
SPD 3	South east (coast)	3	4 794	2 095
SPD 4	South east (Chatham)	4	1 626	1 422
SPD 5	Southland, sub-Antarctic	5&6	3 700	1 527
SPD 7	Challenger	7	1 902	960
SPD 8	Central (west), Auckland (west)	8&9	307	124
Total			12 660	6 293

6. FOR FURTHER INFORMATION

Annala JH., Sullivan KS. (Comp.) 1996: Report from the Fishery Assessment Plenary, April-May 1996: stock assessments and yield estimates. 308 p. (Unpublished report held in NIWA library Wellington).

Bradford E. 1998. Harvest estimates from the 1996 national recreational fishing surveys. New Zealand Fisheries Assessment Research Document 1998/16. 27p.

Boyd RO., Reilly JL. 2005. 1999/2000 national marine recreational fishing survey: harvest estimates. Draft New Zealand Fisheries Assessment Report.

Da Silva HM. 1993. The causes of variability in the stock-recruitment relationship of spiny dogfish, *Squalus acanthias*, in the NW Atlantic. *ICES CM 1993/G:52*. 17 p.

Francis MPF., Francis RICC. 1992. Growth, mortality, and yield estimates for rig (*Mustelus lenticulatus*). New Zealand Fisheries Assessment Research Document 1992/5. 32 p.

Hanchet SM. 1986. The distribution and abundance, reproduction, growth and life history characteristics of the spiny dogfish (*Squalus acanthias* Linnaeus) in New Zealand. PhD Thesis, University of Otago, New Zealand.

Hanchet SM. 1988. Reproductive biology of *Squalus acanthias* from the east coast, South Island, New Zealand. New Zealand Journal of Marine and Freshwater Research 22: 537–549.

Hanchet SM. 1991. Diet of spiny dogfish, *Squalus acanthias* Linnaeus, on the east coast, South Island, New Zealand. Journal of Fish Biology 39: 313–323.

Hanchet SM., Ingerson, JKV. 1997. A summary of biology and commercial landings, and a stock assessment of spiny dogfish (*Squalus acanthias*). New Zealand Fisheries Assessment Research Document 1997/6. 32p.

Manning MJ., Hanchet SM., Stevenson ML. 2004. A description and analysis of New Zealand's spiny dogfish (*Squalus acanthias*) fisheries and recommendations on appropriate methods to monitor the status of the stocks. New Zealand Fisheries Assessment Report 2004/61. 135p.

Palmer G. 1994. Spiny dogfish – pest or potential. Seafood New Zealand, March 1994. 31–36p.

Phillips NL. 2004. Length Erequency distributions of spiny dogfish from the Chatham Rise, Sub-Antarctic, and the west coast South Island fisheries. New Zealand Fisheries Assessment Report 2004/53.

Stevenson ML. 2007. Inshore trawl survey of the west coast of the South Island and Tasman and Golden Bays, March–April 2007 (KAH0704). New Zealand Fisheries Assessment Report 2007/41.

Teirney LD., Kilner AR., Millar RE., Bradford E., Bell JD. 1997. Estimation of recreational catch from 1991/92 to 1993/94 New Zealand. Fisheries Assessment Research Document 1997/15. 43 p.