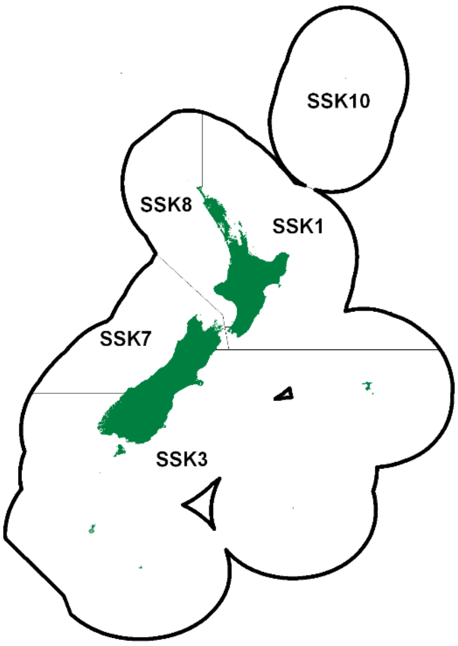
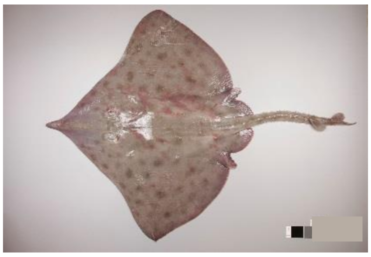
SMOOTH SKATE (SSK)
(*Dipturus innominata*)
Uku





1. FISHERY SUMMARY

1.1 Commercial fisheries

Smooth skate (*Dipturus innominata*, SSK), which are also known as barndoor skates, are fished commercially in close association with rough skates (RSK) in New Zealand. Smooth skates grow considerably larger than rough skates, but both species are landed and processed. Two other species of deepwater skate (*Bathyraja shuntovi* and *Raja hyperborea*) are large enough to be of commercial interest but are relatively uncommon and probably comprise a negligible proportion of the landings.

Skate flesh ammoniates rapidly after death, so the wings are removed at sea, and chilled or frozen. On arrival at the shore factories, the wings are machine-skinned, graded and packed for sale. Most of the product is exported to Europe, especially France and Italy. Skates of all sizes are processed, though some factories impose a minimum weight limit of about 1 kg (200 g per wing), and occasionally wings from very large smooth skates are difficult to market.

Smooth skates occur throughout New Zealand, but are most abundant around the South Island in depths down to 500 m. Most of the catch is taken as bycatch by bottom trawlers, but skates are also taken by longliners. Significant longline bycatch has been reported from the Bounty Plateau in QMA 6. While there is no clear separation of the depth ranges inhabited by rough and smooth skates, smooth skates tend to occur slightly deeper than rough skate (Beentjes & Stevenson 2000, 2001, Stevenson & Hanchet 2000).

Many fishers and processors did not previously distinguish rough and smooth skates in their landing returns, and coded them instead as "skates" (SKA). Because it is impossible to determine the species composition of the catch from landings data prior to introduction of these species into the QMS, all pre-QMS data reported here consist of the sum of the three species codes RSK, SSK and SKA. Landings have been converted from processed weight to whole weight by application of conversion factors. Further, following introduction into the QMS in 2003, the two skate species were not always correctly identified and a considerable, but unknown, catch of either species is misidentified with over-reporting of rough skate and, correspondingly, under-reporting of smooth skate (Beentjes 2005). Neither fishers nor processors were distinguishing between the two skate species or reporting catches of each species correctly at the time of the study in 2004. It is not known if reporting has improved since that time.

There have been historical changes to the conversion factors applied to skates by MAF Fisheries and Ministry of Fisheries. No record seems to have been kept of the conversion factors in use before 1987, so it is not possible to reconstruct the time series of landings data using the currently accepted factors. Consistent and appropriate conversion factors have been applied to skate landings since the end of the 1986–87 fishing year. Before that, it appears that a lower conversion factor was applied, resulting in an underestimation of landed weight by about 20%. No correction has been made for that in this report.

New Zealand annual skate landings, estimated from a variety of sources, are shown in Table 1. No FSU deepwater data were available before 1983, and it is not known whether deepwater catches, including those of foreign fishing vessels, were significant during that period. CELR and CLR data are provided by inshore and deepwater trawlers respectively. "CELR estimated" landings were always less than "CELR landed" landings, because the former include only the top five fish species (by weight) caught by trawlers, whereas the latter include all species landed. As a relatively minor bycatch, skates frequently do not fall into the top five species. The sum of the "CELR landed" and CLR data provides an estimate of the total skate landings. This estimate usually agreed well with LFRR data supplied by fish processors, especially in 1993–94 and 1994–95, but in 1992–93 the difference was 467 t. The "best estimate" of the annual historical landings comes from FSU data up to 1985–86, and LFRR data thereafter.

Table 1: New Zealand skate landings for calendar years 1974–1983, and fishing years (1 October – 30 September) 1983–84 to 1995–96. Values in parentheses are based on part of the fishing year only. Landings do not include foreign catch before 1983, or unreported discards. FSU = Fisheries Statistics Unit; CELR = Catch, Effort and Landing Return; CLR = Catch Landing Return; LFRR = Licensed Fish Receivers Return; Best Estim. = best available estimate of the annual skate catch; - = no data.

			FSU		CELR		CELR Landed		
Year	Inshore	Deepwater	Total	Estim..	Landed	CLR	+CLR	LFRR	Best Estimate
1974	23	-	-	-	-	-	-	-	23
1975	30	-	-	-	-	-	-	-	30
1976	28	-	-	-	-	-	-	-	28
1977	27	-	-	-	-	-	-	-	27
1978	36	-	-	-	-	-	-	-	36
1979	165	-	-	-	-	-	-	-	165
1980	441	-	-	-	-	-	-	-	441
1981	426	-	-	-	-	-	-	-	426
1982	648	-	-	-	-	-	-	-	648
1983	634	178	812	-	-	-	-	-	812
1983–84	686	298	983	-	-	-	-	-	983
1984–85	636	250	886	-	-	-	-	-	886
1985–86	613	331	944	-	-	-	-	-	944
1986–87	723	285	1 007	-	-	-	-	1 019	1 019
1987–88	1 005	421	1 426	-	-	-	-	1 725	1 725
1988–89	(530)	(136)	(665)	(252)	(265)	(28)	(293)	1 513	1 513
1989–90	-	-	-	780	1 171	410	1 581	1 769	1 769
1990–91	-	-	-	796	1 334	359	1 693	1 820	1 820
1991–92	-	-	-	1 112	1 994	703	2 698	2 620	2 620
1992–93	-	-	-	1 175	2 595	824	3 418	2 951	2 951
1993–94	-	-	-	1 247	2 236	788	3 024	2 997	2 997
1994–95	-	-	-	956	1 973	829	2 803	2 789	2 789
1995–96	-	-	-	-	-	-	-	2 789	2 789

Total skate landings (based on the "best estimate" in Table 1) were negligible up to 1978, presumably because of a lack of suitable markets and the availability of other more abundant and desirable species. Landings then increased linearly to reach nearly 3000 t in 1992–93 and 1993–94, and remained between 2600 and 3100 t until the separation of skate species under the QMS. Reported landings of smooth skate are provided in Table 2.

Smooth (SSK) skates were introduced into the QMS as a separate species from 1 October 2003 with allowances, TACCs and TACs in Table 3. Figure 1 shows the historical landings and TACC values for the main SSK stocks. Owing to problems associated with identification of rough and smooth skates, reported catches of each species are probably not accurate (Beentjes 2005). Initiatives to improve identification of these species begun in 2003 may have resulted in more accurate data.

Table 2: Reported landings (t) of SKA and SSK by QMA and fishing year, 1996–97 to 2015–16.

Fishstock	SSK 1		SSK 3		SSK 7		SSK 8		SSK 10		Total
FMAs	1–2		3–6		7		8–9		10		All
Skate (SKA)*	Land.	TACC	Land.	TAC C	Land.	TACC	Land.	TACC	Land.	TACC	Total
1996–97	43	-	894	-	380	-	30	-	0	-	1 347
1997–98	44	-	855	-	156	-	31	-	0	-	1 086
1998–99	48	-	766	-	228	-	12	-	0	-	1 054
1999–00	75	-	775	-	253	-	25	-	0	-	1 128
2000–01	88	-	933	-	285	-	28	-	0	-	1 334
2001–02	132	-	770	-	311	-	35	-	0	-	1 248
2002–03	121	-	857	-	293	-	32	-	0	-	1 303
2003–04	< 1	-	< 1	-	< 1	-	< 1	-	0	-	1
Smooth skate (SSK)											
1996–97	10	-	782	-	102	-	5	-	0	-	899
1997–98	5	-	901	-	121	-	4	-	0	-	1 031
1998–99	5	-	1 011	-	100	-	15	-	0	-	1 131
1999–00	5	-	877	-	73	-	16	-	0	-	971
2000–01	9	-	859	-	104	-	7	-	0	-	979
2001–02	17	-	794	-	89	-	7	-	0	-	907
2002–03	19	-	704	-	167	-	3	-	0	-	893
2003–04	79	37	431	579	146	213	15	20	0	0	671
2004–05	82	37	408	579	125	213	15	20	0	0	630
2005–06	72	37	468	579	163	213	12	20	0	0	715
2006–07	58	37	473	579	155	213	6	20	0	0	693
2007–08	47	37	422	579	171	213	21	20	0	0	661
2008–09	38	37	332	579	168	213	22	20	0	0	560
2009–10	36	37	290	579	194	213	26	20	0	0	546
2010–11	27	37	307	579	243	213	32	20	0	0	609
2011–12	24	37	283	579	209	213	27	20	0	0	544
2012–13	36	37	292	579	231	213	39	20	0	0	598
2013–14	43	37	336	579	225	213	39	20	0	0	641
2014–15	27	37	361	579	198	213	30	20	0	0	617
2015–16	38	37	405	579	222	213	30	20	0	0	695

*Use of the code SKA ceased once skates were introduced into the QMS in October 2003 and rough skates and smooth skates were recognised as a separate species. From this time all landings of skates have been reported against either the RSK or SSK code.

Table 3: Recreational and customary non-commercial allowances (t), Total Allowable Commercial Catches (TACC, t) and Total Allowable Catch (TAC, t) declared for SSK on introduction into the QMS in October 2003.

Fishstock	Recreational Allowance	Customary non-commercial Allowance	Other Mortality	TACC	TAC
SSK 1 (FMAs 1–2)	1	1	1	37	40
SSK 3 (FMAs 3–6)	1	1	6	579	587
SSK 7	1	1	2	213	217
SSK 8 (FMAs 8–9)	1	1	1	20	23
SSK 10	0	0	0	0	0

1.2 Recreational fisheries

Recreational fishing surveys indicate that skates are very rarely caught by recreational fishers.

1.3 Customary non-commercial fisheries

Quantitative information on the level of customary non-commercial take is not available.

1.4 Illegal catch
Quantitative information on the level of illegal catch is not available.

1.5 Other sources of mortality
Because skates are taken mainly as bycatch of bottom trawl fisheries, historical catches have probably been proportional to the amount of effort in the target trawl fisheries. Past catches were probably higher than historical landings data suggest because of unrecorded discards and unrecorded foreign catch before 1983.

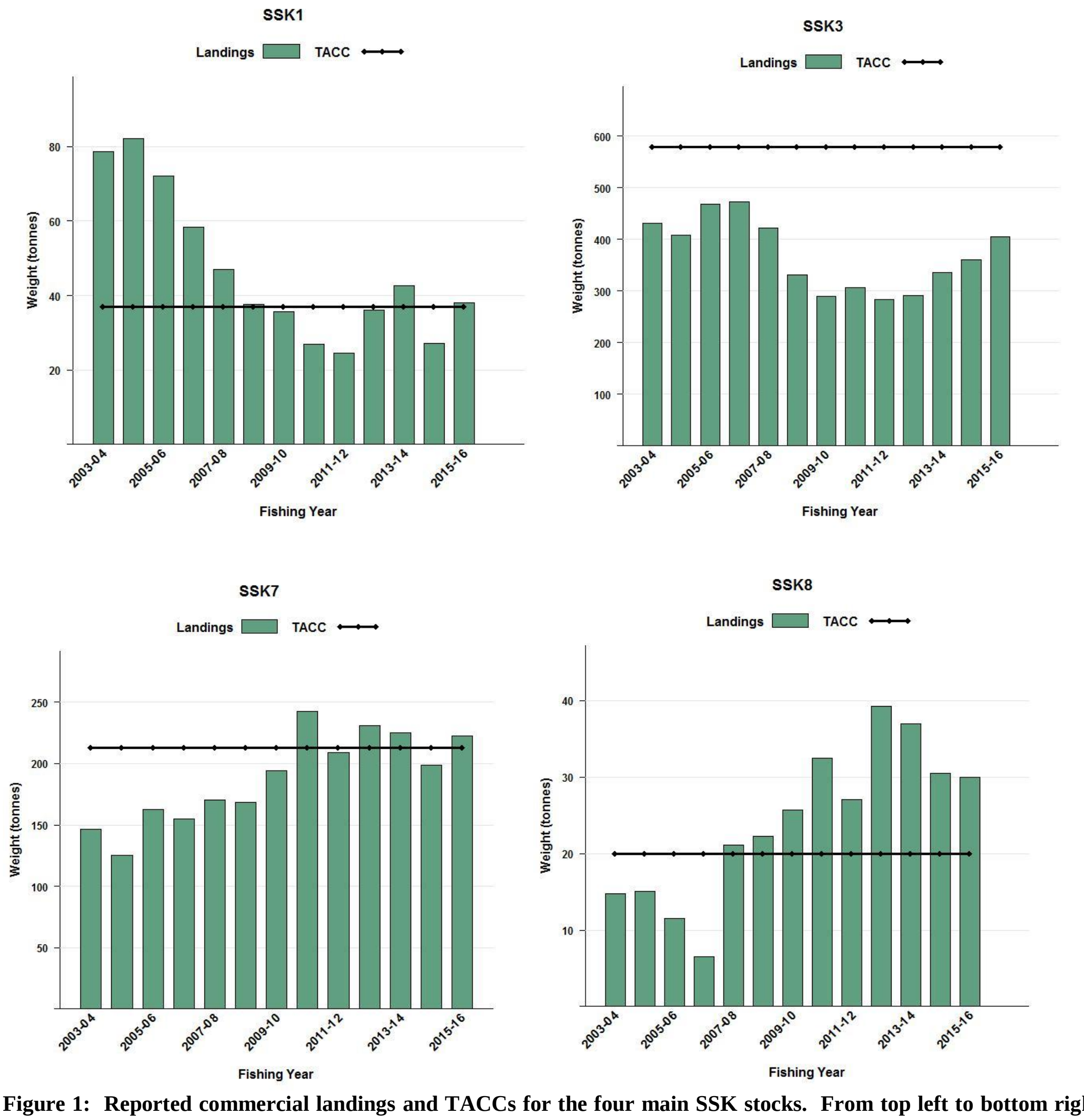


Figure 1: Reported commercial landings and TACCs for the four main SSK stocks. From top left to bottom right: SSK 1 (Auckland East), SSK 3 (South East Coast, South East Chatham Rise, Sub-Antarctic, Southland), SSK 7 (Challenger), and SSK 8 (Central Egmont, Auckland West).

2. BIOLOGY

Little is known about the reproductive biology of smooth skates. Smooth skates reproduce by laying yolky eggs, enclosed in leathery cases, on the seabed. Two eggs are laid at a time, but the number of eggs laid annually by a female is unknown. A single embryo develops inside each egg case and the young hatch at about 10–15 cm pelvic length (body length excluding the tail) (Francis 1997).

The greatest reported age for smooth skate is 28 years for a 155 cm pelvic length female (Francis et al 2004). Females grow larger than males, and also appear to live longer. There are no apparent differences in growth rate between the sexes. Males reach 50% maturity at about 93 cm and 8 years, and females at 112 cm and 13 years. However, the small sample size of mature animals, particularly females, means that the maturity ogives are poorly defined. The most plausible estimate of M is 0.10–0.20. Biological parameters relevant to stock assessment are shown in Table 4.

Table 4: Estimates of biological parameters for skates.

Fishstock			Estimate	Source
1. Natural mortality (M)				
SSK 3			0.12–0.15	Francis et al (2004)
2. Weight = a (length) ^{b} (weight in g, length in cm pelvic length)				
		a	b	
SSK both sexes		0.0268	2.933	Francis (1997)
3. von Bertalanffy growth parameters*				
	K	t_0	L_∞	
SSK 3 (both sexes)	0.095	-1.06	150.5	Francis et al (2001b)
SSK 3 (Males)	0.117	-1.28	133.6	Francis et al (2004)

3. STOCKS AND AREAS

Nothing is known about the stock structure or movement patterns of smooth skates. Smooth skates are distributed throughout most of New Zealand, from the Three Kings Islands to Campbell Island and the Chatham Islands, including the Challenger Plateau, Chatham Rise and Bounty Plateau. Smooth skates have not been recorded from QMA 10.

In this report, smooth skate landings have been presented by QMA. QMAs form appropriate management units in the absence of any information on biological stocks.

4. STOCK ASSESSMENT

4.1 Biomass estimates

Relative biomass estimates are available for smooth skates from a number of trawl survey series (Table 5). Biomass estimates are not provided for surveys of: (a) west coast North Island because of major changes in survey areas and strata during the series; or (b) east Northland, Hauraki Gulf and Bay of Plenty because of the low relative biomass of smooth skates present (usually less than 100 t). In the first survey of each of two series (east coast South Island and Chatham Rise) the two skate species were not (fully) distinguished. Furthermore, there are doubts about the accuracy of species identification in some other earlier surveys (prior to 1996). Consequently, trends in biomass of individual species must be interpreted cautiously. To enable comparison among all surveys within each series, total skate biomass is also reported.

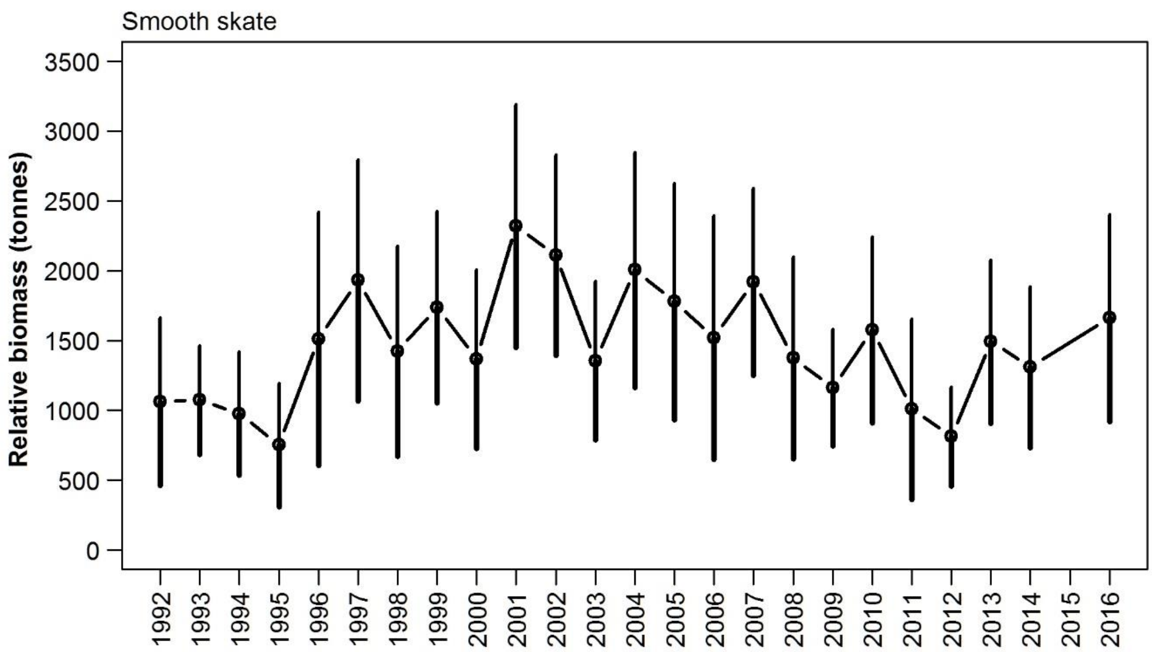
As the catch from the east coast South Island trawl surveys changes without wide inter-annual fluctuations and the CVs are relatively low it appears that they are able to track smooth skate biomass in FMAs 3 and 7, and on the Chatham Rise. West coast South Island surveys (Figure 2) show that the relative biomass of smooth skate in FMA 7 declined substantially from 1997 to 2009, but appear to have increased since then. The 2015 estimate is similar to the levels seen before the decline and is in fact the highest in the time series. Smooth skate relative biomass on the Chatham Rise increased to 2001, and has declined since then.

ECSI trawl surveys

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, in order to monitor elephant fish and red gurnard. Prior to 2014, only the 2007 and 2012 surveys provided full coverage of the 10–30 m depth range.

Smooth skate biomass estimates in the core strata (30–400 m) for the east coast South Island winter trawl surveys in recent years were higher overall than in the 1990s (Figure 3). The additional biomass captured in the 10–30 m depth range was negligible in 2007, 2012, 2014, and 2016 indicating that in terms of biomass, only the existing core strata time series in 30–400 m should be monitored.

The smooth skate length distributions for the east coast South Island winter trawl surveys have no clear modes and comprise multiple year classes with the possibility of a juvenile mode centred about 20 cm corresponding to 0+ fish in shallower depths (Beentjes et al 2015, 2016). The rest of the distribution includes multiple year classes from about 1 to 25 years. The 30–100 m strata tend to have larger skates than the deeper strata. The surveys appears to be monitoring pre-recruited lengths down to 0+ age, but probably not the full extent of the recruited distribution. Length frequency distributions are reasonably consistent among surveys with differences mainly confined to recruitment of the first few year classes. No lengths were measured before 1996. The addition of the 10–30 m depth range has not changed the shape of the length frequency distribution (Beentjes et al 2015, 2016).



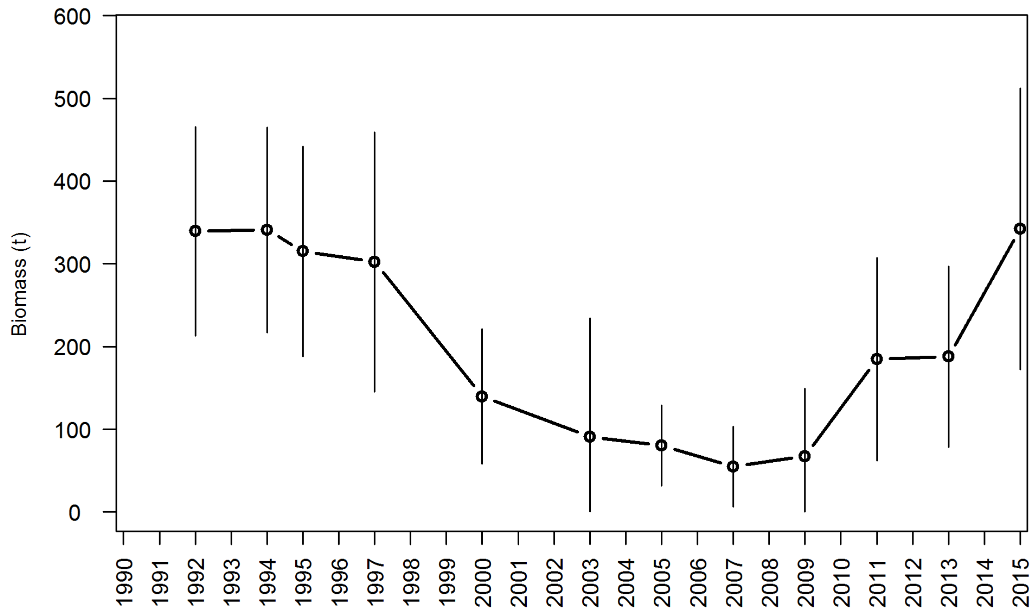


Figure 2: Smooth skate biomass for the Chatham Rise (top) and west coast South Island inshore (bottom) trawl surveys (± two standard errors).

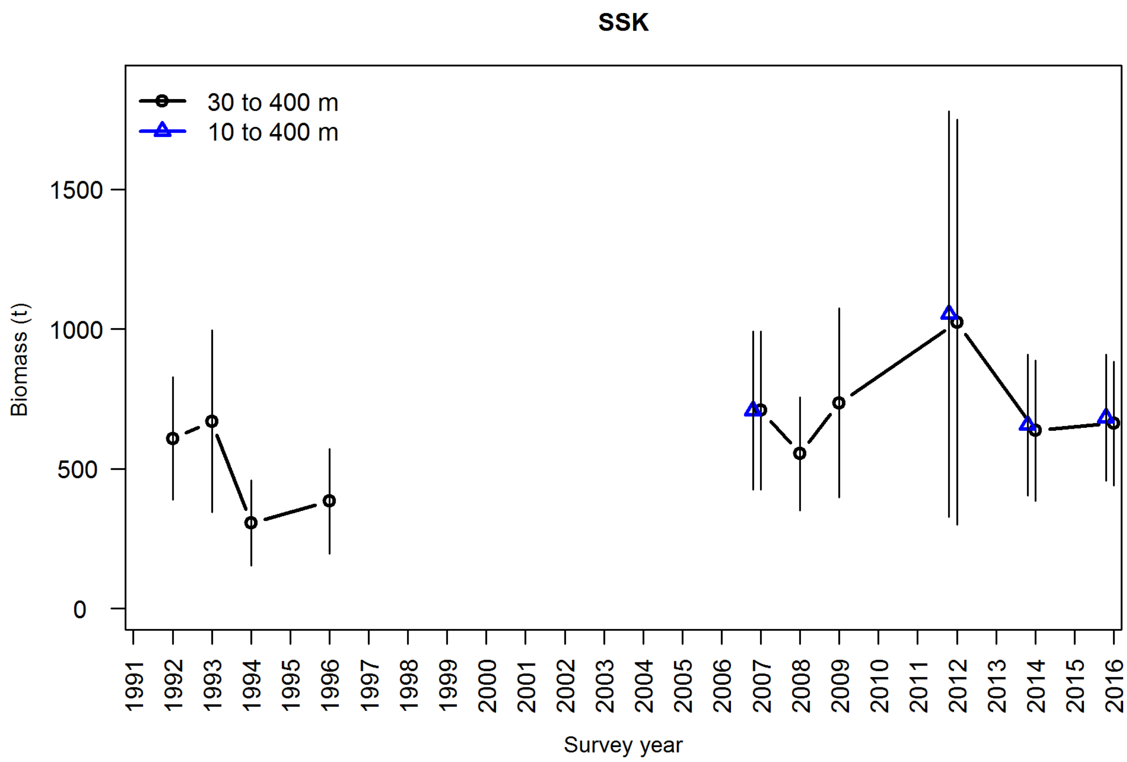


Figure 3: Smooth skate total biomass for the ECSI winter surveys in core strata (30–400 m), and core plus shallow strata (10–400 m) in 2007, 2012, 2014 and 2016. Error bars are ± two standard errors.

4.3 Yield estimates and projections

MCY cannot be estimated.

The *MCY* estimator that has the lowest data requirements ($MCY = cY_{AV}$; Method 4), relies on selecting a time period during which there were "no systematic changes in fishing mortality (or fishing effort, if this can be assumed to be proportional to fishing mortality)". This method was not applied because no information is currently available on skate fishing mortality, or on trawl fishing effort in the main skate fishing areas.

CAY cannot be estimated.

4.4 Other factors

Species that constitute a minor bycatch of trawl fisheries are often difficult to manage using TACCs and ITQs. Skates are widely and thinly distributed, and would be difficult for trawlers to avoid after the quota had been caught. A certain level of incidental bycatch is therefore inevitable. However, skates are relatively hardy, and frequently survive being caught in trawls (although mortality would depend on the length of the tow and the weight of fish in the cod end). Skates returned to the sea alive probably have a greater chance of survival than most other fishes.

Table 5: Doorspread biomass estimates (t) and coefficients of variation (CV %) of smooth skates and total skates (smooth and rough) **[Continued on next page.]**

		Smooth skate		Total skates	
Year	Trip Code	Biomass	CV	Biomass	CV
East coast North Island					
1993	KAH9304	23	52	99	-
1994	KAH9402	144	38	333	-
1995	KAH9502	20	59	72	-
1996	KAH9602	85	36	394	-
South Island west coast and Tasman/Golden Bays (FMA 7)					
1992	KAH9204	339	19	512	-
1994	KAH9404	341	18	537	-
1995	KAH9504	315	20	566	-
1997	KAH9701	302	26	487	-
2000	KAH0004	140	29	326	-
2003	KAH0304	91	79	134	-
2005	KAH0503	80	30	138	-
2007	KAH0704	55	44	300	-
2009	KAH0904	67	61	181	-
2011	KAH1104	185	33	532	-
2013	KAH1305	188	29	431	-
2015	KAH1503	342	25	492	
East coast South Island (FMA 3) Winter		30–400 m		10–400 m	
1991	KAH9105	-	-	1 928	25
1992	KAH9205	609	18	833	16
1993	KAH9306	670	24	1 010	21
1994	KAH9406	306	25	823	15
1996	KAH9606	385	24	562	18
2007	KAH0705	705	20	1 587	-
2008	KAH0806	554	18	1 412	-
2009	KAH0905	736	23	1 765	-
2012	KAH1207	1 025	35	2 158	-
2014	KAH1402	637	20	1 790	-
2016	KAH1605	663	17	1 805	-
East coast South Island (FMA 3) Summer					
1996–97	KAH9618	721	32	2 057	-
1997–98	KAH9704	485	21	1 567	-
1998–99	KAH9809	450	26	1 625	-
1999–00	KAH9917	369	30	698	-
2000–01	KAH0014	248	33	470	-
Chatham Rise					
1991–92	TAN9106	-	-	2 129	-
1992–93	TAN9212	1 071	18	1 126	-
1994	TAN9401	958	23	1 178	-
1995	TAN9501	769	31	845	-
1996	TAN9601	1 511	30	1 522	-
1997	TAN9701	1 932	22	1 944	-
1998	TAN9801	1 425	26	1 935	-
1999	TAN9901	1 738	20	1 772	-
2000	TAN0001	1 369	23	1 369	-
2001	TAN0101	2 321	19	2 393	-
2002	TAN0201	2 111	17	2 148	-
2003	TAN0301	1 355	21	1 387	-
2004	TAN0401	2 006	21	2 066	-
2005	TAN0501	1 780	24	1 869	-
2006	TAN0601	1 521	29	1 577	-
2007	TAN0701	1 922	17	1 951	-
2008	TAN0801	1 376	26	1 376	-
2009	TAN0901	1 162	18	1 185	-
2010	TAN1001	1 576	21	1 576	-
2011	TAN1101	1 009	32	1 009	-
2012	TAN1201	813	22	813	-
2013	TAN1301	1 494	20		
2014	TAN1401	1 309	22		
2016	TAN1601	1 662	22		
Stewart-Snares Shelf					
1993	TAN9301	528	20	1 120	-
1994	TAN9402	342	21	1 406	-
1995	TAN9502	335	19	1 136	-
1996	TAN9604	504	29	1 559	-
Survey discontinued					
Stewart-Snares Shelf and Sub-Antarctic (Summer)*					
1991	TAN9105	382	23	419	-
1992	TAN9211	113	47	165	-
1993	TAN9310	117	43	249	-
2000	TAN0012	434	66	267	-

Table 5 continued.

Stewart-Snares Shelf and Sub-Antarctic (Autumn)*					
1992	TAN9204	93	61	141	-
1993	TAN9304	177	33	428	-
1996	TAN9605	835	39	857	-
1998	TAN9805	536	62	607	-

*Biomass estimates are for core 300–800 m strata only

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). Smooth skate was ranked second highest in terms of risk of the eleven QMS chondrichthyan species. Data were described as existing but poor 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.

Relative biomass estimates of smooth skate from the west coast South Island inshore trawl survey time series showed a strong decline between 1997 and 2009. Since then however estimates have increased with each survey and the 2015 estimate is the highest in the time series.
For all other skate QMAs it is Unknown if recent catch levels or the TACC will cause skate populations to decline.

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