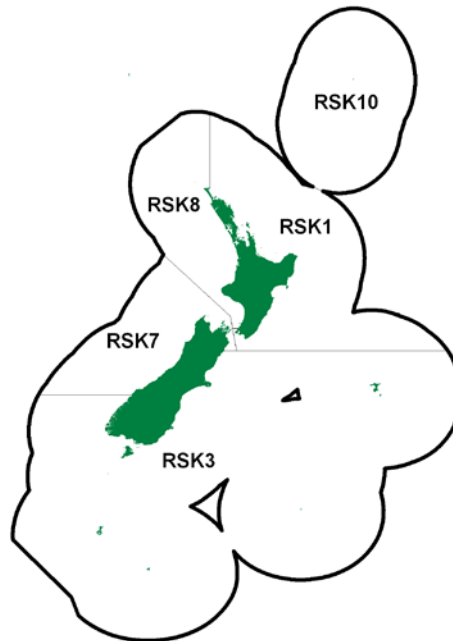


**ROUGH SKATE (RSK)***(Zearaja nasuta)*

Waewae

**1. FISHERY SUMMARY****1.1 Commercial fisheries**

Rough skate (*Zearaja nasuta*, RSK) are fished commercially in New Zealand in close association to smooth skates, which are also known as barndoor skates. Although rough skates grow considerably smaller than smooth skates, RSK is still 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.

Rough 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. There is no clear separation of the depth ranges inhabited by rough and smooth skates; however, smooth skate tend to occur slightly deeper than rough skate (Beentjes & Stevenson 2000, 2001, Stevenson & Hanchet 2000).

Many fishers and processors do not distinguish rough and smooth skates in their landing returns, and code 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.

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

## ROUGH SKATE (RSK)

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) 1983-84-1995-96. 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.**

Year	FSU			CELR		CELR Landed		LFRR	Best Estimate
	Inshore	Deepwater	Total	Estim	Landed	CLR	+CLR		
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 have remained between 2600 and 3100 t ever since (Table 2).

Rough skates (RSK) were introduced into the QMS as separate species from 1 October 2003 with allowances, TACCs and TACs as follow in Table 2. Figure 1 shows the historical landings and TACC values for the main RSK stocks. Owing to problems associated with identification of rough and smooth skates, reported catches of each species are probably not accurate. 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 RSK by QMA and fishing year, 1996-97 to 2011-12.**

QMA	1	TACC	3	TACC	7	TACC	8	TACC	10	TACC	Total
FMA	1-2		3-6		7	8-9		10		All	
Skate (SKA)*											
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
Rough skate (RSK)											
1996-97	15	-	265	-	69	-	3	-	0	-	352
1997-98	32	-	493	-	44	-	5	-	0	-	574
1998-99	22	-	607	-	33	-	4	-	0	-	666
1999-00	20	-	720	-	37	-	2	-	0	-	779
2000-01	27	-	569	-	42	-	4	-	0	-	642
2001-02	24	-	607	-	25	-	3	-	0	-	659
2002-03	18	-	1 060	-	27	-	11	-	0	-	1 118
2003-04	48	111	1 568	1 653	191	-	33	-	0	-	1 840
2004-05	72	111	1 815	1 653	173	201	55	21	0	0	2 115
2005-06	72	111	1 446	1 653	153	201	28	21	0	0	1 699
2006-07	68	111	1 475	1 653	197	201	35	21	0	0	1 768
2007-08	80	111	1 239	1 653	206	201	46	21	0	0	1 573
2008-09	79	111	1 591	1 653	226	201	46	21	0	0	1 942
2009-10	87	111	1 546	1 653	225	201	46	21	0	0	1 905
2010-11	91	111	1 547	1 653	199	201	45	21	0	0	1 882
2011-12	76	111	1 257	1 653	189	201	41	21	0	0	1 563

\*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, customary, and other mortality allowances (t), Total Allowable Commercial Catches (TACC, t) and Total Allowable Catches (TAC, t) declared for RSK on introduction into the QMS in October 2003.**

Fishstock	Recreational Allowance	Customary non-commercial Allowance	Other Mortality	TACC	TAC
RSK 1 (FMAs 1-2)	1	1	1	111	114
RSK 3 (FMAs 3-6)	1	1	17	1 653	1 672
RSK 7	1	1	2	201	205
RSK 8 (FMAs 8-9)	1	1	1	21	24
RSK 10	0	0	0	0	0

## 1.2 Recreational fisheries

Recreational fishing surveys indicate that rough 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.

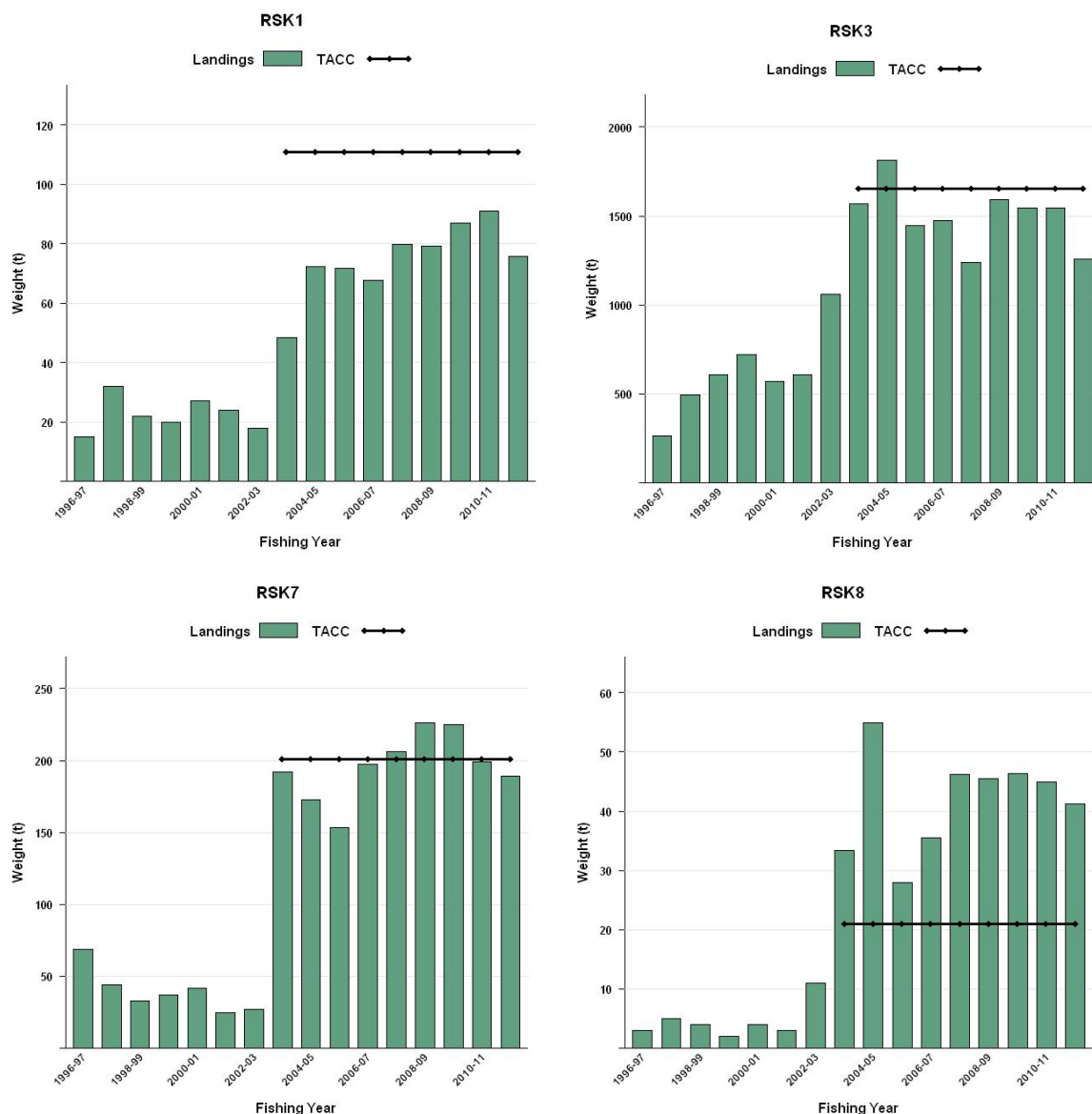
## 1.4 Illegal catch

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.

## ROUGH SKATE (RSK)



**Figure 1: Historical landings and TACC for the four main RSK stocks. From top left to bottom right: RSK1 (Auckland East), RSK3 (South East Coast, South East Chatham Rise, Sub Antarctic, Southland), RSK7 (Challenger), and RSK8 (Central Egmont, Auckland West).**

## 2. BIOLOGY

Little is known about the reproductive biology of rough skates. Rough skates reproduce by laying yolky eggs, enclosed in leathery cases, on the seabed. Rough skates lay their eggs in spring-summer (Francis 1997). 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).

Rough skates grow to at least 79 cm pelvic length, and females grow larger than males. The greatest reported age is 9 years for a 70 cm pelvic length female, and females may live longer than males (Francis *et al.* 2001a, b). There are no apparent differences in growth rate between the sexes. Males reach 50% maturity at about 52 cm and 4 years, and females at 59 cm and 6 years. The most plausible estimate of  $M$  is 0.25-0.35. Biological parameters relevant to stock assessment are shown in Table 4.

**Table 4: Estimates of biological parameters for Rough skates (RSK).**

Fishstock	Estimate			Source
<u>1. Natural mortality (M)</u>				
RSK 3	0.25-0.35			Francis <i>et al.</i> (2001b)
<u>2. Weight = a (length)<sup>b</sup> (weight in g, length in cm pelvic length)</u>				
	a	b		
RSK males	0.0393	2.838		Francis (1997)
RSK females	0.0218	3.001		Francis (1997)
<u>3. von Bertalanffy growth parameters</u>				
	K	t <sub>0</sub>	L <sub>∞</sub>	
RSK 3 (both sexes)	0.16	-1.2	91.3	Francis <i>et al.</i> (2001b)
RSK 3 (both sexes)	0.096	-0.78	151.8	Francis <i>et al.</i> (2004)

### 3. STOCKS AND AREAS

Nothing is known about stock structure or movement patterns in skates. Rough 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. Rough skates have not been recorded from QMA 10.

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

### 4. STOCK ASSESSMENT

This is the first stock assessment for skates. No yield estimates have been made for skates.

#### 4.1 Estimates of fishery parameters and abundance

Relative biomass estimates are available for rough 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 rough 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 South Island trawl surveys changes without wide inter-annual fluctuations and the CVs are relatively low it appears that they are able to track rough skate biomass in FMA 3, 7, and on the Stewart Snares. West Coast South Island surveys show that the relative biomass of rough skate in FMA 7 declined in the early 2000s but has since increased marginally.

#### 4.2 Biomass estimates

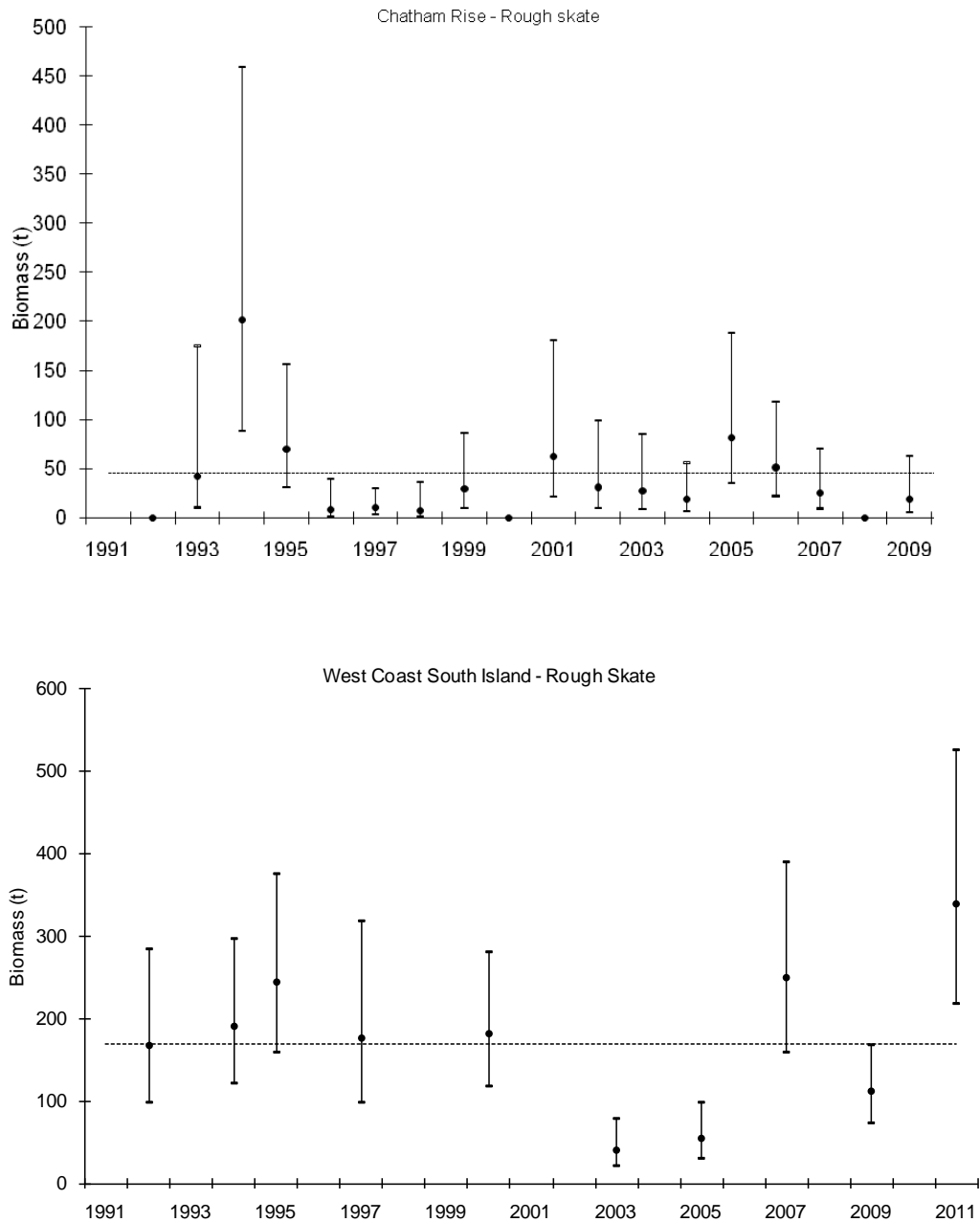
Biomass in the core strata (30–400 m) for the east coast South Island trawl survey in recent years is about double that of the 1990s (Figure 4). Coefficients of variation are variable ranging from 19 to 30% (mean 22%), but overall are low to medium. The additional biomass captured in the 10–30 m depth range accounted for 30% and 20% of the biomass in the core plus shallow strata (10–400 m) for 2007 and 2012 respectively, indicating that in terms of biomass, it essential to monitor the core plus shallow strata (10–400 m).

#### 4.3 Length frequency distributions

The length distributions for the east coast South Island trawl survey have no clear modes, comprise multiple year classes, and there are no small skate in the deep 200 to 400 m strata (Figure 5). The survey appears to be monitoring pre-recruited lengths down to 1+ age and the full recruited distribution, but no individual cohorts are discernible. Plots of time series length frequency

## ROUGH SKATE (RSK)

distributions are reasonably consistent among surveys with no lengths measured before 1996. The addition of the 10–30 m depth range has changed the shape of the length frequency distribution slightly.



**Figure 3: Rough skate biomass  $\pm 95\%$  CI (estimated from survey CVs assuming a lognormal distribution) and the time series mean (dotted line) estimated from the Chatham Rise (Top) and West Coast South Island (Bottom) trawl surveys.**

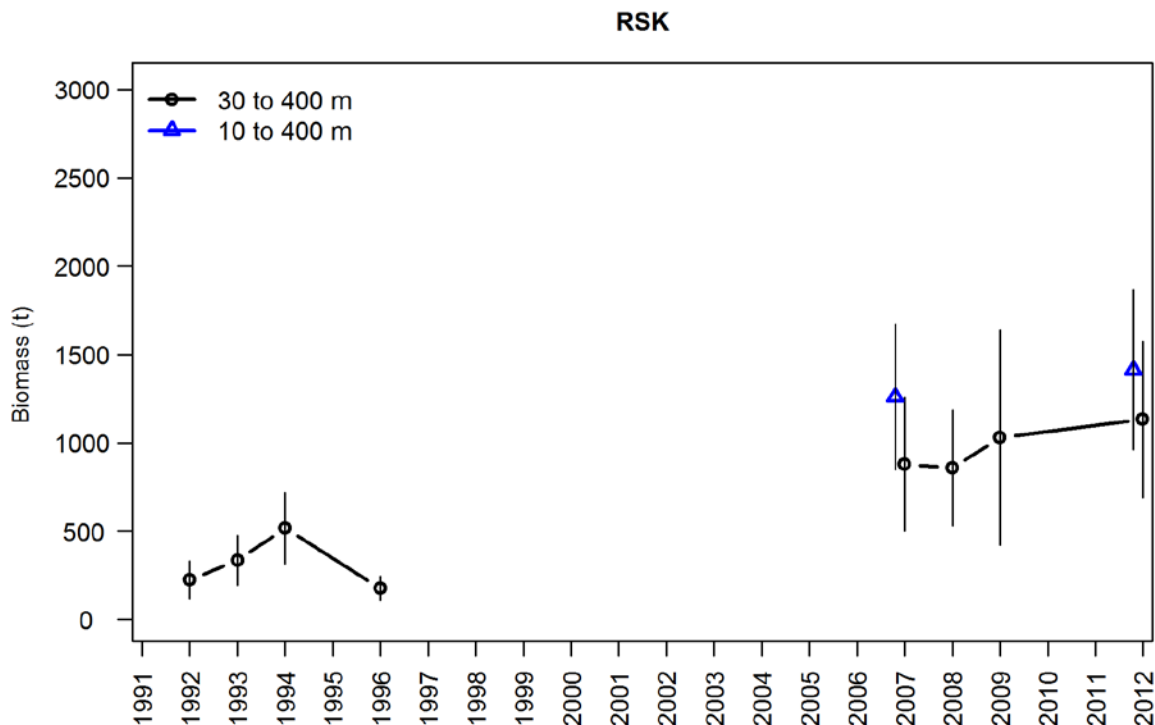


Figure 4: Rough skate total biomass and 95% confidence intervals for the all ECSI winter surveys in core strata (30–400 m), and core plus shallow strata (10–400 m) in 2007 and 2012.

### 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 (though 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.

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**Table 5: Doorspread biomass estimates (t) and coefficients of variation (CV %) of rough skates and total skates (both rough and smooth).**

Year	Trip Code	Rough skate		Total		Total Biomass Estimate	CV (%)
		Biomass	CV	Biomass	CV		
East coast North Island							
1993	KAH9304	76	28	99	-	-	-
1994	KAH9402	189	12	333	-	-	-
1995	KAH9502	52	20	72	-	-	-
1996	KAH9602	309	24	394	-	-	-
1992	KAH9204	173	27	512	-	-	-
1994	KAH9404	196	23	537	-	-	-
1995	KAH9504	251	22	566	-	-	-
1997	KAH9701	185	30	487	-	-	-
2000	KAH0004	186	23	326	-	-	-
2003	KAH0304	43	34	134	-	-	-
2005	KAH0503	58	30	138	-	-	-
2007	KAH0704	256	23	300	-	-	-
2009	KAH0904	114	21	181	-	-	-
2011	KAH1104	347	23	532	-	-	-
East coast South Island (FMA 3) Winter							
		30-400m				10-400m	
1991	KAH9105	-	-	1928	25	-	-
1992	KAH9205	224	24	829	16	-	-
1993	KAH9306	335	21	993	21	-	-
1994	KAH9406	517	20	823	15	-	-
1996	KAH9606	177	19	562	18	-	-
2007	KAH0705	878	22	1 580	-	1 261	16
2008	KAH0806	858	19	1 412	-	-	-
2009	KAH0905	1 029	30	1 765	-	-	-
2012	KAH1207	1 113	20	2 138	-	1 414	16
East coast South Island (FMA 3) Summer							
1996-97	KAH9618	1 336	15	2 057	-	-	-
1997-98	KAH9704	1 082	13	1 567	-	-	-
1998-99	KAH9809	1 175	10	1 625	-	-	-
1999-00	KAH9917	329	23	698	-	-	-
2000-01	KAH0014	222	34	470	-	-	-
Chatham Rise							
1991-2	TAN9106	-	-	2 129	-	-	-
1992-3	TAN9212	55	83	1 126	-	-	-
1994	TAN9401	220	44	1 178	-	-	-
1995	TAN9501	76	43	845	-	-	-
1996	TAN9601	11	100	1 522	-	-	-
1997	TAN9701	12	58	1 944	-	-	-
1998	TAN9801	10	100	1 935	-	-	-
1999	TAN9901	34	60	1 772	-	-	-
2000	TAN0001	0	-	1 369	-	-	-
2001	TAN0101	72	59	2 393	-	-	-
2002	TAN0201	37	65	2 148	-	-	-
2003	TAN0301	32	64	1 387	-	-	-
2004	TAN0401	22	60	2 066	-	-	-
2005	TAN0501	89	45	1 869	-	-	-
2006	TAN0601	56	45	1 577	-	-	-
2007	TAN0701	29	56	1 951	-	-	-
2008	TAN0801	0	-	1 376	-	-	-
2009	TAN0901	23	67	1 185	-	-	-
2010	TAN1001	-	-	1 576	-	-	-
2011	TAN1101	-	-	1 009	-	-	-
2012	TAN1201	-	-	813	-	-	-
Stewart-Snares Shelf							
1993	TAN9301	592	20	1 120	-	-	-
1994	TAN9402	1 064	15	1 406	-	-	-
1995	TAN9502	801	7	1 136	-	-	-
1996	TAN9604	1 055	11	1 559	-	-	-
Survey discontinued							
Stewart-Snares Shelf and Sub-Antarctic (Summer)*							
1991	TAN9105	37	72	419	-	-	-
1992	TAN9211	52	69	165	-	-	-
1993	TAN9310	132	57	249	-	-	-
2000	TAN0012	201	56	267	-	-	-
Stewart-Snares Shelf and Sub-Antarctic (Autumn)*							
1992	TAN9204	48	100	141	-	-	-
1993	TAN9304	251	57	428	-	-	-
1996	TAN9605	22	71	857	-	-	-
1998	TAN9805	71	77	607	-	-	-

\*Biomass estimates are for core 300-800 m strata only



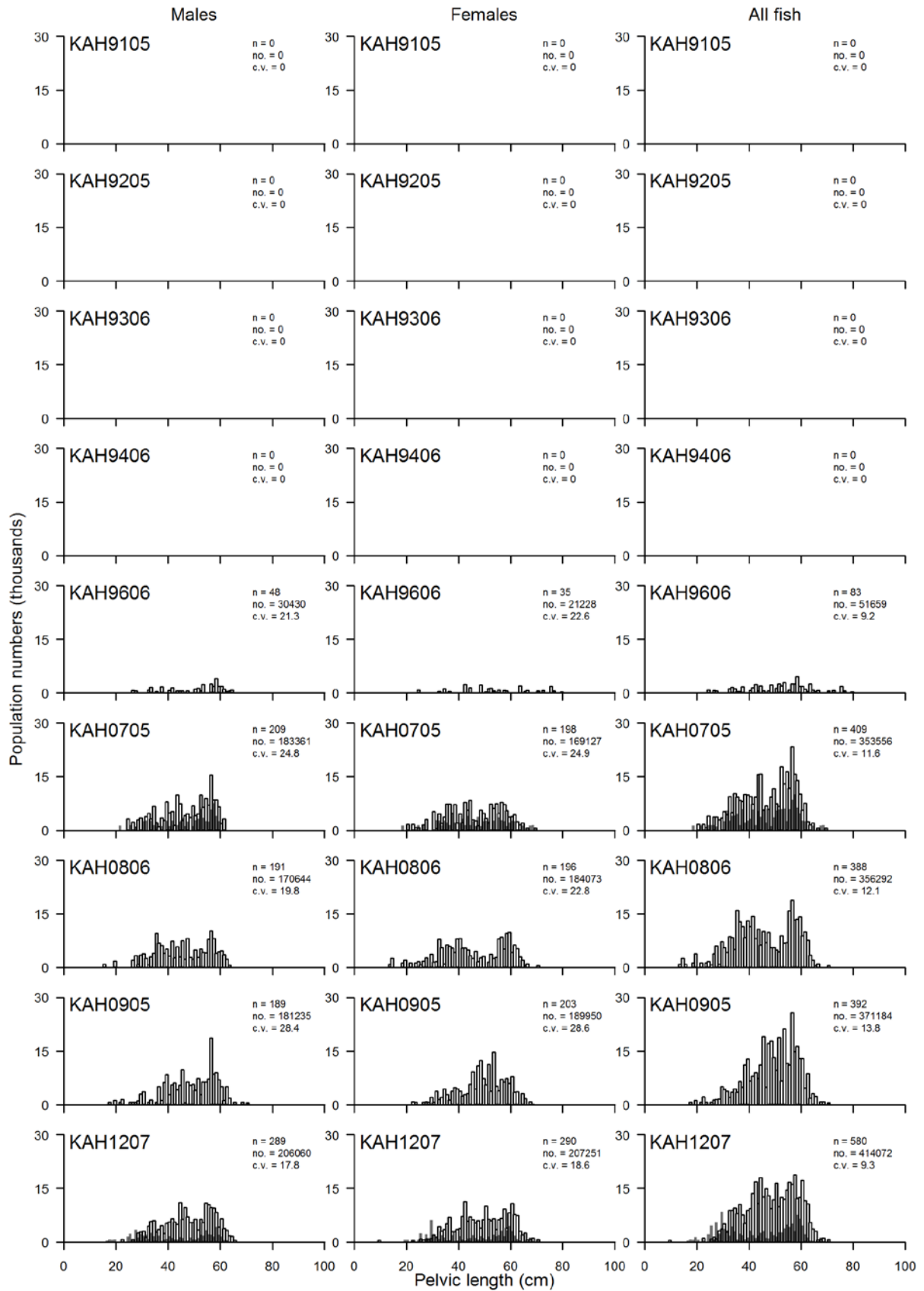


Figure 5: Scaled length frequency distributions for rough skate in core strata (30–400 m) for all nine ECSI winter surveys. The length distribution is also shown in the 10–30 m depth strata for the 2007 and 2012 surveys overlaid in red for species with many length classes, otherwise in light grey (not stacked). Population estimates are for the core strata only. n, number of fish measured; no., population number; c.v., coefficient of variation.

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### 5. STATUS OF THE STOCKS

No estimates of current and reference biomass are available.

For rough skate it is Unknown if recent catch levels or the TACC will cause their populations to decline. Reported landings and TACCs for the 2011-12 fishing year are summarised in Tables 6.

**Table 6: Summary of TACCs (t), and reported landings (t) for rough skates for the most recent fishing year.**

Fishstock		QMA	2011-12 Actual TACC	2011-12 Reported landings
RSK 1 (FMAs 1-2)	Auckland (East) Central (East)	1 & 2	111	76
RSK 3 (FMAs 3-6)	South-east (Coast) (Chatham), Southland, and Sub-Antarctic	3, 4, 5 & 6	1 653	1 257
RSK 7	Challenger	7	201	189
RSK 8 (FMAs 8-9)	Central (West), Auckland (West)	8 & 9	21	41
RSK 10	Kermadec	10	0	0
Total			1 986	1 563

### 6. FOR FURTHER INFORMATION

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