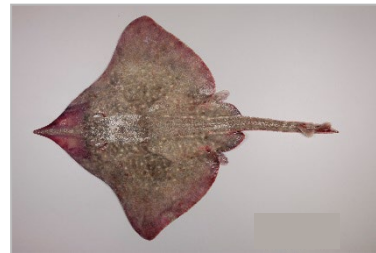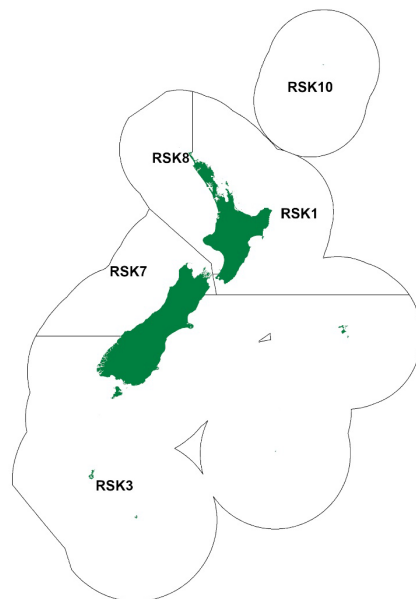# ROUGH SKATE (RSK)

(*Zearaja nasuta*)
Waewae, Uku

1.   FISHERY SUMMARY

1.1   Commercial fisheries

Rough skates (*Zearaja nasuta*, RSK), which are also known as barndoor skates, are fished commercially in New Zealand in close association with smooth skates. Although rough skates reach considerably smaller sizes 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, although 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 skates tend to occur slightly deeper than rough skates (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 in 2003, 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 this 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.

Year	Inshore	FSU Deepwater	FSU Total	CELR Estim.	CELR Landed	CLR	CELR Landed +CLR	LFRR	Best Estim.
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 more 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 rough skate are provided in Table 2.

Rough skates were introduced into the QMS as a separate species from 1 October 2003 with allowances, TACCs, and TACs as given in Table 3. 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 landings 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. About 83% of

rough skate landings since the fishing year 2003–04 have come from RSK 3. Landings recorded for RSK 3 have generally been below the TACC, averaging just over 1500 t annually from 2003–04 to 2018–19 and landings in 2019–20, 2020–21, and 2021–22 are the lowest since inclusion in the QMS. In contrast RSK 8 has been consistently over-caught, relative to the TACC, since it was introduced to the QMS. It was put on Schedule 6 on 1 October 2006. Owing to discarding and misidentification of the two skate species, RSK and SSK, catches are likely to be inaccurate.

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

Fishstock	RSK 1		RSK 3		RSK 7		RSK 8		RSK 10		
FMA	1–2		3–6		7		8–9		10		All
Skate (SKA)*	Land.	TACC	Land.	TACC	Land.	TACCl	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
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
2012–13	92	111	1 573	1653	180	201	44	21	0	0	1 889
2013–14	105	111	1 798	1 653	166	201	54	21	0	0	2 122
2014–15	88	111	1 324	1 653	151	201	41	21	0	0	1 605
2015–16	87	111	1 263	1 653	171	201	31	21	0	0	1 553
2016–17	106	111	1 528	1 653	165	201	37	21	0	0	1 836
2017–18	120	111	1 345	1 653	153	201	39	21	0	0	1 657
2018–19	84	111	1 185	1 653	136	201	26	21	0	0	1 432
2019–20	71	111	1 054	1 653	163	201	39	21	0	0	1 326
2020–21	57	111	1 054	1 653	173	201	47	21	0	0	1 331
2021–22	30	111	811	1 653	167	201	20	21	0	0	998

*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 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.

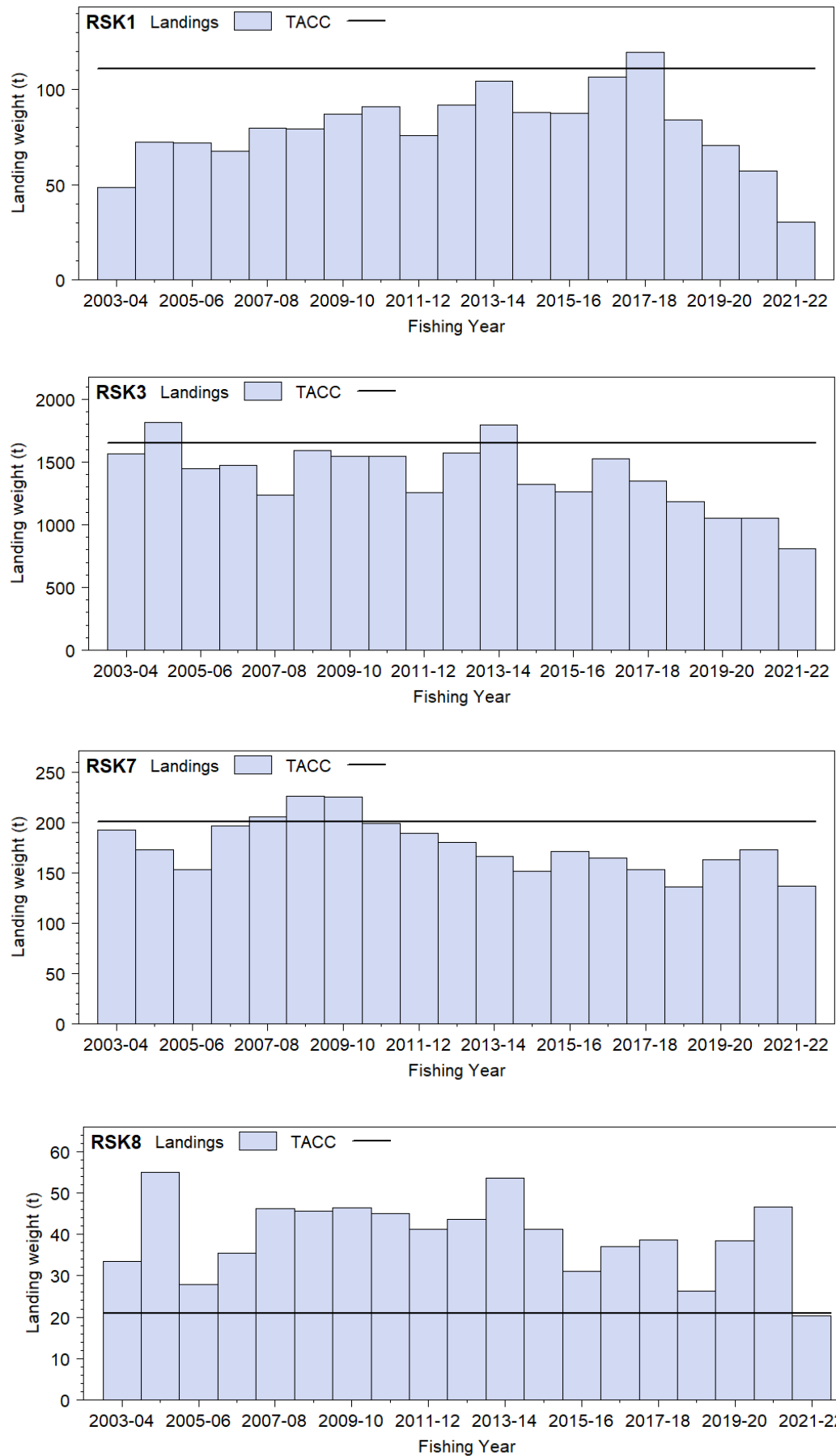| Fishstock	Recreational allowance	Customary non-commercial allowance	Other mortality	TACC	TAC
RSK 1 (FMAS 1–2)	1	1	1	111	114
RSK 3 (FMAs 3–6)	1	1	17	1 653	1 672
RSK 7	1	1	2	201	205
RSK 8 (FMAs 8–9)	1	1	1	21	24
RSK 10	0	0	0	0	0

ROUGH SKATE (RSK)

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

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.

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
1. Natural mortality (*M*)				
RSK 3		0.25–0.35		Francis et al (2001b)
2. Weight = *a* (length)*ᵇ* (weight in g, length in cm pelvic length)				
	a	*b*		
RSK males	0.0393	2.838		Francis (1997)
RSK females	0.0218	3.001		Francis (1997)
3. von Bertalanffy growth parameters				
	K	*t₀*	*L∞*	
RSK 3 (both sexes)	0.16	-1.2	91.3	Francis et al (2001b)
RSK 3 (both sexes)	0.096	-0.78	151.8	Francis et al (2004)

3.   STOCKS AND AREAS

Nothing is known about stock structure or movement patterns in skates. Inshore trawl surveys of the east and west coasts of the South Island used to tag and release live rough skate, but this has been discontinued. Tag returns have been low and data from what returns there have been have not been analysed. 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

4.1 Biomass estimates

4.1.1 Trawl Surveys
Relative biomass estimates are available for rough skates from a number of trawl survey series (Table 5). In the first survey (1991) 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).

All potential surveys were reviewed to determine which might provide reliable indices for abundance (Holmes et al 2022). Surveys rejected are listed in Table 6 together with the main reasons for their exclusion. Indices taken forward for consideration for partial quantitative assessment were:
- east coast South Island (ECSI) *Kaharoa* trawl survey, and
- west coast South Island (WCSI) *Kaharoa* trawl survey.

Estimates of biomass for RSK from the ECSI *Kaharoa* and WCSI *Kaharoa* trawl surveys are provided in Figures 2 and 3. Biomass estimates have been relatively stable for the ECSI time series since the latter was reinstated in 2007. Biomass estimates have fluctuated for the WCSI time series. CVs are relatively low for both time series (generally < 30%).

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 (Beentjes & Stevenson 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 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.

The proportion of biomass captured in the 10–30 m depth ranged from 16% to 38%, indicating that it is essential to monitor the core plus shallow strata (10–400 m) for this species (Beentjes et al in press). The core strata biomass series does indicate biomass to be higher in the period since the reinstatement of the survey in 2007 than in the 1990s and, in 2014 and 2016, biomass was more than double that of the highest biomass estimate of the 1990s (Table 5, Figure 2) (MacGibbon et al 2019). The biomass estimate in 2021 was double that of 2018 and the highest in the series for both core and core plus shallow strata (Figure 2). In 2022, biomass declined to the level observed between 2009 and 2018. Biomass estimates for the core strata (30–400 m) and core plus shallow (10–400 m) have similar trends (Figure 2) for overlapping periods.

The rough skate length distributions for the east coast South Island winter trawl survey core strata (30–400 m) have no clear modes, comprise multiple year classes, and very small skate tend to be found in shallow water in some surveys (Beentjes & MacGibbon 2013, Beentjes et al 2015, 2016, McGibbon et al 2019). The survey appears to be monitoring pre-recruited lengths down to 1+ age and the full recruited distribution, but no individual cohorts are discernible. Length frequency 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 only slightly for some surveys, with more smaller skate present (Beentjes et al 2015, 2016, Beentjes & MacGibbon 2013, MacGibbon et al 2019).

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

Year	Trip Code	Biomass	CV
East coast North Island (RSK 1) Autumn 20–400m			
1993	KAH9304	76	28
1994	KAH9402	189	12
1995	KAH9502	52	20
1996	KAH9602	309	24
Discontinued			
East coast South Island (RSK 3) Winter 30–400 m (10–400 m)			
1991	KAH9105	–	–
1992	KAH9205	224	24
1993	KAH9306	335	21
1994	KAH9406	517	20
1996	KAH9606	177	19
2007	KAH0705	878 (1 261)	22 (16)
2008	KAH0806	858	19
2009	KAH0905	1 029	30
2012	KAH1207	1 113 (1 414)	20 (16)
2014	KAH1402	1 153 (1 597)	38 (28)
2016	KAH1605	1 142 (1 576)	30 (22)
2018	KAH1803	978 (1 213)	16 (14)
2021	KAH2104	2 097 (2 486)	22 (19)
2022	KAH2204	998 (1 219)	24 (20)
East coast South Island (RSK 3) Summer 30–400 m			
1996–97	KAH9618	1 336	15
1997–98	KAH9704	1 082	13
1998–99	KAH9809	1 175	10
1999–00	KAH9917	329	23
2000–01	KAH0014	222	34
Sub-Antarctic (RSK 3) Summer 300–800m			
1991	TAN9105	42	72.8
1992	TAN9211	52	68.8
1993	TAN9310	133	56.9
2000	TAN0012	201	56.4
2001	TAN0118	158	51.3
2002	TAN0219	55	47.4
2003	TAN0317	78	42.9
2004	TAN0414	25	72.4
2005	TAN0515	116	45.9
2006	TAN0617	159	74.1
2007	TAN0714	115	67.3
2008	TAN0813	362	56.9
2009	TAN0911	190	52.4
2011	TAN1117	106	61.6
2012	TAN1215	68	75.4
2014	TAN1412	11	93.4
2016	TAN1614	6	100
2018	TAN1811	466	89.6
2020	TAN2014	130	57.1
South Island west coast and Tasman Bay/Golden Bay (RSK 7)			
1992	KAH9204	173	27
1994	KAH9404	196	23
1995	KAH9504	251	22
1997	KAH9701	185	30
2000	KAH0004	186	23
2003	KAH0304	43	34
2005	KAH0503	58	30
2007	KAH0704	256	23
2009	KAH0904	114	21
2011	KAH1104	347	23
2013	KAH1305	243	24
2015	KAH1503	150	20
2017	KAH1703	270	21
2019	KAH1902	132	26
2021	KAH2103	123	26

Year	Trip	Biomass	CV
Chatham Rise (RSK 3) Summer 200–800 m			
1991–92	TAN9106	0	–
1992–93	TAN9212	55	83.1
1994	TAN9401	221	44.3
1995	TAN9501	76	43.2
1996	TAN9601	11	100
1997	TAN9701	12	58.4
1998	TAN9801	10	100
1999	TAN9901	34	60.1
2000	TAN0001	0	–
2001	TAN0101	72	58.5
2002	TAN0201	37	64.5
2003	TAN0301	32	63.9
2004	TAN0401	22	60.4
2005	TAN0501	89	45.4
2006	TAN0601	56	59
2007	TAN0701	29	94.9
2008	TAN0801	0	–
2009	TAN0901	23	66.8
2010	TAN1001	0	–
2011	TAN1101	154	54.9
2012	TAN1201	0	–
2013	TAN1301	38	78.5
2014	TAN1401	37	69.1
2013	TAN1301	38	2016
2018	TAN1801	10	83
2020	TAN2001	0	–
2022	TAN2201	9	100
Stewart-Snares shelf (RSK 3) Summer 30–600m			
1993	TAN9301	592	20
1994	TAN9402	1 064	15
1995	TAN9502	801	7
1996	TAN9604	1 055	11
Discontinued			
West Coast South Island (*Tangaroa*) (RSK 7) 200–			
2012	TAN1210	12	39
2013	TAN1308	8	40
2016	TAN1609	4	48
2018	TAN1807	5	51
2021	TAN2107	5	48

Table 6: **Surveys considered but rejected for providing indices of abundance of rough skates and main reason(s) for their rejection.**

FMA	Survey	Reason(s) for rejection
RSK 1	HAGU Hauraki Gulf	Very low biomass of rough skate present. Only very shallow strata (< 75 m) in recent surveys.
RSK 1	BPLE Bay of Plenty	Very low biomass of rough skate present. Only very shallow strata (< 100 m) in recent surveys.
RSK 3	Chatham Rise	Very low occurrence of rough skate in catches. Relative biomass CVs always > 40%.
RSK 3	Sub-Antarctic Summer	Shallowest strata too deep (>300m). Relative biomass CVs always > 40% (often much higher).
RSK 3	Sub-Antarctic Autumn	Discontinued survey.
RSK 3	Stewart-Snares shelf	Discontinued survey.
RSK 7	WCSI (*Tangaroa*)	Very low occurrence of rough skate in catches. Relative biomass CVs always 40% or higher.
RSK 8	WCNI	Few of the historical surveys go >100 m and cover the area south of Cape Egmont*

* There is potential to use the WCNI (west coast North Island) survey in future if strata remain consistent with the 2020 survey (including southern strata).
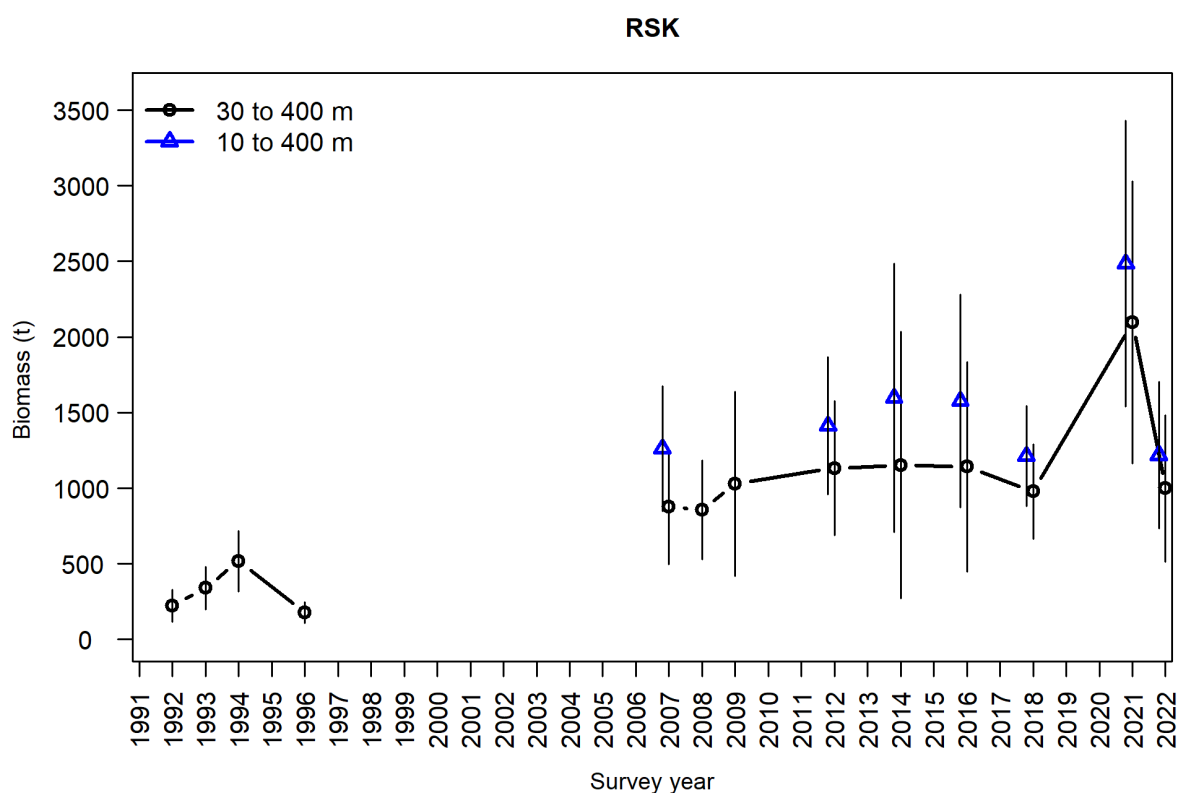

Figure 2: **Rough skate total biomass for the ECSI winter surveys in core strata (30–400 m), and core plus shallow strata (10–400 m). Error bars are ± two standard deviations.**

WCSI trawl surveys

The west coast South Island autumn trawl surveys have been undertaken since 1992 and regularly catch rough skate (MacGibbon 2019). However, biomass has fluctuated with no apparent trend throughout the time series and CVs are relatively modest, ranging from 20% to 34%, making it unclear to what degree the survey monitors abundance. The amount of rough skate caught in Tasman Bay and Golden Bay (TBGB) can be significant, but it is highly variable between years and shows a different trend to the west coast (Figure 3).
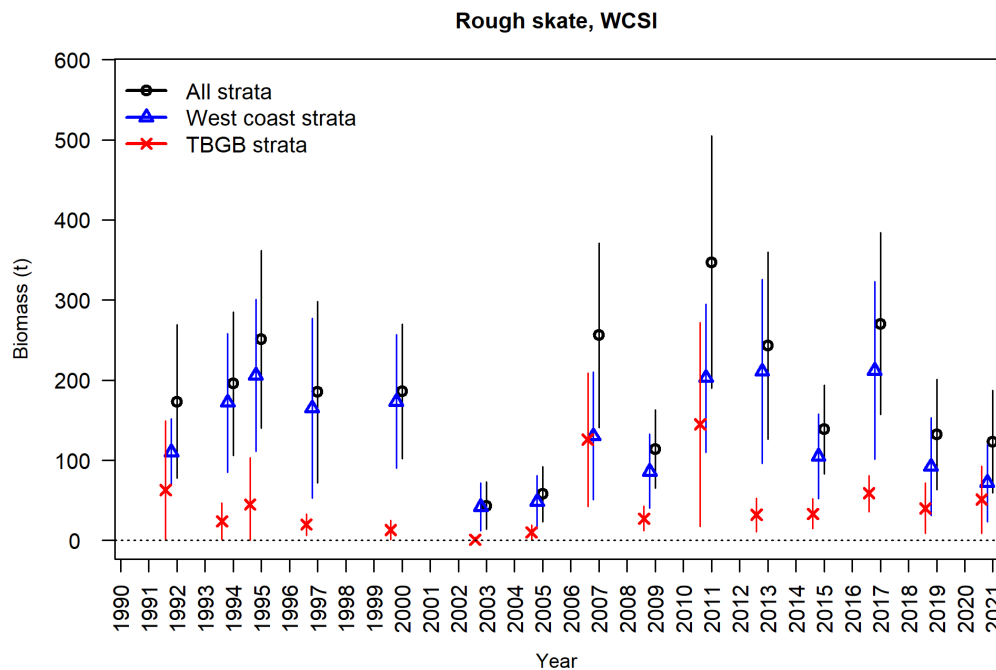
Rough skate, WCSI

Figure 3: Rough skate biomass for the west coast South Island inshore trawl survey time series (error bars are ± two standard deviations).

Establishing B_{MSY} compatible reference points

In 2022 the Working Group accepted the mean of relative biomass estimates from the core plus shallow strata (10–400 m) ECSI *Kaharoa* survey over the years 2007–2018 as a B_{MSY} proxy for rough skate in RSK 3. This period was chosen because both biomass and catch were relatively stable over this period (Figure 4A). It was also evident (from the core series) that biomass had increased substantially since the 1990s, and this was correlated with a reduction in fishing effort in the mixed species inshore trawl fishery for FMA 3 (Starr et al in prep).

It was not possible to agree on a target period for RSK 7 because the survey series had high interannual variability during the period when catch information was available, i.e., after 2004 when the two species were introduced to the QMS (Figure 4B). It has already been noted that fluctuations in biomass estimates of rough skate from the WCSI suggest that abundance is probably not being monitored adequately (Stevenson & Hanchet 2000). There was a period of stability in the survey series from 1993 to 2000, but there are no catch data for those years. The WG recommended investigating reasons for the high variability (the biomass estimates have relatively low CVs) of survey biomass in the latter part of the series, with a view to identifying strata with consistent biomass estimates with lower interannual variability.
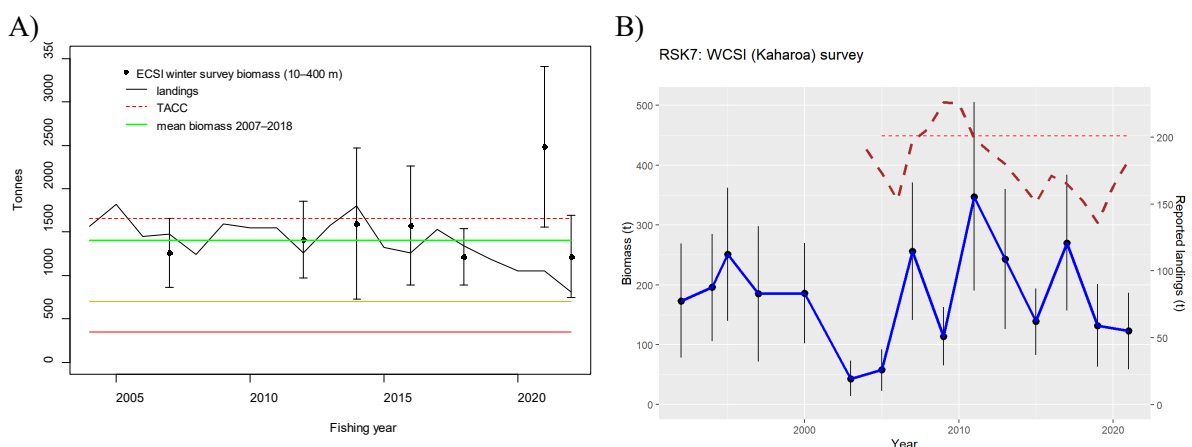
A)

B)

Figure 4: A) ECSI Kaharoa trawl survey relative biomass estimates in 10–400 m. Vertical lines are ± 2 se. The green line represents the accepted B_{MSY} proxy of geometric mean abundance over years 2007 to 2018 (1403 t), and the orange line shows soft limit (50% B_{MSY} proxy), and the red line shows hard limit (25% B_{MSY} proxy). B) WCSI Kaharoa inshore trawl survey relative biomass, blue line plus vertical lines showing ± 2 s.d. (left axis). QMR/MHR landings are shown by dashed line and TACC for the management area by red dotted line, with scale on right axis.

4.2 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.

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). Rough skate was ranked number one (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.

4.3 Future research considerations

- Work to determine the extent of current misidentification of RSK and SSK in commercial fisheries (the study of Beentjes 2005 was conducted not long after RSK and SSK were required to be reported separately under the QMS).
- Investigate alternative stratum combinations in compiling the WCSI *Kaharoa* survey index with a view to understanding the high variability of survey biomass results from the current series and identifying strata with consistent biomass estimates with lower interannual variability. This may be informed by spatio-temporal modelling of survey data (e.g., VAST, or INLA).
- Improve our understanding of stock structure, particularly in relation to the links between Tasman Bay and Golden Bay and the west coast of South Island—nothing is known about the stock structure or movement patterns of rough skates.
- Investigate currently available maturity information (largely for males), to determine whether more information on female maturity should be collected from trawl surveys.
- Improve species catch information. Reliable catch information at species level limits our current determination of a stable reference period for RSK 7, as well as estimation of relative exploitation rate for all stocks; but trend in effort could be used to infer historical catches or relative fishing mortality to identify stable periods.
- Explore use of other data. The estimation of catches based on models using species mix data from landings or observer data could be explored, particularly where the TACC may be limiting landings. This would be particularly useful for estimating relative exploitation rate.

5. STATUS OF THE STOCKS

No estimates of current and reference biomass are available for RSK 1, RSK 7, RSK 8, and RSK 10.
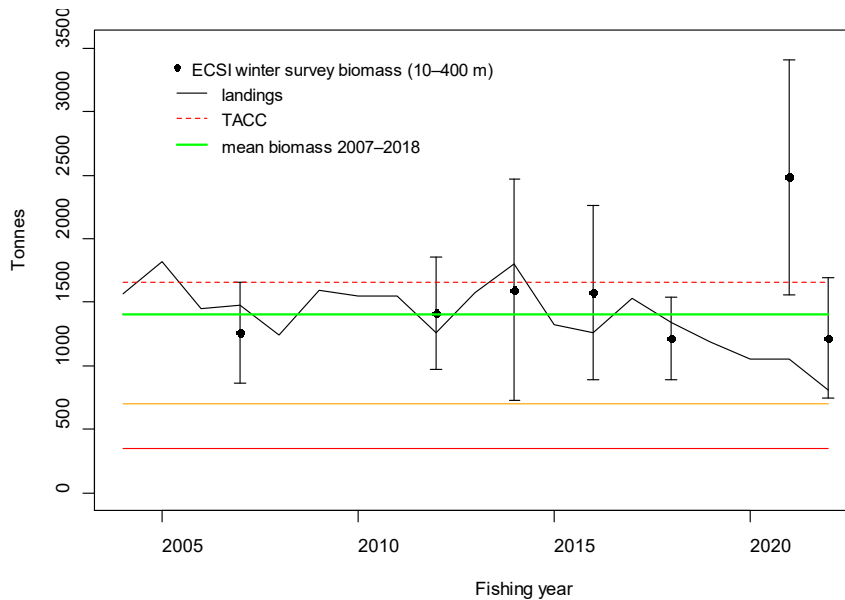
- **RSK 3**

Stock Structure Assumptions
For the purposes of this summary RSK 3 is considered to be a single management unit.

Stock Status	
Year of Most Recent Assessment	2023
Assessment Runs Presented	Abundance index based on ECSI research trawl survey (10–400 m)
Reference Points	Interim Target: B_{MSY} proxy based on geometric mean survey index for the period 2007 to 2018 (a period with high yield when both catch and survey index were stable) Soft Limit: 50% B_{MSY} proxy Hard Limit: 25% B_{MSY} proxy Overfishing threshold: F_{MSY} proxy based on mean relative

	exploitation rate for the period 2007 to 2018
Status in relation to Target	About as Likely as Not (40–60%) to be at or above the target
Status in relation to Limits	Soft Limit: Unlikely (< 40%) to be below Hard Limit: Very Unlikely (< 10%) to be below
Status in relation to Overfishing	Unknown

Historical Stock Status Trajectory and Current Status

RSK 3 relative biomass from ECSI *Kaharoa* trawl survey in 10–400 m (black points plus vertical lines showing ± 2 s.e.) Reported QMR/MHR landings, and TACC for RSK 3 are also shown. Green line represents the B_{MSY} proxy of geometric mean survey abundance from 2007 to 2018 (1403 t). Orange line shows soft limit (50% B_{MSY} proxy), and red line shows hard limit (25% B_{MSY} proxy). Reported landings are believed to be inaccurate.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Relative biomass was stable around the target between 2007 and 2018, it increased to above the target in 2021, and then returned to the target level in 2022.
Recent Trend in Fishing Intensity or Proxy	Unknown
Other Abundance Indices	ECSI *Kaharoa* trawl survey core area series showed abundance increased 2–3 fold since the early 1990s (which informed the use of the reference period).
Trends in Other Relevant Indicators or Variables	ECSI mixed species inshore bottom trawl effort has declined by more than 50% since 1990, which may explain the declining catch of RSK, which is predominantly a bycatch species.

Projections and Prognosis	
Stock Projections or Prognosis	Unknown
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown Hard Limit: Unknown
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unknown

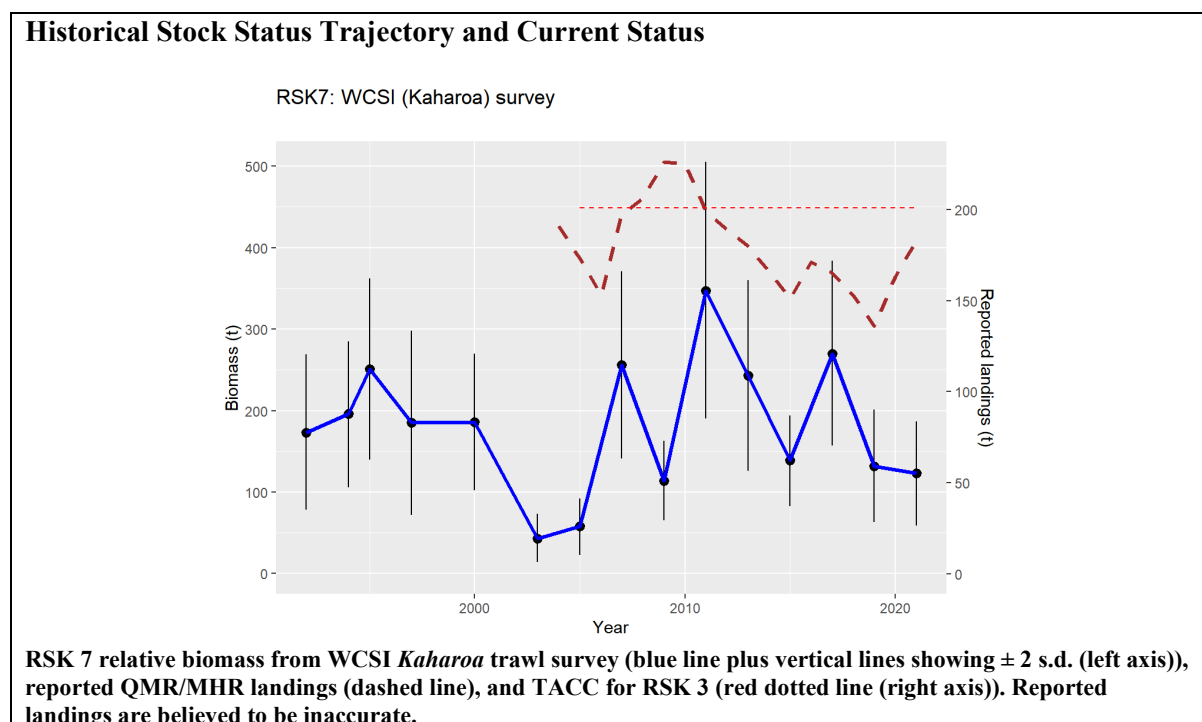| Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Survey abundance index	
Assessment Dates	Latest assessment: 2023	Next assessment: 2025
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	Survey abundance index	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	-	

Qualifying Comments
-

Fishery Interactions
Rough skate constitute a bycatch of trawl fisheries. Skates are widely distributed and difficult for trawlers to avoid.

- **RSK 7**

Stock Structure Assumptions
For the purposes of this summary RSK 7 is considered to be a single management unit.

Stock Status	
Year of Most Recent Assessment	2022
Assessment Runs Presented	Abundance index based on research trawl survey
Reference Points	Target: B_{MSY} proxy Soft Limit: 50% B_{MSY} proxy Hard Limit: 25% B_{MSY} proxy Overfishing threshold: F_{MSY} proxy
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unknown
Status in relation to Overfishing	Unknown

Historical Stock Status Trajectory and Current Status

RSK7: WCSI (Kaharoa) survey

RSK 7 relative biomass from WCSI *Kaharoa* trawl survey (blue line plus vertical lines showing ± 2 s.d. (left axis)), reported QMR/MHR landings (dashed line), and TACC for RSK 3 (red dotted line (right axis)). Reported landings are believed to be inaccurate.

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Fishery and Stock Trends

Recent Trend in Biomass or Proxy	Relative biomass was stable between 1992 and 2000. Since 2007 abundance estimates have fluctuated, however, considering the full survey series, there is no evidence of a long-term trend.
Recent Trend in Fishing Intensity or Proxy	Unknown
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis

Stock Projections or Prognosis	Unknown
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown Hard Limit: Unknown
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unknown

Assessment Methodology and Evaluation

Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Survey abundance index	
Assessment Dates	Latest assessment: 2022	Next assessment: 2024
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	Survey abundance index	1 – High Quality
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	In the period since RSK entered the QMS abundance estimates have shown large inter-annual fluctuations. The reasons for these fluctuations are unknown.	

Qualifying Comments

As there was no period with stable catch and abundance available, it was not possible to determine reference points, nor therefore stock status.

Fishery Interactions

Rough skate constitute a bycatch of trawl fisheries. Skates are widely distributed and difficult for trawlers to avoid.

6.   FOR FURTHER INFORMATION

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