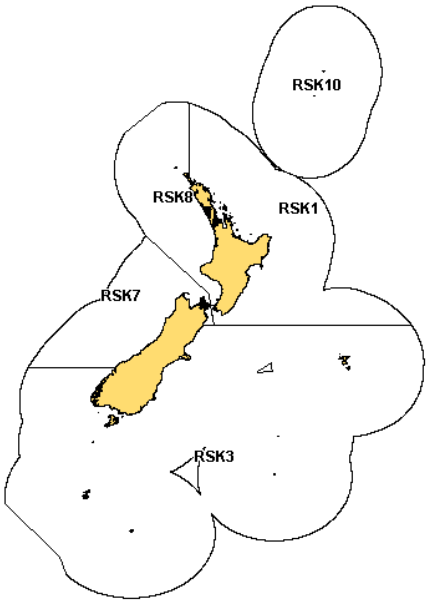
ROUGH SKATE (RSK) and SMOOTH SKATE (SSK)

(*Raja nasuta* and *R. innominata*)



Note: QMA boundaries are the same for SSK as RSK.

1. FISHERY SUMMARY

(a) Commercial fisheries

Two endemic species of skate, rough skate (*Raja nasuta*, RSK) and smooth skate (*R. innominata*, SSK), are fished commercially in New Zealand. Smooth skates, which are also known as barndoor 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 and both species 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 and 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. There is no clear separation of the depth ranges inhabited by the two species, and both species are often caught in the same trawl tows; 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, all historical 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 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 Inshore	FSU Deep-water	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	–	–	–	–	1019	1019
1987–88	1005	421	1 426	–	–	–	–	1725	1725
1988–89	(530)	(136)	(665)	(252)	(265)	(28)	(293)	1513	1513
1989–90	–	–	–	780	1171	410	1581	1769	1769
1990–91	–	–	–	796	1334	359	1693	1820	1820
1991–92	–	–	–	1112	1994	703	2698	2620	2620
1992–93	–	–	–	1175	2595	824	3418	2951	2951
1993–94	–	–	–	1247	2236	788	3024	2997	2997
1994–95	–	–	–	956	1973	829	2803	2789	2789
1995–96	–	–	–	–	–	–	–	2789	2789

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 (RSK) and smooth (SSK) skates were introduced into the QMS as separate species from 1 October 2003 with allowances, TACCs and TACs as follows in Table 3.

Table 2: Reported landings (t) of skates by QMA and fishing year, 1996–97 to 2005–06.

QMA	1	3	7	8	10	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	1 568	191	33	0	1 840
2004-05	72	1 815	173	55	0	2 115
2005-06	72	1 446	153	28	0	1 699
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	431	146	15	0	671
2005-06	72	468	163	12	0	715
All Skate						
1996–97	68	1 941	551	38	0	2 598
1997–98	81	2 249	321	31	0	2 682
1998–99	75	2 384	361	31	0	2 851
1999–00	100	2 372	363	26	0	2 861
2000–01	85	2 361	431	20	0	2 897
2001–02	116	2 171	425	33	0	2 745
2002-03	158	2 612	487	46	0	3 314
2003-04	127	1 999	337	48	0	2 511
2004-05	154	2 223	298	70	0	2 745
2005-06	144	1 914	316	40	0	2 414

*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 Maori allowances, TACC's and TACs for skates.

Fishstock	Recreational Allowance	Māori Customary Allowance	TACC	TAC
RSK 1 (FMAs 1-2)	1	1	111	114
RSK 3 (FMAs 3-6)	1	1	165.3	1672
RSK 7	1	1	201	205
RSK 8 (FMAs 8-9)	1	1	21	24
RSK 10	0	0	0	0
SSK 1 (FMAs 1-2)	1	1	37	40
SSK 3 (FMAs 3-6)	1	1	579	587
SSK 7	1	1	213	217
SSK 8 (FMAs 8-9)	1	1	20	23
SSK 10	0	0	0	0

Owing to problems associated with identification of rough and smooth skates, reported catches of each species are probably not accurate. Recent (2003) initiatives to improve identification of theses species should, however, result in more accurate data in the future.

(b) Recreational fisheries

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

(c) Maori customary fisheries

Quantitative information on the level of Maori customary take is not available.

(d) Illegal catch

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

(e) 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

Rough and smooth skates reproduce by laying yolky eggs, enclosed in leathery cases, on the seabed. Little is known about the reproductive biology of either species. Rough skates lay their eggs in spring–summer (Francis, 1997). In both species, 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.

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 than them. 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)				
RSK 3	0.25-0.35			Francis et al. (2001b)
SSK 3	0.12-0.15			Francis et al. (2004)
2. Weight = a (length) ^{b} (weight in g, length in cm pelvic length)				
RSK males	a = 0.0393		b = 2.838	Francis (1997)
RSK females	a = 0.0218		b = 3.001	Francis (1997)
SSK both sexes	a = 0.0268		b = 2.933	Francis (1997)
3. von Bertalanffy growth parameters*				
	K	**t_0**	**L**	
RSK 3 (both sexes)	0.16	-1.2	91.3	Francis et al. (2001b)
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)
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. Both rough and 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. Skates have not been recorded from QMA 10.

In this report, 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.

(a) Estimates of fishery parameters and abundance

Relative biomass estimates are available for rough and 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 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.

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

		Rough skate		Smooth skate		Total skates	
Year	**Trip Code**	**Biomass**	***CV***	**Biomass**	***CV***	**Biomass**	***CV***
East coast North Island							
1993	kah9304	76	28	23	52	99	
1994	kah9402	189	12	144	38	333	
1995	kah9502	52	20	20	59	72	
1996	kah9602	309	24	85	36	394	
South Island west coast and Tasman/Golden Bays (FMA 7)							
1992	kah9204	173	27	339	19	512	
1994	kah9404	196	23	341	18	537	
1995	kah9504	251	22	315	20	566	
1997	kah9701	185	30	302	26	487	
2000	kah0004	186	23	140	29	326	
2003	kah0304	43	34	91	79	134	
2005	kah0503	58	30	80	30		
East coast South Island (FMA 3) Winter							
1991	kah9105	–	–	–	–	1 928	25
1992	kah9205	224	24	605	18	829	16
1993	kah9306	335	21	658	25	993	21
1994	kah9406	517	20	306	25	823	15
1996	kah9606	177	19	385	24	562	18
East coast South Island (FMA 3) Summer							
1996-97	kah9618	1 336	15	721	32	2 057	
1997-98	kah9704	1 082	13	485	21	1 567	
1998-99	kah9809	1 175	10	450	26	1 625	
1999-00	kah9917	329	23	369	30	698	
2000-01	kah0014	222	34	248	33	470	

Survey discontinued

Table 5: (*Continued*)

Chatham Rise						
1991–2	tan9106	–	–	–	–	2 129
1992–3	tan9212	55	83	1 071	18	1 126
1994	tan9401	220	44	958	23	1 178
1995	tan9501	76	43	769	31	845
1996	tan9601	11	100	1 511	30	1 522
1997	tan9701	12	58	1 932	22	1 944
1998	tan9801	10	100	1 425	26	1 935
1999	tan9901	34	60	1 738	20	1 772
2000	tan0001	0	-	1 369	23	1 369
2001	tan0101	72	59	2 321	19	2 393
2002	tan0201	37	65	2 111	17	2 148
2003	tan0301	32	64	1 355	21	1 387
2004	tan0401	22	60	2 006	21	2 066
2005	tan0501	89	45	2 780	24	
Stewart–Snares Shelf						
1993	tan9301	592	20	528	20	1 120
1994	tan9402	1 064	15	342	21	1 406
1995	tan9502	801	7	335	19	1 136
1996	tan9604	1 055	11	504	29	1 559
Survey discontinued						
Stewart–Snares Shelf and Subantarctic (Summer)*						
1991	tan9105	37	72	382	23	419
1992	tan9211	52	69	113	47	165
1993	tan9310	132	57	117	43	249
2000	tan0012	201	56	434	66	267
Stewart–Snares Shelf and Subantarctic (Autumn)*						
1992	tan9204	48	100	93	61	141
1993	tan9304	251	57	177	33	428
1996	tan9605	22	71	835	39	857
1998	tan9805	71	77	536	62	607

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

According to both CVs and levels of catch, the trawl surveys appear to have accurately tracked the abundance of one or both skate species in FMA 3 (summer surveys), FMA 7 (both species), and on the Chatham Rise (SSK) and Stewart Snares shelf (both species). West Coast South Island surveys suggest that the relative biomasses of both species in FMA 7 have declined substantially since 2000. Substantial declines in the abundance of rough and smooth skates were also observed on the east coast of the South Island in 2000. The Stewart-Snares Shelf survey was unfortunately discontinued after 1996, but to date the abundance of the two skates appears to have been stable. Smooth skate relative biomass on the on the Chatham Rise was fairly stable between 1995 and 2003, fluctuating between 1300 and 2300 t, with no overall trend.

(b) Biomass estimates

There are no absolute biomass estimates for rough or smooth skates.

(c) Estimation of Maximum Constant Yield (MCY)

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.

(d) Estimation of Current Annual Yield (CAY)

CAY cannot be estimated.

(e) Other yield estimates and stock assessment results

No other yield estimates are available.

(f) 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 codend). Skates returned to the sea probably have a greater chance of survival than most other fishes.

5. STATUS OF THE STOCKS

No estimates of current and reference biomass are available.

Relative biomass estimates from trawl surveys in QMAs 3 and 7 revealed declines for both species in recent years. It is not known if recent catch levels or the total quota are sustainable or at levels that will allow the stock to move towards a size that will support the maximum sustainable yield.

Reported landings and TACCs for the 2005/06 fishing year are summarised in Tables 6 and 7.

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

Fishstock	QMA		2005-06 Actual TACC	2005-06 Reported landings
RSK 1 (FMAs 1-2)	Auckland (East) Central (East)	1 & 2	111	72
RSK 3 (FMAs 3-6)	South-east (Coast) (Chatham), Southland, and Sub-antarctic	3, 4, 5 & 6	165.3	1446
RSK 7	Challenger	7	201	153
RSK 8 (FMAs 8-9)	Central (West), Auckland (West)	8 & 9	21	28
RSK 10	Kermadec	10	0	0
Total			1986	1699

Table 7: Summary of TACCs (t), and reported landings (t) for smooth skates for the most recent fishing year.

Fishstock	QMA		2004-05 Actual TACC	2005-06 Reported landings
SSK 1 (FMAs 1-2)	Auckland (East) Central (East)	1 & 2	37	72
SSK 3 (FMAs 3-6)	South-east (Coast) (Chatham), Southland, and Sub-Antarctic	3, 4, 5 & 6	579	468
SSK 7	Challenger	7	213	163
SSK 8 (FMAs 8-9)	Central (West), Auckland (West)	8 & 9	20	12
SSK 10	Kermadec	10	0	0
Total			849	714

6. FOR FURTHER INFORMATION

Beentjes, M. P.; Stevenson, M. L. (2000). Review of the east coast South Island winter trawl survey time series, 1991-96. *NIWA Technical Report 86*. 64 p.

Beentjes, M. P.; Stevenson, M. L. (2001). Review of the east coast South Island summer trawl survey time series, 1996-97 to 1999-2000. *NIWA Technical Report 108*. 92 p.

Francis, M. P. 1997: A summary of biology and commercial landings, and a stock assessment of rough and smooth skates (*Raja nasuta* and *R. innominata*). *New Zealand Fisheries Assessment Research document 97/5* 27p.

Francis, M. P.; Ó Maolagáin, C.; Stevens, D. (2001a). Age, growth, and sexual maturity of two New Zealand endemic skates, *Dipturus nasutus* and *D. innominatus*. *New Zealand Journal of Marine and Freshwater Research 35*: 831-842.

Francis, M. P.; Ó Maolagáin, C.; Stevens, D. (2001b). Age, growth, maturity, and mortality of rough and smooth skates (*Dipturus nasutus* and *D. innominatus*). *New Zealand Fisheries Assessment Report 2001/17*. 21 p.

Francis, M. P.; Ó Maolagáin, C.; Stevens, D. (2004). Revised growth, longevity and natural mortality of smooth skate (*Dipturus innominatus*). Final Research Report for Ministry of Fisheries Project MOF2003/01H (Dated June 2004).

Stevenson, M. L.; Hanchet, S. (2000). Review of the inshore trawl *survey* series of the west coast South Island and Tasman and Golden Bays, 1992-97. *NIWA Technical Report 82*. 79 p.