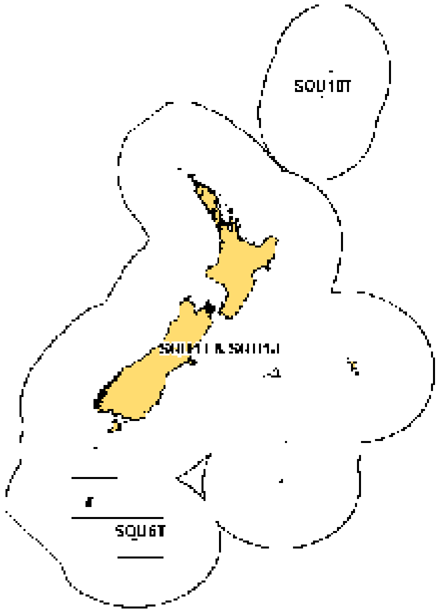
ARROW SQUID (SQU)

(*Nototodarus gouldi, N. sloanii*)



1. FISHERY SUMMARY

(a) Commercial fisheries

The New Zealand arrow squid fishery is based on two related species. *Nototodarus gouldi* is found around mainland New Zealand north of the Subtropical Convergence, whereas *N. sloanii* is found in and to the south of the convergence zone.

Except for the Southern Islands fishery, for which a separate TACC is set, the two species are managed as a single fishery within an overall TACC. The Southern Islands fishery (SQU 6T) is almost entirely a trawl fishery. Although the species (*N. sloanii*) is the same as that found around the south of the South Island, there is evidence to suggest that the Auckland Island shelf stock is different from the mainland stocks. Because the Auckland Island shelf squid are readily accessible to trawlers, and because they can be caught with little finfish bycatch and are therefore an attractive resource for trawlers, a quota has been set separately for the Southern Islands.

The New Zealand squid fishery began in the late 1970s and reached a peak in the early 1980s when over 200 squid jigging vessels came to fish in the New Zealand EEZ. The discovery and exploitation of the large squid stocks in the southwest Atlantic substantially increased the supply of squid to the Asian markets causing the price to fall. In the early 1980s, Japanese squid jiggers would fish in New Zealand for a short time before continuing on to the southwest Atlantic. In the late 1980s, the jiggers stopped transit fishing in New Zealand and the number of jiggers fishing declined from over 200 in 1983 to around 15 in 1994. The jig catch in SQU 1J declined from 53872 t in 1988–89 to 4865 t in 1992–93 but increased significantly to over 30 000 t in 1994–95, before declining to just over 9000 t in 1997–98. The jig catch declined to low levels for the next 5 years but has increased in 2004–05 to 8981 t.

From 1986 to 1998 the trawl catch fluctuated between about 30 000–60 000 t, but in the last few years dropped to much lower levels as the impact of management measures to protect the Hooker's sea lion (*Phocarctos hookeri*) restricted the catch from SQU 6T.

Recent catch data are given in Table 1. A breakdown of catch by foreign licensed nation to 1993–94 is given in the 1995 Plenary report. It has not been updated here because of the relatively low foreign licensed catch in recent years.

Catch and effort data from the SQU 1T fishery show that the catch occurs between December and May, with peak harvest from January to April. The catch has been taken from the Snares shelf on the south coast of the South Island right through to the Mernoo Bank (east cost), but statistical area 28 (Snares shelf and Snares Island region) has accounted for over 77% of the total in recent years. Based on observer data, squid accounts for 67% of the total catch in the target trawl fishery, with bycatch principally of barracouta, jack mackerel , silver warehou and spiny dogfish.

For 2005-06 a 10% in-season increase to the SQU 1T TACC has been approved by the Minister of Fisheries. The catch for December –March was 40% higher than the average over the previous 8 years and catch rates were double the average, indicating an increased abundance of squid this season. In 2003-04, a 30% in-season increase to the TACC was agreed, but catches did not reach the higher limit. Note that the TACC automatically reverts to the original value at the end of the fishing year.

Table 1: Reported catches (t) and TACs (t) of arrow squid from 1986–87 to 2004–05. Source – QMS.

Fishstock	SQU1J*		SQU1T*		SQU6T†		SQU10T‡		Total	
	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC
1986–87	32 394	57 705	25 621	30 962	16 025	32 333	0	10	74 040	121 010
1987–88	40 312	57 705	21 983	30 962	7 021	32 333	0	10	69 316	121 010
1988–89	53 872	62 996	26 825	36 081	33 462	35 933	0	10	114 160	135 080
1989–90	13 895	76 136	13 161	47 986	19 859	42 118	0	10	46 915	166 250
1990–91	11 562	46 087	18 680	42 284	10 658	30 190	0	10	40 900	118 571
1991–92	12 985	45 766	36 653	42 284	10 861	30 190	0	10	60 509	118 571
1992–93	4 865	49 891	30 862	42 615	1 551	30 369	0	10	37 278	122 875
1993–94	6 524	49 891	33 434	42 615	34 534	30 369	0	10	74 492	122 875
1994–95	33 615	49 891	35 017	42 741	30 683	30 369	0	10	99 315	123 011
1995–96	30 805	49 891	17 823	42 741	14 041	30 369	0	10	62 668	123 011
1996–97	20 792	50 212	24 769	42 741	19 843	30 369	0	10	65 403	123 332
1997–98	9 329	50 212	28 687	44 741	7 344	32 369	0	10	45 362	127 332
1998–99	3 240	50 212	23 362	44 741	950	32 369	0	10	27 553	127 332
1999–00	1 457	50 212	13 049	44 741	6 241	32 369	0	10	20 747	127 332
2000–01	521	50 212	31 297	44 741	3 254	32 369	<1	10	35 071	127 332
2001–02	799	50 212	35 872	44 741	11 502	32 369	0	10	48 173	127 332
2002–03	2 896	50 212	33 936	44 741	6 887	32 369	0	10	43 720	127 332
2003–04	2 267	50 212	48 060	58 163#	34 635	32 369	0	10	84 962	127 332
2004-05	8 981	50 212	49 780	44 741	27 314	32 369	0	10	86 075	127 332

* All areas except Southern Islands and Kermadec.
† Southern Islands.
‡ Kermadec.
# In season increase of 30% for 2003-04.

Sea lion interactions – Squid 6T

Landings in SQU 6T have been irregular over time, caused by both the variable availability of squid and also the seasonal closures caused by sea lion incidental mortality. Table 2 shows the estimates of sea lion mortalities and the fishery-related mortality limits (FRML) set for each year. The fishery has been closed by triggering the FRML in 6 of the last 10 seasons. For the 2005-06 season, the FRML has been set at 150 sea lions to allow the fishery to take advantage of an increased abundance of squid.

Table 2: Squid 6T fishery – estimated mortalities of sea lions from 1987–88 to 2004–05.

	SQU6T		Sea lion	Estimated	Closure
	Landings	TAC	FRML	mortalities	date
1987–88	7 021	32 333	-	33	
1988–89	33 462	35 933	-	141	
1989–90	19 859	42 118	-	117	
1990–91	10 658	30 190	-	21	
1991–92	10 861	30 190	32	82	
1992–93	1 551	30 369	63	17	
1993–94	34 534	30 369	63	32	
1994–95	30 683	30 369	69	109	
1995–96	14 041	30 369	73	101	4 May
1996–97	19 843	30 369	79	123	28 May
1997–98	7 344	32 369	63	62	27 Mar
1998–99	950	32 369	64	14	-
1999–00	6 241	32 369	65	71	8 Mar
2000–01	3 254	32 369	75	67	-
2001–02	11 502	32 369	79	84	13 Apr
2002–03	6 887	32 369	70	39	-
2003–04	34 635	32 369	62	118	-
2004-05	27 314	32 369	115	115	20 Apr

(b) Recreational fisheries

The amount of arrow squid caught by recreational fishers is not known.

(c) Maori customary fisheries

No quantitative information is available on the current level of Maori customary take.

(d) Illegal catch

There is no quantitative information available on the level of illegal catch.

(e) Other sources of mortality

No information is available on other sources of mortality.

2. BIOLOGY

Two species of arrow squid are caught in the New Zealand fishery. Both species are found over the continental shelf in water up to 500 m depth, though they are most prevalent in water less than 300 m depth. Both species are sexually dimorphic, though similar in biology and appearance. Individuals can be identified to species level based on sucker counts on Arm I and differences in the hectocotylized arm of males.

Recent work on the banding of statoliths from *N. sloanii* suggests that the animals live for around 1 year. Growth is rapid. Modal analysis of research data has shown increases of 3.0–4.5 cm per month for Gould's arrow squid measuring between 10 and 34 cm Dorsal Mantle Length (DML).

Estimated ages suggest that *N. sloanii* hatches in July and August, with spawning occurring in June and July. It also appears that *N. gouldi* may spawn one to two months before *N. sloanii*, although there are some indications that *N. sloanii* spawns at other times of the year. All squid taken by the fishery do not appear to have spawned.

Tagging experiments indicate that arrow squid can travel on average about 1.1 km per day with a range of 0.14–5.6 km per day.

Biological parameters relevant to stock assessment are shown in Table 3.

Table 3: Estimates of biological parameters.

Fishstock	Estimate				Source
1. Weight = a (length)^b (Weight in g, length in cm dorsal length)					
			a	b	
N. gouldi	≤ 12 cm DML		0.0738	2.63	Mattlin et al. (1985)
N. sloanii	≥ 12 cm DML		0.0290	3.00	
2. von Bertalanffy growth parameters					
	K	**t_0**	**L_{∞}**		
N. gouldi	2.1–3.6	0	35		Gibson and Jones (1993)
N. sloanii	2.0–2.8	0	35		

3. STOCKS AND AREAS

There are no new data which would alter the stock boundaries given in previous assessment documents. It is assumed that the stock of *N. gouldi* (the northern species) is a single stock, and that *N. sloanii* around the mainland comprises a unit stock for management purposes, though the detailed structure of these stocks is not fully understood. The distribution of the two species is largely geographically separate but those occurring around the mainland are combined for management purposes. The Auckland Islands Shelf stock of *N. sloanii* appears to be different from the mainland stock and is managed separately.

4. STOCK ASSESSMENT

There are no new data which would alter the conclusions regarding yield estimates given in the 1998 Plenary Report. These conclusions have not changed since the 1990 Plenary Report.

Arrow squid live for one year, spawn once then die. Every squid fishing season is therefore based on what amounts to a new stock. It is not possible to calculate reliable yield estimates from historical catch and effort data for a resource which has not yet hatched, even when including data which are just one year old. Furthermore, because of the short life span and rapid growth of arrow squid, it is not possible to estimate the biomass prior to the fishing season. Moreover, the biomass increases rapidly during the season and then decreases to low levels as the animals spawn and die.

(a) Estimates of fishery parameters and abundance

No estimates are available.

(b) Biomass estimates

Biomass estimates are not available for squid.

(c) Estimation of Maximum Constant Yield (MCY)

It is not possible to estimate MCY.

(d) Estimation of Current Annual Yield (CAY)

It is not possible to estimate CAY.

(e) Other yield estimates and stock assessment results

There are no other yield estimates of stock assessment results available for arrow squid.

(f) Other factors

N. gouldi spawns one to two months before *N. sloanii*. This means that at any given time *N. gouldi* is older and larger than *N. sloanii*. The annual squid jigging fishery begins on *N. gouldii* and at some time during the season the biomass of *N. sloanii* will exceed that of *N. gouldi* and the fleet will move south. If *N. sloanii* are abundant the fleet will remain in the south fishing for *N. sloanii*. If *N. sloanii* are less abundant the fleet will return north and resume fishing *N. gouldi*.

5. STATUS OF THE STOCKS

No estimates of current and reference biomass are available. There is also no proven method at this time to estimate yields from the squid fishery before a fishing season begins based on biomass estimates or CPUE data.

Because squid live for about one year, spawn and then die, and because the fishery is so variable, it is not practical to predict future stock size in advance of the fishing season. As a consequence, it is not possible to estimate a long-term sustainable yield for squid nor determine if recent catch levels or the current TACC will allow the stock to move towards a size that will support the MSY. There will be some years in which economic or other factors will prevent the TACC from being fully taken, while in other years the TACC may be lower than the potential yield. It is not known whether New Zealand squid stocks have ever been stressed through fishing mortality.

There is continuing concern about the by-catch of sea lions in the Southern Islands trawl squid fishery (SQU 6T) that has been addressed by a management plan restricting the total number of kills per season.

Summary of TACCs (t) and reported landings (t) of arrow squid for the most recent fishing year.

Fishstock	2004–05 Actual TACC	2004–05 Reported landings
SQU 1J	50 212	8 981
SQU 1T	44 741	49 780
SQU 6T	32 369	27 314
SQU 10T	10	0
Total	127 332	86 075

6. FOR FURTHER INFORMATION

Förch, E.C. (1983). Squid – current research. *In:* Taylor, J.L. and Baird, G.G. (eds.) *New Zealand finfish fisheries: the resources and their management*, pp. 33–34. Trade Publications Ltd., Auckland.

Gibson, D.; Jones, J.B. (1993). Fed up with parasites? — old fish are. *Marine Biology 117: 495–500*.

Gibson, D. J. M. (1995). The New Zealand Squid Fishery, 1979–93. *MAF Fisheries Technical Report No 42*. 43 p.

Mattlin, R.H. (1983). Squid. Taylor, J.L. and Baird, G.G. (eds.) *New Zealand finfish fisheries: the resources and their management*, pp. 30–32. Trade Publications Ltd., Auckland.

Mattlin, R.H.; Colman, J.A. (1988). Arrow squid. *N.Z. Fisheries Assessment Research Document 88/34*. 16 p.

Mattlin, R.H.; Scheibling, R.E.; Förch, E.C. (1985). Distribution, abundance and size structure of arrow squid (*Nototodarus* sp.) off New Zealand. *NAFO Scientific Council Studies 9*: 39–45.

Smith, P.J.; Mattlin, R.H.; Roeleveld, M.A.; Okutani, T. (1987). Arrow squids of the genus *Nototodarus* in New Zealand waters: systematics, biology and fisheries. *N.Z. Journal of Marine and Freshwater Research 21: 315–326*.

Uozumi, Y.; Ohara, H. (1992). Age and growth of *Nototodarus sloanii* (Cephalopoda: Oegopsida) based on daily increment counts in statoliths. *Nippon Suisan Gakkaishi 59*: *1469–1477*.