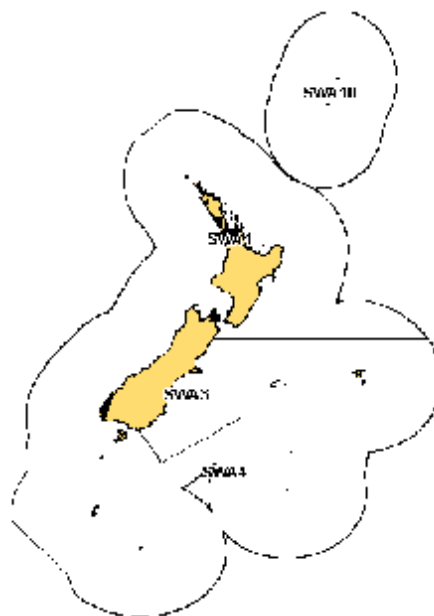


## SILVER WAREHOU (SWA)

(*Seriolella punctata*)



### 1. FISHERY SUMMARY

#### (a) Commercial fisheries

Silver warehou are common around the South Island and on the Chatham Rise in depths of 200–800 m. The majority of the commercial catch is taken from the Chatham Rise, Canterbury Bight, southeast of Stewart Island and the west coast of the South Island. Reported landings by nation from 1974 to 1987–88 are shown in Table 1.

**Table 1: Reported landings (t) by nation from 1974 to 1987–88. Source: 1974–1978 (Paul 1980); 1978 to 1987–88 (FSU).**

Fishing Year	New Zealand			Foreign Licensed				Grand Total
	Domestic	Chartered	Total	Japan	Korea	USSR	Total	
1974*								7 412
1975*								6 869
1976*			estimated as 70% of total warehou landings				13 142	
1977*								12 966
1978*								12 581
1978–79**	?	629	629	3 868	122	212	4 203	4 832
1979–80**	?	3 466	3 466	4 431	217	196	4 843	8 309
1980–81**	?	2 397	2 397	1 246	–	13	1 259	3 656
1981–81**	?	2 184	2 184	1 174	186	3	1 363	3 547
1982–83**	?	3 363	3 363	1 162	265	189	1 616	4 979
1983†	?	1 556	1 556	510	98	3	611	2 167
1983–84§	303	3 249	3 552	418	194	3	615	4 167
1984–85§	203	4 754	4 957	1 348	387	15	1 749	6 706
1985–86§	276	5 132	5 408	1 424	217	5	1 646	7 054
1986–87§	261	4 565	4 826	1 169	29	100	1 299	6 125
1987–88§	499	7 008	7 507	431	111	39	581	8 088

\* Calendar year.

\*\* 1 April to 31 March.

† 1 April to 30 September.

§ 1 October to 30 September.

Before the establishment of the EEZ, silver warehou landings were lumped with white and blue warehou landings under the title "warehou". Between 1974 and 1977, 70% of the "warehou" landings are estimated to have been silver warehou because of the areas fished. The depth distributions of silver warehou and blue warehou are reasonably distinct, and white warehou form a very small proportion of more recent warehou catches and biomass estimates from trawl surveys.

The estimated catches of silver warehou before the declaration of the EEZ were particularly high in 1976, 1977 and 1978 (Table 1). Concern about overfishing on the eastern Stewart–Snares shelf led to closure of this area to trawlers between October 1977 and January 1978. The high catch in 1978 represents a shift in effort, particularly by Japan, to the Chatham Rise, presumably because of the restriction on the Stewart–Snares shelf. Total reported catches since 1978–79 have been generally lower than estimated landings before 1978.

An initial TAC of 18000 t set in 1979–80 (based on total warehou landings) was subsequently halved. In 1981 a controlled fishing period was re-introduced on the Stewart-Snares shelf and retained until 1984–85 when the TACs for areas D, E and F were amalgamated.

In recent years, most of the silver warehou catch has been taken as a by-catch of the hoki, squid, barracouta and jack mackerel trawl fisheries. Catches from SWA 1 have increased substantially since 1985–86 following the development of the west coast South Island hoki fishery. Overruns of the TAC are probably partly related to the hoki fleet fishing in relatively shallow water (northern grounds) in the later part of the season, but could also reflect changes in abundance. Some target fishing for silver warehou does still occur, predominantly on the Mernoo Bank and along the Stewart-Snares shelf. Recent reported landings and actual TACs are shown in Table 2.

The TACC in SWA 1 was increased in 1991–92 under the "adaptive management" programme (AMP). A review of this fishstock at the completion of 5 years in the AMP concluded that it was not known if the current TACC would be sustainable and an appropriate monitoring programme was not in place. Under the criteria developed for the AMP the Minister therefore removed this fishstock from the AMP in October 1997 and set the TACC at 2132 t. A new AMP proposal in 2002 resulted in the TACC being increased to 3000 t from 1 October 2002, within a TAC of 3003 t

**Table 2: Reported landings (t) of silver warehou by Fishstock from 1983–84 to 2004–05 and TACCs (t) from 1986–87 to 2004–05.**

Fishstock FMA (s)	SWA 1		SWA 3		SWA 4		SWA 10		Total	
	1, 2, 7, 8 & 9		3		4, 5 & 6		10		Landings	TACC
1983–84*	541	–	725	–	1 829	–	0	–	3 095	–
1984–85*	587	–	1 557	–	4 563	–	0	–	6 707	–
1985–86*	806	–	2 284	–	3 966	–	0	–	7 056	–
1986–87†	1 337	1 800	1 931	2 600	2 779	3 600	0	10	6 047	§ 8 010
1987–88†	2 947	1 815	3 810	2 601	2 600	3 600	0	10	9 357	§ 8 026
1988–89†	1 605	1 821	1 476	2 640	2 789	3 745	0	10	5 870	8 216
1989–90†	2 316	2 128	2 713	3 140	3 596	3 855	0	10	8 625	9 133
1990–91†	2 121	2 128	1 889	3 144	3 176	3 855	0	10	7 186	9 137
1991–92†	1 388	2 500	2 661	3 144	3 018	3 855	0	10	7 066	9 509
1992–93†	1 231	2 504	2 432	3 145	3 137	3 855	0	10	6 800	9 514
1993–94†	2 960	2 504	2 724	3 145	2 993	3 855	0	10	8 677	9 514
1994–95†	2 281	2 504	2 336	3 280	2 638	4 090	0	10	7 255	9 884
1995–96†	2 884	2 504	2 939	3 280	3 581	4 090	0	10	9 404	9 884
1996–97†	3 636	2 504	4 063	3 280	5 336	4 090	0	10	13 035	9 884
1997–98†	3 380	2 132	3 721	3 280	3 944	4 090	0	10	11 045	9 512
1998–99†	1 980	2 132	2 796	3 280	4 021	4 090	0	10	8 797	9 512
1999–00†	2 525	2 132	4 129	3 280	4 606	4 090	0	10	11 260	9 512
2000–01†	3 025	2 132	3 664	3 280	4 650	4 090	0	10	11 339	9 512
2001–02†	1 004	2 132	2 899	3 280	4 648	4 090	0	10	8 551	9 512
2002–03†	1 029	3 000	3 772	3 280	4 746	4 090	0	10	9 547	10 380
2003–04†	1 595	3 000	3 606	3 280	5 529	4 090	0	10	10 730	10 380
2004–05†	1 467	3 000	3 797	3 280	4 279	4 090	0	10	9 543	10 380

\* FSU data.

† QMS data.

§ Totals do not match those in Table 1 as the data were collected independently and there was under-reporting to the FSU in 1987–88.

**(b) Recreational fisheries**

There are no current recreational fisheries for silver warehou.

**(c) Maori customary fisheries**

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

**(d) Illegal catch**

Silver warehou have been misreported as white and blue warehou in the past. The extent of this practice is unknown and could lead to under-reporting of silver warehou catches.

**(e) Other sources of mortality**

Other sources of mortality are unknown.

**2. BIOLOGY**

Initial growth is rapid and fish reach sexual maturity at around 45 cm fork length in 4 years. Based on a study of ageing methodology and growth parameters (Horn & Sutton 1995), maximum age has been revised to 23 years for females and 19 years for males. An estimate of instantaneous natural mortality ( $M$ ) was derived by using the equation  $M = \log_e 100/A_{\max}$ , where  $A_{\max}$  is the age reached by 1% of the virgin population. From their study,  $A_{\max}$  of 19 years for female silver warehou and 17 years for males produced estimates of  $M$  of 0.24 and 0.27 respectively. Horn & Sutton (1995) qualified this result as the samples used in their study were not from virgin populations and the sampling method did not comprehensively sample the whole population. They concluded that whilst  $M$  is likely to fall within the range 0.2–0.3, 0.25 is probably a satisfactory estimate at this stage.

Horn & Sutton also calculated von Bertalanffy growth curve parameters from their sample of fish from off the south and southeast coasts of the South Island (Table 3). Other biological parameters relevant to the stock assessment are shown in Table 3. Length weight regressions were calculated from two series of random trawl surveys using *Tangaroa*. One series was conducted on the Chatham Rise in January, 1992–97 and the other in Southland during February–March, 1993–96.

Silver warehou is a schooling species, aggregating to both feed and spawn. During spring-summer, both adult and juvenile silver warehou migrate to feed along the continental slope off the east and southeast coast of the South Island. Late-stage silver warehou eggs and larvae have been identified in plankton samples, and the early life history of silver warehou appears typical of many teleosts. Juvenile silver warehou inhabit shallow water at depths of 150–200 m and remain apart from sexually mature fish. Few immature fish are consequently taken by trawlers targeting silver warehou. Juveniles have been caught in Tasman Bay, on the east coast of the South Island and around the Chatham Islands. Once sexually mature, fish move out to deeper water along the shelf edge.

**Table 3: Estimates of biological parameters of silver warehou.**

**1. Weight = a (length)<sup>b</sup>** (Weight in g, length in cm Total Length)

	<b>a</b>	<b>b</b>
Chatham Rise	0.00848	3.214
Southland	0.00473	3.380

**2. Von Bertalanffy growth parameters**

	<b>Female</b>	<b>Male</b>	<b>Source</b>
$L_{\infty}$	54.5	51.8	Horn & Sutton 1995
$k$	0.33	0.41	
$t_0$	-1.04	-0.71	

### 3. STOCKS AND AREAS

The stock structure is unknown. However, there is no new data which would alter the stock boundaries given in previous assessment documents. Horn et al. (2001) found no differences in growth rates of silver warehou from the Southern Plateau, Chatham Rise and WCSI, and reached the same conclusions as Livingston (1988) based on an analysis of gonad stages (ripe female samples) and juvenile distribution.

Livingston (1988) found that spawning occurs on the Chatham Rise (Mernoo), east coast North Island and west coast South Island in late winter and at the Chatham Islands in late spring-early summer. There is some evidence for another spawning ground on the Stewart-Snares shelf, also in late winter. It is uncertain whether the same stock migrates from one area to another, spawning whenever conditions are appropriate, or if there are several separate stocks. The current boundaries bear little relation to known spawning areas and silver warehou distribution.

### 4. STOCK ASSESSMENT

The assessment of silver warehou stocks was not updated in 2006. There are no new data that would alter the yield estimates given in the 1997 Plenary Report. Yield estimates are based on commercial landings only.

#### (a) Estimates of fishery parameters and abundance

CPUE data of silver warehou from the west coast South Island hoki fishery were analysed as a possible means of monitoring abundance in this part of SWA 1. However, the Middle Depths FAWG did not accept that the CPUE from the WCSI fishery were an index of abundance.

Age frequency distributions from otoliths collected by the Scientific Observer Programme from the west coast south island hoki fishery indicate that a wide range of year classes were present in the catch for all seasons 1992–96. Catch curve analysis based on the age structure of annual catches made from 1992–2003 suggested that fishing mortality is lower than natural mortality.

#### (b) Biomass estimates

Estimates of reference and current biomass are not available for any Fishstock.

Biomass indices from *Tangaroa* trawl surveys in QMAs 3 (part), 4 and 5 since 1991 are variable between years and have high c.v.s, and are therefore unsuitable for stock assessment.

#### (c) Estimation of Maximum Constant Yield (MCY)

##### (i) Auckland, Central, Challenger (SWA 1)

MCY was estimated using the equation  $MCY = cY_{av}$  (Method 4). Two values for  $Y_{av}$  were determined from distinct periods in the catch history.  $Y_{av}$  values were calculated from landings for 1983–84 to 1986–87 (818 t) and from the estimated catch for 1983–84 to 1990–91 (1713 t). These values were used to calculate two alternative estimates for MCY. The value of  $c$  was set equal to 0.8, based on an  $M$  of 0.25.

$$MCY = 0.8 * 818 \text{ t} = 654 \text{ t (rounded to 650 t).}$$

$$MCY = 0.8 * 1713 \text{ t} = 1370 \text{ t (rounded to 1400 t).}$$

The level of risk to the stock by harvesting the population at the estimated MCY value cannot be determined.



**(d) Estimation of Current Annual Yield (CAY)**

An estimate of current biomass is not available, and CAY cannot be estimated.

**(e) Other Factors**

The degree of interdependence between Fishstocks is unknown. The 1996–97 landings were the highest on record but catches have decreased in both 1997–98 and 1998–99.

**5. ANALYSIS OF ADAPTIVE MANAGEMENT PROGRAMMES (AMP)**

The Ministry of Fisheries revised the AMP framework in December 2000. The AMP framework is intended to apply to all proposals for a TAC or TACC increase, with the exception of fisheries for which there is a robust stock assessment. In March 2002, the first meeting of the new Adaptive Management Programme Working Group was held. Two changes to the AMP were adopted:

- a new checklist was implemented with more attention being made to the environmental impacts of any new proposal
- the annual review process was replaced with an annual review of the monitoring requirements only. Full analysis of information is required a minimum of twice during the 5 year AMP.

**SWA 1**

The SWA 1 TACC was increased from 2132 to 3000 t in October 2002 under the Adaptive Management Programme (AMP). The AMP was not reviewed in 2006.

**Mid-term Review of SWA 1 AMP in 2005**

In 2005 the AMP FAWG reviewed the performance of the AMP after 2 years at the higher TACC (SeaFIC 2005).

*Characterisation*

- Between 70 and 95% of the catch is made while targeting hoki using midwater and more recently bottom trawl on the west coast of the South Island. Owing to lower effort directed at hoki on the WCSI the SWA1 catch has remained below 1600t since 2001/02.

*Abundance Indices*

- SWA 1 is largely taken as a by-catch of the west coast hoki fishery.
- Given that CPUE is unlikely to track abundance, SWA 1 is monitored using biological information and mortality (Z) estimates based on the age structure of the catch (catch curves).
- The Chapman and Robson estimate of total mortality was not sensitive to age at full recruitment. This analysis suggested that fishing mortality was substantially lower than natural mortality and that total mortality had not increased from 1992 to 2003.

*Decision Rule*

- All information will be used to review the performance of the stock

*Biological Data*

- Length data and otoliths are collected from the WCSI spawning fishery by observers
- Spatial and temporal coverage was good in some years but inadequate in others.
- It was noted that many of the length frequency sample sizes were very small (less than 10 fish per tow) even when the estimated catch of silver warehou was large.
- Consistency in the size and age structure of the catch and the ability to track strong year classes indicates that the catch was adequately sampled.

*Effects of Fishing*

- Given that most of the catch is taken as bycatch of the hoki spawning fishery, environmental impacts of increasing the SWA 1 TACC are considered negligible.

*Conclusion*

- Given an estimate of natural mortality of 0.25, the Z-analysis suggests that fishing mortality is on average less than natural mortality.

**6. STATUS OF THE STOCKS**

No estimates of reference current absolute biomass are available. The TACC for SWA 1 was increased to 3000 t from 1 October 2002 under the AMP.

The landings of silver warehou have declined since 1996–97, when the landings were the highest ever reported. Annual catches of silver warehou are largely dependent on the main target fisheries within each area. The annual distribution of fishing effort has been variable, and no conclusions regarding the level of exploitation can be made from the catch histories. The sustainability of current TACCs and recent catch levels for all Fishstocks is not known, and it is not known if they will allow the stocks to move towards a size that will support the maximum sustainable yield.

**Summary of yields (t), TACCs (t), and reported landings (t) of silver warehou for the most recent fishing year.**

Fishstock		FMA	MCY	2004–05	2004–05
				Actual TACC	Reported landings
SWA 1	Auckland (East) (West), Central (East) (West), & Challenger	1, 2, 7, 8, & 9	650–1400	3 000	1 467
SWA 3	South–East (Coast)	3	–	3 280	3 797
SWA 4	South–East (Chatham), Southland, and Sub–Antarctic	4, 5 & 6	–	4 090	4 279
SWA 10	Kermadec	10	–	10	0
Total			–	10 380	9 543

**7. FOR FURTHER INFORMATION**

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