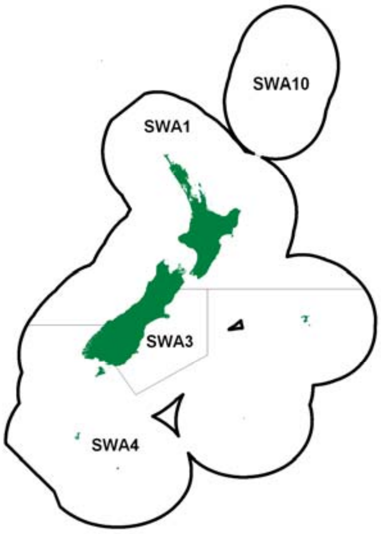
SILVER WAREHOU (SWA)

(*Seriolella punctata*)
Warehou



1. FISHERY SUMMARY

1.1 Commercial fisheries

Silver warehou entered the Quota Management System (QMS) on 1 October 1986. 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.

Commercial fishing for silver warehou developed in the late 1960s and early 1970s. Before the establishment of the Exclusive Economic Zone (EEZ), silver warehou, common or blue warehou, and white warehou were all lumped under the category of "warehous". Estimated total annual catches of silver warehou based on area of capture were about 13 000 t in 1976, 1977, and 1978 (Paul 1980, Livingston 1988; Table1). Concern about overfishing on the eastern Stewart-Snares shelf led to closure of this area to trawlers between October 1977 and January 1978. Initially, effort shifted to the Chatham Rise and total estimated catch did not change (Ministry of Fisheries, 2010). The catches did drop significantly after the establishment of the EEZ, and the reported landings fluctuated between 3 000 t and 8 000 t from 1978–79 to 1985–86 (Livingston, 1988, Table 1 and Table 2).

Some target fishing for silver warehou does still occur, predominantly on the Mernoo Bank and along the Stewart-Snares shelf. Recent reported landings are shown in Table 2, while Figure 1 shows the historical landings and TACC values for the main SWA stocks.

SWA 1

In recent years, most of the silver warehou catch has been taken as a bycatch of the hoki, squid, barracouta and jack mackerel trawl fisheries. Catches from SWA 1 increased substantially after 1985–86 following the development of the west coast South Island hoki fishery. Overruns of the TAC probably partly reflected the hoki fleet fishing in relatively shallow water (northern grounds) in the later part of the season, but could also have reflected changes in abundance.

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, with 1 t customary and 2 t recreational allowances within a TAC of 3003 t. Catches have not approached the new TACC level in recent years as reductions in the hoki quota have resulted in much less effort on the WCSI in winter.

SWA 3 and 4

In most years from 2000–01 to 2006–07 catches in SWA 3 and SWA 4 were well above the TACCs as fishers landed catches well in excess of ACE holdings and paid deemed values for the overcatch. From 1 October 2007 the deemed values were increased to $1.22 per kg for all SWA stocks and two differential rates were also introduced. The second differential rate applies to all catch over 130% of ACE holding at which point the deemed value rate increased to $3 per kg. The effect of these measures was seen immediately in 2007–08 as fishing without ACE was reduced and catch fell well below the TACCs in both SWA 3 and SWA 4.

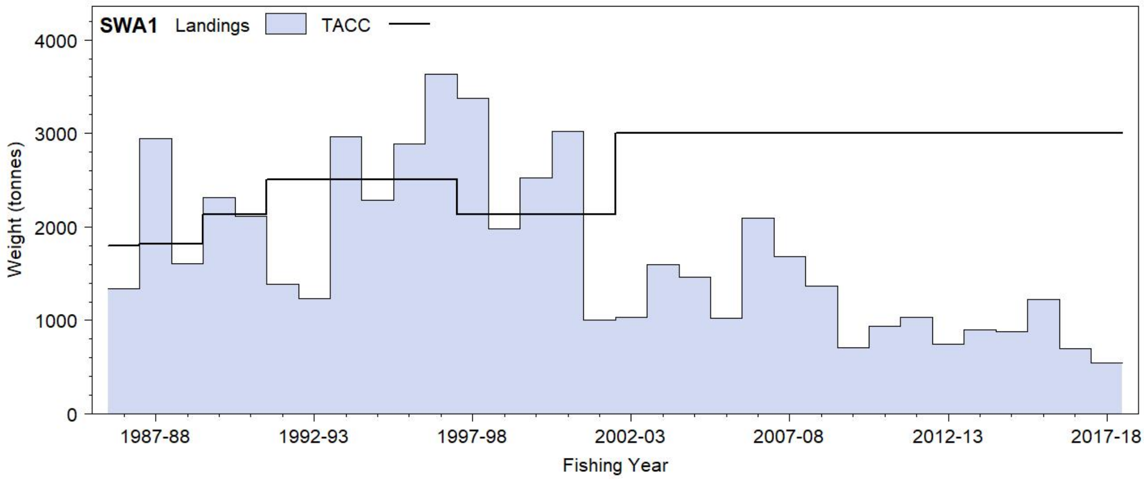
Table 2: Reported landings (t) of silver warehou by Fishstock from 1983–84 to present and TACCs (t) from 1986–87 to present. QMS data from 1986–present. [Continued on next page].

Fishstock	SWA 1		SWA 3		SWA 4		SWA 10			
FMA (s)	1, 2, 7, 8 & 9		3		4, 5 & 6		10			Total
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	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

Table 2 [Continued]

Fishstock	SWA 1		SWA 3		SWA 4		SWA 10			
FMA (s)	1, 2, 7, 8 & 9		3		4, 5 & 6		10		Total	Total
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
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
2005–06	1 023	3 000	4 524	3 280	5 591	4 090	0	10	11 138	10 380
2006–07	2 093	3 000	6 059	3 280	6 022	4 090	0	10	14 174	10 380
2007–08	1 679	3 000	2 918	3 280	3 510	4 090	0	10	8 107	10 380
2008–09	1 366	3 000	3 264	3 280	4 213	4 090	0	10	8 843	10 380
2009–10	712	3 000	2 937	3 280	3 429	4 090	0	10	7 078	10 380
2010–11	938	3 000	3 559	3 280	3 507	4 090	0	10	8 004	10 380
2011–12	1 029	3 000	3 318	3 280	2 783	4 090	0	10	7 130	10 380
2012–13	748	3 000	3 788	3 280	4 128	4 090	0	10	8 664	10 380
2013-14	903	3 000	3 201	3 280	3 885	4 090	0	10	7 989	10.380
2014–15	878	3 000	3 820	3 280	4 355	4 090	0	10	9 053	10 380
2015–16	1 225	3 000	2 734	3 280	3 555	4 090	0	10	7 515	10 380
2016–17	696	3 000	3 667	3 280	4 307	4 090	0	10	8 670	10 380
2017–18	543	3 000	3 396	3 280	4 714	4 090	0	10	8 653	10 380

§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.



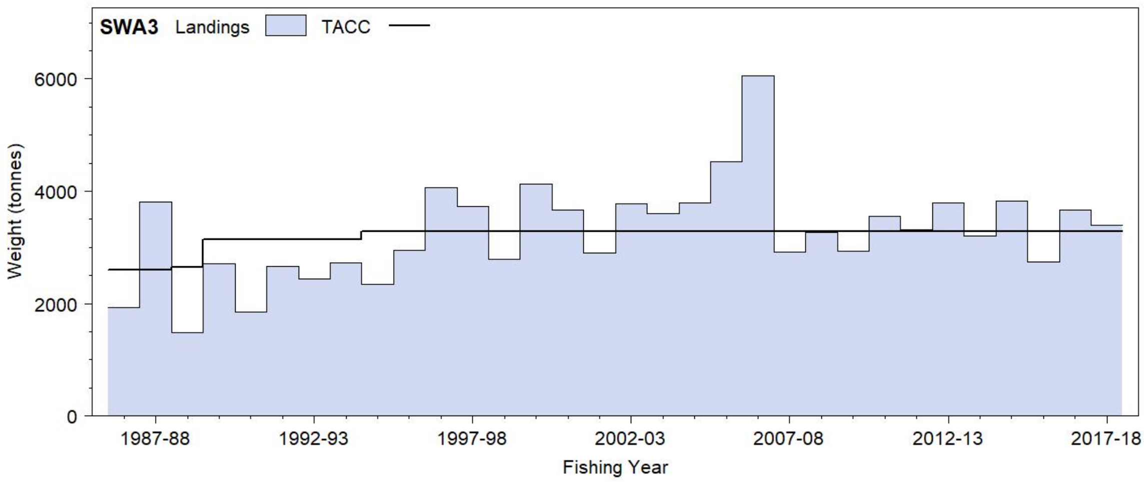


Figure 1: Reported commercial landings and TACCs for the three main SWA stocks. From top to bottom: SWA 1 (Auckland East) and SWA 3 (South East Coast). Note that these figures do not show data prior to entry into the QMS. [Continued on next page].

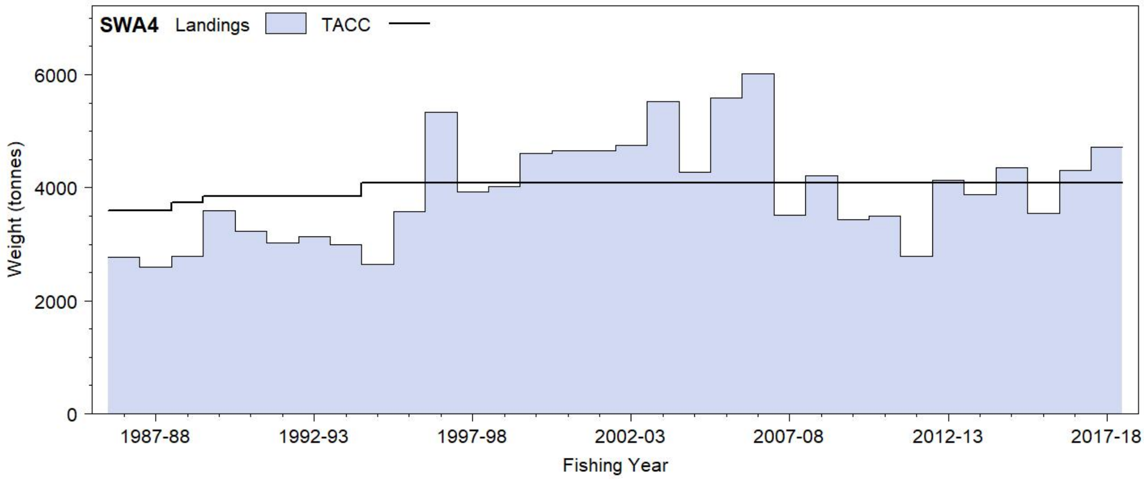


Figure 1 [Continued]: Reported commercial landings and TACCs for the three main SWA stocks. SWA 4 (South East Chatham Rise). Note that these figures do not show data prior to entry into the QMS.

1.2 Recreational fisheries
There are no current recreational fisheries for silver warehou.

1.3 Customary non-commercial fisheries
Quantitative information on the current level of customary non-commercial take is not available.

1.4 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.

1.5 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 is considered to be 23 years for females and 19 years for females. 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. Based on these results M is likely to fall within the range 0.2–0.3.

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.

Fishstock							Estimate	Source
1. Weight = a(length)^b (Weight in g, length in cm, total length).								
						Both sexes		
						a	b	Tangaroa Survey:
Chatham Rise						0.00848	3.214	January 1992–97
Southland						0.00473	3.380	February–March 1993–96
2. von Bertalanffy growth parameters								
	Female			Males				
	L_∞	k	t_0	L_∞	k	t_0		
All areas	54.5	0.33	-1.04	51.8	0.41	-0.71		Horn & Sutton (1995)

3. STOCKS AND AREAS

The stock structure is not well known.

Horn et al (2001) suggest four distinct spawning areas: off west coast South Island, southern South Island, eastern North Island, and on the Chatham Rise, with possible sub-areas of spawning within these. For example, Livingston (1988) inferred from voyage reports the time of spawning on the Chatham Islands was later (spring–summer) than that at the Mernoo Bank (winter–spring). The peak timing for spawning appears to be earliest on the WCSI (winter), then proceeding in a southeast direction, at the Mernoo Bank (winter-spring), Stewart-Snares Shelf, and around the Chatham Islands (spring–summer). 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 management areas bear little relation to known spawning areas and silver warehou distribution. Horn et al (2001) investigated growth rates, gonad staging information, and age structure with regard to stock structure, but found no evidence from these characteristics for separate reproductive units.

4. STOCK ASSESSMENT

An assessment of the silver warehou stock on the western Chatham Rise and east coast South Island was attempted in 2018. While the assessment was not accepted by the Deepwater Fisheries Assessment Working Group, biomass information derived from the assessment was considered adequate to provide sustainability advice on this stock. Further work is being done that may later support an assessment of the east coast South Island/western Chatham Rise stock. This assessment was based on the following stock structure assumption: there was a break in the spatial distribution of catches between the fishery on Chatham Rise and east coast South Island down to roughly 45.4 $^{\circ}$ south, and the Stewart-Snares shelf. The western Chatham Rise (west of 180°) down to the Otago Peninsula on the east coast of the South Island (see Figure 2) is assessed as one stock based on the timing and location of spawning, and the natural breaks in catch spatial distribution between it and neighbouring fisheries.

4.1 Estimates of fishery parameters and abundance

Bottom trawl surveys have been conducted since the early 1990s using either the *Tangaroa* (Chatham Rise survey, Sub-Antarctic survey, and three surveys of the WCSI). These surveys all encounter silver warehou, and the *Tangaroa* surveys on the WCSI are now optimised to estimate biomass for this species. However, for the other surveys the average CVs are high, and they have not been considered suitable for stock assessment or good monitoring tools for these stocks (Ministry of Fisheries 2008). They may, nonetheless, be useful in interpreting CPUE analysis.

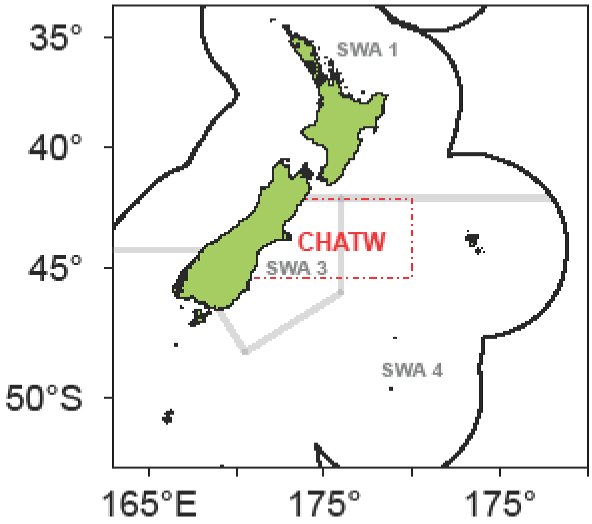


Figure 2: Map showing western Chatham Rise area (CHATW) in red and SWA 1, 3 and 4 boundaries (grey).

A biomass time series is available for the Chatham Rise East area (Chatham Rise survey). There is a *Kaharoa* survey for the ECSI that occurs over the area out to 400 m and catches both juvenile and adult silver warehou. The Chatham Rise survey overlaps considerably in area with the ECSI fishery. There is also a WCSI *Tangaroa* survey for years 2000, 2012, 2013, and 2017. The inshore WCSI *Kaharoa* survey has yet to be determined for its applicability.

Table 4: Biomass indices (t) and estimated coefficients of variation (CV).

Fishstock	Area	Vessel	Trip code	Date	Biomass	CV (%)
SWA 3&4	Chatham Rise	*Tangaroa*	TAN9106	Jan–Feb 1992	4 489	54
			TAN9212	Jan–Feb 1993	2 694	51
			TAN9401	Jan 1994	11 640	49
			TAN9501	Jan 1995	3 737	28
			TAN9601	Jan 1996	1 707	28
			TAN9701	Jan 1997	2 101	32
			TAN9801	Jan 1998	4 708	48
			TAN9901	Jan 1999	6 760	34
			TAN0001	Jan 2000	5 425	46
			TAN0101	Jan 2001	2 728	22
			TAN0201	Jan 2002	6 410	81
			TAN0301	Jan 2003	7 815	74
			TAN0401	Jan 2004	20 548	40
			TAN0501	Jan 2005	6 671	22
			TAN0601	Jan 2006	7 704	48
			TAN0701	Jan 2007	14 646	32
			TAN0801	Jan 2008	15 546	36
			TAN0901	Jan 2009	15 061	34
			TAN1001	Jan 2010	80 469	58
			TAN1101	Jan 2011	82 075	62
			TAN1201	Jan 2012	16 055	52
			TAN1301	Jan 2013	6 945	29
			TAN1401	Jan 2014	2 658	61
			TAN1601	Jan 2016	14 983	25
SWA 3	ECSI	Kaharoa	KAH9105	Winter 1991	29	21
			KAH9205	Winter 1992	32	22
			KAH9306	Winter 1993	256	44
			KAH9406	Winter 1994	35	28
			KAH9606	Winter 1996	231	32
			KAH0705	May-June 2007	445	44
			KAH0806	May-June 2008	319	32
			KAH0905	May-June 2009	446	42
			KAH1207	April-June 2012	438	46
			KAH1402	April-June 2014	626	83
			KAH1605	April-June 2016	428	53

Table 4 [continued]

Fishstock	Area	Vessel	Trip code	Date	Biomass	CV (%)
SWA 1	WCSI	*Tangaroa*	TAN0007	Aug 2000	1 507	25
			TAN1210	Aug 2012	617	32
			TAN1308	Aug 2013	313	23
			TAN1609	Aug 2016	VM	VM

Merged (stratified) and unmerged (tow-level) datasets were modelled separately to derive relative biomass indices based on CPUE data (McGregor, 2016). Positive catch models based on the lognormal distribution were applied to both datasets within each region and binomial/delta-lognormal models were developed for the unmerged datasets. Each record in the unmerged datasets represented a tow which allowed for the inclusion of fine scale spatial and temporal information, as well as other factors which may influence CPUE, such as tow distance or bottom depth. However, these tow-by-tow data are limited by the design of the forms used to collect these data, whereby only the top five species taken in the tow are required to be reported. Consequently some tows which may have captured SWA would not have had this information reported because the species did not qualify in the top five, leading to a “false zero” for the tow in question. This data omission at the tow level will bias the CPUE for the positive catch records but should be compensated when the delta-lognormal model is created by adding the catch success/failure model based on the binomial distribution.

Length and age data are collected during the course of trawl surveys and by the Observer Programme from commercial fishing vessels. A feature of these time series, especially with the Chatham Rise and ECSI surveys, is that the size distributions are extremely variable among years. The Chatham Rise survey sometimes completely lack the typical 50 cm size class, and often lacks the 25 or 35 cm modes even though the appropriate mode is present in the subsequent year. The variability is highest in the ECSI survey, which shows up to four distinct size modes, but usually only one or two simultaneously. Beentjes et al (2004) noted that variability in adult size classes captured in this survey is a common feature and considered it to be a result of either environmental influences on fish distribution, fish schooling by size, or the result of problems with gear performance (Beentjes et al 2004).

East Chatham Rise (part of SWA 4)

Trawl survey and CPUE indices

The Chatham Rise trawl survey index suggests an overall upward trend, although the 2010 and 2011 years are difficult to interpret given the very large CIs (Figure 3). Two further surveys have been completed since 2011.

Both the stratified and un-stratified CPUE series (Figure 3) showed a very slight increasing trend from 1998 to 2011. CPUE showed an increase in 2005 about the time when twin trawls were increasingly used. A large proportion of zeroes were found in the tow by tow unmerged data, which has a strong influence on the combined index. CPUE was not considered likely to be a good index here, but the slight increase matched the trend in the trawl survey data for Eastern Chatham Rise.

The tow-level CPUE and trawl survey biomass estimates have peaks in one where there are troughs in the other, but both suggest a slight overall upward trend.

Length and age data

The age and length frequency data may prove useful in interpreting trends in the trawl survey and CPUE relative abundance indices in the future.

Conclusions

The CPUE time series is currently not a useful relative abundance index for this area. The trawl surveys are not considered a good monitoring tool or useful for stock assessment for this area.

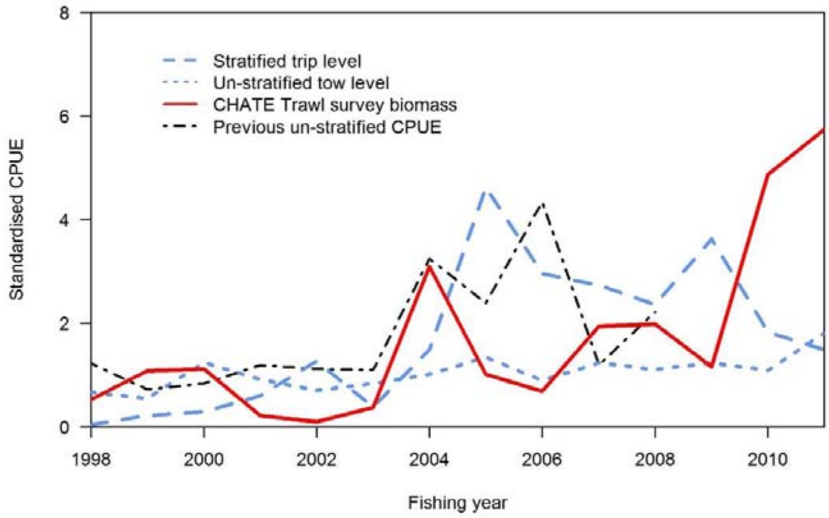


Figure 3. East Chatham Rise standardised CPUE (1998–2011) for merged (stratified, trip level) and unmerged (un-stratified, tow level) data; previous un-stratified CPUE (1998–2008) data; and biomass estimates from Chatham Rise East *Tangaroa* trawl surveys 1998–2011.

Western Chatham Rise (parts of SWA 3 and SWA 4)

Trawl survey and CPUE indices

The *Kaharoa* east coast South Island inshore surveys (Figure 4) suggest an upward trend, but estimates are highly uncertain. Biomass in the core strata (30–400 m) for the recent years (through 2012) is higher overall than in the 1990s by about two-fold. The hoki research survey strata on the West Chatham Rise showed a similar trend to the East Chatham Rise with higher abundance and high CVs in the last 2 years.

Both the stratified and un-stratified CPUE series (Figure 4) showed a slight increasing trend from 1998 to 2011. The fishery was bycatch of HOK and SQU fisheries before 2008 with increasing target SWA catches since. Twin trawls also appear to influence these indices as the CPUE jumps up in 2004.

The ECSI tow-level CPUE and ECSI trawl survey both show a similar upward trend, although the CPUE index does not match the sudden increase in the 2010 and 2011 trawl survey biomass estimates. The two series look a close match with the biomass estimates for 2010–2011 removed. The biomass estimates have higher year to year variability, but the general trend is similar.

The CPUE indices showed a general increase from the late-1990's through to 2017 except for an abrupt decrease when the deemed values were increased at the start of the 2008 fishing year (Figure 4). The CPUE indices have continued to increase and catches have remained high (McGregor et al in prep).

Length and age data

The *Kaharoa* trawl survey is monitoring pre-recruited cohorts, but not fish in the recruited size range. Plots of time series length frequency distributions consistently show the presence of the pre-recruited cohorts on nearly all surveys, with indications that these could be tracked through time (modal progression). Therefore, the age and length frequency data may prove useful in interpreting trends in the trawl survey and CPUE indices in the future.

Length data have been collected from the Observer Programme, and some tracking of length modes is possible (Figure 5), suggesting the passage of strong and weak year classes.

Otoliths collected by the Observer Programme were aged for fishing years 2000–01, 2004–05, 2009–10, 2012–13 and 2015–16 (Horn et al 2012, Horn & McGregor 2018), with 300 otolith pairs read for each of these years except 2004–05 which was slightly lower due to fewer samples collected in this year. The age compositions suggest strong year classes in 2005 and 1999 (McGregor et al in prep.).

Conclusions

McGregor (2016) showed that the East Coast South Island CPUE time series was the most promising as an index of abundance. The trawl surveys are not considered a good monitoring tool or useful for stock assessment for this area.

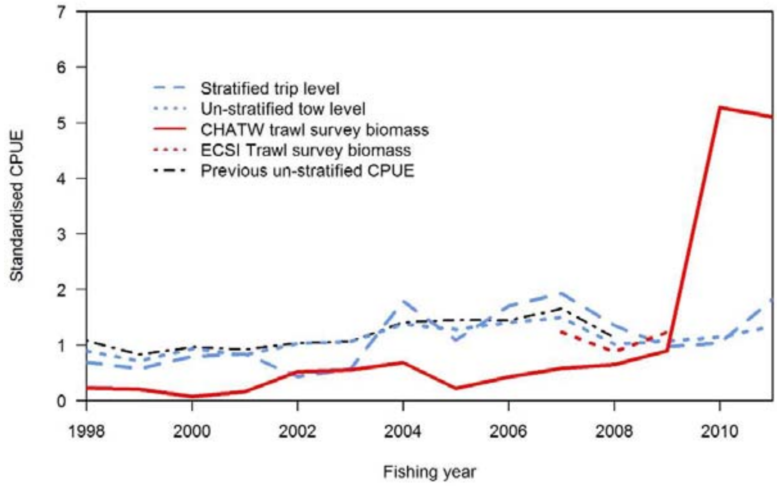


Figure 4. East Coast South Island standardised CPUE (1998–2011) for merged (stratified, trip level) and unmerged (un-stratified, tow level) data; previous un-stratified CPUE (1998–2008) data; and biomass estimates from Chatham Rise West *Tangaroa* (1998–2011) and East Coast South Island *Kaharoa* (2007–09) trawl surveys.

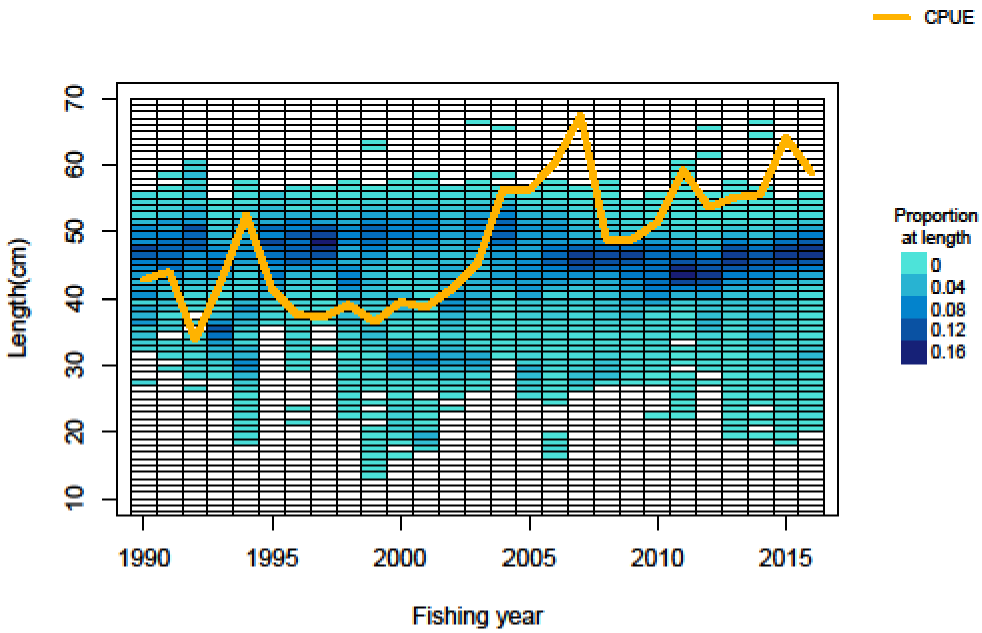


Figure 5. Western Chatham Rise standardised CPUE (1990–2016) unmerged (un-stratified, tow level) data (gold line); raw proportions at length from observer data from East Coast South Island/Western Chatham Rise (blue rectangles).

Southland (Sub-Antarctic) (part of SWA 4)

Trawl survey and CPUE indices

The Sub-Antarctic trawl survey index and CPUE indices (Figure 6) are generally flat, except that the increase in 2008 and 2009 in the trawl survey is not reflected in the CPUE indices.

Length and age data

The age and length frequency data may prove useful in interpreting trends in the trawl survey and CPUE relative abundance indices in the future. Length data from the Observer Programme show some tracking of length modes (Figure 7), and these may indicate strong and weak year classes.

Conclusions

The CPUE and trawl survey indices have remained flat while catches have remained high.

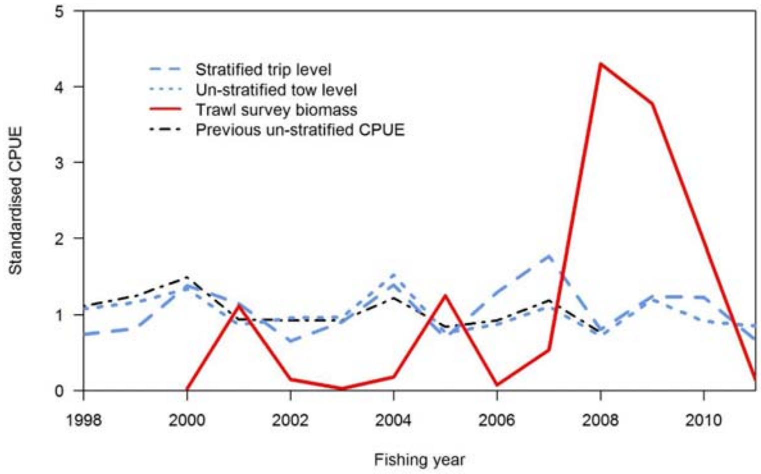


Figure 6. Southland standardised CPUE (1998–2011) for merged (stratified, trip level) and unmerged (un-stratified, tow level) data; previous un-stratified CPUE (1998–2008) data; and biomass estimates from Sub-Antarctic *Tangaroa* trawl surveys 2000–11.

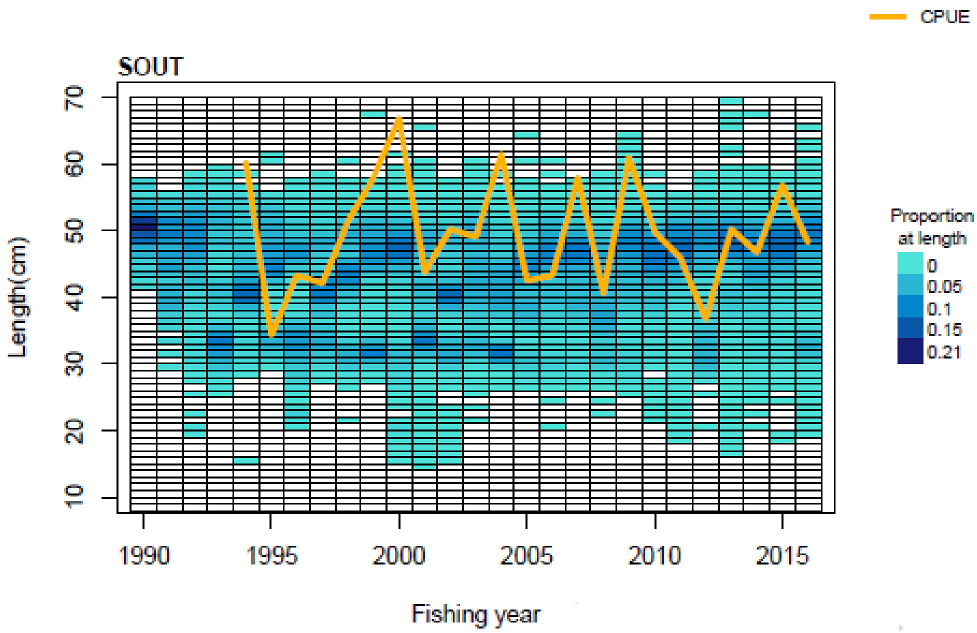


Figure 7. Sub-Antarctic standardised CPUE (1990-2016) unmerged (un-stratified, tow level) data (gold line); raw proportions at length from observer data from Sub-Antarctic (blue rectangles).

West coast South Island (part of SWA 1)

Trawl survey and CPUE indices

The WCSI *Kaharoa* survey includes the TBGB (Tasman Bay Golden Bay) area, which is a shallow area and dominated by juvenile SWA. When separated out, the TBGB index shows a downward trend (Figure 8) while the WCSI index with TBGB omitted is fairly flat, with highly variable CIs. There are also biomass estimates from the WCSI *Tangaroa* survey for 2000, 2012 and 2013. The biomass estimate for 2012 is more than double that for 2000.

Both the stratified and un-stratified CPUE series (Figure 8) showed a decreasing trend from 1998 to 2003 and have remained relatively flat since.

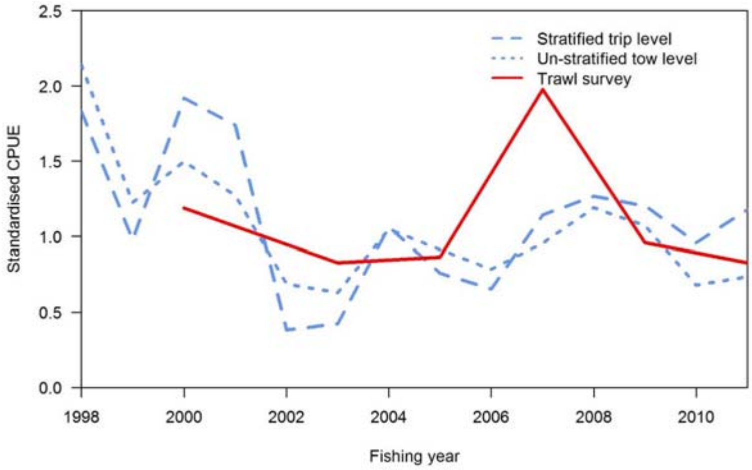


Figure 8. West Coast South Island standardised CPUE (1998–2011) for merged (stratified, trip level) and unmerged (un-stratified, tow level) data; and biomass estimates from Tasman Bay – Golden Bay *Kaharoa* trawl surveys 1998–2011.

A CPUE analysis for this stock was also conducted in 2009 (Cordue 2009) using selected observer catch and effort data for a core fleet of vessels for positive bottom and midwater trawl SWA catches in area FMA 7 for winter fishing within a WCSI box (40.2°S–43.3°S). The resulting index (Figure 9) is noisy but shows a general trend of slow CPUE decline from 1986 to 1992, a steep increase from 1992 to 1996 and high levels through to 2000, followed by a steep decline back to low levels by 2002 and a stable trend at slightly above historically lowest levels through 2008. This CPUE index was possibly consistent with strong year classes in 1993–94 and in 1997 (evident in the length frequency data), and resulting increased abundance over the ensuing few years. This CPUE standardisation might be indexing SWA 1 abundance and, given the substantial amount of catch-at-age data for this stock, it was recommended that a stock assessment should now be conducted to investigate the coherence between catch-at-age data and this abundance index.

The Working Group noted that this Fishstock sustained catches which averaged 2800 t/year from 1993–94 to 2000–01 without resulting in high Z estimates, but that this occurred over a period where CPUE indices indicate abundance of more than double current levels. A stock assessment is considered to be a more appropriate methodology to assess this Fishstock than relying on analyses of catch curve.

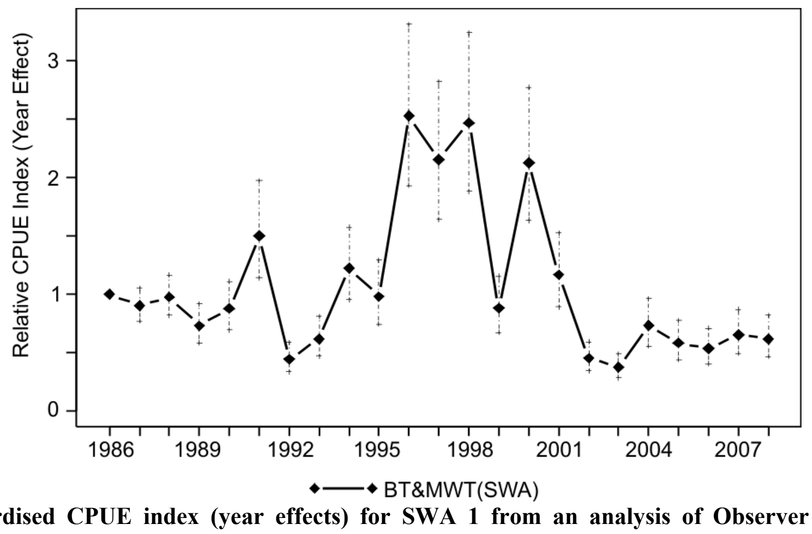


Figure 9. Standardised CPUE index (year effects) for SWA 1 from an analysis of Observer Programme trawl records (Cordue 2009).

Length and age data
The WCSI inshore trawl series typically has a dominant 20 cm mode and a smaller mode around 35 cm. 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 1992–2005 suggested that fishing mortality was lower than natural mortality (SeaFIC 2007**).** Observer length data may help interpret patterns in CPUE.

Conclusions
McGregor (2016) suggests that the West Coast South Island CPUE time series are more promising as indices of abundance. In addition, Observer length data may help interpret patterns in the CPUE. The inshore *Kaharoa* trawl surveys are not considered a good monitoring tool or useful for stock assessment for this area. The biomass estimates from the WCSI *Tangaroa* survey may prove useful for this stock once the time series is extended.

4.2 Yield estimates and projections
MCY cannot be determined. Problems with misreporting of warehou catches and the lack of consistent catch histories make *MCY* estimates based on catch data alone unreliable.

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

4.3 Other factors
The degree of interdependence between Fishstocks is unknown.

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.

The SWA 1 TACC was increased from 2132 t to 3000 t in October 2002 under the Adaptive Management Programme (AMP). A mid-term review of the SWA 1 AMP was carried out in 2009 (AMP WG/09/10, 11). This programme has been discontinued.

6. STATUS OF THE STOCKS

All stocks
There are no stock assessments available for any silver warehou stocks and the status of all stocks is unknown.

McGregor and Horn (in prep) showed that the biomass indices for the Western Chatham Rise stock had not declined and catch rates in recent years have increased. The total catches have also increased in recent years, and are around the TACC. Age composition data suggest that the increase in catch rates and catches was consistent with the recruitment of some relatively large year classes. The preliminary stock assessment analyses and biomass indices from CPUE and the trawl survey suggested that stock status has not declined at recent catch levels.

Yield estimates, TACCs and reported landings for the 2017–18 fishing year are summarised in Table 5.

Table 5: Summary of yields (t), TACCs (t), and reported landings (t) of silver warehou for the most recent fishing year.

Fishstock		FMA	*MCY*	2017–18 Actual TACC	2017–18 Reported landings
SWA 1	Auckland (East) (West), Central (East) (West), and Challenger	1, 2, 7, 8, & 9	-	3 000	543
SWA 3	South-East (Coast)	3	-	3 280	3 396
SWA 4	South-East (Chatham), Southland, and Sub-Antarctic	4, 5 & 6	-	4 090	4 714
SWA 10	Kermadec	10	-	10	0
Total			-	10 380	8 653

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