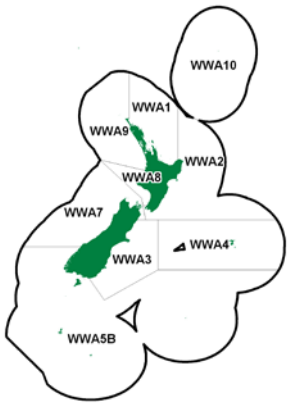
WHITE WAREHOU (WWA)

(Seriolella caerulea)
Warehou



1. FISHERY SUMMARY

1.1 Commercial fisheries

White warehou are predominantly taken as bycatch from target trawl fisheries on hoki and silver warehou, and to a lesser extent, hake, ling and scampi. White warehou are mostly caught in 150 to 800 m depth by larger vessels owned or chartered by New Zealand fishing companies.

Prior to the establishment of the EEZ on 1 March 1978, white warehou landings were combined with both silver and blue (or common) warehou as ‘warehous’. An estimate of total white warehou catches for 1970 to 1977 calendar years has been made (Table 1). From 1978–79 to 1982–83 annual catches of up to 900 t during the fishing year were reported, mainly from Southland and the Chatham Rise (Table 2).

Annual catches of white warehou have been variable (i.e., ranging from 315 t in the 1978–79 fishing year to 3694 t in 1996–97, Tables 2 and 3). White warehou entered the Quota Management System on 1 October 1998, with an initial Total Allowable Commercial Catch (TACC) of 3374 t. The TACCs for each QMA are given in Table 3. A nominal allowance of 1 t was made for both recreational and customary catch in each of WWA 2–7. TACCs were increased from 1 October 2006 in WWA 3 to 583 t, in WWA 4 to 330 t, and in WWA 7 to 127 t. In these stocks, landings were above the TACC for a number of years and the TACCs were increased to the average of the previous 7 years plus an additional 10%. Despite this change the catch in WWA 3 in 2006–07 was well above the new TACC, but has been under the TACC since 2007–08. From 1 October 2007, WWA 5 was merged with WWA 6 to create WWA 5B. TACCs have been under-caught in WWA 3, 4 and 5B in recent years, with only the WWA7 catch approaching the available quota. Landings from 2014–15 represented only 23% of the current TACC and was the lowest reported annual catch since the mid 1980s. Figure 1 shows the historical landings and TACC values for the main white warehou stocks.

White warehou are almost entirely caught from 300–700 m bottom trawls targeted on hoki, squid, ling and silver warehou (Ballara & Baird 2012), with a smaller amount by midwater trawl, and most catch is recorded on Trawl Catch Effort and Processing Returns. In 2013 and 2014, about 20% of the west coast South Island (WCSI) white warehou catch was reported on the TCER form (Ballara 2015). From 1990 to 2014, 52 238 t of white warehou catch was reported: 70% from the Sub-Antarctic area, 24% from off the east coast South Island (ECSI) and across the Chatham Rise, and 4% from the WCSI (Ballara 2015).

Target fishing on white warehou has been reported from around Mernoo Bank, the Stewart-Snares shelf, Puysegur Bank and on the west coast of the South Island, with the best catch rates recorded in the southern areas. Target fisheries accounted for only 8% of the total white warehou catch for the years from 1988–89 to 1994–95. In the Sub-Antarctic, 36% of catches are from target fishing,

although since 2003 this has been over 50% in most years; the remainder was primarily from tows targeting ling, hoki, and silver warehou (Ballara 2015). The greatest catches in this area are from waters off the Stewart-Snares shelf, near the Puysegur Bank, and off the Auckland Islands Shelf. About 63% of the catch from off the ECSI and the Chatham Rise was from hoki target tows, with only 1% from white warehou targeted tows (Ballara 2015). The highest catches were from the east coast statistical areas. There appeared to be no definite season for white warehou catches in those areas. Catches off the WCSI were from bottom and mid-water hoki and hake tows, and were restricted to the months in which those target fisheries operated (June–September).

Table 1: Estimated catch (t) of white warehou for years 1970 to 1977.

Vessel nationality	1970*	1971*	1972	1973	1974	1975	1976	1977
Japanese	17	25	222	447	234	1 453	1 558	334
Russian	NA	NA	1 300	1 200	1 480	40	440	1 260
Korean	-	-	-	-	-	-	-	400
Total	17	25	1 522	1 647	1 714	1 493	1 998	1 994

* Japanese data only.

Table 2: Reported landings (t) of white warehou by fishing year and area, by foreign licensed and joint venture vessels, 1978–79 to 1983–83. The EEZ areas correspond approximately to the QMAs as indicated. Fishing years are from 1 April to 31 March. The 1983–83 is a six month transitional period from 1 April to 30 September. No data are available for the 1980–81 fishing year.

EEZ area	B	C(M)	C(1)	D	E(B)	E(P)	E(C)	E(A)	F(E)	F(W)	G	H	
QMA area	1& 2		3	4				6		5	7	8 & 9	Total
1978–79	1	20	10	1	0	5	0	141	86	26	20	6	315
1979–80	2	8	5	230	57	5	4	312	34	97	42	0	795
1980–81	-	-	-	-	-	-	-	-	-	-	-	-	-
1981–82	0	41	2	53	0	2	5	153	27	248	10	1	542
1982–83	0	375	1	88	0	11	0	198	39	137	33	0	882
1983–83	0	167	5	49	0	0	0	12	9	34	24	0	300

Note: The EEZ area E(A) also included part of QMA 5, south of 48º30' S.

1.2 Recreational fisheries

The recreational take of white warehou is likely to be very small given its distribution and depth preferences.

1.3 Customary non-commercial fisheries

No quantitative information is available on the current level of customary non-commercial take.

1.4 Illegal catch

Silver warehou were reported as white warehou when the latter was a non QMS species. Compliance investigations in 1988 successfully proved that substantial quantities of silver warehou were reported as white warehou, but catch statistics were not altered as a result. The true extent of misreporting is unknown and thus the accuracy of annual catch records cannot be determined.

1.5 Other sources of mortality

No information is available on other sources of mortality.

Table 3: Reported landings (t) of white warehou by fishstock and fishing year, 1982–83 to 2015–16. The data in this table has been updated from that published in previous Plenary Reports by using the data through 1996–97 in table 44 on p. 296 of the "Review of Sustainability Measures and Other Management Controls for the 1998–99 Fishing Year - Final Advice Paper" dated 6 August 1998. Data since 1997–98 are based on catch and effort returns. There are no landings reported from QMA 10.

Fishstock	WWA 1		WWA 2		WWA 3		WWA 4		WWA 5(5B)*	
FMA	1		2		3		4		5 (&6)*	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1982–83	0	-	35	-	179	-	69	-	248	-
1983–84	0	-	28	-	111	-	33	-	282	-
1984–85	0	-	2	-	123	-	39	-	150	-
1985–86	0	-	5	-	589	-	61	-	277	-
1986–87	0	-	10	-	239	-	29	-	167	-
1987–88	< 1	-	9	-	431	-	26	-	113	-
1988–89	6	-	1	-	118	-	43	-	843	-
1989–90	1	-	9	-	484	-	16	-	555	-
1990–91	2	-	12	-	695	-	88	-	568	-
1991–92	6	-	22	-	589	-	113	-	833	-
1992–93	2	-	13	-	281	-	106	-	560	-
1993–94	6	-	34	-	197	-	23	-	1 235	-
1994–95	4	-	41	-	327	-	243	-	1 936	-
1995–96	2	-	68	-	566	-	137	-	1 555	-
1996–97	3	-	89	-	508	-	220	-	2 309	-
1997–98	2	-	31	-	516	-	153	-	1 217	-
1998–99	< 1	4	34	73	398	399	120	220	1 269	2 127
1999–00	< 1	4	48	73	559	399	277	220	1 112	2 127
2000–01	< 1	4	21	73	661	399	303	220	703	2 127
2001–02	0	4	8	73	446	399	262	220	921	2 127
2002–03	< 1	4	20	73	852	399	397	220	1 462	2 127
2003–04	< 1	4	47	73	458	399	365	220	1 141	2 127
2004–05	< 1	4	24	73	347	399	365	220	1 568	2 127
2005–06	< 1	4	35	73	589	399	312	220	1 176	2 127
2006–07	< 1	4	10	73	733	583	304	330	1 484	2 127
2007–08	< 1	4	43	73	345	583	207	330	*1 431	*2 617
2008–09	< 1	4	22	73	302	583	85	330	1 644	2 617
2009–10	< 1	4	7	73	355	583	179	330	1 106	2 617
2010–11	< 1	4	12	73	391	583	81	330	787	2 617
2011–12	< 1	4	3	73	204	583	112	330	978	2 617
2012–13	< 1	4	6	73	174	583	117	330	1 037	2 617
2013–14	< 1	4	8	73	302	583	110	330	1 373	2 617
2014–15	< 1	4	7	73	225	583	69	330	447	2 617
2015–16	<1	4	5	73	269	583	51	330	699	2 617

Fishstock	WWA 6		WWA 7		WWA 8		WWA 9			
FMA	6		7		8		9		Total	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1982–83	7	-	24	-	< 1	-	0	-	562	-
1983–84	24	-	29	-	< 1	-	0	-	510	-
1984–85	12	-	15	-	< 1	-	0	-	342	-
1985–86	43	-	81	-	< 1	-	0	-	1 058	-
1986–87	144	-	15	-	< 1	-	0	-	573	-
1987–88	20	-	28	-	< 1	-	0	-	629	-
1988–89	16	-	10	-	0	-	0	-	1 040	-
1989–90	291	-	83	-	0	-	0	-	1 438	-
1990–91	278	-	69	-	1	-	0	-	1 713	-
1991–92	1 028	-	45	-	0	-	0	-	2 636	-
1992–93	645	-	125	-	2	-	0	-	1 734	-
1993–94	592	-	69	-	0	-	0	-	2 156	-
1994–95	185	-	80	-	0	-	0	-	2 816	-
1995–96	50	-	62	-	0	-	0	-	2 440	-
1996–97	494	-	71	-	0	-	0	-	3 694	-
1997–98	126	-	98	-	< 1	-	< 1	-	2 155	-
1998–99	412	490	73	60	< 1	1	0	0	2 306	3 374
1999–00	211	490	153	60	< 1	1	0	0	2 351	3 374
2000–01	119	490	90	60	< 1	1	0	0	1 897	3 374
2001–02	219	490	85	60	< 1	1	< 1	0	1 941	3 374
2002–03	457	490	158	60	0	1	0	1	3 346	3 374
2003–04	211	490	135	60	0	1	0	1	2 357	3 374
2004–05	436	490	123	60	< 1	1	0	1	2 863	3 374
2005–06	250	490	133	60	0	1	0	1	2 495	3 374
2006–07	563	490	121	127	0	1	0	0	3 215	3 735
2007–08	N/A	N/A	90	127	0	1	< 1	0	2 116	3 735
2008–09	N/A	N/A	110	127	< 1	1	< 1	0	2 164	3 735
2009–10	N/A	N/A	44	127	< 1	1	0	0	1 691	3 735
2010–11	N/A	N/A	52	127	< 1	1	0	0	1 324	3 735
2011–12	N/A	N/A	77	127	< 1	1	< 1	0	1 375	3 735
2012–13	N/A	N/A	118	127	< 1	1	0	0	1 452	3 735
2013–14	N/A	N/A	115	127	< 1	1	< 1	0	1 908	3 735
2014–15	N/A	N/A	98	127	0	1	0	0	846	3 735
2015–16	N/A	N/A	44	127	0	1	<1	0	817	3 735

* In 2007–08 WWA 5 was merged with WWA 6 to create WWA 5B. The landings and TACC for WWA 5B are presented after 2007–08 in the WWA 5(5B)* column.

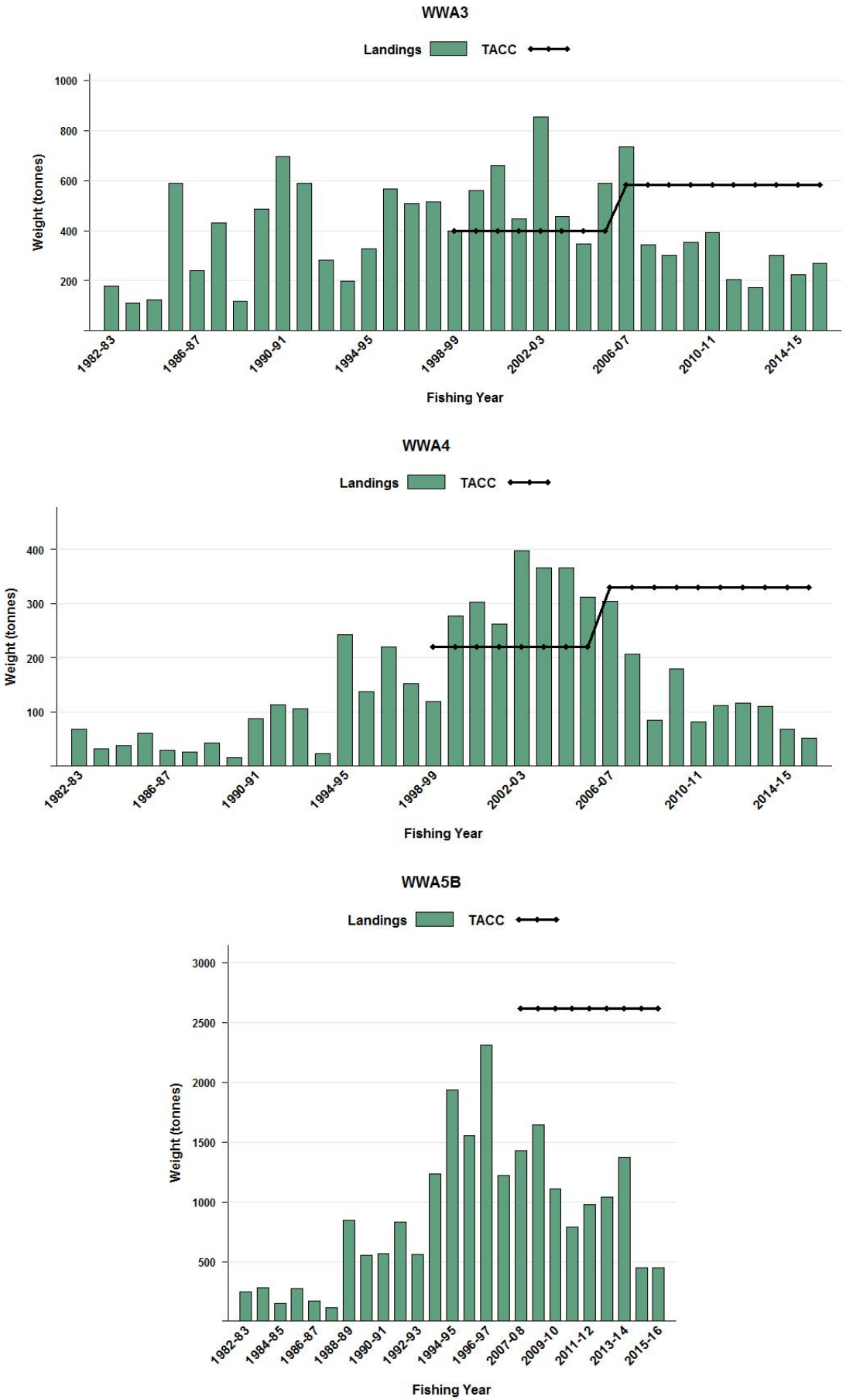


Figure 1 Reported commercial landings and TACC for the four main WWA stocks. WWA 3 (South East Coast), WWA 4 (South East Chatham Rise), WWA 5B* (Southland, Sub-Antarctic) [Continued on next page].

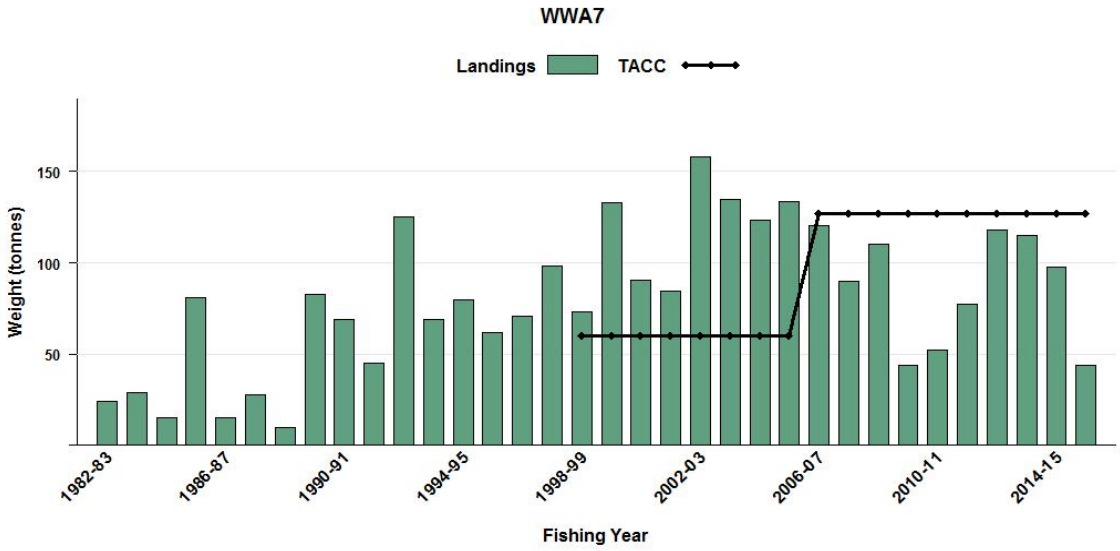


Figure 1 [Continued]: Reported commercial landings and TACC for the four main WWA stocks. WWA 7 (Challenger).

2. BIOLOGY

Adult white warehou range between 40 and 60 cm fork length (FL) and reach a maximum length and weight of 67 cm and 5.7 kg respectively. White warehou were aged by Gavrilov (1979) who gives the maximum age as 12 years, but this was likely to be an underestimate because he read whole otoliths and scales (Horn & Sutton 1996). Ageing of white warehou was partially validated by Horn (1999, 2001), based on a dataset of otoliths, covering all months of the year, collected during 1992–98 from the Chatham Rise and Sub-Antarctic Growth of females is significantly faster than that of males and thus females are significantly larger at age than males (Horn 2001). Females also attain larger maximum size than males. Fish grow rapidly until they spawn (at about 3 or 4 years), and growth is much slower after 6–8 years (Horn 2001).

Instantaneous natural mortality (*M*) was estimated (sing several methods) to be between 0.20 and 0.28, and to be higher for males relative to females (Horn 1999). The Working Group considered the data inadequate for establishing a difference in M by sex and recommended the use 0.25 for both sexes in any stock assessment modelling with sensitivity tests of plus or minus 0.05.

Ripe and running ripe fish have been recorded from the ECNI, Chatham Rise, WCSI, off Puysegur, and in the Sub-Antarctic, especially off the Stewart-Snares shelf. Most ripe and running ripe females were seen in waters off the WCSI in July–October, in the Sub-Antarctic (off Puysegur and between the Stewart-Snares shelf and the Auckland Islands Shelf) in March–December, and the western Chatham Rise from May–October) (Ballara 2015). These data suggest that the spawning season may extend from winter to late spring, or that there are multiple stocks with differences in the timing of their spawning seasons.

Sex ratio data derived from scaled length frequencies appear to show a slight bias towards males. On the Chatham Rise sex ratios vary from 1.0 : 1 to 1.4 : 1 (males to females). In the southern area, ratios vary from 0.7 : 1 to 4.2 : 1, but sample sizes at either extreme of the range are very small. There are insufficient data to enable detection of any changes in sex ratio with season.

Feeding records from the MPI research database *trawl* show salps as the predominant prey item observed in white warehou stomachs. Gavrilov & Markina (1979) noted salps (*Iasis*) and the tunicate *Pyrosoma* as major food items. Horn et al. (2011) found that the diet on the Chatham Rise was dominated by pelagic tunicates (mainly *Iasis* and *Salpa* species), with the remainder comprising mostly small crustaceans (amphipods, copepods, and euphausiids). An unknown but small component of the crustacean prey was ingested unintentionally owing to a common commensal relationship between some crustaceans (primarily amphipods) and tunicates.

Table 4: Estimates of biological parameters of white warehou.

Fishstock	Estimate						Source
1. Weight = a(length)^b (Weight in g, length in cm, total length).							
	Female		Male		Both sexes		
	a	b	a	b	a	b	
Chatham Rise	0.0177	3.069	0.0247	2.981	0.0200	3.037	Horn (1999)
Sub-Antarctic	0.0106	3.197	0.0138	3.132	0.0111	3.188	Horn (1999)

	2. von Bertalanffy growth parameters (4-parameter curve)								
	Female				Males				
	L_∞	k	t_0	P	L_∞	k	t_0	P	
Chatham Rise	61.0	0.131	0.14	0.350	57.1	0.153	0.19	0.328	Horn (2001)
Sub-Antarctic	70.2	.058	0.22	0.281	62.4	0.098	0.14	0.297	Horn (2001)

3. STOCKS AND AREAS

The existence of three possible spawning areas for white warehou (Mernoo Bank, Puysegur Bank and the west coast of the South Island) at the same time of year, suggests the possibility of three separate stocks. Bagley & Hurst (1997) proposed the following Fishstock areas: WWA 1 (QMAs 1, 2, 3 and 4), WWA 5 (QMAs 5 and 6) and WWA 7 (QMAs 7, 8 and 9) for white warehou. However, TACs were set for each QMA (1–9) in 1998 and each Fishstock is managed separately (note WWA 5 and WWA 6 were merged to form Fishstock WWA 5B in 2007-08).

4. STOCK ASSESSMENT

No assessments are available for any stocks for white warehou, therefore estimates of biomass and yield are not available.

4.1 Estimates of fishery parameters and abundance

CPUE analyses were carried out for Chatham Rise and Sub-Antarctic fisheries (Ballara 2015). The Chatham Rise stock showed increased CPUE from 1994 to 2006, but flatter since then (Table 5). The pattern did not match the trawl survey but neither series indicates a problem with WWA abundance in this area. The Sub-Antarctic fishery showed an initial decline to 1997 but was very flat since then (Table 5). There is little data available for the WCSI fishery with low catches and many years with less than 100 records. There are quite strong impacts of varying vessels and target species and the WG queried the reliability of the CPUE as abundance indicators.

4.2 Biomass estimates

Several time series of relative abundance estimates are available from trawl surveys, but these estimates may not be reliable indicators of relative abundance because of large fluctuations between years and moderate to high CVs. The larger biomass estimates are generally associated with moderate to high CVs (i.e., over 40%), having resulted from one or two large catches. Smaller biomass estimates have lower CVs, but this could be because the survey missed the main white warehou schools.

The Chatham Rise trawl surveys show an increase in biomass up until 2004, then a decrease to 2010 and flat since then (Table 6, Figure 2). Although the CVs are quite high, the period of increased abundance coincided with stronger recruitment of small fish to the shallow strata in 2001 and 2002 and to the deeper strata in 2004. The length data from the surveys showed the progression of a mode from 30 cm in 2001 to 45 cm in 2004. The survey time series may be an adequate monitoring tool, despite the high CVs.

Table 5: Chatham Rise and Sub-Antarctic TCEPR tow-by-tow lognormal CPUE indices by fishing year, where 1993–94 is 1994.

Year	Chatham Rise	Sub-Antarctic
1992	-	1.73
1993	-	1.26
1994	0.67	2.00
1995	0.79	2.57
1996	0.71	2.69
1997	0.75	1.03
1998	0.75	0.80
1999	0.73	1.24
2000	0.82	0.93
2001	0.95	0.79
2002	0.87	0.67
2003	1.23	0.75
2004	1.34	0.75
2005	1.14	0.82
2006	1.45	0.87
2007	1.39	0.94
2008	1.10	0.93
2009	1.04	0.78
2010	1.22	0.79
2011	1.11	0.71
2012	1.16	0.63
2013	1.15	0.80
2014	1.20	0.83

The Sub-Antarctic summer time series does not appear useful to monitor abundance. Length modes do not follow the series and CVS are high from occasional large catches. More stations in the area of white warehou abundance could possibly increase the utility of the survey. Autumn, spring, and the Southland surveys also do not appear to be useful, and the fish appear to remain in the southern area all year. Biomass estimates from the Chatham Rise survey are much higher than for the Sub-Antarctic survey, although catches are much lower.

There were two recent surveys on the WCSI but these covered only the northern area. It appears that much of the WWA biomass is further down the WCSI so these surveys may not be able to monitor the stock abundance in WWA 7.

Table 6: Biomass indices (t) for white warehou from *Tangaroa* trawl surveys.

Year	Sub-Antarctic Summer (Nov–Dec)	Sub-Antarctic Autumn	Sub-Antarctic Spring	Southland	Chatham Rise Summer (Jan)	WCSI Winter
1991	1 605	-	-	-	-	-
1992	243	256	350	-	2 227	-
1993	293	907	-	18	2 939	-
1994	-	-	-	46	1 606	-
1995	-	-	-	2	734	-
1996	-	239	-	102	533	-
1997	-	-	-	-	2 287	-
1998	-	2 887	-	-	1 009	-
1999	-	-	-	-	3 136	-
2000	266	-	-	-	2 385	-
2001	2 433	-	-	-	4 262	12
2002	853	-	-	-	6 881	-
2003	709	-	-	-	3 685	-
2004	1 061	-	-	-	7 932	-
2005	538	-	-	-	4 542	-
2006	646	-	-	-	2 929	-
2007	1 707	-	-	-	2 853	-
2008	2 283	-	-	-	1 899	-
2009	2 093	-	-	-	3 667	-
2010	-	-	-	-	983	-
2011	390	-	-	-	1 861	-
2012	1 259	-	-	-	1 925	65
2013	-	-	-	-	2 030	26
2014	211	-	-	-	1 299	-

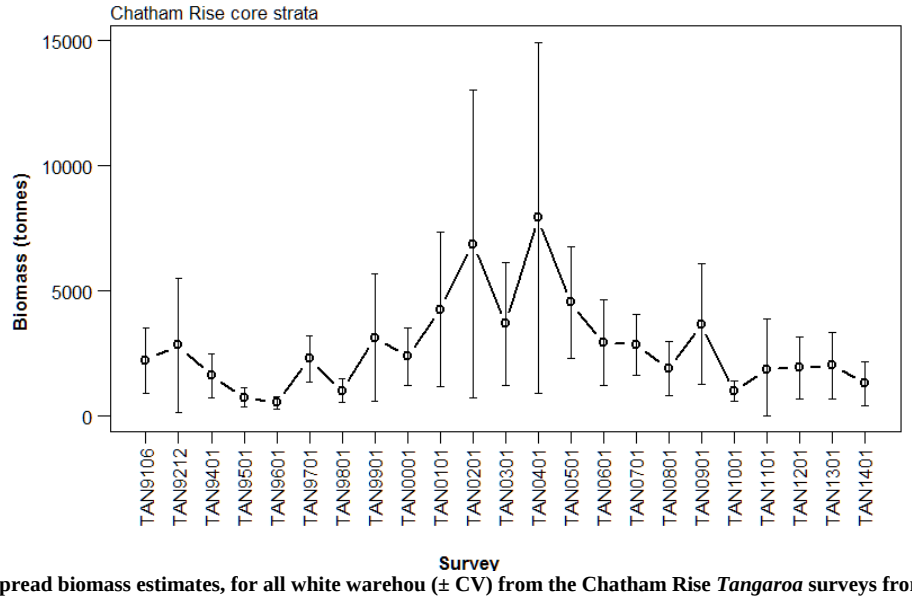


Figure 2: Doorspread biomass estimates, for all white warehou (± CV) from the Chatham Rise *Tangaroa* surveys from 1991 to 2014.

4.3 Yield estimates and projections

MCY cannot be determined. Problems with mis-reporting of silver warehou as white warehou and the lack of consistent catch histories make *MCY* estimates based on catch data alone unreliable. Also the amount of effort on white warehou relates very closely to effort on other target species such as hoki and silver warehou. Large fluctuations in the availability of white warehou to the trawl, as indicated by trawl surveys, are also likely to apply to commercial fishing operations. Estimates of *M* need to be determined.

CAY cannot be estimated because of the lack of current biomass estimates.

4.4 Other factors

None

5. STATUS OF THE STOCKS

It is not known whether recent catches are sustainable or if they are at levels that will allow the stock to move towards a size that will support the maximum sustainable yield.

TACCs were increased from 1 October 2006 in WWA 3 to 583 t, in WWA 4 to 330 t, and in WWA 7 to 127 t. In these stocks landings were above the TACC for a number of years and the TACCs have been increased to the average of the previous 7 years plus an additional 10%.

TACCs and reported landings for the 2013–14 fishing year are summarised in Table 7.

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

Fishstock		FMA	2015–16 Actual TACC	2015–16 Reported landings
WWA 1	Auckland (East)	1	4	< 1
WWA 2	Central (East)	2	73	5
WWA 3	South-east (Coast)	3	583	269
WWA 4	South-east (Chatham)	4	330	51
WWA 5B	Southland, Sub-Antarctic	5 & 6	2 617	699
WWA 7	Challenger	7	127	44
WWA 8	Central (West)	8	1	0
WWA 9	Auckland (West)	9	0	<1
WWA 10	Kermadec	10	0	0
Total			3 735	817

6. FOR FURTHER INFORMATION

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