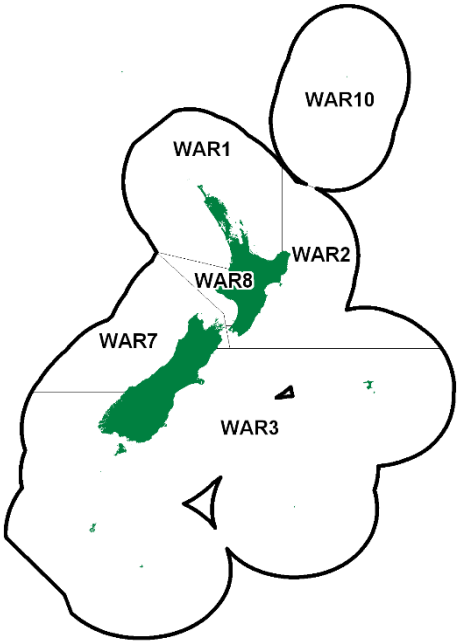
BLUE WAREHOU (WAR)

(Seriolella brama)
Warehou



1. FISHERY SUMMARY

Blue warehou was introduced into the Quota Management System (QMS) on 1 October 1986. Current allowances, TACCs and TACs are shown in Table 1.

Table 1: Recreational and Customary non-commercial allowances, TACCs and TACs for blue warehou by Fishstock.

Fishstock	Recreational Allowance	Customary non-commercial allowance	Other sources of mortality	TACC	TAC
WAR 1				41	
WAR 2				578	
WAR 3				2531	
WAR 7				1120	
WAR 8				233	
WAR 10				10	

1.1 Commercial fisheries

Blue (or common) warehou are caught in coastal waters of the South Island and lower North Island down to depths of about 400 m. Annual landings were generally less than 100 t up to the early 1960s, increased to about 1000 t by the early 1970s, and peaked at 4387 t in 1983–84 before declining steadily through to 1988–89 (Table 2). Figure 1 shows the historical landings and TACC values for the main WAR stocks.

The decline was most notable in WAR 3, from which most of the catch is recorded. A TACC reduction for WAR 3, from 3357 to 2528 t, was approved for the 1990–91 fishing year. In 1990–91, total catch increased substantially. The largest increase was in WAR 3 and catches in this area exceeded 2000 t for the following three years. There is no direct correlation between WAR 3 catches and fluctuations in effort in the Snares squid fishery where blue warehou is mostly taken as bycatch. In 1996–97, total catch increased again to 1990–91 levels and total catch has been maintained at this level since. Increased catches in WAR 2, 3 and 7 contributed to the increased total catch.

Until the mid 1980s, the main domestic fishing method used to catch blue warehou was gill-netting. The majority of the landings are now taken as a bycatch from trawling. Bull & Kendrick (2006) describe the commercial fishery from 1989–90 to 2002–03.

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

Fishstock		WAR 1		WAR 2		WAR 3		WAR 7
FMA		1 & 9		2		3, 4, 5 & 6		7
	Landings	TACC	Landings	TACC	Landings	TACC	Landings‡	TACC
1983–84*	13	-	346	-	3 222	-	702	-
1984–85*	5	-	278	-	1 313	-	478	-
1985–86*	15	-	185	-	1 584	-	955	-
1986–87	7	30	190	480	1 330	3 210	780	910
1987–88	7	41	204	560	976	3 223	685	962
1988–89	12	41	177	563	672	3 348	561	969
1989–90	17	41	201	570	814	3 357	607	1 047
1990–91	14	41	250	570	2 097	2 528	758	1 117
1991–92	25	41	235	570	2 514	2 528	1 001	1 117
1992–93	15	41	199	578	2 310	2 530	539	1 120
1993–94	16	41	233	578	688	2 530	436	1 120
1994–95	15	41	203	578	1 274	2 530	468	1 120
1995–96	32	41	368	578	1 573	2 530	756	1 120
1996–97	24	41	563	578	1 814	2 531	1 428	1 120
1997–98	20	41	402	578	2 328	2 531	860	1 120
1998–99	15	41	503	578	1 978	2 531	1 075	1 120
1999–00	9	41	422	578	2 761	2 531	1 147	1 120
2000–01	12	41	388	578	1 620	2 531	1 572	1 120
2001–02	7	41	294	578	1 614	2 531	1 046	1 120
2002–03	5	41	429	578	3 514	2 531	961	1 120
2003–04	6	41	392	578	3 539	2 531	755	1 120
2004–05	6	41	402	578	2 963	2 531	756	1 120
2005–06	4	41	293	578	3 505	2 531	691	1 120
2006–07	4	41	235	578	3 326	2 531	823	1 120
2007–08	7	41	198	578	684	2 531	569	1 120
2008–09	9	41	210	578	2 021	2 531	733	1 120
2009–10	6	41	204	578	2 601	2 531	414	1 120
2010–11	11	41	102	578	2 086	2 531	633	1 120
2011–12	13	41	131	578	2 425	2 531	714	1 120
2012–13	8	41	172	578	1 847	2 531	632	1 120
2013–14	17	41	153	578	1 819	2 531	551	1 120
2014–15	24	41	123	578	2 674	2 531	823	1 120
2015–16	5	41	167	578	1 861	2 531	764	1 120
2016–17	14	41	143	578	2 357	2 531	875	1 120
2017–18	13	41	88	578	1 468	2 531	772	1 120
2018–19	7	41	45	578	2 063	2 531	763	1 120
2019–20	3	41	55	578	1 971	2 531	639	1 120
2020–21	3	41	35	578	1 374	2 531	601	1 120
2021–22	2	41	40	578	1 651	2 531	453	1 120

Fishstock		WAR 8		WAR 10		
FMA		8		10		Total
	Landings	TACC	Landings	TACC	Landings	TACC
1983–84*	104	-	0	-	4 387	-
1984–85*	91	-	0	-	2 165	-
1985–86*	43	-	0	-	2 782	-
1986–87	40	210	0	10	2 347	4 850
1987–88	43	218	0	10	1 915	5 014
1988–89	44	231	0	10	1 466	5 162
1989–90	57	233	0	10	1 696	5 459
1990–91	113	233	0	10	3 232	4 499
1991–92	132	233	<1	10	3 905	4 499
1992–93	152	233	<1	10	3 215	4 512
1993–94	126	233	0	10	1 500	4 512
1994–95	114	233	0	10	2 074	4 512
1995–96	186	233	0	10	2 913	4 512
1996–97	161	233	0	10	3 990	4 513
1997–98	111	233	0	10	3 720	4 513
1998–99	168	233	0	10	3 739	4 513
1999–00	116	233	0	10	4 455	4 513
2000–01	143	233	0	10	3 735	4 513
2001–02	146	233	0	10	3 107	4 513
2002–03	192	233	0	10	5 101	4 513
2003–04	129	233	0	10	4 821	4 513
2004–05	157	233	0	10	4 284	4 513
2005–06	76	233	0	10	4 569	4 513
2006–07	59	233	0	10	4 448	4 513
2007–08	72	233	0	10	1 530	4 513
2008–09	146	233	0	10	3 119	4 513
2009–10	159	233	0	10	3 384	4 513
2010–11	92	233	0	10	2 924	4 512

Table 2 [Continued]:

Fishstock		WAR 8		WAR 10		
FMA		8		10		Total
	Landings	TACC	Landings	TACC	Landings	TACC
2011–12	97	233	0	10	3 381	4 512
2012–13	111	233	0	10	2 770	4 512
2013–14	161	233	0	10	2 701	4 512
2014–15	69	233	0	10	3 713	4 512
2015–16	95	233	0	10	2 891	4 512
2016–17	59	233	0	10	3 448	4 512
2017–18	134	233	0	10	2 476	4 512
2018–19	50	233	0	10	2 929	4 512
2019–20	71	233	0	10	2 738	4 512
2020–21	28	233	0	10	2 041	4 512
2021–22	45	233	0	10	2 191	4 512

* FSU data.
‡ Includes landings from unknown areas before 1986–87.

Catches have fluctuated in most stocks but overall the total landings have increased. In 2002–03, total reported landings of blue warehou were the highest on record, with catches in WAR 3 exceeding the TACC by 983 t. From 2002–03 to 2006–07 catches in WAR 3 were well above the TACC 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 $0.90 per kg for WAR 3 and WAR 7 stocks and differential rates were also introduced. The differential rate applied to all catch over 110% of ACE holding at which point the deemed value rate increased to $2 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 TACC in WAR 3. Landings subsequently increased again and exceeded the TACC slightly in 2009-10 and 2014-15. In all other areas landings are below the TACCs.

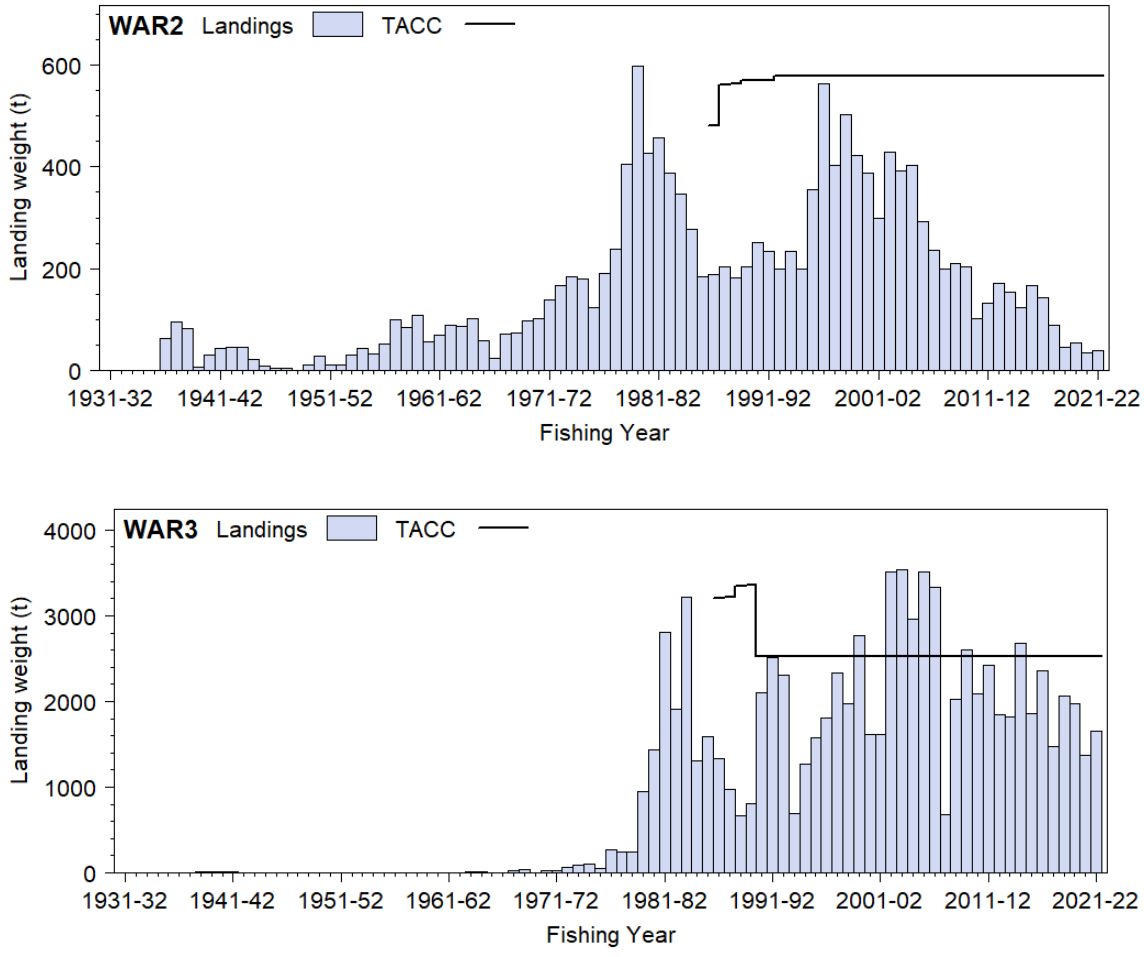


Figure 1: Reported commercial landings and TACC for the four main WAR stocks. WAR 2 (Central East) and WAR 3 (South East Coast). [Continued on next page]

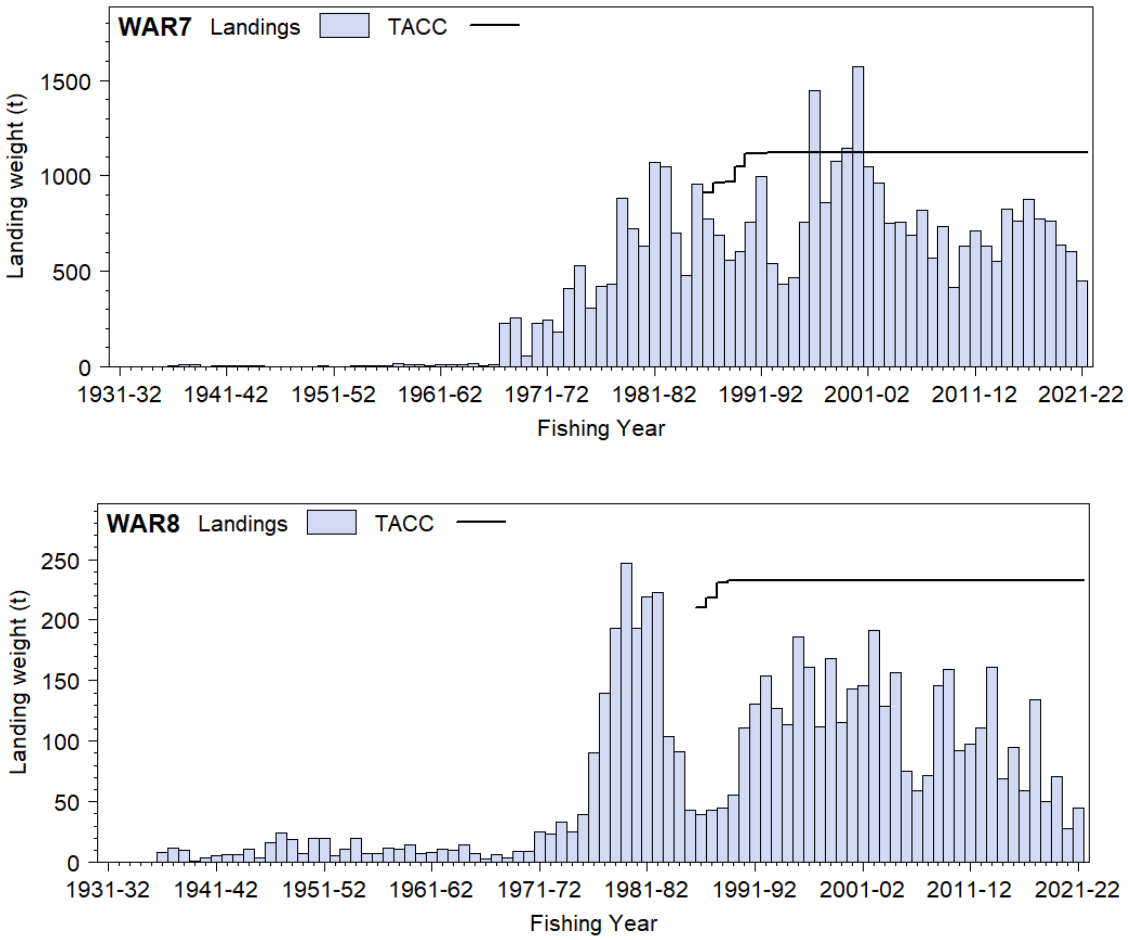


Figure 1 [Continued]: Reported commercial landings and TACC for the four main WAR stocks. WAR 7 (Challenger) and WAR 8 (Central Egmont).

1.2 Recreational fisheries

Estimates of recreational catch in the MAF Fisheries Central and South regions are shown in Table 3. Surveys in the North region in 1993–94 indicated that blue warehou were not caught in substantial quantities.

Table 3: Estimated harvest (t) of blue warehou by recreational fishers. Surveys were carried out in the MAF Fisheries Southern region in 1991–92 and in the Central region in 1992–93.

Fishstock	Survey	Estimated harvest	CV
1991–92			
WAR 3	Southern	10–20	-
1992–93			
WAR 2	Central	10.0	0.62
WAR 7	Central	1.7	0.65
WAR 8	Central	0.6	1.02

Blue warehou harvest estimates from the 1996 national survey were; WAR 2, 7000 fish; WAR 3, 3000 fish and WAR 7, 1000 fish. There are locally important fisheries which will not have been adequately sampled by these surveys.

The harvest estimates provided by telephone-diary surveys between 1993 and 2001 are no longer considered reliable for various reasons. A Recreational Technical Working Group concluded that these harvest estimates should be used only with the following qualifications: a) they may be very inaccurate; b) the 1996 and earlier surveys contain a methodological error; and c) the 2000 and 2001 estimates are implausibly high for many important fisheries. In response to these problems and the cost and scale challenges associated with onsite methods, a National Panel Survey was conducted for the first time

throughout the 2011–12 fishing year. The panel survey used face-to-face interviews of a random sample of 30 390 New Zealand households to recruit a panel of fishers and non-fishers for a full year. The panel members were contacted regularly about their fishing activities and harvest information collected in standardised phone interviews. The national panel survey was repeated during the 2017–18 fishing year using very similar methods to produce directly comparable results (Wynne-Jones et al 2019). Recreational catch estimates from the two national panel surveys are given in Table 4 in numbers of fish (insufficient data are available to convert these numbers to catch weight). Note that national panel survey estimates do not include recreational harvest taken under s111 general approvals.

Table 4: Recreational harvest estimates for blue warehou stocks (Wynne-Jones et al 2014, 2019). Insufficient data on fish weights were obtained from boat ramp surveys to convert numbers caught to tonnes.

Stock	Year	Method	Number of fish	Total weight (t)	CV
WAR 2	2011–12	Panel survey	1 485	-	-
	2017–18	Panel survey	265	-	1.00
WAR 3	2011–12	Panel survey	483	-	-
	2017–18	Panel survey	206	-	1.00
WAR 8	2011–12	Panel survey	0	-	-
	2017–18	Panel survey	568	-	0.72

1.3 Customary non-commercial fisheries

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

1.4 Illegal catch

No quantitative information is available on the level of illegal catch.

1.5 Other sources of mortality

No information is available on other sources of mortality.

2. BIOLOGY

Blue warehou average 40–60 cm fork length (FL) and reach a maximum of about 75 cm. Validated ageing of blue warehou shows rapid growth up to the time of first spawning (about 4–5 years), but negligible growth after about 10 years. Female blue warehou grow significantly faster and reach a larger size than males. Maximum recorded ages are 22 years for males, and 21 years for females. The best estimate of M is now considered to be 0.24 (Bagley et al 1998).

Blue warehou feed on a wide variety of prey, mainly salps but also euphausiids, krill, crabs and small squid.

Known spawning areas include the west coast of the South Island (in August–September), Kaikoura (in March, April, May), Southland (in November), and Hawke Bay (in September). Eggs are found in the surface plankton and juvenile fish are believed to occur in inshore areas.

Biological parameters relevant to the stock assessment are shown in Table 5.

Table 5: Estimates of biological parameters for blue warehou.

Fishstock	Estimate	Source
1. Natural mortality (M)		
WAR 3	0.24	Bagley et al (1998)

2. Weight = a(length)^b (Weight in g, length in cm total length).

	Females		Males		
	a	b	a	b	
WAR 3	0.016	3.07	0.015	3.09	Bagley et al (1998)

3. Von Bertalanffy growth parameters

	Females			Males			
	$L_{¥}$	k	t_0	$L_{¥}$	k	t_0	
WAR 3	66.3	0.209	-0.79	63.8	0.241	-0.46	Bagley et al (1998)
	Both Sexes						
WAR 1, 2, 7, 8 (part)	65.5	0.169	-1.35				Jones (1994)
WAR 8 (New Plymouth)	57.7	0.314	0.02				Jones (1994)

The seasonal pattern of landings suggest that there is a coastal migration of blue warehou. There is a winter/spring fishery for blue warehou at New Plymouth and north Wairarapa, a summer fishery with a small autumn peak at Wellington and a summer/autumn fishery along the east coast South Island. The west coast South Island has a fishery in August/September which picks up again in summer. There is a summer fishery in Tasman Bay.

3. STOCKS AND AREAS

No definite stock boundaries are known; however, Bagley et al (1998), after considering known spawning grounds and seasonal fishing patterns, suggested that there may be four stocks:

i. A southern population, mainly off Southland but perhaps extending into the Canterbury Bight. The main spawning time is November in inshore waters east and west of Stewart Island.
ii. A central eastern population, located on the northeast coast of the South Island and south east coast of the North Island (including Wellington), spawning mainly in the northern area in winter/early spring and also in autumn off Kaikoura.
iii. A south western population which spawns on the west coast of the South Island in winter.
iv. A north western population which may spawn off New Plymouth in winter/spring.

The proposed stock structure is tentative and there may be overlap between stocks. The available age and length frequency data are insufficient to compare by area and tagging studies have been minimal (about 150 fish tagged) with no returns.

For modelling WAR 3, the area on the east coast of the South Island south of Banks Peninsula including Southland was assumed to be a single stock. Movement between the west coast of the South Island and Southland is possible but there was no evidence for this from Southland seasonal trawl surveys. Also, the existence of two spawning periods, from August to September off the west coast of the South Island and from November to December in Southland, suggests two separate stocks.

4. STOCK ASSESSMENT

4.1 Estimation of fishery parameters and abundance

Biomass estimates are available from a number of early trawl surveys (Table 6) but the CVs are rather high for the *Shinkai Maru* data. From the age data from the *Tangaroa* Southland trawl surveys (1993–96) it appears that these surveys did not sample the population consistently, as apparently strong year classes did not follow through the time series of surveys.

Table 6: Trawl survey biomass indices (t) and coefficients of variation (CV) for recruited blue warehou.

Fishstock	Area	Vessel	Trip code	Date	Biomass (*t*)	CV (%)
WAR 3	Southland	*Shinkai Maru*	SHI8101	Jan–Mar 81	2 100	43
			SHI8201	Mar–May 82	800	62
			SHI8302	Apr–83	4 700	72
			SHI8601	Jun–86	2 000	59
WAR 3	Southland	*Tangaroa*	TAN9301	Feb–Mar 93	2 297	36
			TAN9402	Feb–Mar 94	1 629	38
			TAN9502	Feb–Mar 95	1 103	38
			TAN9604	Feb–Mar 96	1 615	40

4.2 Biomass estimates

Estimates of current and reference biomass are not available for any blue warehou Fishstocks.

4.3 Yield estimates and projections

MCY was estimated using the equation $MCY = cY_{AV}$ (Method 4) for all stocks. The value of c was set equal to 0.8 based on the revised estimate of $M = 0.24$ from the validated ageing work completed in 1997.

Auckland, Central (East) (WAR 1 and 2)
Average landings into Wellington over the period 1977 to 1983 were relatively stable at 300 t. Landings along the east coast of the North Island have shown large fluctuations. At Gisborne landings increased from 2 t in 1978 to 140 t in 1979 before declining to 2 t again in 1983. In Napier landings fluctuated from 1 t in 1960 to 87 t in 1972, decreased to less than 20 t in 1975 before peaking at 123 t in 1978 and then declining to 30–40 t. Y_{AV} for Central (East) (FMA 2) was estimated as 300–350 t.

$$MCY = 0.8 \times (300\text{–}350\ t)$$
$$= 240\text{–}280\ t$$

South-east (south of Banks Peninsula), Southland, and Sub-Antarctic (WAR 3)
The catches from 1983–84 to 1985–86 were considered to be a sustainable level of catch. Y_{AV} = 2040 t

$$MCY = 0.8 \times 2040\ t$$
$$= 1630\ t$$

Challenger (WAR 7)
The catches from 1983–84 to 1985–86 were considered to be a sustainable level of catch. Y_{AV} = 710 t.

$$MCY = 0.8 \times 710\ t$$
$$= 570\ t$$

Central (West) (WAR 8)
The average domestic landings in the Central (West) zone from 1977 to 1983 were 70 t, and the average (declining) catch over 1983–84 to 1985–86 was 79 t. An *MCY* of 80 t is suggested for this area. New Plymouth has a peak seasonal catch in July, the season extending from June to September.

$$MCY = 80\ t$$

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

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

4.4 Factors modifying yield estimates
No information available.

5. STATUS OF THE STOCKS

Estimates of reference and current biomass are not available.

For all Fishstocks there is insufficient information to estimate current stock status.

From 2002–03 to 2006–07 catches in WAR 3 were well above the TACC as fishers landed catches well in excess of ACE holdings. Deemed values were increased from 1 October 2007 and landings in WAR 3 in 2007–08 were much reduced to 684 t, well below the current TACC. WAR 3 landings have since increased to more than 2000 t.

6. FOR FURTHER INFORMATION

Bagley, N W; Ballara, S L; Horn, P L; Hurst, R J (1998) A summary of commercial landings and a validated ageing method for blue warehou, *Seriolella brama* (Centrolophidae), in New Zealand waters, and a stock assessment of the Southern (WAR 3) Fishstock. New Zealand Fisheries Assessment Research Document 1998/20. 46 p. (Unpublished document held by NIWA library, Wellington.)

Bagley, N W; Hurst, R J (1995) Trawl survey of middle depth and inshore bottom species off Southland, February–March 1994 (TAN 9402). *New Zealand Fisheries Data Report*: 57, 50 p.

Bagley, N W; Hurst, R J (1996a) Trawl survey of middle depth and inshore bottom species off Southland, February–March 1995 (TAN 9502). *New Zealand Fisheries Data Report*: 73, 47 p.

Bagley, N W; Hurst, R J (1996b) Trawl survey of middle depth and inshore bottom species off Southland, February–March 1996 (TAN 9604). *New Zealand Fisheries Data Report*: 77, 51 p.

Bagley, N W; Hurst, R J (1997) A summary of biology and commercial landings, and a stock assessment of white warehou, *Seriolella caerulea* Guichenot, 1848 (Stromateoidei: Centrolophidae) in New Zealand waters. New Zealand Fisheries Assessment Research Document *19*97/13 34 p. (Unpublished document held by NIWA library, Wellington.)

Bull, B; Kendrick, T H (2006) Fishery characterisations and CPUE analyses for blue warehou (*Seriolella brama*). Final Research Report for Ministry of Fisheries Project MID2003-01. (Unpublished report held by Fisheries New Zealand, Wellington.)

Cordue, P L (1995) MIAEL estimation of biomass and fishery indicators for the 1995 assessment of hoki stocks. New Zealand Fisheries Assessment Research Document 1995/13. 38 p. (Unpublished document held by NIWA library, Wellington.)

Gavrilov, G M (1979) *Seriolella* of the New Zealand plateau. TINRO, Vladivostok, 1979: 1–79. (Translation No. 204 held in NIWA library, Wellington.)

Gavrilov, G M; Markina, N P (1970) The feeding ecology of fishes of the genus *Seriolella* (fam. Nomeidae) on the New Zealand plateau. *Journal of Ichthyology* 19(6): 128–135.

Horn, P L (1999) Stock assessment of blue warehou *Seriolella brama* in New Zealand waters. New Zealand Fisheries Assessment Research Document. 1999/26. (Unpublished document held by NIWA library, Wellington.)

Hurst, R J (1985) Common warehou. In: Colman, J A; McKoy, J L; Baird, G G (Comps. and Eds.) (1985) Background papers for the 1985 Total Allowable Catch recommendations. (Unpublished report, held in NIWA library, Wellington.) pp 63–65.

Hurst, R J; Bagley, N W (1994) Trawl survey of middle depth and inshore bottom species off Southland, February–March 1993 (TAN 9301). *New Zealand Fisheries Data Report*: 52, 58 p.

Jones, J B (1988) Blue warehou. New Zealand Fisheries Assessment Research Document 1988/11. 19 p. (Unpublished document held in NIWA library, Wellington.)

Jones, J B (1994) Notes on warehou age determination. Draft New Zealand Fisheries Assessment Research Document. 15 p.

Jones, J B; Hurst, R J (1988) Common warehou. In: Baird, G G; McKoy, J L (Comps. and Eds.). Papers from the workshop to review fish stock assessments for the 1987–88 New Zealand fishing year. Pp 67–73.

McKoy, J L (1988) (Comp.) Blue warehou. Report from the fishery assessment meeting April–May, 1988. Pp 37–39.

Tsarev, V T (1971) Short notes on *Seriolella brama* (Gunther) in the south western part of the Pacific Ocean. Izvestiya TINRO [Transactions of the Pacific Ocean Scientific Research Institute for Fisheries and Oceanography] 79: 165–167.[In Russian]

Wynne-Jones, J; Gray, A; Heinemann, A; Hill, L; Walton, L (2019). National Panel Survey of Marine Recreational Fishers 2017–2018. Draft New Zealand Fisheries Assessment Report held by Fisheries New Zealand.

Wynne-Jones,J; Gray, A; Hill, L; Heinemann, A (2014) National Panel Survey of Marine Recreational Fishers 2011–12: Harvest Estimates. *New Zealand Fisheries Assessment Report 2014/67*.