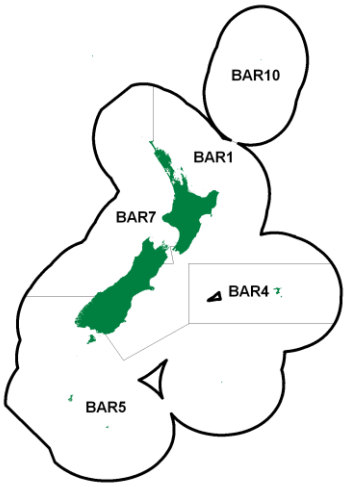
BARRACOUTA (BAR)

(*Thyrsites atun*)
Manga, maka



1. FISHERY SUMMARY

1.1 Commercial fisheries

Barracouta are caught in coastal waters around mainland New Zealand, The Snares and Chatham Islands, down to about 400 m and have been managed under the Quota Management System since 1 October 1986. Historical catch summaries are given in Tables 1 and 2. Catches by New Zealand vessels increased significantly in the late 1960s and total annual catch peaked at about 47 000 t in 1977, with the addition of foreign vessels around New Zealand. Between 1983–84 and 2013–14, catches fluctuated between 18 000 and 29 000 t per annum (Table 3), at an average 25 000 t. Figure 1 shows the historical landings and TACC values for the main BAR stocks.

Table 1: Reported landings (t) for the main QMAs from 1931 to 1982.

Year	BAR 1	BAR 4	BAR 5	BAR 7	Year	BAR 1	BAR 4	BAR 5	BAR 7
1931–32	4	0	0	0	1957	163	0	20	80
1932–33	55	0	0	77	1958	146	0	15	78
1933–34	5	0	1	0	1959	139	0	18	71
1934–35	36	0	0	52	1960	117	0	13	90
1935–36	1	0	0	0	1961	187	0	22	68
1936–37	26	0	0	35	1962	104	0	25	44
1937–38	21	0	0	26	1963	63	0	4	20
1938–39	91	0	22	55	1964	66	0	4	21
1939–40	107	0	27	50	1965	111	0	1	76
1940–41	153	0	53	30	1966	62	0	1	116
1941–42	212	0	86	17	1967	53	0	1	178
1942–43	371	0	151	20	1968	10 113	0	3	1 196
1943–44	192	0	79	7	1969	8 499	0	2	5 756
1944	247	0	97	50	1970	12 984	0	2	3 960
1945	306	0	114	32	1971	11 327	0	191	4 006
1946	391	0	125	63	1972	29 307	2	86	3 487
1947	590	0	213	45	1973	14 856	0	79	4 698
1948	466	0	172	27	1974	23 420	0	106	9 028
1949	425	0	169	40	1975	8 985	0	855	6 257
1950	430	0	153	76	1976	19 124	5	495	6 795
1951	266	0	95	47	1977	69 81	9 095	2 041	33 266
1952	190	0	56	68	1978	6 833	17	1 162	6 918
1953	202	0	41	77	1979	6 474	4 057	3 380	5 263
1954	166	0	35	38	1980	5 649	1 854	7 867	5 146
1955	139	0	14	58	1981	6 993	2 030	8 311	11 141
1956	165	0	16	45	1982	5 393	787	6 909	7 064

Notes:
1. The 1931–1943 years are April–March but from 1944 onwards are calendar years.
2. Data up to 1985 are from fishing returns: Data from 1986 to 1990 are from Quota Management Reports.
3. Data for the period 1931 to 1982 are based on reported landings by harbour and are likely to be underestimated as a result of under-reporting and discarding practices. Data includes both foreign and domestic landings. Data were aggregated to FMA using methods and assumptions described by Francis & Paul (2013).

Table 2: Reported landings (t) by nationality from 1977 to 1987–88.

Fishing	New Zealand		Foreign			Total	
Year	Domestic	Chartered	Japan	Korea	USSR	(FSU)	(QMS)
1977	4 697	0	34 357	8 109	0	47 163	-
1978–79	5 335	58	4 781	2 481	0	12 655	-
1979–80	7 748	6 679	4 339	3 879	47	22 922	-
1980–81	10 058	4 995	4 227	15	60	19 355	-
1981–82	12 055	11 077	2 813	373	0	26 328	-
1982–83	10 814	7 110	1 746	1 888	31	21 589	-
1983–83*	7 763	2 961	803	1 115	0	12 642	-
1983–84	12 390	10 226	1 786	4 355	0	28 757	-
1984–85	7 869	10 425	1 430	5 252	0	24 976	-
1985–86	8 427	7 865	1 371	815	0	18 478	-
1986–87	9 829	13 732	1 575	742	0	25 878	27 660†
1987–88	9 335	12 077	896	609	0	22 971	26 607†

* 6 month changeover in fishing years.

† The discrepancies between QMS and FSU total landings are due to under-reporting to the FSU.

Over 99% of the recorded catch is taken by trawlers. Major target fisheries have been developed on spring spawning aggregations (Chatham Islands, Stewart Island, west coast South Island and northern and central east coast South Island) as well as on summer feeding aggregations, particularly around The Snares and on the east coast of the South Island. Barracouta also comprise a significant proportion of the bycatch in the west coast North Island jack mackerel fishery, The Snares squid fishery, and the east coast South Island red cod and tarakihi fisheries. Catches have increased in recent years in BAR 1 to the level of the TACC, but have dropped in BAR 4 in the last three years. The TACC in BAR 5 was reduced from 9282 t to 7470 t on 1 October 1998 with a 2 t customary and 3 t recreational allocation and a TAC of 7475 t. Recent catches have fluctuated about the new TACC in this fishery. In BAR 7 the catch limit was exceeded from 2004–05 to 2006–07 (catches nearly reached 15 000 t in 2006–07), but catch has decreased since, to well below the TACC.

Table 3: Reported landings (t) of barracouta by Fishstock from 1983–84 to 2014–15 and actual TACCs (t) from 1986–87 to 2014–15. QMS data from 1986-present. [Continued on next page]

Fishstock	BAR 1		BAR 4		BAR 5		BAR 7	
FMAs	1, 2, 3		4		5 & 6		7, 8, 9	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1983–84*	7 805	-	1 743	-	11 291	-	7 222	-
1984–85*	5 442	-	1 909	-	12 487	-	4 425	-
1985–86*	5 395	-	1 509	-	6 380	-	4 536	-
1986–87	8 877	8 510	3 084	3 010	7 653	9 010	8 046	10 510
1987–88	9 256	8 837	1 775	3 010	6 457	9 011	9 117	10 603
1988–89	5 838	9 426	946	3 010	5 323	9 011	8 071	10 702
1989–90	9 209	9 841	1 349	3 016	5 960	9 282	7 050	10 925
1990–91	9 401	9 957	1 399	3 016	8 817	9 282	7 138	10 925
1991–92	6 733	9 957	1 156	3 016	6 897	9 282	7 326	10 925
1992–93	9 032	9 969	2 251	3 016	7 019	9 282	10 141	10 925
1993–94	7 299	9 969	606	3 016	3 410	9 282	8 030	10 925
1994–95	10 023	9 969	331	3 016	2 645	9 282	9 345	10 925
1995–96	11 252	9 969	2 234	3 016	4 255	9 282	8 593	10 925
1996–97	11 873	11 000	1 081	3 016	2 839	9 282	10 203	10 925
1997–98	11 543	11 000	1 966	3 016	6 167	9 282	8 717	10 925
1998–99	9 229	11 000	459	3 016	7 302	7 470	4 427	10 925
1999–00	10 032	11 000	1 911	3 016	6 205	7 470	3 288	10 925
2000–01	7 118	11 000	2 122	3 016	6 101	7 470	6 890	10 925
2001–02	6 900	11 000	1 160	3 019	5 883	7 470	7 655	11 173
2002–03	7 595	11 000	573	3 019	7 843	7 470	9 025	11 173
2003–04	5 949	11 000	477	3 019	6 919	7 470	9 114	11 173
2004–05	6 085	11 000	98	3 019	8 593	7 470	12 156	11 173
2005–06	7 030	11 000	687	3 019	9 479	7 470	10 685	11 173
2006–07	5 351	11 000	3 233	3 019	6 334	7 470	14 699	11 173
2007–08	5 987	11 000	2 975	3 019	8 561	7 470	10 451	11 173
2008–09	8 861	11 000	968	3 019	7 659	7 470	8 955	11 173
2009–10	10 635	11 000	1 223	3 019	6 951	7 470	9 642	11 173
2010–11	11 420	11 000	1 190	3 019	8 201	7 470	6 129	11 173
2011–12	9 305	11 000	1 423	3 019	7 071	7 470	8 643	11 173
2012–13	9 740	11 000	706	3 019	7 931	7 470	6 897	11 173
2013–14	11 309	11 000	1 4832	3 019	6 886	7 470	6 637	11 173
2014–15	6 902	11 000	3 671	3 019	6 779	7 470	6 974	11 173

Table 3 Continued: Reported landings (t) of barracouta by Fishstock from 1983–84 to 2014–15 and actual TACCs (t) from 1986–87 to 2014–15. QMS data from 1986-present.

Fishstock	BAR 10			
FMAs	10		Total	
	Landings	TACC	Landings	TACC
1983–84*	0	-	28 061	-
1984–85*	0	-	24 263	-
1985–86*	0	-	17 820	-
1986–87	0	10	27 660	31 050
1987–88	0	10	26 605	31 471
1988–89	0	10	20 178	32 159
1989–90	0	10	23 568	33 073
1990–91	0	10	26 755	33 190
1991–92	0	10	22 212	33 190
1992–93	0	10	28 443	33 202
1993–94	0	10	19 345	33 202
1994–95	0	10	22 345	33 202
1995–96	0	10	26 334	33 202
1996–97	0	10	25 996	34 233
1997–98	0	10	28 393	34 233
1998–99	0	10	21 417	32 421
1999–00	0	10	21 436	32 421
2000–01	0	10	22 231	32 421
2001–02	0	10	21 598	32 672
2002–03	0	10	25 036	32 672
2003–04	0	10	22 459	32 672
2004–05	0	10	26 919	32 672
2005–06	0	10	27 881	32 672
2006–07	0	10	29 617	32 672
2007–08	0	10	27 968	32 672
2008–09	0	10	26 443	32 672
2009–10	0	10	28 451	32 672
2010–11	0	10	26 937	32 672
2011–12	0	10	26 442	32 672
2012–13	0	10	24 973	32 672
2013–14	0	10	26 313	32 672
2014–15	0	10	24 327	32 672

* FSU data.

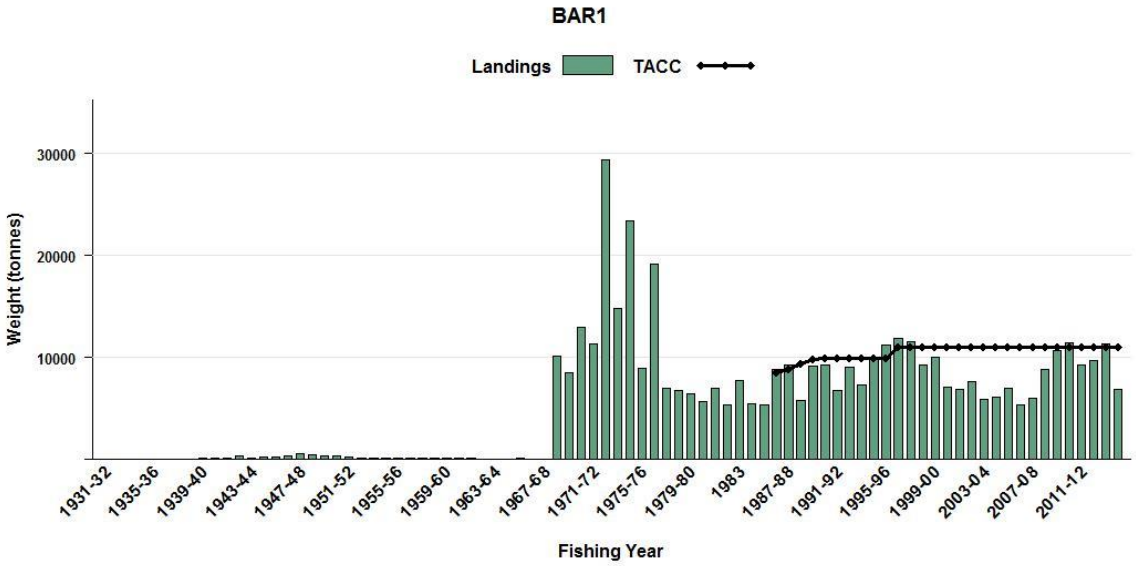


Figure 1: Reported commercial landings and TACC for the four main BAR stocks. BAR 1 (Auckland East), **[Continued on next page].**

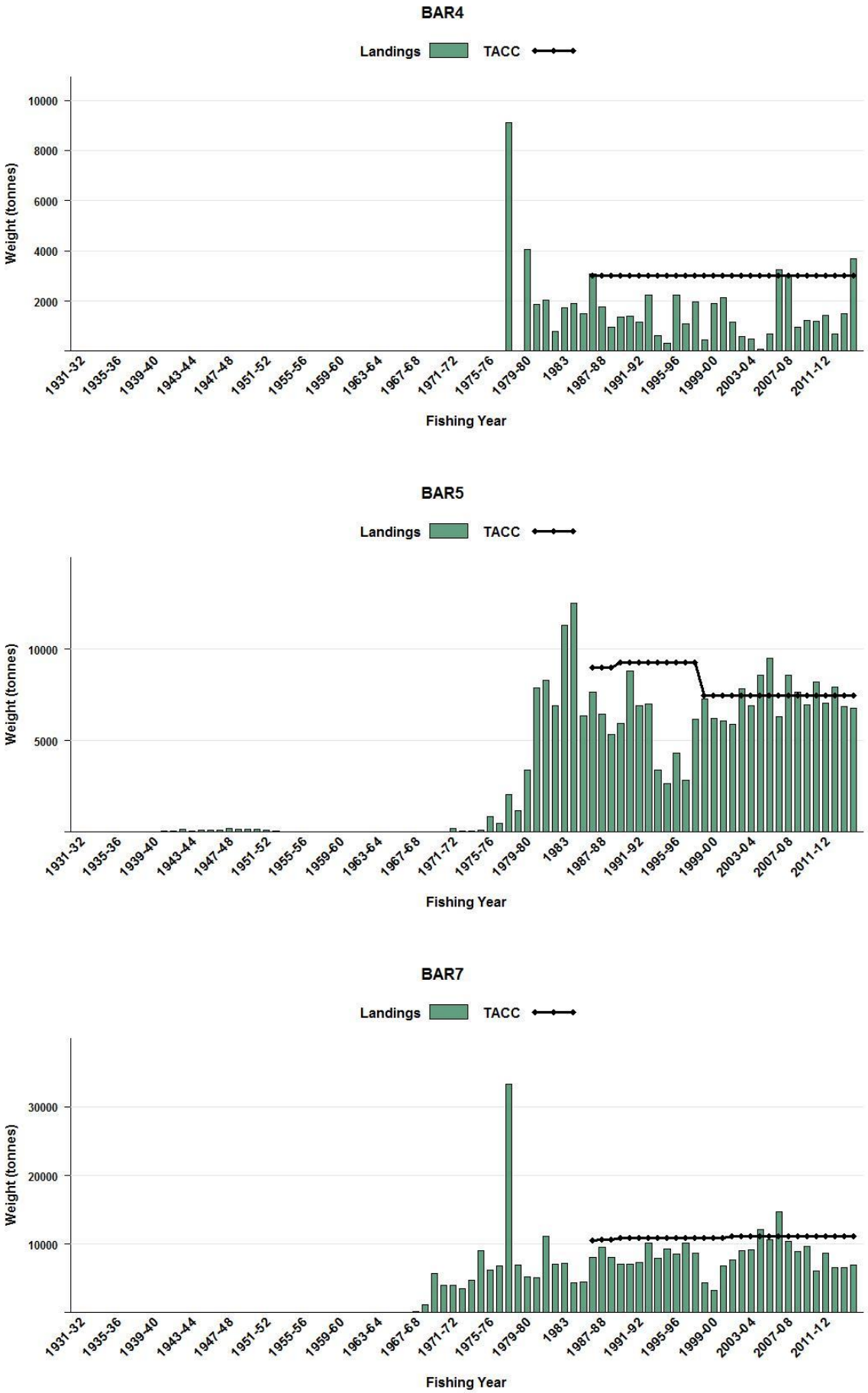


Figure 1: [Continued] Reported commercial landings and TACC for the four main BAR stocks. From top to bottom: BAR 4 (Chatham Rise), and BAR 5 (Southland), BAR 7 (Challenger).

1.2 Recreational fisheries

Barracouta are commonly encountered by recreational fishers in New Zealand, more frequently in the southern half of BAR 7 and BAR 1. Barracouta are typically harvested as bait for other fishing rather than for consumption. They are predominantly taken on rod and reel (97.9%) with a small proportion taken by net methods (1.7%). The catch is taken predominantly from boat (95.5%) with a small proportion from land based fishers (4.5%).

1.2.1 Management controls

The main method used to manage recreational harvests of barracouta is daily bag limits. General spatial and method restrictions also apply. Fishers can take up to 30 barracouta as part of their combined daily bag limit in the Fiordland and Southland Fishery Management Areas. There is currently no bag limit in place in the other Fishery Management Areas.

1.2.2 Estimates of recreational harvest

There are two broad approaches to estimating recreational fisheries harvest: the use of onsite or access point methods where fishers are surveyed or counted at the point of fishing or access to their fishing activity; and offsite methods where some form of post-event interview and/or diary are used to collect data from fishers.

The first estimates of recreational harvest for barracouta were calculated using an offsite approach, the offsite regional telephone and diary survey approach. Estimates for 1996 came from a national telephone and diary survey (Bradford 1998). Another national telephone and diary survey was carried out in 2000 (Boyd & Reilly 2002). The harvest estimates provided by these telephone diary surveys (Table 4) are no longer considered reliable.

In response to the cost and scale challenges associated with onsite methods, in particular the difficulties in sampling other than trailer boat fisheries, offsite approaches to estimating recreational fisheries harvest have been revisited. This led to the development and implementation of a national panel survey for the 2011–12 fishing year (Wynne-Jones et al 2014). The panel survey used face-to-face interviews of a random sample of 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 catch information collected in standardised phone interviews. Note that the national panel survey estimate does not include recreational harvest taken under s111 general approvals. Recreational catch estimates from the national panel survey are given in Table 4.

Table 4: Recreational harvest estimates for barracouta stocks. Early surveys were carried out in different years in the regions: South in 1991–92, Central in 1992–93, and North in 1993–94 (Teirney et al 1997). The estimated Fishstock harvest is indicative in these surveys and made by combining estimates from the different years. Some early survey harvests are presented as a range to reflect the considerable uncertainty in the estimates. The telephone/diary surveys ran from December to November but are denoted by the January calendar year. The national panel survey ran through the October to September fishing year but is denoted by the January calendar year. A mean weight of 2.14kg was used for the national panel survey.

Fishstock		Survey	Number	CV	Total Survey harvest (*t*)
BAR 1	1992	South	27 000	47%	30–90
BAR 7	1992	South	2 100	44%	-
BAR 1	1993	Central	17 000	22%	25–35
BAR 7	1993	Central	15 600	24%	25–35
BAR 1	1996	National	68 000	8%	160–190
BAR 7	1996	National	74 000	15%	160–220
BAR 1	2000	National	156 000	35%	182 –377
BAR 5	2000	National	2 000	51%	2–7
BAR 7	2000	National	35 000	28%	68–120
BAR 1	2012	Panel survey	22 224		47.7
BAR 5	2012	Panel survey	666		1.4
BAR 7	2012	Panel survey	16 743		35.9
All combined	2012	Panel survey	39 652	18%	85.05

1.3 Customary non-commercial fisheries

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

1.4 Illegal catch

Quantitative information on the level of illegal catch is not available.

1.5 Other sources of mortality

There may have been considerable amounts of barracouta discarded prior to the QMS, either because of quota restrictions under the deepwater policy, low value, or undesirable small size fish. There is also likely to be some mortality associated with escapement from trawl nets. Some discarding may also have occurred in BAR 1 because of the lack of quota availability and the high deemed value in relation to the low value of the fish.

2. BIOLOGY

Barracouta spawn mainly in late-winter/spring (August–September) on the east and west coasts of both of the main islands, and in late spring (November–December) in Southland and in the Chatham Islands. Some spawning activity may also extend into summer/autumn. Sexual maturity is reached at about 50–60 cm fork length (FL) at about 2–3 years of age.

Juvenile barracouta have been recorded from inshore areas (less than 100 m) all around New Zealand and the Chatham Islands, although they appear to be less common on the west coast of the South Island. Adult fish are found down to about 400 m depth. Tagging experiments indicated that mature fish from the east coast South Island waters migrate after June to northern waters off the east coast North Island to spawn during August–September; research survey results and commercial fishing patterns show some consistency with this movement (see Hurst et al 2012).

No age data are available for the period prior to the onset of commercial fishing, which developed rapidly from 1968. Ageing studies carried out in the mid-1970s showed that the maximum age rarely exceeded 10 years.

M was estimated using the equation $M = \log_e 100$/maximum age, where maximum age is the age to which 1% of the population survives in an unexploited stock. Using 10 years for the maximum age suggests an *M* of up to 0.46. The effect of fishing on age structure prior to the mid-1970s is unknown, but *M* is unlikely to be less than 0.3, which has been assumed in previous stock assessments.

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

Table 5: Estimates of biological parameters.

Fishstock	Estimate	Source
1. Natural mortality (*M*)		Hurst (unpub. data)
All-both sexes	Less than 0.46 *M* = 0.30 considered best estimate for all areas for both sexes	

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

	Females		Males		
	a	b	a	b	
BAR 4	0.0074	2.94	0.0117	2.82	Hurst & Bagley (1992)
BAR 5	0.0075	2090	0.0075	2.90	Hurst & Bagley (1992)

3. Von Bertalanffy growth parameters

	Both sexes				
	K	t_0	L_∞		Grant et al (1978)
Tasmania	0.45	0.166	91.17	(unconstrained)	
	0.42	-0.25	91.01	(constrained, t_0 fixed)	
Southland	0.336	-0.35	81.1	Male	Horn (2002)
	0.259	-0.60	89.3	Female	Horn (2002)

3. STOCKS AND AREAS

There are thought to be at least four main stocks, based on known spawning locations and movements. Stock boundaries are not well understood, but the Chatham Islands stock is probably separate. There may be some overlap between mainland stock management areas as currently defined from analysis of tagging data, commercial fishery data, biological data (i.e., length frequencies, otoliths, parasites, spawning areas and seasons) and from seasonal relative biomass estimates. In particular, it appears that there is considerable overlap of Southland fish with other areas, probably the west coast of the South Island and possibly the east coast as well. However, there are not enough data at this stage to alter the existing stock boundaries.

4. STOCK ASSESSMENT

There are no stock assessments available for any barracouta stocks and TACCs have remained constant in all stocks since 2001–02. Hurst et al (2012) provided a comprehensive characterisation of all barracouta stocks and provided CPUE indices for BAR 1 (east coast South Island), BAR 4 (west coast South Island), and BAR 5 for 1989–90 to 2007–08. McGregor (in prep.) characterised the fisheries and estimated CPUE indices for the fisheries on the WCNI and WCSI (BAR 7) and the southern Snares fishery (BAR 5). In BAR 4 the fishery has been highly variable and no standardised analysis is possible.

A time series of trawl surveys was carried out in the Southland area (QMA 5) in February–March from 1993 to 1996 using *Tangaroa* (Table 6). Trawl surveys on the east and west coasts of the South Island in autumn using *Kaharoa* may help interpretation of trends in biomass around the South Island. The long time series of trawl surveys on the Chatham Rise (deeper than 200 m) and Sub-Antarctic (deeper than 300 m) using *Tangaroa* are not considered to adequately survey the preferred depth range of barracouta.

4.1 BAR 1 Auckland (E), Central (E), South-East (Coast)

4.1.1 Estimates of fishery parameters and abundance

The results from trawl surveys carried out during the mid 1980s (sometimes from a variety of different vessels) were used to provide an approximate estimate of minimum absolute biomass. This approach required an assumption about catchability to convert the trawl survey catches to estimates of absolute biomass. This method is now considered obsolete and the estimates of absolute biomass have not been included.

4.1.2 Biomass estimates

There is no trawl survey series for BAR 1 off the east coast of the North Island. The trawl survey information discussed below is for the east coast of the South Island.

The ECSI winter surveys from 1991 to 1996 in 30–400 m were replaced by summer trawl surveys (1996–97 to 2000–01) which also included the 10–30 m depth range, but these were discontinued after the fifth in the annual time series because of the extreme fluctuations in catchability between surveys (Francis et al 2001). The winter surveys were reinstated in 2007 and this time included additional 10–30 m strata in an attempt to index elephant fish and red gurnard which were added to the list of target species. Only the 2007, 2012, and 2014 surveys provide full coverage of the 10–30 m depth range.

The 2014 barracouta biomass estimate was the highest recorded in the east coast South Island winter trawl survey time series core strata (30–400 m) (Table 6, Figure 2). Biomass has been steadily increasing and in 2014 was more than four-fold larger than the average biomass of the early 1990s. The additional biomass captured in the 10–30 m depth range accounted for 15% and 6% of the biomass in

the core plus shallow strata (10–400 m) for 2007 and 2012 respectively, but was less than 1% in 2014; however shallow strata should continue to be monitored for this species.

A comparison of the pre-recruit and recruited biomass (where recruited fish are over 60 cm long) for the ECSI winter survey, based on the core strata, is shown in Figure 3. During the 1991–93 surveys, the pre-recruit and recruited estimates were similar, but in 1994 and 1996, most of the total biomass was from the recruited fish. For the renewed series, from 2007, the main increase has come from the recruited fish, with significantly higher biomass for recruited fish compared with pre-recruits in the 2009 and 2102 surveys. The 2014 survey indicated an increase in the pre-recruit biomass, although the uncertainty around this estimate is high.

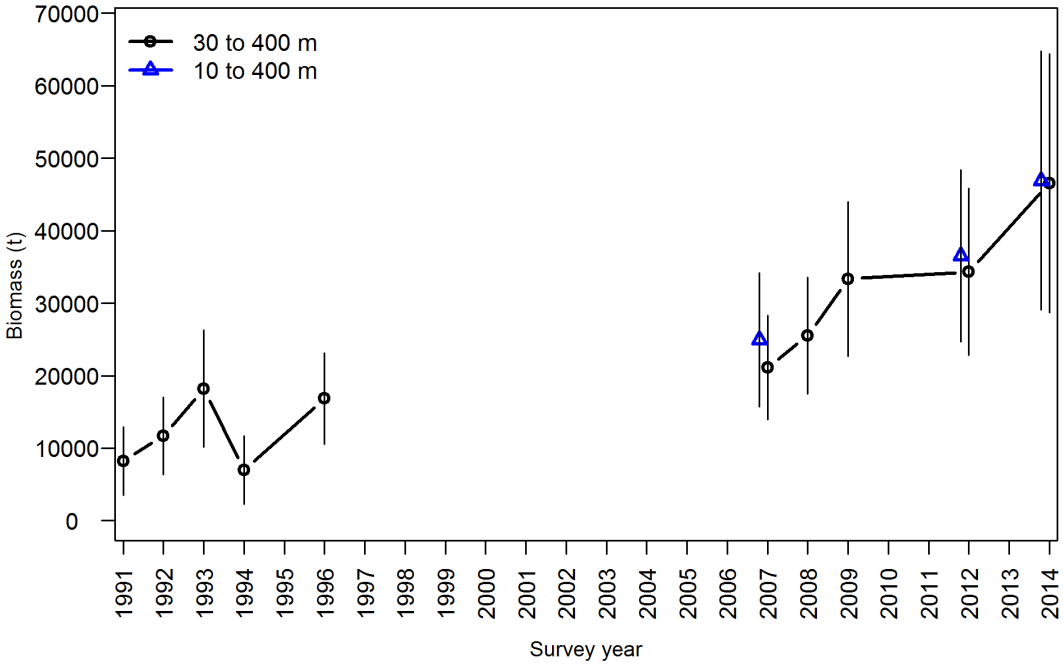


Figure 2: Barracouta total biomass and 95% confidence intervals for the all ECSI winter surveys in core strata (30–400 m), and core plus shallow strata (10–400 m) in 2007, 2012, and 2014.

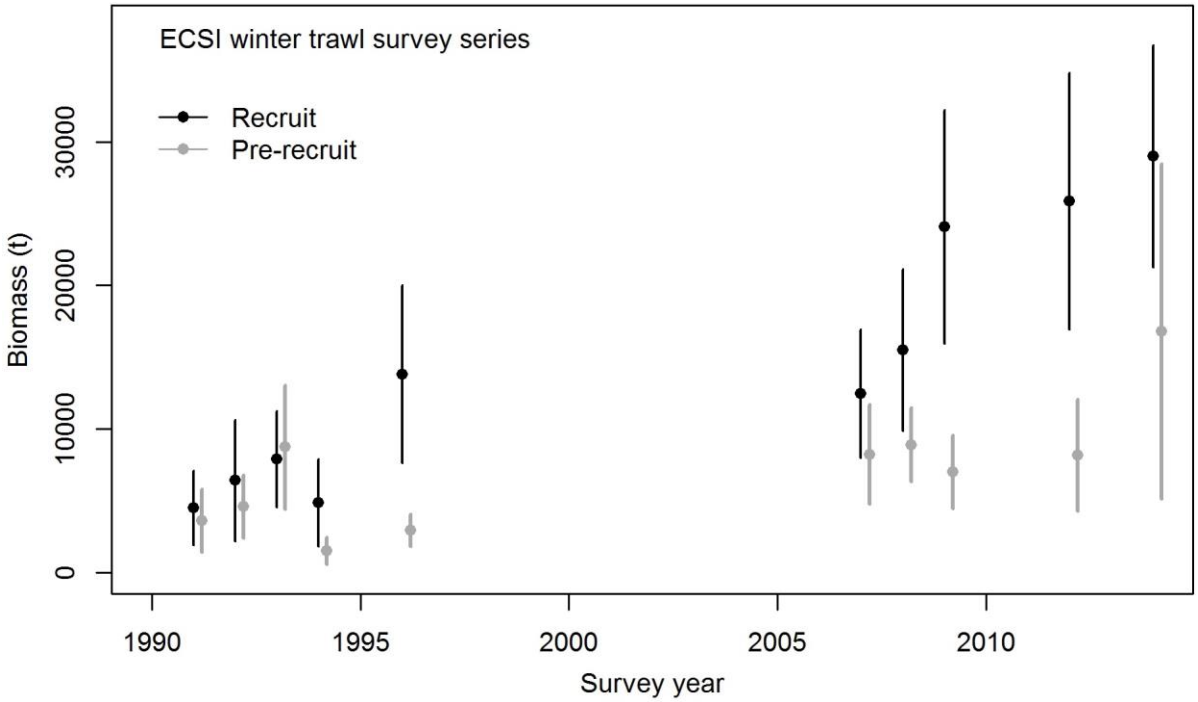


Figure 3: Barracouta pre-recruit and recruited biomass estimates and associated confidence intervals from the ECSI winter trawl survey core strata (30–400 m). Recruited fish were defined as fish over 60 cm fork length.

Table 6: Relative biomass indices (t) and coefficients of variation (CV) for barracouta for east coast South Island (ECSI) - winter, east coast North Island (ECNI), west coast South Island (WCSI) and Southland survey areas. Biomass estimates for ECSI in 1991 have been adjusted to allow for non-sampled strata (7 & 9 equivalent to current strata 13, 16 and 17). – , not measured; NA, not applicable.

Region	Fishstock	Year	Trip number	Total Biomass estimate	CV (%)	Total Biomass estimate	CV (%)
ECSI (winter)	BAR 1				30–400 m		10–400 m
		1991	KAH9105	8 361	29	-	-
		1992	KAH9205	11 672	23	-	-
		1993	KAH9306	18 197	22	-	-
		1994	KAH9406	6 965	34	-	-
		1996	KAH9608	16 848	19	-	-
		2007	KAH0705	21 132	17	24 939	19
		2008	KAH0806	25 544	16	-	-
		2009	KAH0905	33 360	16	-	-
		2012	KAH1207	34 325	17	36 526	16
		2014	KAH1402	46 563	19	46 903	19
ECNI	BAR 1	1993	KAH9304	2 673	15	-	-
		1994	KAH9402	8 433	33	-	-
		1995	KAH9502	2 103	29	-	-
		1996	KAH9602	2 495	23	-	-
WCSI	BAR 7	1992	KAH9203	2 478	14	-	-
		1994	KAH9404	5 298	16	-	-
		1995	KAH9504	4 480	13	-	-
		1997	KAH9701	2 993	19	-	-
		2000	KAH0004	1 787	11	-	-
		2003	KAH0304	4 485	20	-	-
		2005	KAH0503	2 763	13	-	-
		2013	KAH1305	3 423	16	-	-
Southland	BAR 5	1993	TAN9301	11 587	18	-	-
		1994	TAN9402	6 151	20	-	-
		1995	TAN9502	4 539	17	-	-
		1996	TAN9604	7 693	19	-	-

4.1.3 Length frequency distributions

The length distributions from the east coast South Island winter trawl survey show at least three clear pre-recruit modes at about 20 cm, 35 cm, and 50 cm (combined males, females, and unsexed) consistent with ages of 0+, 1+, and 2+ (Figure 4). Length frequency distributions are consistent among the surveys, showing the presence of the pre-recruited cohorts, with indications that these could be tracked through time (modal progression) (Beentjes et al 2015). The addition of the 10–30 m depth range does not change the shape of the length distributions.

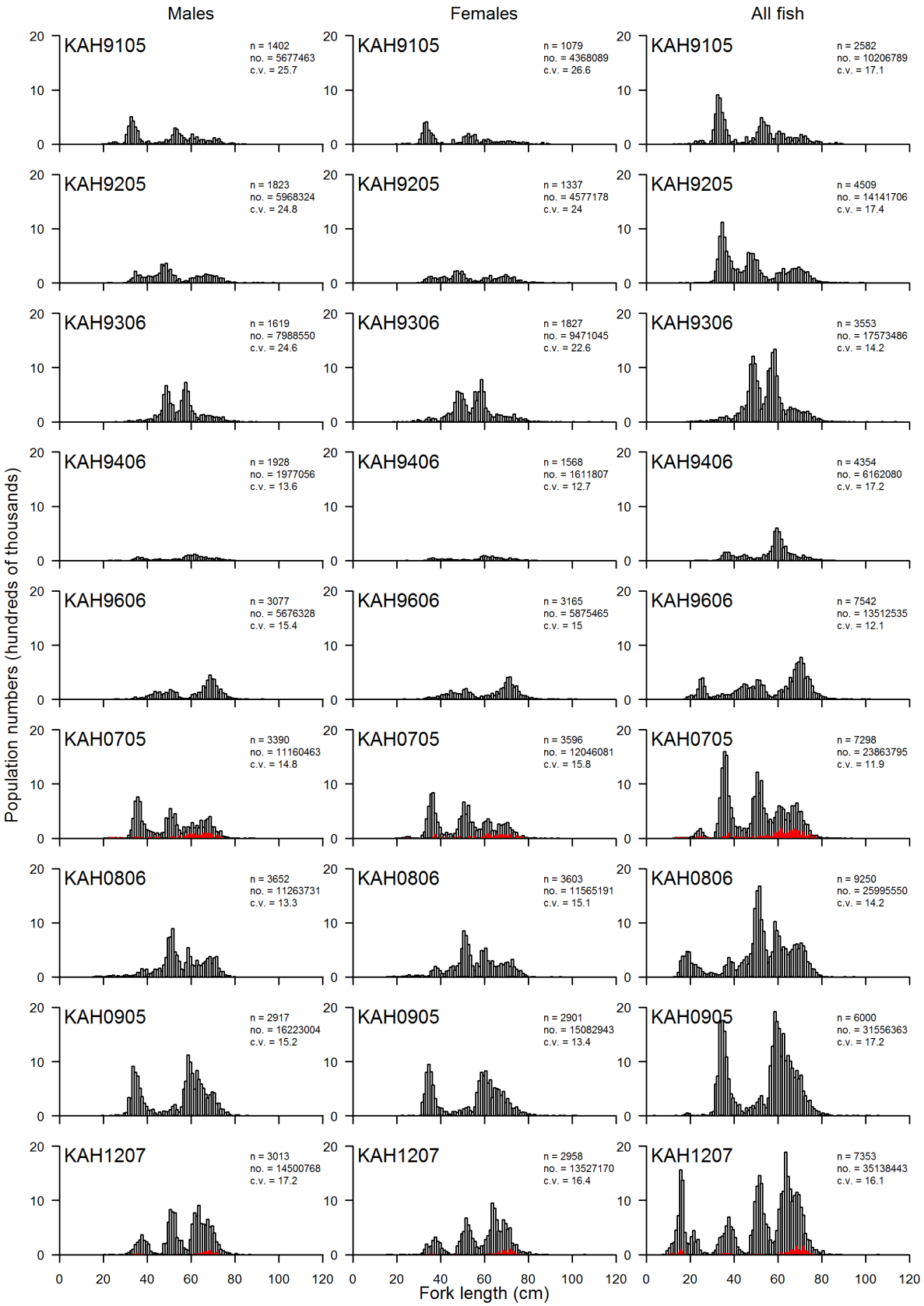


Figure 4: Scaled length frequency distributions for barracouta in core strata (30–400 m) for the ECSI winter surveys listed in Table 6, except for KAH1402. Where possible, data from the 10–30 m stratum were also included and are shown in red for 2007 and 2012. n, number of fish measured; no., core strata population estimates; c.v., coefficient of variation. This plot is from figure 4 from Beentjes & MacGibbon (2013) [Continuation on next page for KAH1402].

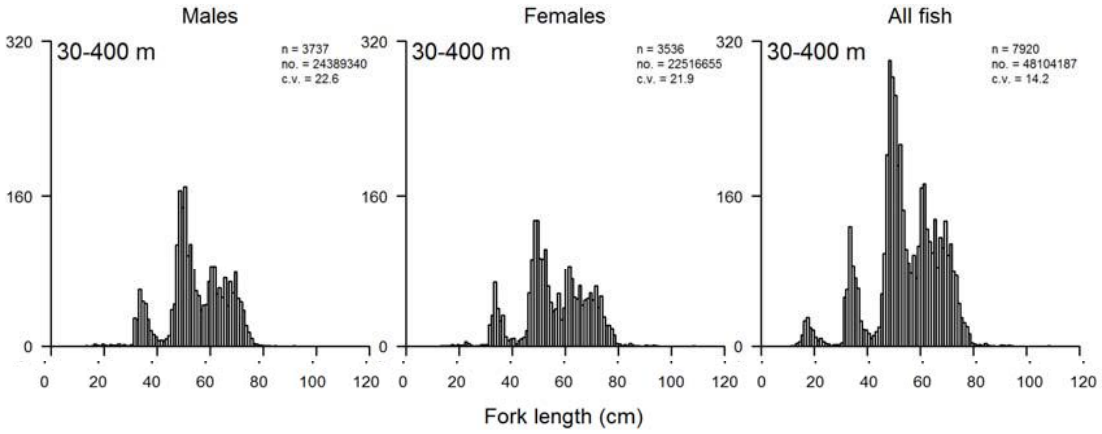


Figure 4: [Continued]. Scaled length frequency distributions showing population numbers (tens of thousands) of barracouta in core strata (30–400 m) for the KAH1402 ECSI winter survey (from Beentjes et al. 2015).

4.1.4 CPUE indices

Two sets of standardised CPUE indices were derived for BAR 1: one for the northern waters off the east coast of the North Island (ECNI) and one for the east coast South Island, ECSI (Baird 2016). Each set had three CPUE series defined by form type: a merged CELR/TCER day-level model for 1989–90 to 2013–14; a TCER tow-level model for 2007–08 to 2013–14; and a TCEPR tow-level model for 1989–90 to 2013–14. All ECNI series were rejected by the Working Group because of shifts in targeting through time, high inter-annual variability, and unacceptably low levels of data. Thus, the following sections on CPUE pertain to the ECSI waters only.

Three standardised CPUE series for the east coast South Island part of BAR 1 were prepared, as outlined above, using data from 1989–90 to 2013–14, with each series based on the catch of barracouta in bottom trawl fisheries defined by different target species, including barracouta (Baird 2016). Two CPUE series were rejected by the SINS Working Group: the CPUE index based on the TCEPR data (targeting barracouta, red cod, and arrow squid), primarily because of inter-annual inconsistencies in the underlying catch and effort data; and the short TCER series with only seven years of data.

The SINS Working Group accepted the combined index (delta lognormal model) series based on the daily data from CELR and TCER forms (targeting barracouta, red cod, and tarakihi) as an index of abundance for BAR 1 (Figure 5). After a peak period during 1996–97 and 1997–98, there was a period of relatively lower CPUE from 1998–99 to 2008–09, followed by an increase up to 2012–13, to a level similar to the earlier peak. The most recent index (2013–14) showed a modest drop, but remained above the series mean. The TCER tow-level CPUE series, for which additional explanatory variables were incorporated into the model, was very similar to the CELR/TCER day-level series for the overlapping period (2007–08 to 2013–14). Figure 6 provides a comparison of the ECSI indices with the ECSI winter trawl survey indices. The increase in abundance measured by the trawl survey for 2007 onwards follows a similar trajectory to that for the ECSI CELR/TCER indices.

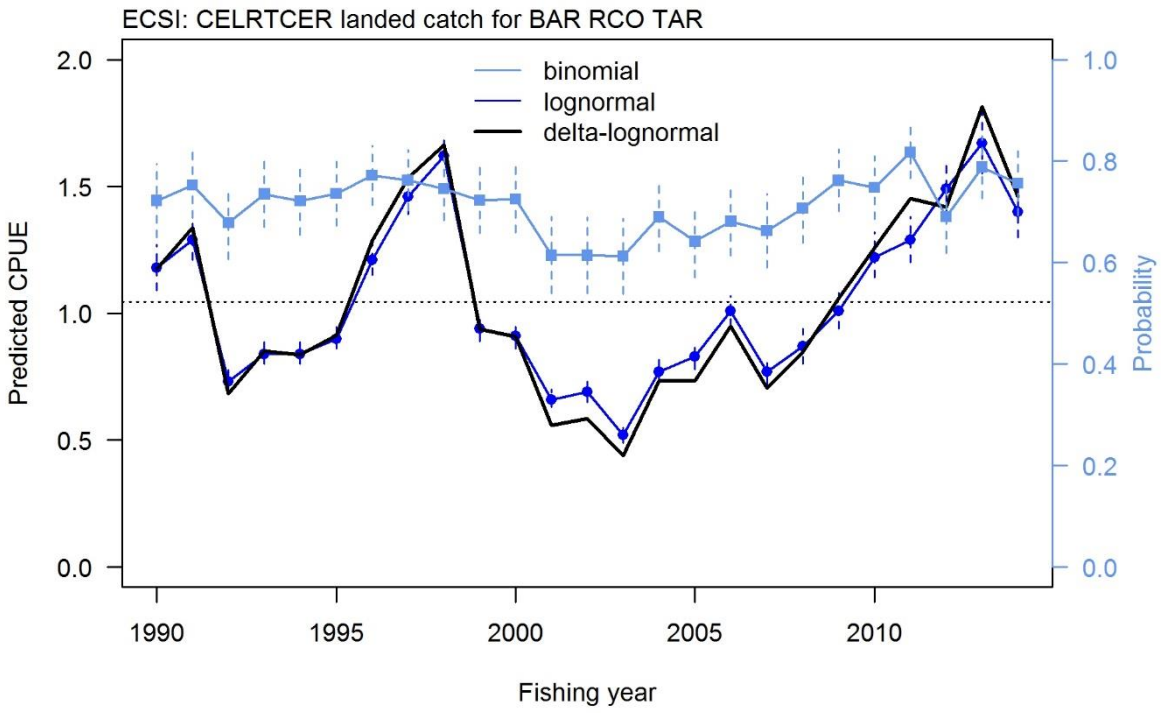


Figure 5 : East coast South Island part of BAR 1 CPUE indices from the standardised lognormal, binomial, and the combined (delta lognormal) models, based on the merged day-level CELR and TCER data for 1989–90 to 2013–14.

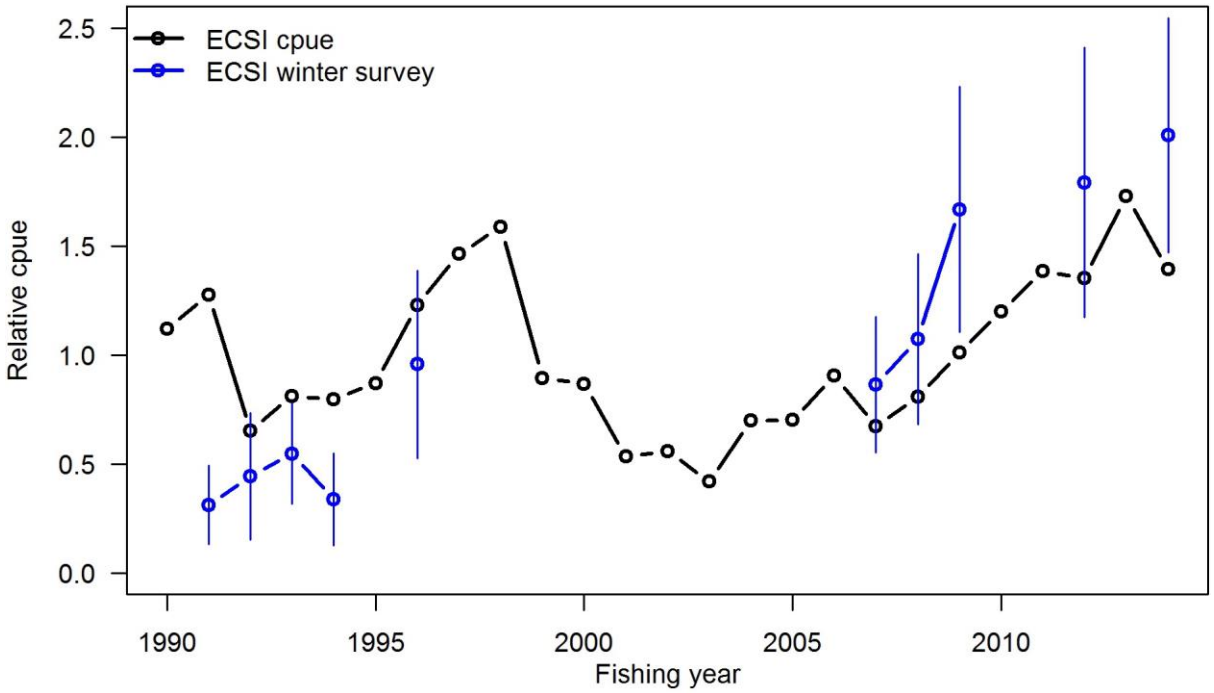


Figure 6: Comparison of the BAR 1 ECSI delta-lognormal indices for 1990–2014 and the recruited biomass (and associated variance) from the ECSI winter trawl survey series. The recruited biomass is based on fish over 60 cm fork length. Each series has been standardised to the mean for concurrent years.

4.2 BAR 5 Southland, Sub-Antarctic

4.2.1 CPUE indices

Marsh (in prep) used unmerged (tow level) data to fit a delta-lognormal CPUE index (Model 1b) for the BAR 5 region. The trend oscillates between 1990 and 2000, followed by a period of decline until 2007. After 2007 the index increases and remains high through to 2015 (Figure 7). The current stock status is unknown, due to the lack of a quantitive assessment for this stock.

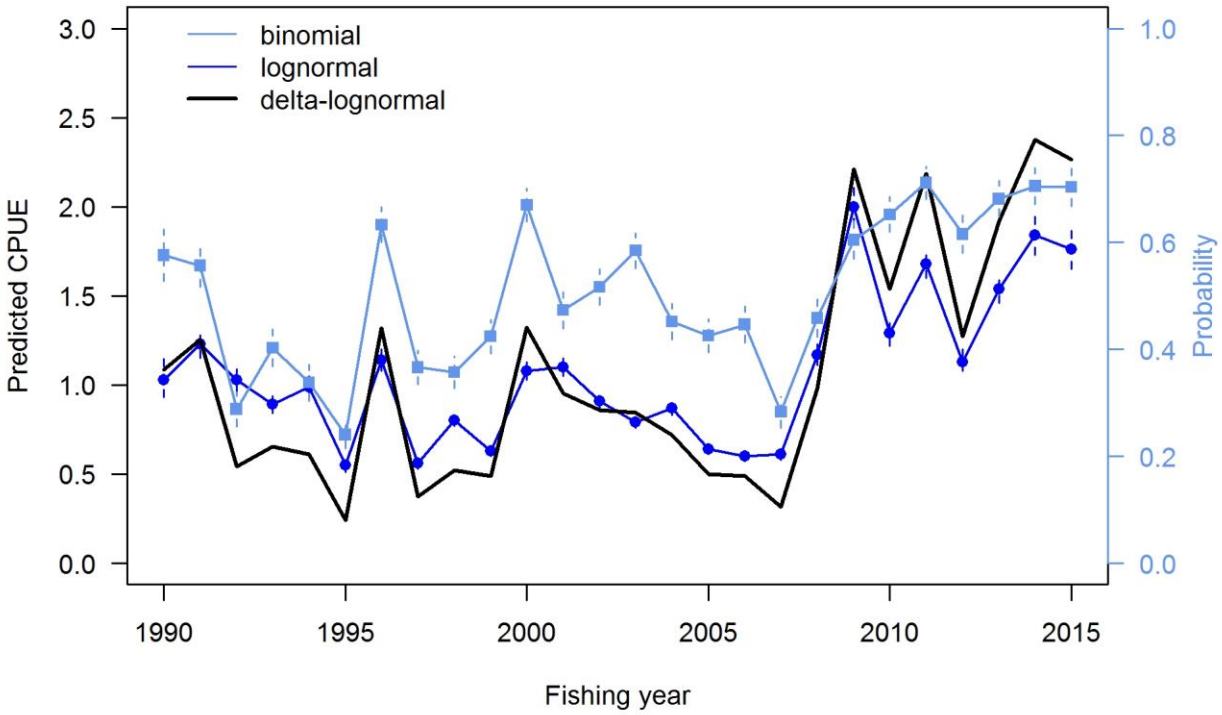


Figure 7 : BAR 5 CPUE Model 1b (South): binomial, lognormal and combined delta-lognormal CPUE indices for 1990–2015.

4.3 BAR 7 Challenger, Central (W) Auckland (W)

4.3.1 CPUE indices

McGregor (in prep.) looked at the separate fisheries on the WCNI and WCSI. The three CPUE options for the WCNI all gave similar patterns to the inshore *Kaharoa* WCSI trawl survey. The WG considered that the tow level CPUE was the best data to use to monitor this stock. The CPUE shows an increasing trend from 2000 to 2004 and is then generally flat (Figure 8).

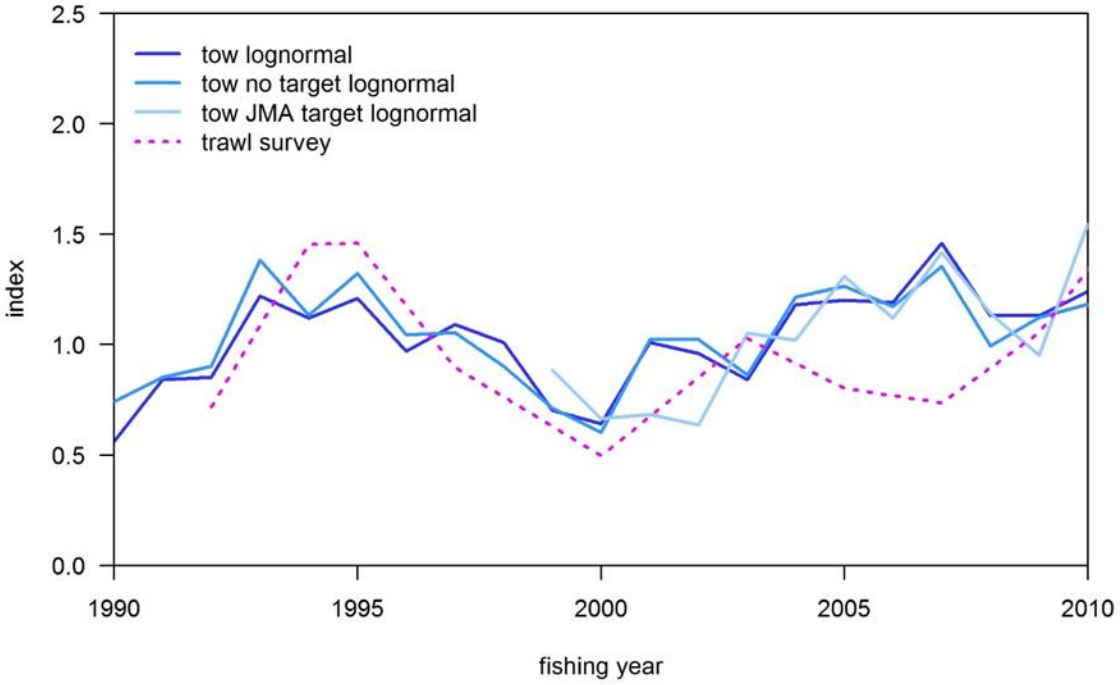


Figure 8: West Coast CPUE for Models 2b (tow level), 3 (JMA target) and 4 (no target) and Trawl Survey abundance index for calendar years 1990–2010. Model 3 (JMA target) is actually based on fishing years, months Nov-May, whereas the other models here are calendar year, Jun-Nov. Trawl survey is based on fishing year.

The WCSI data series shows a similar increase from 2000 and is then generally flat, for the tow level CPUE based on all target from June to October (Figure 9).

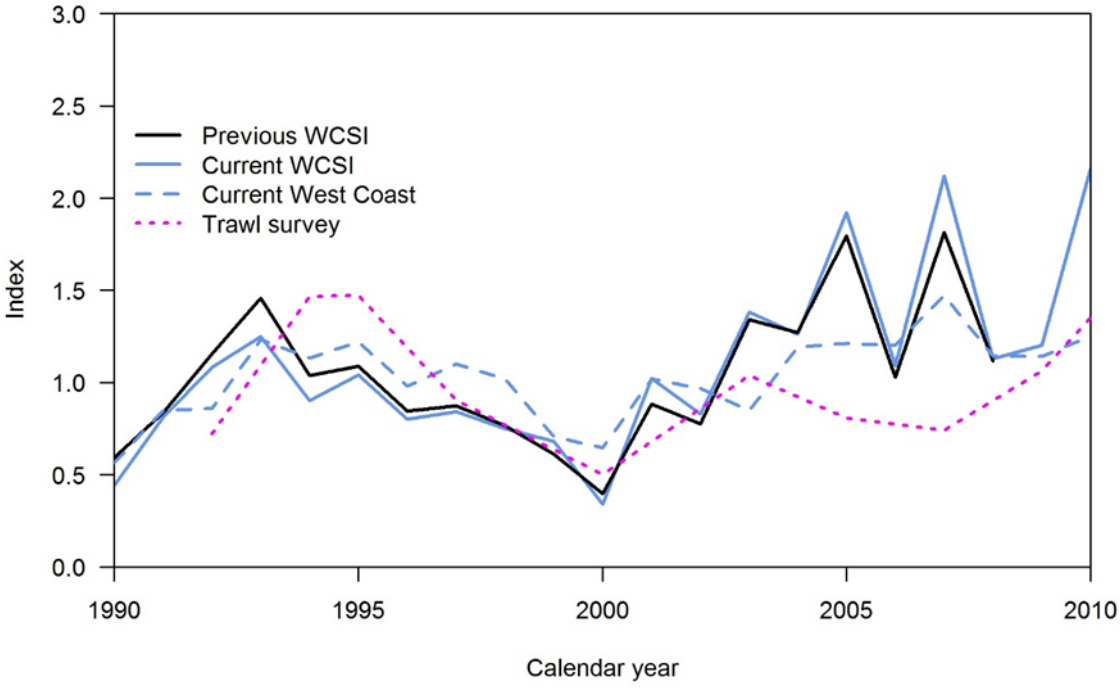


Figure 9: West Coast South Island current and previous CPUE, West Coast North Island CPUE and trawl survey abundance index for calendar years 1990–2010. Trawl survey is based on fishing year.

4.4 Yield estimates and projections

It is not feasible to estimate *MCY* from commercial landings data for most Fishstocks (except for BAR 1), as the amount of effort has varied considerably since the beginning of the fishery in the late

1960s i.e., foreign licensed access has declined, effort was encouraged by subsidies in 1979 and 1981, an unknown amount of fish has been and may still be dumped, and effort is related to the availability of more preferred, higher value species. These, and other factors, also result in CPUE data being of limited use.

Estimates of current biomass are not available and *CAY* cannot be estimated.

4.4.1 Auckland (East), Central (East) and South-East (Coast) (BAR 1)

MCY was estimated using the equation $MCY = cY_{AV}$ (Method 4), where Y_{AV} average estimated catch from 1968–1975 and c = 0.7. The estimated average catch includes 2000 t which is assumed to have been caught and either dumped or not reported. Fishing activity is assumed to have been on the total stock, even though the entire area was not fished. Due to problems with QMA boundaries not corresponding to the fishing history boundaries, 500 t is subtracted and added to BAR 7.

$$MCY = 0.7 * (12\ 000\ t - 500\ t) = 8050\ t.$$

The level of risk to the stock by harvesting the population at the estimated *MCY* value cannot be determined. However, the risk is probably low given the sustainability of catches at about the *MCY* level since 1970.

MCY has not been determined for the other Fishstocks.

4.5 Other factors

The relationship of the southern area stock to the east and west coast South Island stocks is uncertain, so these areas have been treated separately as in the past. However, if fish from BAR 5 overlap significantly with other South Island stocks, then the *MCY*s for all Fishstocks on the South Island may all need adjusting downward.

Barracouta are part of the shelf (30–300 m) mixed fishery and are usually the dominant species in these depths around the South Island (except perhaps in good red cod years in the Canterbury Bight). Any increase or decrease in barracouta quotas will have overflow effects onto bycatch species. The economics of targeting on barracouta is probably affected by its availability relative to other more preferred species and this will, in turn, affect fishing patterns.

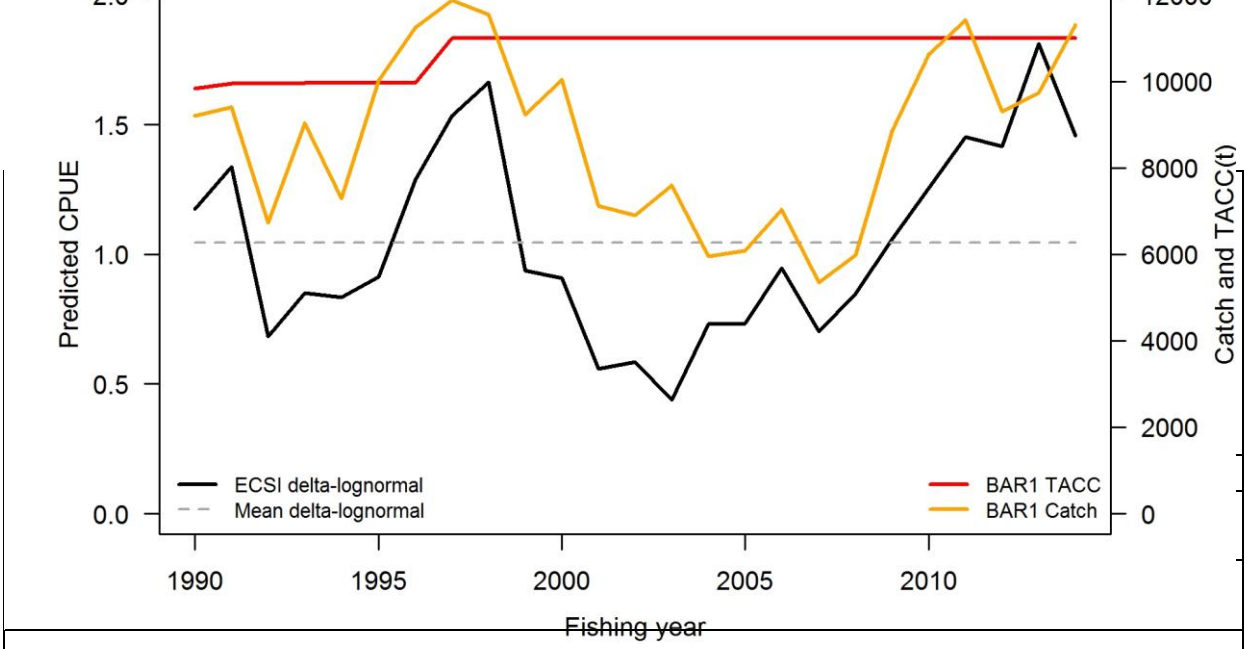
An analysis of trends in biomass of the Southland fishery suggests that recruitment may have been relatively low in the years after 1989 and that biomass may have declined between surveys by the *Shinkai Maru* (1981 and 1986) and the *Tangaroa* (annually 1993 to 1996). The scale of decline appeared to be greater than could be explained by different catching efficiencies of the two vessels.

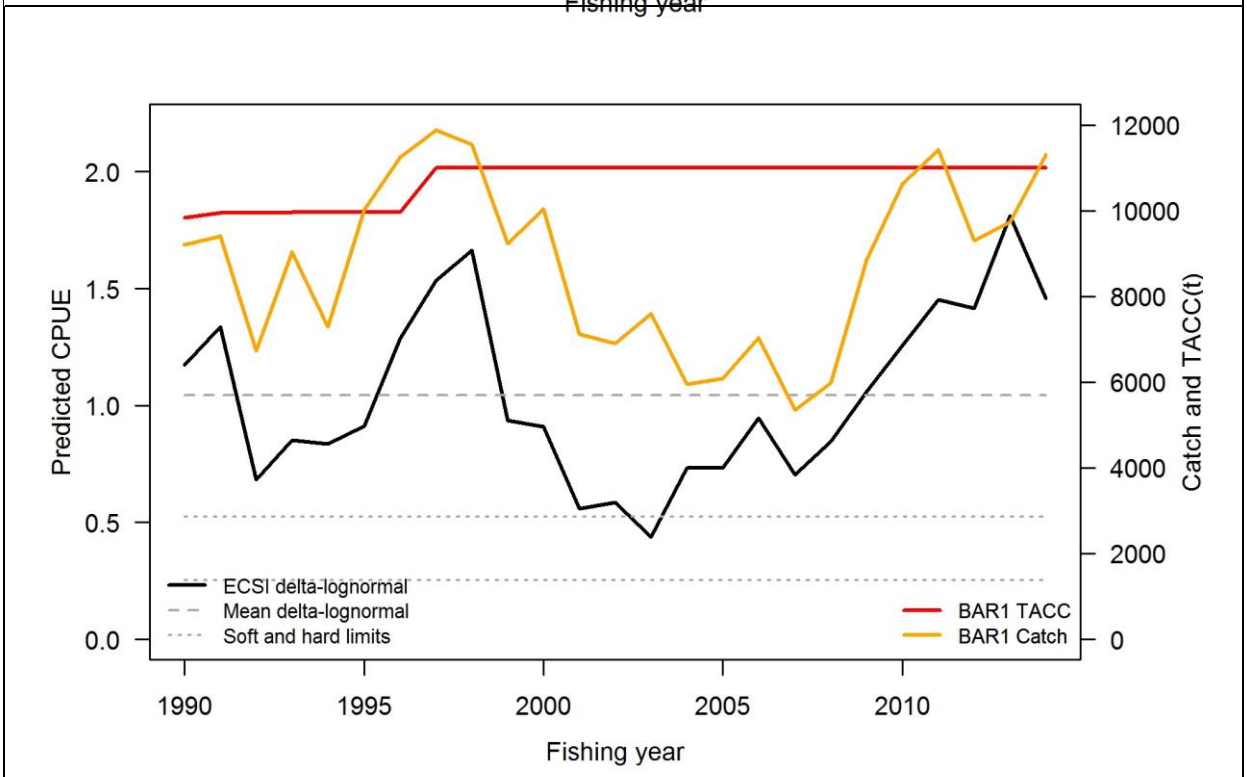
5. STATUS OF THE STOCKS

BAR 1

The current uinderstanding of the BAR 1 stock is that adult barracouta undertake an annual northward migration from the east coast of the South Island to spawn off the east coast of the North Island during July/August–September (see Hurst et al 2012). For the purposes of this analysis barracouta in BAR 1 are assumed to comprise a single stock.

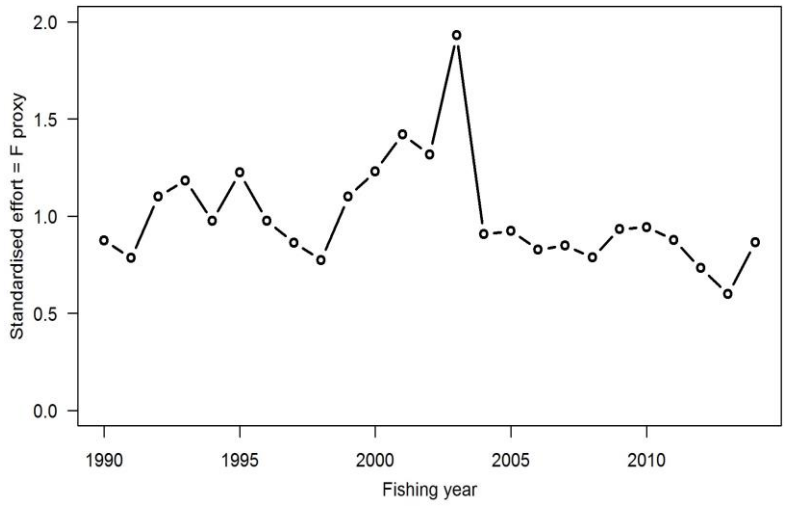
Stock Status	
Year of Most Recent Assessment	2016
Assessment Runs Presented	BAR 1 ECSI CELR/TCER day-level series (target species BAR, RCO, TAR)





Comparison of the ECSI CPUE series with the trajectories of catch (BAR 1 (QMR/MHR)) and TACCs from 1989–90 to 2013–14. Compare with the trawl survey trajectory shown in Figure 6.

Fishery and Stock Trends	
Recent trend in Biomass or Proxy	The BAR 1 CPUE series increased steeply from 2002–03 to a peak in 2012–13. The 2013–14 value was lower than the peak, but well above the series mean.

Recent trend in Fishing Mortality or Proxy	
Other Abundance Indices	The winter ECSI trawl survey series for recruited fish has a trend that is similar to the BAR 1 CPUE index, with a peak in 2014.
Trends in Other Relevant Indicator or Variables	Recent landings (2008–09 to 2013–14) are at a similar level to those recorded during 1994–95 to 1999–2000.

Projections and Prognosis	
Stock Projections or Prognosis	Quantitative stock projections are unavailable.
Probability of Current Catch or TACC causing Biomass to remain below or decline below Limits	Soft Limit: Unlikely (< 40%) as above average pre-recruit abundance was observed in the ESCSI trawl survey in 2014. Hard Limit: Unlikely (< 40 %)
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unknown

Assessment Methodology and Evaluation		
Assessment Type	Level 2: Partial Quantitative Stock Assessment.	
Assessment Method	Standardised CPUE series	
Assessment Dates	Latest assessment: 2016	Next assessment: 2019
Overall assessment quality rank	1 – High Quality.	
Main data inputs (rank)	- Catch and effort data - Trawl survey biomass indices and associated length	1 – High Quality 1 – High Quality

Data not used (rank)	TCEPR CPUE Series (ECSI) Standardised CPUE series (ECNI) Summer ECSI trawl survey data	3 – Low Quality: few vessels and highly variable CPUE 3 – Low Quality: insufficient data and high interannual variability 3 – Low Quality: variable catchability between years
Changes to Model Structure and Assumptions	N/A	
Major Sources of Uncertainty		

Qualifying Comments

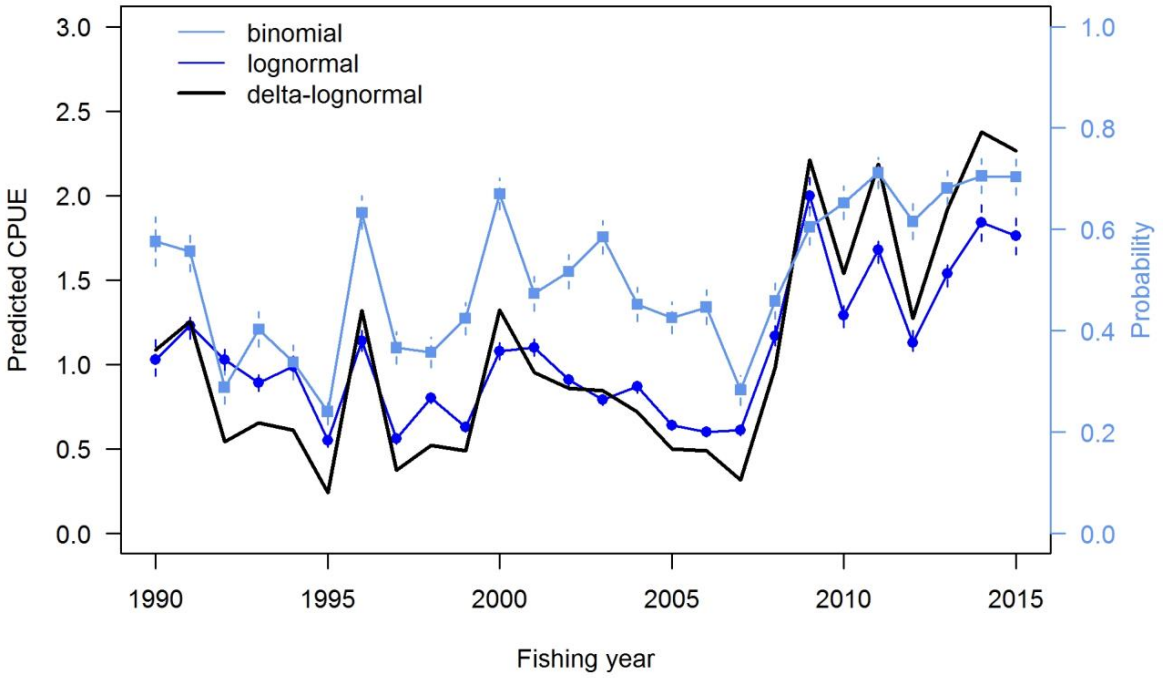
Fishery Interactions
Barracouta in the ECSI part of BAR 1 are taken as bycatch by inshore bottom trawl fisheries targeting, amongst others, red cod and tarakihi,. and red cod and arrow squid by deepwater vessels. ECSI bycatch also comes from midwater effort targeting jack mackerels. In the ECNI part of BAR 1, most barracouta bycatch is from tarakihi and red gurnard effort; currently, there is little targeting of barracouta in this area. The trawl fishery in the ECSI area is subject to management measures designed to reduce interactions with endemic Hector's dolphins and seabirds. There is also a risk of incidental capture of sea lions from Otago Peninsula south.

- **BAR 5**

CPUE analyses were completed for the main fisheries in BAR 5. The relationship between these southern fisheries and the WCSI is uncertain.

Stock Status	
Year of Most Recent Assessment	2016
Assessment Runs Presented	Standardised CPUE Sub-Antarctic (tow level)
Reference Points	Target: 40% B_0 Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: $F_{40\%B0}$
Status in relation to Target	Unknown
Status in relation to Limits	B_{2015} is Very Unlikely (< 10%) to be below both the soft and hard limits
Status in relation to Overfishing	Unknown

Historical Stock Status Trajectory and Current Status



BAR 5 CPUE Model 1b (South): binomial, lognormal and combined delta-lognormal CPUE indices for 1990–2015.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	-
Recent Trend in Fishing Intensity or Proxy	-
Other Abundance Indices	CPUE has remained at a high level since 2009 despite catches at or above the TACC.
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	-
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Very Unlikely (< 10%) Hard Limit: Very Unlikely (< 10%)
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unknown

Assessment Methodology and Evaluation		
Assessment Type	Level 2: Partial Quantitative Stock Assessment.	
Assessment Method	Standardised CPUE	
Assessment Dates	Latest assessment: 2016	Next assessment: 2019
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	Commercial CPUE	1 – High Quality

Data not used (rank)		
Changes to Model Structure and Assumptions	N/A	
Major sources of Uncertainty		

Qualifying Comments
None

Fishery Interactions
Barracouta are taken as a target species in BAR 5 and also as by-catch in the squid and warehou target fisheries.

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