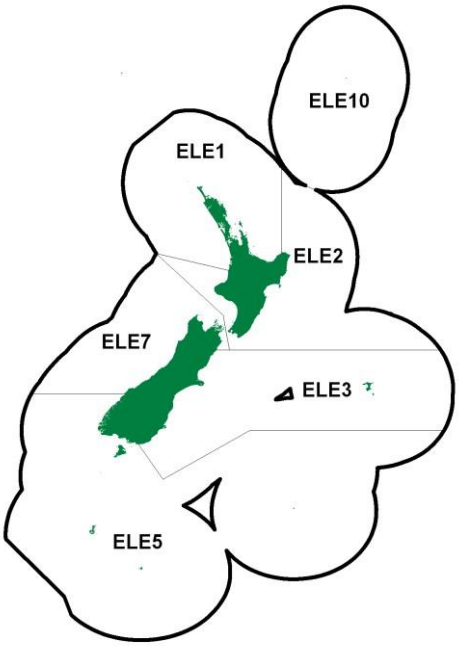
ELEPHANTFISH (ELE)

(*Callorhinchus milii*)
Reperepe



1.1 Commercial fisheries

From the 1950s to the 1980s, landings of elephantfish of around 1000 t/year were common. Most of these landings were from the area now encompassed by ELE 3, but fisheries for elephantfish also developed on the south and west coasts of the South Island in the late 1950s and early 1960s, with average catches of around 70 t per year in the south (in the 1960s to the early 1980s) and 10–30 t per year on the west coast. Total annual landings of elephantfish dropped considerably in the early 1980s (between 1982–83 and 1994–96 they ranged between 500 and 700 t) but later increased to the point that they have annually exceeded 1000 t since the 1995–96 fishing season. Reported landings since 1931 are shown in Tables 1 and 2, while an historical record of landings and TACC values for the three main ELE stocks are depicted in Figure 1. ELE 3 has customary, recreational and other mortality allowances of 5 t, 5 t, and 50 t respectively, and ELE 5 has allowances 5 t, 5 t, and 7 t respectively.

Table 1: Reported total landings of elephantfish for calendar years 1936 to 1982. Sources: MAF and FSU data.

Year	Landings (t)	Year	Landings (t)	Year	Landings (t)	Year	Landings (t)	Year	Landings (t)
1936	116	1946	235	1956	980	1966	1 112	1976	705
1937	184	1947	188	1957	1 069	1967	934	1977	704
1938	201	1948	230	1958	1 238	1968	862	1978	596
1939	193	1949	310	1959	1 148	1969	934	1979	719
1940	259	1950	550	1960	1 163	1970	1 128	1980	906
1941	222	1951	602	1961	983	1971	1 401	1981	690
1942	171	1952	459	1962	1 156	1972	1 019	1982	661
1943	220	1953	530	1963	1 095	1973	957		
1944	270	1954	853	1964	1 235	1974	848		
1945	217	1955	802	1965	1 111	1975	602		

The TACC for ELE 3 has, with the exception of 2002–03, been consistently exceeded since 1986–87. The ELE 3 TACC was consequently increased to 500 t for the 1995–96 fishing year, and then increased twice more under an Adaptive Management Programme (AMP): initially to 825 t in October 2000 and then to 950 t in October 2002. This new TACC combined with the allowances for customary and recreational fisheries (5 t each), increased the new TAC for the 2002–03 fishing year in ELE 3 to 960 t. For the 2009–10 fishing year, the TACC was increased from 960 t to 1000 t where it presently remains. ELE 3 fishing is seasonal, mostly occurring in spring and summer in inshore waters. Most of the increase in catch from the early 2000s in the ELE 3 trawl fishery has been taken as a bycatch of the flatfish target fishery and an emerging target ELE fishery (Starr & Kendrick 2013). During the 1990s, the level of elephantfish bycatch

from the RCO 3 trawl fishery increased from around 80 t/year to greater than 400 t in 2000–01 (Starr & Kendrick 2013). There was a steady increase in the level of ELE 3 bycatch from the FLA 3 trawl fishery, with catches increasing from around 70 t in 1994–95 to 300 t in 1999–00. There is also a significant setnet fishery in ELE 3, largely directed at rig and elephantfish, with the former fishery taking about 100 t/year and the latter between 40 and 70 t/year between 2008–09 and 2010–11.

The fishery in ELE 5 is mainly a trawl fishery targeted at flatfish and to a lesser extent giant stargazer. Very little catch in ELE 5 is taken by target setnet fisheries. Catches have been increasing consistently since 1992–93, exceeding the TACCs since 1995–96. The ELE 5 TACC was increased from 71 t to 100 t under an AMP in October 2001. The TACC was further increased under the AMP to 120 t in October 2004 and catches have exceeded this TACC by 70% in 2007–08 and 2008–09. For the 2009–10 fishing season, the TACC has was increased by 17% up from 120 t to 140 t. The ELE 5 TACC was further increased to 170t in 2012–13. All AMP programmes ended on 30 September 2009.

From 1 October 2008, a suite of regulations intended to protect Maui's and Hector's dolphins was implemented for all of New Zealand by the Minister of Fisheries. For ELE 3, commercial and recreational set netting was banned in most areas to 4 nautical miles offshore of the east coast of the South Island, extending from Cape Jackson in the Marlborough Sounds to Slope Point in the Catlins. Some exceptions were allowed, including an exemption for commercial and recreational set netting to only one nautical mile offshore around the Kaikoura Canyon, and permitting setnetting in most harbours, estuaries, river mouths, lagoons and inlets except for the Avon-Heathcote Estuary, Lyttelton Harbour, Akaroa Harbour and Timaru Harbour. In addition, trawl gear within 2 nautical miles of shore was restricted to flatfish nets with defined low headline heights. For ELE 7, both commercial and recreational setnetting were banned to 2 nautical miles offshore, with the recreational closure effective for the entire year and the commercial closure restricted to the period 1 December to the end of February. The closed area extends from Awarua Point north of Fiordland to the tip of Cape Farewell at the top of the South Island. Some interim relief to these regulations was provided in ELE 5 from 1 October 2008 to 24 December 2009.

Table 2: Reported landings (t) for the main QMAs from 1931 to 1990

Year	ELE 1	ELE 2	ELE 3	ELE 5	Year	ELE 1	ELE 2	ELE 3	ELE 5
1931–32	0	0	0	0	1957	0	2	992	28
1932–33	0	0	0	0	1958	0	0	1140	47
1933–34	0	0	0	0	1959	0	0	1066	37
1934–35	0	0	0	0	1960	0	1	1099	38
1935–36	0	0	0	0	1961	0	0	913	43
1936–37	0	0	79	0	1962	0	4	1066	73
1937–38	0	0	183	0	1963	0	2	976	111
1938–39	0	0	194	1	1964	0	3	1109	107
1939–40	0	1	190	1	1965	0	7	983	88
1940–41	0	1	243	8	1966	0	1	985	99
1941–42	0	0	220	1	1967	0	1	812	77
1942–43	0	0	163	6	1968	0	1	757	54
1943–44	0	0	219	1	1969	0	1	824	75
1944	0	0	251	10	1970	0	3	987	87
1945	0	2	205	3	1971	0	0	1243	103
1946	0	0	228	3	1972	0	0	928	70
1947	0	2	176	0	1973	0	0	864	73
1948	0	2	227	0	1974	0	0	766	97
1949	0	1	296	2	1975	0	1	557	55
1950	0	1	522	14	1976	0	0	622	91
1951	0	2	585	6	1977	0	0	601	114
1952	0	0	440	9	1978	0	0	552	49
1953	0	3	514	13	1979	0	0	661	63
1954	0	2	839	5	1980	0	0	794	129
1955	0	3	771	4	1981	0	1	543	114
1956	0	1	933	16	1982	0	0	584	85

Table 2 [Continued].

Year	ELE 7	Year	ELE 7
1931–32	0	1957	46
1932–33	0	1958	51
1933–34	0	1959	44
1934–35	0	1960	27
1935–36	0	1961	27
1936–37	1	1962	14
1937–38	0	1963	8
1938–39	2	1964	16
1939–40	1	1965	34
1940–41	1	1966	27
1941–42	0	1967	45
1942–43	0	1968	52
1943–44	0	1969	33
1944	0	1970	53
1945	3	1971	37
1946	4	1972	15
1947	10	1973	21
1948	9	1974	41
1949	13	1975	28
1950	13	1976	52
1951	10	1977	45
1952	5	1978	26
1953	3	1979	18
1954	7	1980	34
1955	25	1981	16
1956	29	1982	34

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 3: Reported landings (t) of elephantfish by Fishstock from 1983–84 to 2012–13 and actual TACCs (t) from 1986–87 to 2013–14. QMR data from 1986 – present. No landings have been reported from ELE 10.

Fishstock	ELE 1		ELE 2		ELE 3		ELE 5		ELE 7			
FMA (s)	1 & 9		2 & 8		3 & 4		5 & 6		7		Total	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1983–84*	< 1	-	5	-	605	-	94	-	60	-	765	-
1984–85*	< 1	-	3	-	517	-	134	-	50	-	704	-
1985–86*	< 1	-	4	-	574	-	57	-	46	-	681	-
1986–87	< 1	10	2	20	506	280	48	60	29	90	584	470
1987–88	< 1	10	3	20	499	280	64	60	44	90	610	470
1988–89	< 1	10	1	22	450	415	49	62	43	100	543	619
1989–90	< 1	10	3	22	422	418	32	62	55	101	510	623
1990–91	< 1	10	5	22	434	422	55	71	59	101	553	636
1991–92	< 1	10	11	22	450	422	58	71	78	101	597	636
1992–93	< 1	10	5	22	501	423	39	71	61	102	606	638
1993–94	< 1	10	6	22	475	424	46	71	41	102	568	639
1994–95	< 1	10	5	22	580	424	60	71	39	102	684	639
1995–96	< 1	10	7	22	688	500	72	71	93	102	862	715
1996–97	< 1	10	9	22	734	500	74	71	94	102	912	715
1997–98	< 1	10	12	22	910	500	95	71	66	102	1 082	715
1998–99	< 1	10	9	22	842	500	129	71	117	102	1 098	715
1999–00	< 1	10	6	22	950	500	105	71	87	102	1 148	715
2000–01	2	10	7	22	956	825	153	71	90	102	1 207	1 040
2001–02	< 1	10	9	22	852	825	105	100	88	102	1 053	1 057
2002–03	1	10	9	22	950	950	106	100	59	102	1 125	1 194
2003–04	< 1	10	10	22	984	950	102	100	42	102	1 139	1 194
2004–05	< 1	10	13	22	972	950	125	120	74	102	1 184	1 214
2005–06	< 1	10	14	22	1 023	950	147	120	76	102	1 260	1 214
2006–07	< 1	10	17	22	960	950	158	120	116	102	1 251	1 214
2007–08	< 1	10	16	22	1 092	950	202	120	125	102	1 435	1 214
2008–09	1	10	21	22	1 063	950	208	120	91	102	1 384	1 214
2009–10	< 1	10	21	22	1 089	1 000	176	140	86	102	1 372	1 274
2010–11	< 1	10	14	22	1 123	1 000	153	140	93	102	1 384	1 283
2011–12	< 1	10	16	22	1 074	1 000	157	140	130	102	1 377	1 283
2012–13	< 1	10	16	22	1 140	1 000	157	170	123	102	1 436	1 304
2013–14	<1	10	16	22	1110	1000	173	170	96	102	1394	1304

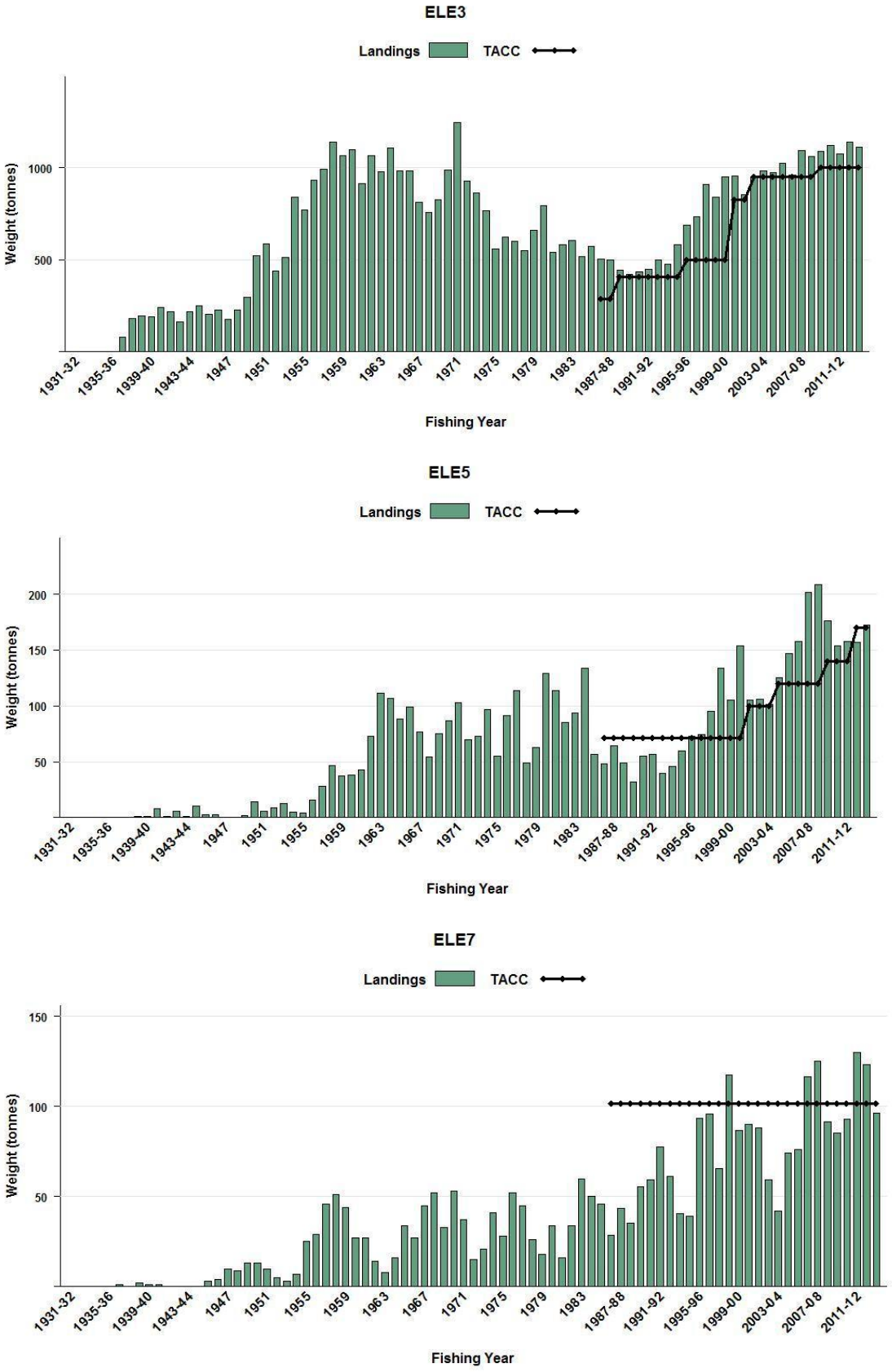


Figure 1: Reported commercial landings and TACC for the three main ELE stocks. From top left: ELE 3 (South East Coast and Chatham Rise), ELE 5 (Southland and Sub-Antarctic), and ELE 7 (Challenger).

1.2 Recreational fisheries

Catches of elephantfish by recreational fishers are low compared to those of the commercial sector. Recreational fishing surveys carried out by the MAF Fisheries in the early 1990s estimated the recreational catch of elephantfish in the South region of ELE 3 in 1991–92 at 3000 fish, 1000 fish in the central region of ELE 7 in 1992–93, and no catch was reported in the North region in 1993–94 (Teirney et al 1997). The national diary survey of recreational fishers in 1996 estimated that recreational catches of elephantfish were fewer than 500 fish in ELE 2, 1000 fish in ELE 3 and fewer than 500 fish in ELE 7 (Bradford 1998). Estimates from the 1999–2000 recreational survey were 1000 fish in ELE 2, 2000 fish in ELE 3 and fewer than 500 in ELE 7 (Boyd & Reilly 2002). Owing to biases inherent in telephone relative to face-to-face interviews, the 1999–2000 estimate is regarded to be the most accurate. The Recreational Technical Working Group concluded that the harvest estimates from the diary surveys 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.

1.3 Customary non-commercial fisheries

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

1.4 Illegal catch

There are reports of discards of juvenile elephantfish by trawlers from some areas. However, no quantitative estimates of discards are available.

1.5 Other sources of mortality

The significance of other sources of mortality has not been documented.

2. BIOLOGY

Elephantfish are uncommon off the North Island and occur south of East Cape on the east coast and south of Kaipara on the west coast. They are most plentiful around the east coast of the South Island.

Males mature at a length of 50 cm fork length (FL) at an age of 3 years, females at 70 cm FL at 4 to 5 years of age. The maximum age cannot be reliably estimated, but appears to be at least 9 years and may be as high as 15 years. The M value of 0.35 used is based on unvalidated ageing work indicating a maximum age of 13 years. This results from use of the equation $M = \log_e 100/\text{maximum age}$, where maximum age is the age to which 1% of the population survives in an unexploited stock.

Mature elephantfish migrate to shallow inshore waters in spring and aggregate for mating. Eggs are laid on sand or mud bottoms, often in very shallow areas. They are laid in pairs in large yellow-brown egg cases. The period of incubation is at least 5–8 months, and juveniles hatch at a length of about 10 cm FL. Females are known to spawn multiple times per season. After egg laying the adults are thought to disperse and are difficult to catch; however, juveniles remain in shallow waters for up to 3 years. During this time juveniles are vulnerable to incidental trawl capture, but are of little commercial value.

Biological parameters relevant to the stock assessment are shown in Table 4. Provisional von Bertalanffy growth curves based on MULTIFAN are available for Pegasus Bay and Canterbury Bight in 1966–68 and 1983–88. Because the growth curves were based on a MULTIFAN analysis of length-frequency data, the ages of the larger fish were probably underestimated and the growth curves are only reliable to about 4–5 years. Fish appeared to grow faster in the 1980s than in the 1960s.

Table 4: Estimates of biological parameters for elephant fish.

Fishstock	Estimate				Source
1. Natural mortality (*M*)					
All	0.35				Francis (1997)
2. Weight = a (length)^b (Weight in g, length in cm fork length)					
	Both sexes				
	a	b			
ELE 3	0.0091	3.02			Gorman (1963)
3. von Bertalanffy Growth Function					
	Pegasus Bay 1966–68		Canterbury Bight 1966–68		
	Males	Females	Males	Females	Francis (1997)
K (yr^{-1})	0.231 ± 0.002	0.096 ±0.001	0.089 ± 0.002	0.060 ± 0.001	
L_∞ (cm)	74.7 ± 0.12	156.9 ± 1.38	141.5 ± 2.28	203.6 ± 3.2	
t_0 (yr)	-0.78 ± 0.008	-0.87 ± 0.006	-0.96 ± 0.008	-1.06 ± 0.009	
	Pegasus Bay 1983–84		Canterbury Bight 1988		
	Males	Females	Males	Females	
K (yr^{-1})	0.473 ± 0.009	0.195 ±0.008	0.466 ± 0.008	0.224 ± 0.001	
L_∞ (cm)	66.9 ± 0.52	113.9 ± 2.89	62.7 ± 0.23	94.1 ± 0.26	
t_0 (yr)	-0.24 ± 0.017	-0.53 ± 0.023	-0.38 ± 0.015	-0.69 ± 0.006	

3. STOCKS AND AREAS

There are no data that would alter the current stock boundaries. Results from tagging studies conducted during 1966–69 indicate that elephantfish tagged in the Canterbury Bight remained in ELE 3. Separate spawning grounds to maintain each 'stock' have not been identified. The boundaries used are related to the historical fishing pattern when this was a target fishery.

4. STOCK ASSESSMENT

4.1 Estimates of fishery parameters and abundance

4.1.1 Trawl survey biomass indices

4.1.2 Biomass estimates

ECSI Trawl Survey

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 elephantfish and red gurnard which were included in the target species. Only the 2007, 2012, and 2014 surveys provide full coverage of the 10–30 m depth range.

Elephantfish total biomass in the east coast South Island winter surveys core strata (30–400 m) increased markedly in 1996 and although it has fluctuated since then it remained high with the 2014 biomass 8% below the post-1994 average of 1032 t (Table 4, Figure 2). The post 1994 average biomass was about three-fold greater than that of the early 1990s, indicating that the large increase in biomass between 1994 and 1996 was sustained. The proportion of pre-recruited biomass in the core strata varied greatly among surveys ranging from 50% in 2007 to only 5% in 2012, the latter value reflecting the high numbers of large fish present in 2012 (Table 4). In 2014 18% of the total biomass was pre-recruit fish. Similarly, the proportion of juvenile biomass (based on the length-at-50% maturity) in 2012 was the lowest of all surveys at 23% and in 2014 it increased to 28% (Figure 3).

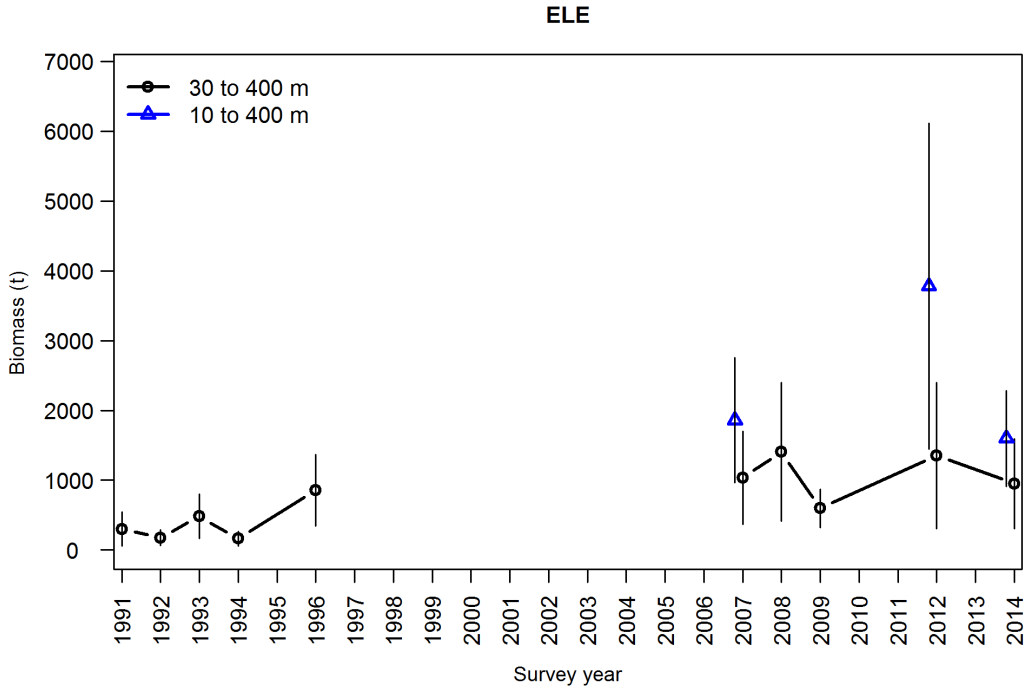


Figure 2: Elephantfish total biomass and 95% confidence intervals for all ECSI winter surveys in core strata (30–400 m), and core plus shallow strata (10–400 m) in 2007, 2012 and 2014.

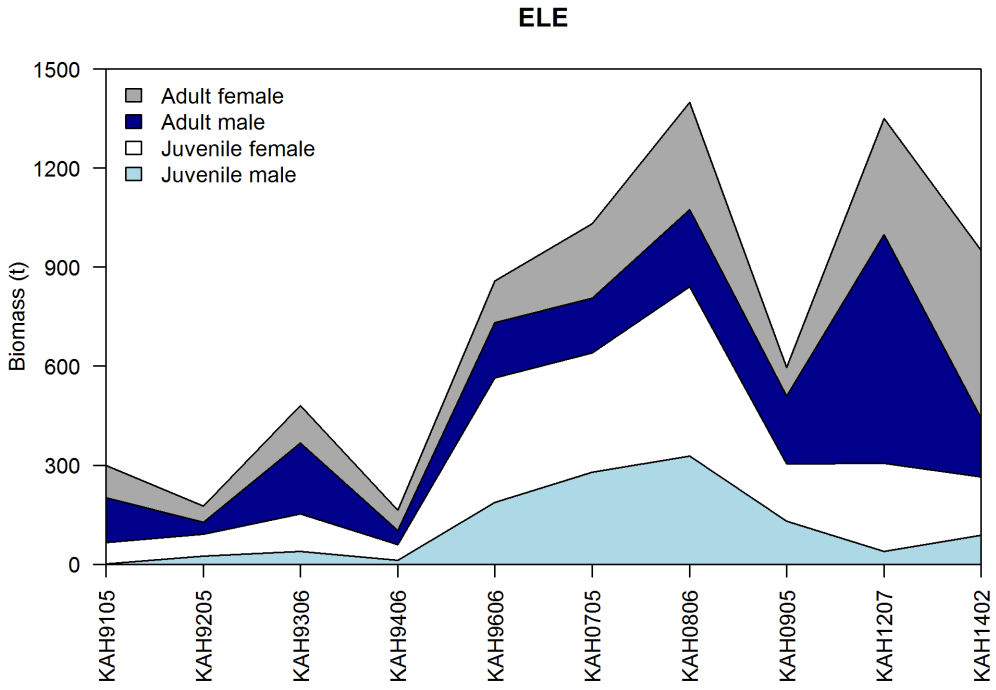


Figure 3: Elephantfish juvenile and adult biomass for ECSI winter surveys in core strata (30–400 m), where juvenile is below and adult is equal to or above the length at which 50% of fish are mature.

Biomass in the core plus shallow strata in 2014 was less than half that in 2012 (Figure 2). The additional elephantfish biomass captured in the 10–30 m depth range accounted for 44%, 64% and 41% of the biomass in the core plus shallow strata (10–400 m) for 2007, 2012 and 2014 respectively, indicating that it is essential to continue monitoring the shallow strata for elephantfish biomass (Table 4, Figure 2). Further, the addition of the 10–30 m depth range had a significant effect on the shape of the length frequency distributions with the appearance of strong 1+ and 2+ cohorts, otherwise poorly represented in the core

strata (Figure 5). The proportion of pre-recruit biomass in the core plus shallow strata was also greater than that of the core strata alone, a reflection of the larger numbers of smaller elephantfish found in the shallow strata (Table 5).

The distribution of elephantfish hot spots varies, but overall this species is consistently well represented over the entire survey area from 10 to 100 m, but is most abundant in the shallow 10 to 30 m.

WCSI Trawl Survey

For WCSI Trawl Surveys, elephantfish (ELE 7) total biomass estimates are variable between successive surveys and the biomass estimates are frequently imprecise, particularly for the higher biomass estimates (Table 5). The last three trawl surveys (2009, 2011 and 2013) have estimated relatively high levels of recruited biomass compared to the biomass estimates from the earlier surveys (Figure 4). However, of the three recent surveys, only the 2013 survey provided a biomass estimate with a reasonable level of precision (CV 26%). The survey estimates of pre-recruit biomass are also poorly determined.

4.1.3 Length frequency distributions

The size distributions of elephantfish are inconsistent among the core strata (30–400 m) for the east coast South Island trawl surveys and generally characterised by a wide right hand tail of 3+ and older fish (up to about 10 years) and the occasional poorly represented 1+ and 2+ cohort modes (see 2007 and 2008 surveys, Figure 5). The time series of length frequency distributions in the shallow plus core strata (10–400) includes only the 2007, 2012 and 2014 surveys, and have similar modal distributions, but with higher proportions of juvenile cohorts.

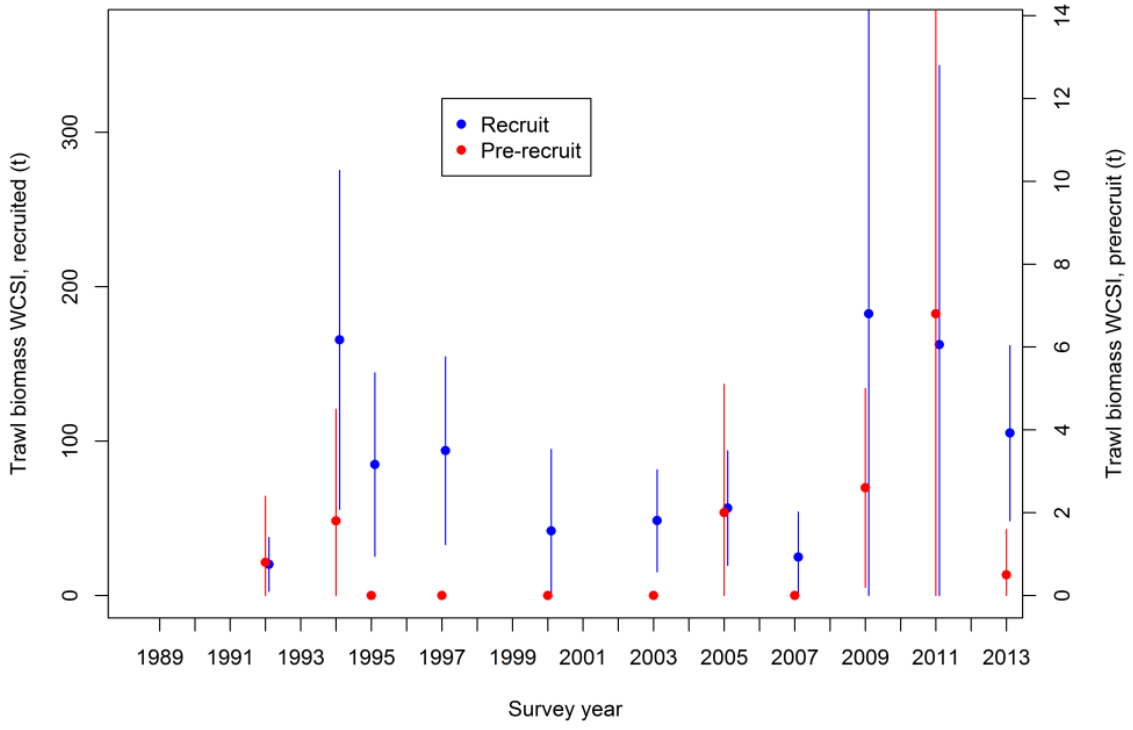


Figure 4: Elephantfish trawl survey pre-recruit and recruited biomass estimates for the west coast South Island area of the WCSI trawl survey, with associated confidence intervals. Recruited fish were defined as fish above 40 cm T.L.

Table 5: Relative biomass indices (t) and coefficients of variation (CV) for elephant fish for east coast South Island (ECSI) - summer and winter, west coast South Island (WCSI) and the Stewart-Snares Island survey areas*. Biomass estimates for ECSI in 1991 have been adjusted to allow for non-sampled strata (7 and 9 equivalent to current strata 13, 16 and 17). The sum of pre-recruit and recruited biomass values do not always match the total biomass for the earlier surveys because at several stations length frequencies were not measured, affecting the biomass calculations for length intervals. – , not measured; NA, not applicable. Recruited is defined as the size-at-recruitment to the fishery (50 cm).

Region	Fishstock	Year	Trip number	Total Biomass estimate	CV (%)	Total Biomass estimate	CV (%)	Pre-recruit	CV (%)	Pre-recruit	CV (%)	Recruited	CV (%)	Recruited	CV (%)
ECSI(winter)	ELE 3			30–400 m		10–400 m		30–400 m		10–400 m		30–400 m		10–400 m	
		1991	KAH9105	300	40	-	-	NA	NA	-	-	NA	NA	-	-
		1992	KAH9205	176	32	-	-	54	83	-	-	122	28	-	-
		1993	KAH9306	481	33	-	-	60	56	-	-	421	34	-	-
		1994	KAH9406	152	33	-	-	22	51	-	-	142	34	-	-
		1996	KAH9606	858	30	-	-	338	40	-	-	520	26	-	-
		2007	KAH0705	1 034	32	1 859	24	516	59	1 201	36	518	21	658	20
		2008	KAH0806	1404	35	-	-	627	57	-	-	777	27	-	-
		2009	KAH0905	596	23	-	-	210	38	-	-	387	25	-	-
		2012	KAH1207	1 351	39	3 781	31	66	46	581	25	1 285	39	3 199	36
		2014	KAH1402	951	34	1600	21	174	32	429	25	777	40	1 171	28
ECSI(summer)	ELE 3	1996–97	KAH9618	1 127	31	-	-	-	-	-	-	-	-	-	-
		1997–98	KAH9704	404	18	-	-	-	-	-	-	-	-	-	-
		1998–99	KAH9809	1 718	28	-	-	-	-	-	-	-	-	-	-
		1999–00	KAH9917	1 097	25	-	-	-	-	-	-	-	-	-	-
								-	-	-	-	-	-	-	-
		2000–01	KAH0014	693	18	-	-	-	-	-	-	-	-	-	-
								-	-	-	-	-	-	-	-
WCSI	ELE 7	1992	KAH9204	38	42	-	-	-	-	-	-	-	-	-	-
		1994	KAH9404	167	33	-	-	-	-	-	-	-	-	-	-
		1995	KAH9504	85	35	-	-	-	-	-	-	-	-	-	-
		1997	KAH9701	94	33	-	-	-	-	-	-	-	-	-	-
		2000	KAH0004	42	63	-	-	-	-	-	-	-	-	-	-
		2003	KAH0304	49	34	-	-	-	-	-	-	-	-	-	-
		2005	KAH0503	59	33	-	-	-	-	-	-	-	-	-	-
		2007	KAH0704	28	53	-	-	-	-	-	-	-	-	-	-
		2009	KAH0904	185	83	-	-	-	-	-	-	-	-	-	-
		2011	KAH1104	170	53	-	-	-	-	-	-	-	-	-	-
		2013	KAH1305	110	26										
Stewart-Snares	ELE 5	1993	TAN9301	219	33	-	-	-	-	-	-	-	-	-	-
		1994	TAN9402	177	47	-	-	-	-	-	-	-	-	-	-
		1995	TAN9502	69	49	-	-	-	-	-	-	-	-	-	-
		1996	TAN9604	137	46	-	-	-	-	-	-	-	-	-	-

*Assuming area availability, vertical availability and vulnerability equal 1.0. Biomass is only estimated outside 10 m depth except for COM9901 and CMP0001. Note: because trawl survey biomass estimates are indices, comparisons between different seasons (e.g., summer and winter ECSI) are not strictly valid.

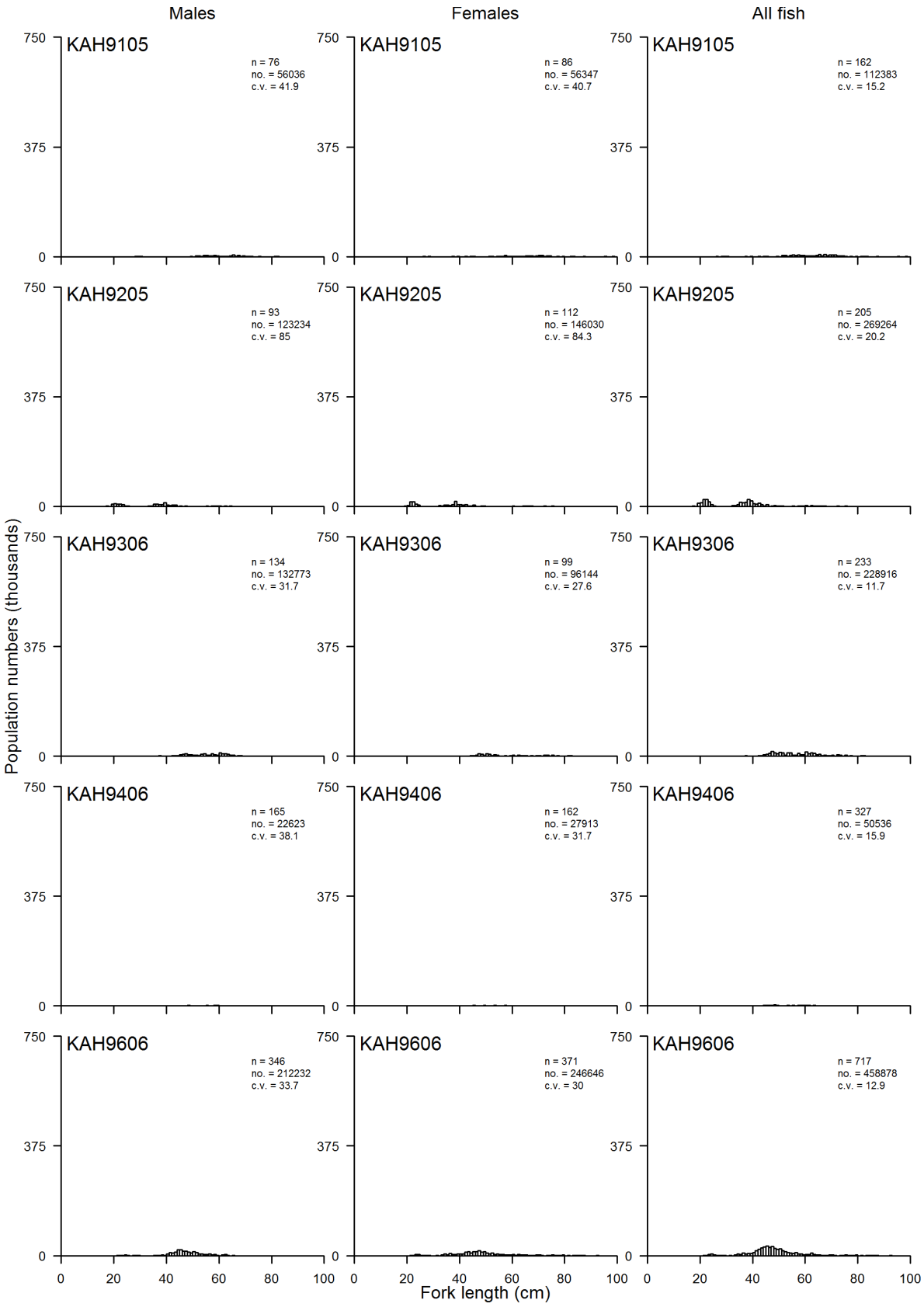


Figure 5 Scaled length frequency distributions for elephantfish in core strata (30–400 m) for all ten ECSI winter surveys. The length distribution is also shown in the 10–30 m depth strata for the 2007, 2012 and 2014 surveys overlaid (not stacked) in light grey. Population estimates are for the core strata only, in thousands of fish. Scales are the same for males, females and unsexed [Continued on next page]

ELEPHANT FISH (ELE)

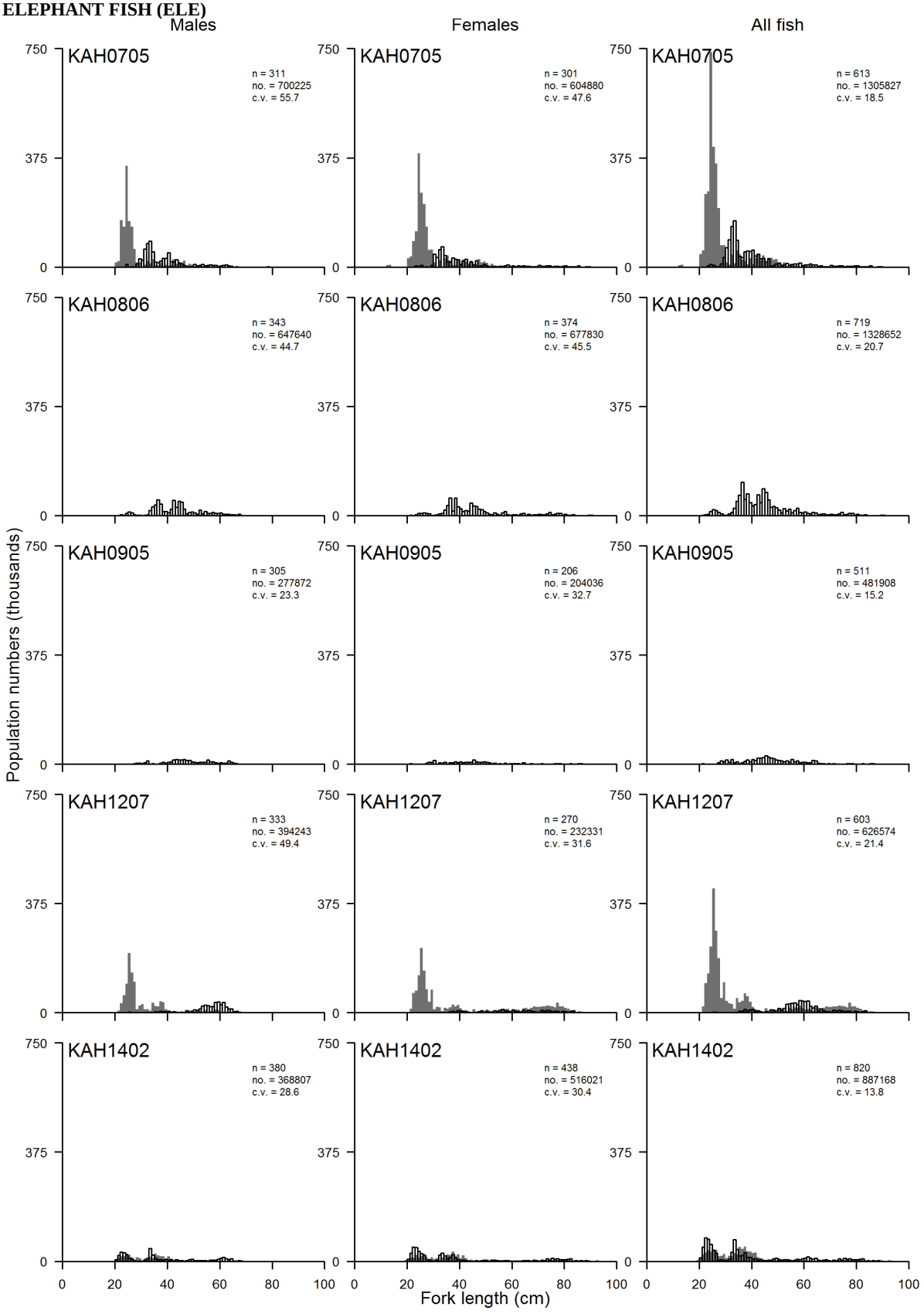


Figure 5 [continued]: Scaled length frequency distributions for elephantfish in core strata (30–400 m) for all ten ECSI winter surveys.The length distribution is also shown in the 10–30 m depth strata for the 2007, 2012 and 2014 surveys overlaid (not stacked) in light grey. Population estimates are for the core strata only, in thousands of fish. Scales are the same for males, females and unsexed

4.1.2 CPUE biomass indices

ELE 3 and ELE 5

Three standardised CPUE series for ELE 3 were prepared for 2012, with each series based on the bycatch of elephantfish in bottom trawl fisheries defined by different target species combinations. Initially, the Working Group accepted a series based solely on the bycatch of elephantfish when targeting red cod. It then requested two further analyses: one [ELE 3(MIX)] where the target species definition was expanded to include STA, BAR, TAR, and ELE, as well as RCO to investigate the effect of target species switching by explicitly standardising for target species effects. The second analysis [ELE 3(MIX)-trip] was done on all trips that targeted RCO, STA, BAR, TAR, and ELE at least once, then amalgamating all data to the level of a trip. This removed the differences between the TCEPR, TCER and CELR forms, but loses all targeting information.

The three sets of ELE 3 CPUE indices (ELE 3(RCO), ELE 3(MIX) and ELE 3(MIX)-trip) were very similar for the 1989–90 to 2010–11 years. In 2014, the ELE 3(MIX) CPUE model was updated to include additional data from 2011–12 and 2012–13 (Langley 2014).The resulting CPUE indices were very similar to the previous analysis for the comparable period. Standardised CPUE has fluctuated without trend since 2009–10 and the 2012–13 data point is near the interim target (see below) (Figure 6).

The Working Group agreed in 2009 to drop the ELE 3-SN(SHK) and ELE 5-SN(SHK) (setnet with shark target species) indices because the setnet fisheries in these two QMAs have been substantially affected by management interventions (including measures to reduce the bycatch of Hector's dolphins) and no longer appeared to be an appropriate index of ELE abundance in either QMA.

***B_{MSY}* conceptual proxy:** The Working Group proposed using the average of the ELE 3(MIX) series from 1998–99 to 2010–11 to represent a "*B_{MSY}* conceptual proxy" for the ELE 3 Fishstock. This period was selected because of its relative stability following a period of continuous increase. However, the Working Group has concerns about the reliability of this as a proxy and suggested that it only be used on an interim basis.

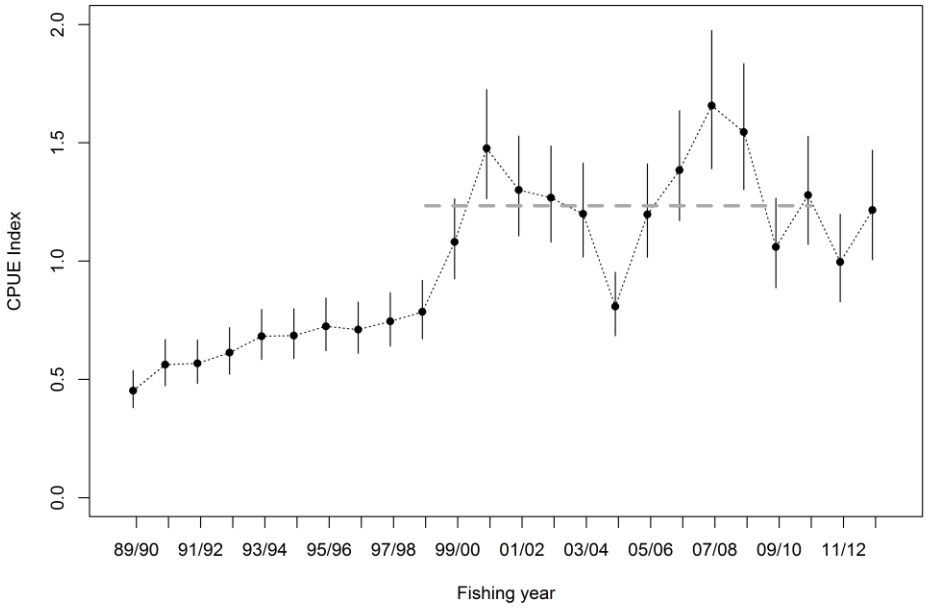


Figure 6: Standardised CPUE indices for the ELE 3 bottom trawl fisheries [ELE 3(MIX)]. The horizontal grey line is the mean of ELE 3(MIX) from 1998–99 to 2010–11 (*B_{MSY}* conceptual proxy). The CPUE series has been normalised to a geometric mean of 1.0. Error bars show 95% confidence intervals.

Two standardised CPUE series for ELE 5 were prepared for 2012 with each series based on the bycatch of elephantfish in the bottom trawl fisheries defined by target species combinations (Starr & Kendrick 2013). One of these series [ELE 5 (MIX)] is analogous to the MIX series developed for ELE 3, with the series defined by six target species in all valid ELE 5 statistical areas. The second ELE 5 analysis [ELE 5 (MIX)-trip] was a trip-based analysis using the same target species selection method as described for ELE 3(MIX)-trip. The two sets

of indices were very similar.

In 2014, the ELE 5(MIX) CPUE model was updated to include data from 2011–12 to 2012–13 (Langley 2014). The two most recent indices were lower than the peak CPUE from 2008–09 to 2010–11, although CPUE has been maintained at a relatively high level compared to the 1990s–early 2000s (Figure 7). There are relatively broad confidence intervals associated with the individual CPUE indices and there is no strong trend in the CPUE indices during 2005–06 to 2012–13.

***B*$_{MSY}$ conceptual proxy:** The Working Group was unable to agree on an appropriate "*B*$_{MSY}$ conceptual proxy" for ELE 5 because of the continually increasing nature of the series. CPUE would need to stabilise or decline before a suitable target could be established.

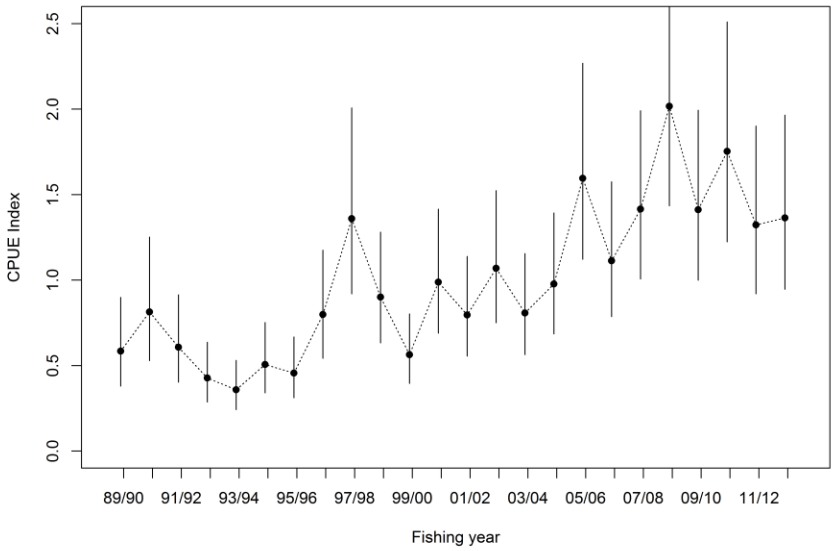


Figure 7: Standardised CPUE indices for a mixed target species ELE 5 bottom trawl fisheries [ELE 5- (MIX)]. Error bars show 95% confidence intervals.

ELE 7

A preliminary CPUE analysis of the catch of elephantfish from the WCSI inshore trawl fishery was conducted in 2013 and updated in 2014 (Langley 2014). The analysis included all bottom trawl catch and effort data targeting either flatfish, red gurnard, red cod or elephantfish. These target trawl fisheries encompass almost all the trawl fishing effort within the depth range that encompasses most of the catch of elephantfish off the west coast of the South Island (5–80 m). The primary analysis was conducted based on catch and effort data from 1989–90 to 2012–13 aggregated in a format that was consistent with the CELR reporting format. The landed catch of elephantfish from each trip was apportioned to the effort records either based on the associated level of estimated catch or, where estimated catches were not recorded, in proportion to the number of trawls in each aggregated effort record.

The data set included a significant proportion of trip and effort records with no elephantfish catch, although the proportion of nil catch records decreased steadily over the study period. Thus, the overall CPUE for the fishery was modelled in two components: the binomial model of the proportion of positive catches and the lognormal model of the magnitude of the positive catch. The two components were combined to generate a time series of delta-lognormal CPUE indices. The sensitivity of the catch threshold used to define a positive catch (i.e. 0, 1kg, 2kg and 5kg) was investigated. The resulting binomial and lognormal CPUE indices were sensitive to the applied catch threshold; however, the compensatory changes in the two sets of indices resulted in delta-lognormal indices that were relatively insensitive to the applied catch threshold.

The resulting CPUE indices fluctuated over the study period with a marked peak in CPUE in 1999–2000 and 2000–01 and low CPUE in 1997–98 and 2003–04 (Figure 8). The CPUE indices remained stable during 2007–08 to 2009–10, increased in 2010–11, increased markedly in 2011–12 and remained at the higher level in 2012–13. In 2014, the SINS WG concluded that the CPUE indices were unlikely to be a reliable index of stock abundance, primarily on the basis that the large inter-annual variations in the CPUE indices especially during the late 1990s and early 2000s were not consistent with the dynamics of the stock and may be attributable to changes in the operation of the WCSI trawl fishery at that time.

A separate delta-lognormal CPUE analysis was conducted for the location based TCER catch and effort data from 2007–08 to 2012–13 (Langley 2014). The resulting CPUE models incorporated a number of additional explanatory variables available in the high resolution data format. The TCER delta-lognormal CPUE indices were broadly similar to the CELR format CPUE indices for the comparative period The TCER indices exhibited a comparable increase in CPUE from 2009–10 to 2011–12, although the TCER indices were higher in 2007–08 to 2008–09 than the CELR format indices. In 2015, the TCER CPUE indices were updated to include the 2013–14 fishing year (Figure 8). The SINS WG concluded that the TCER CPUE indices represented the best available information for monitoring trends in ELE 7 stock abundance.

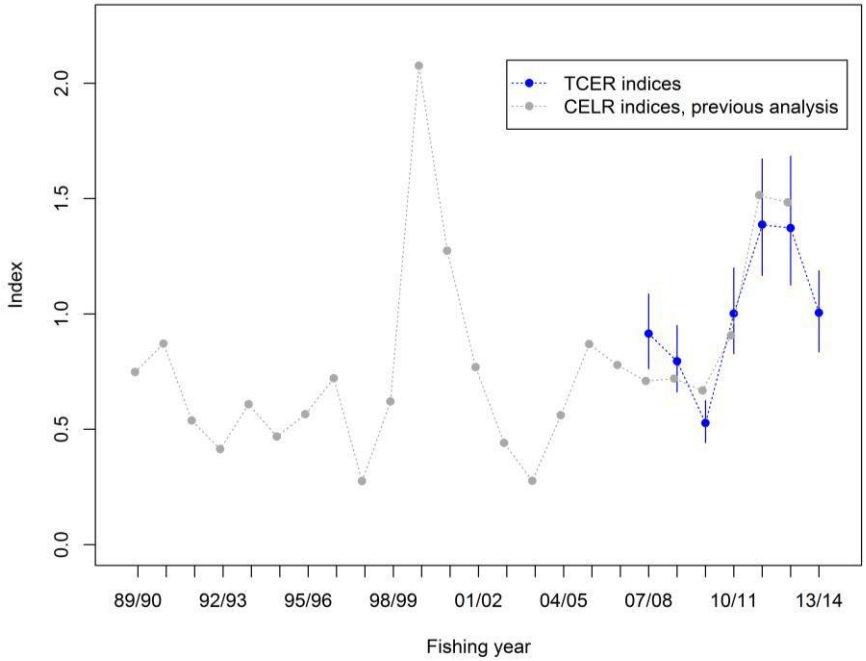


Figure 8. Standardised Delta-lognormal CPUE indices for the ELE 7 inshore WCSI trawl fishery for the entire time series configured in CELR data format and for indices derived from the location based TCER data set. Both sets of indices are normalised to the comparable time period (2007–08 to 2012–13). The error bars represent the 95% confidence interval.

4.2 Biomass Estimates

Estimates of current and reference absolute biomass are not available.

4.3 Yield estimates and projections

No other yield estimates are available.

5. STATUS OF THE STOCKS

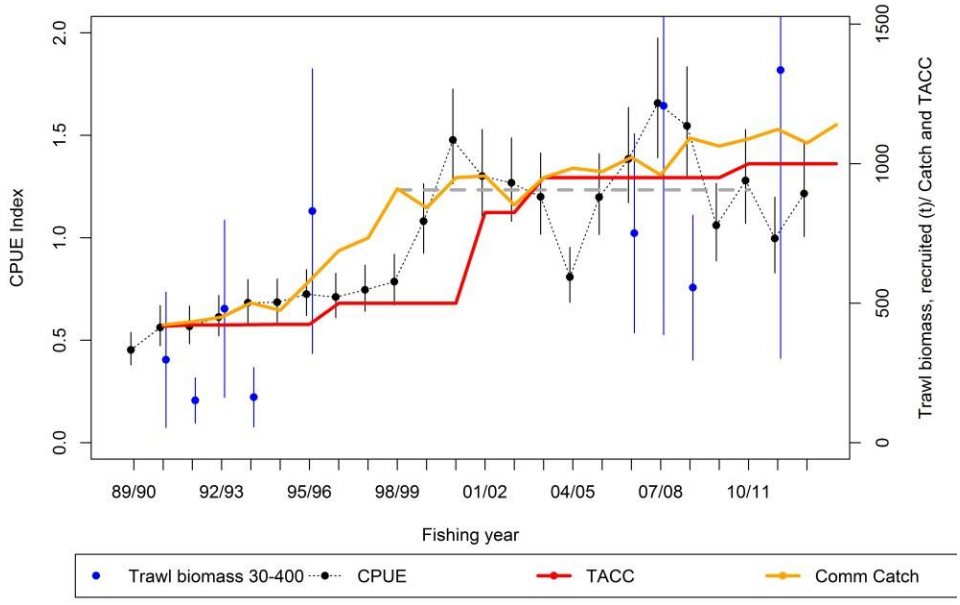
ELE 1
No estimates of current and reference biomass are available.

ELE 2
It is not known if recent catch levels or the current TACC are sustainable. The state of the stock in relation to B_{MSY} is unknown.

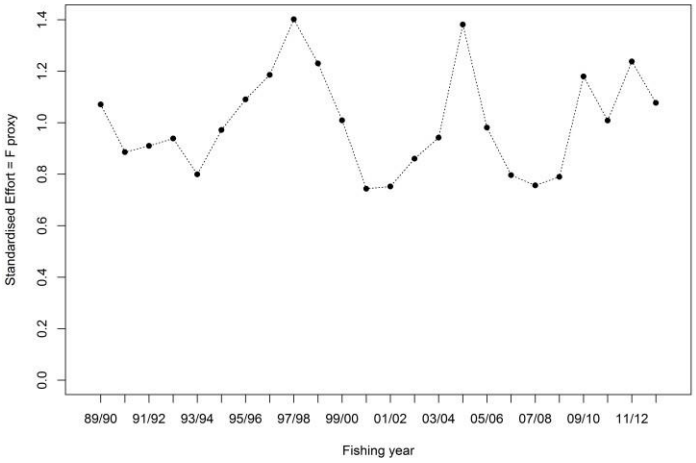
ELE 3
Stock Structure Assumptions
No information is available on the stock separation of elephantfish. The Fishstock ELE 3 is treated in this summary as a unit stock.

Stock Status	
Year of Most Recent Assessment	2014
Assessment Runs Presented	Update ELE 3 (MIX) CPUE series
Reference Points	(Proposed) Target: B_{MSY}-compatible proxy based on CPUE (average from 1998–99 to 2010–11 of the ELE 3(MIX) model as defined in Starr & Kendrick 2013) Soft Limit: 50% of target Hard Limit: 25% of target Overfishing threshold: F_{MSY} (assumed)
Status in relation to Target	About as Likely as Not (40–60%) to be at or above the target
Status in relation to Limits	Soft Limit: Unlikely (< 40%) to be below Hard Limit: Very Unlikely (< 10%) to be below
Status in relation to Overfishing	Overfishing is Unlikely (< 40%) to be occurring

Historical Stock Status Trajectory and Current Status
CPUE, Catch and TACC Trajectories



Comparison of the mixed target species bottom trawl CPUE series (ELE 3(MIX)) with the trajectories of catch (ELE 3(QMR/MHR)) and TACCs from 1989–90 to 2012–13 and winter trawl survey estimates of recruited biomass (fish greater than 40 cm). The dashed line is the target.

Fishery and Stock Trends	
Recent trend in Biomass or Proxy	The ELE 3(MIX) CPUE series, which is considered to be an index of stock abundance, showed a generally increasing trend from the beginning to reach a peak in 2007–08. CPUE indices have remained relatively stable below the peak level since 2009–10, remaining near the proposed target.
Recent trend in Fishing Mortality or Proxy	 Fishing mortality proxy is Standardised Fishing Effort = Total catch/CPUE (normalised). Fishing mortality proxy has fluctuated about the average level and was above average in the most recent years.
Other Abundance Indices	Although there is high inter-annual variation, the winter ECSI trawl survey index shows a trend that is consistent with the ELE 3(MIX) CPUE index.
Trends in Other Relevant Indicator or Variables	Current landings (2007–08 to 2012–13) are at a similar level to those recorded in the 1960s and early 1970s. The stock was believed to be at low levels in the early 1980s.

Projections and Prognosis	
Stock Projections or Prognosis	Quantitative stock projections are unavailable.
Probability of Current Catch or TACC causing decline below Limits	Soft Limit: Unlikely (< 40%) Hard Limit: Very Unlikely (< 10%)
Probability of Current Catch or TACC causing Overfishing to continue or to commence	The TACC and current reported catches are Unlikely (< 40%) to cause overfishing.

Assessment Methodology and Evaluation		
Assessment Type	Level 2: Standardised CPUE abundance index and the winter ECSI trawl survey index.	
Assessment Method	Evaluation of agreed standardised CPUE indices which reflect changes in abundance as well as the trawl survey biomass indices.	
Assessment Dates	Latest assessment: 2014	Next assessment: 2015
Overall assessment quality rank	1 – High Quality. The Southern Inshore Working Group agreed that the ELE 3(MIX) CPUE index was a credible measure of abundance.	
Main data inputs (rank)	- Catch and effort data - Trawl survey biomass indices and associated length frequencies	1 – High Quality 1 – High Quality

Data not used (rank)	Compass Rose trawl survey data Summer ECSI trawl survey data	3 – Low Quality: insufficient data 3 – Low Quality: variable catchability between years
Changes to Model Structure and Assumptions	None since 2012 assessment	
Major Sources of Uncertainty	- It is possible that discarding and management changes in this fishery have biased the CPUE trends reported for this fishery.	

Qualifying Comments
Elephantfish have shown good recovery since apparently being at low biomass levels in the mid-1980s. Good abundance of pre-recruit elephantfish was seen in the 2007 length frequencies from the resumed winter east coast South Island trawl survey. There are potentially enough data to undertake a quantitative stock assessment for ELE 3, but this would require ageing of spines collected by the trawl survey. This may allow the estimation of B_{MSY} and other reference points. With respect to the conceptual proxy, the Working Group and the Plenary has concerns about the reliability of this as a proxy and suggested that it only be used on an interim basis. The historical catches may be poorly estimated. Both current and historical estimates of landings exclude fish discarded at sea and the quantum of discards is unknown. Management interventions since the stock was introduced into the QMS may have influenced the rate of discarding and therefore the reliability of CPUE as a measure of relative abundance.

Fishery Interactions
Elephantfish in ELE 3 are taken as bycatch by bottom trawl fisheries targeting red cod, flatfish and barracouta. Targeting elephantfish in the bottom trawl fishery has increased to around a third of the landings since 2004–05 when the deemed value regime changed. Around 15% of the ELE 3 landings are taken by setnet in a fishery targeted at a number of shark species, including rig, elephantfish, spiny dogfish and school shark. Both the trawl and setnet fisheries have been subject to management measures designed to reduce interactions with endemic Hector's dolphins. This may have reduced juvenile and egg mortality in shallow water. Incidental captures of seabirds occur and there is a risk of incidental capture of Hector's dolphins. There is also a risk of incidental capture of sea lions from Otago Peninsula south.

ELE 5

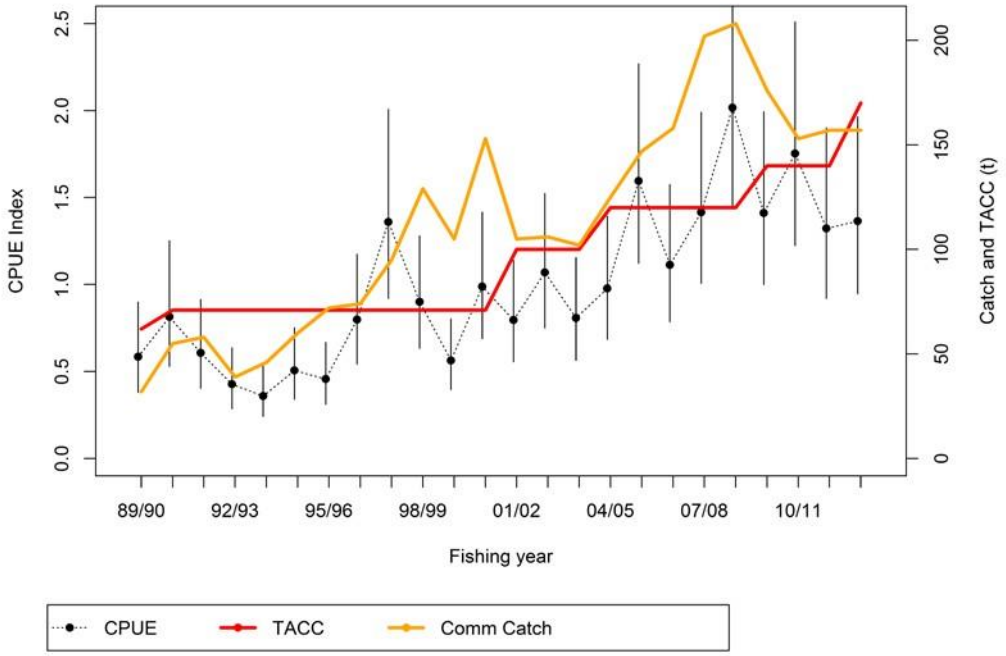
Stock Structure Assumptions

No information is available on the stock separation of elephantfish. The Fishstock ELE 5 is treated in this summary as a unit stock.

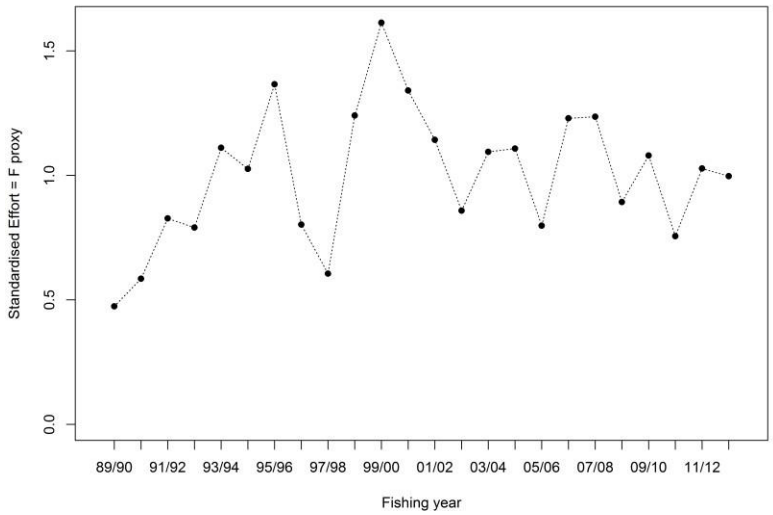
Stock Status	
Year of Most Recent Assessment	2014
Assessment Runs Presented	Update of CPUE indices only
Reference Points	Target: B_{MSY}-compatible proxy based on CPUE (to be determined) Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: F_{MSY} (assumed)
Status in relation to Target	Unknown

Status in relation to Limits	Soft Limit: Unlikely (< 40%) to be below Hard Limit: Unlikely (< 40%) to be below
Status in relation to Overfishing	Overfishing is Unlikely (< 40%) to be occurring

Historical Stock Status Trajectory and Current Status



Comparison of the mixed target species bottom trawl CPUE series (ELE 5(MIX)) with the trajectories of catch (ELE 5(QMR/MHR)) and TACCs from 1989–90 to 2012–13.

Fishery and Stock Trends	
Recent trend in Biomass or Proxy	The ELE 5 (MIX) CPUE series increased up to 2005–06 and has fluctuated without trend since then.
Recent Trend in Fishing Mortality or Proxy	 Fishing mortality proxy is Standardised Fishing Effort = Total catch/CPUE (normalised). Fishing mortality proxy has remained relatively stable over the last 10 years, while total catches have increased.
Other Abundance Indices	-
Trends in Other Relevant Indicator or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	CPUE and catch in ELE 5 have both increased since the early 1990s.
Probability of Current Catch and TACC causing decline below Limits	Soft Limit: Unlikely (< 40%) Hard Limit: Unlikely (< 40%)
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unlikely (< 40%)

Assessment Methodology and Evaluation		
Assessment Type	Level 2: Partial Quantitative Stock Assessment	
Assessment Method	Evaluation of agreed standardised CPUE indices	
Assessment Dates	Latest assessment: 2014	Next assessment: 2016
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- ELE 5 (MIX) CPUE index - Catch and effort data derived from the Ministry for Primary Industries compulsory catch reporting system	1 – High Quality: The Southern Inshore Working Group agreed that this index was a credible measure of abundance 1 – High Quality
Data not used (rank)	Length frequency data summarised from setnet logbooks compiled under the industry Adaptive Management Programme	3 – Low Quality: data sparse and outdated
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	The index of abundance is based on relatively small amounts of data and consequently has relatively high uncertainty. It is possible that discarding and management changes in this fishery have biased the CPUE trends reported for this fishery.	

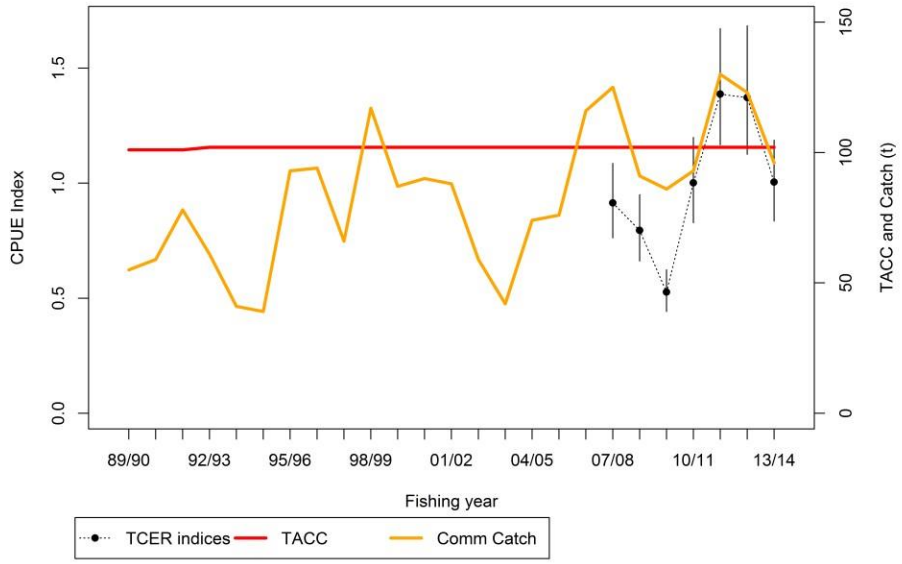
Qualifying Comments
Elephantfish have shown good recovery since apparently being at low biomass levels in the mid-1980s. The historical catches may be poorly estimated. Both current and historical estimates of landings exclude fish discarded at sea and the quantum of discards is unknown. Management interventions since the stock was introduced into the QMS may have influenced the rate of discarding and therefore the reliability of CPUE as a measure of relative abundance.

Fishery Interactions
Elephantfish in ELE 5 are taken by bottom trawl in fisheries targeted at flatfish and stargazer. Targeting elephantfish in the bottom trawl fishery was low (average 14% from 1989–90 to 2010–11) but has increased to about 20% of the landings since 2002–03. Around 12% of the ELE 5 landings are taken by setnet in a fishery targeted mainly at school shark. Both the trawl and setnet fisheries have been subject to management measures designed to reduce interactions with endemic Hector's dolphins. Incidental captures of seabirds occur and there is a risk of incidental capture of Hector's dolphins.

ELE 7

Stock Status	
Year of Most Recent Assessment	2015
Assessment Runs Presented	ELE 7 standardised CPUE based mixed target species in the bottom trawl fishery
Reference Points	Target: Not established but B_{MSY} assumed Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: F_{MSY} (assumed)
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unlikely (< 40%) Hard Limit: Very Unlikely (< 10%)
Status in relation to Overfishing	Overfishing is Unlikely (< 40%) to be occurring

Historical Stock Status Trajectory and Current Status



Standardised TCER CPUE index for ELE 7 (black dots), commercial landings (yellow line) and TACC (red line).

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	CPUE indices indicate biomass increased considerably from 2009–10 to 2011–12, remained at the higher level in 2012–13 and declined in 2013–14.
Recent Trend in Fishing Mortality or Proxy	Catches declined from a high in 1998–99 to a low in 2003–04 but have risen to and fluctuated around the level of the TACC since 2006–07.
Other Abundance Indices	Trawl survey biomass trends for this stock are unreliably estimated by the West Coast South Island survey. However, recent biomass estimates have been relatively high compared to the long term average.
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis		
Stock Projections or Prognosis	CPUE indices and catches for 2011–12 and 2012–13 were relatively high levels (series beginning 1989–90), lower in 2013–14. Recent trawl survey biomass estimates are also relatively high.	
Probability of Current Catch or TACC causing decline below Limits	Soft Limit: Unlikely (< 40%) Hard Limit: Unlikely (< 40%)	
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Current catches and the current TACC are Unlikely (< 40%) to cause overfishing.	
Assessment Methodology		
Assessment Type	Level 2: Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE index and relative biomass estimates from inshore WCSI trawl survey	
Assessment dates	Latest assessment: 2015	Next assessment: 2017
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Standardised CPUE (MIX) (from 2007–08) - Standardised CPUE (MIX) (pre 2007–08) - Catch and effort data derived from the Ministry for Primary Industries compulsory catch reporting system	1 – High Quality: The SINSWG had more confidence in this part of the CPUE index as a credible measure of abundance 2 – Medium or Mixed Quality: less catch (data) and lack of spatial resolution 1 – High Quality
Data not used (rank)	- Biomass estimates from inshore WCSI trawl survey	2 – Medium or Mixed Quality: low precision and high variability
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	-It is possible that discarding and management changes in this fishery have biased the CPUE trends. -The CPUE indices are derived from a data set with a high proportion of zero catch records and the indices may be sensitive to the treatment of zero catch records (although this was not apparent from a limited number of sensitivity analyses conducted).	
Qualifying Comments		
The pre-QMS catches are not well reported. Both current and historical estimates of landings exclude fish discarded at sea and the quantum of discards is unknown.		

Fishery Interactions
Trawl target sets for ELE 7 tend to be in shallow water mostly around 25 m. Elephant fish are landed with rig, school shark and spiny dogfish in setnets and in bottom trawls as bycatch in flatfish and red cod target sets. Incidental captures of seabirds occur and there is a risk of incidental capture of Hector's dolphins.

7. FOR FURTHER INFORMATION

Beentjes, M P; MacGibbon, D; Lyon, W S (2015) Inshore trawl survey of Canterbury Bight and Pegasus Bay, April–June 2014 (KAH1402). *New Zealand Fisheries Assessment Report 2015/14*. 136 p.

Boyd, R O; Reilly, J L (2002) 1999/2000 national marine recreational fishing survey: harvest estimates. Draft New Zealand Fisheries Assessment Report. (Unpublished report held by Ministry for Primary Industries, Wellington.)

Bradford, E (1998) Harvest estimates from the 1996 national recreational fishing surveys. New Zealand Fisheries Assessment Research Document 1998/16. 27 p. (Unpublished report held by NIWA library, Wellington.)

Coakley, A (1971) The biological and commercial aspects of the elephantfish. *Fisheries Technical Report* No: 76. 29 p.

Francis, M P (1996) Productivity of elephantfish - has it increased? Seafood New Zealand February 96: 22–25.

Francis, M P (1997) Spatial and temporal variation in the growth rate of elephantfish (*Callorhinchus milii*). *New Zealand Journal of Marine and Freshwater Research* 31: 9–23.

Francis, R I C C; Hurst, R J; Renwick, J A (2001) An evaluation of catchability assumptions in New Zealand stock assessments. *New Zealand Fisheries Assessment Report 2001/1*. 37 p.

Francis, M P; Paul, L J (2013) New Zealand inshore finfish and shellfish commercial landings, 1931–82. *New Zealand Fisheries Assessment Report 2013/55*. 136 p.

Gorman, T B S (1963) Biological and economic aspects of the elephantfish, *Callorhynchus milii* Bory, in Pegasus Bay and the Canterbury Bight. *Fisheries Technical Report No: 8*. 54 p.

Langley, A D (2001) The analysis of ELE 3 catch and effort data from the RCO 3 target trawl fishery, 1989–90 to 1999–2000. *New Zealand Fisheries Assessment Report 2001/66*. 33 p.

Langley. A D (2014) Updated CPUE analyses for selected South Island inshore finfish stocks. *New Zealand Fisheries Assessment Report 2014/40*. 116 p.

Lydon, G J; Middleton, D A J; Starr, P J (2006) Performance of the ELE 3 and ELE 5 Logbook Programmes. AMP-WG-06/18. (Unpublished manuscript available from the NZ Seafood Industry Council, Wellington.)

MacGibbon, D J; Stevenson, M L (2013) Inshore trawl survey of the west coast South Island and Tasman and Golden Bays, March-April 2013 (KAH1305). *New Zealand Fisheries Assessment Report 2013/66*. 115 p.

McClatchie, S; Lester, P (1994) Stock assessment of the elephantfish (*Callorhinchus milii)*. New Zealand Fisheries Assessment Research Document 1994/6. 17 p. (Unpublished report held by NIWA library, Wellington.)

Raj, L; Voller, R (1999) Characterisation of the south-east elephantfish fishery-1998. 55 p. (Unpublished report available at NIWA library, Wellington.)

Seafood Industry Council (SeaFIC) (2000) Proposal to the Inshore Fishery Assessment Working Group. Placement of the ELE 3 into Adaptive Management Programme dated 23 March 2000 (presented to the Inshore Fishery Assessment Working Group 28 March 2000). (Unpublished report held by Ministry for Primary Industries, Wellington.)

Seafood Industry Council (SeaFIC) (2002) Report to the Inshore Fishery Assessment Working Group: Performance of the ELE 3 Adaptive Management Programme (dated 25 February 2002). (Unpublished report held by Ministry for Primary Industries, Wellington.)

Seafood Industry Council (SeaFIC) (2003a) 2003 performance report: ELE 3 Adaptive Management Programme. AMP-WG-2003/06. 3 p. (Unpublished report held by Ministry for Primary Industries, Wellington.)

Seafood Industry Council (SeaFIC) (2003b) Report to the Adaptive Management Fishery Assessment Working Group: Performance of the ELE 5 Adaptive Management Programme and request for an additional increase in ELE 5. AMP-WG-2003/07. 39 p. (Unpublished report held by Ministry for Primary Industries, Wellington.)

Seafood Industry Council (SeaFIC) (2005a) 2005 Report to the Adaptive Management Programme Fishery Assessment Working Group: Performance of the ELE 3 Adaptive Management Programme. AMP-WG-2005/16. (Unpublished report held by Ministry for Primary Industries, Wellington.)

Seafood Industry Council (SeaFIC) (2005b) 2005 Report to the Adaptive Management Programme Fishery Assessment Working Group: Performance of the ELE 5 Logbook Programme. AMP-WG-05/23. (Unpublished report held by Ministry for Primary Industries, Wellington.)

Southeast Finfish Management Company (SEFMC) (2002a) 2002 Report to the Inshore Fishery Assessment Working Group. Performance of the ELE 3 Adaptive Management Programme (dated 25 February 2002). (Unpublished report held by Ministry for Primary Industries, Wellington.)

Southeast Finfish Management Company (SEFMC) (2002b) 2002 Report to the Inshore Fishery Assessment Working Group. Performance of the ELE 5 Adaptive Management Programme (dated 25 February 2002). (Unpublished report held by Ministry for Primary Industries, Wellington.)

Southeast Finfish Management Company (SEFMC) (2003) 2003 Report to the Inshore Fishery Assessment Working Group. Performance of the ELE 5 Adaptive Management Programme and request for an increase in ELE 5 (dated 13 Nov 2003). (Unpublished report held by Ministry for Primary Industries, Wellington.)

Starr, P J; Kendrick, T H (2013) ELE 3&5 Fishery Characterisation and CPUE. *New Zealand Fisheries Assessment Report 2013/38*. 95 p.

Starr, P J; Kendrick, T H; Lydon, G J; Bentley, N (2007a) Report to the Adaptive Management Programme Fishery Assessment Working Group: Full-term review of the ELE 3 Adaptive Management Programme. AMP-WG-07/07. 104 p. (Unpublished report held by Ministry for Primary Industries, Wellington.)

Starr, P J; Kendrick, T H; Lydon, G J; Bentley, N (2007b) Report to the Adaptive Management Programme Fishery Assessment Working Group: Two-year review of the ELE 5 Adaptive Management Programme. AMP-WG-07/10. 89 p. (Unpublished report held by the Ministry for Primary Industries, Wellington.)

Sullivan, K J (1977) Age and growth of the elephantfish *Callorhinchus milii* (Elasmobranchii: Callorhynchidae). *New Zealand Journal of Marine and Freshwater Research* 11: 745–753.

Teirney, L D; Kilner, A R; Millar, R E; Bradford, E; Bell, J D (1997) Estimation of recreational catch from 1991/92 to 1993/94. New Zealand Fisheries Assessment Research Document 1997/15. 43 p. (Unpublished report held by NIWA library, Wellington.)