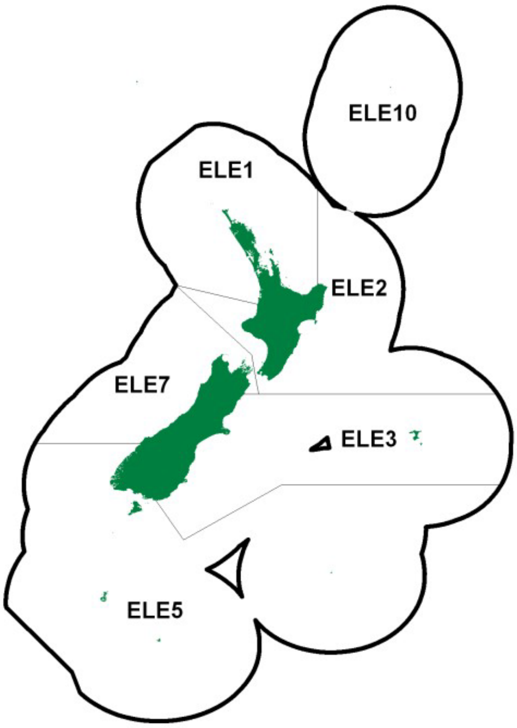
ELEPHANTFISH (ELE)

(*Callorhinchus milii*)
Reperepe



1. FISHERY SUMMARY

Elephantfish 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 elephantfish by Fishstock.

Fishstock	Recreational allowance	Customary non-commercial allowance	Other sources of mortality	TACC	TAC
ELE 1				10	
ELE 2				22	
ELE 3	15	5	115	1 150	1 285
ELE 5	5	5	8.5	170	188
ELE 7	10	5	10	102	127
ELE 10				10	

1.1 Commercial fisheries

From the mid-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 off 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 off the west coast. Total annual landings of elephantfish dropped considerably in the early 1980s (between 1982–83 and 1994–95 they ranged between 500 and 750 t) but later increased to the point that they have annually exceeded 1000 t since the 1997–98 fishing season. Reported landings since 1931 are shown in Tables 2 and 3, and an historical record of landings and TACC values for the three main ELE stocks are depicted in Figure 1.

Table 2: 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		

Table 3: Reported landings (t) for the main QMAs from 1931 to 1990.

Year	ELE 1	ELE 2	ELE 3	ELE 5	ELE 7	Year	ELE 1	ELE 2	ELE 3	ELE 5	ELE 7
1931–32	0	0	0	0	0	1957	0	2	992	28	46
1932–33	0	0	0	0	0	1958	0	0	1 140	47	51
1933–34	0	0	0	0	0	1959	0	0	1 066	37	44
1934–35	0	0	0	0	0	1960	0	1	1 099	38	27
1935–36	0	0	0	0	0	1961	0	0	913	43	27
1936–37	0	0	79	0	1	1962	0	4	1 066	73	14
1937–38	0	0	183	0	0	1963	0	2	976	111	8
1938–39	0	0	194	1	2	1964	0	3	1 109	107	16
1939–40	0	1	190	1	1	1965	0	7	983	88	34
1940–41	0	1	243	8	1	1966	0	1	985	99	27
1941–42	0	0	220	1	0	1967	0	1	812	77	45
1942–43	0	0	163	6	0	1968	0	1	757	54	52
1943–44	0	0	219	1	0	1969	0	1	824	75	33
1944	0	0	251	10	0	1970	0	3	987	87	53
1945	0	2	205	3	3	1971	0	0	1 243	103	37
1946	0	0	228	3	4	1972	0	0	928	70	15
1947	0	2	176	0	10	1973	0	0	864	73	21
1948	0	2	227	0	9	1974	0	0	766	97	41
1949	0	1	296	2	13	1975	0	1	557	55	28
1950	0	1	522	14	13	1976	0	0	622	91	52
1951	0	2	585	6	10	1977	0	0	601	114	45
1952	0	0	440	9	5	1978	0	0	552	49	26
1953	0	3	514	13	3	1979	0	0	661	63	18
1954	0	2	839	5	7	1980	0	0	794	129	34
1955	0	3	771	4	25	1981	0	1	543	114	16
1956	0	1	933	16	29	1982	0	0	584	85	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).

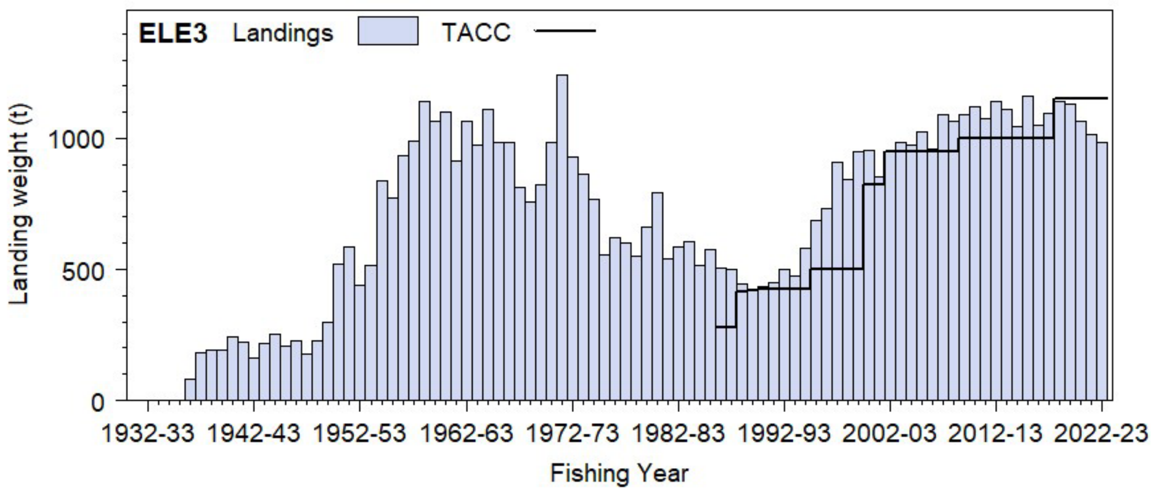
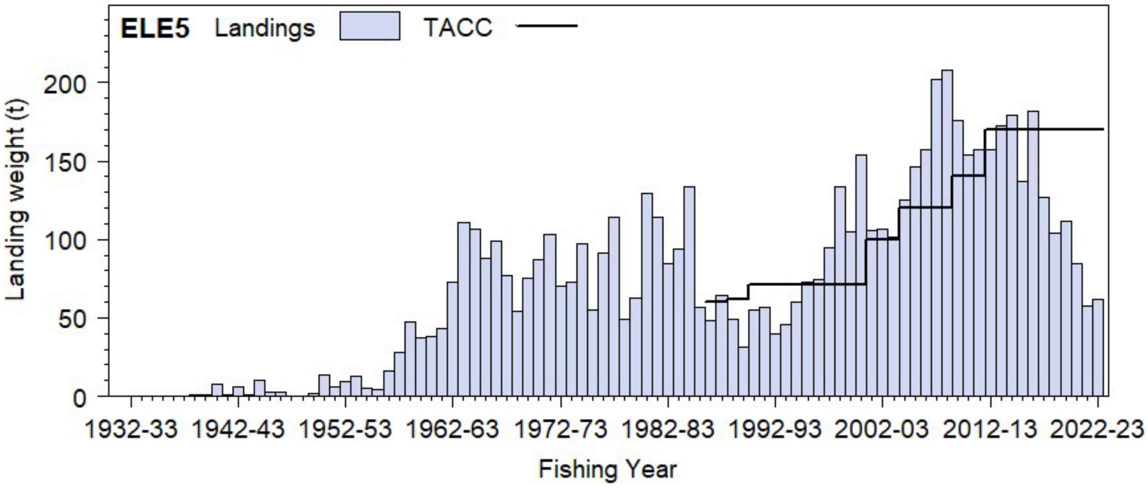


Figure 1: Reported commercial landings and TACC for the three main ELE stocks. ELE 3 (South East Coast and Chatham Rise). **[Continued on next page]**



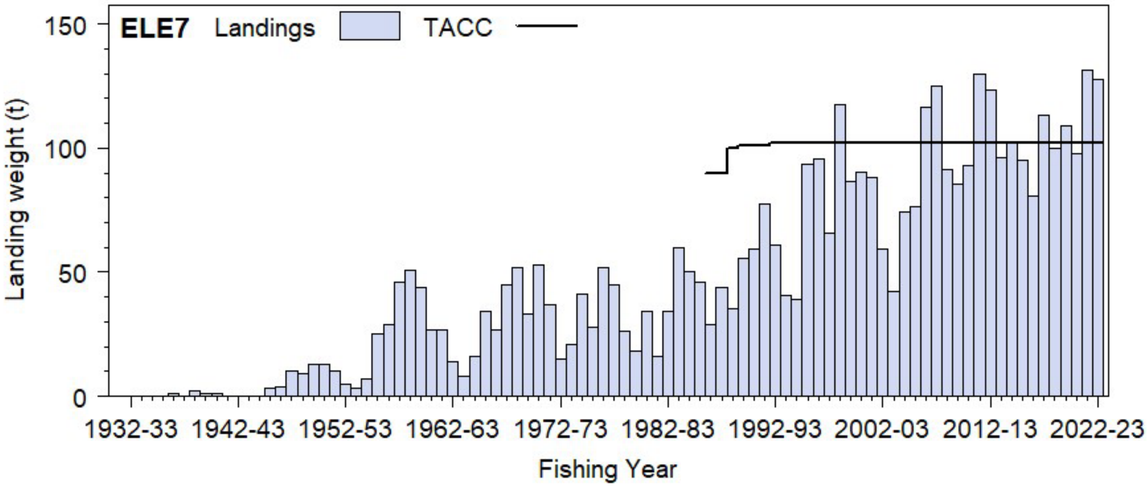


Figure 1 [Continued]: Reported commercial landings and TACC for the three main ELE stocks. From top: ELE 5 (Southland and Sub-Antarctic) and ELE 7 (Challenger).

The TACC for ELE 3 was consistently exceeded between 1986–87 and 2017–18, with the exception of 2002–03 (Table 4). The ELE 3 TACC was 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 950 t to 1000 t. This was followed by a further increase to 1150 t from the 2018–19 fishing year. 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 elephantfish 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 set net fishery in ELE 3, largely directed at rig and elephantfish.

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 set net fisheries. Catches increased consistently from 1992–93 (39 t) to 2008–09 (208 t), before decreasing again. The TACCs were exceeded in most years from 1995–96 to 2011–12. 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 landings exceeded this TACC by 70% in 2007–08 and 2008–09. For the 2009–10 fishing season, the TACC was increased by 17% up from 120 t to 140 t. All AMP programmes ended on 30 September 2009. The ELE 5 TACC was further increased to 170 t in 2012–13; landings have generally remained below the TACC since, with a steady decline to 2021–22 when 58 t of elephantfish were landed.

Elephantfish within ELE 7 are largely taken as bycatch off the west coast of the South Island by inshore bottom trawl targeting flatfish, and more importantly since about 2010–11, red gurnard. Lower levels of bycatch (with occasional periods of higher bycatch) are also reported from barracouta, red cod and tarakihi target trawling. Landings fluctuated between about 10 and 50 t from the 1950s to 1980s, fluctuated around an increasing trend until about 2010, and have fluctuated around the TACC of 102 t since then. Landings in 2021–22 (131 t) and 2022–23 (127 t) were among the highest reported, and exceeded the TACC.

Table 4: Reported landings (t) of elephantfish by Fishstock from 1983–84 to present and actual TACCs (t) from 1986–87 to present. 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	1 110	1 000	173	170	96	102	1 394	1 304
2014–15	< 1	10	11	22	1 048	1 000	179	170	102	102	1 340	1 304
2015–16	< 1	10	9	22	1 159	1 000	137	170	95	102	1 400	1 304
2016–17	< 1	10	12	22	1 051	1 000	182	170	81	102	1 326	1 304
2017–18	< 1	10	8	22	1 098	1 000	126	170	113	102	1 346	1 304
2018–19	< 1	10	9	22	1 142	1 150	104	170	100	102	1 354	1 464
2019–20	< 1	10	6	22	1 133	1 150	111	170	109	102	1 359	1 464
2020–21	< 1	10	10	22	1 065	1 150	85	170	98	102	1 258	1 464
2021–22	< 1	10	7	22	1 013	1 150	58	170	131	102	1 209	1 464
2022–23	< 1	10	9	22	984	1 150	62	170	127	102	1 182	1 464

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 from 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 Kaikōura Canyon, and permitting set netting 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.

1.2 Recreational fisheries

Catches of elephantfish by recreational fishers are low compared with those of the commercial sector. Catches estimated using national panel surveys in 2011–12, 2017–18 and 2022–23 (Wynne-Jones et al 2014, 2019, Heinemann & Gray, in prep) are shown in Table 5. Recreational catch exceeded 1000 fish only in ELE 3 in the two surveys and all estimates are quite uncertain. Regional surveys in the early 1990s (Teirney et al 1997) and national surveys in 1996, 1999, and 2000 (Bradford 1998, Boyd & Reilly 2004) showed similarly low numbers of fish harvested and similar geographical patterns. No estimates of mean weight are available to convert these estimates of harvested fish to harvested weights.

Table 5: Recreational harvest estimates for elephantfish stocks (Wynne-Jones et al 2014, 2019; Heinemann & Gray in prep). Insufficient data on mean fish weights are available from boat ramp surveys to convert numbers to catch weights.

Stock	Year	Method	Number of fish	Total weight (t)	CV
ELE 2	2011–12	Panel survey	183	–	0.84
	2017–18	Panel survey	339	–	0.72
	2022–23	Panel survey	105	–	1.01
ELE 3	2011–12	Panel survey	4 853	–	0.39
	2017–18	Panel survey	2 458	–	0.36
	2022–23	Panel survey	2 598	–	0.74
ELE 5	2011–12	Panel survey	202	–	0.91
	2017–18	Panel survey	60	–	1.00
	2022–23	Panel survey	17	–	1.34
ELE 7	2011–12	Panel survey	960	–	0.97
	2017–18	Panel survey	189	–	0.40
	2022–23	Panel survey	380	–	0.62

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 of elephantfish is unknown. However, a tagged, 73 cm total length, Australian male was at liberty for 16 years, suggesting a longevity for males of at least 20 years (Coutin 1992, Francis 1997). Females probably also live to at least 20 years. A longevity of 20 years suggests that M is about 0.23. 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.

Von Bertalanffy growth curves based on MULTIFAN analysis of length frequency data are available for Pegasus Bay and Canterbury Bight in 1966–68 and 1983–88. However, the ages of the larger fish were probably underestimated and the growth curves are only reliable to about 4–5 years (Francis 1997). New empirical growth curves were developed by fitting a von Bertalanffy growth function to a dataset consisting of (a) the first six length frequency modes from the study by Francis (1997) and (b) an approximate maximum size and age for male and female elephantfish. The latter points 'anchor' the curves at the right-hand end and generate more plausible curve shapes, L_∞ estimates, and therefore length-at-age. The largest measured fish in the ELE 3 samples from 1966–68 and 1983–88 (i.e., 76 cm FL for males and 97 cm FL for females) were considered to be reasonable estimates of the mean maximum lengths of elephantfish in an unfished population. The following data points were therefore used in fitting the growth curves: 76 cm and 20 years for males, and 97 cm and 20 years for females. The best fitting growth model had separate male and female coefficients for K and L_∞ and a common coefficient for t_0 (M. Francis, unpubl. data).

Biological parameters relevant to the stock assessment are shown in Table 6.

Table 6: Estimates of biological parameters for elephantfish.

Fishstock	Estimate						Source
1. Natural mortality (M)							
All	0.23						See text
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							
	Females			Males			
	L_∞	k	t_0	L_∞	k	t_0	
ELE 3	97.88	0.26	-0.55	75.03	0.34	-0.55	See text

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

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 officially included in the target species in 2012. The 2007 survey and all surveys from 2012 onwards provide full coverage of the 10–30 m depth range (Figure 2).

Total biomass in the core strata increased markedly in 1996 and, although it has fluctuated since then, it has remained high with the post-1994 average of 1032 t up to and including 2014, about three-fold greater than that of the early 1990s (Figure 2). Biomass then fluctuated greatly with the largest of the time series of nearly 7000 t in 2016 (one particularly large catch resulting in a survey CV of 68%), to the 2021 estimate of 170 t which was the second lowest of the series. The 2022 biomass estimate of 798 t was 23% below the 1996 to 2014 average. In the core plus shallow strata, biomass followed the same trend as the core strata biomass. The biomass in the 10–30 m depth range has varied greatly between the seven surveys, comprising 7–64% of the core plus shallow biomass, averaging 40%, and in 2022 it was 19%. This indicates the importance of shallow strata for elephantfish biomass as well as variability in inshore-offshore spatial distribution at this time of year (Table 7, 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, particularly in 2007, 2012, and 2021. The proportion of pre-recruit biomass in the core plus shallow strata was also generally greater than that of the core strata alone, indicating that younger fish are more common in shallow water in some surveys (Table 7). For the seven core plus shallow strata surveys, the juvenile biomass (based on the length-at-50% maturity) was highly variable (9–77%), and in 2022 it was 46%. The distribution of elephantfish hot spots has varied, but overall this species was consistently well represented over the entire survey area from 10 to 100 m, but often was most abundant in the shallow 10 to 30 m.

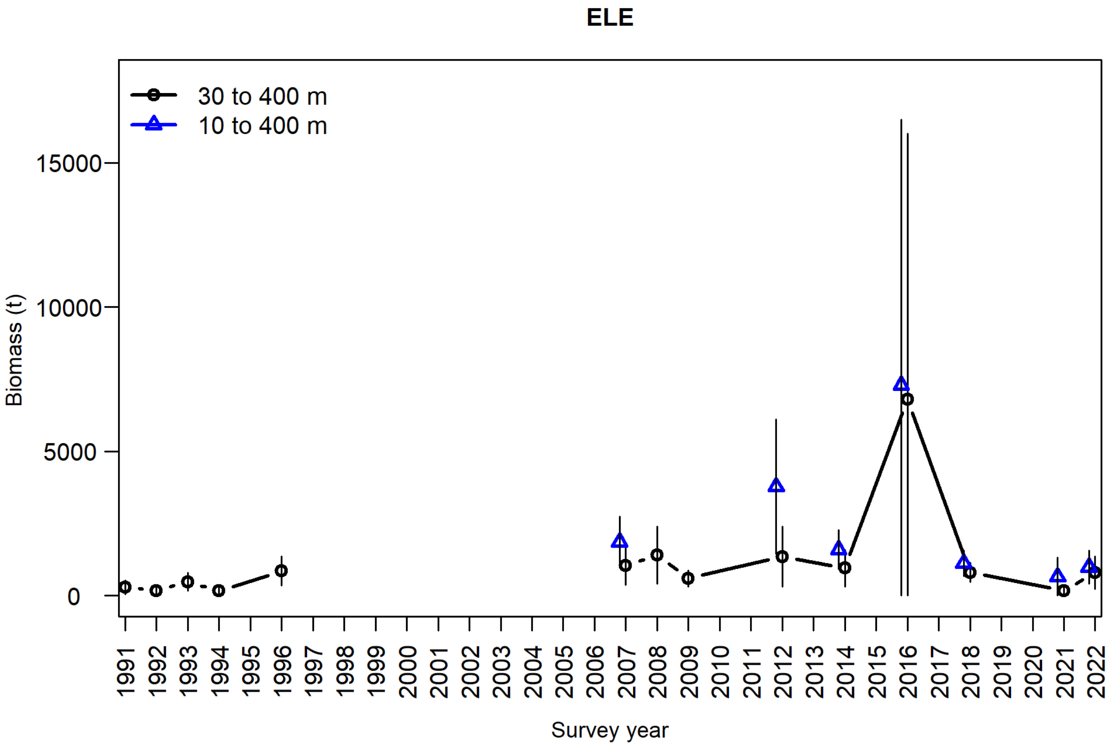


Figure 2: Elephantfish total biomass and 95% confidence intervals for all ECSI winter surveys in core strata (30–400 m), and core plus shallow strata (10–400 m) in 2007, 2012, 2014, 2016, 2018, 2021, and 2022.

WCSI trawl survey

Trawl surveys from the west coast South Island inshore time series catch elephantfish but catches are inconsistent and typically low. Biomass estimates are variable ranging from 21–185 t (mean 89 t) and CVs are imprecise ranging from 26–83% (mean 48%) (Table 7). The time series is not likely to provide a valid index of abundance.

Table 7: Relative biomass indices (t) and coefficients of variation (CV) for elephantfish for east coast South Island (ECSI) - summer and winter, west coast South Island (WCSI), and the Stewart-Snares shelf 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 (%)
				30–400 m		10–400 m		30–400 m		10–400 m		30–400 m		10–400 m	
ECSI(winter)	ELE 3														
		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	1 404	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	1 600	21	174	32	429	25	777	40	1 171	28
		2016	KAH1605	6 812	68	7 299	63	62	43	167	30	6 750	68	7 132	64
		2018	KAH1803	807	21	1 118	20	266	34	356	28	541	23	761	24
		2021	KAH2104	170	32	655	51	29	38	120	38	141	39	536	63
		2022	KAH2204	798	36	987	29	263	64	381	45	535	32	606	29

Region	Fishstock	Year	Trip number	Total Biomass estimate	CV (%)
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
Stewart-Snares	ELE 5	1993	TAN9301	219	33
		1994	TAN9402	177	47
		1995	TAN9502	69	49
		1996	TAN9604	137	46

Region	Fishstock	Year	Trip number	Total Biomass estimate	CV (%)
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
		2015	KAH1503	72	45
		2017	KAH1703	92	65
		2019	KAH1902	61	48
		2021	KAH2103	170	77
		2023	KAH2302	25	41

*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.

4.1.2 CPUE biomass indices

ELE 3

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 lost 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. The Working Group agreed in 2009 to drop the ELE 3-SN(SHK) and ELE 5-SN(SHK) (set net with shark target species) indices because the set net 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.

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. The indices were updated again in 2016, extending the time series to 2014–15. Standardised CPUE has fluctuated without trend since 2009–10 and the 2014–15 data point is near the interim target (see below) (Figure 3).

An analysis of more recent CPUE data suggested that bottom trawl fishing operations may be attempting to avoid larger catches of elephantfish. During 2012–13 to 2014–15, there was a lower probability of successive larger catches of elephantfish. This may have negatively biased the CPUE indices from 2012–13 to 2014–15 (Langley 2016 - presentation).

***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.

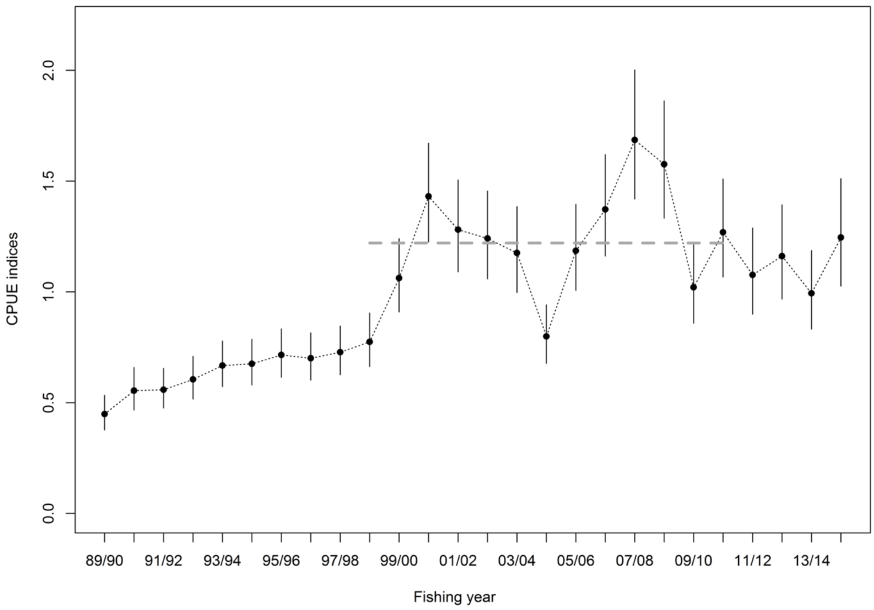


Figure 3: Standardised CPUE indices for the ELE 3 bottom trawl fisheries [ELE 3(MIX)]. The horizontal grey line is the mean of ELE 3(MIX) from 1998–99 to 2010–11 (*B_{MSY}* conceptual proxy). The CPUE series has been normalised to a geometric mean of 1.0. Error bars show 95% confidence intervals.

ELE 5

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 BT(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 BT(MIX)-trip] was a trip-based analysis using the same target species selection method as described for ELE 3-BT(MIX)-trip series. The two sets of indices were very similar.

In 2014, the ELE 5-BT(MIX) CPUE model was updated to include data from 2011–12 to 2012–13 (Langley 2014). This model used the 'daily effort' method to prepare the data, whereby every record was reduced to a day of fishing, with the predominant statistical area and target species for the day assigned to the record. This method was accepted by the Working Group as the best procedure to follow when reducing event-based forms to match earlier daily forms. 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 with the 1990s–early 2000s (Figure 4). The ELE 5-BT(MIX) model was again updated in 2017, with data current to the end of 2015–16. Although the fishery definition and data preparation methods were unchanged, a binomial presence/absence series was added because of a declining trend in the proportion of days with zero catch. The Plenary accepted a revised index which combined the binomial and lognormal series using the delta-lognormal method (Starr & Kendrick 2017). This was done because the Inshore Working Group has adopted the standard of combining positive catch and fishing success models when there is a trend in the proportion zero catch. As well, simulation work has indicated that calculating a combined index may reduce bias when reporting small catch amounts (Langley 2015). Recent indices estimated by this updated series are lower than the peak observed at the end of the 2010 decade, but these indices remain above the long-term average CPUE (Figure 5).

***B_{MSY}* conceptual proxy:** The Plenary agreed in 2017 to use the mean combined ELE5-BT(MIX) CPUE for the period 2005–06 to 2015–16 as a 'B_{MSY} conceptual proxy' for ELE 5. This period was selected because a plot of CPUE against catch (yield curve) appeared to have levelled out and is assumed to represent a stochastic equilibrium (Figure 5).

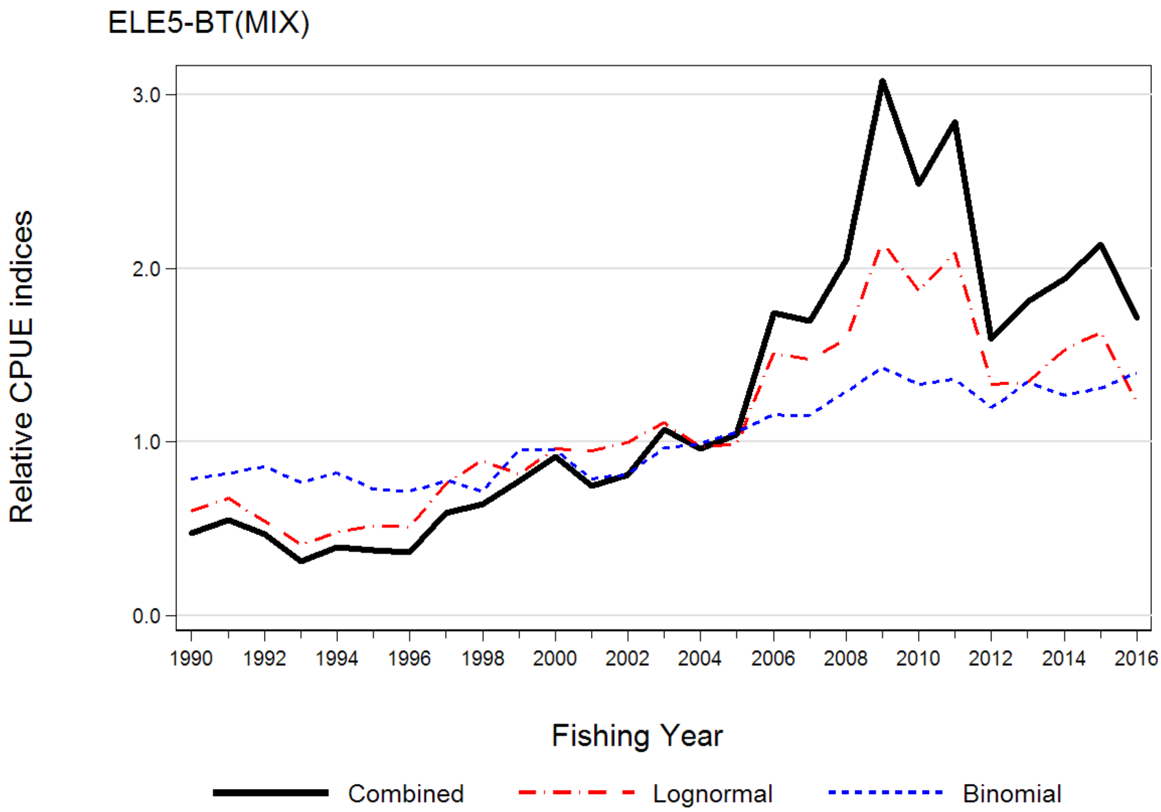


Figure 4: Plots of three ELE5-BT(MIX) CPUE series: a) positive catch (lognormal); b) presence/absence (binomial), and c) combined series using the delta-lognormal method.

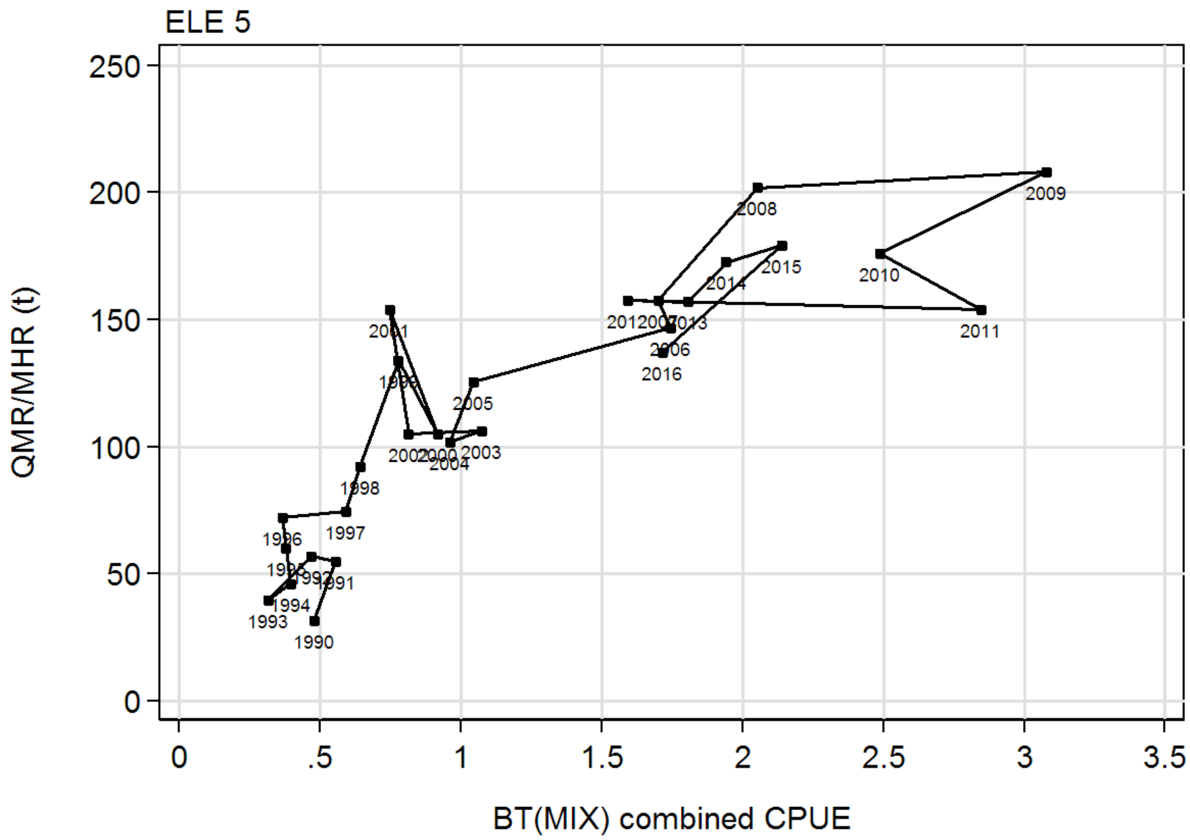


Figure 5: Trace yield plot for ELE 5, showing CPUE and QMR/MHR landings plotted sequentially by fishing year.

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, 1 kg, 2 kg, and 5 kg) 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. 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 Inshore Working Group 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. The Inshore Working Group concluded that the TCER CPUE indices represented the best available information for monitoring trends in ELE 7 stock abundance.

A 'rapid update' of the ELE 7 tow-by-tow standardised CPUE analysis was reviewed and accepted by the Inshore Working Group in 2019 (Starr & Kendrick 2019). This analysis duplicated the Langley (2014) analysis reported above, extending the analysis by four years as well as providing additional diagnostics supporting the standardisation procedure (Figure 6). The Inshore Working Group agreed that this series indexed ELE 7 abundance, with the 2017–18 index near the series mean (Figure 6). In addition, the Inshore Working Group agreed that the mean (2007–08 to 2017–18) index of this series could serve as a B_{msy} proxy target for this stock (see BMSY-conceptual proxy below). The CPUE analysis was updated in 2024 to include the 2007–08 to 2022–23 years (Figure 6).

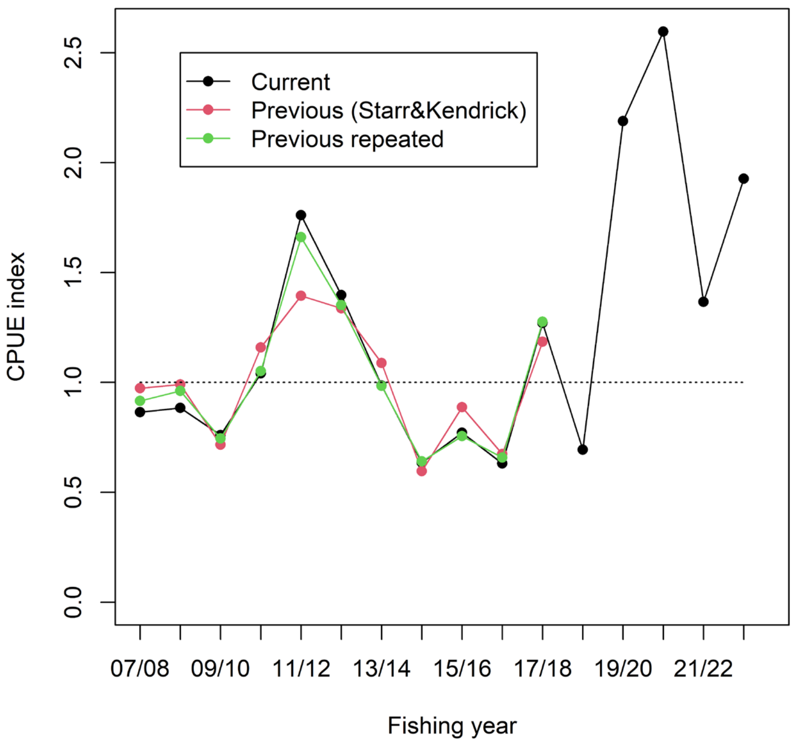


Figure 6: Standardised delta-lognormal CPUE indices for the ELE 7 inshore WCSI trawl fishery based on tow-by-tow TCER and ERS data. Both sets of indices are normalised to the comparable time period (2007–08 to 2013–14).

As part of the 2024 analysis the trawl data set was also aggregated by trip and a separate delta-lognormal CPUE analysis was conducted to derive trip-based CPUE indices. The trip based data set avoids the need to allocate small landed catches of ELE equally amongst individual trawl records for those trips without associated trawl ELE catch records. This has the potential to bias both the binomial and lognormal CPUE indices. Conversely, the lower spatial resolution of the trip based data potentially reduces the explanatory power of the CPUE models and may bias the indices if there is an appreciable change in the operation of the trawl fishery (depth and location).

The trend in the trip based CPUE indices was broadly comparable to the trawl-based indices, although the indices for 2019–20 and 2020–21 were considerably lower for the trip based index (Figure 7). This difference was not attributable to any difference in the proportion of trawl catch records allocated based on effort. For both analyses, the CPUE indices for the two most recent years were similar and well above the respective reference period for each series. Overall, the trip based indices were less variable between years, presumably due to the effect of averaging individual catches over a trip. However, the trip indices were less precise due to the smaller number of records in the data set. The Inshore Working Group retained the trawl-based indices for the 2024 assessment of ELE 7. A trip-based analysis, extending back to 1989–90, was found to be less reliable because in the absence of a depth co-variate (not available in CELR data, which was the only data source used prior to 2007–08), the model was not able to account for recent changes in depth when targetting specific species, e,g, red gurnard.

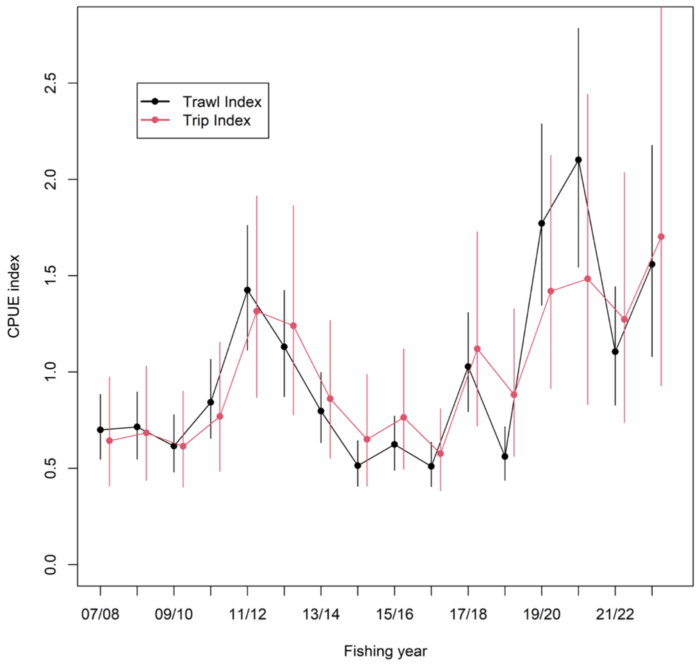


Figure 7: Standardised delta-lognormal CPUE indices for the ELE 7 inshore WCSI trawl fishery based on tow-by-tow and trip aggregated TCER and ERS data. Both sets of indices are normalised to the comparable time period (2007–08 to 2013–14).

To provide an indication of longer-term trends in the abundance of ELE 7, the trip based CPUE analysis was extended to include the data from 1989–90 to 2022–23. The fishing effort data were summarised in a format that was consistent over the time period to account for changes in reporting. Within each trip, effort data were aggregated by fishing day; daily fishing effort (number of trawls and trawl duration) was included in the final CPUE data set for records that predominantly targeted ELE, RCO, FLA or GUR. A delta-lognormal model was used to derive the CPUE indices.

Over the longer term, there was a general increase in the trip based CPUE indices, corresponding to the overall increase in annual ELE 7 catches (Figure 8). The indices fluctuate considerably over the period, with higher CPUE indices occurring every 5–7 years. The trip based CPUE indices are broadly comparable to the trawl-based indices from the corresponding period, although the trip-based indices are lower in the most recent years. The most recent index (2022–23) also differs considerably from the shorter series of trip-based indices derived directly from the trawl data set (see above). These differences are attributable to differences in the data aggregation and selection procedures used to derive the two data sets. In recent years, the operation of the inshore trawl fleet has extended into deeper water, beyond the main depth range of elephantfish. Those trawls are not included in the trawl based data set, whereas the trawl records were included in the aggregated effort from the individual fishing trips. Those records are likely to introduce a (negative) bias in the recent indices from the long-term trip based CPUE.

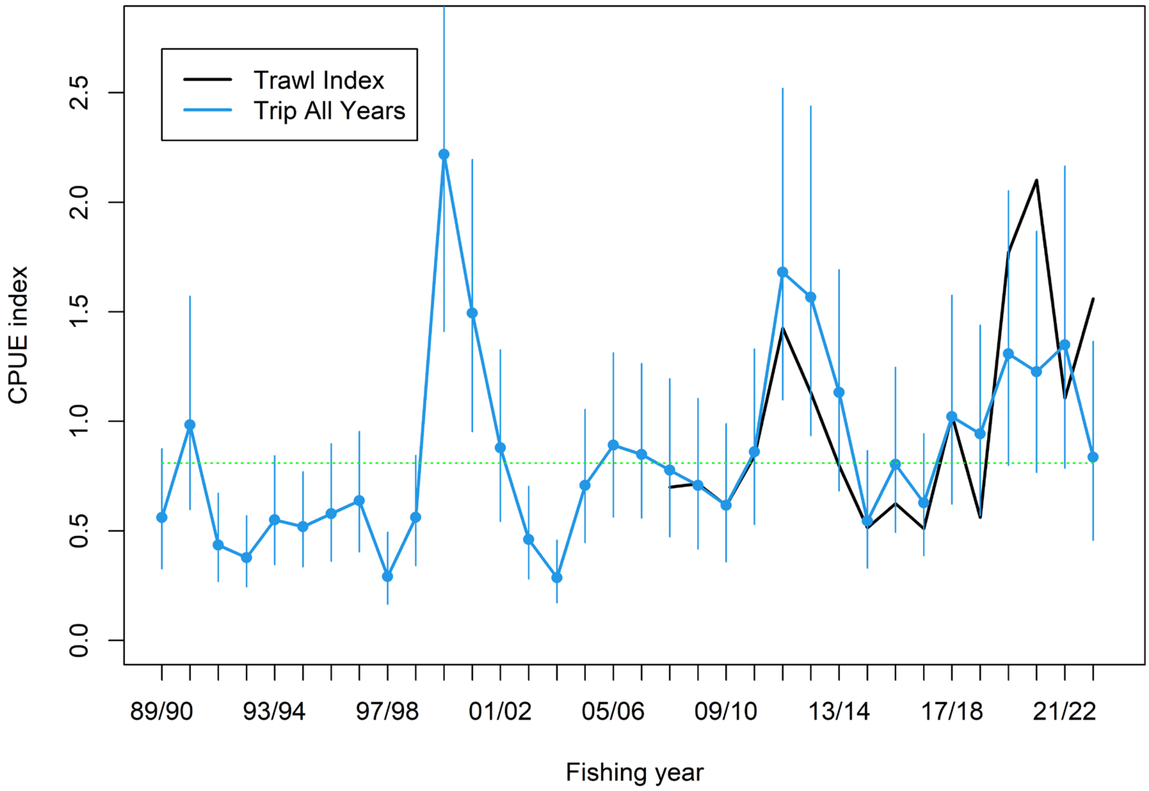


Figure 8: A comparison of the longer-term trip based CPUE indices (95% confidence interval) and the trawl-based index. The horizontal green line represents the target reference level (i.e., average of the trawl indices from 2007–08 to 2017–18).

B_{MSY}-conceptual proxy (ELE 7)

The Inshore Working Group agreed that the geometric mean of the tow-by-tow CPUE index from 2007–08 to 2017–18 could serve as a B_{MSY} proxy target for this stock. This period coincides with high and relatively stable CPUE (having increased from a lower level in the 1990s, observed in trip-based indices; Figure 8) and landings (ranging from 81–130 t). A further consideration in selecting this period was that ELE 7 did not experience the high catches observed for ELE 3 in the 1960s and 1970s and was therefore not considered to be depleted when included in the QMS in 1986 or before the beginning of the trip-based CPUE series began in 1989–90. The shorter (starting in 2007–08) event-based series was accepted as the index of abundance for Partial Quantitative stock assessment because it includes additional explanatory variables (e.g., depth) that allow for better standardisation of changes in fisher behaviour. The soft limit is set at 50% of the target, and the hard limit is set at 25% of the target.

4.2 Stock assessment models

A preliminary stock assessment model was developed for ELE 3. Estimates of current and reference absolute biomass are not available for the other elephantfish stocks.

ELE 3

A stock assessment model was developed for ELE 3 in 2016 using the Stock Synthesis (3.24f) software to implement an age-structured population model. The data sets available for inclusion in the assessment model are, as follows:

- Annual reported catch of elephantfish (1931–2015). The historical catches were derived from Francis & Paul (2013). Additional unreported landed catches were included for the period prior to the introduction of the QMS. The level of unreported landed catch was assumed to represent a third of the reported catch. The magnitude of unreported landed catch was based on

discussions with commercial operators in the ELE 3 fishery.
- A time series of estimates of the magnitude of the discarded catch (unreported but not landed) of elephantfish (1931–2015). Based on the discussions with commercial operators it was assumed that the discarded (and unreported catch) represented 25% of total landed catch (reported and unreported combined). The discarded catch comprised smaller elephantfish, usually less than 50 cm FL.
- BT MIX CPUE indices 1989–90 to 2014–15 (26 observations).
- ECSI trawl survey pre-recruit (< 50 cm), recruited (50+ cm), and total biomass estimates from the time series of winter surveys, 30–400 m depth (11 observations).
- ECSI trawl survey length compositions (male and female); winter surveys, 30–400 m depth (11 observations).
- Aggregated length compositions (male and female) of the commercial trawl catch sampled by Scientific Observers during 2009–10.

Additional data are available from the summer ECSI trawl surveys. These data were not included in the analysis because it has previously been concluded that the summer survey series does not represent a reliable index of abundance for elephantfish. In recent years, the winter trawl survey has been extended to include the shallower areas of Canterbury Bight and Pegasus Bay (10–30 m), partly to improve the monitoring of the abundance of elephantfish. However, the time series of surveys that includes this area is limited (four surveys).

Initial modelling results revealed that the scaled length compositions derived from the winter trawl surveys were highly variable (amongst surveys) and inconsistent with the other key input data sets. Further examination of the length composition data revealed that few elephantfish were caught and sampled during each survey and the scaled length compositions were typically dominated by the sampled catch from a limited number of trawls. The length and sex compositions of these larger catches were highly variable.

On that basis, it was concluded that the survey length compositions were unlikely to be representative of the length composition of the elephantfish population and these data were excluded from the final set of model options. Further, the estimates of trawl survey biomass for pre-recruit (< 50 cm) fish are relatively imprecise (CVs 32–83%) and preliminary modelling indicated that these indices were not consistent with the other abundance indices (especially the CPUE indices). Thus, the pre-recruit trawl survey biomass indices were also excluded from the final set of model options.

Model configuration

The final assessment model was configured, as follows.
- Model period 1931–2015, terminal year represents 2014–15 fishing year.
- Age classes 0–19 and 20+ years, two sexes.
- Initial (1931) population age structure assumes equilibrium, unexploited conditions.
- Annual recruitment derived from Beverton and Holt stock-recruitment relationship; R_0 parameter estimated (uninformative beta prior) and steepness fixed at 0.6 (base model option), recruitment deviates from SRR estimated for 1989–2013 assuming a SigmaR of 0.6.
- Sexual maturity (female fish) at 70 cm (FL).
- Two commercial fisheries: discard and retained catch. The selectivity of the commercial catch is assumed to be equivalent for the two main fishing methods (BT and SN).
- Commercial length composition data from 2009–10 are partitioned at 50 cm to characterise the length composition of discard (< 50 cm) and retained (50+ cm) commercial catches. Both length compositions are assigned a relatively high weighting (ESS 100) to ensure that the model approximates these observations.
- The length-based selectivity of discard commercial fishery is parameterised using a double normal selectivity function (equivalent for both sexes). Selectivity is effectively truncated at about 50 cm (FL).
- Two alternative length-based selectivity options were adopted for the retained commercial fishery with selectivity parameterised using either a logistic or double normal function. Selectivity was allowed to vary by sex.

- The CPUE indices are assumed to represent the relative abundance of the component of the population that is vulnerable to the retained commercial fishery. The CPUE indices were assigned a CV of 20%.
- The ECSI recruited (50+ cm) total biomass estimates were assigned the native CVs from individual surveys. The length-based selectivity of the survey was assumed to be knife edge at 50 cm (FL), with full selectivity for all the larger length intervals.

Model options that assumed a logistic selectivity function for the (retained) commercial fishery resulted in a poor fit to the (retained) commercial length composition for male and female fish (from 2009–10). These models consistently over-estimated the number of larger male (> 68 cm FL) and female (> 90 cm FL) elephantfish in the commercial catch.

The alternative model option with selectivity parameterised by a double normal function resulted in a substantial improvement in the fit to the commercial length compositions (relative to the logistic selectivity model). The double normal selectivity model estimated selectivity for male and female fish started to rapidly decline above 70 cm and 85 cm FL, respectively. The lower selectivity of larger female fish meant that approximately 40–50% of the mature female population (by weight) is estimated to be invulnerable to the commercial fishery and, consequently, not monitored by the CPUE indices.

Separate model runs were conducted for the two selectivity options, each with three assumed values of SRR steepness: a base level of 0.6 bracketed by values of 0.5 and 0.7. MCMCs were conducted for the six model options. However, the results of the MCMCs were not satisfactory for the model options with the lowest value of steepness and, consequently, only MCMC results for the 0.6 steepness options are reported.

Model results

The overall fit to the CPUE indices was acceptable for all model options. The CPUE indices exhibit a general increase with marked peaks in the early and late 2000s. The models account for these trends by estimating higher recruitments for 1996–1998, 2004, and 2009. As previously noted, the double normal selectivity parameterisation substantially improved the fit to the retained commercial length composition data (compared with logistic selectivity). There was also a marginal improvement in the fit to the CPUE indices with the double normal selectivity.

All model options also estimated an increase in stock abundance that was consistent with the overall increase in the ECSI trawl survey recruited biomass estimates between the 1990s and the more recent period, although the fit to the individual biomass estimates is poor. The quality of the fit is consistent with the relatively low precision of the biomass estimates and the likelihood that the survey vulnerability of elephantfish varies amongst survey years (as indicated by the variability in the length composition of the survey catches).

Two indicators of stock status were derived from the assessment models: current (2014–15) female spawning (=mature) biomass relative to unexploited spawning biomass (SB_{2015}/SB_0), and current spawning biomass relative to the spawning biomass in 1985 (SB_{2015}/SB_{1985}). The latter metric provides an indication of the extent of the stock recovery from the period when the stock was estimated to be at the lowest level.

The MPD results indicate that stock abundance has increased considerably from a low level (approx. 10–20% SB_0) in 1985 (Table 8, Figure 9). The double normal selectivity model runs represent a somewhat more optimistic estimate of the current stock status relative to both SB_0 and SB_{1985}. MPD estimates of stock status tended to be near the lower bound of the MCMC confidence intervals, indicating that the MPD estimates are likely to represent minimum biomass levels consistent with the catch history.

Table 8: Estimates of stock status for the range of commercial selectivity and SRR steepness options (MPD estimates). MCMC estimates (median value and 95% confidence interval) are also presented for the two selectivity options with SRR steepness of 0.60.

Selectivity	**Steepness**		SB_{2015}/SB_0	SB_{2015}/SB_{1985}
Double normal				
	0.6	MPD	0.390	2.99
		MCMC	0.471 (0.266–0.872)	2.86 (2.08–3.97)
	0.7	MPD	0.321	3.77
Logistic				
	0.6	MPD	0.279	2.50
		MCMC	0.386 (0.217–0.651)	2.63 (1.86–3.61)
	0.7	MPD	0.229	3.03

The results are also sensitive to the assumptions regarding SRR steepness. Higher values of steepness correspond to lower estimates of SB_0 and a higher level of depletion by 1985, and while the relative level of recovery from 1985 is higher than for lower steepness options, the current level of stock biomass relative to SB_0 is lower.

The median estimates of SB_{2015}/SB_0 stock status from the MCMCs are more optimistic than the corresponding MPD results for the SRR steepness 0.60 model runs. The MCMC results also reveal that there is considerable uncertainty associated with the estimates of stock status, although the confidence intervals derived from the MCMCs suggest that current biomass is Likely to be above the default soft limit (20% SB_0) and About As Likely as Not to be at or above the default target biomass level (40% SB_0). However, the preliminary nature of the model precludes definitive statements about stock status.

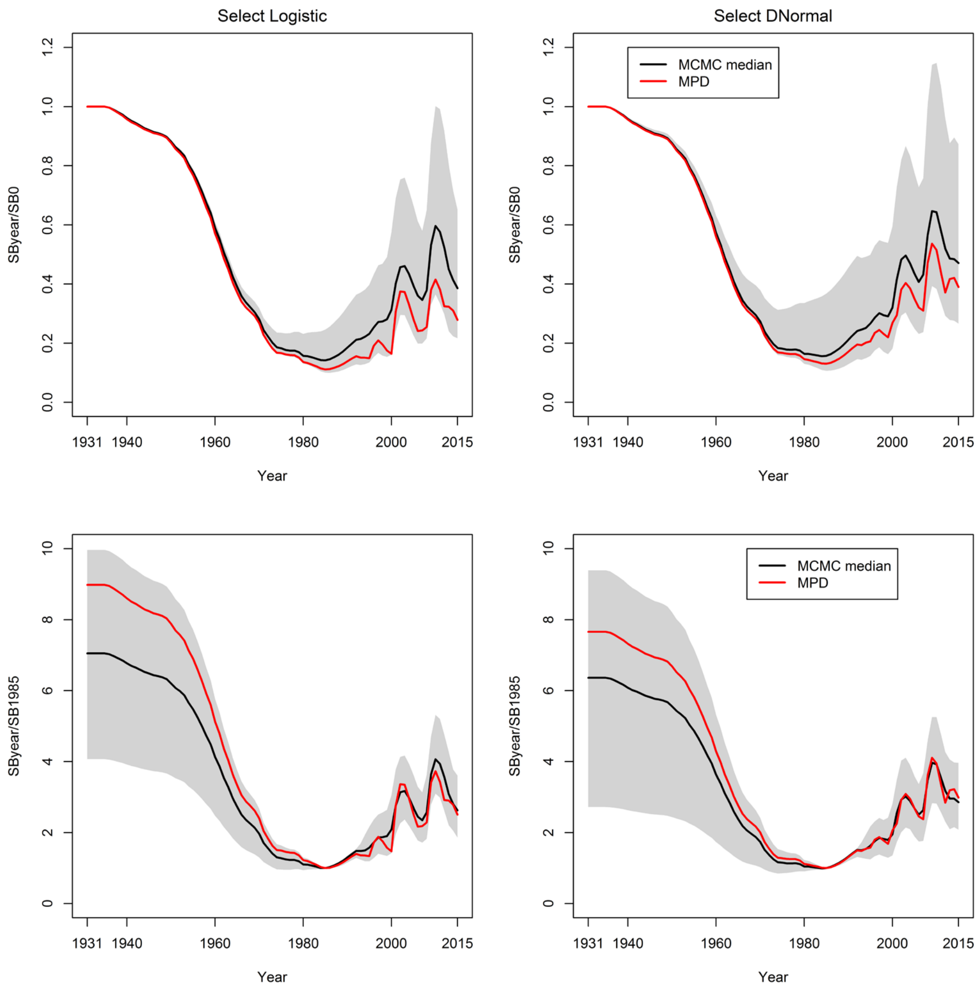


Figure 9: Stock trajectories for the spawning biomass relative to SB_0 (upper panels) and SB_{1985} (lower panels) for logistic (left panels) and double normal (right panels) selectivity options with SRR steepness 0.6. The black line represents the median of the MCMCs (with 95% confidence interval) and the red line represents the MPD.

The Southern Inshore Working Group concluded that this preliminary model produced plausible biomass trajectories, but uncertainty about productivity and fits to commercial length data precluded acceptance of the model as a reliable estimator of current stock status.

These conclusions need to be tempered by the possibility that the models may be over-estimating recruitment in the more recent years. This may provide an explanation for the apparent over-estimation of the proportion of larger, older fish in the population in the late 2000s (that were not apparent in the commercial length composition). Conversely, the recent CPUE indices may be biased low (due to apparent avoidance behaviour) and consequently the model may under-estimate the current level of biomass.

Estimates of SB_{2015}/SB_0 stock status are also highly uncertain (and potentially biased) due to the assumptions associated with the estimation of historical, unexploited biomass.

4.3 Yield estimates and projections
No other yield estimates are available.

4.4 Other factors
A data informed qualitative risk assessment was completed on all chondrichthyans (sharks, skates, rays, and chimaeras) at the New Zealand scale in 2014 (Ford et al 2015). Elephantfish was ranked fourth highest in terms of risk of the eleven QMS chondrichthyan species. Data were described as existing and sound for the purposes of the assessment and consensus over this risk score was achieved by the expert panel. This risk assessment does not replace a stock assessment for this species but may influence research priorities across species.

Future research considerations

CPUE indices (ELE 7)
- Investigate splitting the vessels with long time series into two or more pseudo vessels to test for potential changes in vessel effects over time.
- Explore the use of season:depth interactions in the CPUE standardisation
- Explore the use of environmental covariates in the CPUE standardisation

Identify, and if suitable, analyse datasets to investigate whether availability of elephantfish to the fishery (and therefore exploitation) varies by sex. Probably more relevant to ELE 3.

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**

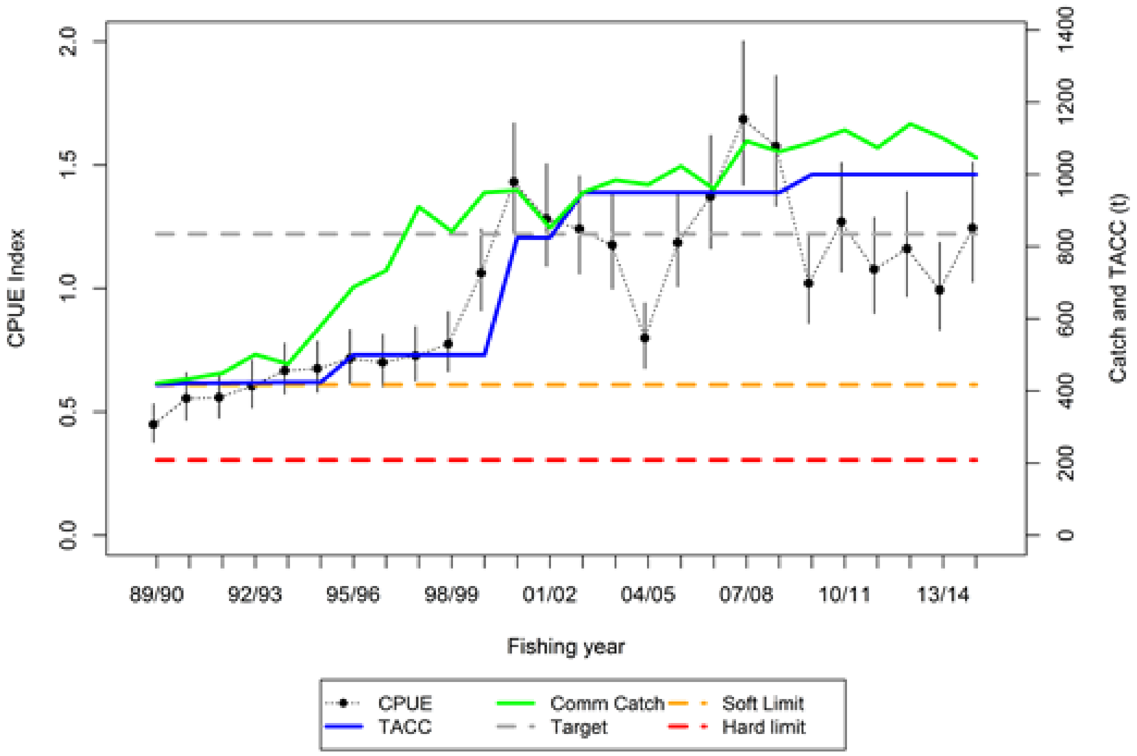
Stock Structure Assumptions
No information is available on the stock separation of elephantfish. The Fishstock ELE 3 is treated in this summary as a unit stock.

Stock Status		
Most Recent Assessment Plenary Publication Year	2016	
Catch in most recent year of assessment	Year: 2014–15	Catch: 1 048 t

Assessment Runs Presented	Update ELE 3 (MIX) CPUE series
Reference Points	Interim target: B_{MSY}-compatible proxy based on CPUE (average from 1998–99 to 2010–11 of the ELE 3(MIX) model as defined by Starr & Kendrick 2013) Soft Limit: 50% of target Hard Limit: 25% of target Overfishing threshold: F_{MSY}
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 About as Likely as Not (40–60%) to be occurring

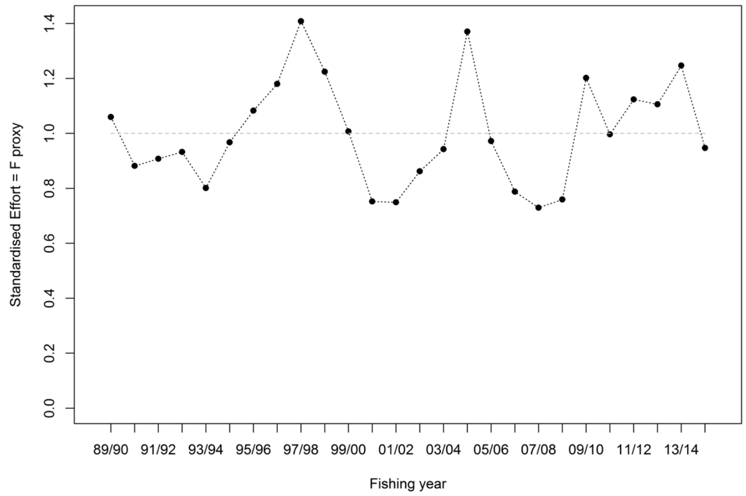
Historical Stock Status Trajectory and Current Status

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 2014–15. The dashed lines represent the interim target and corresponding soft limit and hard limit.

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 Intensity or Proxy	 **Fishing mortality proxy is Standardised Fishing Effort = Total catch/CPUE (normalised). Fishing mortality proxy has fluctuated about the average level and was at about the average in the most recent year.**
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. - Preliminary stock assessment modelling for ELE 3 estimates that the stock abundance has increased substantially from a low level in the 1980s. The assessment models indicate that current biomass levels are probably at or about the default target biomass.
Trends in Other Relevant Indicator or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Quantitative stock projections are unavailable
Probability of Current Catch or TACC causing Biomass to remain below or to 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 About as Likely as Not (40–60%) to cause overfishing

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Evaluation of agreed standardised CPUE indices which reflect changes in abundance.	
Assessment Dates	Latest assessment Plenary publication year: 2016	Next assessment: Unknown
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	1 – High Quality
Data not used (rank)	- *Compass Rose* trawl survey data - Summer ECSI trawl survey data and winter ECSI trawl survey data - Set net CPUE (shark)	3 – Low Quality: insufficient data 2 – Medium or Mixed Quality: variable catchability / selectivity between years 3 – Low Quality: Index compromised by area closures

Changes to Model Structure and Assumptions	None since 2012 assessment
Major Sources of Uncertainty	- It is possible that fisher avoidance and discarding have biased (low) 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. - Preliminary stock assessment modelling results are consistent with assumed level of stock rebuilding, primarily reflecting the increase in the CPUE abundance indices. However, there are considerable uncertainties associated with key biological parameters (natural mortality and growth) and conflict amongst the main input data sets. The modelling results are not considered to be sufficiently reliable to estimate current stock status (relative to *MSY* levels) and potential yields for the stock. With respect to the conceptual B_{msy} proxy, the Plenary had concerns about the reliability of this as a proxy and advised that it only be used in the interim. - 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 40% of the landings since 2004–05 when the deemed value regime changed. Around 15% of the ELE 3 landings are taken by set net in a fishery targeted at a number of shark species, including rig, elephantfish, spiny dogfish, and school shark. Both the trawl and set net fisheries have been subject to management measures designed to reduce interactions with endemic Hector's dolphins. Bottom trawl fishers also have not trawled within one nautical mile of the coast (since 2001) in an effort to preserve ELE egg cases. This may have reduced juvenile and egg mortality in shallow water.

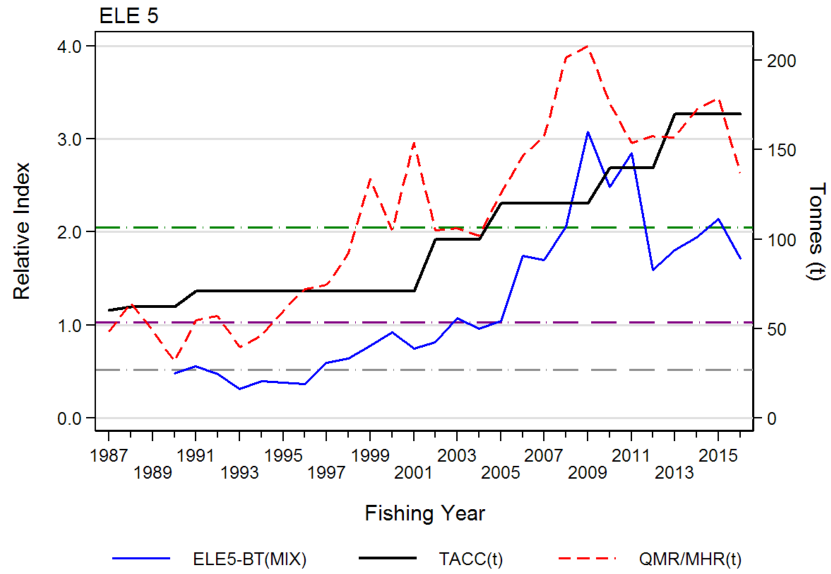
- **ELE 5**

Stock Structure Assumptions

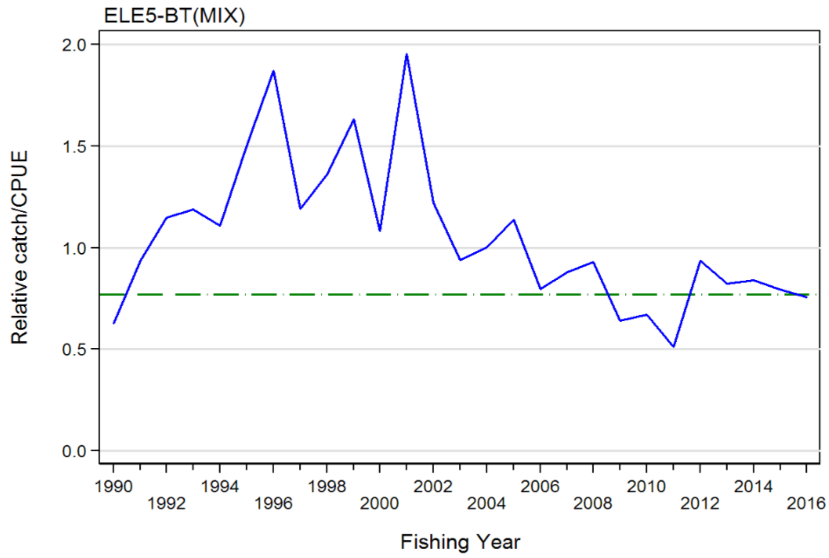
No information is available on the stock separation of elephantfish. The Fishstock ELE 5 is treated in this summary as a unit stock.

Stock Status		
Most Recent Assessment Plenary Publication Year	2017	
Catch in most recent year of assessment	Year: 2015–16	Catch: 137 t
Assessment Runs Presented	Standardised bottom trawl CPUE series based on mixed target species: combined delta-lognormal series	
Reference Points	Target: B_{MSY}-compatible proxy based on mean ELE5-BT(MIX) standardised CPUE: 2005–06 to 2015–16 Soft Limit: 50% of B_{MSY} proxy Hard Limit: 25% of B_{MSY} proxy Overfishing threshold: Mean annual relative exploitation rate for the period: 2005–06 to 2015–16	
Status in relation to Target	About as Likely as Not (40–60%) to be at or above B_{MSY}	
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 About as Likely as Not (40–60%) to be occurring	

Historical Abundance and Catch Trajectories



Comparison of the ELE 5-BT(MIX) CPUE series with the TACC and QMR/MHR landings for ELE 5. The agreed B_{MSY} proxy (geometric average: 2006–2016 ELE 5-BT(MIX) CPUE indices=2.051) is shown as a green line; the calculated Soft Limit (=0.5×B_{MSY} proxy) is shown as a purple line; the calculated Hard Limit (=0.25×B_{MSY} proxy) is shown as a grey line.



Relative fishing pressure for ELE 5 based on the ratio of QMR/MHR landings relative to the ELE5-BT(MIX) CPUE series which has been normalised so that its geometric mean=1.0. Horizontal green line is the geometric mean fishing pressure from 2006 to 2016.

Fishery and Stock Trends	
Recent trend in Biomass or Proxy	The ELE 5 (MIX) CPUE series increased up to a peak in 2008–09, dropped sharply in 2011–12, and has fluctuated without trend close to the target since then.
Recent Trend in Fishing Mortality or Proxy	Fishing mortality proxy has remained relatively stable or declining over the last 10 years.
Other Abundance Indices	-
Trends in Other Relevant Indicator or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Unknown

Probability of Current Catch or TACC causing biomass to remain below or to 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	Current Catch: About as Likely as Not (40–60%) TACC: About as Likely as Not (40–60%)

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Evaluation of agreed standardised CPUE indices	
Assessment Dates	Latest assessment Plenary publication year: 2017	Next assessment: Unknown
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- ELE 5 BT(MIX) CPUE series	1 – High Quality
Data not used (rank)	- Length frequency data summarised from set net logbooks compiled under the industry Adaptive Management Programme	3 – Low Quality: data sparse and outdated
Changes to Model Structure and Assumptions	- Addition of a binomial index to produce a combined CPUE series	
Major Sources of Uncertainty	- It is possible that discarding and management changes (including changes in deemed values) in this fishery has affected CPUE	

Qualifying Comments
Elephantfish have shown strong 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. Confidence intervals for combined CPUE indices are not available.

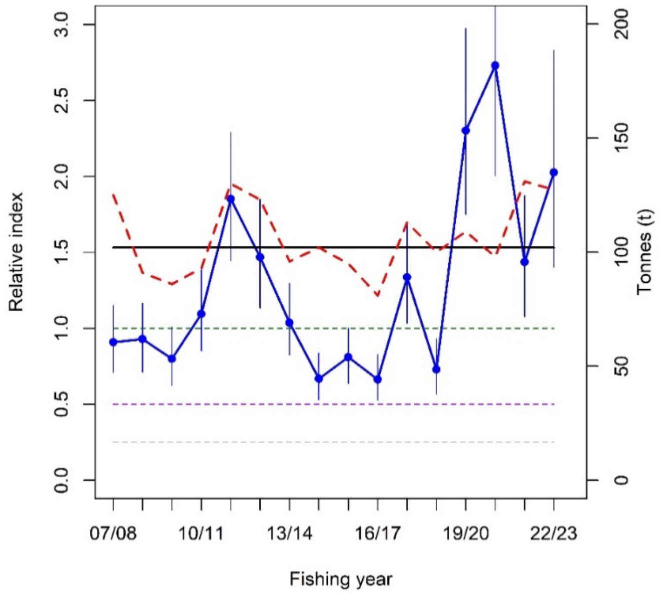
Fishery Interactions
Elephantfish in ELE 5 are taken by bottom trawl in fisheries targeted at flatfish and stargazer. Targeting elephantfish in the bottom trawl fishery was low (average 14% from 1989–90 to 2015–16) but has increased to 19% of the landings since 2002–03. Around 12% of the ELE 5 landings are taken by set net in a fishery targeted at rig and school shark. Incidental captures of seabirds and great white sharks occur, and there is a possibility of incidental capture of Hector's dolphins. However, both the trawl and set net fisheries have been subject to management measures designed to reduce interactions with endemic Hector's dolphins. Interactions with other species are currently being characterised.

- **ELE 7**

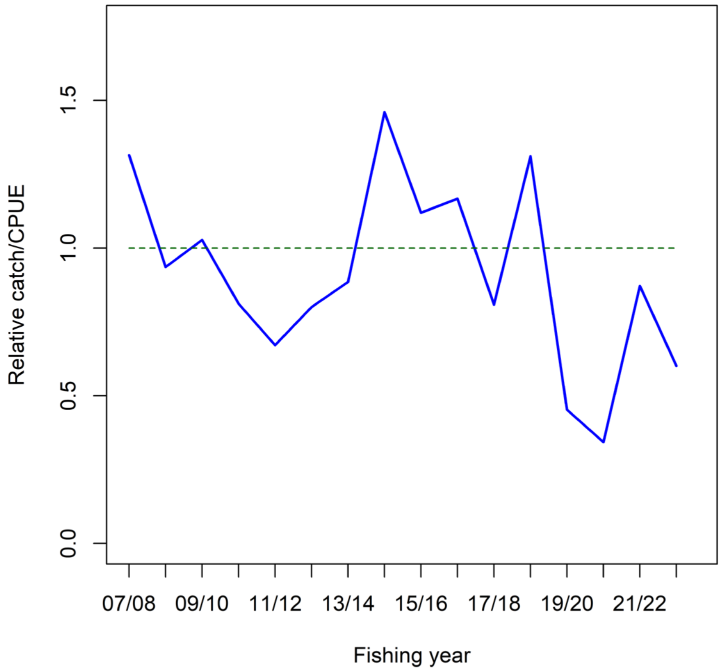
Stock Status		
Most Recent Assessment Plenary Publication Year	2024	
Catch in most recent year of assessment	Year: 2022–23	Catch: 127 t
Assessment Runs Presented	ELE 7 tow-by-tow bottom trawl mixed target species standardised CPUE	
Reference Points	Interim target: B_{MSY} proxy based on the mean of the CPUE series for the period: 2007–08 to 2017–18 Soft Limit: 50% of target Hard Limit: 25% of target Overfishing threshold: Mean annual relative exploitation rate for the period: 2007–08 to 2017–18	
Status in relation to Target	Likely (> 60%) to be above B_{MSY}	
Status in relation to Limits	Soft Limit: Very Unlikely (< 10%)	

	Hard Limit: Very Unlikely (< 10%)
Status in relation to Overfishing	Overfishing is Unlikely (<40) to be occurring

Historical Stock Status Trajectory and Current Status



Comparison of the ELE 7-BT(tow-by-tow) CPUE series (blue line) with the TACC (black line) and QMR/MHR landings (red dashed line) for ELE 7. Error bars on the CPUE series represent 95% confidence intervals. The agreed B_{MSY} proxy (geometric average: 2008–2018 ELE 7-BT(tow-by-tow) CPUE indices=1.0) is shown as a green line; the calculated Soft Limit (=0.5×B_{MSY} proxy) is shown as a purple line; the calculated Hard Limit (=0.25×B_{MSY} proxy) is shown as a grey line.



Relative fishing pressure for ELE 7 based on the ratio of QMR/MHR landings relative to the ELE7-BT(tow-by-tow) CPUE series which has been normalised so that its geometric mean=1.0. Horizontal green line is the geometric mean fishing pressure from 2007–08 to 2017–18.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	CPUE was above the target level from 2019–20 to 2022–23.
Recent Trend in Fishing Intensity or Proxy	Relative exploitation rate was below the threshold level from 2019–20 to 2022–23.
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-Trip based CPUE indices beginning in 1989–90 suggest a general increase in abundance

Projections and Prognosis	
Stock Projections or Prognosis	Biomass is predicted to remain above the target level at the current catch.
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	Current catches and the current TACC are Unlikely (< 40%) to cause overfishing.

Assessment Methodology and Evaluation		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Standardised CPUE index	
Assessment dates	Latest assessment Plenary publication year: 2024	Next assessment: Unknown
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Standardised CPUE (tow-by-tow) (from 2007–08)	1 – High Quality
Data not used (rank)	- Biomass estimates from inshore WCSI trawl survey	2 – Low Quality: low precision and high variability
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	-	

Qualifying Comments
The tendency of ELE to aggregate and migrate leads to interannual variability in catchability. Long term trends in CPUE are assumed to provide a more reliable indication of relative abundance than individual annual indices.

Fishery Interactions
Trawl target sets for ELE 7 tend to be in shallow water mostly around 20–40 m. Elephantfish are caught in bottom trawls as bycatch in flatfish red gurnard and red cod target tows. There is limited targeting of ELE 7.

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