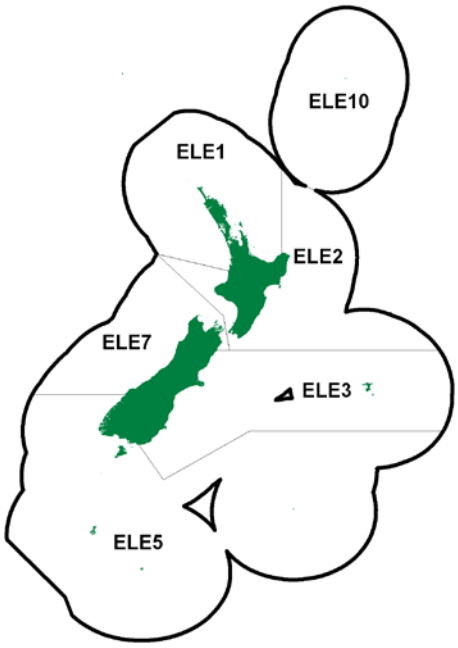
ELEPHANTFISH (ELE)

(*Callorhinchus milii*)
Reperepe



1. FISHERY SUMMARY

1.1 Commercial fisheries

From the 1950s to the 1980s, landings of elephantfish of around 1000 t 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 1936 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. ELE 3 fishing is seasonal, mostly

occurring in spring and summer in inshore waters. Most of the recent increase in catch from the ELE 3 fishery has been taken as a bycatch of the RCO 3 trawl fishery (Raj & Voller 1999). During 1989-90 to 1997-98, the level of elephantfish bycatch from the RCO 3 fishery increased from around 50 t to 300 t (Raj & Voller 1999). There was also a steady increase in the level of ELE 3 bycatch from the FLA 3 trawl fishery, with catches increasing from around 50 t in 1994-95 to 150 t in 1997-98. 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 been increased by 17% up from 120 t to 140 t. All AMP programmes ended on 30th 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. As well, 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) of elephantfish by Fishstock from 1983-84 to 2011-12 and actual TACCs (t) from 1986-87 to 2011-12. QMR data from 1986 - present. No landings have been reported from ELE 10.

Fishstock	ELE 1		ELE 2		ELE 3		ELE 5		ELE 7		Total	
FMA (s)	1 & 9		2 & 8		3 & 4		5 & 6		7			
	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

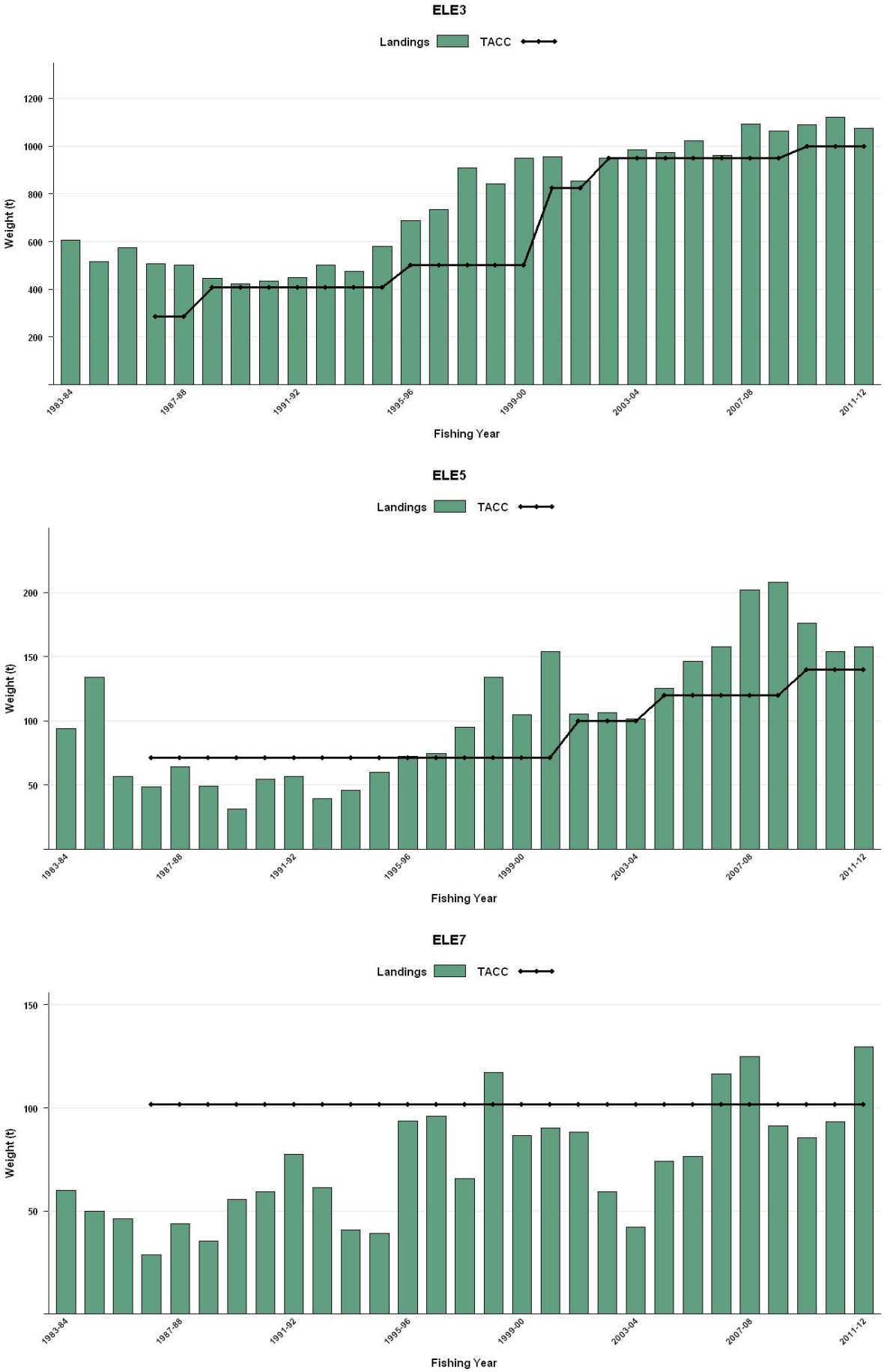


Figure 1: Historical landings and TACC for the three main ELE stocks. From top left: ELE 3 (South East Coast and Chatham Rise), ELE 5 (Southland and Sub Antarctic), and ELE 7 (Challenger).

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 Ministry of 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 less than 500 fish in ELE 2, 1000 fish in ELE 3 and less 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 less than 500 in ELE 7 (Boyd & Reilly 2002). Owing to biases inherent to telephone vs. 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 3. 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 3: 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	9.1-3	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

Indices of relative biomass are available from recent trawl surveys (Table 4, Figure 2). These have not been used to estimate absolute biomass or yields as historically, these trawl surveys have given variable abundance and high CV's for elephantfish, and probably have not monitored their biomass very well. A pilot survey off the east coast of the South Island was undertaken in the summer of 1996-97 and was repeated in 1997-98, 1998-99, 1999-2000 and 2000-01. This survey was initiated for several reasons, including a need to better survey elephantfish in ELE 3 in view of the recent TACC increase. In February 1999, the Inshore Fishery Assessment Working Group concluded that it was not clear whether the East Coast South Island (ECSI) trawl survey was adequately sampling elephantfish, as the commercial fishery for this species included depths < 10 m and the *Kaharoa* is unable to trawl in such areas. Subsequently, in 1999-2000 and 2000-01 the commercial vessel *Compass Rose* carried out surveys (concurrently) with the *Kaharoa* in which it fished areas inside 10 m. In 2001 the Inshore FAWG recommended that the east coast South Island trawl survey be discontinued due to the extreme variability in the catchability of the target species. A workshop (May 2006) to review the monitoring of inshore finfish concluded that the ECSI winter survey series should be reinstated, as based on simulations using existing data, it was predicted to provide useful relative biomass estimates for many species (excluding elephantfish). The workshop concluded that ELE 3 relative biomass should be estimated using industry run "hybrid" surveys.

4.1.2 Biomass estimates

Elephantfish total biomass in the core strata (30–400 m) for the east coast South Island trawl survey increased markedly in 1996 and although it has fluctuated since then it has remained high with 2012 biomass 29% above the post-1994 average of 1049 t. The post 1994 average biomass is about three-fold greater than that of the early 1990s, indicating that the large increase in biomass between 1994 and 1996

has been sustained. The proportion of pre-recruited biomass in the core strata (30–400 m) has 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. Similarly, the proportion of juvenile biomass (based on the length-at-50% maturity) in 2012 was the lowest of all surveys at 23% .

The additional elephantfish biomass captured in the 10–30 m depth range accounted for 44% and 64% of the biomass in the core plus shallow strata (10–400 m) for 2007 and 2012 respectively, indicating that in terms of biomass, it is essential to monitor the shallow strata for elephantfish. Further, the addition of the 10–30 m depth range has 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. The proportion of pre-recruited biomass in the core plus shallow strata is also greater than that of the core strata alone (i.e., 64% compared to 50% in 2007, and 15% compared to 5% in 2012), a reflection of the larger numbers of smaller elephantfish found in the shallow strata. The sex ratio also favours females in the shallow strata, whereas males dominate in the core strata .

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.

4.1.3 Length frequency distributions

The size distributions of elephantfish are inconsistent among the nine core strata (30–400 m) for the east coast South Island trawl survey 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). The time series length frequency distributions in the shallow plus core strata (10–400) includes only the 2007 and 2012 surveys, and have similar distributions, showing clearly the juvenile cohorts.

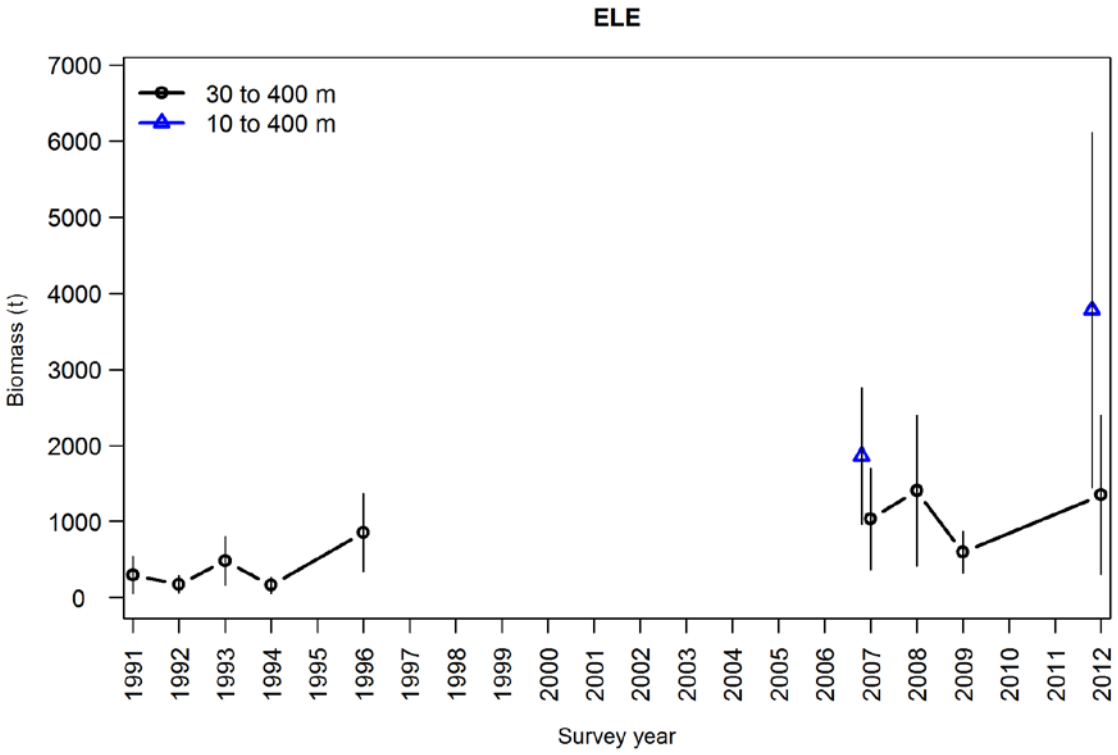


Figure 2: Elephantfish total biomass and 95% confidence intervals for the all ECSI winter surveys in core strata (30–400 m), and core plus shallow strata (10–400 m) for species found in less than 30 m in 2007 and 2012.

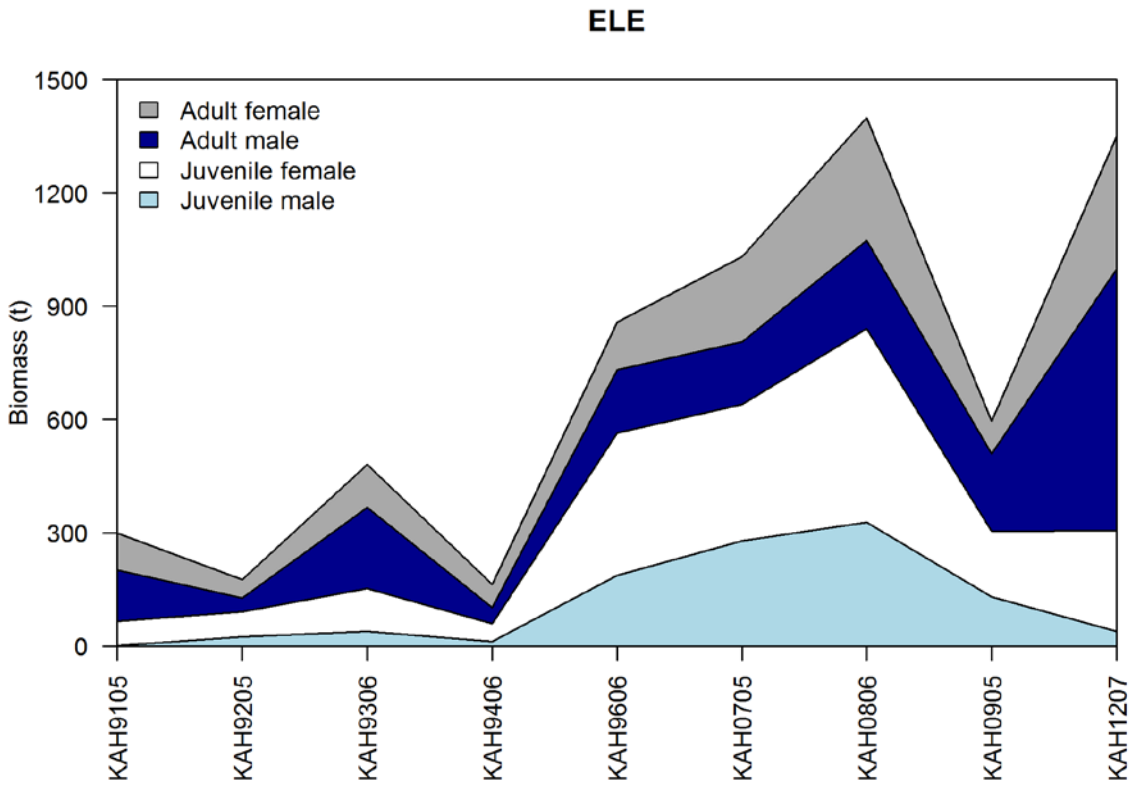


Figure 3: Elephantfish juvenile and adult biomass for ECSI winter surveys in core strata (30–400 m), where juvenile is below and adult is equal to or above length at which 50% of fish are mature.

Table 4: 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 & 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			30-400m		10-400m		30-400m		10-400m		30-400m		10-400m	
		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
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	-	-	-	-	-	-	-	-	-	-
		1999-00	COM9901	802	73	475	79	-	-	-	-	-	-	-	-
		2000-01	KAH0014	693	18	-	-	-	-	-	-	-	-	-	-
		2000-01	CMP0001	1 229	29	84	23	-	-	-	-	-	-	-	-
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	-	-	-	-	-	-	-	-	-	-
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.

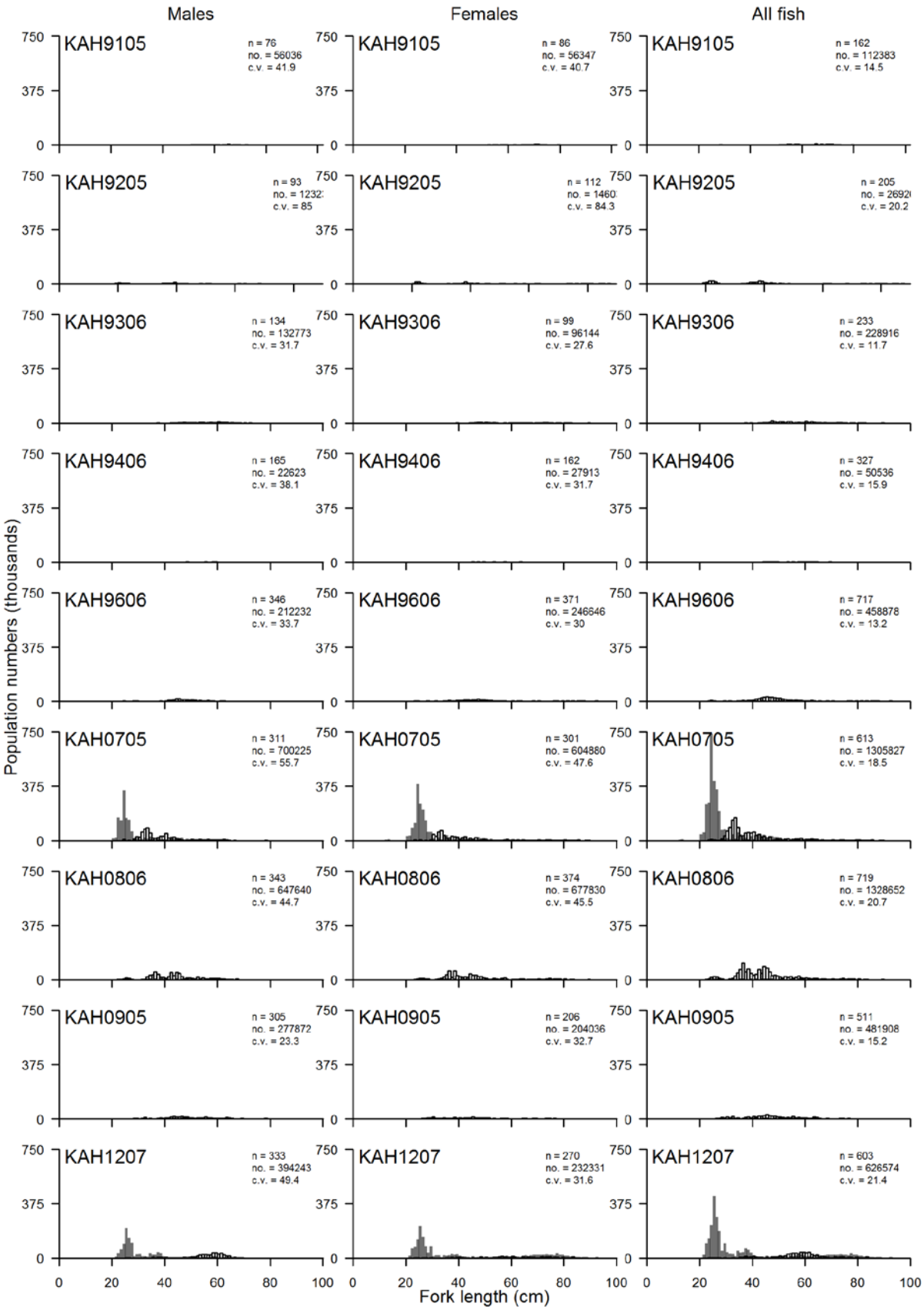


Figure 4: Scaled length frequency distributions for elephantfish in core strata (30–400 m) for all nine the ECSI winter surveys. The length distribution is also shown in the 10–30 m depth strata for the 2007 and 2012 surveys overlayed (not stacked) in light grey for ELE, GUR, RCO, and SPD. Population estimates are for the core strata only, in thousands of fish. Scales are the same for males, females and unsexed, except for NMP where total has a different scale.

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.

Two standardised CPUE series for ELE 5 were prepared for 2012, again with each series based on the bycatch of elephantfish in the appropriate bottom trawl fisheries defined by target species combinations. One of these series [ELE 5 (MIX)] is analogous to the MIX series developed for ELE 3, with the series defined by 6 target species in all valid ELE 5 statistical areas. A series using the same suite of target species but confined to only Area 030 was dropped by the Working Group after it was determined that the Area 030 series showed a very similar trend to the total ELE 5 series, with much wider confidence intervals. 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 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 appear to be an appropriate index of ELE abundance in either QMA.

These analyses were based on data which have been amalgamated into "trip-strata" (Starr 2007), defined as the sum of the catch and effort within a trip characterised by unique statistical areas, target species and method of capture. This approach loses much of the detailed information available in tow-by-tow records, but reduces all data to a common level of stratification, allowing the calculation of linked year coefficients. Unfortunately, the "trip-stratum" approach ignores problems associated with shifts in reporting behaviour associated with changes in form type requirements, while relying on the model parameterisation to adjust for potential biases. The Working Group was concerned in 2009 whether the shift to the new TCER forms in October 2007 may have affected the indices in the 2007–08 fishing year. As a further three years of catch/effort data have now been collected using the new, more detailed, TCER forms, further standardised analyses were run in both ELE 3 and ELE 5 on data which had been summarised to the level of a complete "trip" to test the sensitivity of the annual coefficients to the level of amalgamation. The presumption is that amalgamating the data to the level of a "trip" will minimise the effect of the change in form type, with the definition of a "trip" unaffected by form requirements.

Each series was modelled in the same manner, with log(catch) offered as the dependent variable and a range of explanatory variables offered, including duration and number of tows as continuous polynomials, and statistical area, target species, vessel and month as categorical explanatory variables. In every case, year was forced into the model as the first variable and was considered to be a proxy for relative annual abundance. Data were restricted to vessels which had participated for a specified number of years at a minimum level of participation (expressed as number of trips in a year). This filtering of the data was done to reduce the number of vessels in the data set without overly reducing the amount of catch represented in the model.

Trial models based on five alternative distributional assumptions were fit to a reduced set of explanatory variables, with the distribution giving the best log-likelihood fit selected for the final stepwise model fit. Table 5 lists the distribution giving the best fit for each model. A logit model which modelled the probability of success was also fit to the same data using a binomial distribution. This model was generated as a diagnostic but is not presented.

Table 5: Names and descriptions of the three elephantfish ELE 3 and two ELE 5 bottom trawl CPUE series accepted by the Working Group in 2012. Also shown is the error distribution that had the best fit to the distribution of standardised residuals for the fitted model.

Name	Code	Statistical areas	Target species	Best distribution
ELE 3 bottom trawl mixed	ELE3(MIX)	018, 020, 022,024, 026	RCO, STA, BAR, TAR, ELE	lognormal
ELE 3 bottom trawl flatfish	ELE3(RCO)	018, 020, 022,024, 026	RCO	lognormal
ELE 3 bottom trawl trip-based	ELE3(MIX)-trip	018, 020, 022,024, 026	N/A	lognormal
ELE 5 bottom trawl mixed	ELE5(MIX)	ELE 5 (all statistical areas)	ELE, FLA, STA, BAR, SPD, RCO	lognormal
ELE 5 bottom trawl trip-based	ELE5(MIX)-trip	ELE 5 (all statistical areas)	N/A	lognormal

ELE 3(RCO): This series showed a generally increasing trend from the beginning to the end of the series, with a possible levelling off of the series after 2007-08. There is a period in the middle of the series with four years of declining CPUE, reaching a nadir slightly below the long-term mean in 2004–05 (Figure 3).

ELE 3(MIX): This series has a trajectory similar to the ELE 3(RCO) series, showing an increasing trend which levels of around 2007-08 (Figure 3). Again there is a short period of decline in the early 2000s which reaches a low point in 2004–05 slightly below the long-term average.

ELE 3(MIX)-trip: This series was run as a diagnostic sensitivity to test whether the change in form type in October 2007 introduced a bias into the analysis. This series (Figure 5) was similar to the ELE 3(MIX) series, leading to the conclusion that, for ELE 3, the form type change did not introduce strong bias.

***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.

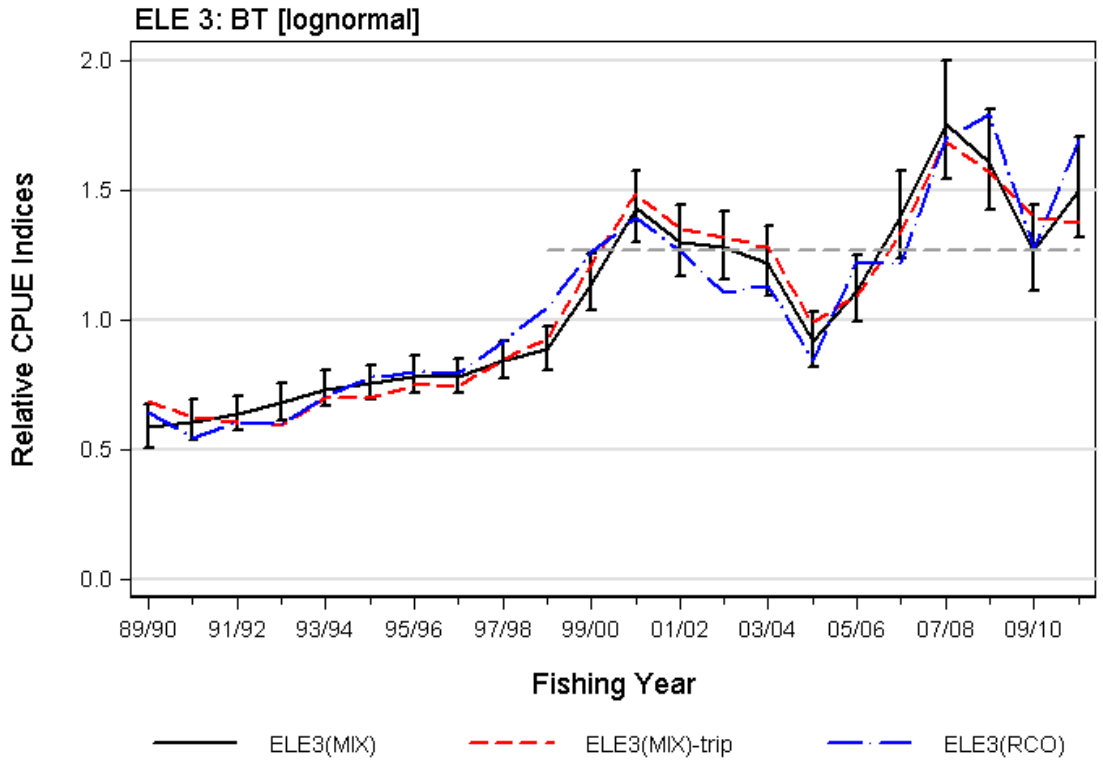


Figure 5: Standardised CPUE indices for three ELE 3 bottom trawl fisheries [ELE 3(MIX), ELE 3 (MIX)-trip and ELE 3(RCO)] (Table 5). The horizontal grey line is the mean of ELE 3(MIX) from 98-99 to 10-11 (*B_{MSY}* conceptual proxy). All series have been normalised to a geometric mean =1.0. Error bars show ±97.5% confidence intervals.

ELE 5(MIX): This series has a continually increasing trend (Figure 6).

ELE 5(MIX)-trip: This series was run as a diagnostic sensitivity to test whether the change in form type in October 2007 introduced a bias into the analysis. This series (Figure 4) was similar to the ELE 5(MIX) series, leading to the conclusion that, for ELE 5, the form type change did not introduce strong bias.

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

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.

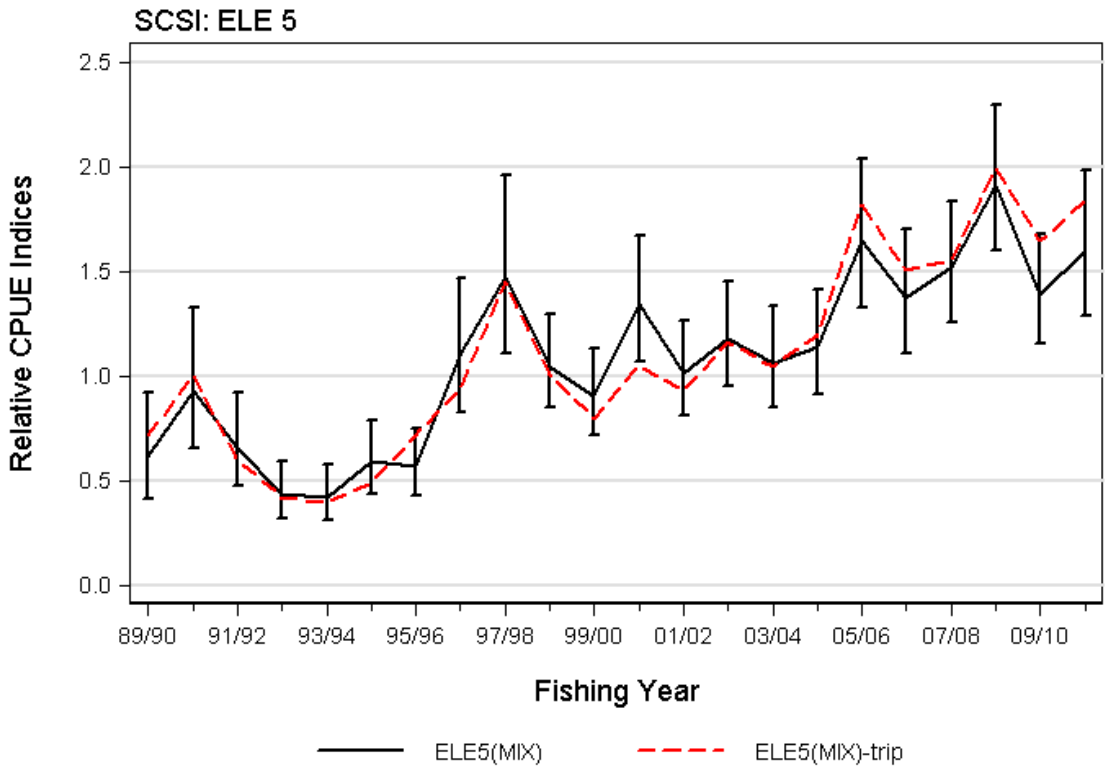


Figure 6:Standardised CPUE indices for a mixed target species ELE 5 bottom trawl fisheries [ELE 5- (MIX)] (Table 5), plotted along with the annual sum of catches from the series statistical areas plus target species listed in Table 5. Both series have been normalised to a geometric mean = 1.0. Error bars show ±97.5% confidence intervals.

5. STATUS OF THE STOCKS

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**

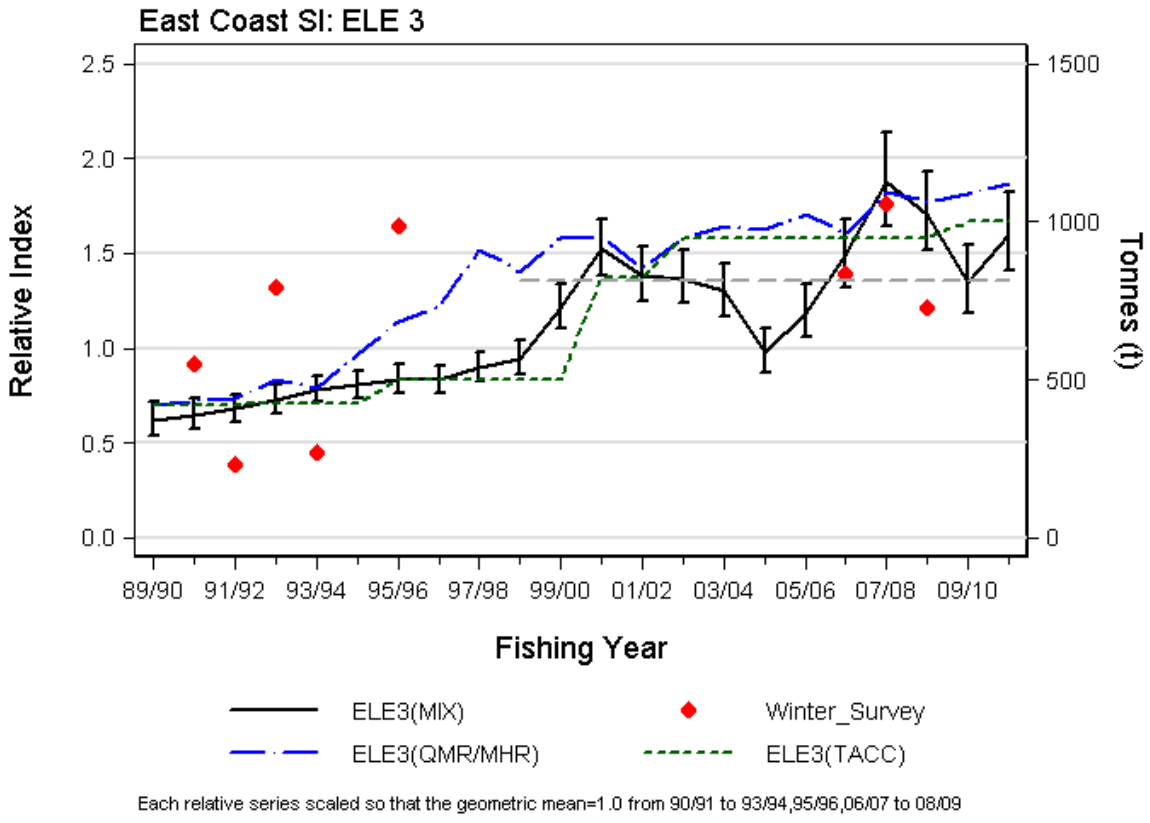
Stock Structure Assumptions

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	2012
Reference Points	(Proposed) Target: B_{MSY}-compatible proxy based on CPUE (average from 1998-99 to 2010-11 of the ELE3(MIX) model as defined in Starr & Kendrick 2012a) Soft Limit: 50% of target Hard Limit: 25% of target
Status in relation to Target	About as Likely as Not 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

Historical Stock Status Trajectory and Current Status

CPUE, Catch and TACC Trajectories



Comparison of the mixed target species bottom trawl CPUE series (ELE3(MIX)) with the trajectories of catch (ELE3(QMR/MHR)) and TACCs from 1989-90 to 2010-11.

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 the end of the series, with a possible levelling off of the series after 2007–08.
Recent trend in Fishing Mortality or Proxy	Unknown. Abundance has increased during a period when catches were increasing.
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 2010-11) 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 / TACC causing decline below Limits	Soft Limit: Unlikely (< 40%) Hard Limit: Very Unlikely (< 10%)	
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: 2012	Next assessment: 2015
Overall assessment quality rank	1 – High Quality. The Southern Inshore Working Group agreed that the ELE3(MIX) CPUE index was a credible measure of abundance.	
Main data inputs (rank)	- Catch and effort data derived from the Ministry for Primary Industries compulsory catch reporting system. - Trawl survey biomass indices and associated length frequencies.	1 – High Quality 1 – High Quality; however, the survey does not cover the full distribution range of elephantfish in ELE 3
Data not used (rank)	3 - Compass Rose trawl survey data - insufficient data 3 - Summer ECSI trawl survey data - variable catchability between years	
Changes to Model Structure and Assumptions	The previously accepted target red cod CPUE series has been expanded to include a range of mixed target species and updated with data up to 2007-08. The winter east coast South Island trawl survey was resumed in 2007 and new biomass index values for elephantfish applicable to 2007, 2008 and 2009 are available.	
Major Sources of Uncertainty	Elephantfish are not thought to be well monitored by the East Coast South Island winter trawl survey. 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. 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. Incidental captures of seabirds occur and there is a risk of incidental capture of Hector's dolphins, there is a risk of incidental capture of sea lions from Otago Peninsula south.

- **ELE 5**

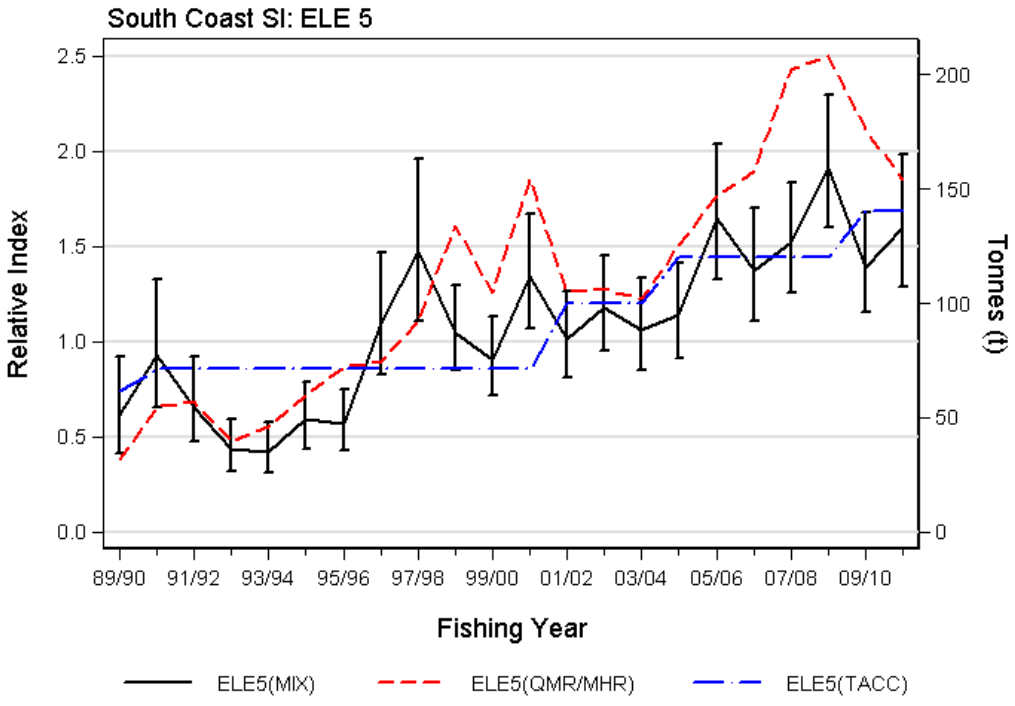
Stock Structure Assumptions

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	2012
Reference Points	Target: B_{MSY}-compatible proxy based on CPUE (to be determined) Soft Limit: 20% B_0 Hard Limit: 10% B_0
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

Historical Stock Status Trajectory and Current Status

CPUE, Catch and TACC Trajectories



Comparison of the mixed target species bottom trawl CPUE series (ELE5(MIX)) with the trajectories of catch (ELE5(QMR/MHR)) and TACCs from 1989-90 to 2010-11.

Fishery and Stock Trends	
Recent trend in Biomass or Proxy	The ELE 5 (MIX) CPUE series has a continually increasing trend.
Recent Trend in Fishing Mortality or Proxy	Unknown. Catches and CPUE have both been steadily increasing since the early 1990s.
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%)	
Assessment Methodology and Evaluation		
Assessment Type	Level 2: Standardised CPUE abundance index	
Assessment Method	Evaluation of agreed standardised CPUE indices which reflect changes in abundance	
Assessment Dates	Latest assessment: 2012	Next assessment: 2014
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	-The Southern Inshore Working Group agreed that the ELE 5 (MIX) CPUE index was a credible measure of abundance. -Catch and effort data derived from the Ministry for Primary Industries compulsory catch reporting system.	1 – High Quality 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	Statistical Area 30 only model was dropped	
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.

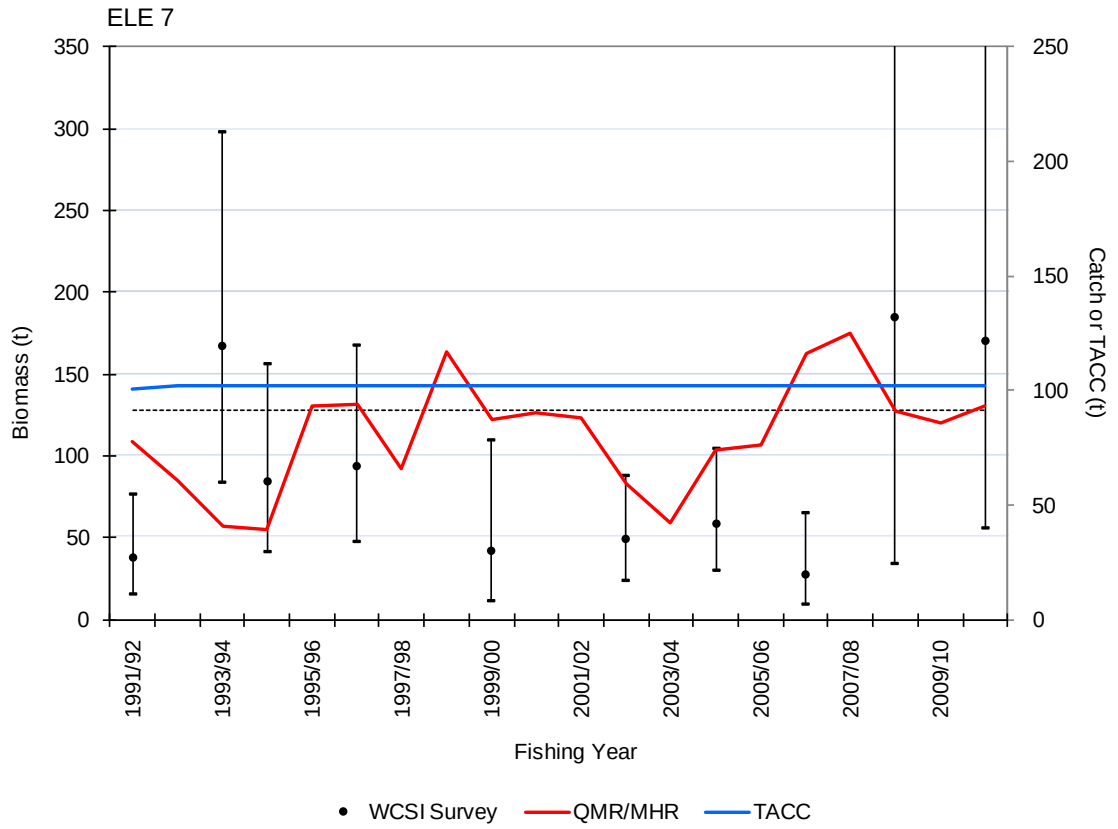
Fishery Interactions
Elephantfish in ELE 5 are taken by bottom trawl in fisheries targeted at flatfish and stargazer. Targeting elephantfish in the bottom trawl fishery was low (average 14% from 1989-90 to 2010-11) but has increased to about 20% of the landings since 2002-03. Around 12% of the ELE 5 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	2009
Assessment Runs Presented	
Reference Points	Target: Not established but B_{MSY} assumed Soft Limit: 20% B_0 Hard Limit: 20% B_0
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unknown

Historical Stock Status Trajectory and Current Status



Elephantfish biomass (points)±95% CI (estimated from survey CV's assuming a lognormal distribution) and the time series mean (dotted line) estimated from the West Coast South Island trawl survey, commercial catch (red line) TACC (blue line).

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Biomass trends for this stock are unreliably estimated by the West Coast South Island survey, particularly for the last year where the survey CV was 83%.
Recent Trend in Fishing Mortality or Proxy	Catch declined continuously from a high in 1998-99 to a low in 2003-04 but increased to above the long-term average since then.
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	Unknown
Probability of Current Catch or TACC causing decline below Limits	Soft Limit: Unknown Hard Limit: Unknown

Assessment Methodology		
Assessment Type	-	
Assessment Method	-	
Main data inputs	-	
Period of Assessment	Latest assessment: 2009	Next assessment: Unknown
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	-	
Qualifying Comments		
-		

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.

TACCs and reported landings are summarised in Table 6.

Table 6: Summary of yields (t), TACCs (t), and reported landings (t) for elephant fish for the most recent fishing year.

Fishstock	QMA		2011-12 Actual TACC	2011-12 Reported Landings
ELE 1	Auckland (East) (West)	1 & 9	10	< 1
ELE 2	Central (East) (West)	2 & 8	22	16
ELE 3	South-East (Coast) (Chatham)	3 & 4	1 000	1 074
ELE 5	Southland and Sub-Antarctic	5 & 6	140	157
ELE 7	Challenger	7	102	130
ELE 10	Kermadec	10	10	0
Total			1 283	1 377

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