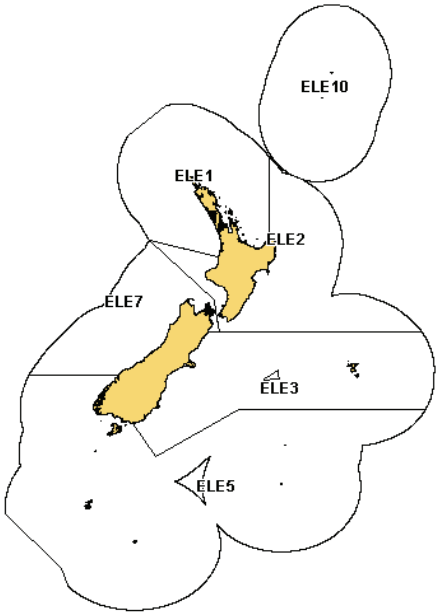
# ELEPHANT FISH (ELE)

(*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.

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 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. In 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. 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.

**Table 2: Reported landings (t) of elephantfish by Fishstock from 1983–84 to 2007–08 and actual TACCs (t) from 1986–87 to 2007–08. QMR data from 1986 – present.**

| Fishstock | ELE 1 | | ELE 2 | | ELE 3 | | ELE 5 | | ELE 7 | |
|---|---|---|---|---|---|---|---|---|---|---|
| FMA (s) | 1 & 9 | | 2 & 8 | | 3 & 4 | | 5 & 6 | | 7 | |
| | Landings | TACC | Landings | TACC | Landings | TACC | Landings | TACC | Landings | TACC |
| 1983–84* | < 1 | – | 5 | – | 605 | – | 94 | – | 60 | – |
| 1984–85* | < 1 | – | 3 | – | 517 | – | 134 | – | 50 | – |
| 1985–86* | < 1 | – | 4 | – | 574 | – | 57 | – | 46 | – |
| 1986–87 | < 1 | 10 | 2 | 20 | 506 | 280 | 48 | 60 | 29 | 90 |
| 1987–88 | < 1 | 10 | 3 | 20 | 499 | 280 | 64 | 60 | 44 | 90 |
| 1988–89 | < 1 | 10 | 1 | 22 | 450 | 415 | 49 | 62 | 43 | 100 |
| 1989–90 | < 1 | 10 | 3 | 22 | 422 | 418 | 32 | 62 | 55 | 101 |
| 1990–91 | < 1 | 10 | 5 | 22 | 434 | 422 | 55 | 71 | 59 | 101 |
| 1991–92 | < 1 | 10 | 11 | 22 | 450 | 422 | 58 | 71 | 78 | 101 |
| 1992–93 | < 1 | 10 | 5 | 22 | 501 | 423 | 39 | 71 | 61 | 102 |
| 1993–94 | < 1 | 10 | 6 | 22 | 475 | 424 | 46 | 71 | 41 | 102 |
| 1994–95 | < 1 | 10 | 5 | 22 | 580 | 424 | 60 | 71 | 39 | 102 |
| 1995–96 | < 1 | 10 | 7 | 22 | 688 | 500 | 72 | 71 | 93 | 102 |
| 1996–97 | < 1 | 10 | 9 | 22 | 734 | 500 | 74 | 71 | 94 | 102 |
| 1997–98 | < 1 | 10 | 12 | 22 | 910 | 500 | 95 | 71 | 66 | 102 |
| 1998–99 | < 1 | 10 | 9 | 22 | 842 | 500 | 129 | 71 | 117 | 102 |
| 1999–00 | < 1 | 10 | 6 | 22 | 950 | 500 | 105 | 71 | 87 | 102 |
| 2000–01 | 2 | 10 | 7 | 22 | 956 | 825 | 153 | 71 | 90 | 102 |
| 2001–02 | < 1 | 10 | 9 | 22 | 852 | 825 | 105 | 100 | 88 | 102 |
| 2002–03 | 1 | 10 | 9 | 22 | 950 | 950 | 106 | 100 | 59 | 102 |
| 2003–04 | < 1 | 10 | 10 | 22 | 984 | 950 | 102 | 100 | 42 | 102 |
| 2004–05 | < 1 | 10 | 13 | 22 | 972 | 950 | 125 | 120 | 74 | 102 |
| 2005–06 | < 1 | 10 | 14 | 22 | 1023 | 950 | 147 | 120 | 76 | 102 |
| 2006–07 | < 1 | 10 | 17 | 22 | 960 | 950 | 151 | 120 | 116 | 102 |
| 2007–08 | < 1 | 10 | 16 | 22 | 1 092 | 950 | 202 | 120 | 125 | 102 |

| Fishstock | ELE 10 | | | |
|---|---|---|---|---|
| FMA (s) | 10 | | Total | |
| | Landings | TACC | Landings | TACC |
| 1983–84* | 0 | – | 765 | – |
| 1984–85* | 0 | – | 704 | – |
| 1985–86* | 0 | – | 681 | – |
| 1986–87 | 0 | 10 | 584 | 470 |
| 1987–88 | 0 | 10 | 610 | 470 |
| 1988–89 | 0 | 10 | 543 | 619 |
| 1989–90 | 0 | 10 | 510 | 623 |
| 1990–91 | 0 | 10 | 553 | 636 |
| 1991–92 | 0 | 10 | 597 | 636 |
| 1992–93 | 0 | 10 | 606 | 638 |
| 1993–94 | 0 | 10 | 568 | 639 |
| 1994–95 | 0 | 10 | 684 | 639 |
| 1995–96 | 0 | 10 | 862 | 715 |
| 1996–97 | 0 | 10 | 912 | 715 |
| 1997–98 | 0 | 10 | 1 082 | 715 |
| 1998–99 | 0 | 10 | 1 098 | 715 |
| 1999–00 | 0 | 10 | 1 148 | 715 |
| 2000–01 | 0 | 10 | 1 207 | 1 040 |
| 2001–02 | 0 | 10 | 1 053 | 1 057 |
| 2002–03 | 0 | 10 | 1 125 | 1 194 |
| 2003–04 | 0 | 10 | 1 139 | 1 194 |
| 2004–05 | 0 | 10 | 1 184 | 1 214 |
| 2005–06 | 0 | 10 | 1 260 | 1 214 |
| 2006–07 | 0 | 10 | 1 244 | 1 214 |
| 2007–08 | 0 | 10 | 1 436 | 1214 |

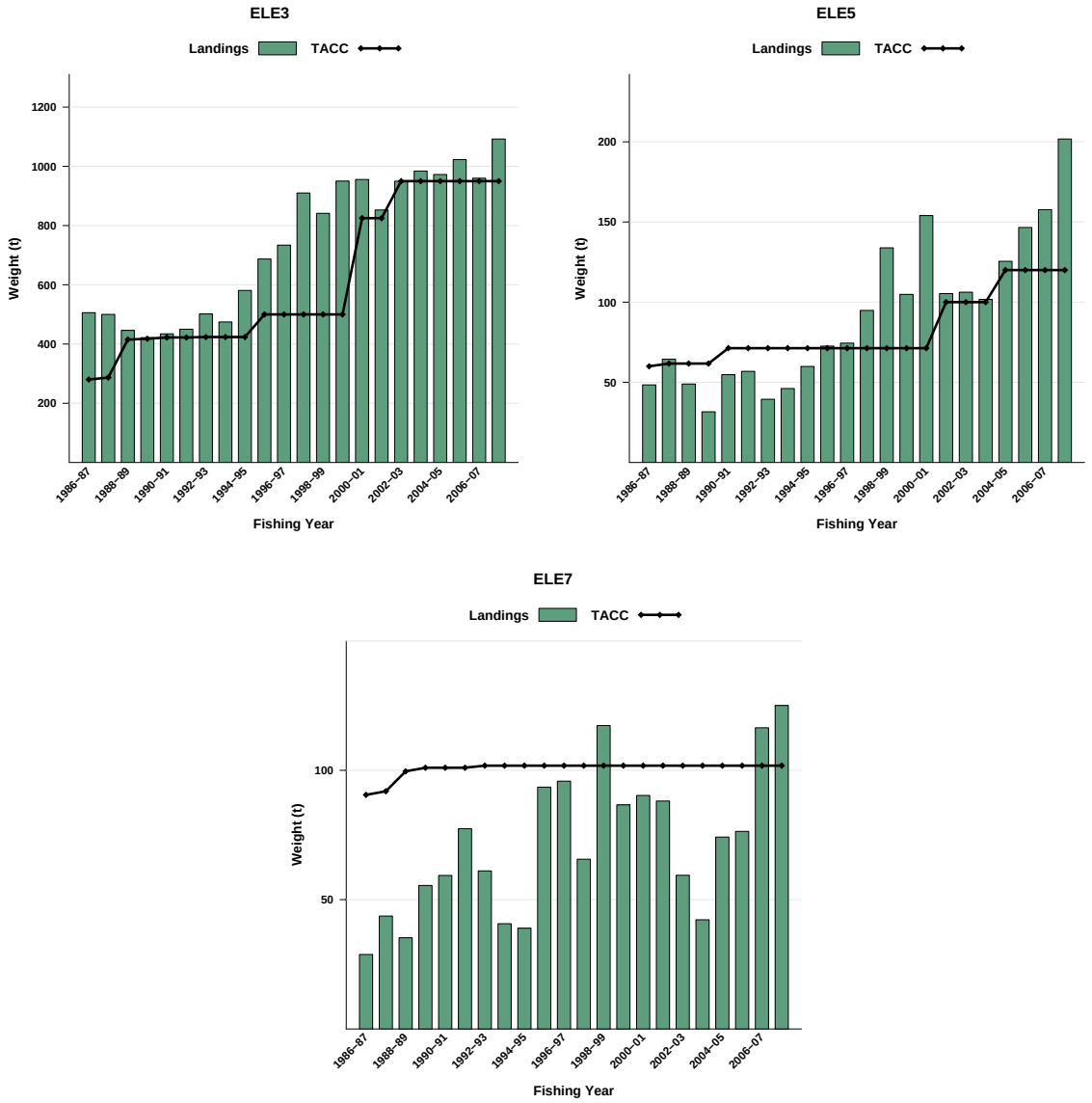



**Figure 1: Historical landings and TACC for the three main ELE stocks. From top left: ELE3 (South East Coast and Chatham Rise), ELE5 (Southland and Sub Antarctic), and ELE7 (Challenger). Note that these figures do not show data prior to entry into the QMS.**

## 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 $M = \log_e 100$/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 | |
| $L_\infty$ (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 | |
| $L_\infty$ (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 new data that alter the stock boundaries given in previous assessment documents.

There is only limited information available to support existing 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

There are no new data which would alter the yield estimates given in the 1996 Plenary Report. The yield estimates are based on commercial landings data only and have not changed since the 1988 Plenary Report.

## 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.

**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*.**

| Region | Fishstock | Year | Trip number | Biomass estimate | CV (%) |
|---|---|---|---|---|---|
| ECSI(winter) | ELE 3 | 1991 | KAH9105 | 300 | 40 |
| | | 1992 | KAH9205 | 176 | 32 |
| | | 1993 | KAH9306 | 481 | 33 |
| | | 1994 | KAH9406 | 152 | 33 |
| | | 1996 | KAH9606 | 858 | 30 |
| | | 2007 | KAH0705 | 1 034 | 32 |
| | | 2008 | KAH0806 | 1404 | 35 |
| 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 |
| | | | | | (inside 10m) |
| | | | | 475 | 79 |
| | | 2000-01 | KAH0014 | 693 | 18 |
| | | 2000-01 | CMP0001 | 1 229 | 29 |
| | | | | | (inside 10m) |
| | | | | 84 | 23 |
| WCSI update | ELE 7 | 1992 | KAH9204 | 38 | 42 |
| | | 1994 | KAH9404 | 167 | 33 |
| | | 1995 | KAH9504 | 85 | 35 |

**Table 4 continued:**

| Region | Fishstock | Year | Trip number | Biomass estimate | CV (%) |
|---|---|---|---|---|---|
| | | 1997 | KAH9701 | 94 | 33 |
| | | 2000 | KAH0004 | 42 | 63 |
| | | 2003 | KAH0304 | 49 | 34 |
| | | 2005 | KAH0503 | 59 | 33 |
| | | 2007 | KAH0704 | 28 | 53 |
| Stewart-Snares | ELE 5 | 1993 | TAN9301 | 219 | 33 |
| | | 1994 | TAN9402 | 177 | 47 |
| | | 1995 | TAN9502 | 69 | 49 |
| | | 1996 | TAN9604 | 137 | 46 |

*Assuming areal 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.

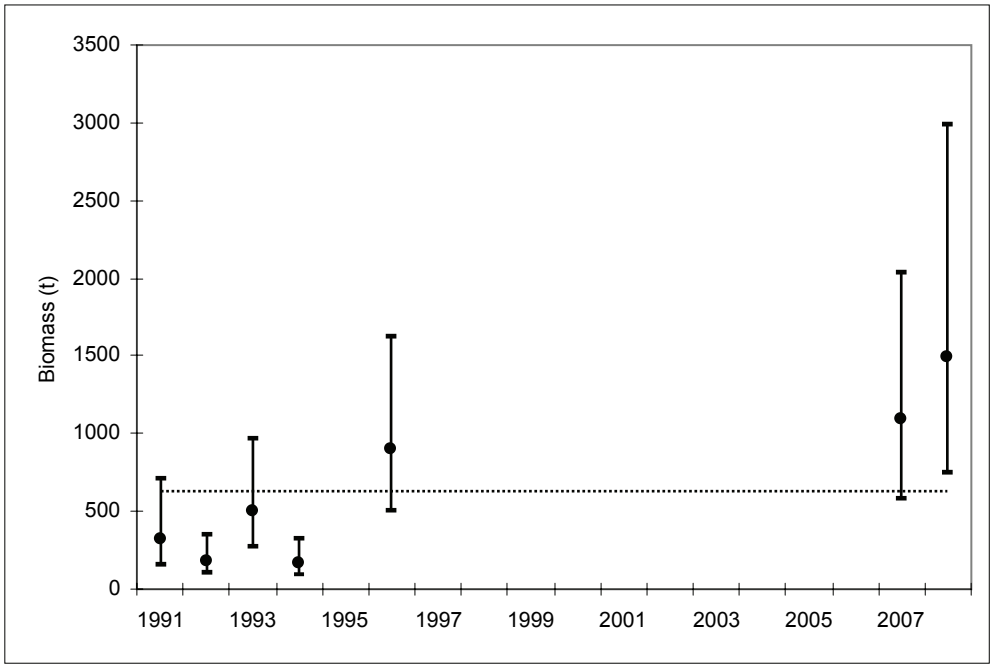



**Figure 2: Elephantfish biomass ±95% CI (estimated from survey CV's assuming a lognormal distribution) and the time series mean (dotted line) estimated from the East Coast South Island trawl survey.**

### 4.1.2 CPUE biomass indices

ELE 3 is monitored using standardized CPUE, based on non-zero catches recorded by bottom trawl fishery targeting RCO, as an index of relative abundance (Figure 3). The CPUE trend was updated to 2005–06 as part of the ELE 3 AMP in 2007 (Starr *et al*. 2007a).

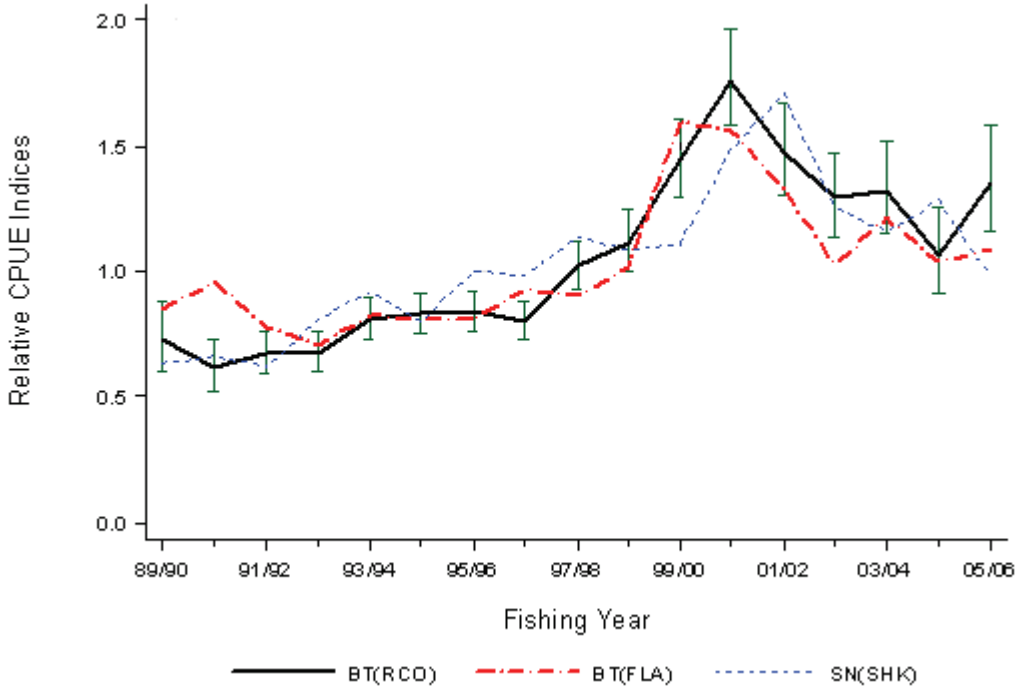



**Figure 3: Comparison of the lognormal indices from three independent CPUE series for ELE 3: target RCO bottom trawl [BT(RCO)], target FLA bottom trawl [BT(FLA)] and target shark setnet [SN(SHK)] (Starr *et al*. 2007a).**

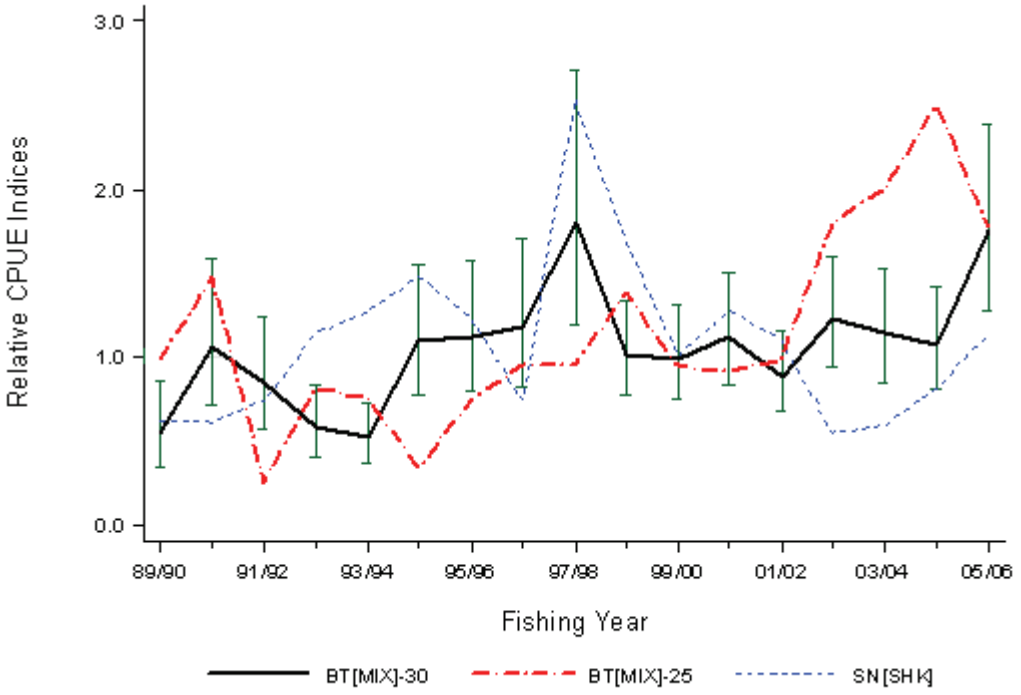



**Figure 4: Comparison of the lognormal indices from three different standardised models derived from catch/effort data for the by-catch ELE 5: a) BT(MIX)-30: flatfish bottom trawl fishery in Area 025 (western Foveaux Strait); a) BT(MIX)-25: flatfish bottom trawl fishery in Area 025 (eastern Foveaux Strait); c) SH(SHK): target school shark setnet fishery operating in both Area 025 and 030. (Starr *et al*. 2007b).**

## 4.2 Biomass Estimates

Estimates of current and reference absolute biomass are not available.

### 4.3 Estimation of Maximum Constant Yield (MCY)

MCY was estimated from the equation MCY = $cY_{AV}$ (Method 4). The value c was set equal to 0.7 based on the estimate of $M$ = 0.35. Mean catches for the years 1983–84 to 1985–86 were used to estimate MCY because the fishery appeared to stabilise after an earlier period of decline.

(i) South–East (Coast) and South–East (Chatham Rise) (ELE 3)

MCY = 0.7 * 565.5 t = 396 t (rounded to 400 t).

(ii) Southland and Sub–Antarctic (ELE 5)

MCY = 0.7 * 94.9 t = 66 t (rounded to 70 t).

(iii) Challenger/Central (Plateau) (ELE 7)

MCY = 0.7 * 52.3 t = 37 t (rounded to 40 t).

The estimate of $M$ is uncertain and recruitment variability may be low, so the estimate of c is uncertain. The MCY estimates are considered approximate and are probably conservative.

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

### 4.4 Estimation of Current Annual Yield (CAY)

CAY cannot be determined.

Yield estimates are summarised in Table 5.

**Table 5: Yield estimates (t) for elephant fish.**

| Parameter | Fishstock | Estimate |
|---|---|---|
| MCY | ELE 3 | 400 |
| | ELE 5 | 70 |
| | ELE 7 | 40 |
| | Total | 510 |
| CAY | All | Cannot be |

### 4.5 Other yield estimates and stock assessment results

No other yield estimates are available.

### 4.6 Other Factors

The amount of quota allocated was below historic catch levels and has reduced elephantfish mainly to a trawl bycatch for inshore vessels. On the east coast of the South Island the availability of elephantfish since the start of the QMS appears to have been high, and many individual fishers have exceeded their quotas. As a result, deeming and bycatch trading of this species has increased.

Target fishing for elephantfish using setnets has decreased since the introduction of the QMS. The distribution of the target trawl species such as red cod, barracouta and flatfish influences the likelihood of fishers encountering elephantfish.

## 5. ANALYSIS OF ADAPTIVE MANAGEMENT PROGRAMMES (AMP)

The Ministry of Fisheries revised the AMP framework in December 2000. The AMP framework is intended to apply to all proposals for a TAC or TACC increase, with the exception of fisheries for which there is a robust stock assessment. In March 2002, the first meeting of the new Adaptive

Management Programme Working Group was held. Two changes to the AMP were adopted:

- a new checklist was implemented with more attention being made to the environmental impacts of any new proposal;
- the annual review process was replaced with an annual review of the monitoring requirements only. Full analysis of information is required a minimum of twice during the 5 year AMP.

**ELE 3 - Three-Yearly Review** (AMP WG/09/05)

**Fishery Characterization**

- ELE 3 has been managed under an AMP since 2000-01. The TACC was increased from 500t to 825t on entry into an AMP, and an additional allowance of 5t was made for each of customary and recreational use, bringing the total TAC to 835t per year. The TACC was again increased to 950t in Oct 2002 in response to ongoing difficulties with limiting catches within the TACC and to an agreed apparent increase in abundance.
- The WG queried whether the high level of landings reported as gutted (GUT) dressed code were correct. If these were headed and gutted (HGU), this would result in substantial under-reporting, given the different conversion factors for these landing states. Fishery managers confirmed that these fish are currently landed in the GUT state, and that the shift from HGU to GUT landings, beginning in the mid-1990s, possibly resulted from benefits to fishermen from reporting under the GUT conversion factor (1.1).
- A historical catch history was reconstructed for ELE 3 in 2007, and updated in this review. Earliest recorded catches averaged around 200t from 1936 to 1947, and then increased steeply to almost 1,200t by 1958. Catches fluctuated between about 750t - 1,300t through to 1974, declined to < 600t in 1975 and then declined slowly to about the level of the TACC of 415t in 1988-89.
- Since then, catches have increased, exceeding the TACC throughout the full history of ELE 3 in the QMS, and reaching levels similar to those reported in the 1950s by 1997-98. As a result of increasing the TACC under the AMP, the level of overcatch decreased, but still exceeded the TACC of 950t by 14% in 2007-08. The 2007–08 landings of 1,092 t are the highest in the time series and represents a level of catch near to the highest reported in the 1960s and the early 1970s. However, these early landings are thought to have been substantially underreported.
- A 58% increase in deemed values in 2002-03 probably resulted in high grading and under-reporting in this Fishstock. In 2005-06, the ELE 3 deemed values were decreased again by 41% to encourage more accurate reporting, apparently successfully. The "ramping" (or acceleration) of deemed value penalties was also suspended in 2005–06.
- ELE 3 are taken primarily by bottom trawl, but there are also significant setnet landings. 83% of the total landings have been taken by BT over the 19 year catch history, with the most of the balance taken by the setnet fishery. A recently developed Danish seine fishery accounts for 1.5 % of the total ELE 3 landings, and 11% of the total ELE 3 landings in 2007–08.
- Over two-thirds of the total ELE 3 landings come from Area 022 (Canterbury Bight) with most of the remainder coming from the adjacent statistical areas 020 (Pegasus Bay – 16%) and 024 (Timaru – 10%).
- The elephantfish fishery is quite seasonal, with trawl and setnet catches being taken mainly in October - March, in a summer fishery in Area 022. Trawl catches have tended to extend further into the fishing year since 1997–98, particularly in areas other than Area 022. Danish seine catches pick up a month or so later than the setnet fishery.
- ELE are caught in a range of target fisheries. The trawl catch of elephantfish is primarily made while targeting red cod, barracouta, elephantfish and flatfish, with a decline in RCO targeting coincident with the decline in that fishery and a significant increase in ELE targeting from 2001–02 onwards. Setnet catches are made in the multispecies shark fishery targeting rig, school shark and elephantfish, but targeting, or reporting of targeting, of ELE in the setnet fishery has increased since 2001–02. There is an increasing shift in effort from BT to DS, particularly in Canterbury Bight, apparently from an increased efficiency when using this gear and more effective targeting of FLA, RCO and ELE.
- Recreational catches are poorly estimated, but are probably < 5t.

## CPUE Analysis

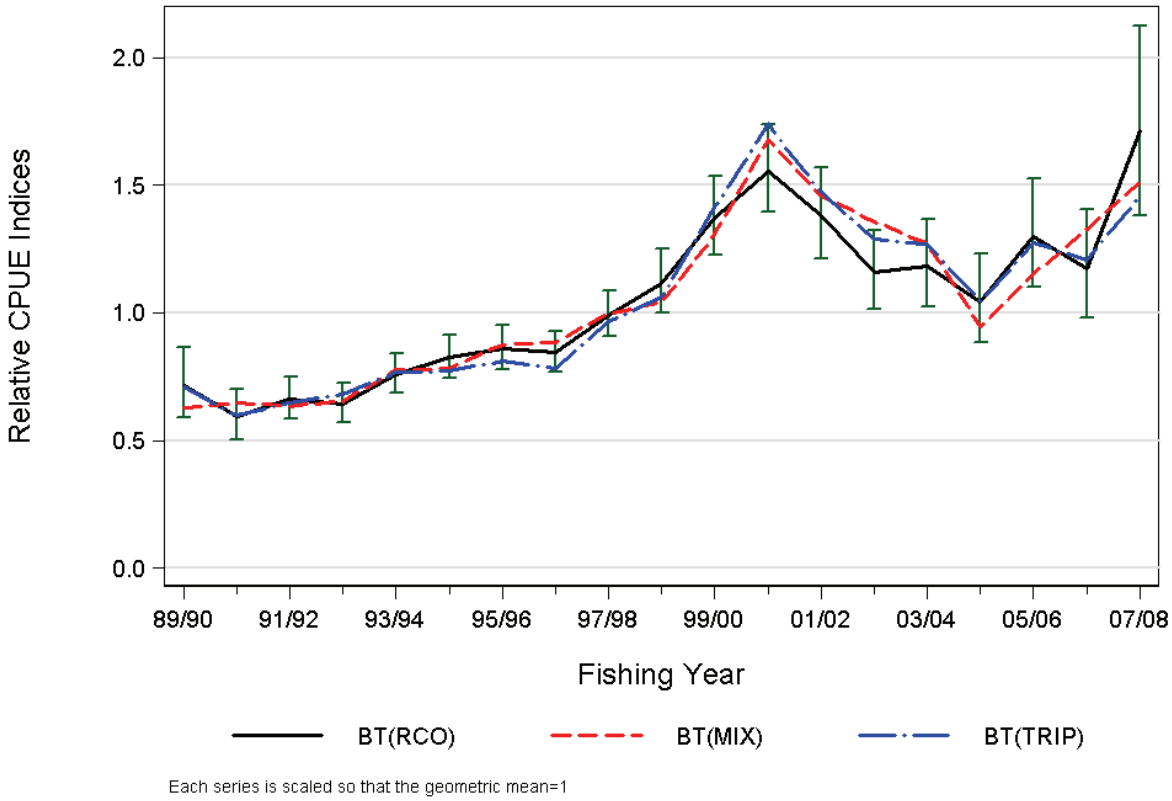



**Figure 5: Comparison of the lognormal indices from three bottom trawl CPUE series for ELE 3 calculated for all valid statistical areas (018, 020, 022, 024, and 026); a) [BT(RCO)]: red cod target; b) [BT(MIX)]: mixed target species; c) [BT(TRIP)]: mixed target species, stratified by trip**

- Three previously explored ELE 3 CPUE indices were updated and presented. These are a) a series based on data from the target red cod trawl fishery, b) a series using target flatfish trawl fishery data and c) a series using target shark setnet fishery data. In 2007, these three sets of indices showed reasonably similar trends, all showing a steady increase in CPUE from 1989-90 to 1999-00 - 2001-02, followed by a decline in catch rates to 2004-05, possibly with some levelling off over the last few years.
- Following initial consideration of these updated analyses, the WG concluded that the SN(SHK) index had been substantially affected by management interventions (including measures to reduce the by-catch of Hector's dolphins) and did not appear to be an appropriate index of ELE abundance. Future emphasis should be on the BT(RCO) and the related BT(MIX) index.

### Effect of the New TCER Forms on Trip Stratum Roll-Up

- There was good uptake of the new TCER form in 2007-08, with 60% of the total days fishing in ELE 3 reporting on this form type, while reporting on the CELR formtype dropped to 13% after previously accounting for 70–90% of the days fishing. The TCER forms have replaced the CELR forms for inshore vessels > 6m length, and report tow-by-tow data rather than daily data as was done previously. When the data collected on these new forms were summarised on a trip basis (for comparability with the older form type), there was a substantial change in the number of tows per trip-stratum (where a "trip-stratum" is a method/target species/statistical area "roll-up" of data within a trip), with the average number of trip-strata within a trip increasing from 2 to 3 and the number of tows per trip-stratum decreasing from 4 to 2.5. The WG was concerned that this shift in underlying data may have contributed to an apparent sharp increase in CPUE observed in 2007-08 and hence an anomalous effect stemming from the change in data reporting procedures.
- In particular, the target species associated with each effort event may now be more correctly reported, with shifts in target species being properly reported when using the tow-by-tow TCER forms, compared with combining multiple target fishing into a single record when reporting on

the daily CELR forms, thus losing the shifts captured on the TCER forms. The WG questioned whether this change in potential targeting resolution might be biasing CPUE upwards when compared to previous years. A possible mechanism by which CPUE would increase as a result of this change in resolution would be by reducing the average tow duration per trip-stratum, an effect which was observed in these data.

- The WG requested two additional CPUE indices be prepared to investigate this effect. To specifically investigate the effect of the change in roll-up, an index series based on a trip-level resolution (rolling up all data within a trip: BT(TRIP)) was prepared for all trips that targeted RCO at least once and fished in ELE3. This would remove the differences between the TCEPR, TCER and CELR forms, but lose any targeting or statistical area information. To investigate the effect of target species switching, a second index series which included effort targeted at other species (RCO, BAR, STA, ELE or TAR: BT(MIX)) index was prepared so that the model could explicitly standardise for targeting effects.

**Updated CPUE Analyses**

- The new BT(TRIP) and BT(MIX) indices corresponded closely with each other, resulting in a slightly lower 2007-08 CPUE compared to the BT(RCO) index, and an increase the CPUE peak in 2000-01 (Figure 5). This gave a slightly less optimistic view of recent trends although, all three indices, including the BT(RCO) series, are highly similar.
- The drop in the 2007-08 CPUE based on the BT(TRIP) indices compared to the BT(RCO) series appeared to confirm that the new TCER forms, along with the associated effect of the trip-stratum roll-up, may be biasing CPUE upwards, but not strongly. The trip index still indicated a sharp rise in CPUE in 2007-08, to about 50% above the long-term average. The BT(MIX) index appeared to provide a very similar estimate of CPUE to the BT(TRIP) index in recent years, which may be the result of dealing appropriately with targeting effects deriving from the change in form type.
- In all three sets of indices, CPUE and catches both increased steadily from 1990-91 to 2000-01. CPUE then declined to average levels by 2004-05, whereas catches remained at the increased levels over this period. The WG noted that the 58% increase in deemed values in 2002-03 followed by a 41% decrease in deemed values in 2005-06 probably resulted in some high-grading over the intervening period, which coincided with the CPUE decline. This activity may have biased the resulting CPUE and consequently the true abundance trend may have been flatter over this period.
- The WG concluded that abundance appears to have increased steadily to about 50% above average levels by 2000-01, and has probably remained stable at around that level since then. Catches remained fairly stable over that same period at between 950t - 1,000t, increasing to 1,092t in 2007-08.

**Trawl Surveys**

- The ECSI winter trawl survey indices for ELE 3 are consistent with the three sets of CPUE indices, with the biomass indices from the most recent two surveys confirming the increases estimated by the CPUE analysis, including the increase in 2007-08.
- The last two surveys also show large numbers of juvenile ELE in the length frequency distributions, suggesting good recruitment over the past few years. Industry participants noted that the voluntary 1nm inshore closure in ELE 3 has excluded fishing from an area where historically a large proportion of the elephantfish catch used to be made. This may be contributing to the estimated increased abundance and the resulting improved recruitment.

**Status of the Stock**

Analysis Recommendations

The following analyses were conducted or recommended during the 2009 review:

- The WG requested that the effect of the new TCER form on the trip stratum roll-up in the BT(RCO) index be explored by calculating a BT(TRIP) index, collapsing the data for trips which targeted RCO at least once up to a full trip, thereby removing the form-type effect. In addition, a mixed target BT(MIX) index using effort from a wider range of target species should be calculated. These two indices were presented to the WG, and are shown in Figure 5.

Abundance Indices

The three CPUE series presented in this analysis show highly similar trends, and appear to provide a reliable picture of changes in abundance in ELE 3 which is consistent with overall catch trends and available information derived from trawl-survey length-frequency composition. The mixed target BT(MIX) index is considered to be the most appropriate index for this stock.

There is concern that high-grading resulting from increased deemed values between 2002-03 and 2005-06 may have contributed to the dip observed in the CPUE indices. Catch and effort have probably been more correctly reported in recent years, and the actual abundance trend may have been flatter over the intervening period.

Sustainability of Current Catches

Catches are currently at their highest levels since 1970, and are near the highest historical catch levels reported over the 1950s and 1960s. Whereas catches have increased steadily from low levels in 1989-90 to the present, CPUE increased up until 2000-01, but appears to have levelled off since then.

Catches at the current TACC, and at catch levels of between 950t to 1,000t are likely sustainable in the short term to medium term. However, targeting on ELE has increased significantly over the past decade and both catch levels and CPUE appears to have levelled off since 2000-01. The recommended indices should continue to be monitored to detect any declines which may result from catches at current levels, or from future poor recruitment.

Stock Status

The state of the stock in relation to BMSY is unknown. However, catches are currently at historically high levels, with abundance at its highest point since 1989–90 and which may be at levels similar to historically high levels over the 1950s and 1960s.

**ELE 5 Three-Yearly Review** (AMP WG/09/06)

**Fishery Characterization**

- ELE 5 has been managed in the context of the AMP since it entered the programme in 2001-02. The ELE 5 TACC was increased from 71t to 100t in 2001–02. Allowances of an additional 5t each for recreational and customary use brought the total TAC to 110t. The TACC was again increased to 120t for 2004-05 onwards as a result of ongoing difficulties with limiting catches within the TACC. An additional 16t allowance for recreational and customary fishing brought the TAC to 136t.
- Catches remained below the TACC until 1995-96, and then escalated rapidly to more than twice the TACC in 2000-01. Following increase in the TACC under the AMP in 2001, catches remained at about the level of the TACC from 2002-03 to 2003-04, and then increased to the level of the new AMP TACC level in 2004–05. From 2005-06 onwards, catches have increasingly exceeded the TACC, reaching 202t in 2007-08, which is the highest level of catch in the data series.
- Catch reporting in the ELE 5 fishery has had similar problems as experienced in the ELE 3 fishery, where the deemed value regime, including the "ramping" provisions introduced with ACE in 2001–02, was linked to likely high-grading and discarding of catch. The ELE 5 deemed value regime was relaxed in 2005–06, including the suspension of the "ramping" provision, which has in turn resulted in an increase in the reported landings in this Fishstock.
- Over 87% of ELE 5 landings have been taken by bottom trawl since 1989-90. with the balance taken by the setnet fishery. Other methods account for less than 1% of the total annual ELE 5 catch.
- 55% of the total ELE 5 landings come from Area 030 (western Foveaux Strait) with most of the remaining landings coming from adjacent Area 025 (eastern Foveaux Strait). Only about 7% of ELE 5 landings come from other statistical areas. The flatfish targeted trawl fishery occurs across both areas, whereas stargazer, and to some extent elephantfish targeting, occurs mainly in the western Strait. In the setnet fishery, rig targeting occurs east of Stewart Island, with

school shark and a small amount of elephantfish target fishing occurs in the Western Strait.

- The setnet fishery is strongly seasonal, occurring mainly from November – February. The trawl fishery also used to be a predominantly summer fishery, but switched to a year-round fishery in 1998–99.
- ELE5 trawl catches are mostly taken in fairly narrow, shallow depths, operating in the range ~40m - 100m, in relatively few bottom trawl target fisheries: mainly targeting FLA. Bottom trawl target fishing for STA operates at slightly deeper depths in the range 30 to 150 m.

## CPUE Analysis

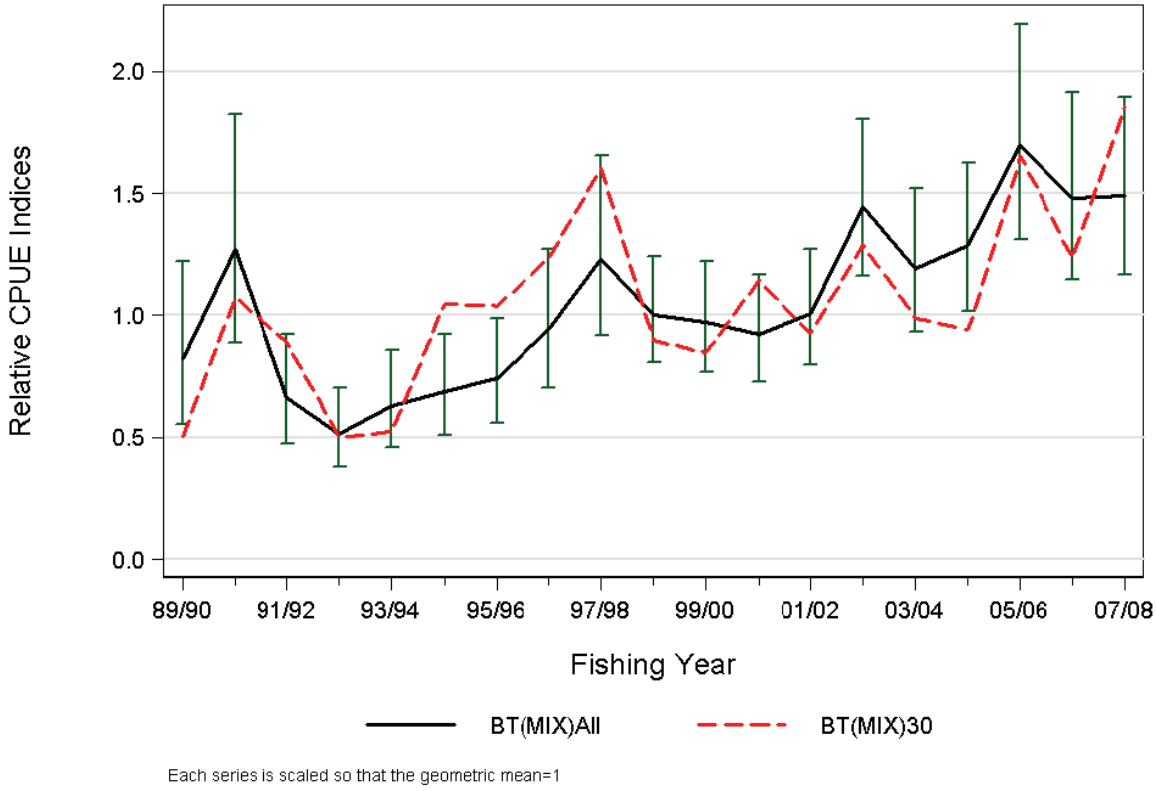



**Figure 6: Comparison of the lognormal indices from two mixed target species bottom trawl CPUE series for ELE 5; a) [BT(MIX)All]: for all valid statistical areas in ELE 5; b) [BT(MIX)30]: statistical area 030 only.**

- There has been an almost complete switch to using the new TCER forms in this fishery in 2007–08. The move to these TCER forms appears to have had little effect on the roll-up of data to trip strata, unlike for the equivalent ELE 3 analyses. Tows / stratum drops slightly to levels similar to those observed in 2003-04 to 2005-06, and number of records per trip stratum increases markedly, as would be expected from a move to tow-by-tow reporting.
- Three fishery definitions were used in 2007 CPUE analyses: the FLA / ELE / STA targeted trawl fishery in each of statistical areas 30 and 25 and a multispecies shark-targeted (SPO, SCH, ELE) setnet fishery. The WG previously noted that differences between trends in different areas may reflect inter-annual changes in availability or targeting in these fishery components, rather than actual abundance. There is also a strong seasonal signal in the trawl indices, with summer catche rates being 6 times greater than the winter catch rates, raising the question of whether the summer fishery dominated index is an index of abundance, or just an index of targeted effort on nearshore summer aggregations.
- Following these conclusions and a comparison with the approach taken for equivalent fisheries in ELE 3, the WG recommended that a more appropriate index for ELE 5 would be a BT(MIX)(All Areas) index, with explicit modelling of the effect of target species on CPUE and including data from all valid ELE 5 statistical areas. In addition to an all areas index, the WG recommended that a similar mixed traget species index (BT(MIX)30) be calculated based on data originating only from Area 30, because there was considerably more data, particularly in

recent years, than in Area 25.

- There is reasonable correspondence between the BT(MIX)All and BT(MIX)30 indices (Figure 2), with the BT(MIX)All series showing a steadily increasing trend from 1992–93 to 2007–08, with subsidiary peaks in 1997-98, 2002-03 and 2005-06. The BT(MIX)30 series shows a similar overall trend but with much more inter-annual variation, probably due to caused by the smaller amount of data available for this series.. The WG noted the relatively wide confidence bounds associated with the BT(MIX)All series which suggest that the observed annual variations in this series should be interpreted with caution.

**Status of the Stock**

Analysis Recommendations

No additional analyses were requested or presented.

Abundance Indices

The BT(MIX) index is considered to be the most appropriate index for monitoring abundance of this stock. Of the sub-area indices, the Area 30 index is considered to be more representative of abundance than the Area 25 index. The shark targeted setnet index presented in previous reviews is not considered to be a reliable indicator of ELE 5 abundance.

There is reasonable correspondence between the BT(MIX)All and BT(MIX)30 indices, both showing CPUE a generally increasing CPUE trend from 1992-93 to 2007–08.

Sustainability of Current Catches: Catches have been increasing steadily since 1992-93 and increased sharply from 2003-04 onwards, reaching the highest levels since 1989-90 in 2007-08.

Catches over the recent period of increasing CPUE from 1998-99 to 2005-06 averaged 122t, close to the current TACC. Catches at this level are likely to be sustainable in the short to medium term (3 to 5 years). However, catches have exceeded the TACC since 2003-04, exceeding the TACC by 68% in 2007-08.

Stock Status

The state of the stock in relation to BMSY is unknown. Catches and catch rates have increased steadily from 1992-93 to historically high levels in 2007-08.

## 6. 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**

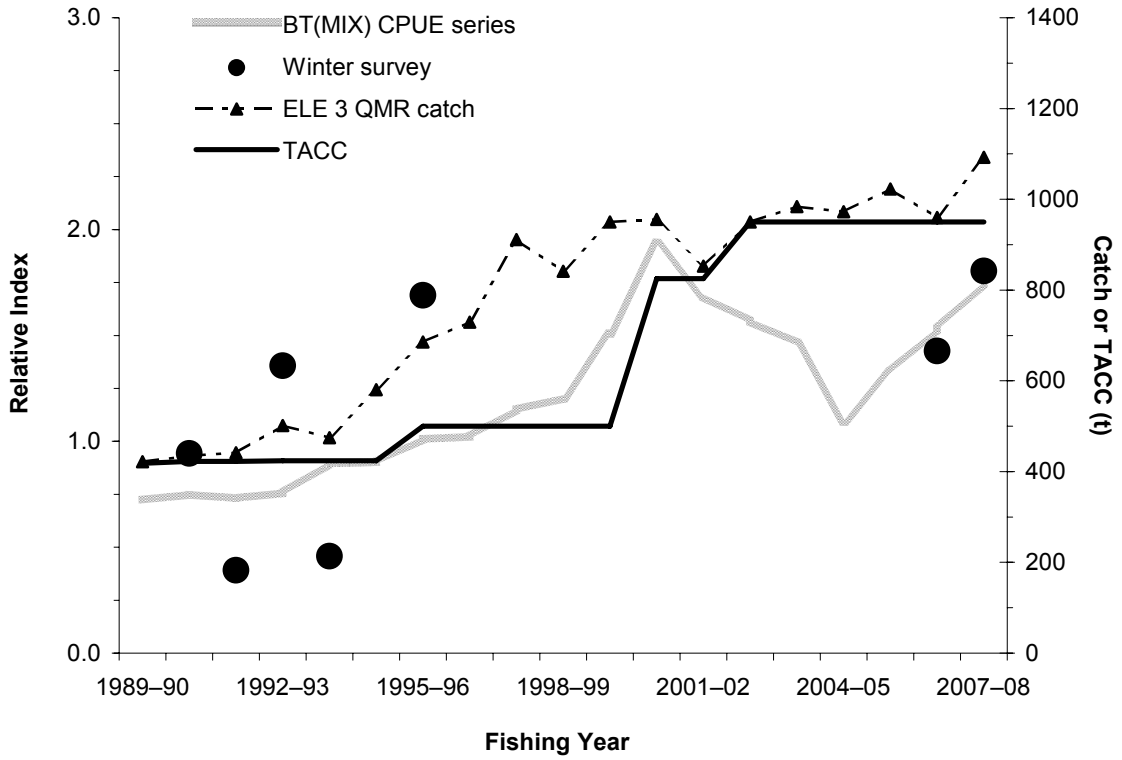
**Stock Structure Assumptions**

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 | 2009 (Standardised CPUE) |
| Reference Points | Target: Not established<br>Soft Limit: Not established<br>Hard Limit: Not established |
| Status in relation to Target | Unknown |
| Status in relation to Limits | Unknown |

| Fishery and Stock Trends | |
|---|---|
| Trend in Biomass or Proxy | A mixed species bottom trawl CPUE series, which is considered to be an index of stock abundance, peaked in 2000–01, then dropped by about 40% to 2004–05 but has since recovered to near the 2000–01 peak. Present CPUE is at a higher level than that observed prior to the mid-1990s. The resumed east coast South Island winter trawl survey has returned two biomass indices in 2007 and 2008 which are similar to the highest estimates from the early 1990s. |
| Trend in Fishing Mortality or Proxy | Unknown. Abundance has increased during a period when catches were increasing. . |

East coast South Island winter trawl survey, CPUE, Catch and TACC Trajectories




**Comparison of two biomass series (east coast South Island winter trawl survey and a mixed target species bottom trawl CPUE series) with the trajectories of catch and TACCs from 1989–90 to 2007–08. The two biomass series have been made relative to a consistent mean (90–91 to 93–94, 95–96, 06–07, and 07–08).**

| | |
|---|---|
| Other Abundance Indices | Independent CPUE series based on bottom trawl flatfish data and setnet target shark data corroborate the trend in the accepted CPUE series. |
| Trends in Other Relevant Indicator or Variables | Current catch levels are approaching the highest historical catch levels recorded for this species, when catch levels exceeded 1000 t/year for over a decade in the 1960s and early 1970s. Subsequently the stock apparently declined to low levels by the mid-1980s. However, it is thought that these early catch levels are substantially under-reported and were probably much higher at that time. |

| Projections and Prognosis | |
|---|---|
| Stock Projections or Prognosis | Quantitative stock projections are unavailable. It is likely that CPUE will remain at levels consistent with that observed in 2007–08 at catch levels between 900 and 1000 t/year in the short-term. |
| Probability of Current Catch / TACC causing decline below | Soft Limit:<br>Hard Limit: |

| | |
|---|---|
| Limits | |

| **Assessment Methodology** | | |
|---|---|---|
| Assessment Type | Level 2: Standardised CPUE abundance index and a trawl survey. | |
| Assessment Method | Evaluation of agreed standardised CPUE indices which reflect changes in abundance as well as the trawl survey biomass indices. | |
| Main data inputs | - Catch and effort data derived from the Ministry of Fisheries compulsory logbooks.<br>- Length frequency data summarised from setnet and trawl logbooks compiled under the industry Adaptive Management Programme.<br>- Trawl survey biomass indices and associated length frequencies | |
| Period of Assessment | Latest assessment: 2009 | Next assessment: 2011 |
| 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 and 2008 are available. | |
| Major Sources of Uncertainty | Elephantfish are not thought to be well monitored by the East Coast South Island winter trawl survey. | |

| **Qualifying Comments** |
|---|
| Elephantfish have shown good recovery since being at very low biomass levels in the mid-1980s. It is possible that discarding and management changes in this fishery have biased the CPUE trends reported for this fishery. In particular, a relaxation of the deemed value regime in 2004–05 has coincided with a subsequent increase in CPUE. Commercial fishermen indicate that they find it difficult to stay within the TACC. A voluntary closure within 1 nm offshore is likely to have reduced the impact of fishing on spawning females. Good abundances of pre-recruit elephantfish are seen in the length frequencies from the resumed winter east coast South Island trawl survey. |

| **Fishery Interactions** |
|---|
| Elephantfish in ELE 3 are taken by bottom trawl in fisheries targeted at red cod, elephantfish, flatfish and barracouta. Targeting on 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 20% of the ELE 3 landings are taken by setnet in a fishery targeted at a number of shark species, including rig, elephantfish and school shark. This latter fishery has been subject to a range of management measures designed to reduce interactions of this fishery with endemic Hector's dolphins. |

**ELE 5**

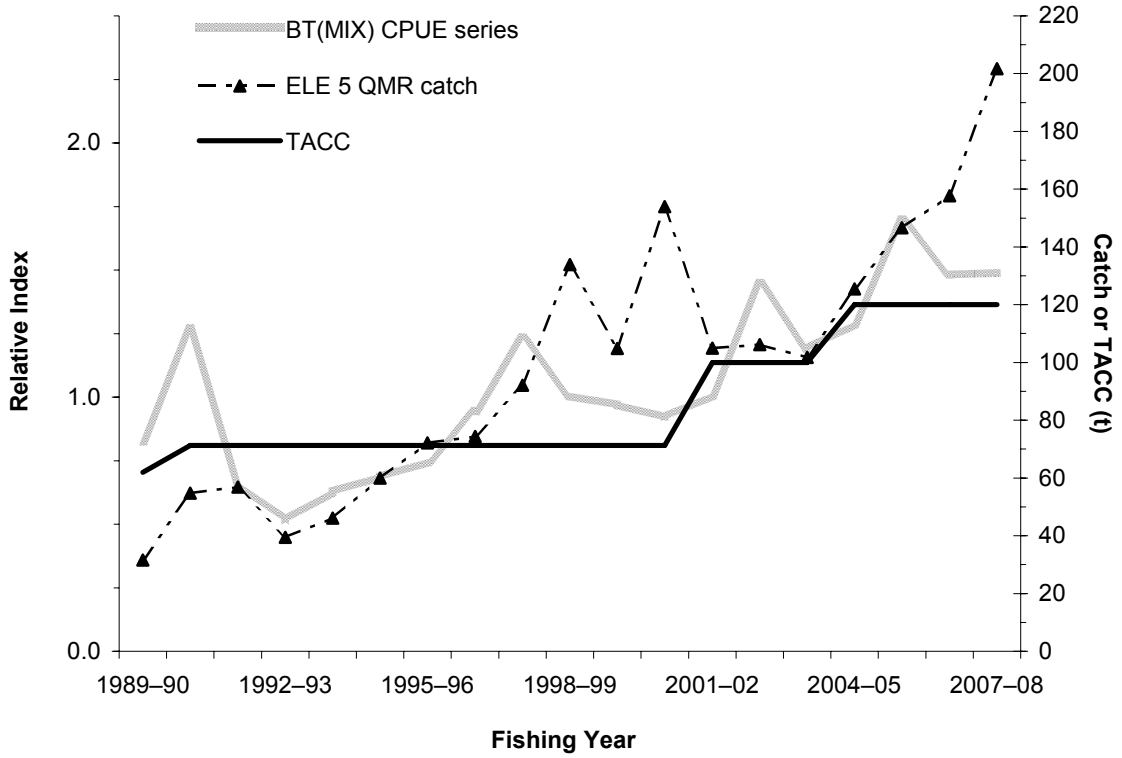
**Stock Structure Assumptions**

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 | 2009 (standardised CPUE abundance index) |
| Reference Points | Target: Not established<br>Soft Limit: Not established<br>Hard Limit: Not established |
| Status in relation to Target | Unknown |
| Status in relation to Limits | Unknown |

| Fishery and Stock Trends | |
|---|---|
| Trend in Biomass or Proxy | A mixed target species bottom trawl CPUE series, which is considered to be an index of stock abundance, has shown a steady increasing trend since the early 1990s. Present CPUE is more than double the lowest level observed in the early 1990s. |
| Trend in Fishing Mortality or Proxy | Unknown. Catches have been steadily increasing since the early 1990s and there has been a further increase since 2004–05 when the deemed value regime was relaxed. |

CPUE, Catch and TACC Trajectories




**Comparison of the mixed target species bottom trawl CPUE series with the trajectories of catch and TACCs from 1989–90 to 2007–08.**

| | |
|---|---|
| Other Abundance Indices | |
| Trends in Other Relevant Indicator or Variables | |

| Projections and Prognosis | |
|---|---|
| Stock Projections or Prognosis | Quantitative stock projections are unavailable. It is likely that CPUE will remain at levels consistent with that observed in 2007–08 at catch levels between 120 and 150 t/year in the short-term. |
| Probability of Current Catch causing decline below Limits | Soft Limit: Unknown.<br>Hard Limit: Unknown. |
| Probability of TACC causing decline below Limits | Soft Limit: Unknown.<br>Hard Limit: Unknown. |

| Assessment Methodology | | |
|---|---|---|
| Assessment Type | Level 2: Standardised CPUE abundance index. | |
| Assessment Method | Evaluation of agreed standardised CPUE indices which reflect changes in abundance. | |
| Main data inputs | - Catch and effort data derived from the Ministry of Fisheries compulsory logbooks.<br>- Length frequency data summarised from setnet logbooks compiled under the industry Adaptive Management Programme. | |
| Period of Assessment | Latest assessment: 2009 | Next assessment: 2011 |
| Changes to Model Structure and Assumptions | A mixed target species CPUE series has been expanded to include all ELE 5 statistical areas and updated with data up to 2007–08. | |
| Major Sources of Uncertainty | The index of abundance is based on relatively small amounts of data and consequently has high uncertainty.<br><br>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 being at very low biomass levels in the mid-1980s. A relaxation of the deemed value regime in 2004–05 has coincided with a subsequent increase in CPUE, which may have levelled off since 2006–07. Commercial fishermen indicate that they find it difficult to stay within the TACC. |

| Fishery Interactions |
|---|
| Elephantfish in ELE 5 are taken by bottom trawl in fisheries targeted at flatfish and stargazer. Targeting on elephantfish in the bottom trawl fishery is low (average near 14% from 1989–90 to 2007–08) but has increased to 20–30% of the landings since 2004–05 when the deemed value regime changed. Around 12% of the ELE 5 landings are taken by setnet in a fishery targeted mainly at school shark. This latter fishery has been subject to a range of management measures designed to reduce interactions of this fishery with endemic Hector's dolphins. |

**ELE 7**

In ELE 7 catches since 1987–88 have been above the MCY and below the TAC. It is not known if recent catch levels and current TACCs are sustainable. The state of the stock in relation to $B_{MSY}$ is unknown.

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 | | MCY | 2007–08 Actual TACC | 2007–08 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 | 400 | 950 | 1 092 |
| ELE 5 | Southland and Sub-Antarctic | 5 & 6 | 70 | 120 | 202 |
| ELE 7 | Challenger | 7 | 40 | 102 | 125 |
| ELE 10 | Kermadec | 10 | – | 10 | 0 |
| Total | | | 510 | 1 214 | 1 436 |

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