# FLATFISH (FLA)

(*Colistium nudipinnis*, *Peltorhamphus novaezelandiae*, *Colistium guntheri*, *Rhombosolea retiaria*, *Rhombosolea plebeia*, *Rhombosolea leporina*, *Rhombosolea tapirina*, *Pelotretis flavilatus*)
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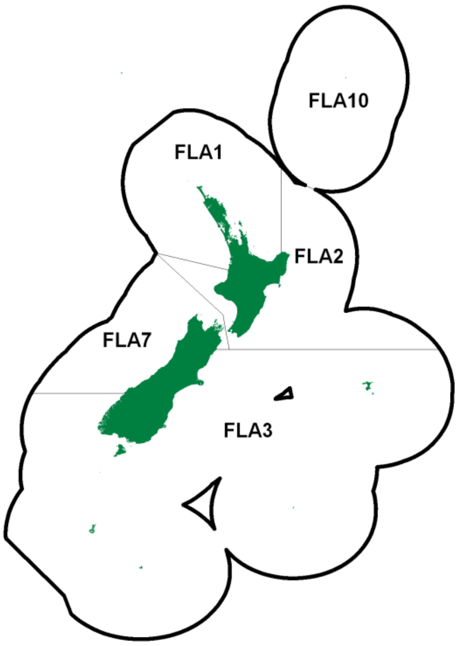
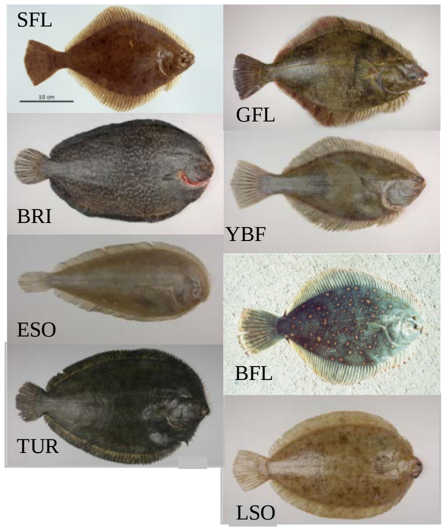



## 1. FISHERY SUMMARY

### 1.1 Commercial fisheries

Flatfish Individual Transferable Quota (ITQ) provides for the landing of eight species of flatfish. These are: the yellow-belly flounder, *Rhombosolea leporine* (YBF); sand flounder, *Rhombosolea plebeian* (SFL); black flounder, *Rhombosolea retiaria* (BFL); greenback flounder, *Rhombosolea tapirina* (GFL); lemon sole, *Pelotretis flavilatus* (LSO); New Zealand sole, *Peltorhamphus novaezeelandiae* (ESO); brill, *Colistium guntheri* (BRI); and turbot, *Colistium nudipinnis* (TUR). For management purposes landings of these species are combined.

Flatfish are shallow water species, taken mainly by target inshore trawl and Danish seine fleets around the South Island. Set and drag net fishing are important in the northern harbours and the Firth of Thames. Important fishing areas are:

| | | |
|---|---|---|
| Yellow-belly flounder | - | Firth of Thames, Kaipara and Manukau harbours; |
| Sand flounder | - | Hauraki Gulf, Tasman/Golden Bay, Bay of Plenty, and Canterbury Bight; |
| Greenback flounder | - | Canterbury Bight, Southland; |
| Black flounder | - | Canterbury Bight; |
| Lemon sole | - | west coast South Island, Otago and Southland; |
| New Zealand sole | - | west coast South Island, Otago and Canterbury Bight; |
| Brill and turbot | - | west coast South Island. |

TACCs were originally set at the level of the sum of the provisional ITQs for each fishery. Between 1983–84 and 1992–93 total flatfish landings fluctuated between 5160 t and 2750 t; from 1992–93 to 1997–98, landings were relatively consistent, between about 4500 t and 5000 t per year. Landings declined to 2963 t in 1999–00, the lowest recorded since 1986–87, and subsequently increased to a peak of 4051 t for the 2006–07 fishing year and have declined since to 2792 t in 2012–13. Landings and TACCs are given in Table 1, while Figure 1 shows the historical landings and TACC values for the main FLA stocks. From 1 October 2007 a TAC and allowances were set for the first time in FLA 3. The FLA 3 TACC was reduced by 47% to 1430 t, customary, recreational and other sources of mortality were allocated; 5, 150 and 32 t respectively. All FLA fisheries have been put on to Schedule 2 of the Fisheries Act 1996. Schedule 2 allows that for certain “highly variable” stocks, the

Total Annual Catch (TAC) can be increased within a fishing season. The base TAC is not changed by this process and the "in-season" TAC reverts to the original level at the end of each season. FLA3 is currently managed using in-season adjustments determined by a decision rule linked to annually calculated early season CPUE.

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. Commercial and recreational set netting was banned in most areas to 4 nautical miles offshore of the east coast of the South Island, extending from Cape Jackson in the Marlborough Sounds to Slope Point in the Catlins. Some exceptions were allowed, including an exemption for commercial and recreational set netting to only one nautical mile offshore around the Kaikoura Canyon, and permitting setnetting in most harbours, estuaries, river mouths, lagoons and inlets except for the Avon-Heathcote Estuary, Lyttelton Harbour, Akaroa Harbour and Timaru Harbour. In addition, trawl gear within 2 nautical miles of shore was restricted to flatfish nets with defined low headline heights. The commercial minimum legal size for sand flounder is 23 cm, and for all other flatfish species is 25 cm.

**Table 1: Reported landings (t) of flatfish by Fishstock from 1983–84 to 2012–13 and actual TACCs (t) from 1986–87 to 2012–13. QMS data from 1986–present.**

| Fishstock | FLA 1 | | FLA 2 | | FLA 3 | | FLA 7 | | FLA 10 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FMA (s) | 1 & 9 | | 2 & 8 | | 3, 4, 5 & 6 | | 7 | | 10 | | Total | |
| | Landings | TACC | Landings | TACC | Landings | TACC | Landings | TACC | Landings | TACC | Landings | TACC |
| 1983–84* | 1 215 | - | 378 | - | 1 564 | - | 1 486 | - | 0 | - | 5 160 | - |
| 1984–85* | 1 050 | - | 285 | - | 1 803 | - | 951 | - | 0 | - | 4 467 | - |
| 1985–86* | 722 | - | 261 | - | 1 537 | - | 385 | - | 0 | - | ‡3 215 | - |
| 1986–87 | 629 | 1 100 | 323 | 670 | 1 235 | 2 430 | 563 | 1 840 | 0 | 10 | ‡2 750 | 6 050 |
| 1987–88 | 688 | 1 145 | 374 | 677 | 2 010 | 2 535 | 1 000 | 1 899 | 0 | 10 | ‡4 072 | 6 266 |
| 1988–89 | 787 | 1 153 | 297 | 717 | 2 458 | 2 552 | 757 | 2 045 | 0 | 10 | 4 299 | 6 477 |
| 1989–90 | 791 | 1 184 | 308 | 723 | 1 637 | 2 585 | 745 | 2 066 | 0 | 10 | 3 482 | 6 568 |
| 1990–91 | 849 | 1 187 | 292 | 726 | 1 340 | 2 681 | 502 | 2 066 | 0 | 10 | 2 983 | 6 670 |
| 1991–92 | 940 | 1 187 | 288 | 726 | 1 229 | 2 681 | 745 | 2 066 | 0 | 10 | 3 202 | 6 670 |
| 1992–93 | 1 106 | 1 187 | 460 | 726 | 1 954 | 2 681 | 1 566 | 2 066 | 0 | 10 | 5 086 | 6 670 |
| 1993–94 | 1 136 | 1 187 | 435 | 726 | 1 926 | 2 681 | 1 108 | 2 066 | 0 | 10 | 4 605 | 6 670 |
| 1994–95 | 964 | 1 187 | 543 | 726 | 1 966 | 2 681 | 1 107 | 2 066 | 0 | 10 | 4 580 | 6 670 |
| 1995–96 | 628 | 1 187 | 481 | 726 | 2 298 | 2 681 | 1 163 | 2 066 | 1 | 10 | 4 571 | 6 670 |
| 1996–97 | 741 | 1 187 | 363 | 726 | 2 573 | 2 681 | 1 117 | 2 066 | 0 | 10 | 4 794 | 6 670 |
| 1997–98 | 728 | 1 187 | 559 | 726 | 2 351 | 2 681 | 1 020 | 2 066 | 0 | 10 | 4 657 | 6 670 |
| 1998–99 | 690 | 1 187 | 274 | 726 | 1 882 | 2 681 | 868 | 2 066 | 0 | 10 | 3 714 | 6 670 |
| 1999–00 | 751 | 1 187 | 212 | 726 | 1 583 | 2 681 | 417 | 2 066 | 0 | 10 | 2 963 | 6 670 |
| 2000–01 | 792 | 1 187 | 186 | 726 | 1 702 | 2 681 | 447 | 2 066 | 0 | 10 | 3 127 | 6 670 |
| 2001–02 | 596 | 1 187 | 177 | 726 | 1 693 | 2 681 | 614 | 2 066 | 0 | 10 | 3 080 | 6 670 |
| 2002–03 | 686 | 1 187 | 144 | 726 | 1 650 | 2 681 | 819 | 2 066 | 0 | 10 | 3 299 | 6 670 |
| 2003–04 | 784 | 1 187 | 218 | 726 | 1 286 | 2 681 | 918 | 2 066 | 0 | 10 | 3 206 | 6 670 |
| 2004–05 | 1 038 | 1 187 | 254 | 726 | 1 353 | 2 681 | 1 231 | 2 066 | 0 | 10 | 3 876 | 6 670 |
| 2005–06 | 964 | 1 187 | 296 | 726 | 1 177 | 2 681 | 1 283 | 2 066 | 0 | 10 | 3 720 | 6 670 |
| 2006–07 | 922 | 1 187 | 296 | 726 | 1 429 | 2 681 | 1 419 | 2 066 | 0 | 10 | 4 066 | 6 670 |
| 2007–08 | 703 | 1 187 | 243 | 726 | 1 365 | 1 430 | 1 313 | 2 066 | 0 | 10 | 3 624 | 5 409 |
| 2008–09 | 639 | 1 187 | 214 | 726 | **1 544 | 1 430 | 1 020 | 2 066 | 0 | 10 | 3 417 | 5 409 |
| 2009–10 | 652 | 1 187 | 212 | 726 | **1 525 | 1 430 | 884 | 2 066 | 0 | 10 | 3 273 | 5 409 |
| 2010–11 | 486 | 1 187 | 296 | 726 | 1 027 | 1 430 | 659 | 2 066 | 0 | 10 | 2 467 | 5 419 |
| 2011–12 | 445 | 1 187 | 262 | 726 | 1 507 | 1 430 | 646 | 2 066 | 0 | 10 | 2 861 | 5 419 |
| 2012–13 | 480 | 1 187 | 274 | 726 | 1 512 | 1 430 | 526 | 2 066 | 0 | 10 | 2 792 | 5 419 |

* FSU data.
‡ Includes 11 t Turbot, area unknown but allocated to QMA 7.
§ Includes landings from unknown areas before 1986–87.
** The TACC was increased in-season under Schedule 2 of the Fisheries Act (1996).

Fishers and processors are required to use a generic flatfish (FLA) code in the monthly harvest returns to report landed catches of flatfish species. Although fishers are now instructed to use specific species codes when reporting estimated catches, they often use the generic FLA code. Beentjes (2003) showed that, for all QMAs combined between 1989–90 and 2001–02, about half of the estimated catch of flatfish was recorded using the generic species code FLA, and the remainder was reported using a combination of 12 other species codes (Table 2). Flatfish species that comprised a large proportion of the total estimated catch over the 13 year period included ESO (16%), LSO (12%), SFL (12%) and YBF (6%). Species that are important contributors to catch in each QMA are FLA 1: YBF, SFL, GFL; FLA 2: ESO, SFL; FLA 3: ESO, LSO, SFL, BFL, BRI; FLA 7: GFL, SFL, TUR (Table 3; codes provided in the caption to Table 2).

**Table 2: Total estimated flatfish catch (t) by species and fishing year for all flatfish QMAs combined. Codes: black flounder (BFL), brill (BRI), New Zealand sole (ESO), flatfish generic codes (FLA, FLO, SOL), greenback flounder (GFL), lemon sole (LSO), sand flounder (SFL), Turbot (TUR), witch (WIT), yellow belly flounder (YBF) (Beentjes 2003).**

| Year | BFL | BRI | ESO | FLA | FLO | GFL | LSO | SFL | SOL | TUR | WIT | YBF | Total (t) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1989–90 | 0 | 0 | 0 | 2 750 | 0 | 0 | 0 | < 1 | 0 | 0 | < 1 | < 1 | 2 750 |
| 1990–91 | 114 | 44 | 238 | 1 566 | 0 | 75 | 103 | 284 | 0 | 24 | 1 | 182 | 2 629 |
| 1991–92 | 23 | 45 | 384 | 1 530 | 0 | 64 | 151 | 336 | < 1 | 64 | 2 | 209 | 2 809 |
| 1992–93 | 40 | 74 | 904 | 1 948 | 0 | 119 | 521 | 688 | 0 | 87 | 3 | 235 | 4 619 |
| 1993–94 | 24 | 54 | 836 | 1 457 | 0 | 94 | 446 | 755 | 0 | 63 | 2 | 249 | 3 980 |
| 1994–95 | 66 | 54 | 742 | 1 546 | < 1 | 92 | 466 | 689 | 3 | 69 | 19 | 277 | 4 024 |
| 1995–96 | 95 | 48 | 730 | 1 523 | 12 | 50 | 607 | 515 | 15 | 61 | 0 | 154 | 3 810 |
| 1996–97 | 39 | 43 | 731 | 1 714 | 32 | 61 | 561 | 477 | 4 | 42 | 5 | 153 | 3 863 |
| 1997–98 | 14 | 33 | 550 | 1 718 | 29 | 59 | 714 | 452 | 4 | 39 | 1 | 162 | 3 775 |
| 1998–99 | 24 | 41 | 418 | 1 294 | 28 | 45 | 667 | 297 | 4 | 37 | 3 | 202 | 3 060 |
| 1999–00 | 61 | 44 | 355 | 1 075 | 7 | 36 | 408 | 247 | 2 | 30 | 1 | 267 | 2 534 |
| 2000–01 | 42 | 42 | 479 | 1 086 | 13 | 29 | 392 | 245 | 3 | 40 | 45 | 316 | 2 733 |
| 2001–02 | 85 | 27 | 495 | 1 098 | 9 | 35 | 271 | 199 | 1 | 41 | 28 | 210 | *2 498 |
| Total | 627 | 550 | 6 864 | 20 305 | 130 | 759 | 5 306 | 5 184 | 36 | 595 | 110 | 2617 | 43 084 |
| Percent | 1.4 | 1.3 | 15.9 | 47.1 | 0.3 | 1.8 | 12.3 | 12.0 | 0.1 | 1.4 | 0.3 | 6.1 | |

* October 2001 to August 2002

**Table 3: Distribution (%) of the total estimated catch of 13 flatfish species by QMA for the period 1989–90 and 2001–02 (Beentjes 2003). Species codes are provided in the caption to Table 1. Catches were allocated to specific QMAs based on the reported statistical area of catch.**

| QMA | BFL | BLF | BRI | ESO | FLA | FLO | GFL | LSO | SFL | SOL | TUR | WIT | YBF | All species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FLA 1 | 6 | | 3 | 2 | 27 | 1 | 26 | 2 | 23 | 8 | 2 | 0 | 83 | 22 |
| FLA 2 | 15 | | 0 | 8 | 13 | 5 | 12 | 1 | 13 | 79 | 4 | 2 | 2 | 10 |
| FLA 3 | 74 | 99 | 62 | 64 | 41 | 94 | 28 | 92 | 29 | 12 | 26 | 87 | 11 | 48 |
| FLA 7 | 5 | 1 | 34 | 27 | 19 | 1 | 34 | 5 | 36 | 1 | 69 | 11 | 3 | 20 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

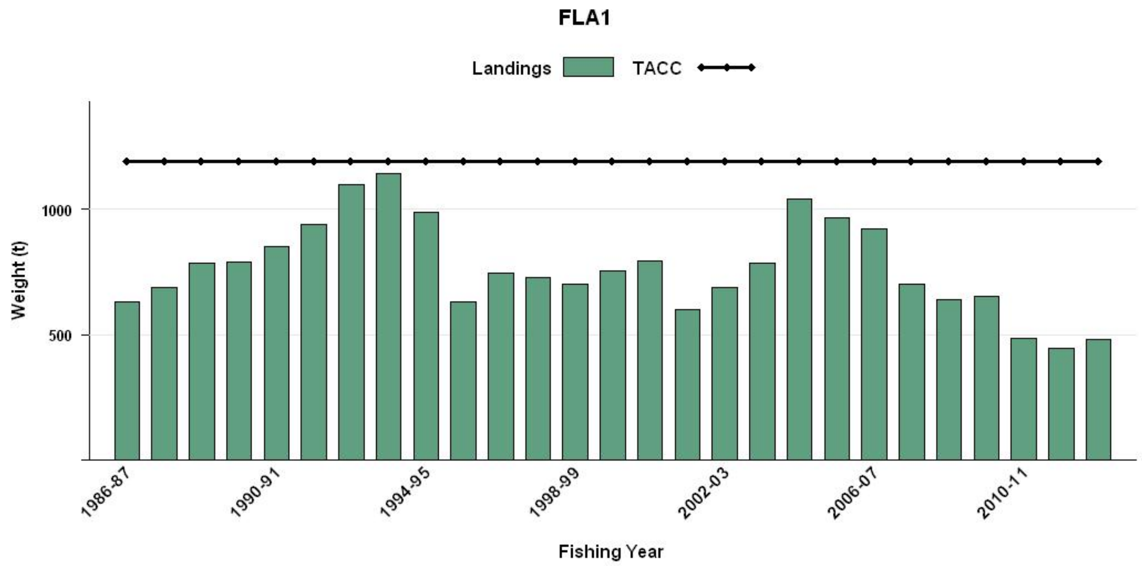



**Figure 1: Historical landings and TACC for the four main FLA stocks. FLA 1 (Auckland). [Continued on next page].**

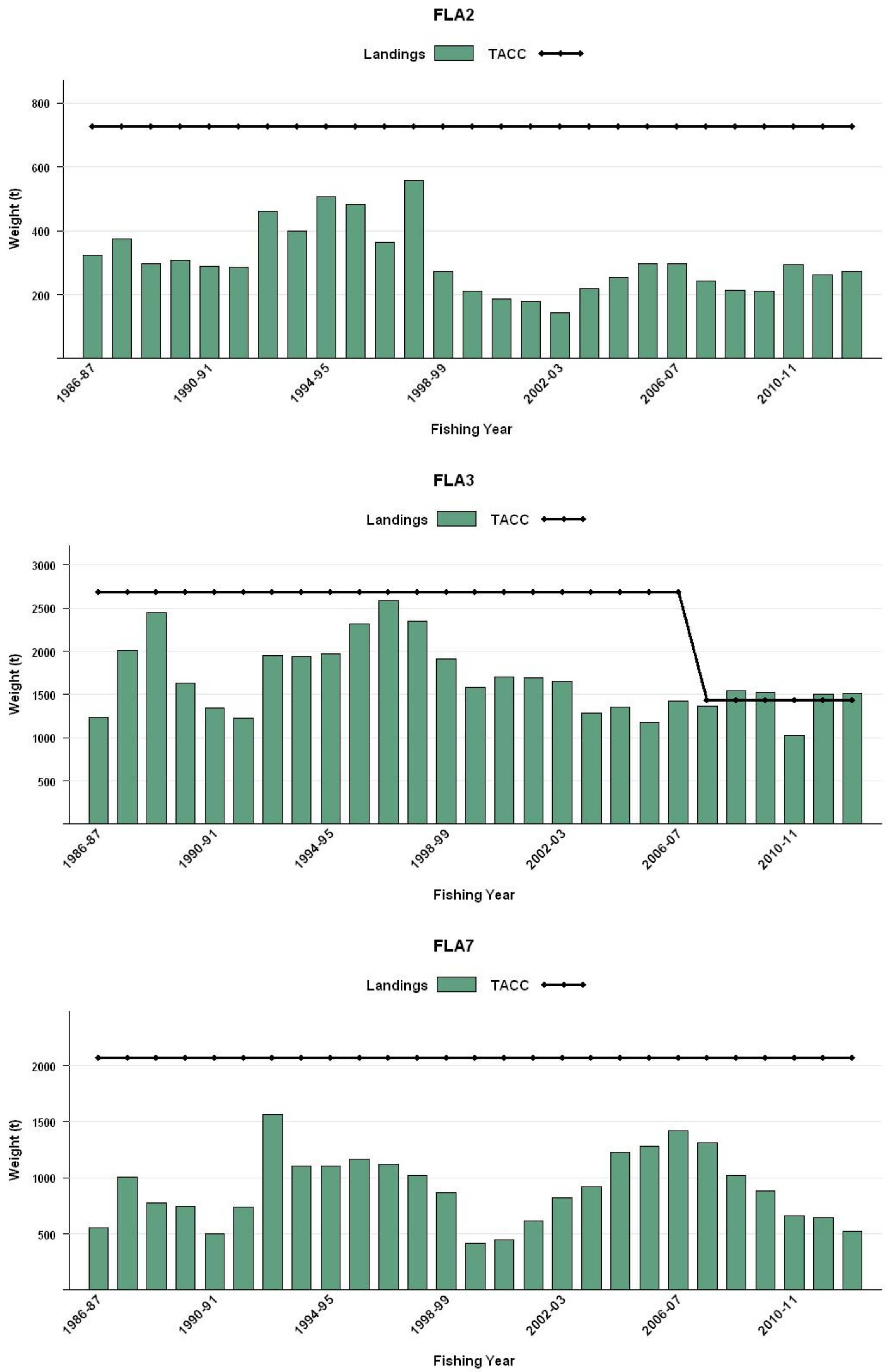



**Figure 1 [Continued]: Historical landings and TACC for the four main FLA stocks. FLA 2 (Central), FLA 3 (South East Coast, South East Chatham Rise, Sub-Antarctic, Southland), and FLA 7 (Challenger).**

### 1.2 Recreational fisheries

There are important recreational fisheries, mainly for the four flounder species, in most harbours, estuaries, coastal lakes and coastal inlets throughout New Zealand. The main methods are setnetting, drag netting and spearing. In the northern region, important areas include the west coast harbours, the lower Waikato, the Hauraki Gulf and the Firth of Thames. In the Bay of Plenty, Ohiwa and Tauranga Harbours are important. In the Challenger FMA, there is a moderate fishery in Tasman and Golden Bays and in areas of the Mahau-Kenepuru Sound and in Cloudy Bay. In the South-East and Southland FMAs, flatfish are taken in areas such as Lake Ellesmere, inlets around Banks Peninsula and the Otago Peninsula, the Oreti and Riverton estuaries, Bluff Harbour and the inlets and lagoons of the Chatham Islands (for further details see the 1995 Plenary Report). Harvest estimates from recreational surveys are given in Table 4. The flatfish MLS for recreational fishers is 25 cm (for all species).

**Table 4: Estimated number and weight of flatfish, by Fishstock and survey, harvested by recreational fishers. Surveys were carried out in different years in the The Fisheries regions: South in 1991–92, Central 1992–93, North 1993–94 (Teirney et al 1997) and nationally in 1996 (Bradford 1998) and 1999–00 (Boyd & Reilly 2005). (- Data not available).**

| Fishstock | Survey | Number | CV% | Harvest range (t) | Point estimate (t) |
|---|---|---|---|---|---|
| 1991–92 | | | | | |
| FLA 1 | South | 3 000 | - | - | - |
| FLA 3 | South | 15 200 | 31 | 50–90 | - |
| FLA 7 | South | 3 000 | - | - | - |
| 1992–93 | | | | | |
| FLA 1 | Central | 6 100 | - | - | - |
| FLA 2 | Central | 73 000 | 26 | 20–40 | - |
| FLA 7 | Central | 37 100 | 59 | 10–30 | - |
| 1993–94 | | | | | |
| FLA 1 | North | 520 000 | 19 | 225–275 | - |
| FLA 2 | North | 3 000 | - | 0–5 | - |
| 1996 | | | | | |
| FLA 1 | National | 308 000 | 11 | 95–125 | 110 |
| FLA 2 | National | 67 000 | 19 | 13–35 | 24 |
| FLA 3 | National | 113 000 | 14 | 30–50 | 40 |
| FLA 7 | National | 44 000 | 18 | 10–20 | 16 |
| 1999–00 | | | | | |
| FLA 1 | National | 702 000 | 25 | 203–336 | - |
| FLA 2 | National | 380 000 | 49 | 82–238 | - |
| FLA 3 | National | 395 000 | 33 | 128–252 | - |
| FLA 7 | National | 114 000 | 53 | 23–73 | - |

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 is no quantitative information on the current level of illegal catch available.

### 1.5 Other sources of mortality

Flatfish have always been subject to ‘high-grading’, and market preference has led to the establishment of ‘processor’ grading and size limits that are greater than the minimum legal size. Fishers often have no market for lower grade/size flatfish, and legal fish of small size may be discarded. The extent of this source of unrecorded fishing mortality is unknown.

## 2. BIOLOGY

Some New Zealand flatfish species are fast-growing and short-lived, generally only surviving to 3–4 years of age, with very few reaching 5–6 years, others such as brill and turbot are longer lived, reaching a maximum age of 21 years and 16 years, respectively (Stevens et al 2001). However, these estimates have yet to be fully validated. Size limits (set at 25 cm for most species) are generally at or above the size at which the fish reach maturity and confer adequate protection to the juveniles.

Sutton et al (2010) undertook an age and growth analysis of greenback flounder. That analysis showed that growth is rapid throughout the lifespan of greenback flounder. Females reached a slightly greater maximum length than males, but the difference was not significant at the 95% level of confidence. Over 90% of sampled fish were 2 or 3 years of age, with maximum ages of 5 and 10 years being obtained for male and female fish respectively. This difference in maximum age resulted in estimated natural mortalities using Hoenig's (1983) method, of 0.85 for males and 0.42 for females. It is suggested that 0.85 is the most appropriate estimate at this stage as only 1% of all fish exceeded 5 years. However, it was also noted that a complete sample of the larger fish was not obtained and as a result these estimates should be considered preliminary. Growth rings were not validated.

Flatfish are shallow-water species, generally found in waters less than 50 m depth. Juveniles congregate in sheltered inshore waters, e.g., estuarine areas, shallow mudflats and sandflats, where they remain for up to two years. Juvenile survival is highly variable. Flatfish move offshore for first spawning at 2–3 years of age during winter and spring. Adult mortality is high, with many flatfish spawning only once and few spawning more than two or three times. However, fecundity is high, e.g., from 0.2 million eggs to over 1 million eggs in sand flounders.

Available biological parameters relevant to stock assessment are shown in Table 5. The estimated parameters in sections 1 and 3 of the table apply only to sand flounder in Canterbury and brill and turbot in west coast South island - growth patterns are likely to be different for these species in other areas and for other species of flatfish.

**Table 5: Estimates of biological parameters of flat fish.**

| Fishstock | Estimate | Source |
|---|---|---|
| 1. Natural mortality (*M*) | | |
| Brill - West coast South Island (FLA 7) | 0.20 | Stevens et al.(2001) |
| Turbot - West coast South island (FLA 7) | 0.26 | Stevens et al (2001) |
| Sand flounder - Canterbury (FLA 3) | 1.1–1.3 | Colman (1978) |
| Lemon sole - West coast South island (FLA 7) | 0.62–0.96 | Gowing et al (unpub.) |

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

| | Females | | Males | | |
|---|---|---|---|---|---|
| | a | b | a | b | |
| Brill (FLA 7) | 0.01443 | 2.9749 | 0.02470 | 2.8080 | Hickman & Tait (unpub.) |
| Turbot (FLA 7) | 0.00436 | 3.3188 | 0.00571 | 3.1389 | Hickman & Tait (unpub.) |
| Sand flounder (FLA 1) | 0.03846 | 2.6584 | - | - | McGregor et al (unpub.) |
| Yellow-belly flounder (FLA 1) | 0.07189 | 2.5117 | 0.00354 | 3.3268 | McGregor et al (unpub.) |
| New Zealand sole (FLA 3) | 0.03578 | 2.6753 | 0.007608 | 3.0728 | McGregor et al (unpub.) |

3. von Bertalanffy growth parameters

| | Females | | | Males | | | |
|---|---|---|---|---|---|---|---|
| | $L_\infty$ | $k$ | $t_0$ | $L_\infty$ | $k$ | $t_0$ | |
| Brill | | | | | | | |
| West coast South Island (FLA 7) | 43.8 | 0.10 | –15.87 | 38.4 | 0.37 | 38.4 | Stevens et al (2001) |
| Turbot | | | | | | | |
| West coast South island (FLA 7) | 57.1 | 0.39 | 0.30 | 49.2 | 0.34 | 49.2 | Stevens et al (2001) |
| Sand flounder | | | | | | | |
| Canterbury (FLA 3) | 59.9 | 0.23 | –0.083 | 37.4 | 0.781 | 37.4 | Mundy (1968), Colman (1978) |
| Lemon sole | | | | | | | |
| West coast South island (FLA 7) | 26.1 | 1.29 | –0.088 | 25.6 | 1.85 | 25.6 | Gowing et al (unpub.) |
| Greenback flounder (FLA 5) | 55.82 | 0.26 | –1.06 | 52.21 | 0.25 | –1.32 | Sutton et al (2010) |

## 3. STOCKS AND AREAS

There is evidence of many fairly localised stocks of flatfish. However, the inter-relationships of neighbouring populations have not been thoroughly studied. The best information is available from studies of the variation in morphological characteristics of sand flounders and from the results of tagging studies, conducted mainly on sand and yellow-belly flounders. Variation in morphological characteristics indicate that sand flounder stocks off the east and south coasts of the South Island are clearly different from stocks in central New Zealand waters and from those off the west coast of the South Island. There also appear to be differences between west coast sand flounders and those in Tasman Bay, and between sand flounders on either side of the Auckland-Northland peninsula. Tagging experiments show that sand flounders, and other species of flounder, can move substantial distances off the east and south coasts of the South Island. However, no fish tagged in Tasman Bay or the Hauraki Gulf have been recaptured very far from their point of release.

Thus, although the sand flounders off the east and south of the South Island appear to be a single, continuous population, fish in fairly enclosed waters may be effectively isolated from neighbouring populations and should be considered as separate stocks. Examples of such stocks are those in Tasman Bay and the Hauraki Gulf and possibly areas such as Hawke Bay and the Bay of Plenty.

There are no new data which would alter the stock boundaries used in previous assessment documents.

## 4. STOCK ASSESSMENT

The yield estimates are based on commercial landings data only and have not changed since the 1992 Plenary Report.

### 4.1 Estimates of fishery parameters and abundance

FLA 1

Standardised CPUE was investigated as a tool for monitoring FLA 1 (Coburn and Beentjes 2005) and the accepted indices were updated with some modification in 2009 (Kendrick & Bentley 2009) and 2012 (Kendrick & Bentley 2012). The inshore FAWG concluded that the accepted indices reflect abundance. Less than half of the estimated flatfish catch in each year is identified by species, but at least 90% of flatfish caught in FLA 1 West are likely to be yellow-belly flounder. This is supported by the fact that the preferred muddy bottom habitat of yellow-belly flounder dominates the west coast harbours.

Three quarters of the west coast catch is taken from Kaipara and Manukau Harbours. Standardised CPUE trends were derived for these two areas using estimated catches described as either YBF or FLA (assumed to be YBF). In spite of fluctuations, both the Manukau and Kaipara series show a long-term declining trend.

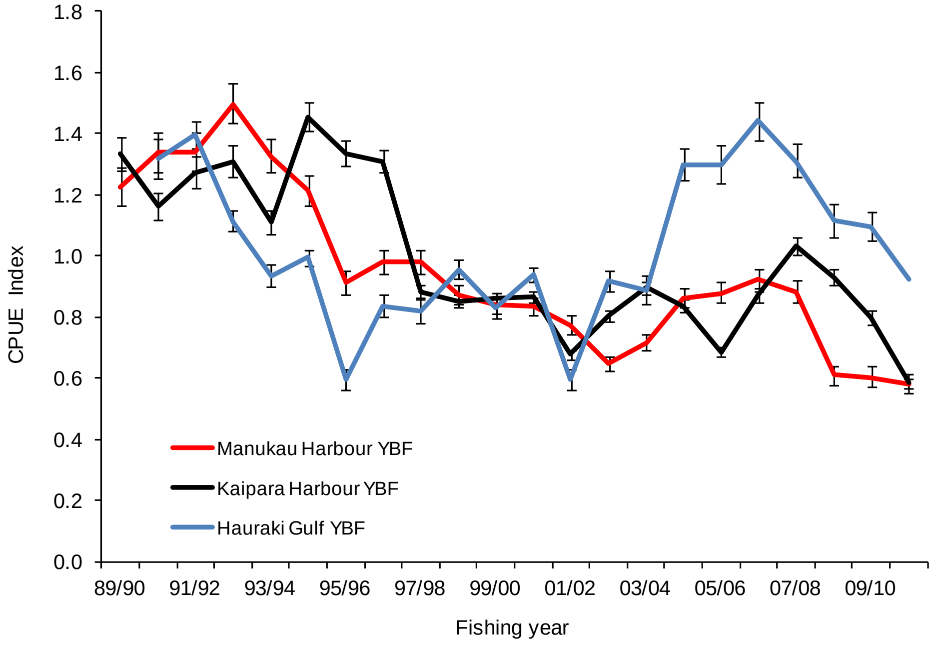



**Figure 2: Comparison of standardised CPUE indices for yellowbelly flounder (YBF or FLA) from models of catch rate in successful set net trips in Manukau Harbour, Kaipara Harbour and in the Hauraki Gulf.**

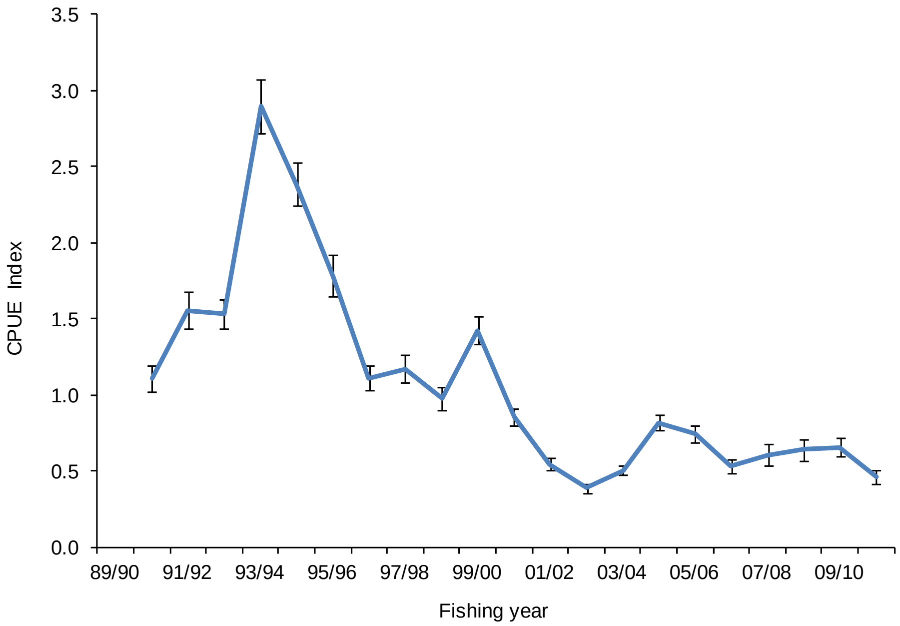



**Figure 3: Standardised CPUE indices for sand flounder (SFL) from a lognormal model of catch rate in successful set net trips in the Hauraki Gulf.**

Most of the flatfish catch from FLA 1 East, including a substantial and variable proportion of sand flounder, is taken in the Hauraki Gulf, particularly from the Firth of Thames. Separate indices were calculated for sand and yellowbelly flounder in Statistical areas 005 to 007, and the portion of FLA catch not identified by species was excluded. The Hauraki Gulf yellowbelly CPUE index fluctuated without trend and is currently near the long-term mean (Figure 2). The sand flounder index peaked between 1990–91 and1993–94 and then declined steeply to its lowest point in 2002–03 after which it has remained at that level (Figure 3).

Coburn and Beentjes (2005) described a negative relationship between sea surface temperature and sand flounder abundance in the Firth of Thames, assuming a 2-year lag between egg production and recruitment. The abundance of yellowbelly flounder in the Firth of Thames did not appear to be related to temperature.

## FLA 2

In 2014, Kendrick & Bentley (in press) provided standardised CPUE for FLA 2 (Figure 4) based on a model of positive catches from statistical areas 013 and 014 using a gamma error distribution, and a core fleet of 20 vessels that had completed at least five trips per year in at least five years. Characterisation done in 2014 suggests that the catch comprises mainly sand flounder (SFL) and English sole (ESO). Estimated catches were allocated to daily aggregated effort using methodology described in Langley (2014) to improve the comparability between the data collected from two different statutory reporting forms (CELR and TCER). The model adjusted for the recent positive influences of shifts in duration, an area x month interaction term, and vessel, and accounted for 37% of the variance in catch. A shorter time series based on TCEPR and TCER format data available since 2007–08, and analysed at tow by tow resolution closely resembles the mixed form series for the years in common (Figure 4).

The CPUE series exhibits moderate fluctuations around the longterm mean, with no overall trend up or down and appears currently to be in an increasing phase.

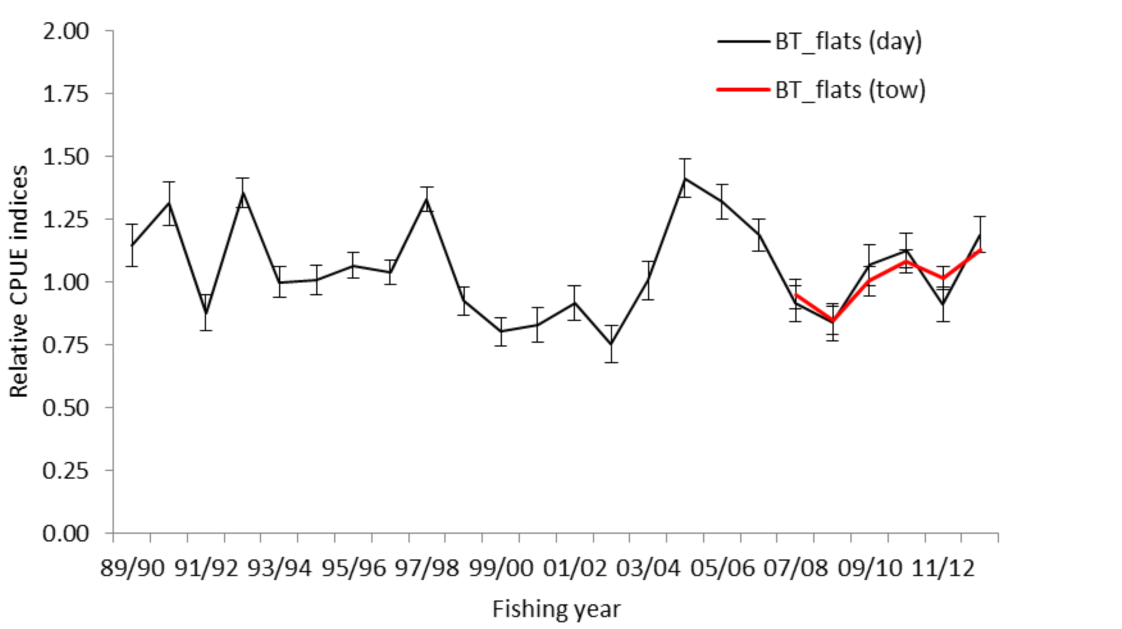



**Figure 4: Standardised CPUE indices in FLA 2 for BT_targetting all species of flatfish, (aggregated to combine data across form types), and a shorter times series based on tow by tow resolution data (Kendrick & Bentley, in prep).**

## Establishing $B_{MSY}$ compatible reference points

The Working Group accepted mean CPUE from the bottom trawl flatfish target series for the period 1989/90 to 2012–13 as a $B_{MSY}$-compatible proxy for FLA 2. The Working Group accepted the default Harvest Strategy Standard definitions that the Soft and Hard Limits would be one half and one quarter the target, respectively.

## FLA 3

The Southern Inshore Working Group accepted a CPUE analysis intended to inform in-season adjustments to the FLA 3 TAC (Kendrick & Bentley In prep.). This analysis estimated trends for three species (New Zealand sole, sand flounder and lemon sole) and the aggregated catch landed to FLA.

These trends were used to evaluate the relative status of these species and to predict in-season abundance of FLA based on early harvest returns to the fishery. There are similarities in the fluctuations of the four standardised CPUE indices (Figure 5), with all indices increasing in the early 1990s and peaking at some point in the five years between 1989–90 and 1993–94. All indices then have a trough in the early- to mid-2000s followed by an increase to the late 2000s. The TOT, ESO and SFL indices show the greatest similarity in their fluctuations. The LSO index had its peak in the 1990s later than the other indices and increased sooner than the other species in the mid-2000s (Figure 5).

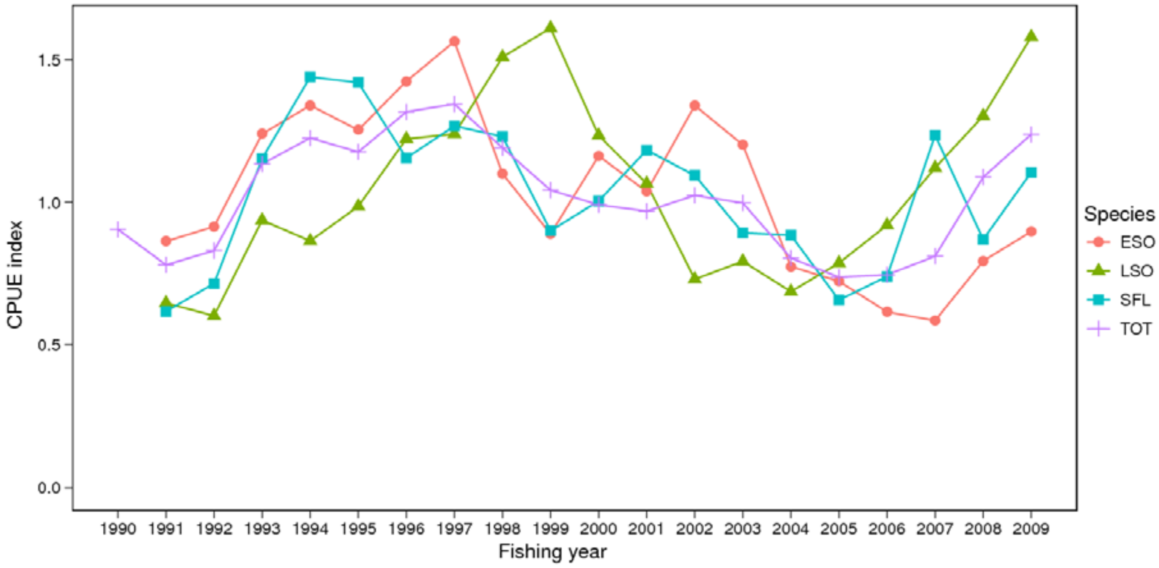



**Figure 5: Comparison of standardised CPUE indices in FLA 3 for TOT, (all flatfish species combined) LSO (lemon sole), ESO (New Zealand sole) and SFL (sand flounder). Note that only the TOT index is available for the 1989–90 fishing year because very little species composition data are available for that year (Kendrick and Bentley, in prep).**

## Biomass estimates

Biomass in the core strata (30–400 m) for the east coast South Island trawl survey (Table 6) shows no trend (Figure 6). Coefficients of variation are moderate to low, ranging from 18 to 33% (mean 24%). The additional biomass captured in the 10–30 m depth range accounted for only 4% and 1% of the biomass in the core plus shallow strata (10–400 m) for 2007 and 2012, respectively, indicating that the existing core strata time series in 30–400 m is the most important, but that shallow strata should also be monitored.

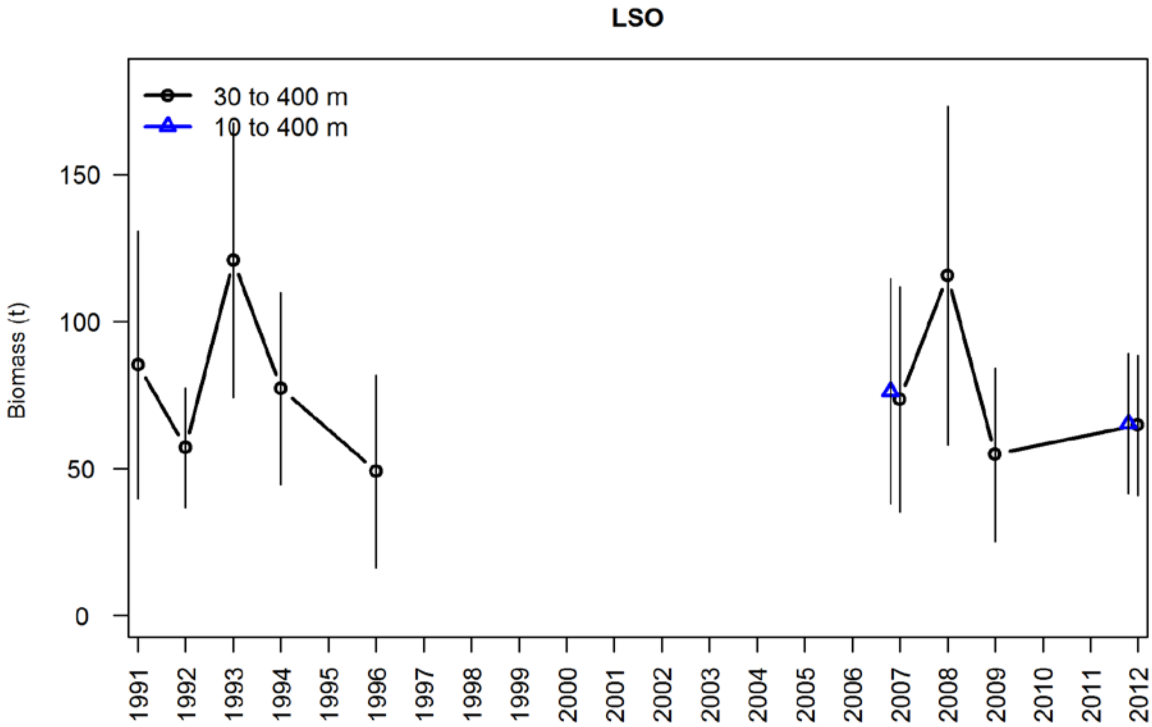



**Figure 6: Lemon sole total biomass and 95% confidence intervals for the all ECSI winter surveys in core strata (30–400 m), and core plus shallow strata (10–400 m) in 2007 and 2012.**

**Table 6: Relative biomass indices (t) and coefficients of variation (CV) for lemon sole for the east coast South Island (ECSI) - winter survey area*. Biomass estimates for ECSI in 1991 have been adjusted to allow for non-sampled strata (7 and 9 are equivalent to current strata 13, 16 and 17). – , not measured; N/A, not applicable.**

| Region | Fishstock | Year | Trip number | Total Biomass estimate | CV (%) | Total Biomass estimate | CV (%) |
|---|---|---|---|---|---|---|---|
| ECSI (winter) | LSO 3 | | | | 30–400 m | | 10–400 m |
| | | 1991 | KAH9105 | N/A | N/A | - | - |
| | | 1992 | KAH9205 | 57 | 18 | - | - |
| | | 1993 | KAH9306 | 121 | 19 | - | - |
| | | 1994 | KAH9406 | 77 | 21 | - | - |
| | | 1996 | KAH9606 | 49 | 33 | - | - |
| | | 2007 | KAH0705 | 74 | 26 | - | - |
| | | 2008 | KAH0806 | 116 | 25 | - | - |
| | | 2009 | KAH0905 | 55 | 27 | - | - |
| | | 2012 | KAH1207 | 65 | 18 | - | - |

## Length frequency distributions

Lemon sole length distributions for the east coast South Island trawl survey show single modes in both 30 to 100 m and 100 to 200 m depths, with lengths ranging from about 10 to 40 cm, and overall smaller than the commercial catch (Figure 7). The single mode probably comprises several year classes. Females are caught in much larger numbers that males. The survey does not monitor pre-recruited fish (less than 25 cm) well, and recruited fish do not appear to be well represented compared to the commercial catch. Plots of time series length frequency distributions are consistent among surveys showing a single mode with similar size ranges. The addition of the 10–30 m depth range does not change the shape of the length frequency distribution to any extent.

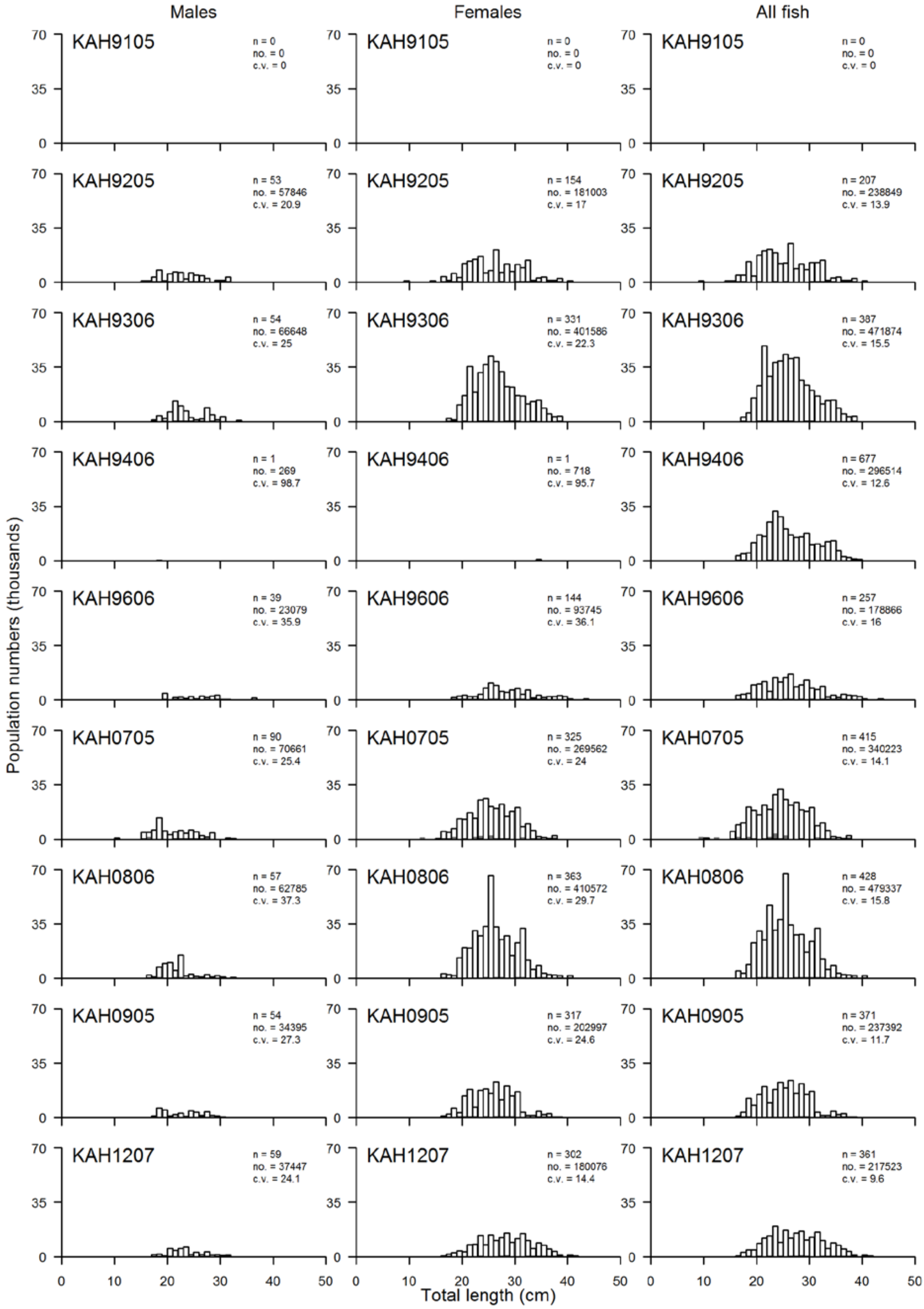



**Figure 7: Scaled length frequency distributions for lemon sole in core strata (30–400 m) for all nine ECSI winter surveys. The length distribution is also shown in the 10–30 m depth strata for the 2007 and 2012 surveys overlaid in red for species with many length classes, otherwise in light grey (not stacked). Population estimates are for the core strata only. n, number of fish measured; no., population number; c.v., coefficient of variation.**

### 4.2 Yield estimates and projections

The Working Group has agreed that *MCY* estimates are not appropriate for flatfish.

No estimate of *CAY* is available for flatfish stocks.

### 4.3 Other Factors

The flatfish complex is comprised of eight species although typically only a few are dominant in any one QMA and some are not found in all areas. For management purposes all species are combined to form a unit fishery. The proportion that each species contributes to the catch is expected to vary annually. It is not possible to estimate *MCY* for each species and stock individually.

Because the adult populations of most species generally consist of only one or two year classes at any time, the size of the populations depends heavily on the strength of the recruiting year class and is therefore thought to be highly variable. Brill and turbot are notable exceptions with the adult population consisting of a number of year classes. Early work revealed that although yellow belly flounder are short-lived, inter-annual abundance in FLA 1 was not highly variable, suggesting that some factor, e.g., size of estuarine nursery area, could be smoothing the impact of random environmental effects on egg and larval survival. Work by NIWA (McKenzie et al 2013) in the Manukau harbour has linked the decrease in local CPUE with an increase in eutrophication, suggesting that there may be factors other than fishing contributing to the decline.

Flatfish TACCs were originally set at high levels so as to provide fishers with the flexibility to take advantage of the perceived variability associated with annual flatfish abundance. This approach has been modified with an in-season increase procedure for FLA 3.

## 5. STATUS OF THE STOCKS

Estimates of current and reference biomass are not available.

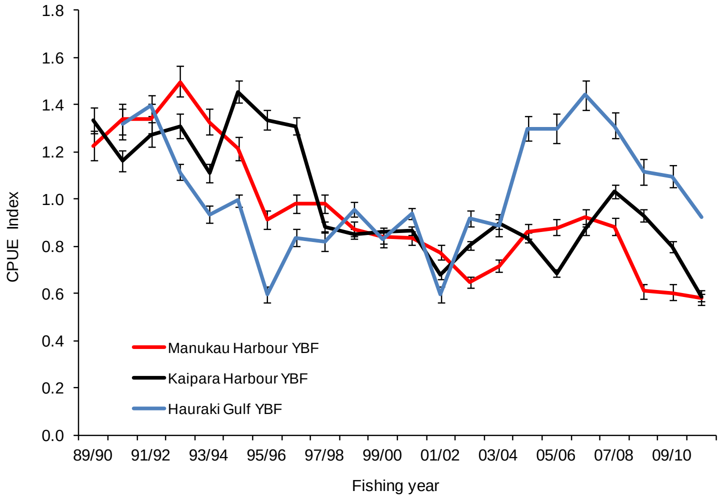
**Yellow-belly flounder in FLA 1**

**Stock Structure Assumptions**

Based on tagging studies, yellow-belly flounder appear to comprise localised populations, especially in enclosed areas such as harbours and bays.

| **Stock Status** | |
|---|---|
| Year of Most Recent Assessment | 2012 |
| Assessment Runs Presented | CPUE in Manukau and Kaipara harbours, and the Hauraki Gulf |
| Reference Points | Target(s): Not established but $B_{MSY}$ assumed<br>Soft Limit: 20% $B_0$<br>Hard Limit: 10% $B_0$ |
| Status in relation to Target | Manukau: Unknown<br>Kaipara: Unknown<br>Hauraki Gulf: Unknown |
| Status in relation to Limits | Unknown |

| Historical Stock Status Trajectory and Current Status |
|---|




**Standardised CPUE indices for yellowbelly flounder (YBF or FLA) from models of catch rate in successful set net trips in Manukau Harbour, Kaipara Harbour and in the Hauraki Gulf (Kendrick & Bentley 2012).**

| **Fishery and Stock Trends** | |
|---|---|
| Recent Trend in Biomass or Proxy | In spite of fluctuations, both the Manukau and Kaipara series show a long-term declining trend.<br>The Hauraki Gulf yellowbelly CPUE index has fluctuated without trend and is currently near the long-term mean. |
| Recent Trend in Fishing Mortality or Proxy | - |
| 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<br>Hard Limit: Unknown |

| **Assessment Methodology and Evaluation** | | |
|---|---|---|
| Assessment Type | Level 2 – Partial Quantitative Stock Assessment | |
| Assessment Method | Standardised CPUE based on positive catches | |
| Assessment Dates | Latest assessment: 2012 | Next assessment: 2015 |
| Overall assessment quality rank | 1 – High Quality | |
| Main data inputs (rank) | Catch and effort data | 1 – High Quality |
| Data not used (rank) | - | |
| Changes to Model Structure and Assumptions | - | |
| Major Sources of Uncertainty | -Uncertainty in the stock structure and relationship between CPUE and biomass | |

| **Qualifying Comments** |
|---|
| Work by NIWA (McKenzie et al 2013) in the Manakau harbour has linked the decrease in local CPUE with an increase in eutrophication, suggesting that there may be factors other than fishing contributing to the decline.<br>The lack of species specific reporting for FLA stocks is limiting the ability to assess these stocks. |

| **Fishery Interactions** |
|---|
| Main bycatch is sand flounder, especially on the east coast. FLA 1 species are mostly targeted with setnets in harbours. Interactions with protected species are believed to be low. |

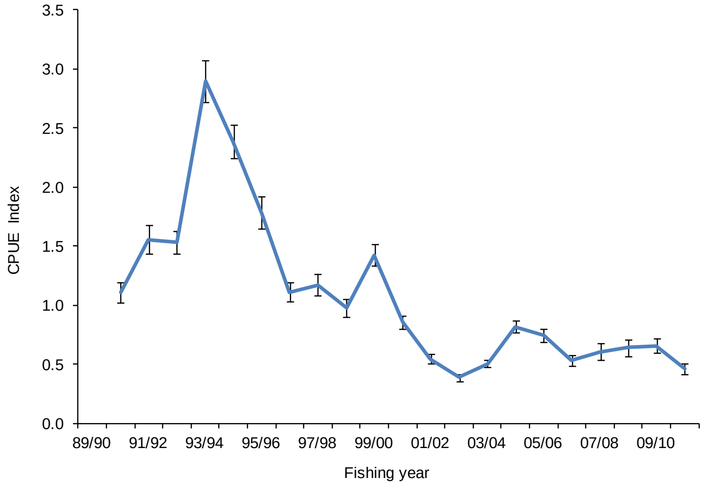
## Sand flounder in FLA 1

### Stock Structure Assumptions

Based on tagging studies and morphological analysis, sand flounder appear to comprise localised populations, especially in enclosed areas such as harbours and bays.

| **Stock Status** | |
|---|---|
| Year of Most Recent Assessment | 2012 |
| Assessment Runs Presented | Standardised CPUE for Hauraki Gulf |
| Reference Points | Target(s): Not established but $B_{MSY}$ assumed<br>Soft Limit: 20% $B_0$<br>Hard Limit: 10% $B_0$ |
| Status in relation to Target | Unknown |
| Status in relation to Limits | Unknown |

**Historical Stock Status Trajectory and Current Status**




**Standardised CPUE indices for sand flounder (SFL) from a model of catch rate in successful set net trips in the Hauraki Gulf.**

| **Fishery and Stock Trends** | |
|---|---|
| Recent Trend in Biomass or Proxy | The sand flounder index peaked from 1990–91 to 1993–94 and then declined steeply to its lowest point in 2002–03, after which it has remained at that level. |
| Recent Trend in Fishing Mortality or Proxy | Unknown |
| 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<br>Hard Limit: Unknown |

| **Assessment Methodology** | | |
|---|---|---|
| Assessment Type | Level 2 - Partial Quantitative stock assessment | |
| Assessment Method | Standardised CPUE based on positive catches | |
| Assessment Dates | Latest assessment: 2012 | Next assessment: 2015 |
| Overall assessment quality rank | 1 – High Quality | |
| Main data inputs (rank) | Catch and effort data | 1 – High Quality |
| Data not used (rank) | - | |

| | |
|---|---|
| Changes to Model Structure and Assumptions | - |
| Major Sources of Uncertainty | - Uncertainty in the stock structure and relationship between CPUE and biomass |

| **Qualifying Comments** |
|---|
| Coburn & Beentjes (2005) described a negative relationship between sea surface temperature and sand flounder abundance in the Firth of Thames, assuming a 2-year lag between egg production and recruitment to the fishery.<br>The lack of species specific reporting for FLA stocks limits the ability to assess these stocks. |

| **Fishery Interactions** |
|---|
| Main QMS bycatch species is yellow belly flounder, especially on the east coast. FLA 1 species are mostly targeted with setnets in harbours. Interactions with protected species are believed to be low. |

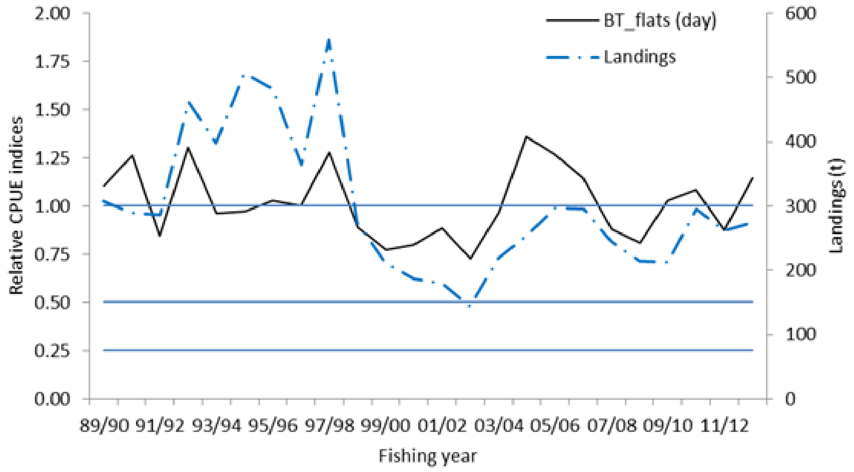
## FLA 2

### Stock Structure Assumptions

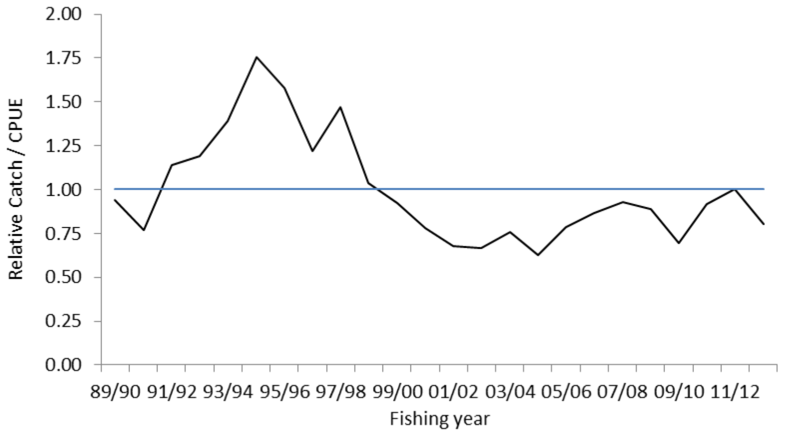
Sand flounder off the East Coast of North Island appear to be a single continuous population. The stock structure of New Zealand sole (ESO) is unknown.

| **Stock Status** | |
|---|---|
| Year of Most Recent Assessment | 2014 |
| Assessment Runs Presented | Standardised CPUE for all flatfish combined in FLA 2 |
| Reference Points | Target: $B_{MSY}$-compatible proxy based on the mean CPUE 1989/90 to 2012–13 for the bottom trawl flatfish target series<br>Soft Limit: 50% of target<br>Hard Limit: 25% of target<br>Overfishing threshold: $F_{MSY}$ |
| Status in relation to Target | About as Likely As Not (40–60%) to be at or above the target |
| Status in relation to Limits | Soft Limit: Very Unlikely (< 10%) to be below<br>Hard Limit: Very Unlikely (< 10%) to be below |
| Status in relation to Overfishing | Overfishing in 2013 was Very Unlikely (< 10%) to be occurring |

**Historical Stock Status Trajectory and Current Status**




**Standardised CPUE indices based on positive catches for BT_flats, (all flatfish species combined) at day resolution and a shorter series that is done on tow based data (Kendrick & Bentley, in prep). Scaling is relative to the years in common. Fishing years are labelled according to the second calendar year e.g. 1990 = 1989/90. In both standardisation models a gamma error distribution was assumed. Horizontal lines are the target and the soft and hard limits.**




**Annual relative exploitation rate for flatfish in FLA 2.**

| **Fishery and Stock Trends** | |
|---|---|
| Recent Trend in Biomass or Proxy | Relative abundance has fluctuated without trend since 1989/90 and is currently above the target. |
| Recent Trend in Fishing Mortality or Proxy | Fishing intensity has be reasonably stable since 2001and is currently below the long term average |
| Other Abundance Indices | - |
| Trends in Other Relevant Indicators or Variables | - |

| **Projections and Prognosis** | |
|---|---|
| Stock Projections or Prognosis | Stock is likely to continue to fluctuate around current levels |
| Probability of Current Catch or TACC causing decline below Limits | Soft Limit: Unknown for TACC; Unlikely (< 10%) for current catch<br>Hard Limit: Unknown for TACC; Unlikely (< 10%) for current catch |

| **Assessment Methodology** | | |
|---|---|---|
| Assessment Type | Level 2 – Partial Quantitative stock assessment | |
| Assessment Method | Standardised CPUE based on positive catches | |
| Assessment Dates | Latest assessment: 2014 | Next assessment: 2017 |
| Overall assessment quality rank | 1 – High Quality | |
| Main data inputs (rank) | - Catch and effort data | 1 – High Quality |
| Data not used (rank) | N/A | |
| Changes to Model Structure and Assumptions | - | |
| Major Sources of Uncertainty | - | |

| **Qualifying Comments** |
|---|
| The lack of species specific reporting for FLA stocks limits the ability to assess these stocks on an individual basis. There is no indication that species composition has changed over the analysis period. |

| **Fishery Interactions** |
|---|
| The fishery is mainly confined to the inshore domestic trawl fleet except for a small incidental bycatch of soles, brill and turbot by offshore trawlers. The main fisheries landing flatfish as bycatch in FLA 2 target gurnard, snapper and trevally. Interactions with protected species are believed to be low. Incidental captures of seabirds occur. |

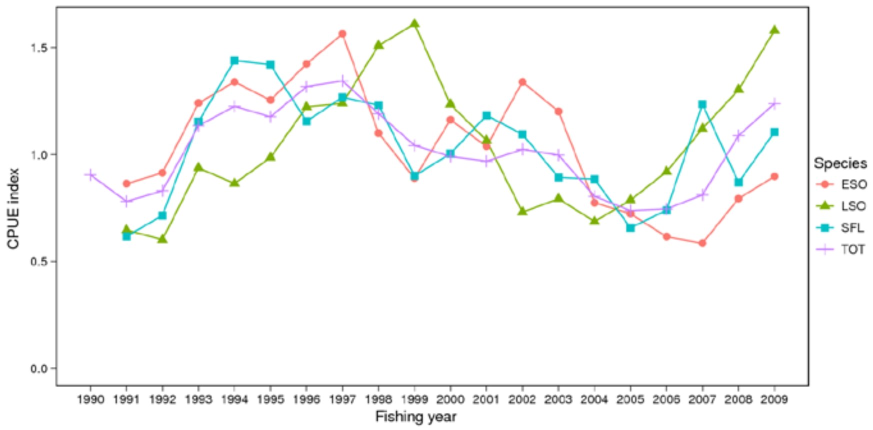
## FLA 3 (Sand flounder, New Zealand sole and lemon sole)

### Stock Structure Assumptions

Sand flounder off the East Coast of South Island appear to be a single continuous population. The stock structure of New Zealand sole and lemon sole is unknown.

| **Stock Status** | |
|---|---|
| Year of Most Recent Assessment | 2010 |
| Assessment Runs Presented | Standardised CPUE for all flatfish combined in FLA 3 |
| Reference Points | Target(s): Not established but $B_{MSY}$ assumed<br>Soft Limit: 20% $B_0$<br>Hard Limit: 10% $B_0$ |
| Status in relation to Target | Unknown |
| Status in relation to Limits | Soft Limit: Unknown<br>Hard Limit: Unlikely (< 40%) to be below |

**Historical Stock Status Trajectory and Current Status**




**Standardised CPUE indices based on positive catches for TOT, (all flatfish species combined) LSO (lemon sole), ESO (New Zealand sole) and SFL (sand flounder) (Kendrick & Bentley in prep).**

| **Fishery and Stock Trends** | |
|---|---|
| Recent Trend in Biomass or Proxy | The most recent index for lemon sole is well above the long-term mean, while sand flounder is near the long-term mean and New Zealand sole is below it. All four indices declined between the late 1990s and the mid 2000s with increases in the last few years. |
| Recent Trend in Fishing Mortality or Proxy | - |
| Other Abundance Indices | - |
| Trends in Other Relevant Indicators or Variables | - |

| **Projections and Prognosis** | |
|---|---|
| Stock Projections or Prognosis | N/A stock managed with annual in-season adjustment procedure |
| Probability of Current Catch or TACC causing decline below Limits | Soft Limit: Unknown<br>Hard Limit: Unknown |

| **Assessment Methodology** | | |
|---|---|---|
| Assessment Type | Level 2 – Partial Quantitative stock assessment | |
| Assessment Method | Standardised CPUE based on positive catches | |
| Assessment Dates | Latest assessment: 2010 | Next assessment: 2013 |
| Overall assessment quality rank | 1 – High Quality | |
| Main data inputs (rank) | - Catch and effort data | 1 – High Quality |
| Data not used (rank) | N/A | |

| | |
|---|---|
| Changes to Model Structure and Assumptions | - |
| Major Sources of Uncertainty | - Uncertainty in stock structure assumptions and the relationship between CPUE and biomass |

| **Qualifying Comments** |
|---|
| The lack of species specific reporting for FLA stocks limits the ability to assess these stocks. |

| **Fishery Interactions** |
|---|
| The fishery is mainly confined to the inshore domestic trawl fleet except for a small incidental bycatch of soles, brill and turbot by offshore trawlers. The main target species landing flatfish as bycatch in FLA 3 are red cod, barracouta, stargazer, gurnard, tarakihi and elephantfish. Interactions with protected species are believed to be low. Incidental captures of seabirds occur. |

TACCs and reported landings are summarised in Table 7

**Table 7: Summary of yields (t), TACCs (t), and reported landings (t) of flatfish for the most recent fishing year.**

| Fishstock | QMA | 2012–13 Actual TACC | 2012–13 Reported Landings |
|---|---|---|---|
| FLA 1 | Auckland (East) (West) 1 & 9 | 1 187 | 480 |
| FLA 2 | Central (East) (West) 2 & 8 | 726 | 274 |
| FLA 3 | South-East (Coast) (Chatham), 3, 4, 5, & 6 Southland and Sub-Antarctic | 1 430 | 1 512 |
| FLA 7 | Challenger 7 | 2 066 | 526 |
| FLA 10 | Kermadec 10 | 10 | 0 |
| Total | | 5 419 | 2 792 |

## 6. FOR FURTHER INFORMATION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