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# Review of flatfish catch data and species composition

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## EXECUTIVE SUMMARY

**Beentjes, M.P. (2003). Review of flatfish catch data and species composition.**

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The objective of this report is to determine whether the flatfish catch effort data are suitable for catch per unit effort (CPUE) analysis. To address this the following data were examined: flatfish commercial catch data for 1989–90 to 2000–01 (catch effort landing returns, CELR; Trawl catch effort processing returns, TCEPR; catch landing returns, CLR; Quota Management System data, QMS), processors' flatfish landing records, and *Kaharoa* trawl survey flatfish catches.

Flatfish estimated catch is about 85% of reported landings from QMS data, and 75% of landings from CELR/CLR. Trends in fishers' estimates appear to be similar to those of actual landings, particularly QMS data, indicating that fishers estimates are a reasonable proxy for landed catch.

For all Quota Management Areas (QMAs) combined, 47% of the estimated catch of flatfish was recorded using the generic species code FLA, and the remainder (53%) used a combination of 12 other codes (species specific codes BRI, BFL, BLF, ESO, GFL, LSO, SFL, TUR, YBF, WIT; generic codes FLO, SOL). In 1989–90, when CELR and TCEPR replaced FSU forms, all estimated catches were reported as FLA, the percentage declining to about 40% by 1992–93 and remaining reasonably stable thereafter.

A total of 60 different fishstock codes were used in the catch landing section of CELRs and in CLRs although 94% of the landed catch was recorded using one of the correct FLA fishstock codes (FLA 1, FLA 2, FLA 3, FLA 7).

Nearly all (99%) of estimated flatfish catch is reported on CELR forms, with the remainder on TCEPR forms. Most of the estimated catch is taken by bottom trawling (75%) and set netting (23%).

The species composition of processors' flatfish landings and those from *Kaharoa* trawl surveys were generally similar to fishers' estimates and support the notion that estimated catches from CELRs are a reasonable reflection of actual flatfish species composition.

There is merit in conducting CPUE analyses for key flatfish species from each QMA, which have been reported by species in the catch effort section of CELR forms. Analyses on the species code FLA would be questionable as it comprises multiple species and trends for all species are unlikely to be similar.

# 1. INTRODUCTION

The flatfish commercial fishery comprises eight species: four flounders (black flounder, *Rhombosolea retiaria*; greenback flounder, *R. taparina*; sandflounder, *R. plebeia*; yellowbelly flounder, *R. leporine*), two soles (lemon sole, *Pelotretus flavilatus*; New Zealand sole, *P. novaezeelandiae*), plus brill, (*Colistium gunetheri*), and turbot, (*Colistium nudipinnis*) (Kirk 1989, Colman 1994, Annala et al. 2002). Witch (*Arnoglossus scapha*) is also caught, but is less desirable and seldom landed. Inshore trawlers account for most of the landings with some setnet and dragnet fishing for yellowbelly flounder in the Firth of Thames, and the Kaipara and Manukau Harbours. The main fishing areas by species are as follows (from Annala et al. 2002):

| | |
|---|---|
| Yellowbelly flounder (YBF) | – Firth of Thames, Kaipara and Manukau harbours |
| Sandflounder (SFL) | – Hauraki Gulf, Tasman/Golden Bay, Bay of Plenty, and Canterbury Bight |
| Greenback flounder (GFL) | – Canterbury Bight, Southland |
| Black flounder (BFL) | – Canterbury Bight |
| Lemon sole (LSO) | – west coast South Island, Otago, Southland |
| New Zealand sole (ESO) | – west coast South Island, Otago, Canterbury Bight |
| Brill and turbot (BRI, TUR) | – west coast South Island |

About 50% of flatfish landed weight is caught in FLA 3 (Figure 1), an area that includes Fishery Management Areas (FMAs) 3, 4, 5, and 6 where annual landings have averaged about 1900 t over the last 10 years (Annala et al. 2002).

For management purposes landings of all flatfish species are combined under the generic species code FLA and managed within the Quota Management System (QMS) essentially as a single species comprising four stocks (FLA 1, FLA 2, FLA 3, FLA 7). Flatfish movements are limited and generally restricted to onshore/offshore spawning migrations (Colman 1974, Roper & Jillett 1981) – so flatfish species in each of the four flatfish Quota Management Areas (QMAs) probably consists of multiple localised stocks. There have been no assessments of flatfish, and for stock assessment purposes flatfish are assessed as a single generic species (FLA), and no landings for individual flatfish species are documented (Annala et al. 2002). The fisheries reporting regulations require that only the code FLA be used in the Catch Landing section of the Catch Effort Landing Return (CELR). However, the codes for individual flatfish species (BRI, BFL, ESO, GFL, LSO, SFL, TUR, and YBF) are required to be used in the Catch Effort section of the form. In practice, however, MFish accept either individual species codes or the generic FLA code because of the difficulties it would impose on fishers to comply with the reporting requirements (Kim Duckworth, Ministry of Fisheries, pers. comm.).

The original TAC was set high because flatfish growth is fast and recruitment variable with the fishery relying on one or two year classes each year (Colman 1994, Annala et al. 2002). The high TACC allows fishers to capitalise on years when abundance is high, a management regime similar to that for red cod which is also fast growing with variable recruitment (Beentjes 2000). Although flatfish catches are not declining, it is difficult to gauge the effect of current fishing pressure on individual species. It is possible that, although FLA landings appear stable, individual species may be stressed. The commercial flatfish comprise four genera and the eight species have distinct life histories with differences in distribution, growth rates, spawning behaviour, and biology (Colman 1994). To more effectively manage flatfish under the QMS, information on catches by species is required.

There are no current trawl surveys or other survey methods that specifically target flatfish and therefore the status of the eight flatfish species are not adequately monitored. Catch effort analyses may provide relative abundance estimates for flatfish, but have not been attempted, probably because of the number of species involved and the uncertainty surrounding reporting of estimated catches. The purpose of this report is to examine and describe the nature and extent of available flatfish data, and make recommendations on whether it is feasible to carry out catch effort analyses.

## 2. METHODS

Data from the following sources were examined: Catch Effort Landing Returns (CELR), Trawl Catch Effort Processing Returns (TCEPR), Catch Landing Returns (CLR), flatfish processors' records, *Kaharoa* trawl surveys, and QMS.

### 2.1 Estimated and landed catch data

Flatfish estimated catch, method of capture, and form type, were extracted from CELR and TCEPR forms for the species codes FLA, BRI, BFL, ESO, GFL, LSO, SFL, TUR, YBF, as well as sometimes used codes BLF (blackflounder), FLO (flounder), WIT (witch), and SOL (sole). The data included the fishing years 1989–90 to 2001–02 (2001–02 data are current to August 2001). The species were selected in consultation with Ministry of Fisheries catch effort data analysts and are thought to represent all the possible entries for flatfish. If more than five quota species were present in the catch and flatfish was not in the top five by weight, they will not have been entered in the catch effort section. In addition, on occasions fewer than five quota species are recorded, even if more than five species are caught. Estimated catches reported by statistical area were converted to fishstock (FLA 1, FLA 2, FLA 3, and FLA 7) although these do not always match the FLA QMA boundaries (Appendix 1). Records with no or an invalid statistical area were excluded from the extract and accounted for 107 t (0.2%) of the total data set.

Estimated catches by species code, QMA, and fishing year were collated and the overall proportion of catch for each species code used was determined. The total estimated catch for each fishing year was compared with fishers' actual landings (CELR and CLR) and data from the QMS to gauge the accuracy of estimates.

Species codes used in the catch landing data (bottom of CELR) and CLR forms was also examined to determine how fishstocks were reported.

### 2.2 Processors' landing data

Commercial fish processors generally maintain records of individual flatfish species landed to pay fishers according to grade and species. We requested flatfish landing data by species and QMA from six of the main flatfish commercial fish processors throughout New Zealand. All but one of the companies provided these data to NIWA for analysis. Data from each company were analysed separately and catches were summed for each species over the years provided, and the relative proportions of the individual flatfish species landed within each QMA was determined. The relative proportions of flatfish species processed were compared with those from the fishers' estimates.

### 2.3 *Kaharoa* trawl survey data

Flatfish catches from *Kaharoa* inshore trawl survey time series in QMAs FLA 2, FLA 3, and FLA 7 were collated to determine the relative proportions of flatfish species found in each area surveyed. Flatfish catch from Hauraki Gulf surveys (FLA 1) were minimal and therefore not included in our analyses. The following surveys were included in the analyses.

1. East coast South Island winter surveys (30–400 m) (KAH9105, KAH9205, KAH9306, KAH9406, KAH9606).
2. East coast South Island summer surveys (10–400 m) (KAH9618, KAH9704, KAH9809, KAH9917, KAH0014).
3. West coast South Island (20–400 m) (KAH9204, KAH9404, KAH9504, KAH9701, KAH0004).

4. East coast North Island (20–400 m) (KAH9304, KAH9402, KAH9502, KAH9602).

For each of the four time series, catch of each flatfish species from all surveys was combined and expressed as a percentage of the total flatfish catch. Catches were used rather than biomass estimates because often the catch of a species on a survey comprised only one to several fish and biomass estimates were associated with high variance.

## 3. RESULTS

### 3.1 Estimated catch

Comparison of estimated flatfish catch with reported landings indicates that fishers' estimates are about 85% of reported landings from QMS data and 75% of landings from CELR/CLR (Figure 2). I can offer no explanation for the 10% difference between the two landing data sources. Trends in fishers' estimates appear to be similar to those of actual landings, particularly QMS data, indicating that fishers' estimates are a reasonable proxy for landed catch. Lower estimated than reported catches are partly because flatfish are often caught in small quantities and/or as bycatch and may not be included in the top five species by weight. When this occurs, landed weight of a species will exceed estimated catch.

#### 3.1.1 All QMAs combined

For all QMAs combined between 1989–90 and 2001–02, about half (47%) of the estimated catch of flatfish was recorded using the generic species code FLA, and the remainder used a combination of 12 other species codes (Table 1). In 1989–90 when CELR and TCEPR replaced FSU forms, all estimated catches were reported as FLA. However, the percentage of catch reported as FLA declined to about 40% by 1992–93 and remained reasonably stable thereafter (Figure 3). Flatfish species that comprised a large proportion of the estimated catch included ESO (16%), LSO (12%), SFL (12%) and YBF (6%) (Table 1, Figure 4). Species caught in small quantities (under 2% of estimated catch) include BFL (occasionally recorded as BLF), BRI, GFL, TUR and WIT. The catch assigned to incorrect codes SOL and FLO accounted for only 0.3 and 0.1% of the total catch respectively (Figure 4). Given that the use of the generic code FLA appears to have been consistent after 1992–93 and is probably confined to the same fishers, the catches of each species probably represent their relative contribution to total flatfish landings throughout New Zealand.

#### 3.1.2 FLA 1

For FLA 1 between 1989–90 and 2001–02, 59% of the estimated catch of flatfish was recorded using the generic species code FLA, and the remainder used a combination of 11 other species codes (Table 2). In 1989–90 all estimated catches were reported as FLA. However, the percentage of catch reported as FLA declined to about 50% by 1993–94, and remained reasonably stable thereafter (see Figure 3). Flatfish species that comprised a large proportion of the estimated catch included YBF (23%), and SFL (13%) (Table 2, Figure 4). Species caught in small quantities (under 2.5% of estimated catch) include BFL, BRI, ESO, GFL, LSO, TUR, and WIT. The catch assigned to incorrect codes SOL and FLO accounted for only 0.03 and 0.01% of the total catch respectively.

Total flatfish estimated catches in FLA 1 peaked in 1993–94, but there is no trend in catches over time (Table 2). Of the main species caught in FLA 1 (YBF and SFL), only SFL shows a trend of declining catch over time with the lowest catch recorded in the 2001–02 fishing year. GFL, although a minor species in FLA 1, also showed a similar trend of declining catches.

FLA 1 contributed 22% of the total estimated flatfish catches in New Zealand between 1989–90 and 2001–02 (Table 3), and was the most important area for YBF, accounting for 83% of catches. FLA 1 has also been an important area for SFL and GFL, contributing 23 and 26% respectively, of the total estimated catch of these species.

### 3.1.3 FLA 2

For FLA 2 between 1989–90 and 2001–02, 63% of the estimated catch of flatfish was recorded using the generic species code FLA, and the remainder used a combination of 11 other species codes (Table 4). In 1989–90 all estimated catches were reported as FLA. However, the percentage of catch reported as FLA declined to about 53% by 1992–93, and remained reasonably stable thereafter (see Figure 3). Flatfish species that comprised a large proportion of the estimated catch included ESO (12%), and SFL (15%) (Table 4, Figure 4). Species caught in small quantities (under 2.5% of estimated catch) include BFL, BRI, GFL, LSO, TUR, WIT, and YBF. The catch assigned to incorrect codes SOL and FLO accounted for only 0.7 and 0.1% of the total catch respectively.

Total flatfish estimated catches in FLA 2 peaked in 1997–98, with the lowest catches recorded in the last two fishing years (Table 4). Neither of the two main species caught in FLA 2 (ESO and SFL), showed any trend in catches.

FLA 2 contributed 10% of the total estimated flatfish catches in New Zealand between 1989–90 and 2001–02, which was less than any other QMA (see Table 3). There were no species that were caught in greater quantities in FLA 2 than in other QMAs. (The species code SOL was used more commonly in FLA 2 but the quantities involved are very small and the code is probably generic for sole or flatfish species.)

### 3.1.4 FLA 3

For FLA 3 between 1989–90 and 2001–02, 40% of the estimated catch of flatfish was recorded using the generic species code FLA, and the remainder used a combination of 12 other species codes (Table 5). In 1989–90 all estimated catches were reported as FLA. However, the percentage of catch reported as FLA declined to about 40% by 1992–93, and remained reasonably stable thereafter (see Figure 3). Flatfish species that comprised a large proportion of the estimated catch included LSO (23%), ESO (21%), and SFL 7% (Table 5, Figure 4). Species caught in small quantities (under 2.5% of estimated catch) include BFL, BLF, BRI, GFL, TUR, WIT, and YBF. The catch assigned to incorrect codes SOL and FLO accounted for only 0.02 and 0.5% of the total catch respectively.

Total flatfish estimated catches in FLA 3 peaked in between 1992–93 and 1997–98, but there is no trend in catches over time (Table 5). Of the main species caught in FLA 3 (ESO, LSO, and SFL), the latter two species show a weak trend of declining catch over time, with relatively poor catches in recent years.

FLA 3 contributed 48% of the total estimated flatfish catches in New Zealand between 1989–90 and 2001–02, the most of any QMA (see Table 3). FLA 3 is the most important area for a number of flatfish species including BLF (74% of total estimated catches), BLF (99%), BRI (62%), ESO (64%), LSO (92%), and WIT (87%) (see Table 3). The incorrect codes SOL and FLA were also used more commonly in FLA 3 than elsewhere.

### 3.1.5 FLA 7

For FLA 7 between 1989–90 and 2001–02, 44% of the estimated catch of flatfish was recorded using the generic species code FLA, and the remainder used a combination of 12 other species codes (Table

6). In 1989–90 all estimated catches were reported as FLA, the percentage declining to about 20% by 1992–93, but then increasing in nearly every year to 63% in 2001–02 (see Figure 3). Flatfish species that comprised a large proportion of the estimated catch included SFL (21%) and ESO (21%), and to a lesser extent TUR (5%), LSO (3%), and GFL (3%) (Table 6, Figure 4). Species caught in small quantities (under 2.5% of estimated catch) included BFL, BLF, BRI, WIT, and YBF. The catch assigned to incorrect codes SOL and FLO accounted for les than 0.01 and 0.01% of the total catch respectively.

Total flatfish estimated catches in FLA 7 peaked in 1992–93, and catches have generally declined each year since then (Table 6). The main species caught in FLA 7, ESO and SFL, both show marked declines in catches since 1992–93.

FLA 7 contributed 20% of the total estimated flatfish catches in New Zealand between 1989–90 and 2001–02, and is the most important area for a number of flatfish species including GFL (34% of total estimated catch, SLF (36%), and TUR (69%) (see Table 3).

### 3.1.6 Reporting forms and fishing methods

The flatfish fishery is confined to inshore waters in depths less than 70 m and is predominantly fished by domestic inshore vessels. Nearly all (99%) of the estimated catch is reported on CELR forms with the remainder on TCEPR forms from larger vessels (Table 7). Most of the estimated catch is taken by bottom trawling (75%) and set netting (23%) (Table 8). Set netting is the most important method for YBF and BFL, and to a lesser extent GFL and SFL, which are generally found in estuaries or shallow coastal waters.

## 3.2 Landed catch

Fishers completing the Catch Landing section of the CELR, or CLR forms, are required to use the fishstock codes FLA 1, FLA 2, FLA 3, and FLA 7 listed in the fisheries reporting regulations. In practice, however, between 1989–90 and 2001–02, as well as the above fishstock codes most of the flatfish species codes have been used in combination with the fishstock number, e.g., LSO 3, ESO 2, YBF 1. Sixty different fishstock codes have been used, including a number of incorrect area suffixes that probably refer to Fishery Management Areas, e.g., BRI 5, GFL 6. Ninety-four percent of the landed catch, however, was landed using one of the correct FLA fishstock codes.

## 3.3 Processors' landing data

Data on flatfish landings by species and QMA were provided by five fish processors (Moana Pacific Fisheries Limited, Ngai Tahu Seafood Resources Limited, Otakou Fisheries Limited, Sanford Limited, and Seamart Wholesale Limited) and included landings from all four flatfish QMAs (FLA 1, FLA 2, FLA 3, and FLA 7). Data from the latter processor were not used in the analyses because they covered only a single year. The period that the data cover varied between processors. The percentages of each flatfish species processed by these companies are shown in Table 9.

FLA 1 – Processors' catch records indicate that YBF and SFL are the main species caught in FLA 1 with smaller contributions from ESO (Table 9). A mixed flounder species category (FLO) is also used and may include GFL, SFL, and YBF in unknown proportions. The proportions of the main species landed by processors are similar to those estimated by fishers (Figure 4).

FLA 2 – The processors' catch records indicate that ESO and LSO are the main species caught in FLA 2, with smaller contributions from TUR (Table 9). Moana Pacific has processed more ESO than LSO compared to Sanfords, although the latter company has processed comparatively small quantities

from FLA 2 and this is likely to be from the southern regions of FMA 2. A mixed flounder species category is also used and this may include GFL and SFL in unknown proportions. The proportions of the main species landed by the main processor in this region (Moana Pacific) differ from those estimated by fishers, in that SFL was represented in higher proportion by the latter (Figure 4). The use of the generic code FLA by fishers and FLO by the processor may partly explain this inconsistency (Figure 4).

FLA 3 – The records from three processors indicate that the proportions of each species processed in FLA 3 are similar (Table 9). ESO, LSO, and SFL are the main species caught in FLA 3 with smaller contributions from BRI. BFL represents a greater proportion of the landed catch from Ngai Tahu Fisheries, which is geographically closer to Te Waihora, the main BFL fishery in FLA 3. The proportions of the main species landed by processors are similar to those estimated by fishers (Figure 4).

FLA 7 – The records from two processor's indicate that LSO, ESO, and YBF are the main species caught in FLA 7 with smaller contributions from BRI and TUR (Table 9). The proportions of each species vary between the two processors, possibly because of the high proportion of processed catch by Sanfords recorded as FLA. The proportions of the main species landed by the processors are broadly similar to those estimated by fishers with some variation between processors.

### 3.4 Trawl survey flatfish catches

The proportion of each flatfish species caught from four *Kaharoa* inshore trawl survey time series (Figure 5) may be biased to some extent as most of the surveys were not shallow and the trawl gear used was not designed to target flatfish.

The east coast South Island surveys caught different proportions of flatfish species in the summer and winter surveys. In winter, catches were dominated by WIT and LSO, with relatively small catches of BRI, ESO, GFL, and SFL, and no TUR or BFL. The summer catches were dominated by WIT, ESO, LSO, and SFL, with relatively small catches of BFL, BRI, GFL, TUR, and YBF. This difference will be partly seasonal and partly a result of the shallower depth range of the summer surveys. However, the summer surveys are considered to be more representative of flatfish relative abundance than winter surveys. The proportions of the main species caught on the summer surveys are similar to fishers' estimates and to that processed in FLA 3, except for WIT which may be caught in similar proportions by fishers but is generally discarded

The west coast South Island survey catches were dominated by WIT, SFL, LSO, and ESO, with relatively small catches of BRI, GFL, and TUR, and no BFL (Figure 5). The proportions of the main species, except for WIT, are similar to fishers' estimates and to that processed in FLA 7 .

The east coast North Island survey catches were WIT, SFL, LSO, and ESO only (Figure 5). The proportions of the main species, except for WIT, are similar to fishers' estimates and to those processed in FLA 2.

## 4. DISCUSSION

The main objective of this report was to determine whether the flatfish catch effort data are suitable for catch per unit effort (CPUE) analysis. To address this I examined flatfish commercial catch data, processors' flatfish landing records, and *Kaharoa* trawl survey flatfish catches. Fishers' catch estimates, which are used in CPUE analyses, were compared with processors' and *Kaharoa* data to validate composition of landed flatfish species in the commercial fishery.

FLA was the species code most commonly used by fishers estimating catch in FLA 2, followed by FLA 1, FLA 7, and FLA 3, and overall accounted for about half of all flatfish landings between 1989–90 and 2001–02. The FLA was used exclusively in 1989–90, the first year of CELR and TCEPR forms, but its use declined as fishers became familiar with reporting forms and the species specific flatfish codes. Given that the use of the generic code FLA appears to have been consistent after 1992–93 with the notable exception of FLA 7, and is probably confined to the same fishers, the catches reported by distinct species proabably represent their relative contribution to total flatfish landings throughout New Zealand and in each QMA.

Assuming that flatfish processors are accepting all species that are caught and reported in the estimated catches by fishers, we would expect the proportions of each species to be similar between the two reporting methods within each QMA. The species composition of processors' flatfish landings and those from *Kaharoa* trawl surveys were generally similar to fishers' estimates and support the notion that estimated catches from CELRs are a reasonable reflection of actual flatfish species composition. Differences in species composition between processors in the same QMA are likely to be attributable to regional variations in species composition and/or proportions, reflecting the areas within each QMA where catches originate. For example, BFL catches were proportionally higher in FLA 3 for Ngai Tahu Fisheries than Otakou Fisheries, probably because of the proximity of the Ngai Tahu Fisheries factory to Te Waihora, a major black flounder fishery. We would need to examine all flatfish catches from all processors throughout New Zealand to make valid comparisons with estimated catches by fishers. Processing may also be subject to market forces and this could bias the species composition.

In conclusion, there is merit in conducting CPUE analyses for key flatfish species from each QMA which have been reported by species in the catch effort section of CELR forms. Analyses on FLA would be questionable as it comprises multiple species and any trend in one species might be confounded by that in other species. Species that are important contributors to catch in each QMA and might be candidates for catch effort analyses are:

| | |
|---|---|
| FLA 1 | YBF, SFL, GFL |
| FLA 2 | ESO, SFL |
| FLA 7 | GFL, SFL, TUR |
| FLA 3 | ESO, LSO, SFL, BFL, BRI |

MFish could improve the quality of the catch effort data by reminding fishers of their legal obligation to use species specific codes to record estimates of flatfish species caught rather than the generic code FLA.

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**Table 1: Flatfish species estimated catch (t) by species and fishing year for all flatfish QMAs combined. Data from CELR and TCEPR forms.**

| Year | BFL | BLF | BRI | ESO | FLA | FLO | GFL | LSO | SFL | SOL | TUR | WIT | YBF | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1989/90 | 0 | 0 | 0 | 0 | 2 750 | 0 | 0 | 0 | <1 | 0 | 0 | <1 | <1 | 2 750 |
| 1990/91 | 114 | 0 | 44 | 238 | 1 566 | 0 | 75 | 103 | 284 | 0 | 24 | 1 | 182 | 2 629 |
| 1991/92 | 23 | 0 | 45 | 384 | 1 530 | 0 | 64 | 151 | 336 | <1 | 64 | 2 | 209 | 2 809 |
| 1992/93 | 40 | 0 | 74 | 904 | 1 948 | 0 | 119 | 521 | 688 | 0 | 87 | 3 | 235 | 4 619 |
| 1993/94 | 24 | 0 | 54 | 836 | 1 457 | 0 | 94 | 446 | 755 | 0 | 63 | 2 | 249 | 3 980 |
| 1994/95 | 66 | 0 | 54 | 742 | 1 546 | <1 | 92 | 466 | 689 | 3 | 69 | 19 | 277 | 4 024 |
| 1995/96 | 93 | 2 | 48 | 730 | 1 523 | 12 | 50 | 607 | 515 | 15 | 61 | 0 | 154 | 3 810 |
| 1996/97 | 39 | <1 | 43 | 731 | 1 714 | 32 | 61 | 561 | 477 | 4 | 42 | 5 | 153 | 3 863 |
| 1997/98 | 14 | <1 | 33 | 550 | 1 718 | 29 | 59 | 714 | 452 | 4 | 39 | 1 | 162 | 3 775 |
| 1998/99 | 24 | 0 | 41 | 418 | 1 294 | 28 | 45 | 667 | 297 | 4 | 37 | 3 | 202 | 3 060 |
| 1999/00 | 61 | <1 | 44 | 355 | 1 075 | 7 | 36 | 408 | 247 | 2 | 30 | 1 | 267 | 2 534 |
| 2000/01 | 42 | 0 | 42 | 479 | 1 086 | 13 | 29 | 392 | 245 | 3 | 40 | 45 | 316 | 2 733 |
| 2001/02 | 85 | <1 | 27 | 495 | 1 098 | 9 | 35 | 271 | 199 | 1 | 41 | 28 | 210 | 2 498 |
| Total | 624 | 3 | 550 | 6 864 | 20 305 | 130 | 759 | 5 306 | 5 184 | 36 | 595 | 110 | 2617 | 43 084 |
| Percent | 1.4 | 0.0 | 1.3 | 15.9 | 47.1 | 0.3 | 1.8 | 12.3 | 12.0 | 0.1 | 1.4 | 0.3 | 6.1 | |

**Table 2: Flatfish species estimated catch (t) by species and fishing year for FLA 1. Data from CELR and TCEPR forms.**

| Year | BFL | BLF | BRI | ESO | FLA | FLO | GFL | LSO | SFL | SOL | TUR | WIT | YBF | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1989/90 | 0 | 0 | 0 | 0 | 572 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 572 |
| 1990/91 | 2 | 0 | 1 | 4 | 527 | 0 | 34 | 3 | 70 | 0 | <1 | 0 | 152 | 794 |
| 1991/92 | 3 | 0 | 1 | 3 | 581 | 0 | 28 | 5 | 79 | 0 | <1 | 0 | 157 | 858 |
| 1992/93 | 3 | 0 | 3 | 19 | 629 | 0 | 33 | 12 | 145 | 0 | 1 | 0 | 178 | 1 023 |
| 1993/94 | 5 | 0 | 2 | 12 | 492 | 0 | 22 | 10 | 299 | 0 | 1 | 0 | 214 | 1 057 |
| 1994/95 | 2 | 0 | 3 | 8 | 462 | 0 | 26 | 4 | 179 | <1 | <1 | <1 | 234 | 918 |
| 1995/96 | 3 | 0 | 2 | 13 | 314 | <1 | 4 | 6 | 83 | <1 | 1 | 0 | 116 | 543 |
| 1996/97 | 5 | 0 | 2 | 16 | 348 | <1 | 8 | 8 | 76 | 1 | 1 | 0 | 125 | 590 |
| 1997/98 | 2 | 0 | 1 | 10 | 314 | <1 | 12 | 8 | 62 | 1 | 1 | 0 | 132 | 542 |
| 1998/99 | 3 | 0 | 1 | 13 | 284 | <1 | 10 | 9 | 44 | <1 | 1 | 0 | 171 | 538 |
| 1999/00 | 3 | 0 | <1 | 8 | 323 | <1 | 10 | 4 | 64 | <1 | 1 | 0 | 236 | 650 |
| 2000/01 | 5 | 0 | 2 | 5 | 364 | <1 | 7 | 6 | 50 | <1 | 1 | 0 | 278 | 718 |
| 2001/02 | 1 | 0 | 1 | 6 | 273 | 0 | 5 | 6 | 27 | <1 | 2 | <1 | 189 | 509 |
| Total | 37 | 0 | 19 | 118 | 5 483 | 1 | 200 | 80 | 1 179 | 3 | 10 | 0 | 2 183 | 9 314 |
| Percent | 0.4 | 0.0 | 0.2 | 1.3 | 58.9 | 0.0 | 2.1 | 0.9 | 12.7 | 0.0 | 0.1 | 0.0 | 23.4 | |

**Table 3: Percent of total estimated catch of flatfish species reported from each QMA for catches between 1989–90 and 2001–02. Data from CELR and TCEPR forms.**

| 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 |

**Table 4: Flatfish species estimated catch (t) by species and fishing year for FLA 2. Data from CELR and TCEPR forms.**

| Year | BFL | BLF | BRI | ESO | FLA | FLO | GFL | LSO | SFL | SOL | TUR | WIT | YBF | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1989/90 | 0 | 0 | 0 | 0 | 253 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 253 |
| 1990/91 | 10 | 0 | <1 | 21 | 204 | 0 | 7 | 3 | 32 | 0 | 1 | 0 | 2 | 281 |
| 1991/92 | 12 | 0 | <1 | 38 | 180 | 0 | <1 | 4 | 21 | 0 | 3 | 0 | 3 | 262 |
| 1992/93 | 25 | 0 | <1 | 82 | 227 | 0 | 22 | 9 | 60 | 0 | 2 | 0 | 4 | 432 |
| 1993/94 | 12 | 0 | <1 | 43 | 227 | 0 | 15 | 12 | 83 | 0 | 1 | 0 | 3 | 396 |
| 1994/95 | 21 | 0 | <1 | 56 | 278 | <1 | <1 | 10 | 107 | 3 | 2 | 2 | 5 | 485 |
| 1995/96 | 8 | 0 | <1 | 51 | 297 | 2 | 2 | 14 | 76 | 10 | 2 | 0 | 3 | 466 |
| 1996/97 | <1 | 0 | <1 | 42 | 238 | <1 | 4 | 5 | 44 | 3 | 2 | 0 | 8 | 346 |
| 1997/98 | <1 | 0 | <1 | 83 | 313 | 1 | 9 | 9 | 79 | 2 | 3 | 0 | 12 | 512 |
| 1998/99 | 1 | 0 | <1 | 38 | 145 | 1 | 11 | 5 | 48 | 4 | 3 | 0 | 5 | 261 |
| 1999/00 | 1 | 0 | <1 | 20 | 127 | 1 | 10 | 2 | 35 | 2 | 1 | 0 | 3 | 205 |
| 2000/01 | <1 | 0 | <1 | 24 | 93 | <1 | 4 | 1 | 34 | 3 | 1 | 0 | 5 | 166 |
| 2001/02 | 0 | 0 | <1 | 23 | 98 | 1 | 2 | 1 | 30 | 1 | 2 | 1 | 4 | 162 |
| Total | 91 | 0 | 3 | 520 | 2 682 | 6 | 88 | 74 | 650 | 28 | 24 | 2 | 58 | 4 226 |
| Percent | 2.2 | 0 | 0.1 | 12.3 | 63.5 | 0.1 | 2.1 | 1.8 | 15.4 | 0.7 | 0.6 | 0.1 | 1.4 | 100 |

**Table 5: Flatfish species estimated catch (t) by species and fishing year for FLA 3. Data from CELR and TCEPR forms.**

| Year | BFL | BLF | BRI | ESO | FLA | FLO | GFL | LSO | SFL | SOL | TUR | WIT | YBF | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1989/90 | 0 | 0 | 0 | 0 | 1 320 | 0 | 0 | 0 | 0 | 0 | 0 | <1 | 0 | 1 320 |
| 1990/91 | 93 | 0 | 30 | 185 | 585 | 0 | 10 | 86 | 115 | 0 | 7 | <1 | 25 | 1 136 |
| 1991/92 | 8 | 0 | 20 | 219 | 563 | 0 | 19 | 125 | 70 | 0 | 9 | <1 | 37 | 1 069 |
| 1992/93 | 4 | 0 | 32 | 397 | 846 | 0 | 34 | 460 | 152 | 0 | 5 | 1 | 33 | 1 964 |
| 1993/94 | 3 | 0 | 25 | 519 | 513 | 0 | 37 | 389 | 139 | 0 | 12 | 1 | 22 | 1 659 |
| 1994/95 | 42 | 0 | 27 | 449 | 536 | <1 | 36 | 418 | 172 | 0 | 15 | 11 | 30 | 1 738 |
| 1995/96 | 80 | 2 | 33 | 468 | 598 | 10 | 12 | 553 | 157 | 4 | 15 | <1 | 30 | 1 962 |
| 1996/97 | 33 | <1 | 28 | 505 | 785 | 32 | 21 | 523 | 192 | <1 | 9 | 5 | 16 | 2 148 |
| 1997/98 | 10 | <1 | 21 | 325 | 737 | 28 | 23 | 671 | 134 | <1 | 15 | 1 | 16 | 1 979 |
| 1998/99 | 14 | 0 | 29 | 244 | 514 | 26 | 15 | 626 | 96 | 0 | 17 | 3 | 21 | 1 607 |
| 1999/00 | 57 | <1 | 38 | 290 | 446 | 6 | 3 | 393 | 87 | 0 | 19 | 1 | 25 | 1 366 |
| 2000/01 | 36 | 0 | 34 | 394 | 460 | 12 | 2 | 379 | 99 | <1 | 20 | 45 | 29 | 1 512 |
| 2001/02 | 83 | <1 | 24 | 406 | 423 | 8 | 3 | 256 | 93 | 0 | 11 | 26 | 15 | 1 347 |
| Total | 462 | 3 | 340 | 4 402 | 8 326 | 122 | 214 | 4 878 | 1 507 | 4 | 154 | 96 | 301 | 20 808 |
| Percent | 2.2 | 0.0 | 1.6 | 21.2 | 40.0 | 0.6 | 1.0 | 23.4 | 7.2 | 0.0 | 0.7 | 0.5 | 1.4 | 100 |

**Table 6: Flatfish species estimated catch (t) by species and fishing year for FLA 7. Data from CELR and TCEPR forms.**

| Year | BFL | BLF | BRI | ESO | FLA | FLO | GFL | LSO | SFL | SOL | TUR | WIT | YBF | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1989/90 | 0 | 0 | | 0 | 604 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 604 |
| 1990/91 | 9 | 0 | 12 | 27 | 250 | 0 | 23 | 11 | 66 | 0 | 15 | <1 | 3 | 417 |
| 1991/92 | <1 | 0 | 25 | 125 | 206 | 0 | 16 | 18 | 165 | <1 | 52 | 2 | 11 | 621 |
| 1992/93 | 8 | 0 | 39 | 406 | 246 | 0 | 28 | 41 | 331 | 0 | 78 | 2 | 20 | 1200 |
| 1993/94 | 4 | 0 | 26 | 264 | 226 | 0 | 19 | 36 | 234 | 0 | 49 | <1 | 10 | 868 |
| 1994/95 | 1 | 0 | 24 | 228 | 270 | 0 | 30 | 35 | 231 | 0 | 51 | 6 | 8 | 884 |
| 1995/96 | 2 | <1 | 13 | 197 | 314 | <1 | 32 | 35 | 199 | <1 | 43 | 0 | 4 | 840 |
| 1996/97 | 1 | 0 | 12 | 168 | 343 | <1 | 29 | 24 | 165 | 0 | 31 | 0 | 4 | 778 |
| 1997/98 | 2 | 0 | 11 | 132 | 353 | 1 | 15 | 26 | 177 | <1 | 20 | 0 | 2 | 741 |
| 1998/99 | 5 | 0 | 11 | 123 | 351 | <1 | 9 | 27 | 108 | 0 | 15 | 0 | 5 | 654 |
| 1999/00 | <1 | 0 | 5 | 36 | 178 | 0 | 13 | 9 | 61 | 0 | 10 | 0 | 2 | 313 |
| 2000/01 | 1 | 0 | 7 | 56 | 169 | 0 | 17 | 5 | 62 | 0 | 17 | <1 | 4 | 338 |
| 2001/02 | <1 | 0 | 3 | 61 | 304 | <1 | 26 | 8 | 49 | 0 | 25 | 1 | 2 | 479 |
| Total | 34 | <1 | 188 | 1824 | 3814 | 1 | 257 | 274 | 1848 | <1 | 408 | 12 | 76 | 8736 |
| Percent | 0.4 | 0.0 | 2.2 | 20.9 | 43.7 | 0.0 | 2.9 | 3.1 | 21.2 | 0.0 | 4.7 | 0.1 | 0.9 | |

**Table 7: Flatfish species estimated catch (t) by reporting form (CELR, TCEPR) for all QMAs combined.**

| Year | BFL | BLF | BRI | ESO | FLA | FLO | GFL | LSO | SFL | SOL | TUR | WIT | YBF | Total | Percent |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CELR | 620 | 3 | 546 | 6 828 | 20 065 | 129 | 755 | 5 033 | 5 139 | 36 | 588 | 104 | 2 616 | 42 462 | 98.6 |
| TCEPR | 2 | | 4 | 36 | 240 | 1 | 4 | 273 | 45 | 0 | 7 | 6 | 0 | 617 | 1.4 |
| Total | 622 | 3 | 550 | 6 864 | 20 305 | 130 | 759 | 5 306 | 5 183 | 36 | 595 | 110 | 2 616 | 43 080 | |

**Table 8: Flatfish species estimated catch (t) by fishing method for all QMAs combined. BT, bottom trawl; SN, set net; DS, Danish sein. Data from CELR and TCEPR forms.**

| Year | BFL | BLF | BRI | ESO | FLA | FLO | GFL | LSO | SFL | SOL | TUR | WIT | YBF | Total | Percent |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BT | 177 | 2 | 539 | 6 747 | 14 181 | 126 | 479 | 5 236 | 3 744 | 23 | 575 | 104 | 317 | 32 251 | 75.1 |
| SN | 431 | 1 | 10 | 94 | 5 812 | 4 | 270 | 63 | 1 065 | 8 | 8 | 2 | 2 292 | 10 059 | 23.1 |
| DS | 7 | 0 | 0 | 3 | 128 | 0 | 3 | 1 | 328 | 4 | 0 | 0 | 1 | 475 | 1.2 |
| 0ther | 10 | 0 | 1 | 19 | 184 | 0 | 7 | 7 | 47 | 1 | 12 | 5 | 7 | 299 | 0.6 |
| Total | 624 | 3 | 550 | 6 864 | 20 305 | 130 | 759 | 5 306 | 5 184 | 36 | 595 | 110 | 2 617 | 43 084 | |

**Table 9: Percent of total catch of flatfish species processed in FLA 1, FLA 2, FLA 3, and FLA 7 by processors. (Moana Pacific Fisheries Ltd, 1992–93 to 2001–03; Sanfords Ltd, 1992–93 to 2000–01; Ngai Tahu Seafood Resources Ltd, 1999–2000 to 2001–02; Otakou Fisheries Ltd, 1992–93 to 1995–96).**

| Processor | QMA | BFL | BRI | ESO | FLA | FLO | GFL | LSO | SFL | TUR | YBF | Total percent |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Moana Pacific | FLA 1 | 0.0 | 0.6 | 9.7 | 0.0 | 39.6 | 0.0 | 0.1 | 23.6 | 0.0 | 26.4 | 100 |
| Moana Pacific | FLA 2 | 0.0 | 0.7 | 46.9 | 0.0 | 43.3 | 0.0 | 6.9 | 0.5 | 1.6 | 0.1 | 100 |
| Sanfords | | 0.0 | 7.3 | 17.1 | 1.0 | 17.4 | 0.0 | 47.5 | 9.5 | 0.3 | 0.0 | 100 |
| Sanfords | FLA 3 | 0.0 | 5.4 | 34.0 | 6.2 | 5.1 | 0.0 | 36.8 | 12.3 | 0.1 | 0.1 | 100 |
| Ngai Tahu Seafood | | 11.8 | 5.3 | 43.3 | 0.0 | 2.7 | 0.0 | 26.5 | 8.7 | 0.9 | 0.7 | 100 |
| Otakou Fisheries | | 4.2 | 0.0 | 43.0 | 0.0 | 0.0 | 0.0 | 40.6 | 12.1 | 0.1 | 0.0 | 100 |
| Sanfords | FLA 7 | 0.0 | 3.8 | 22.8 | 24.9 | 10.4 | 0.0 | 24.7 | 12.5 | 0.2 | 0.6 | 100 |
| Ngai Tahu Seafood | | 0.0 | 2.7 | 16.1 | 0.0 | 0.0 | 0.0 | 54.2 | 0.1 | 3.8 | 23.0 | 100 |

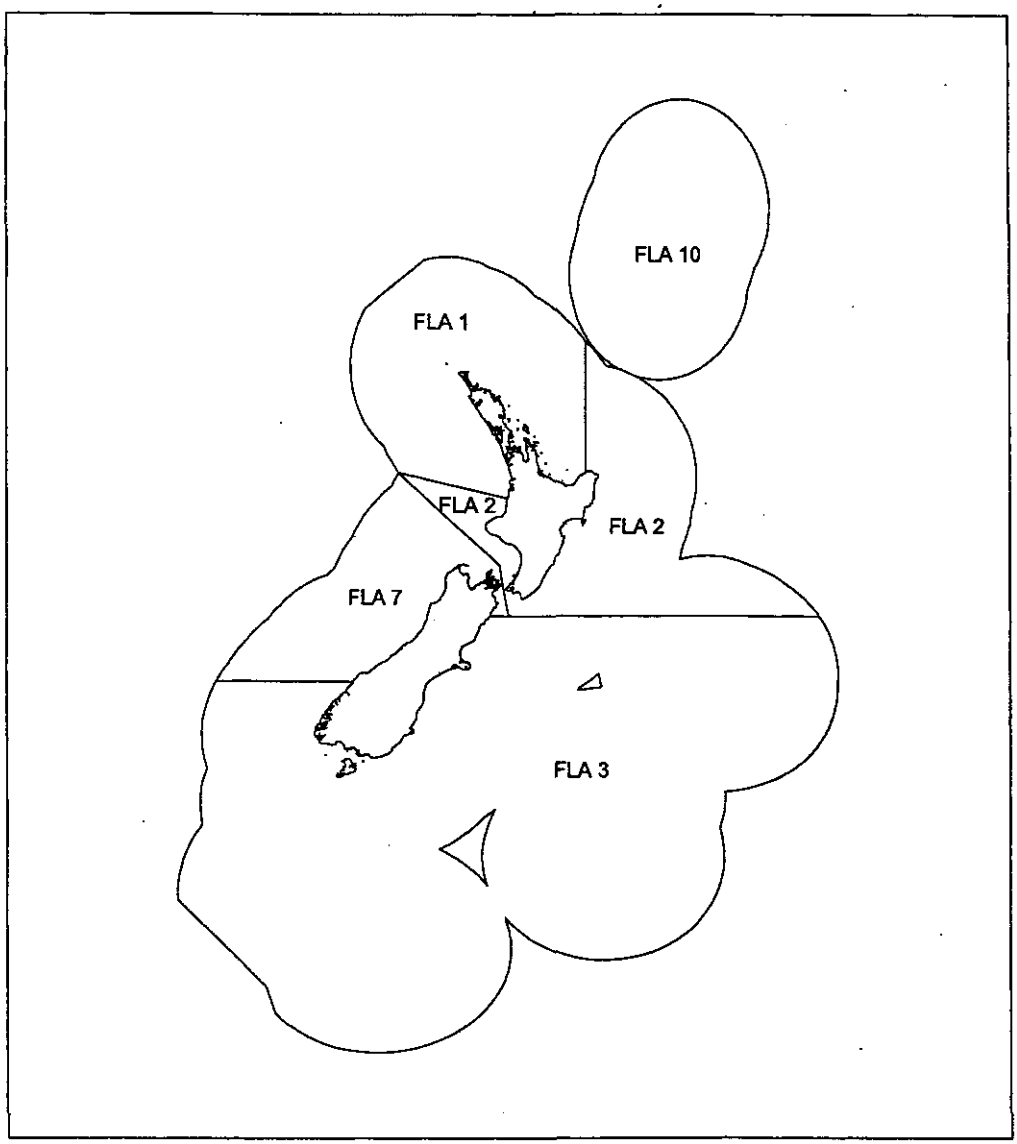



**Figure 1: Flatfish Quota Management Areas.**

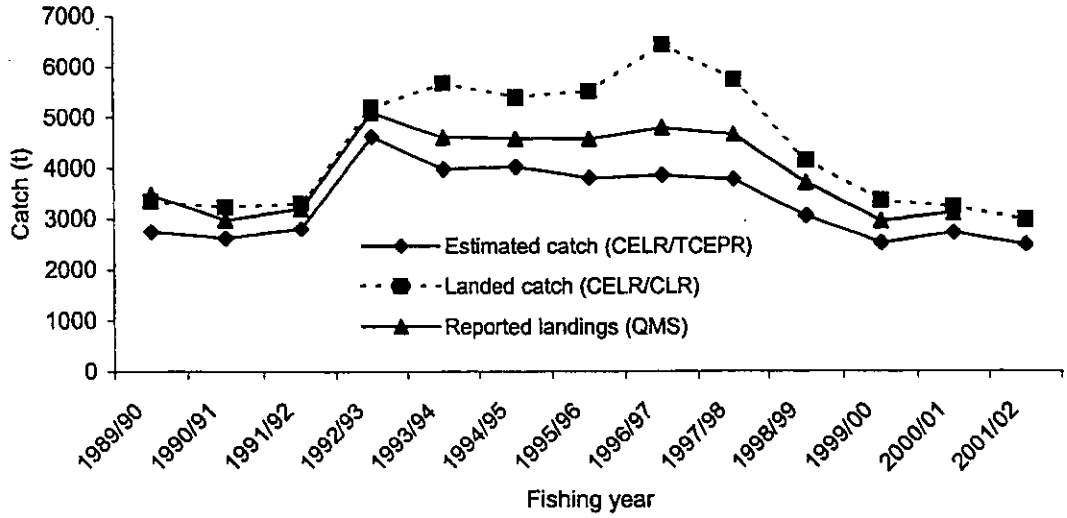



**Figure 2: Catch of flatfish (all species) for all QMAs combined from three sources: 1) estimates from CELRs and TCEPRs; 2) landings from CLRs and CELRs; 3) reported landings from QMS (from Annala et al. 2002).**

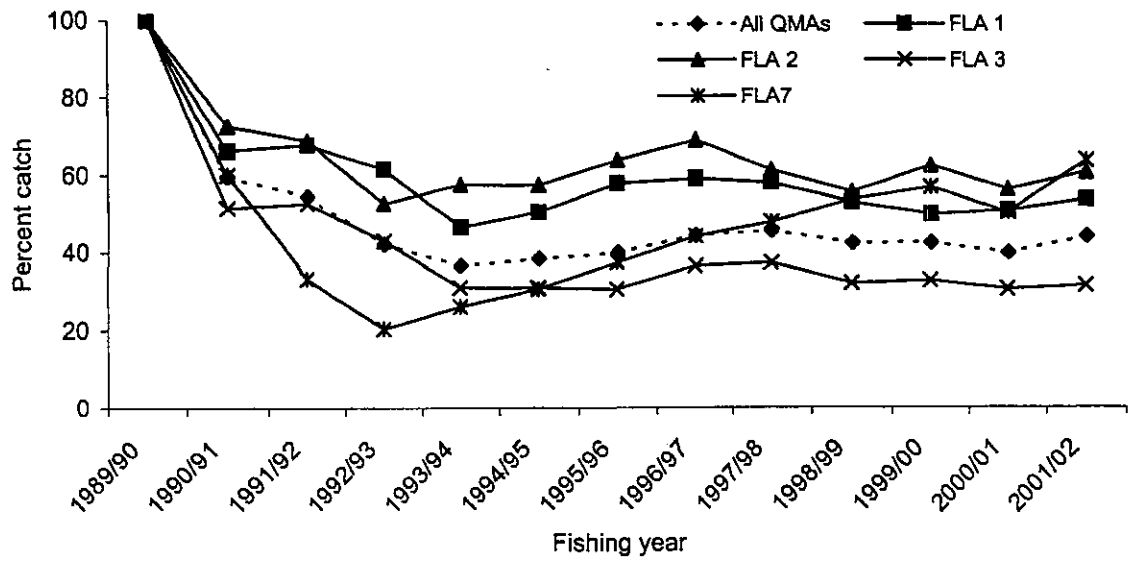



**Figure 3: The percentage of estimated flatfish catch reported by species code FLA for all QMAs combined, and for each QMA separately from 1989–90 to 2001–02.**

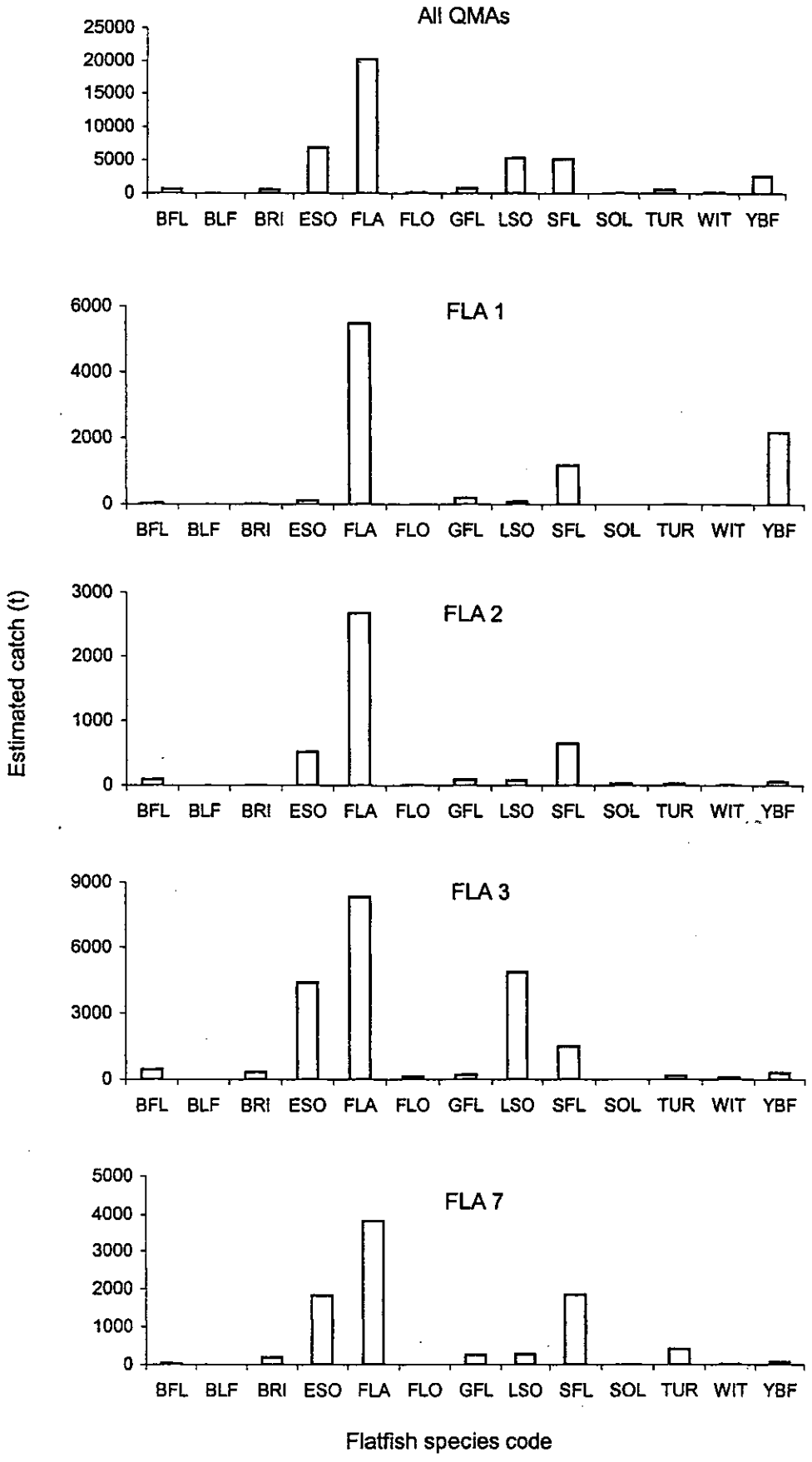
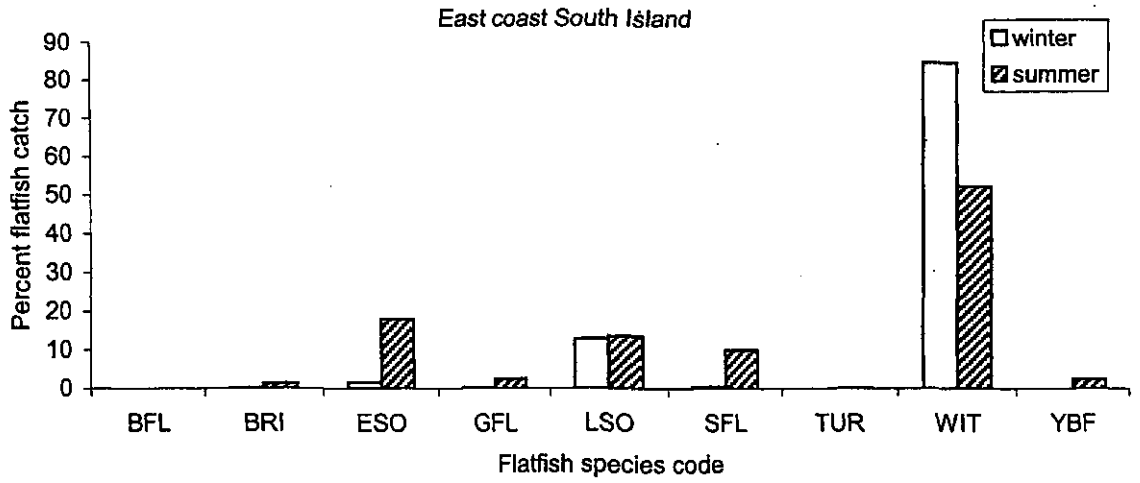
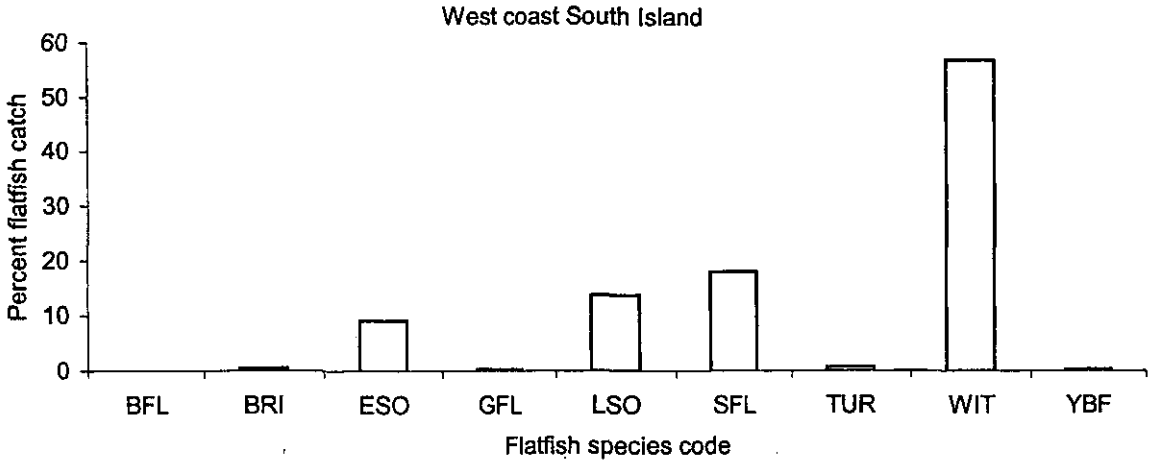



**Figure 4: Estimated catches of flatfish species codes for all QMAs combined and individually for each QMA. Data are from CELRs and TCEPRs.**



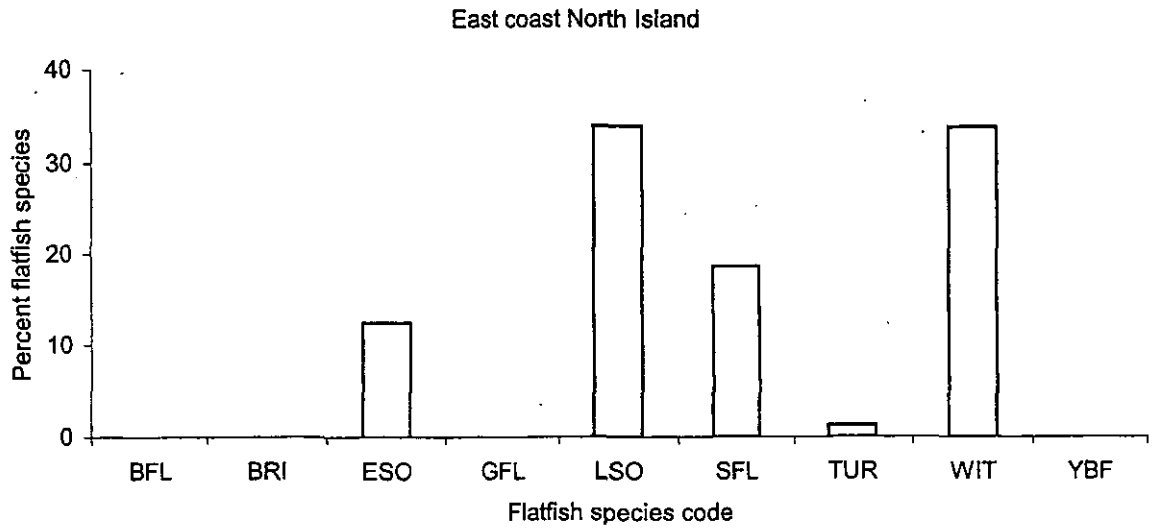




**Figure 5: Percent of flatfish species catch from trawl survey time series in east coast South Island, west coast South Island, and east coast North Island.**

**Appendix 1: Allocation of catches by statistical area to flatfish Quota Management Areas.**

FLA 1

- General statistical areas 001 to 010, 009H, 042 to 048, and 101 to 107.
- Rock lobster statistical areas 901 to 908 and 937 to 939.
- North Island eel statistical areas 1, 2, 3, and 5.
- West Coast scallop statistical areas 9A to 9D.
- Northland scallop statistical areas 1A to 1S.
- Hauraki/Great Barrier – Bay of Plenty scallop statistical areas 2A to 2Y.

FLA 2

- General statistical areas 011 to 016, 037, 039, 040, 041, 201 to 206, and 801.
- Rock lobster statistical areas 909 to 915 and 934 to 936.
- North Island eel statistical areas 4 and 6 to 12.

FLA 3

- General statistical areas 018 to 032, 049 to 052, 301 to 303, 401 to 412, 501 to 503, and 601 to 625.
- Rock lobster statistical areas 917 to 927 and 940 to 943.
- South Island eel statistical areas AR, AS1, AS2, AT, AU, AV, AW, AY, and AZ.
- Paua statistical areas A1 to A17, B1 to B16, and D1 to D11.
- Foveaux Strait dredge oyster statistical areas A, C5, E6, E7, F8, F9, G8, G9, H, K, L, and S5 to S8.
- Chatham Islands scallop and dredge oyster statistical areas 4A to 4H.

FLA 7

- General statistical areas 017, 033 to 035, 036, 038, and 701 to 706.
- Rock lobster statistical areas 916 and 928 to 933.
- South Island eel statistical areas AN, AP, AQ, and AX.
- Nelson Marlborough scallop and dredge oyster statistical areas 7A, 7AA, 7B, 7BB, 7C, 7CC, 7D, 7DD, 7E, 7EE, 7F, 7FF, 7G, 7GG, 7H, 7HH, 7I, 7II, 7J, 7JJ, 7K, 7KK, 7L, 7LL, 7M, 7MM, and 7N to 7R.

The fishstock codes for QMA 10 and ET were excluded.