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Catch per unit effort (CPUE) analyses and characterisation of the North Island commercial freshwater eel fishery, 1990–91 to 2011–12

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The New Zealand commercial freshwater eel fishery developed in the late 1960s and landings consist of both the endemic longfin eel (*Anguilla dieffenbachii*), and the shortfin eel (*A. australis*) which is also found in southeast Australia. Landings from the north of the North Island can include the occasional Australian longfin eel (*A. reinhardtii*). The North Island fishery has been controlled under a Quota Management System (QMS) since 2004–05 and is administered by the Ministry for Primary Industries (MPI). Catch per Unit Effort (CPUE) is one of the management tools used by MPI to monitor the fishery.

This report presents the results of a CPUE analyses for the North Island commercial freshwater eel fishery) for the fishing years 1991 to 2012 (i.e., fishing years 1990–91 to 2011–12). Analyses were carried out for shortfin and longfin eels individually for all twelve North Island eel statistical areas (ESAs AA–AM). Standardised CPUE analyses were carried out for pre- and post-QMS, and the continuous data sets, to investigate whether the arrival of new entrants and the loss of existing fishers following introduction of North Island eels into the QMS in 2004–05 influenced CPUE trends. Many “new entrants” were fishers that had previously fished under somebody else’s permit, but then obtained their own permit with the introduction to the QMS. In situations where a fisher fished for somebody else prior to the QMS, obtained their own permit with the introduction of North Island eels to the QMS, and the original permit holder ceased operating, the two permit numbers were linked for the purposes of the CPUE analysis.

Trends in pre- and post-QMS standardised CPUE series were very similar to those for the corresponding periods in the continuous series in each ESA. The continuous series were therefore accepted by the Eel Working Group as indices of abundance.

Groomed data sets used for the CPUE analyses were based on estimated catch, and these represented 81% and 72% of the landed shortfin and longfin catch, respectively. Differences in estimated and landed catch for each species were most pronounced prior to 2002 and were largely due to a significant portion of the catch being reported as unidentified eel (EEU), as well as the removal of some suspect records (i.e., from the analysis data set) which had been recorded on catch effort landing returns (CELRs). Catch and effort associated with EEU records were not used in the CPUE analysis.

Throughout the 22 year North Island time series, shortfin groomed estimated catches were overall more than twice that of longfin, but over the last five years as longfin catch has decreased, shortfin accounted for 84% of the catch. Shortfin is the dominant species with respect to catch proportions in all ESAs except Rangitikei-Wanganui (AH), Wellington (AM), and Taranaki (AJ) which have yielded more longfin. Hauraki (AC) yielded the highest proportion of shortfin in the catch at more than 5 to 1. The largest contributors continue to be the Waikato (AD) with 27%, and Northland (AA) with 20% of the North Island eel catch. In terms of total catch, the key areas for longfin since 1991 have been, in descending order, Waikato (AD), Northland (AA), Rangitikei-Wanganui (AH), and Taranaki (AJ), which together represent about 61% of the total longfin catch. Similarly, for shortfin, the key areas have been Northland (AA), Waikato (AD), Hawke’s Bay (AG), and Auckland (AB), which together represent 64% of the total shortfin catch.

Standardised and unstandardised CPUE analyses were carried out separately for each species (i.e., longfin and shortfin) using effort and estimated catches recorded by core fishers. Standardised CPUE analyses were done using a Generalised Linear Model (GLM), where the response variable was daily catch. Zero catches were ignored. Predictor variables permit number, number of net lifts, and month were accepted by all models, with lifts and permit number explaining most of the variation. The results

indicate that catch rates are very dependent on fisher experience and/or ability, number of nets used, and season.

Shortfin

In general, CPUE trends for shortfin eels in each ESA, were either flat or declining from 1991 to 2005, followed by strong increases likely to be the result of reduced catches associated with the introduction of North Island eels to the QMS. The exception was Northland (ESA AA), where CPUE steadily increased throughout the time series

The non-reporting of the voluntary return of legal sized shortfin under 300 g alive to the water, and the introduction of the voluntary code of practice to use 31 mm escape tubes (legally 25 mm) from 2010–11 are likely to have biased shortfin CPUE estimates low, since about 2009–10.

Longfin

For longfin there was generally less data than for shortfin for most areas and indices were often more variable or associated with wider confidence intervals. In general, apart from Rangitikei-Whanganui (ESA AH), which showed a steadily declining CPUE trend throughout the time series, CPUE initially declined, and then was either flat with no clear trend or there was an increase in CPUE between 2005 and 2011. Most increases in CPUE were only slight.

The longfin fishery appears to be showing indications of a halt and in some cases a reversal in the declines in CPUE that have been observed in previous analyses. The non-reporting of legal sized and over 4 kg longfins returned alive to the water, and the voluntary code of practice to use 31 mm escape tubes (legally 25 mm) from 2010–11 suggest that the longfin CPUE estimates are conservative, at least since about 2007–08.

1. INTRODUCTION

This report presents the results of a catch-per-unit-effort analysis (CPUE) for the commercial freshwater eel fishery (*Anguilla australis* and *A. dieffenbachii*) for all North Island eel statistical areas (ESA) for the fishing years 1990–91 to 2011–12, and updates previous similar analyses (Beentjes & Bull 2002, Beentjes & Dunn 2003a, 2003b, 2010).

1.1 Commercial fishery

The commercial freshwater eel fishery in New Zealand developed in the late 1960s and landings consist of both the endemic longfin eel (*Anguilla dieffenbachii*), and the shortfin eel (*A. australis*) which is also found in southeast Australia. Landings from the north of the North Island can include the occasional Australian longfin eel (*A. reinhardtii*).

Historical catches

Total New Zealand commercial eel catches peaked in 1972 at about 2100 t. From 1972 to 1999 catch fluctuated somewhat, but there was no clear trend, and annual catches averaged about 1300 t (Figure 1). Since 1999, however, New Zealand catches progressively declined to a low of 520 t in 2008–09 before increasing again over the last three years to 752 t in 2011–12 (Ministry for Primary Industries 2013). North Island catches have contributed between 50 and 70% of the New Zealand total eel catch, and over the last ten years the average has been 59%.

Shortfin has consistently been the dominant species in the North Island, representing, on average, about 70% of the catch, increasing to 79% over the last ten years (Figure 1). Shortfin catches declined overall from 1995–96 until 2008–09 in the North Island, but have increased in the last few years (Figure 1). Similarly, longfin catches declined from 1990–91 to 2008–09 and have since stabilised.

In the South Island there is little difference between longfin and shortfin catches until 2003, but over the last 10 years shortfin landings significantly exceeded those of longfin with the exception of 2011–12. Both South Island shortfin and longfin catches declined after about 1993–94, although the decline has been most marked for longfin. Over the past ten years shortfin catch has been remarkably stable whereas longfin catch has been variable (Figure 1).

The trends of declining catches preceded the introduction of eels into the Quota Management System (QMS) in both the North (2004–05) and South Islands (2000–01), possibly because permits were restricted, and progressively these fishers retired.

The North Island fishery is dominated by shortfin eels, and although longfin is caught throughout the North Island, it only approaches 50% or more of the catch in Rangitikei-Wanganui (AH), Taranaki (AJ), and in catchments of Waikato (AD) that drain westward to the coast (Figure 2) (Beentjes 2005, 2008a, 2008b, 2013).

Quota Management System (QMS)

The South Island eel fishery was introduced into the Quota Management System (QMS) in 2000–01, with five Quota Management Areas (ANG 11 to ANG 16) and Total Allowable Commercial Catches (TACC) set for both species combined (Table 1, Figure 3). TACCs have been consistently under-caught in all South Island QMAs, with the exception of ANG 13 (Te Waihora), which was 100% caught between 2003–04 and 2008–09 (Ministry for Primary Industries 2013). The combined South Island TACC (420 t) has been between 51 and 78% caught over the last seven years with the highest catch in the most recent year (2011–12). (Figure 1). The Chatham Island eel fishery was introduced into the QMS in 2003–04 with single QMAs for each species (SFE 17 and LFE 17) and landings are insignificant. The North Island eel fishery was introduced into the QMS in 2004–05 with four separate QMAs each for shortfin and longfin (LFE 20–23 and SFE 20–23). The TACCs were subsequently reduced for all North Island stocks in 2007–08, overall by 58% for longfin (193 to 81 t for all stocks combined) and 26% for shortfin (457 to 337 t, for all stocks combined). The 2011–12 fishing year is the first year that TACCs have been caught for all North Island shortfin and longfin stocks (Ministry for Primary Industries 2013) (Figure 1).

1.2 Reporting

The introduction of the Catch Effort Landing Return (CELR) in October 1989 replaced the Fisheries Statistics Unit (FSU) eel returns. Data quality for the first two years of the CELR system was poor (Jellyman 1993), and the data from 1989–90 were deemed unsuitable for inclusion in the analysis. The CELR form was in turn replaced by an Eel Catch Effort Return (ECER) and an Eel Catch Landing Return (ECLR) on 1 October 2001. Changes included dedicated fields for shortfin and longfin estimated catch (i.e., no provision to include unidentified eels EEU), the removal of target species field, and inclusion of a field for name of the catcher (i.e., fisher ID). The reporting of EEU was prohibited by MPI in about 2000, pre-dating the introduction of the ECER by two years. Before 2000, EEU was commonly used, particularly in the North Island where the proportion of total eel catch recorded as EEU was as much as 83% of the eel catch in ESA AD (Waikato). When landing the catch to the LFR (Licensed Fish Receiver) the fisher completes the ECLR (Eel Catch Landing Return). On the ECLR the catch is entered by fish stock; for the North Island these are SFE 20–23 and LFE 20–23, and the South Island SFE 11–16 and LFE 11–16. Note that for eels caught in the South Island, ANG codes are not used on the ECLRs, but are used on Monthly Harvest Returns (MHR).

Statistical areas for reporting catch effort data were changed from numeric codes (1–23) to alpha codes (AA–AZ) in July 2000 (see Figure 2, Table 1). In this report we refer to ESAs by the current alpha codes, although some previous analyses used the numeric codes. Table 1 shows the relationship between ESAs (numeric and alpha), QMAs, and area names.

The data used in the CPUE analyses presented in this report include data from CELR (1990–91 to 1999–2000) and ECER (2001–02 to 2011–12) forms.

1.3 Previous catch effort analyses

Catch location associated with effort on CELRs/ECERs is recorded as ESA (Figure 3), which generally include multiple catchments. Hence, assuming there are sufficient data, the highest spatial resolution at which CPUE analyses can be carried out is at the level of the ESA.

Previous New Zealand commercial eel fishery CPUE analyses include:

1. **All ESAs throughout New Zealand for 1990–91 to 1998–99** (Beentjes & Bull 2002). Results indicated that in some areas abundance of longfin was declining. This was most apparent in combined ESAs AB and AC (Auckland, Hauraki), AH to AM (Rangitikei-Wanganui, Taranaki, Manawatu, Wairarapa, Wellington), AT to AV (south Canterbury, Waitaki, Otago), and particularly ESA AW (Southland).
2. **ESAs of concern (highlighted from the first analyses) for 1990–91 to 2000–01** (Beentjes & Dunn 2003a). Results showed continuing declines in longfin abundance.
3. **North Island ESA groupings corresponding to QMAs 20, 21, 22, and 23, for 1990–91 to 2002–03 (before North Island eels were introduced into the QMS in 2004–05)** (Beentjes & Dunn 2003b)**.** The trend of declining longfin abundance was evident in all four QMAs.
4. **All South Island ESAs for 1990–91 to 2005–06** (Beentjes & Dunn 2008)**.** Both longfin and shortfin eels showed a general increase in CPUE across most ESAs since about 2000. For some areas this represented a reversal of the trend of declining CPUE apparent from the previous South Island CPUE analyses.
5. **All North Island ESAs for 1990–91 to 2006–07** (Beentjes & Dunn 2010)**.** Shortfin did not show any consistent trend in CPUE across ESAs and were regarded as relatively stable. Longfin in contrast showed strong evidence of earlier declines in CPUE in all ESAs, but with indications of a flattening or reversal of these trends in recent years.

6. **All South Island ESAs for 1990–91 to 2009–10** (Beentjes & Dunn 2013). For the data rich areas (AX, AV, AW, and AS1), pre-QMS shortfin indices showed declines in CPUE for ESAs AV and AW, but in AX the initial decline was followed by a sharp increase in CPUE for the most recent years. Post-QMS, shortfin showed trends of increasing CPUE in all areas and that was most marked in AW and AS1. For the data rich areas (AX, AV, AW, and AS1), pre-QMS longfin indices showed clear declines in CPUE for ESAs AV and AW, but in AX CPUE increased over time. Post-QMS, longfin showed clear trends of increasing CPUE in AX and AV and to a lesser extent in AW.

1.4 Specific objective

To analyse CPUE trends in the North Island commercial eel fisheries (LFE20, LFE21, LFE22, LFE23, SFE20, SFE21, SFE22, SFE23) using data up to the end of the fishing year 2011/12.

2. METHODS

2.1 Catch effort data extraction

Estimates of catch and effort for each day's fishing were recorded on CELR forms up to 30 September 2001, and then on ECERs after this time, although there was a transition period in early 2001–02 when either form was accepted. The catch effort data used in this report were extracted from the Ministry for Primary Industries Catch Effort Database *Warehou*, and for each daily record from fishing years (1 October to 30 September) 1990–91 to 2011–12 for all North Island ESAs, the following variables were extracted.

CELR (1990–91 to 2001–02)

- Date nets were lifted
- Permit number (encoded)
- Vessel registration number
- Location landed
- Method
- Form number
- Eel statistical area (ESA)
- Number of net lifts
- Nets in the water at midnight
- Target species
- Total weight (weight of shortfin, SFE; longfin, LFE; unidentified, EEU; and bycatch)
- Weight of individual species (includes SFE, LFE, EEU, and bycatch species)

ECER (2001–02 to 2011–12)

- Date nets were lifted
- Permit number (encrypted*)
- Method
- Eel statistical area (ESA)
- Number of net lifts
- Estimated catch weight of shortfin (SFE)
- Estimated catch weight of longfin (LFE)

*the encrypted permit number represents the Ministry of Fisheries *Permit Holder FIN Number* (CELR) and *Client Number of Permit Holder* (ECER). A permit holder is entitled to employ others to fish on their permit, and hence one permit number may have catch landed from more than one fisher. It is more usual, however, for the permit holder to also be the person listed as the catcher on ECERs. The catcher has only been recorded since 2001–02 when ECERs were introduced.

In the current analyses we extracted data for the years 2007–08 to 2011–12 (five years) for all North Island ESAs and appended these to the existing groomed data sets from previous analyses creating a time series for each ESA from 1990–91 to 2011–12 (22 years) (Table 2).

In this report, henceforth, fishing years (1 October to 30 September) are referred to by the year when the fishing season ends, e.g., 1990–91 is referred to as 1991.

2.2 Environmental variables

Mean daily river flow data for some important rivers from, or near each ESA were obtained from regional councils and the NIWA hydrological database (NIWA Water Resources and Climate Archive) (Appendix 1). Moon phase was included as a factor to account for possible changes in catchability with changes in the lunar cycle. The relative phase (0–1) of the moon (moon cycle) was determined for each record in the data set based on the date of each record, using an algorithm from Meeuse (1998). Both river flow and moon phase were included as predictor variables because they have been shown to affect eel catch rates (Jellyman 1991, Beentjes & Willsman 2000, Beentjes & Bull 2002, Beentjes & Dunn 2008, 2010). When river flow from more than one river per area was used in standardised CPUE analyses, they were treated as separate variables.

2.3 Data error checking

CELR catch effort data were error checked and groomed using the criteria of Beentjes & Willsman (2000). Errors from CELR data were extensive and were corrected where possible, or the record was deleted. The extent and type of errors and the percent of records remaining after grooming up to 2002–03 are documented elsewhere (Beentjes & Bull 2002, Beentjes & Dunn 2003a, 2003b). From 2003–04 to 2006–07 when fishers were transitioning between CELRs and ECER forms, there were few records removed compared to the earlier data (Beentjes & Dunn 2010). For the current analyses there were very few deletions and virtually all data were retained.

2.4 Linking permits

The previous North Island CPUE analyses determined that some of the new entrants, post introduction of North Island eel stocks into the QMS in 2004–05, were not new to the fishery, i.e., they had fished for existing permit holders during the permit moratorium and following introduction of eels into the QMS began fishing under their own permit entity (Beentjes & Dunn 2010). These fishers were all new entrants that had fished for someone else pre-QMS and if they were the only fisher that had landed catch under a pre-QMS *Client_name*, and that client did not land catch pre- and post-QMS, they were linked in the analyses, i.e., new entrant *Client_key* was changed to the existing *Client_key* of the previous employer. In all, there were 16 linkages made where existing permit entities were combined with permit entities that first appeared in 2004–05 (Beentjes & Dunn 2010). These linkages were retained in the current analyses.

2.4.1 South Island permits in data

Inspection of the unencrypted data during the previous analyses revealed a number of South Island fishers that had been recorded as fishing in the North Island (Beentjes & Dunn 2010). After contacting some of these individuals and speaking with MPI at this time, it was clear that this was implausible and more likely an error in reporting of statistical area or data punching. This resulted in data from 10

South Island permit holders being excluded from the analysis in 2001–02 and 2002–03, accounting for 76 t of catch (0.7% of the total data in the dataset). The bulk of this misreporting was from ESAs AA (70%), AB (18%), and AM (10%).

2.5 Continuous or pre- and post-QMS analyses

The last South Island CPUE analyses was split between pre- and post-QMS data sets because of the discontinuity of fishers following the introduction of South Island eels into the QMS in 2000–01 (Beentjes & Dunn 2013). Unlike the North Island, it was not possible to link the identity of South Island fishers pre- and post-QMS because the ECER form, which includes a field identifying fishers that landed the catch, did not come into effect until 2001–02, a year after South Island eels were introduced into the QMS. Despite linking permits in the North Island, following the introduction into the QMS in 2004–05, there is still a clear drop in numbers of existing fishers and the appearance of new entrants (Appendix 2). To determine whether models spanning the entire period (1991–2012) for each statistical area were able to reliably estimate fisher coefficients over the transition, separate pre- and post-QMS CPUE series were estimated for each species and statistical area and then overlaid on the respective full series.

2.6 Analysis of CPUE data

2.6.1 Unstandardised CPUE analyses

Unstandardised CPUE analyses were carried out for each data set for SFE and LFE. It is presented in two forms: 1) as total catch/total lifts per year for records where shortfin and longfin sum to the total eel catch (excludes zeros associated with EEU catch) using all raw data, and 2) as total catch per year for core fishers (see below), which is plotted alongside the standardised CPUE indices.

2.6.2 Standardised CPUE analyses

Core fishers

For each ESA, standardised CPUE analyses were conducted separately for SFE and LFE. A selection criterion was applied to each dataset restricting data analysis to core fishers (identified by permit number). Shortfin core fishers were defined as those that 1) caught shortfin eels in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Longfin core fishers were defined in the same way as shortfin but using only longfin catch data.

The GLM model

Estimates of year effects and associated standard errors were obtained using a forward stepwise Generalised Linear Model (GLM) (McCullagh & Nelder 1989), with daily catch modelled as the response variable. Using daily catch as the response variable and lift as a possible predictor allows the model to consider non-linear relationships between catch and effort. Records with a catch of zero were not included in the analyses. Whilst zero catches can provide useful information in some fisheries, it is generally not so in eel fisheries for following reasons:

1. Fishers that record zero for one species are often fishing habitat preferred by the other, and without including habitat or target species as explanatory variables the models are unable to account for this behaviour. Unfortunately neither habitat nor target species are recorded on the catch effort forms.
2. Where catches comprise a mix of the two eel species, small proportions of one species are likely to be recorded as zeros since fishers tend to estimate catches based on a visual inspection of unsorted catches.

3. There are many records before 2002 where eels were reported as EEU (unspecified species) and hence for these records shortfin and longfin catch are given a value of zero in the input data even though it is clearly not zero but unknown.

The GLM model used the log-normal transformation of positive daily catch. This implies a multiplicative model, i.e., the combined effect of two predictors is the product of their individual effects. The predictor variables used in the model were fishing year, permit number (fisher), number of lifts, month (season), river flow (for selected rivers within each ESA analysis), and moon phase. Variables were treated as categorical, except number of lifts, daily mean river flow, and moon phase, which were entered as continuous variables. Continuous variables were typically fitted as a 3-degree polynomial, with the number of lifts and river flow fitted as a 3-degree polynomial in log space.

A stepwise regression procedure was used to fit the GLM of CPUE (daily catch) on these predictor variables. The relative year effect from the model was then interpreted as the CPUE index, and presented using the canonical form, scaled to have a mean of 1.0. Model fits were investigated using standard residual diagnostics. Plots of model residuals and fitted values were investigated for evidence of departure from model assumptions. Influence step plots and coefficient-distribution-influence plots (CDI), were used to interpret the standardisation effects of explanatory variables (Bentley et al. 2012).

The stepwise fitting method began with a basic model in which the only predictor was the year, and iteratively included predictors until there was insufficient improvement in the model. For all analyses, the improvement in the residual deviance, i.e., (new deviance – old deviance) / (saturated deviance – null deviance), and termed R^2 was used as the criterion for including predictors. At each step, the predictor with the greatest improvement in R^2 was included, providing that its inclusion resulted in an improvement in R^2 of at least 0.5%.

The inclusion of first order interaction terms was considered, but it was found that they generally required many additional degrees of freedom and often appeared to have a spurious significance. Interactions tended to be between permit number (typically the most important predictor) and the other variables. These interactions appeared to be a reflection of variability in predictor variables among fishers rather than relative changes in the CPUE index.

Data for pre- and post-QMS indices plotted on the same figure as continuous indices are scaled to the mean of the overlapping period. Normally we scale to a mean of 1 to see how it moves above and below this mean.

3. RESULTS

3.1 Descriptive analyses

3.1.1 Groomed data used in the CPUE analyses

A comparison of total groomed estimated catch for the North Island extracted from CELRs/ECERs with the reported landed weights is shown in Figure 4. The groomed total estimated eel catch, including unclassified (EEU), was less than the landed catch before 2002 in some years by as much as 20%, after which they were virtually identical. Grooming of estimated catch data from throughout the country before 2002 resulted in the deletion of between 2 and 12% of records (Beentjes & Dunn 2003a) which undoubtedly resulted in an underestimate of the total estimated catch over this period. There is also a small amount of set net catch from ESA AC (Hauraki) that is excluded from the estimated catch. From 2002, with the introduction of the ECER form, the quality of the eel fishery catch effort data improved significantly and since then deletions to the extracted catch effort data sets have been negligible. Despite the loss of data from the early years, the total estimated and landed catch have the same temporal trend.

When plotted by species the estimated catch as a proportion of the landed catch is much less than for total catch because EEU is not included (Figure 4). Before 2002, however, the data on landed catch by species is not of a high standard and is only estimated (Ministry for Primary Industries 2013). For both shortfin and longfin the match from 2002 onward is close.

3.1.2 Spatial and temporal distribution of species catch

The relative amounts of groomed estimated catch reported as SFE, LFE, or EEU in each ESA for all years combined are shown in Table 3 and Figure 5, and by year in Figure 6. Overall, the total recorded North Island catch from 1990–91 to 2011–12 was 55% shortfin, 22% longfin, and 22% EEU. When EEU was a valid species code (i.e., pre 2002) it accounted for over one third (36%) of the estimated North Island eels catch. Some proportion of annual catch was recorded as EEU in all North Island ESAs and this ranged from less than 0.05% (Poverty Bay, AF) to 45% (Waikato, AD). EEU was not recorded in any ESA after 2001 with all catches reported by species (LFE or SFE). This coincides with the introduction of the ECER in 2002 when EEU was no longer accepted as a valid reporting species code (Figure 6). The proportion of the shortfin catch in individual ESAs was two to six times greater than longfin in all ESAs except Rangitikei-Wanganui (AH) and Taranaki (AJ), where longfin was dominant, and Wellington (AM) where the ratio was even (Table 3, Figure 5). Nearly half of the North Island total eel catch was taken from just the two ESAs: Waikato (AD) and Northland (AA), which contributed 27% and 21%, respectively.

In terms of individual species, by far the largest proportion of the shortfin catch (22%) comes from Northland (AA), with two-thirds (64%) from just four ESAs (Northland AA, Auckland AB, Waikato AD, and Hawke’s Bay AG) (Table 3, Figure 5). Almost three quarters (71%) of the longfin catch is from five ESAs (Northland, AA, Waikato AD, Rangitikei-Wanganui AH, Taranaki AJ, and Hawkes Bay AG). The Waikato (AD) and Northland (AA) contributed the bulk of the EEU reported catch (72%).

Because there was significant amount of data before 2002 deleted during the grooming process it is not valid to consider trends in the groomed estimated catch before 2002. From 2002 to 2009, however, there is a trend of declining estimated catch of all eels after which annual estimated catch is comparatively stable or increasing (Figure 6).

3.2 Fishery characterisation and CPUE analyses by ESA

The number of records (including those with zero catch), number of fishers, and groomed estimated catch of shortfin, longfin, and unidentified eels are presented in Table 2. For all ESAs the continuous versus pre- and post QMS CPUE trends showed no marked differences (Appendix 3). Results are therefore presented standalone for each ESA beginning with the characterisation of the fishery, followed by the continuous time series CPUE analyses and diagnostics for shortfin, and longfin, in that order. No CPUE analyses were carried out for ESA AM (Wellington) because of insufficient data.

3.2.1 Northland (ESA AA)

Fishery characteristics 1991–2012

Reported annual eel catches in ESA AA have been variable, but declined sharply in 2005 (Appendix A1). A high proportion of the total eel catch (20%) has been reported as unidentified (EEU) and before 2002 it was about one third to a half of the catch (Table 3, Appendix A1). Over the 22 year time series, Northland has contributed 20% of the total North Island eel catch and shortfin have been the dominant species in the catch (LFE 19%, SFE 61%) (Table 3, Appendix A1).

The number of lifts ranges between a few to over 100 per day (mean 23), but most often 20 or 30 lifts per day have been reported (Appendix A2), with the median number of lifts per day declining in the last 10 years (Appendix A3).

There were very few zero records for total catch, which suggests that there were few trips where eels were not caught (Appendix A4). The higher proportions of zeros for shortfin and longfin in the 1990s is likely to be related to the reporting of EEU during this period. There are no trends for either species after 2002 when this time series is more meaningful.

Annual unstandardized catch rates (total catch / total number of lifts in each year) from raw data show a clear increasing trend for shortfin (Appendix A5) from about 2.5 kg per lift before 1997 to 5 kg per lift in the most recent years. Longfin catch rates were stable moving from at about 1 kg per lift. The total eel shows an increasing trend from about 4 to 6 kg per lift.

Shortfin CPUE analyses

The Northland shortfin non-zero catch over the time series was most commonly between 20 and 120 kg per day (mean catch including zeros = 61 kg per day), with no trend in the non-zero median catch per day (Appendices A6 and A7). The Northland shortfin fishery operates all year round, but catches peak from October to March (A8).

The relationship between shortfin catch and years of participation in the fishery is shown in Appendix A9. The original number of records (positive catches only), fishers, and shortfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The shortfin core data used in the CPUE analyses retain 94% of the catch, but lose about two thirds of the original fishers (Appendix 2). The shortfin core data set contains 20 pre-QMS and 17 post-QMS fishers (11 existing and 6 new entrants) (Appendices 2 and A10).

The standardised CPUE for shortfin catch followed the same general pattern as unstandardised catch per day with a progressive increase over time (Appendix A11). The narrow confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses. The variables permit, lifts, month, and Manganui River flow were included in the model in that order and explained 37% of the variation in CPUE (Appendix 4). The shortfin catch by core fishers does not follow the same trend as the CPUE indices although before 2002 a large proportion of the catch was reported as EEU (A11).

Residual diagnostics are shown in Appendix A12, influence step plots in Appendix A13, and CDI plots for each of the model predictor variables in Appendices A14–A17. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

Longfin CPUE analyses

The Northland longfin non-zero catch over the time series was most commonly between 20 and 80 kg per day (mean catch including zeros = 19 kg per day). The non-zero median catch per day declines after 2000 and then is flat (Appendices A18 and A19). The Northland longfin fishery operates all year round, but catches are generally lower over the winter months (A20).

The relationship between longfin catch and years of participation in the fishery is shown in Appendix A21. The original number of records (positive catches only), fishers, and longfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The longfin core data used in the CPUE analyses retain 90% of the catch, but lose about two thirds of the original fishers (Appendix 2). The longfin core data set contains 14 pre-QMS and 12 post-QMS fishers (7 existing and 5 new entrants) (Appendices 2 and A22).

The standardised CPUE for longfin catch followed the same general pattern as unstandardised catch per day but drops lower in the last four years (Appendix A23). Overall the CPUE indices show a decline from about 2000 to 2009, and are then flat over the last four years. The confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses. The variables permit, month, lifts, and Manganui River flow were included in the model in that order and explained 24% of the variation in CPUE (Appendix 4). The longfin catch by core fishers follows the same trend as the CPUE indices, but only after 2000 when EEU was no longer used (A23).

Residual diagnostics are shown in Appendix A24, influence step plots in Appendix A25, and CDI plots for each of the model predictor variables in Appendices A26–A29. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

3.2.2 Auckland (ESA AB)

Fishery characteristics 1991–2012

Reported annual eel catches in ESA AB have been highly variable between and among years with highest sustained catches recorded in the second half of the 1990s (Appendix B1). A high proportion of the total eel catch (17%) has been reported as unidentified (EEU) and before 2002 it was one-quarter of the catch (Table 3, Appendix B1). Over the 22 year time series, Auckland has contributed 9% of the total North Island eel catch and shortfin have been the dominant species in the catch (LFE 19%, SFE 64%) (Table 3, Appendix B1).

The number of lifts ranges between a few to over 100 per day (mean 27), but most often 20 or 30 lifts per day have been reported (Appendix B2), with no trend in the median number of lifts per day (Appendix B3).

There were very few zero records for total catch, which suggests that there were few trips where eels were not caught (Appendix B4). The higher proportions of zeros for shortfin and longfin in the 1990s are likely to be related to the reporting of EEU during this period. There are no trends for either species after 2002 when this time series is more meaningful.

Annual unstandardized catch rates (total catch / total number of lifts in each year) from raw data were highly variable for shortfin before 2001, ranging from about 3 to 6 kg per lift and after 2001 showed a clear increasing trend (Appendix B5) from about 3 kg to over 5 kg per lift in the most recent years. Longfin catch rates initially declined from about 3 to 1 kg per lift between 1991 and 1997 and then remained stable. The total eel catch showed a slight increasing trend, from about 5 to 6 kg per lift.

Shortfin CPUE analyses

The Auckland shortfin non-zero catch over the time series was most commonly between 20 and 120 kg per day (mean catch including zeros = 89 kg per day), with no trend in the non-zero median catch per day (Appendices B6 and B7). The Auckland shortfin fishery operates all year round, but catches peak from October to April (B8).

The relationship between shortfin catch and years of participation in the fishery is shown in Appendix B9. The original number of records (positive catches only), fishers, and shortfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The shortfin core data used in the CPUE analyses retain 91% of the catch, but lose about two thirds of the original fishers (Appendix 2). The shortfin core data set contains 12 pre-QMS and 8 post-QMS fishers (6 existing and 2 new entrants) (Appendices 2 and B10).

The standardised CPUE for shortfin catch followed the same general pattern as unstandardised catch per day although it is less spikey – there is no clear trend until after 2002 when standardised CPUE generally increases over time (Appendix B11). The narrow confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses. The variables permit, lifts, and month were included in the model in that order and explained 54% of the variation in CPUE (Appendix 4). The shortfin catch by core fishers does not follow the same trend as the CPUE indices (B11).

Residual diagnostics are shown in Appendix B12, influence step plots in Appendix B13, and CDI plots for each of the model predictor variables in Appendices B14–B16. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

Longfin CPUE analyses

The Auckland longfin non-zero catch over the time series was most commonly between 20 and 120 kg per day (mean catch including zeros = 27 kg per day). The non-zero median catch per day declines after 2003 and is lowest over the last four years (Appendices B17 and B18). The Auckland longfin fishery operates all year round, but catches are generally lower over the winter months (B19).

The relationship between longfin catch and years of participation in the fishery is shown in Appendix B20. The original number of records (positive catches only), fishers, and longfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The longfin core data used in the CPUE analyses retain 82% of the catch, but loses nearly three quarters of the original fishers (Appendix 2). The longfin core data set contains 9 pre-QMS and 7 post-QMS fishers (5 existing and 2 new entrants) (Appendices 2 and B21).

The standardised CPUE for longfin catch followed the same general pattern as unstandardised catch per day and shows a strong decline from 1991 to 2005 although the indices are unstable and confidence intervals are relatively large. From 2005 to 2012 indices have stabilised with indications of a slight decline (Appendix B22). The variables permit, lifts and month were included in the model in that order and explained 34% of the variation in CPUE (Appendix 4). The longfin catch by core fishers follows the same trend as the CPUE indices, but only after 2001 (B22).

Residual diagnostics are shown in Appendix B23, influence step plots in Appendix B24, and CDI plots for each of the model predictor variables in Appendices B25–A27. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

3.2.3 Hauraki (ESA AC)

Fishery characteristics 1991–2012

Reported annual eel catches in ESA AC have been variable, but with no strong trends although the catch in three of the last four years are the lowest in the times series. (Appendix C1). A low proportion of the total eel catch (9%) has been reported as unidentified (EEU) and before 2002 it was 16% of the catch (Table 3, Appendix C1). Over the 22 year time series, Hauraki has contributed 6% of the total North Island eel catch and shortfin have been the dominant species in the catch (LFE 14%, SFE 77%) (Table 3, Appendix C1).

The number of lifts ranges between a few to over 70 per day (mean 24), but most often 15, 20, or 30 lifts per day have been reported (Appendix C2), with no trend in the median number of lifts per day (Appendix C3).

There were no zero records for total catch, which suggests that eels were caught on all trips (Appendix C4). The higher proportions of zeros for shortfin and longfin in the 1990s are likely to be related to the reporting of EEU during this period. There are no trends for either species after 2002 when this time series is more meaningful.

Annual unstandardized catch rates (total catch / total number of lifts in each year) from raw data show no clear trends for shortfin (Appendix C5) and ranged from about 3 kg to 5 kg per lift. Longfin catch rates show no trends and range from 0.5 to 1 kg per lift. The total eel catch shows no trends, ranging from about to 3 to 5 kg per lift.

Shortfin CPUE analyses

The Hauraki shortfin non-zero catch over the time series was most commonly between 40 and 120 kg per day (mean catch including zeros = 75 kg per day), with no trend in the non-zero median catch per day (Appendices C6 and C7). The Hauraki shortfin fishery operates all year round, but the catches in May to July are considerably less than in other months (C8).

The relationship between shortfin catch and years of participation in the fishery is shown in Appendix C9. The original number of records (positive catches only), fishers, and shortfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The shortfin core data used in the CPUE analyses retain 98% of the catch, but loses nearly two thirds of the original fishers (Appendix 2). The shortfin core data set contains 8 pre-QMS and 6 post-QMS fishers (2 existing and 4 new entrants) (Appendices 2 and C10).

The standardised CPUE for shortfin catch followed the same general pattern as unstandardised catch per day. CPUE fluctuated without trend until 2007, after which it increased steeply (Appendix C11). The narrow confidence intervals around the indices indicate that there were sufficient data for these analyses to provide reliable results. The variables lifts, permit, month, and Piako River flow were included in the model in that order and explained 27% of the variation in CPUE (Appendix 4). The shortfin catch by core fishers does not follow the same trend as the CPUE indices (C11).

Residual diagnostics are shown in Appendix C12, influence step plots in Appendix C13, and CDI plots for each of the model predictor variables in Appendices C14–C17. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

Longfin CPUE analyses

The Hauraki longfin non-zero catch over the time series was most commonly between 10 and 40 kg per day (mean catch including zeros = 13 kg per day). The non-zero median catch per day shows an early decline in 1994 and then is stable (Appendices C18 and C19). The Hauraki longfin fishery operates all year round, but catches are considerably less between May and September (C20).

The relationship between longfin catch and years of participation in the fishery is shown in Appendix C21. The original number of records (positive catches only), fishers, and longfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The longfin core data used in the CPUE analyses retain 79% of the catch, but lose about two thirds of the original fishers (Appendix 2). The longfin core data set contains 7 pre-QMS and 5 post-QMS fishers (3 existing and 3 new entrants) (Appendices 2 and C22).

The standardised CPUE for longfin catch followed the same general pattern as unstandardised catch per day and shows a decline from 1991 to 2010 which is initially steep, but levels out after 1999 (Appendix C23). CPUE has increased in the last two years. The confidence intervals around the indices indicate that there were sufficient data for these analyses to provide reliable results. The variables permit, month, and lifts were included in the model in that order and explained 28% of the variation in CPUE (Appendix 4). The longfin catch by core fishers follows a similar trend that of the CPUE indices (C23).

Residual diagnostics are shown in Appendix C24, influence step plots in Appendix C25, and CDI plots for each of the model predictor variables in Appendices C26–C28. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

3.2.4 Waikato (ESA AD)

Fishery characteristics 1991–2012

Reported annual eel catches in ESA AD are characterised by a peak in the mid 1990s and a decline in 2003 after which catches have been reasonably stable (Appendix D1). A high proportion of the total eel catch (45%) has been reported as unidentified (EEU) and before 2002 it was 71% of the catch

(Table 3, Appendix D1). Over the 22 year time series, Waikato has contributed 27% of the total North Island eel catch, the most of any ESA, and shortfin have been the dominant species in the catch (LFE 15%, SFE 40%) (Table 3, Appendix D1).

The number of lifts ranges between a few to over 90 per day (mean 28), but most often 20, 30, 40 or 50 lifts per day have been reported (Appendix D2), with no trend in the median number of lifts per day (Appendix D3).

There were very few zero records for total catch, which suggests that there were few trips where eels were not caught (Appendix D4). The higher proportions of zeros for shortfin and longfin in the 1990s are likely to be related to the reporting of EEU during this period. There are no trends for either species after 2002 when this time series is more meaningful.

Annual unstandardized catch rates (total catch / total number of lifts in each year) from raw data for shortfin declined from about 3 kg per lift in 1991 to 1.5 kg per lift in 2003 and then increased steadily to about 3.5 kg per lift (Appendix D5). Longfin catch rate declines from about 3 kg per lift in 1991 to 1 kg per lift in 1998 and then was stable. The total eel catch shows an increasing trend from about 3 to 4 kg per lift.

Shortfin CPUE analyses

The Waikato shortfin non-zero catch over the time series was most commonly between 20 and 120 kg per day (mean catch including zeros = 32 kg per day), with no trend in the non-zero median catch per day (Appendices D6 and D7). The Waikato shortfin fishery operates all year round and there is no indication of clear seasonality around catches (D8).

The relationship between shortfin catch and years of participation in the fishery is shown in Appendix D9. The original number of records (positive catches only), fishers, and shortfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The shortfin core data used in the CPUE analyses retain 98% of the catch, but lose about half of the original fishers (Appendix 2). The shortfin core data set contains 20 pre-QMS and 15 post-QMS fishers (11 existing and 4 new entrants) (Appendices 2 and D10).

The standardised CPUE for shortfin catch followed the same general pattern as unstandardised catch per day with a downward trend from 1996 until 2003, followed by an upward trend until 2011, after which it dropped again in 2012 (Appendix D11). The narrow confidence intervals around the indices indicate that there were sufficient data for these analyses to provide reliable results. The variables permit, lifts, month, and Waikato River flow were included in the model in that order and explained 38% of the variation in CPUE (Appendix 4). The shortfin catch by core fishers does not follow the same trend as the CPUE indices although before 2002 a large proportion of the catch was reported as EEU (D11).

Residual diagnostics are shown in Appendix D12, influence step plots in Appendix D13, and CDI plots for each of the model predictor variables in Appendices D14–D17. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

Longfin CPUE analyses

The Waikato longfin non-zero catch over the time series was most commonly between 20 and 60 kg per day (mean catch including zeros = 12 kg per day). The non-zero median catch per day declines after 1999 and then is flat (Appendices D18 and D19). The Waikato longfin fishery operates all year round, but longfin catches are generally lower over the winter months (D20).

The relationship between longfin catch and years of participation in the fishery is shown in Appendix D21. The original number of records (positive catches only), fishers, and longfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The longfin core data used in the CPUE analyses retain 97% of the catch, but lose just under a half of the original fishers (Appendix 2). The longfin core data set contains 20 pre-QMS and 15 post-QMS fishers (11 existing and 4 new entrants) (Appendices 2 and D22).

The standardised CPUE for longfin catch followed the same general pattern as unstandardised catch per day and shows an overall decline until about 2008 after which it increases (Appendix D23). The confidence intervals around the indices indicate that there were sufficient data for these analyses to provide reliable results. The variables permit, month and lifts were included in the model in that order and explained 43% of the variation in CPUE (Appendix 4). The longfin catch by core fishers does not follow the same trend as the CPUE indices although before 2002 a large proportion of the catch was reported as EEU (D23).

Residual diagnostics are shown in Appendix D24, influence step plots in Appendix D25, and CDI plots for each of the model predictor variables in Appendices D26–D28. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

3.2.5 Bay of Plenty (ESA AE)

Fishery characteristics 1991–2012

Reported annual eel catches in ESA AE have been variable, but overall declined after 1996 and then were stable (Appendix E1). A small proportion of the total eel catch (8%) has been reported as unidentified (EEU) and before 2002 it was 12% of the catch (Table 3, Appendix E1). Over the 22 year time series, Bay of Plenty has contributed only 3% of the total North Island eel catch and shortfin have been the dominant species in the catch (LFE 27%, SFE 65%) (Table 3, Appendix E1).

The number of lifts ranges between a few to over 70 per day (mean 27), but most often 20, 30, or 40 lifts per day have been reported (Appendix E2), with the median number of lifts per day increasing but becoming more variable over time (Appendix E3).

There were no zero records for total catch, which suggests that there were no trips recorded where eels were not caught (Appendix E4). The higher proportions of zeros for shortfin and longfin in the 1990s are likely to be related to the reporting of EEU during this period. There are no trends for either species after 2002 when this time series is more meaningful, although it varies considerably between years, a reflection of the low catches and numbers of fishers in this area, and possibly targeting practices.

Annual unstandardized catch rates (total catch / total number of lifts in each year) from raw data show a decline for shortfin (Appendix E5) from about 5 kg per lift in 1991 to 1.5 kg per lift in 2000 followed by a steady increase up to about 6 kg per lift. Longfin catch rates varied from about 1 to 3 kg per lift, with no trend. The total eel catch shows the same trend as shortfin and ranges from about 3 to 8 kg per lift.

Shortfin CPUE analyses

The Bay of Plenty shortfin non-zero catch over the time series was most commonly between 20 and 140 kg per day (mean catch including zeros = 81 kg per day), with no trend in the non-zero median catch per day until the last five years when it has increased markedly (Appendices E6 and E7). The Bay of Plenty shortfin fishery operates all year round, but catches tend to be lowest in the July to September period (E8).

The relationship between shortfin catch and years of participation in the fishery is shown in Appendix E9. The original number of records (positive catches only), fishers, and shortfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The shortfin core data used in the CPUE analyses retain 90% of the catch, but lose more than half of the original fishers (Appendix 2). The shortfin core data set contains 5 pre-QMS and 4 post-QMS fishers (1 existing and 3 new entrants) (Appendices 2 and E10).

The standardised CPUE for shortfin catch followed the same general pattern as unstandardised catch per day with a variable but slight decline until 2007, after which it increased steeply (Appendix E11). The narrow confidence intervals around the indices before 2005 indicate that that there were sufficient data for these analyses to provide reliable results, but after that the confidence intervals are much larger, reflecting the loss of fishers and data. The variables permit, lifts and month were included in the model in that order and explained 54% of the variation in CPUE (Appendix 4). The shortfin catch by core fishers does not follow the same trend as the CPUE indices (E11).

Residual diagnostics are shown in Appendix E12, influence step plots in Appendix E13, and CDI plots for each of the model predictor variables in Appendices E14–E16. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

Longfin CPUE analyses

The Bay of Plenty longfin non-zero catch over the time series was most commonly between 20 and 120 kg per day (mean catch including zeros = 34 kg per day). The non-zero median catch per day is highly variable but shows no trend (Appendices E17 and E18). The Bay of Plenty longfin fishery is seasonal with little catch taken from July to September (E19).

The relationship between longfin catch and years of participation in the fishery is shown in Appendix E20. The original number of records (positive catches only), fishers, and longfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The longfin core data used in the CPUE analyses retain 91% of the catch, but lose more than half of the original fishers (Appendix 2). The longfin core data set contains 5 pre-QMS and 4 post-QMS fishers (1 existing and 3 new entrants) (Appendices 2 and E21).

The standardised CPUE for longfin catch followed the same general pattern as unstandardised catch per day, but drops lower in the last four years (Appendix E22). Overall the CPUE indices show a decline from about 1991 to 2005, and since then have fluctuated without trend. The high confidence intervals around the indices reflect the low number of fishing events available for this analysis. The variables permit, lifts and month were included in the model in that order and explained 43% of the variation in CPUE (Appendix 4). The longfin catch by core fishers does not follow the same trend as the CPUE indices (E22).

Residual diagnostics are shown in Appendix E23, influence step plots in Appendix E24, and CDI plots for each of the model predictor variables in Appendices E25–E27. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

3.2.6 Poverty Bay (ESA AF)

Fishery characteristics 1991–2012

Reported annual eel catches in ESA AF have been variable with some years having no or very little catch, but overall there are no clear trends in the annual catch. (Appendix F1). Longfin catch was negligible or non-existent over the last five years. None of the total eel catch has been reported as unidentified (EEU), the only ESA where this has occurred (Table 3, Appendix F1). Over the 22 year time series, Poverty Bay has contributed only 2% of the total North Island eel catch and shortfin have been the dominant species in the catch (LFE 24%, SFE 76%) (Table 3, Appendix F1).

The number of lifts ranges between a few to over 120 per day (mean 32), but most often 20, 30, or 40 lifts per day have been reported (Appendix F2), with the median number of lifts per day increasing but becoming more variable over time (Appendix F3).

There were no zero records for total catch, which suggests that there were no trips recorded where eels were not caught (Appendix F4). The zero records for shortfin have declined over time whereas longfin have been highly variable, a reflection of the low catches and numbers of fishers in this area, and possibly targeting practices.

Annual unstandardized catch rates (total catch / total number of lifts in each year) from raw data are too variable to interpret sensibly, a reflection of the low catches and numbers of fishers in this area (Appendix F5).

Shortfin CPUE analyses

The Poverty Bay shortfin non-zero catch over the time series was most commonly between 20 and 220 kg per day (mean catch including zeros = 171 kg per day), with variable non-zero median catch per day showing no trends (Appendices F6 and F7). These daily catches are very high relative to the other ESAs despite the total catch from the area being low. The Poverty Bay shortfin fishery operates all year round, but catches tend to be lowest in the period June to August (F8) and in recent years fishing has been confined to just one or two months per year.

The relationship between shortfin catch and years of participation in the fishery is shown in Appendix F9. The original number of records (positive catches only), fishers, and shortfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The shortfin core data used in the CPUE analyses retain 91% of the catch, but lose nearly two thirds of the original fishers (Appendix 2). The shortfin core data set contains 4 pre-QMS and 2 post-QMS fishers (1 existing and 1 new entrants) (Appendices 2 and F10).

The standardised CPUE for shortfin catch followed the same general pattern as unstandardised catch per day. CPUE fluctuated without trend until 2003, after which it rose steeply (Appendix F11). The wide confidence intervals around the indices and missing years reflect the paucity of data, particularly after 2005. The variables lifts, month, permit, and Waipaoa River flow were included in the model in that order and explained 54% of the variation in CPUE (Appendix 4). The shortfin catch by core fishers does not follow the same trend as the CPUE indices (F11).

Residual diagnostics are shown in Appendix F12, influence step plots in Appendix F13, and CDI plots for each of the model predictor variables in Appendices F14–F17. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

Longfin CPUE analyses

The Poverty Bay longfin non-zero catch over the time series was most commonly between 20 and 160 kg per day (mean catch including zeros = 54 kg per day) with variable non-zero median catch per day showing no trends (Appendices F18 and F19). The Poverty Bay longfin fishery operates mainly in spring and summer and in recent years catches have been non-existent or confined to just one or two months per year (F20).

The relationship between longfin catch and years of participation in the fishery is shown in Appendix F21. The original number of records (positive catches only), fishers, and longfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The longfin core data used in the CPUE analyses retain 80% of the catch, but lose almost three quarters of the original fishers (Appendix 2). The longfin core data set contains 3 pre-QMS and 1 post-QMS fishers (1 existing and 0 new entrants) (Appendices 2 and F22).

The standardised CPUE for longfin catch followed the same general pattern as unstandardised catch per day (Appendix F23). The CPUE indices are highly variable with large confidence intervals and only extend to 2007. The variables month, permit, lifts, moon phase, and Waipaoa River flow were included in the model in that order and explained 48% of the variation in CPUE (Appendix 4). There are insufficient data for this CPUE analysis to be considered indicative of longfin abundance in Poverty Bay. The longfin catch by core fishers does not follow the same trend as the CPUE indices (F23).

Residual diagnostics are shown in Appendix F24, influence step plots in Appendix F25, and CDI plots for each of the model predictor variables in Appendices F26–F30. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

3.2.7 Hawkes Bay (ESA AG)

Fishery characteristics 1991–2012

Reported annual eel catches in ESA AG have been variable with no clear trend, although longfin from 2009 to 2011 was negligible (Appendix G1). A low proportion of the total eel catch (2%) has been reported as unidentified (EEU) and before 2002 it was only 4% of the catch (Table 3, Appendix G1). Over the 22 year time series, Hawkes Bay has contributed 9% of the total North Island eel catch and shortfin have been the dominant species in the catch (LFE 24%, SFE 74%) (Table 3, Appendix G1).

The number of lifts ranges between a few to over 200 per day (mean 31), but most often between 10 and 40 lifts per day have been reported (Appendix G2) with the median number of lifts per day showing no trends until the last few years when it has increased sharply (Appendix G3).

There were no zero records for total catch except in 1997, which suggests that there were few trips where eels were not caught (Appendix G4). The low proportions of catch reported as EEU suggests that the trends throughout the time series are valid. There are no trends for longfin with the exception of the high proportions in 2009 to 2011, but shortfin show a decline in the zero catches over time.

Annual unstandardized catch rates (total catch / total number of lifts in each year) from raw data for shortfin declined steeply between 1991 and 1998 from about 8 to 2 kg per lift and then increased steeply up to 6 kg per lift (Appendix G5). Longfin catch rates are variable, ranging from about 4 to 0.5 kg per lift and overall show a declining trend over time. The total eel catch rates have a similar trend to shortfin.

Shortfin CPUE analyses

The Hawkes Bay shortfin non-zero catch over the time series was most commonly between 20 and 300 kg per day (mean catch including zeros = 157 kg per day) with non-zero median catch per day dropping in the mid to late 1990s and then increasing after then (Appendices G6 and G7). The Hawkes Bay shortfin fishery is seasonal with little catch in July and August (G8).

The relationship between shortfin catch and years of participation in the fishery is shown in Appendix G9. The original number of records (positive catches only), fishers, and shortfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The shortfin core data used in the CPUE analyses retain 92% of the catch, but lose about two thirds of the original fishers (Appendix 2). The shortfin core data set contains 9 pre-QMS and 5 post-QMS fishers (3 existing and 2 new entrants) (Appendices 2 and G10).

The standardised CPUE for shortfin catch followed the same general pattern as unstandardised catch per day but was higher in the mid to late 1990s and lower in the last four years. The standardised CPUE index shows a declining trend until 2002 and an increasing trend after that (Appendix G11). The narrow confidence intervals around the indices indicate that there were sufficient data for these analyses to provide reliable results, with the exception of the last few years. The variables permit, lifts, and month were included in the model in that order and explained 67% of the variation in CPUE (Appendix 4). The shortfin catch by core fishers does not follow the same trend as the CPUE indices (G11).

Residual diagnostics are shown in Appendix G12, influence step plots in Appendix G13, and CDI plots for each of the model predictor variables in Appendices G14–G16. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

Longfin CPUE analyses

The Hawkes Bay longfin non-zero catch over the time series was most commonly between 20 and 140 kg per day (mean catch including zeros = 50 kg per day). The non-zero median catch per day declines steeply after 1996 and then shows no trend (Appendices G17 and G18). The Hawkes Bay longfin fishery is strongly seasonal with very little catch landed over the winter months (G19).

The relationship between longfin catch and years of participation in the fishery is shown in Appendix G20. The original number of records (positive catches only), fishers, and longfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The longfin core data used in the CPUE analyses retain 74% of the catch, but lose three quarters of the original fishers (Appendix 2). The longfin core data set contains 4 pre-QMS and 3 post-QMS fishers (1 existing and 2 new entrants) (Appendices 2 and G21).

The standardised CPUE for longfin catch followed the same general pattern as unstandardised catch per day showing a progressive decline to 2011 and an increase in the last year (Appendix G22). The confidence intervals around the indices indicate that there were sufficient data for these analyses to provide reliable results for most years. The variables permit, lifts and month were included in the model in that order and explained 42% of the variation in CPUE (Appendix 4). The longfin catch by core fishers follows the same declining trend as the CPUE indices (G22).

Residual diagnostics are shown in Appendix G23, influence step plots in Appendix G24, and CDI plots for each of the model predictor variables in Appendices G25–G27. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

3.2.8 Rangitikei-Wanganui (ESA AH)

Fishery characteristics 1991–2012

Reported annual eel catches in ESA AH have been variable, but have generally declined over time, although they have been stable over the last five years (Appendix H1). A low proportion of the total eel catch (5%) has been reported as unidentified (EEU) and before 2002 it was 7% of the catch (Table 3, Appendix H1). Over the 22 year time series, Rangitikei-Wanganui has contributed 8% of the total North Island eel catch and shortfin and longfin have been landed in similar quantities (LFE 48%, SFE 47%), although the proportion of longfin catch has dropped away over the last six years (Table 3, Appendix H1).

The number of lifts ranges between a few to 200 per day (mean 27), but most often between 20 and 40 lifts per day have been reported (Appendix H2), with the median number of lifts per day showing signs of increasing over time (Appendix H3).

There were no zero records for total catch with the exception of 1997, which suggests that there were few trips where eels were not caught (Appendix H4). The higher proportions of zeros for shortfin and longfin in the 1990s are only slightly inflated by the reporting of EEU during this period. There are no trends for longfin with the exception of the high proportions in 2008 and 2011, but shortfin show a decline in the zero catches over time.

Annual unstandardized catch rates (total catch / total number of lifts in each year) from raw data for shortfin show no trend until after 2002 when catch rates increased steadily from about 3 to 8 kg per lift (Appendix H5). Longfin catch rates show a steady decline over time from about 6 to 1.5 kg per lift. The total eel catch and shows a similar trend to shortfin.

Shortfin CPUE analyses

The Rangitikei-Wanganui shortfin non-zero catch over the time series was most commonly between 20 and 220 kg per day (mean catch including zeros = 105 kg per day), with a trend of increasing non-zero median catch per day after 2005 (Appendices H6 and H7). The Rangitikei-Wanganui shortfin fishery is strongly seasonal with few catches landed from May to July (H8).

The relationship between shortfin catch and years of participation in the fishery is shown in Appendix H9. The original number of records (positive catches only), fishers, and shortfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The shortfin core data used in the CPUE analyses retain 74% of the catch, but lose more than two thirds of the original fishers (Appendix 2). The shortfin core data set contains 11 pre-QMS and 6 post-QMS fishers (6 existing and zero new entrants) (Appendices 2 and H10).

The standardised CPUE for shortfin catch followed the same general pattern as unstandardised catch per day with no trend until 2005, after which it increases steeply (Appendix H11). The wider confidence intervals around the indices after 2005 reflect the loss of fishers and data in the analyses. The variables lifts, permit, month, and Whanganui River flow were included in the model in that order and explained 40% of the variation in CPUE (Appendix 4). The shortfin catch by core fishers does not follow the same trend as the CPUE indices (H11).

Residual diagnostics are shown in Appendix H12, influence step plots in Appendix H13, and CDI plots for each of the model predictor variables in Appendices H14–H17. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

Longfin CPUE analyses

The Rangitikei-Wanganui longfin non-zero catch over the time series was most commonly between 20 and 220 kg per day (mean catch including zeros = 107 kg per day). The non-zero median catch per day declines until 2004 after which it is variable (Appendices H18 and H19 The Rangitikei-Wanganui longfin fishery is strongly seasonal with few catches landed from May to July (H20).

The relationship between longfin catch and years of participation in the fishery is shown in Appendix H21. The original number of records (positive catches only), fishers, and longfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The longfin core data used in the CPUE analyses retain 91% of the catch, but lose more than two thirds of the original fishers (Appendix 2). The longfin core data set contains 10 pre-QMS and 5 post-QMS fishers (5 existing and zero new entrants) (Appendices 2 and H22).

The standardised CPUE for longfin catch followed the same general pattern as unstandardised catch per day, but is higher in the first seven years and lower from 2003 onward (Appendix H23). Overall the CPUE indices show a continual decline throughout the time series, but this is less steep after 2004. The confidence intervals around the indices indicate that there were sufficient data for these analyses to provide reliable results. The variables permit, lifts, and month were included in the model in that order and explained 38% of the variation in CPUE (Appendix 4). The longfin catch by core fishers follows the same declining trend as the CPUE indices (H23).

Residual diagnostics are shown in Appendix H24, influence step plots in Appendix H25, and CDI plots for each of the model predictor variables in Appendices H26–H28. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

3.2.9 Taranaki (ESA AJ)

Fishery characteristics 1991–2012

Reported annual eel catches in ESA AJ have been variable, but are considerable smaller over the last eight years with the notable exception of 2006 (Appendix J1). Nine percent of the total eel catch has been reported as unidentified (EEU) and before 2002 it was 14% of the catch (Table 3, Appendix J1). Over the 22 year time series, Taranaki has contributed 4% of the total North Island eel catch and longfin have been the dominant species in the catch (LFE 58%, SFE 32%) (Table 3, Appendix J1).

The number of lifts ranges between a few to more than 120 per day (mean 24), but most often 20, 30 or 40 lifts per day have been reported (Appendix J2), with no trend in median number of lifts per day (Appendix J3).

There were few zero records for total catch, which suggests that there were few trips where eels were not caught (Appendix J4). The higher proportions of zeros for shortfin and longfin in the 1990s are inflated by the reporting of EEU during this period. There are no consistent trends for longfin, but shortfin show a decline in the zero catches over time.

Annual unstandardized catch rates (total catch / total number of lifts in each year) from raw data show a clear and steady increasing trend for shortfin from about 0.5 to over 5 kg per lift (Appendix J5). Longfin catch rates initially declined from about 6 to 2 kg per lift and then after 2003 increased again, but were variable. The total eel catch shows a similar trend to longfin.

Shortfin CPUE analyses

The Taranaki shortfin non-zero catch over the time series was most commonly between 20 and 120 kg per day (mean catch including zeros = 41 kg per day), with indications of a trend of increasing non-zero median catch per day after 2005 (Appendices J6 and J7). The Taranaki shortfin fishery is strongly seasonal with few catches landed from May to September (J8).

The relationship between shortfin catch and years of participation in the fishery is shown in Appendix J9. The original number of records (positive catches only), fishers, and shortfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The shortfin core data used in the CPUE analyses retain 81% of the catch, but lose nearly three quarters of the original fishers (Appendix 2). The shortfin core data set contains 6 pre-QMS and 4 post-QMS fishers (4 existing and zero new entrants) (Appendices 2 and J10).

The standardised CPUE for shortfin catch followed the same general pattern as unstandardised catch per day with no trend until 2005 after which it increases steeply (Appendix J11). The wider confidence intervals around the indices after 2005 reflect the loss of data in the analyses. The variables permit, lifts, month, and Patea River flow were included in the model in that order and explained 34% of the variation in CPUE (Appendix 4). The shortfin catch by core fishers does not follow the same trend as the CPUE indices (J11).

Residual diagnostics are shown in Appendix J12, influence step plots in Appendix J13, and CDI plots for each of the model predictor variables in Appendices J14–J17. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

Longfin CPUE analyses

The Taranaki longfin non-zero catch over the time series was most commonly between 20 and 120 kg per day (mean catch including zeros = 74 kg per day). The non-zero median catch per day declines until 2003 after which it is variable (Appendices J18 and J19). The Taranaki longfin fishery is strongly seasonal with few catches landed from June to August (J20).

The relationship between longfin catch and years of participation in the fishery is shown in Appendix J21. The original number of records (positive catches only), fishers, and longfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The longfin core data used in the CPUE analyses retain 94% of the catch, but lose more than half of the original fishers (Appendix 2). The longfin core data set contains 8 pre-QMS and 5 post-QMS fishers (5 existing and zero new entrants) (Appendices 2 and J22).

The standardised CPUE for longfin catch followed the same general pattern as unstandardised catch per day, showing a general decline until 2003, then fluctuating without trend after this date (Appendix J23). The confidence intervals around the indices indicate that there were sufficient data for these analyses to provide reliable results. The variables permit, lifts, and month were included in the model in that order and explained 58% of the variation in CPUE (Appendix 4). The longfin catch by core fishers fluctuated without trend until 2003, after which it dropped steeply (J23).

Residual diagnostics are shown in Appendix J24, influence step plots in Appendix J25, and CDI plots for each of the model predictor variables in Appendices J26–J28. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

3.2.10 Manawatu (ESA AK)

Fishery characteristics 1991–2012

Reported annual eel catches in ESA AK have been variable, but apart from a few big catches in the mid 1990s have been of similar magnitude over time (Appendix K1). The 2004 catch is particularly low relative to any year coinciding with non-operation of Levin Eel Trading during this season. A third of the total eel catch (33%) has been reported as unidentified (EEU) and before 2002 it was over half (52%) of the catch (Table 3, Appendix K1). Over the 22 year time series, Manawatu has contributed 7% of the total North Island eel catch and shortfin have been the dominant species in the catch (LFE 11%, SFE 55%) (Table 3, Appendix K1).

The number of lifts ranges between a few to more than 90 per day (mean 27), but most often 20, 30 or 40 lifts per day have been reported (Appendix K2), with no trend in median number of lifts per day (Appendix K3).

There were few zero records for total catch, which suggests that there were few trips where eels were not caught (Appendix K4). The higher proportions of zeros for shortfin and longfin in the 1990s are strongly inflated by the substantial reporting of EEU during this period. There are no consistent trends for longfin or shortfin after 2000 when EEU was no longer used.

Annual unstandardized catch rates (total catch / total number of lifts in each year) from raw data for shortfin were variable, but overall declined from over 8 to about 3 kg per lift in 2003 and then steadily increased to over 8 kg per lift (Appendix K5). Longfin catch rates ranged from less than 0.5 to 3 kg per lift, but with no trends. The total eel catch shows a similar trend to shortfin.

Shortfin CPUE analyses

The Manawatu shortfin non-zero catch over the time series was most commonly between 20 and 160 kg per day (mean catch including zeros = 109 kg per day), with indications of a drop in the non-zero median catch per day from 1994 to 2003 (Appendices K6 and K7). The Manawatu shortfin fishery is strongly seasonal with few catches landed from May to August (K8).

The relationship between shortfin catch and years of participation in the fishery is shown in Appendix K9. The original number of records (positive catches only), fishers, and shortfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The shortfin core data used in the CPUE analyses retain 86% of the catch, but lose more than two thirds of the original fishers (Appendix 2). The shortfin core data set contains 8 pre-QMS and 7 post-QMS fishers (6 existing and 1 new entrant) (Appendices 2 and K10).

The standardised CPUE for shortfin catch followed the same general pattern as unstandardised catch per day, showing an initial steep decline followed by a flat period from 1994 to 2003 and then an increase in 2004 followed by a second flat period (Appendix K11). The confidence intervals around the indices indicate that there were sufficient data for these analyses to provide reliable results. The variables permit, lifts, and month were included in the model in that order and explained 50% of the variation in CPUE (Appendix 4). The shortfin catch by core fishers does not follow the same trend as the CPUE indices (K11).

Residual diagnostics are shown in Appendix K12, influence step plots in Appendix K13, and CDI plots for each of the model predictor variables in Appendices K14–K16. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

Longfin CPUE analyses

The Manawatu longfin non-zero catch over the time series was most commonly between 20 and 120 kg per day (mean catch including zeros = 22 kg per day). The non-zero median catch per day shows no clear trend (Appendices K17 and K18). The Taranaki longfin fishery is strongly seasonal with few catches landed from May to September (K19).

The relationship between longfin catch and years of participation in the fishery is shown in Appendix K20. The original number of records (positive catches only), fishers, and longfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The longfin core data used in the CPUE analyses retain 60% of the catch, but lose more than three quarters of the original fishers (Appendix 2). The longfin core data set contains 6 pre-QMS and 5 post-QMS fishers (4 existing and 1 new entrant) (Appendices 2 and K21).

The standardised CPUE for longfin catch followed the same general pattern as unstandardised catch per day, and has largely fluctuated without trend, with higher interannual variability and large confidence intervals in some years. (Appendix K22). The variables permit, lifts, month, and moon phase were included in the model in that order and explained 21% of the variation in CPUE (Appendix 4). The longfin catch by core fishers does not follow the same trend as the CPUE indices (K22).

Residual diagnostics are shown in Appendix K23, influence step plots in Appendix K24, and CDI plots for each of the model predictor variables in Appendices K25–K28. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

3.2.11 Wairarapa (ESA AL)

Fishery characteristics 1991–2012

Reported annual eel catches in ESA AL have been variable, but overall were lower after 2003. The 2004 catch is particularly low relative to any year coinciding with non-operation of Levin Eel Trading during this season (Appendix L1). Fourteen percent of the total eel catch has been reported as unidentified (EEU) and before 1999 it was nearly one quarter (24%) of the catch (Table 3, Appendix L1). Over the 22 year time series, Wairarapa has contributed 5% of the total North Island eel catch and shortfin have been the dominant species in the catch (LFE 33%, SFE 52%) (Table 3, Appendix L1).

The number of lifts ranges between a few to more than 100 per day (mean 31), but most often 20, 30, 40 or 50 lifts per day have been reported (Appendix L2), with no trend in median number of lifts per day (Appendix L3).

There were few zero records for total catch, which suggests that there were few trips where eels were not caught (Appendix L4). The higher proportions of zeros for shortfin and longfin in the 1990s are strongly inflated by the substantial reporting of EEU during this period. After 1999 when EEU was no longer used there are no consistent trends for longfin although the shortfin proportion of zeros appears to be declining.

Annual unstandardized catch rates (total catch / total number of lifts in each year) from raw data for shortfin show no clear trend until 2004 after which catch rates increased from about 3 to 5 kg per lift. (Appendix L5). Longfin catch rates ranged from about 1.5 to 5.5 kg per lift but overall there were no trends. The total eel catch trend was similar to shortfin.

Shortfin CPUE analyses

The Wairarapa shortfin non-zero catch over the time series was most commonly between 20 and 220 kg per day (mean catch including zeros = 102 kg per day), with no trends in the non-zero median catch per day (Appendices L6 and L7). The Wairarapa shortfin fishery is strongly seasonal with few catches landed from June to August (L8).

The relationship between shortfin catch and years of participation in the fishery is shown in Appendix L9. The original number of records (positive catches only), fishers, and shortfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The shortfin core data used in the CPUE analyses retain 94% of the catch, but lose almost two thirds of the original fishers (Appendix 2). The shortfin core data set contains 6 pre-QMS and 7 post-QMS fishers (4 existing and 3 new entrant) (Appendices 2 and L10).

The standardised CPUE for shortfin catch followed the same general pattern as unstandardised catch per day showing a general decline until 2004 followed by an increase (Appendix L11). The confidence intervals around the indices indicate that there were sufficient data for these analyses to provide reliable results for most years. The variables permit, lifts, month, and Ruamahanga River flow were included in the model in that order and explained 44% of the variation in CPUE (Appendix 4). The shortfin catch by core fishers does not follow the same trend as the CPUE indices (L11).

Residual diagnostics are shown in Appendix L12, influence step plots in Appendix L13, and CDI plots for each of the model predictor variables in Appendices L14–L17. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

Longfin CPUE analyses

The Wairarapa longfin non-zero catch over the time series was most commonly between 20 and 120 kg per day (mean catch including zeros = 65 kg per day). The non-zero median catch per day overall is lower after 2001 (Appendices L18 and L19). The Wairarapa longfin fishery is strongly seasonal with few catches landed from May to August (L20).

The relationship between longfin catch and years of participation in the fishery is shown in Appendix L21. The original number of records (positive catches only), fishers, and longfin catch, and those included in the CPUE model core data following the restrictions are shown in Appendix 2. The longfin core data used in the CPUE analyses retain 94% of the catch, but lose nearly two thirds of the original fishers (Appendix 2). The longfin core data set contains 5 pre-QMS and 6 post-QMS fishers (2 existing and 4 new entrants) (Appendices 2 and L22).

The standardised CPUE for longfin catch followed the same general pattern as unstandardised catch, showing an overall decline until 2003, after which it has fluctuated without trend (Appendix L23). The confidence intervals around the indices indicate that there were sufficient data for these analyses to provide reliable results for most years. The variables permit, lifts, and month were included in the model in that order and explained 37% of the variation in CPUE (Appendix 4). The longfin catch by core fishers follows the same trend as the CPUE indices apart from the period in the early 2000s (L23).

Residual diagnostics are shown in Appendix L24, influence step plots in Appendix L25, and CDI plots for each of the model predictor variables in Appendices L26–L28. Standardised indices and 95% confidence intervals are tabulated in Appendix 5.

3.2.12 Wellington (ESA AM)

Fishery characteristics 1991–2012

Reported annual eel catches in ESA AM have been highly variable with catches landed from only seven years of the 22 year time series, and not since 2008 (Appendix M1). Three percent of the total eel catch has been reported as unidentified (EEU), although this was only for 1991, 1992, and 1993

(Table 3, Appendix M1). Over the 22 year time series Wellington has contributed only 0.05% of the total North Island eel catch and longfin have been the dominant species in the catch (LFE 58%, SFE 39%) (Table 3, Appendix M1). There are too few data to present sensible plots on lifts or catch per day, zero catch, seasonal catch, or catch rates, and no CPUE analyses were carried out for Wellington.

4. DISCUSSION

This report presents fishery characterisations and catch per unit effort analyses for the North Island commercial freshwater eel fishery from 1991 to 2012 carried out at the level of eel statistical area for individual species (shortfin and longfin). Initial CPUE analyses were carried out for pre- and post-QMS data sets to investigate if the arrival of new entrants and the loss of existing fishers following introduction of the North Island eels into the QMS in 2004–05 resulted in different CPUE trends to those using the continuous 22 year time series. For all ESAs there were no marked differences between the indices generated pre- and post-QMS, and those from continuous time series data sets (see Appendix 3). Hence we accepted the continuous time series analyses as valid and have presented the associated fishery characterisation, CPUE analyses, and diagnostics.

4.1 Catch and species distribution

Throughout the 22 year North Island time series, shortfin estimated groomed catches overall were more than twice that of longfin, but over the last five years as longfin catch has decreased, shortfin accounted for 84% of the catch (see Figure 6). The species catch composition from groomed estimated catch in the last five years is the same as that recorded for the landed catch (Beentjes 2013). Shortfin is the dominant species with respect to catch proportions in all ESAs except Rangitikei-Wanganui (AH), Wellington (AM), and Taranaki (AJ) which have yielded more longfin (see Table 3, Figure 5). Hauraki (AC) yielded the highest proportion of shortfin in the catch at more than 5 to 1.

The relative proportions of the North Island eel catch contributed by each ESA from 1990–91 to 2011–12 have remained largely unchanged since the 1980s (Jellyman 1994). The largest contributors of eels continue to be the Waikato (AD) with 27%, and Northland (AA) with 20% of the North Island eel catch (see Table 3). The key areas for longfin since 1991 have been, in descending order, Waikato (AD), Northland (AA), Rangitikei-Wanganui (AH), and Taranaki (AJ), which together represent about 61% of the total longfin catch (see Table 3). Similarly, for shortfin, the key areas have been Northland (AA), Waikato (AD), Hawke's Bay (AG), and Auckland (AB) which together represent 64% of the total shortfin catch (see Table 3).

Historic reporting of catches as EEU has presented problems in the catch effort analyses for individual eel species. The extent to which EEU rather than LFE or SFE was recorded by fishers varied between regions. It was used extensively in Waikato (71% of catch before 2002) and Northland (34% of catch before 2002), and resulted in considerable data loss in the individual species CPUE analyses, although this was offset to some extent by the large data sets for both these areas. Replacement of the CELR form with the ECER and ECLR on 1 October 2001 did not give the option of recording EEU and there have been no records of EEU in the catch effort data since 2000–01.

4.2 Estimated catch and factors affecting CPUE indices

Catch effort reporting forms

In the freshwater eel fishery, catch of each species is estimated by observation of catches in fyke nets or in holding bags, rather than from standard fish bins containing separated species as in marine fisheries. There is therefore the possibility that in catches dominated by one species, the minor catch may be overlooked or underestimated. Only two species (SFE and LFE) are caught in any abundance in fyke nets and these will always have been included in the catch-effort section of CELRs which only allows reporting of the top five species, whereas the current ECER form (introduced 2001–02) has dedicated fields for SFE and LFE catch.

Loss of data from grooming and use of EEU code

Overall, total groomed estimated eel catch used in the CPUE analyses was 87% of the total reported landed catch for the North Island over the 22 year time series (see Figure 4). Before 2001, between 6 and 11% of records were deleted because of errors in reporting on CELRs (Beentjes & Dunn 2003a). With the introduction of the ECER form in 2001–02, very few records were removed from the analyses during grooming. The trends in estimated and landed total eel catch are similar, however, indicating that estimated catch is likely to be proportional to total landed catch, and hence can be legitimately used for CPUE analysis. The estimated species catch as a proportion of the landed catch is less because we also lose all catch (22%) that was reported as EEU from the analyses (see Figure 4). Hence, shortfin groomed estimated catch is 81% and longfin 72% of respective species landed catch and this discrepancy occurs almost entirely before 2002.

Although the CPUE analyses are missing catch effort data before 2001 because of grooming deletions, and have less species specific catch effort data because of the option available to fishers of reporting EEU before 2002, both the catch and effort from these records are excluded from analyses. Hence we end up with less data before 2002 in our CPUE analyses, but of higher quality.

Non-reporting of legal sized eels on catch effort forms

A further issue is the non-reporting of the estimated catch for eels returned alive to the water. Fishers are legally entitled to return eels of legal size (220 g to 4000 g) to the water, but are still legally required to complete the catch effort section of the ECER including estimates of released legal sized eels, and to report the released estimated catch as 'Destination X' in the ECLR destination field. Unfortunately the original instructions to fishers by MPI on ECLRs did not include destination X as a reporting option and hence it was not used. This has been rectified and fishers should now be reporting destination X on ECLRs. Discussion with North Island fishers at the Eel Working Group meeting on 25 July 2013 (EELWG-2013-23) (http://cs.fish.govt.nz/forums/thread/8725.aspx) suggest that the non-reporting of legal sized longfin eels on ECERs was common, i.e., eels caught and released were not entered into the estimated catch field of ECLRs. The reason that fishers do not always report released legal sized eels on ECERs or ECLRs is because they have had no practical field procedures in place to estimate quantities of these eels which are 'flicked' out of the nets before the retained catch is put in holding bags (Pers. Comm., Mike Holmes, commercial eel fisher). This is more likely to have been an issue in recent years (2008–09 to 2010–11) when there was no market for medium sized longfin eels and fishers were discouraged from landing these sized eels into the North Island processors. Further, a 58% cut to North Island longfin quota in 2007–08 and the withholding of quota for lease by the major North quota holder in 2010–11 resulted in many fishers having insufficient quota to cover their catch of longfin which are necessarily released alive upon capture. This is a particular problem for QMA 23 (ESAs AH, Rangitikei-Wanganui; AJ, Taranaki) where longfin quota was reduced from 41 to 9 tonnes in 2007–08 and fishers often have no option but to either target shortfin by fishing in areas where longfin are not commonly caught, or to release longfin caught. There is also a voluntary code of practice to release longfin eels caught that are in a migratory condition although there is no information on compliance.

The implications for CPUE are that the effort (i.e., number of fyke nets) will be fully recorded, but not always the total amount of catch associated with that effort. If non-reporting of released legal sized longfin eels is commonplace then we would expect estimated catch and CPUE indices in recent years to be conservative. We will only know the magnitude of the unreported released catch if fishers begin to correctly fill in their ECERs and ECLRs, after which we would expect the estimated catch to exceed the landed catch if this was significant. Indeed, if both forms are filled out correctly, we expect the sum of the landed greenweight and estimated catch recorded in the destination X field of ECLRs to be equal to the estimated catch on ECERs (assuming that estimates of catch are close to the actual catch).

Release of over 4 kg eels

Also missing from the estimated catch are longfin eels over 4 kg which must legally be returned to the water on capture (in fishing regulations from April 2007), but are not required to be reported on ECERs or ECLRs because they do not fall within the legal size limit. The extent of these over 4 kg longfin eel releases, while unknown, is thought to be minor from most commonly harvested fisheries, but nonetheless will underestimate CPUE indices for longfin eels after April 2007. The planned introduction of a voluntary logbook programme to both the North and South Islands, should capture the release of over 4 kg longfin eels as well as other information such as finer scale catch location details.

Escape tube modifications

The legal escape tube size in the North Island eel fishery until recently was 25 mm and was designed to allow eels smaller than 220 g (minimum legal size, MLS) to escape from the fyke nets if captured, although in practice eels below the MLS are often caught. A voluntary code of practice has been in place in the North Island since 2010–11 to use 31 mm tubes, although the level of compliance by fishers is unknown. This became a legal requirement on 1 October 2013, consistent with the South Island where 31 mm has been the legal escape tube size since 1996–97. A 31 mm escape tube can be expected to retain eels larger than about 300 g, hence the North Island CPUE for both species may be conservative in 2010–11 and 2011–12 as eels that would previously have been retained and contribute to the catch, are able to escape. Further, processors agreed not to process eels less than 300 g since about 2009–10 and for one processor as far back as 2006–07 for longfin eels. Most of these eels (220 g to 300 g), if caught by fishers were released at the point of capture and any that were landed into processors were graded out and returned to local rivers without being weighed (Dale Walters, NZ Eel processors, Pers. Comm.). Based on what we learned about fisher field practices, as described above, the small released eels of legal size (220 g to 300g) will not always have been recorded on ECERs and again this will result in a conservative estimate of CPUE for the years concerned.

4.3 CPUE analyses

4.3.1 Core fishers used in CPUE analyses

The restriction of CPUE analyses to core fishers ensured that only committed and experienced fishers (having had at least three years in the fishery) were included in the analyses, hence reducing the overall variability in catch rates. This resulted in very little loss of data, but often considerable loss of fishers from the analyses (see Appendix 2). This was not a problem before the introduction of North Island eel stocks into the QMS in 2004–05 because the fishery was in effect closed to new entrants and few fishers exited the fishery. This was because in order to be eligible to convert provisional catch history to quota shares, fishers needed to have held a fishing permit at the date of the gazette notice of the Minister's decision to introduce North Island eel stocks into the QMS (D. Allen, previously Ministry of Fisheries, pers. comm.).

Following the introduction of the fishery into the QMS, quota shares were allocated and harvesting rights were transferable. TAC/TACCs were set substantially below historic catches, and many long term fishers exited the fishery and were replaced by fewer new entrants. Our exploration of the permit identities from unencrypted data provided by Ministry of Fisheries (now MPI) Research Data Management (RDM) during the previous North Island CPUE analyses (Beentjes & Dunn 2010) revealed that in reality many of the post-QMS entrants were experienced eel fishers by virtue of having previously fished on behalf of other permit holders under FOTFAV (fishing-other-than-from-a-vessel) agreements; many of these fishers subsequently fished ACE (Annual Catch Entitlement). Indeed, in many cases civil agreements were in place for the transfer of harvesting rights from the original permit holder to their agents once eels had entered the QMS. Linking these fishers with the earlier permit holder to a large extent improved the continuity of the time series for all areas. Regardless, comparison of CPUE indices between pre-QMS/post-QMS and continuous time series showed that despite the loss of existing fishers and arrival of new entrants post-QMS, the continuous time series remained unaffected.

4.3.2 Standardised CPUE analyses

The standardised CPUE analyses take into account the effects that the variables: lifts, fisher (permit), season (month), moon phase, and river flow may have had on catch rates (see Appendix 4). The three variables, permit, lifts, and month were included in all models, with lifts and permit typically explaining the most variability in the models (see Appendix 3). The finding that month was an important variable affecting catch rates is understandable since water temperature varies seasonally and eel catch rates have been found to decline markedly in winter (Jellyman 1991, 1997). Further, apart from the northern ESAs, fishing is mainly seasonal in the North Island with little fishing and processing of eels in the winter months (see Figures 7 and 8). The inclusion of permit indicates the importance of fisher experience and/or ability on catch rates. Lifts was always included as it is the key indicator of relative effort. River flow entered the model for six areas for shortfin and only one area for longfin, which is consistent with the fishing practices and increased vulnerability of shortfin during flood events. Moon phase entered the model only twice, in both cases for longfin. Despite the inclusion of explanatory variables into the model there was often little difference between the plotted trends of the unstandardised and the standardised CPUE indices. The step and influence plots were useful for explaining how the different variables entering the model altered the annual CPUE coefficients.

4.3.3 Shortfin CPUE summary

Shortfin standardised CPUE analyses were carried out for all North Island ESAs, except ESA AM, from 1991 to 2012 and were acceptable for all ESA analyses. The standardised CPUE indices are shown in Figure 9 for all ESAs. For each ESA the trends in shortfin standardised CPUE are summarised as follows:

1. Northland (ESA AA): A progressive increase in CPUE over the time series. The narrow confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses.
2. Auckland (ESA AB): Variable until after 2002 when it generally increases. The narrow confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses.
3. Hauraki (ESA AC): CPUE fluctuated without trend until 2007, after which it increased steeply. The narrow confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses.
4. Waikato (ESA AD): Stable initially, declining from 1996 to 2003 followed by an upward trend until 2011. The narrow confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses.
5. Bay of Plenty (ESA AE): Variable, with a slight decline overall until 2002, and then increasing steeply. The narrow confidence intervals around the indices before 2005 indicate that there were adequate fishers and catch in these analyses, but after that the confidence intervals are much larger reflecting the loss of fishers and data.
6. Poverty Bay (ESA AF): CPUE fluctuated without trend until 2003, after which it rose steeply. Wide confidence intervals around the indices and missing years reflect the paucity of fishers and data, particularly after 2005.
7. Hawkes Bay (ESA AG): A declining trend in CPUE until 2002 and thereafter increasing. The narrow confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses.
8. Rangitikei-Whanganui (ESA AH): Relatively stable until 2005 after which it increases steeply. The wider confidence intervals around the indices after 2005 reflect the loss of fishers and data in the analyses.

9. Taranaki (ESA AJ): No trend in CPUE until 2005 after which it increases steeply. The wider confidence intervals around the indices after 2005 reflect the loss of fishers and data in the analyses.
10. Manawatu (ESA AK): An initial steep decline in CPUE followed by a flat period from 1994 to 2003 and then an increase in 2004 followed by a second flat period. The confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses.
11. Wairarapa (ESA AL): A general decline in CPUE until 2004 followed by an increase. The confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses for most years.
12. Wellington (ESA AM): no CPUE analyses carried out because of insufficient data.

4.3.4 Longfin CPUE summary

Longfin standardised CPUE analyses were carried out for all North Island ESAs, except ESA AM, from 1991 to 2012 and were acceptable for all ESAs with the exception of ESA AF (Poverty Bay). The standardised CPUE indices are shown in Figure 9. For each ESA the trends in standardised CPUE were as follows:

1. Northland (ESA AA): Overall the CPUE indices decline from about 2000 to 2009, and are then stable over the last four years. The confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses.
2. Auckland (ESA AB): CPUE declines steeply from 1991 to 2005 although the indices are unstable and confidence intervals are relatively large. From 2005 to 2012 indices have stabilised.
3. Hauraki (ESA AC): CPUE declines steeply from 1991 to 2004 and then levels outs, but continues to decline slightly until 2010, before increasing again. The confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses
4. Waikato (ESA AD): An overall decline in CPUE until about 2008 after which it increases. The confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses.
5. Bay of Plenty (ESA AE): Overall the CPUE declines from about 1991 to 2005, and since then has fluctuated without trend. The high confidence intervals around the indices indicate that there were few fishers and little catch in these analyses.
6. Poverty Bay (ESA AF): The CPUE indices are highly variable with large confidence intervals, missing years, and only extend to 2007. There are insufficient fishers and catch in this analyses to be considered indicative of longfin abundance in Poverty Bay.
7. Hawkes Bay (ESA AG): Variable CPUE indices with a progressive decline to 2011 and an increase in the last year. The confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses for most years.
8. Rangitikei-Whanganui (ESA AH): Overall CPUE shows a continual decline throughout the time series, but this is less steep and more variable after 2004. The confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses.
9. Taranaki (ESA AJ): A general decline until 2003, then fluctuating without trend after this date. The confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses.
10. Manawatu (ESA AK): CPUE has largely fluctuated without trend, with higher interannual variability and large confidence intervals in some years The confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses for most years.
11. Wairarapa (ESA AL): An overall decline until 2003, after which it has fluctuated without trend. The confidence intervals around the indices indicate that there were adequate fishers and catch in these analyses for most years.
12. Wellington (ESA AM): No CPUE analyses carried out because of insufficient data.

4.3.5 General CPUE trends and comments

Shortfin

In general CPUE for shortfin, with the exception of Northland (ESA AA) where CPUE steadily increased throughout the time series, either initially declined or there were no trends, followed by strong increases, beginning from 2002 to 2007 (Figure 9).

The transition from declines to increases or flattening of CPUE for shortfin generally occurred soon after the introduction of North Island eel stocks into the QMS in 2004–05 and may reflect the reduced catch and effort in the fishery. Further shortfin reductions in catch through a 26% TACC reduction in 2007–08 is likely to have contributed to the improved CPUE for North Island shortfin. Indeed, the North Island shortfin TACC was caught for the first time in 2011–12. Perception from the eel industry is that there is not an issue with sustainability of shortfin catches in the North Island. The most recent South Island CPUE indices also displayed a general reversal in declining trends and/or an increase in CPUE for both longfin and shortfin after the QMS was introduced in 2000–01, and this was attributed to the reduction in catch and effort (Beentjes & Dunn 2013). As discussed, the non-reporting of legal sized shortfin under 300 g returned alive to the water, and the introduction of the 31 mm escape tubes in 2010–11, suggest that the shortfin CPUE estimates are conservative, at least since about 2009–10.

Longfin

For longfin there were generally less data than for shortfin for most areas and indices were often more variable or associated with wider confidence intervals. In general, apart from Rangitikei-Whanganui (ESA AH) which showed a steadily declining CPUE trend throughout the time series, CPUE initially declined, and then was either flat with no clear trend or there was an increase in CPUE between 2005 and 2011. Most increases in CPUE were only slight.

The longfin fishery appears to be showing indications of a halt and in some cases a reversal in the declines in CPUE that were observed in previous analyses. The North Island longfin combined TACC was reduced by 58% in 2007–08 and we could expect these substantial reductions in catch to be reflected in CPUE indices. The North Island longfin TACC was also caught in 2011–12, the first time this has occurred. As discussed, the non-reporting of legal sized and over 4 kg longfins returned alive to the water, and the introduction of the 31 mm escape tubes in 2010–11, suggest that recent longfin CPUE estimates are conservative, at least since about 2007–08.

5. ACKNOWLEDGMENTS

This research was carried out by NIWA under contract to the Ministry for Primary Industries (Project EEL2012/01). We thank the Eel Working Group for discussion of the preliminary analyses, Jacques Boubée (NIWA) and Marc Griffiths (Ministry for Primary Industries) for comments on the manuscript, and Marianne Vignaux for editorial comments. We acknowledge Northland, Auckland, Horizons, Waikato, and Greater Wellington Regional Councils, and Trust Power for providing river flow data and Kathy Walter (NIWA) for coordinating the provision of these data.

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Table 1: Eel Quota Management Areas (QMAs) for longfin (LFE) and shortfin (SFE) eel stocks and both species combined (ANG), current Eel Statistical Areas (ESA, from October 2001), and the associated historical ESA up to October 2001.

	QMA		ESA		
Area	LFE	SFE	Alpha (from 1 Oct 2001)		Numeric (before 1 Oct 2001)
Northland	LFE 20	SFE 20	AA		1
Auckland	LFE 20	SFE 20	AB		2
Hauraki	LFE 21	SFE 21	AC		3
Waikato	LFE 21	SFE 21	AD		4
Bay of Plenty	LFE 21	SFE 21	AE		5
Poverty Bay	LFE 21	SFE 21	AF		6
Hawke’s Bay	LFE 22	SFE 22	AG		7
Rangitikei-Wanganui	LFE 23	SFE 23	AH		8
Taranaki	LFE 23	SFE 23	AJ		9
Manawatu	LFE 22	SFE 22	AK		10
Wairarapa	LFE 22	SFE 22	AL		11
Wellington	LFE 22	SFE 22	AM		12
Nelson	ANG 11	ANG 11	AN		13
Marlborough	ANG 11	ANG 11	AP	}	14
South Marlborough	ANG 12	ANG 12	AQ	}	14
Westland	ANG 16	ANG 16	AX		15
North Canterbury	ANG 12	ANG 12	AR		16
South Canterbury	ANG 14	ANG 14	AT		17
Waitaki	ANG 14	ANG 14	AU		18
Otago	ANG 15	ANG 15	AV		19
Southland	ANG 15	ANG 15	AW		20
Te Waihora (outside-migration area)	ANG 13	ANG 13	AS1	}	21
Te Waihora migration area	ANG 13	ANG 13	AS2	}	21
Chatham Islands	LFE 17	SFE 17	AZ		22
Stewart Island	ANG 15	ANG 15	AY		23

Table 2: ESAs, regions, and the number of groomed records (equivalent to the number of fisher days), and estimated catch for shortfin, longfin, and unidentified eels from 1991 to 2012. ESA, eel statistical area.

				Estimated catch (t)		
ESA	Region	Records	Unidentified	Shortfin	Longfin	Total
AA	Northland	24 884	502 888	1 537 455	467 861	2 508 205
AB	Auckland	8461	196 311	751 225	228 664	1 176 200
AC	Hauraki	7976	67 068	601 322	107 066	775 456
AD	Waikato	41 347	1 528 776	1 335 179	506 954	3 370 910
AE	Bay of Plenty	3522	35 090	284 991	118 781	438 862
AF	Poverty Bay	924	10	158 674	50 245	208 929
AG	Hawke’s Bay	5146	21 125	809 029	257 186	1 087 340
AH	Rangitikei-Wanganui	4294	46 282	452 016	462 651	960 949
AJ	Taranaki	3689	44 043	149 840	273 589	467 472
AK	Manawatu	4183	275 947	455 011	94 326	825 284
AL	Wairarapa	3353	93 485	344 845	219 062	657 392
AM	Wellington	23	210	2405	3614	6229
Totals		107 802	2 811 235	6 881 992	27 90 000	12 483 227

Table 3: Percent of groomed estimated catch by species within and among ESAs from combined years 1991 to 2012. ESA, eel statistical area, LFE, longfin; SFE, shortfin; EEU, unclassified.

		Percent species catch within ESA				Percent species catch among ESAs			
ESA	Region	SFE	LFE	EEU		Total	SFE	LFE	EEU
AA	Northland	61.3	18.7	20.0	100	20.09	22.34	16.77	17.89
AB	Auckland	63.9	19.4	16.7	100	9.42	10.92	8.20	6.98
AC	Hauraki	77.5	13.8	8.6	100	6.21	8.74	3.84	2.39
AD	Waikato	39.6	15.0	45.4	100	27.00	19.40	18.17	54.38
AE	Bay of Plenty	64.9	27.1	8.0	100	3.52	4.14	4.26	1.25
AF	Poverty Bay	75.9	24.0	0.0	100	1.67	2.31	1.80	0.00
AG	Hawke’s Bay	74.4	23.7	1.9	100	8.71	11.76	9.22	0.75
AH	Rangitikei-Wanganui	47.0	48.1	4.8	100	7.70	6.57	16.58	1.65
AJ	Taranaki	32.1	58.5	9.4	100	3.74	2.18	9.81	1.57
AK	Manawatu	55.1	11.4	33.4	100	6.61	6.61	3.38	9.82
AL	Wairarapa	52.5	33.3	14.2	100	5.27	5.01	7.85	3.33
AM	Wellington	38.6	58.0	3.4	100	0.05	0.03	0.13	0.01
Overall		55.1	22.3	22.5	100	100	100	100	100

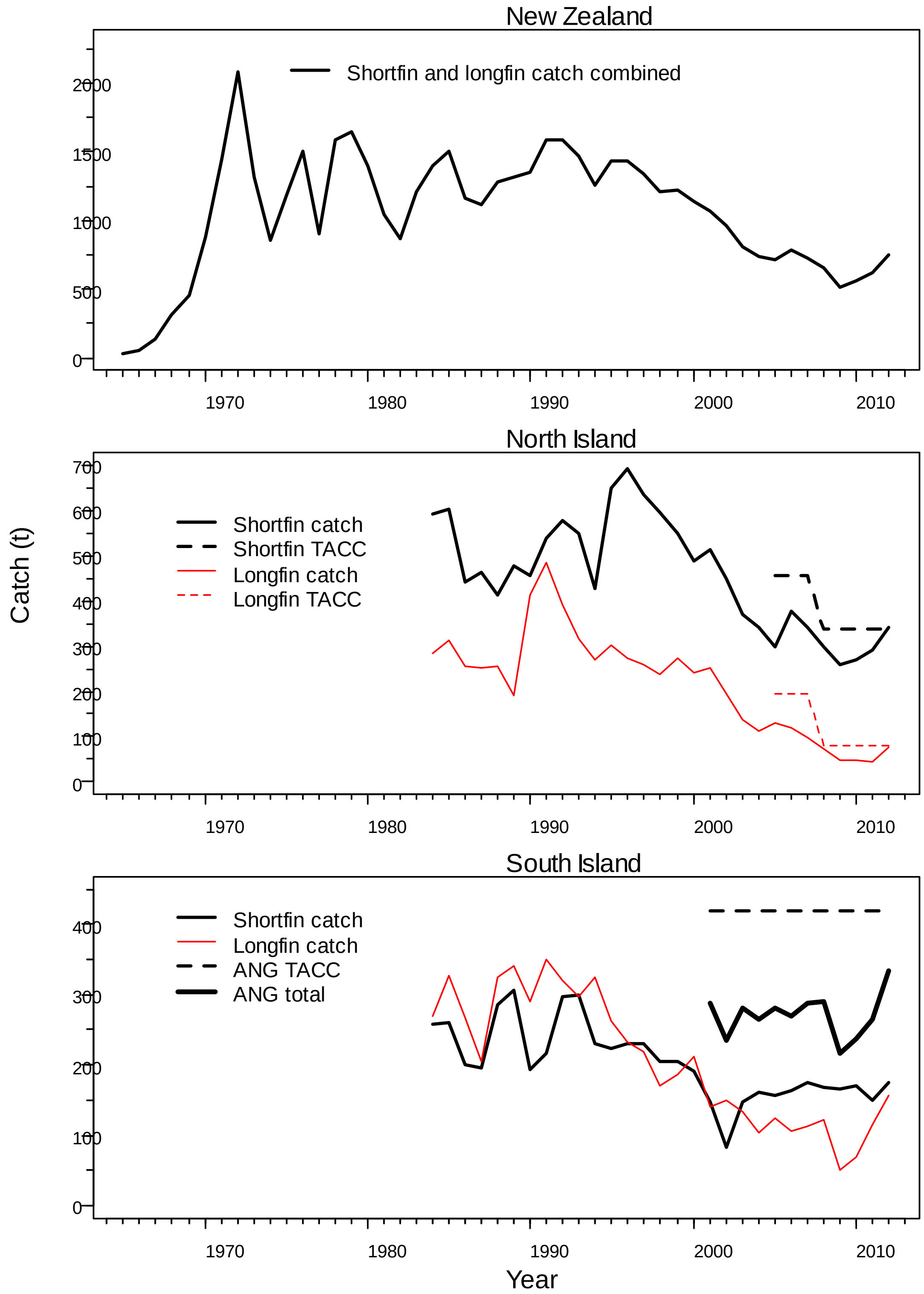


Figure 1: Landed catches of shortfin and longfin eels, and Total Allowable Commercial Catch (TACC) for each species. Data are shown by calendar year up until 1988 and by fishing year from 1988–99 onward (Data from Ministry for Primary Industries 2013). These catches are based on MAF Fisheries Statistics Unit (FSU), Licensed Fish Receiver Returns (LFRR), Quota Management Reports (QMR), and Monthly Harvest Returns (MHR).

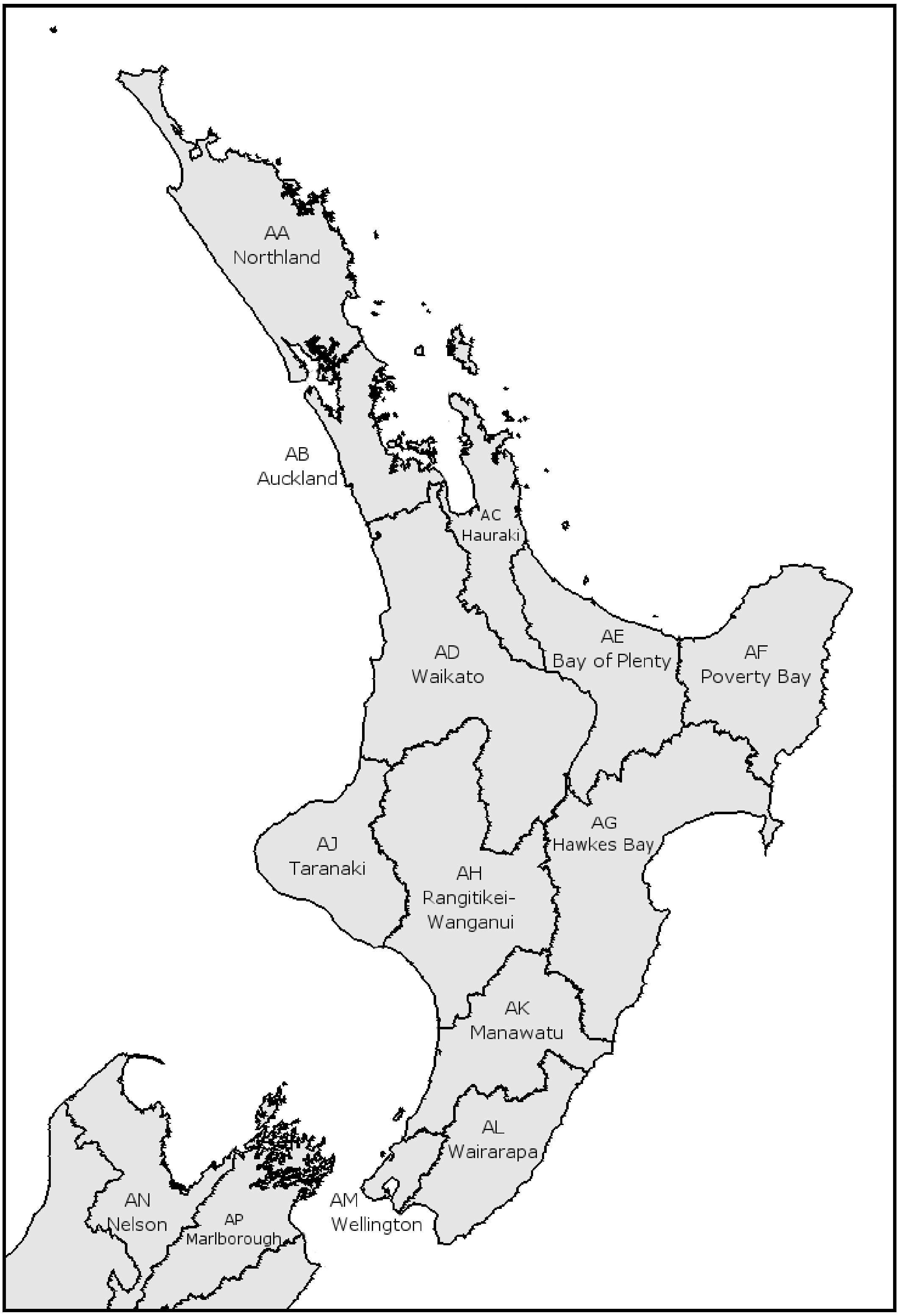


Figure 2: North Island eel statistical areas (ESAs). See Table 1 for old ESA numeric codes 13 to 23.

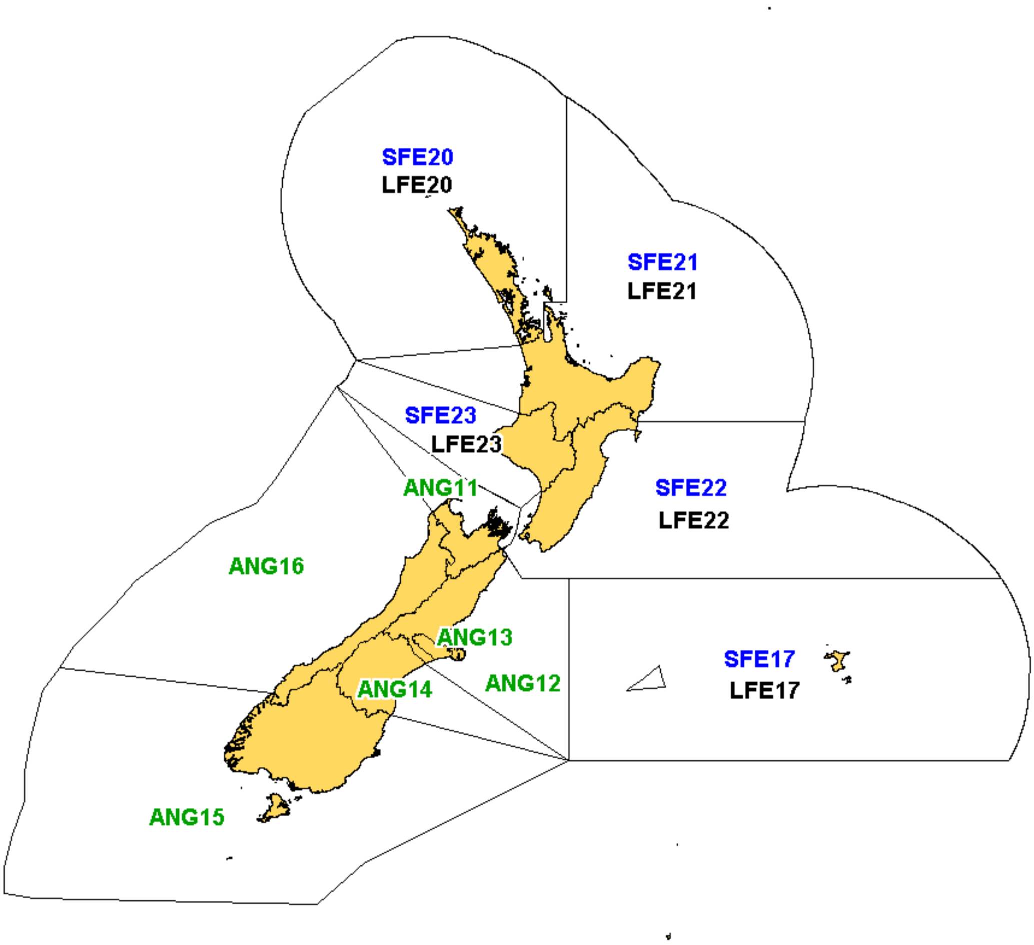


Figure 3: Quota Management Areas for the New Zealand eel fishery (see Table 1 for breakdown by eel statistical areas). Shortfin stocks are denoted by the prefix SFE, and longfin by LFE. ANG comprises both shortfin and longfin combined. (Figure from Ministry for Primary Industries 2013).

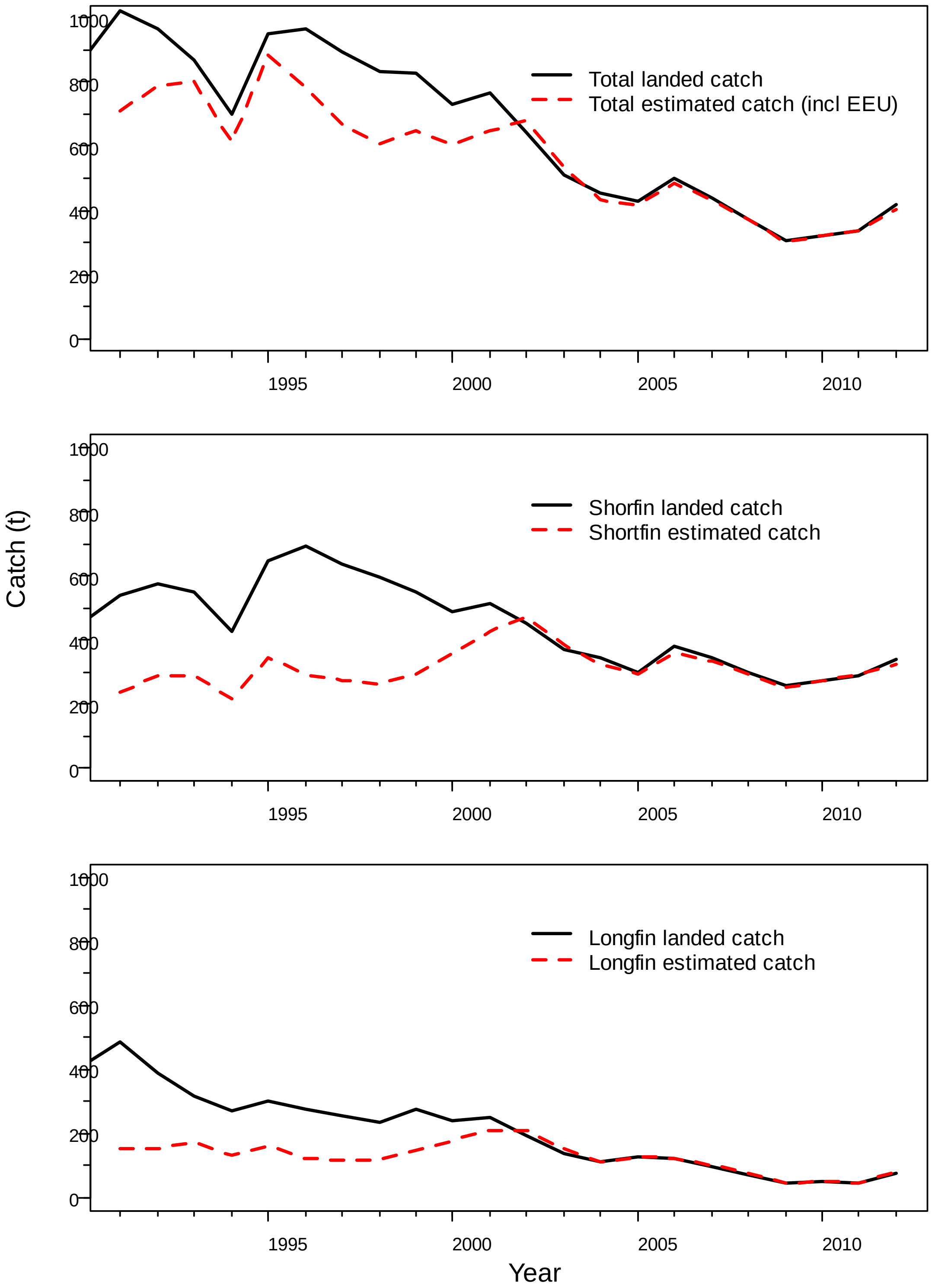


Figure 4: North Island groomed estimated commercial catch of all eels (top), shortfin (middle), and longfin (bottom) from 1991 to 2012, and landed catch from 1990 to 2012. Estimated catches are from CELR and ECER (after 2001). The landed catches are from processors (1992–2000) and LFRR/QMR (2001–2012) (Ministry for Primary Industries 2013). Dates shown represent the end of the fishing year i.e. 1991 = 1990–91 fishing year. EEU, unclassified eel catch.

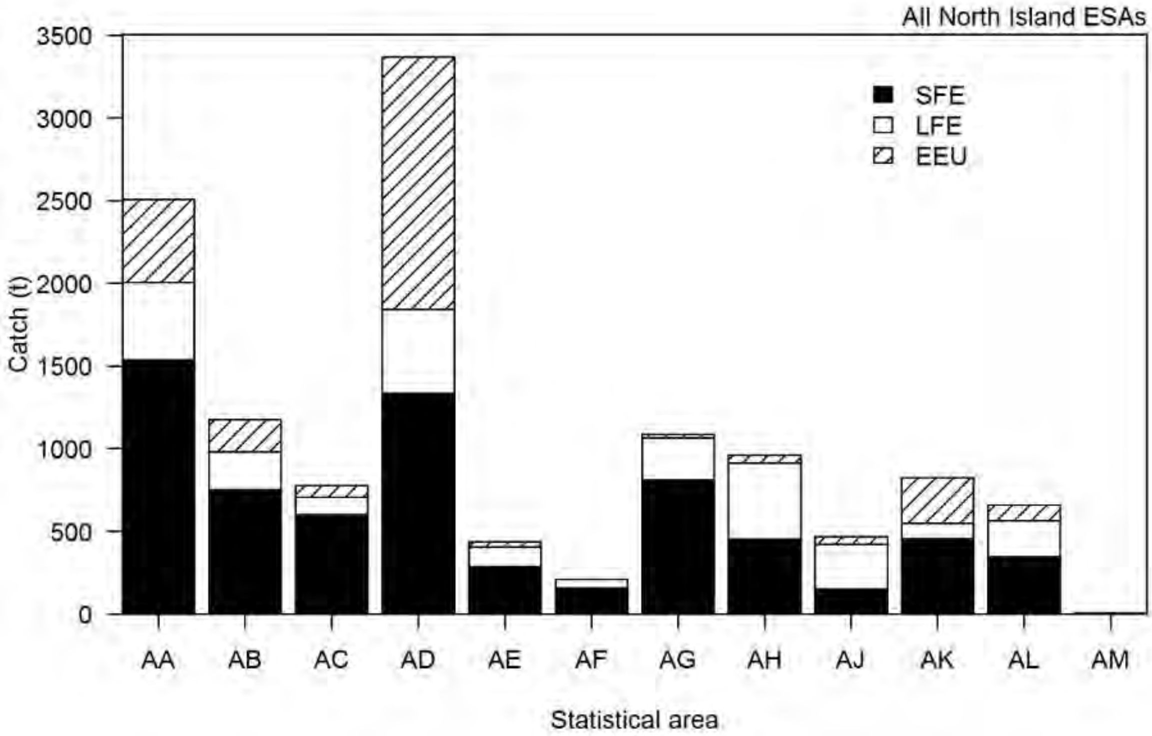


Figure 5: North Island groomed estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) by statistical area for the combined years 1990–91 to 2011–12.

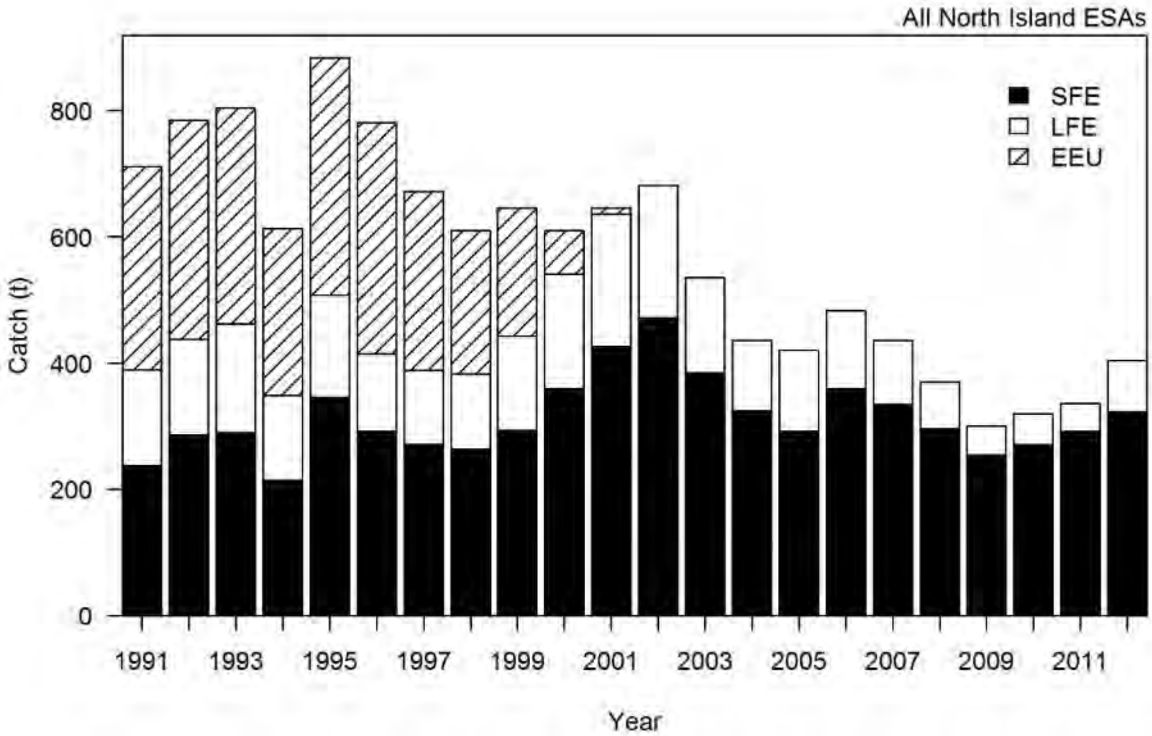
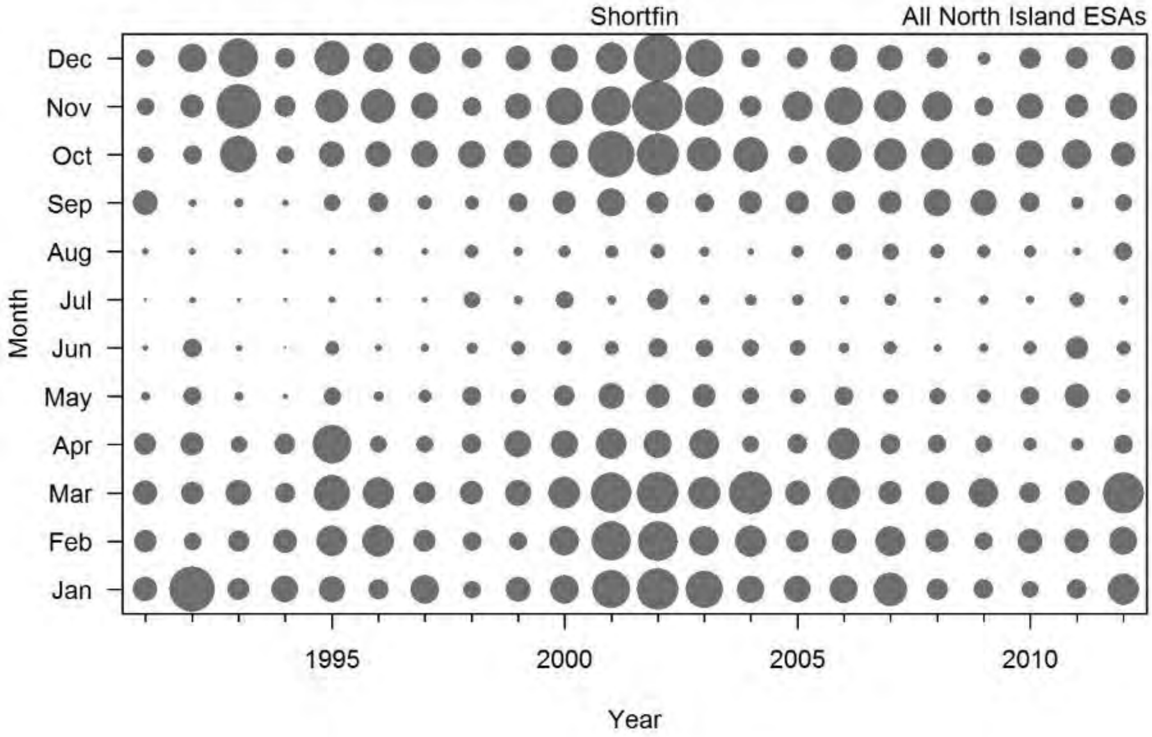


Figure 6: North Island groomed estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12. Dates shown represent the end of the fishing year i.e. 1991 = 1990–91 fishing year.



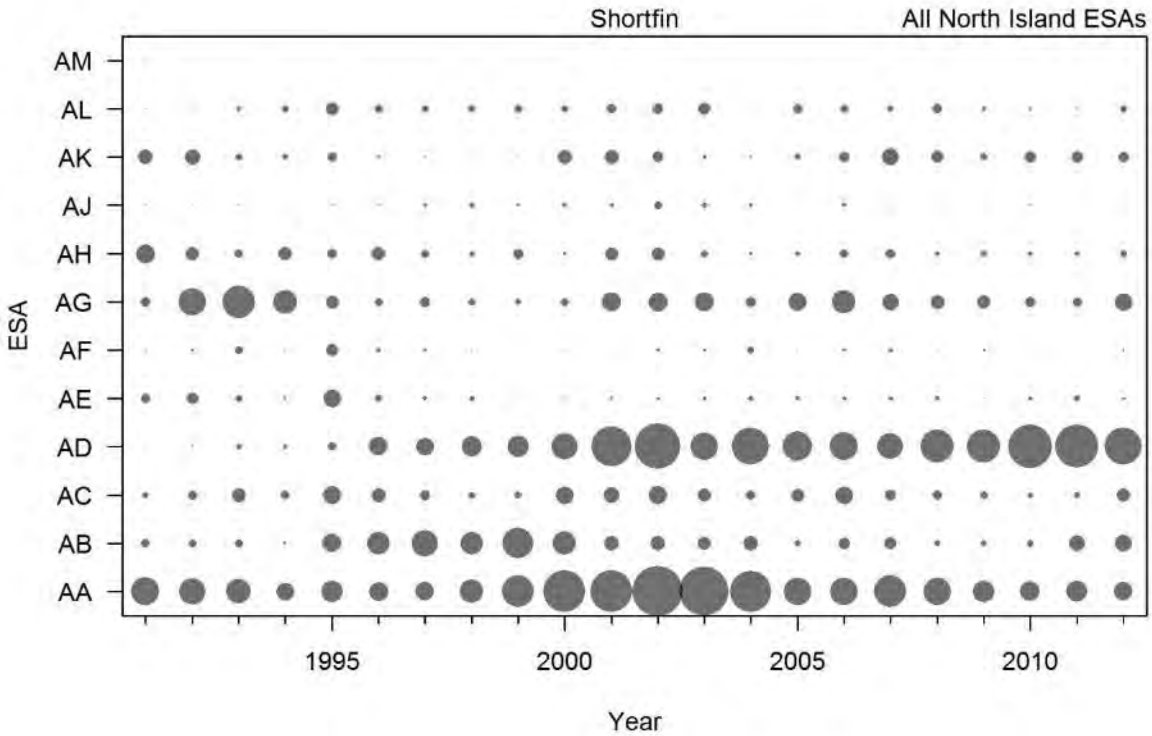
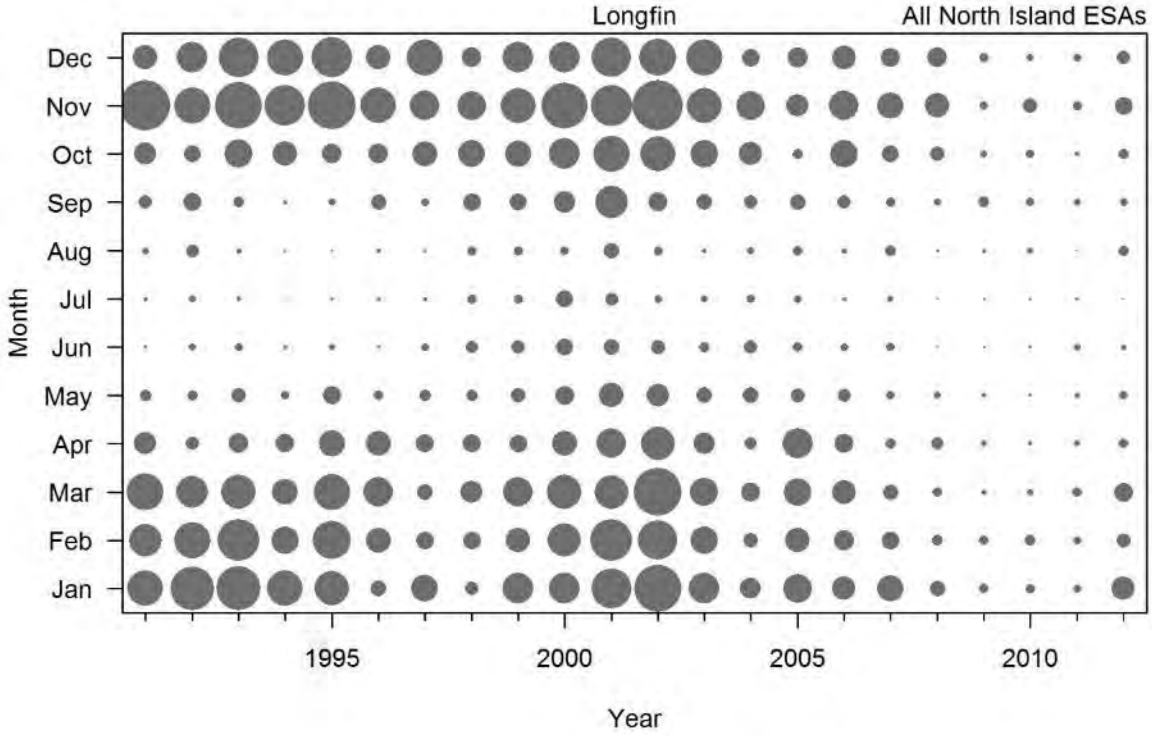


Figure 7: North Island groomed estimated commercial catch of shortfin eel by month (top) and by eel statistical area (ESA) bottom) for the years 1990–91 to 2011–12. Largest bubbles: month plot = 59 873 kg, ESA plot = 121 041 kg. Dates shown represent the end of the fishing year i.e. 1991 = 1990–91 fishing year.



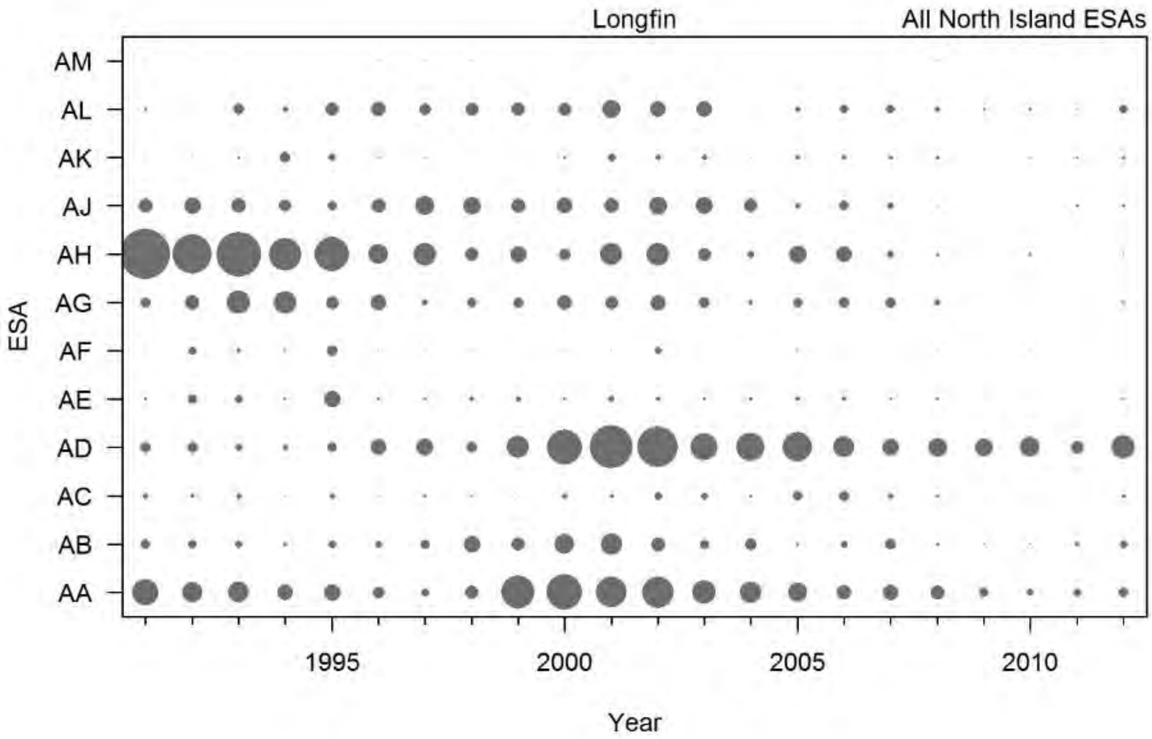
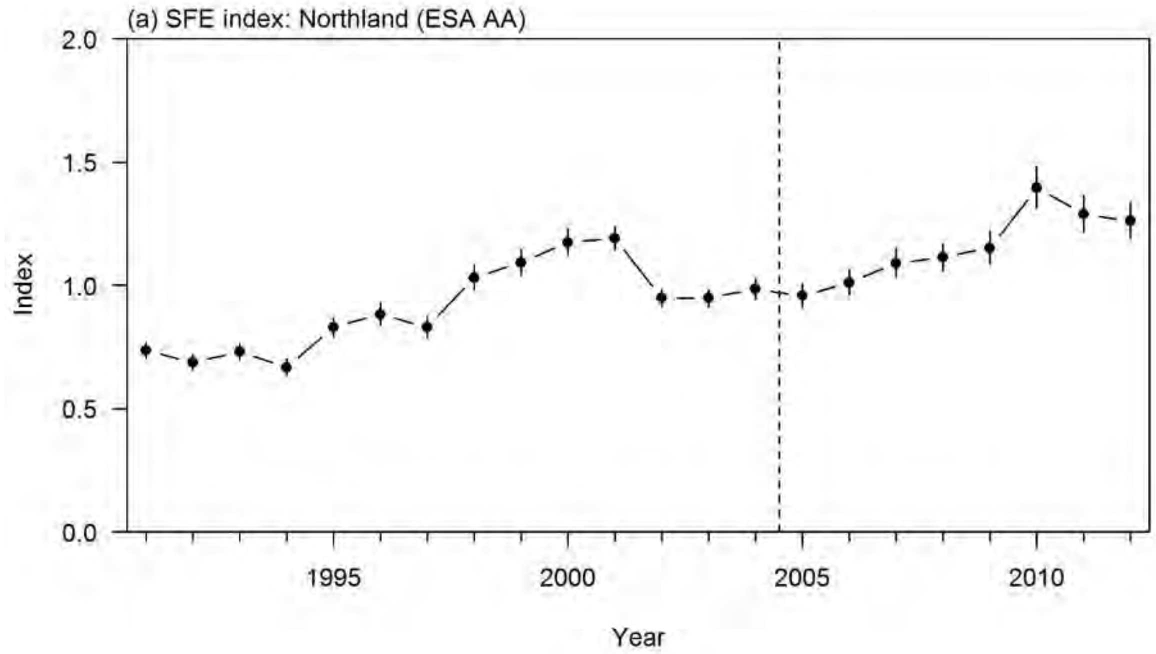


Figure 8: North Island groomed estimated commercial catch of longfin eel by month (top) and by eel statistical area (ESA) bottom) for the years 1990–91 to 2011–12. Largest bubbles: month plot = 28 809 kg, ESA plot = 57 481 kg. Dates shown represent the end of the fishing year i.e. 1991 = 1990–91 fishing year.



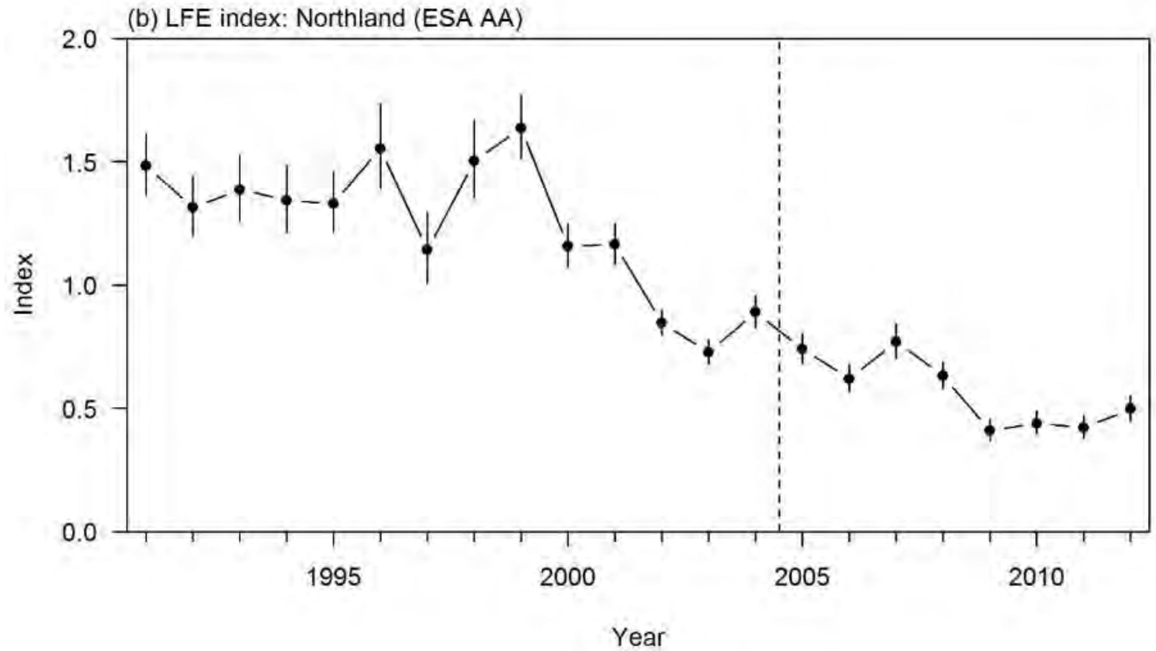
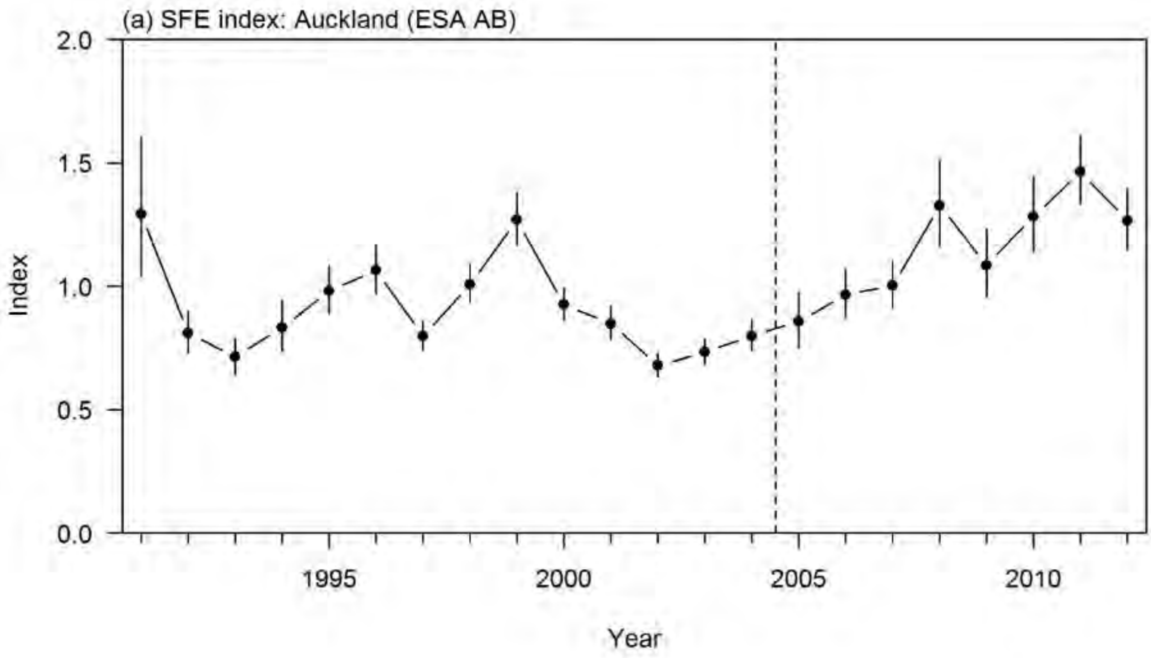
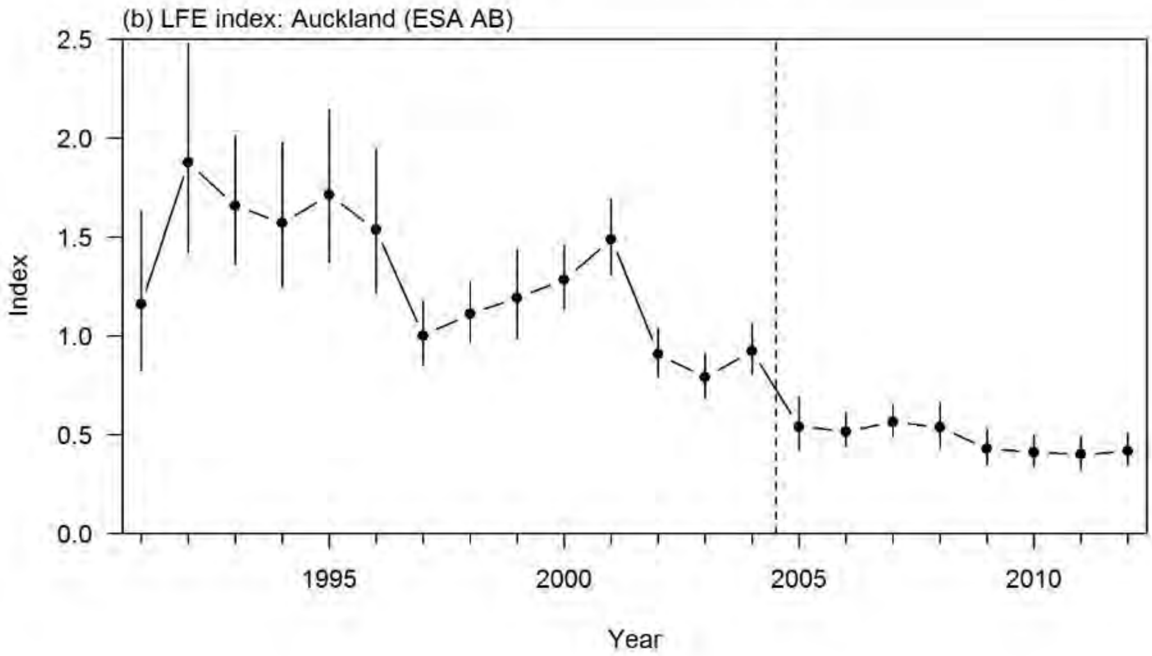


Figure 9: Standardised CPUE indices for shortfin and longfin eels for the years 1991–2012 for each North Island ESA, except AM, where there was insufficient data. The vertical dashed line indicates introduction of the QMS in 2004–05. Dates shown represent the end of the fishing year i.e. 1991 = 1990–91 fishing year.





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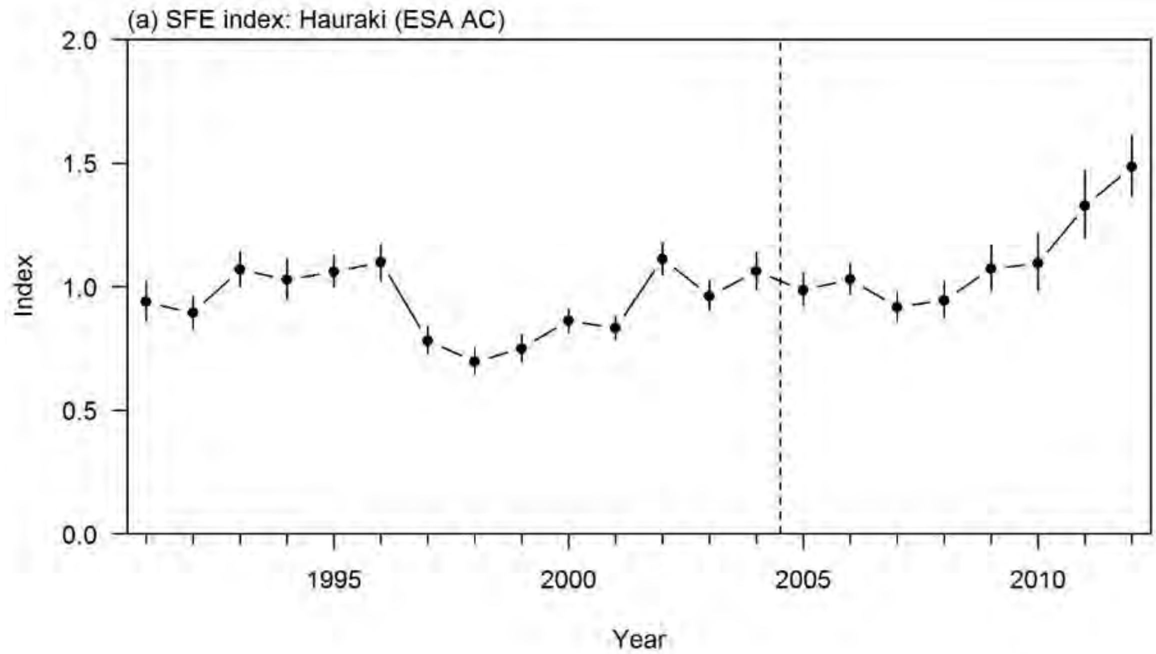

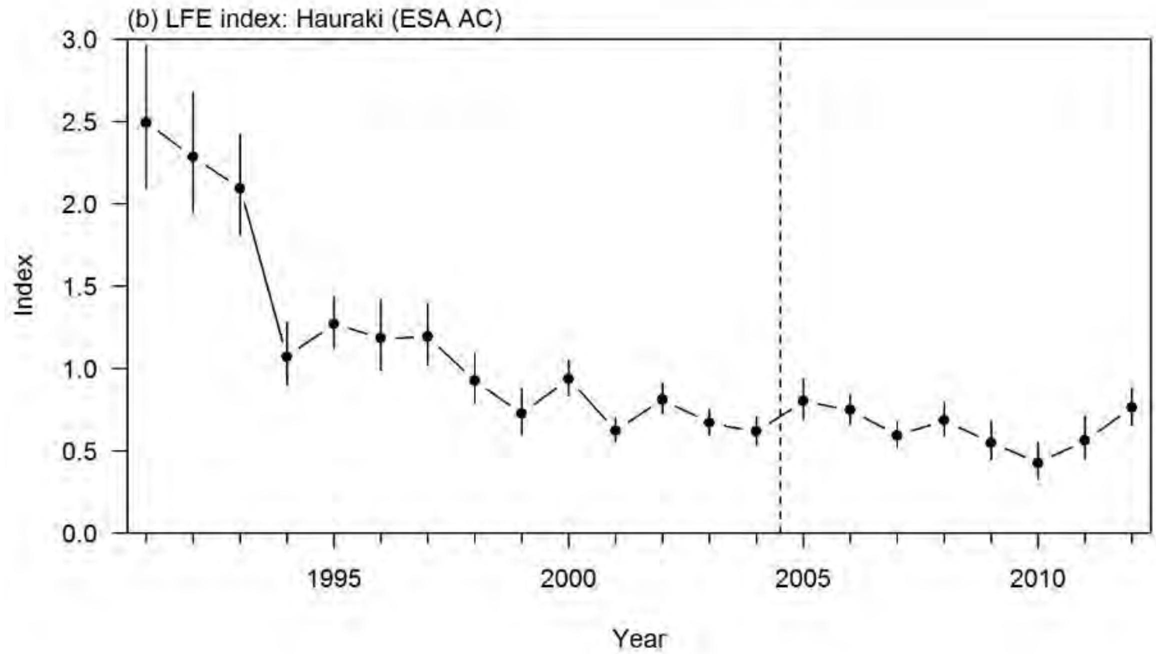

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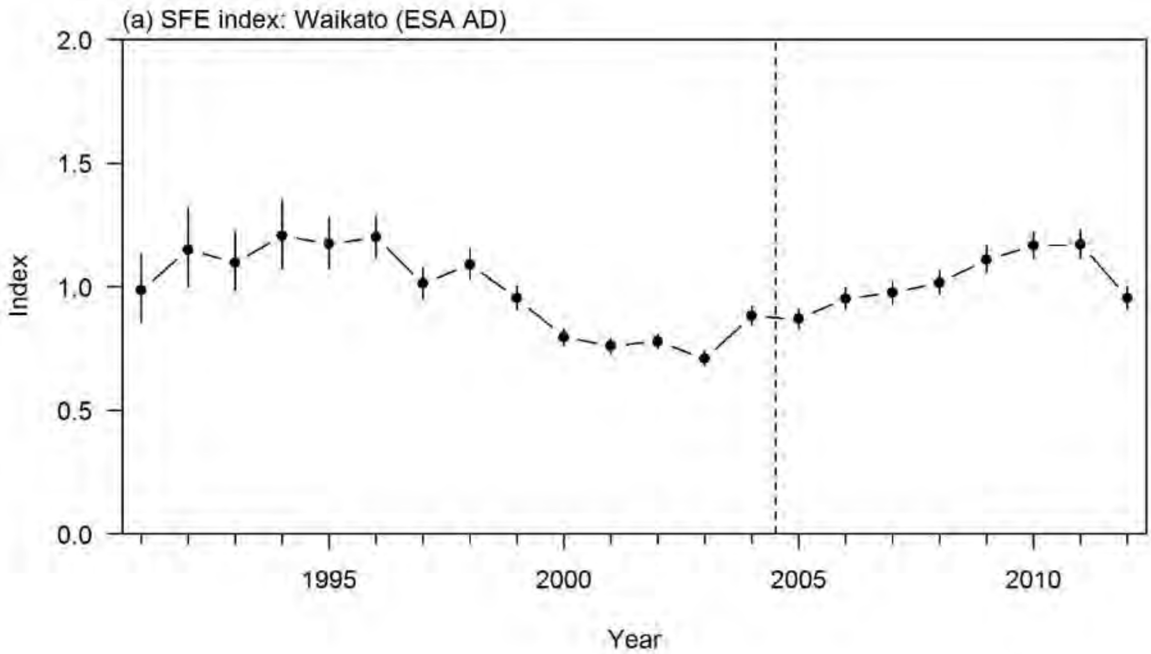

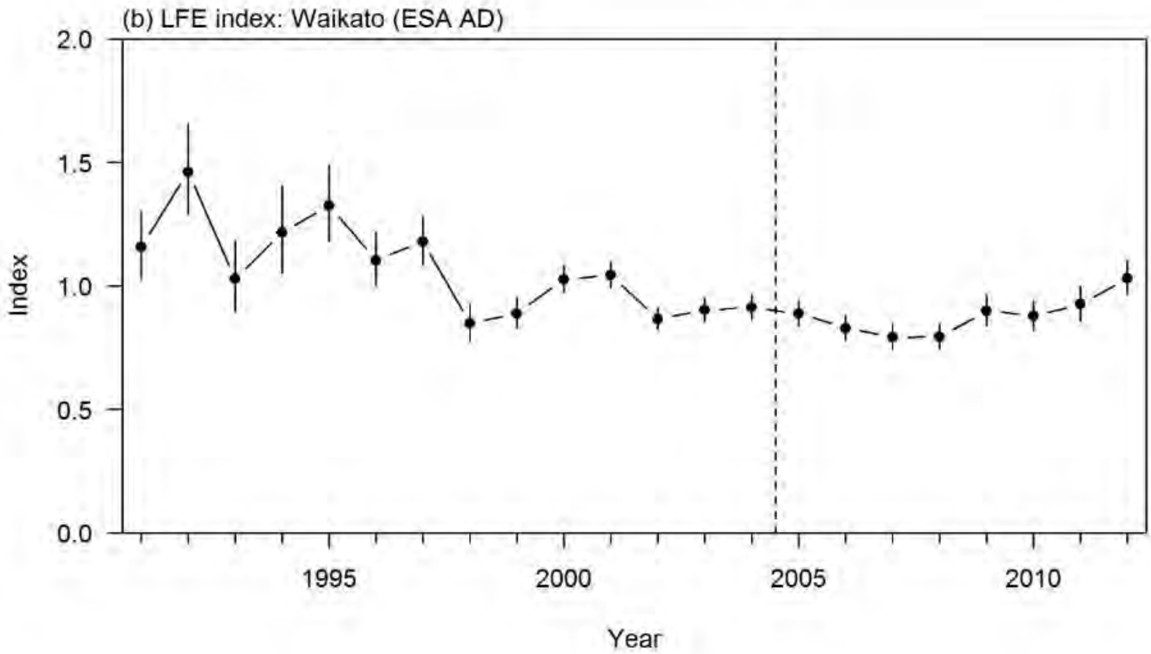

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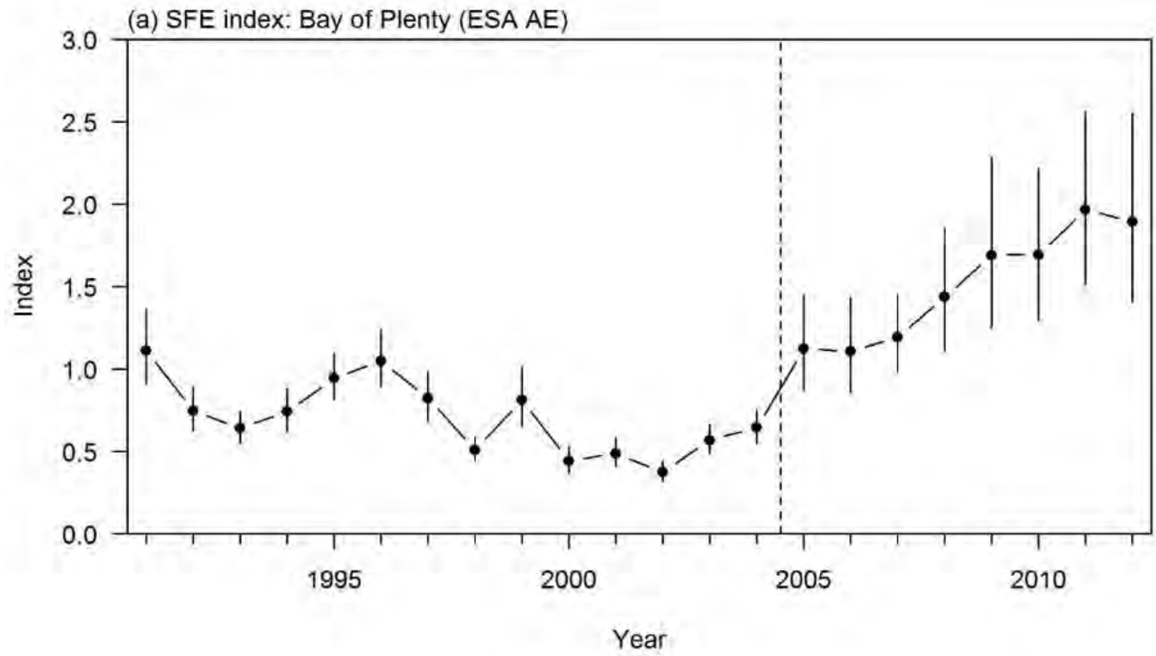

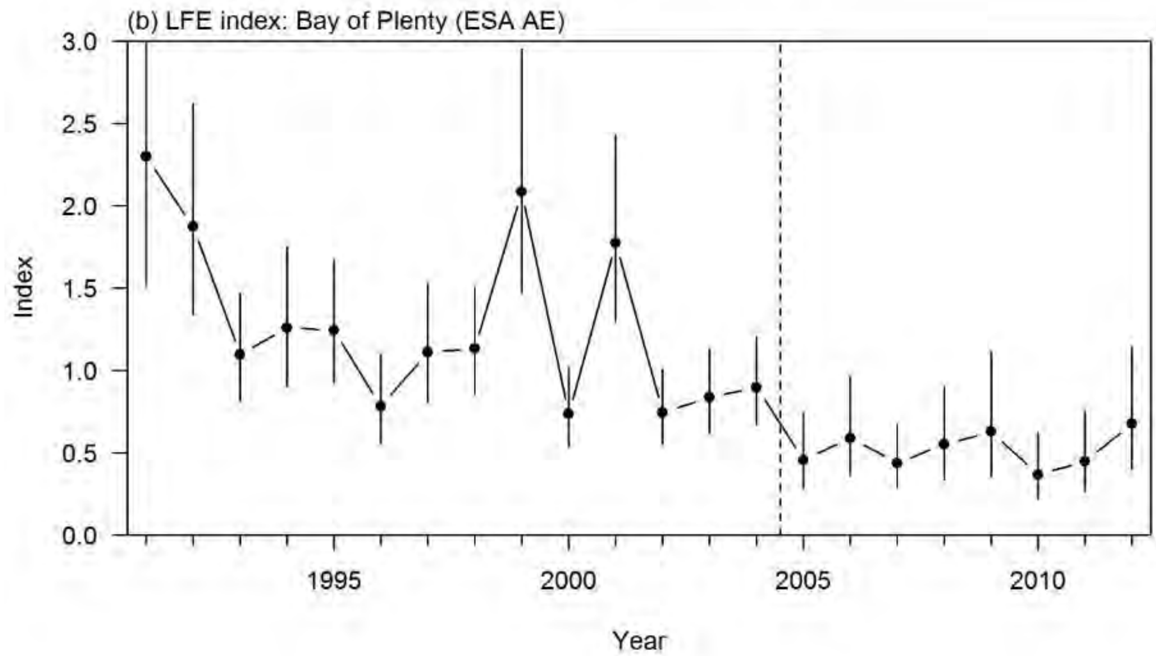

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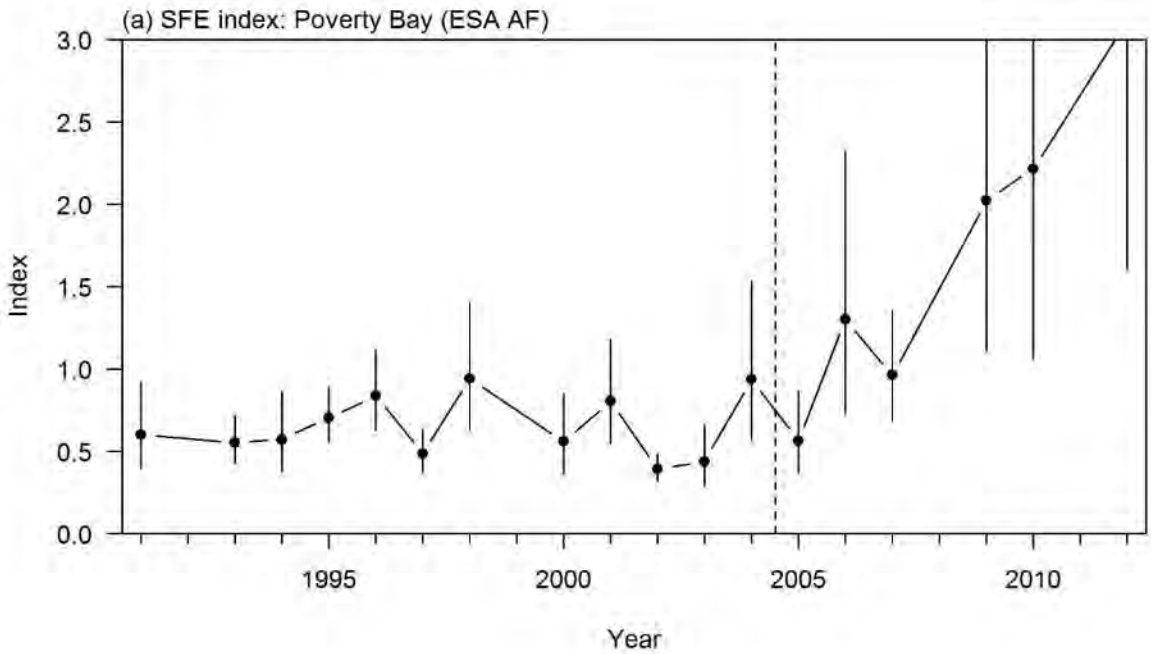

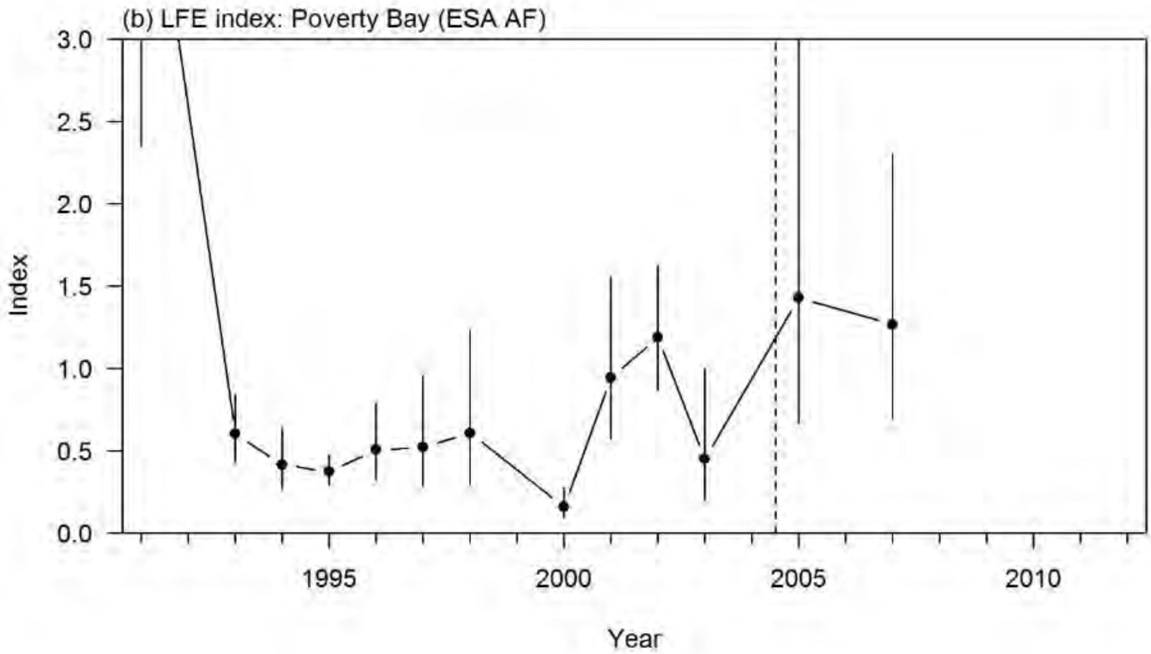

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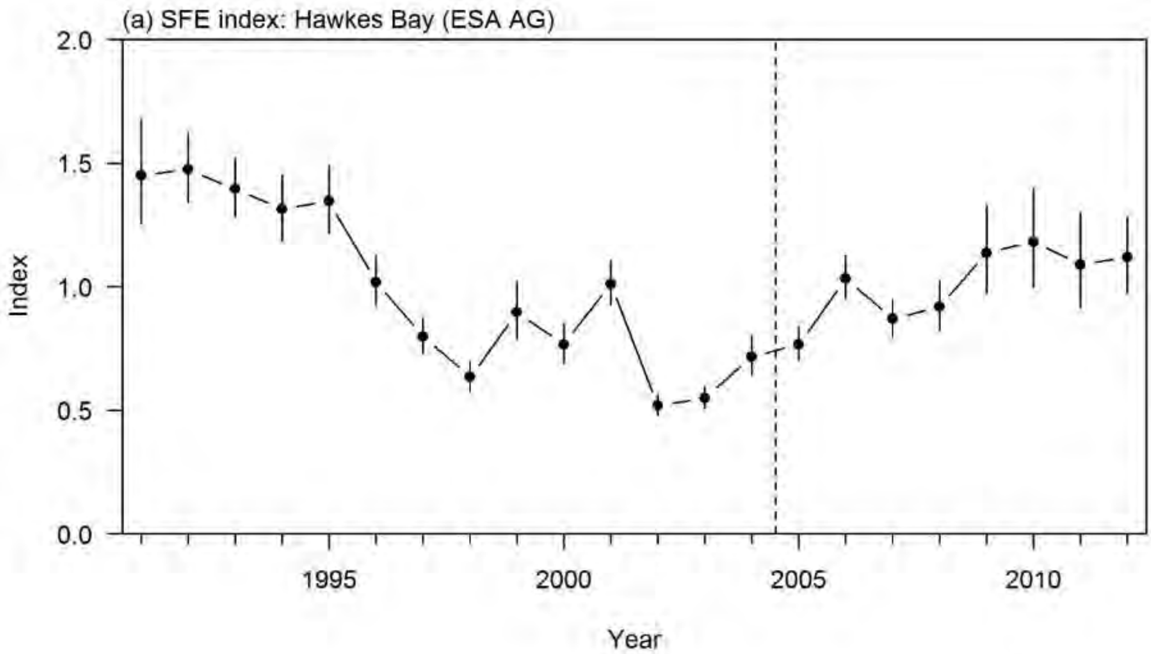

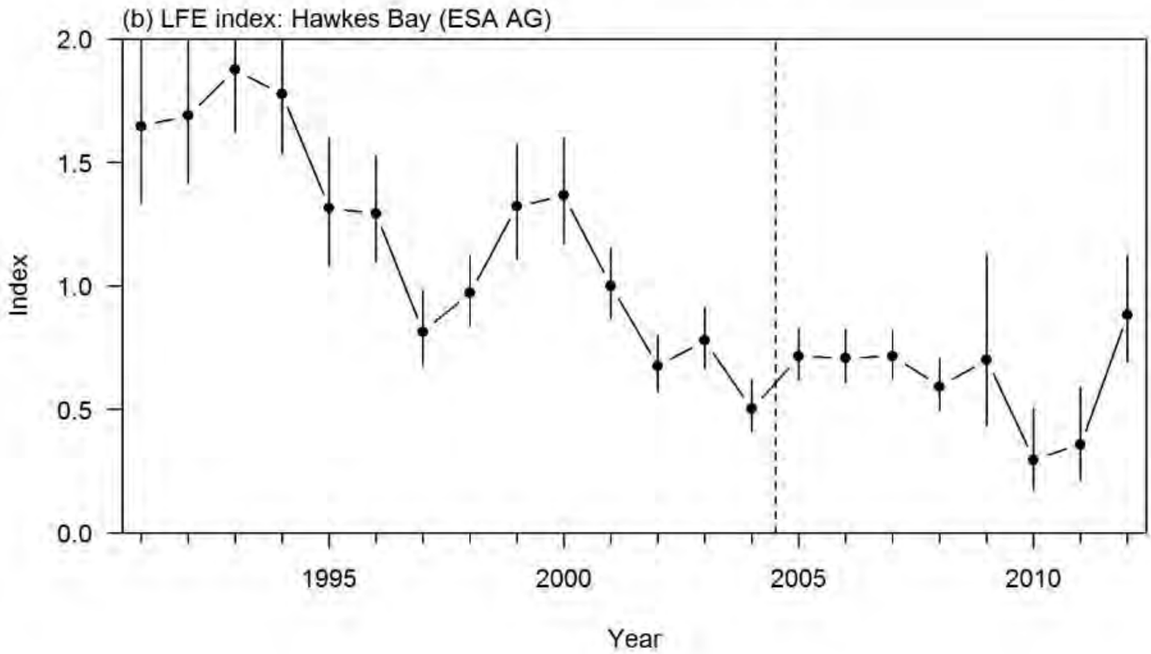

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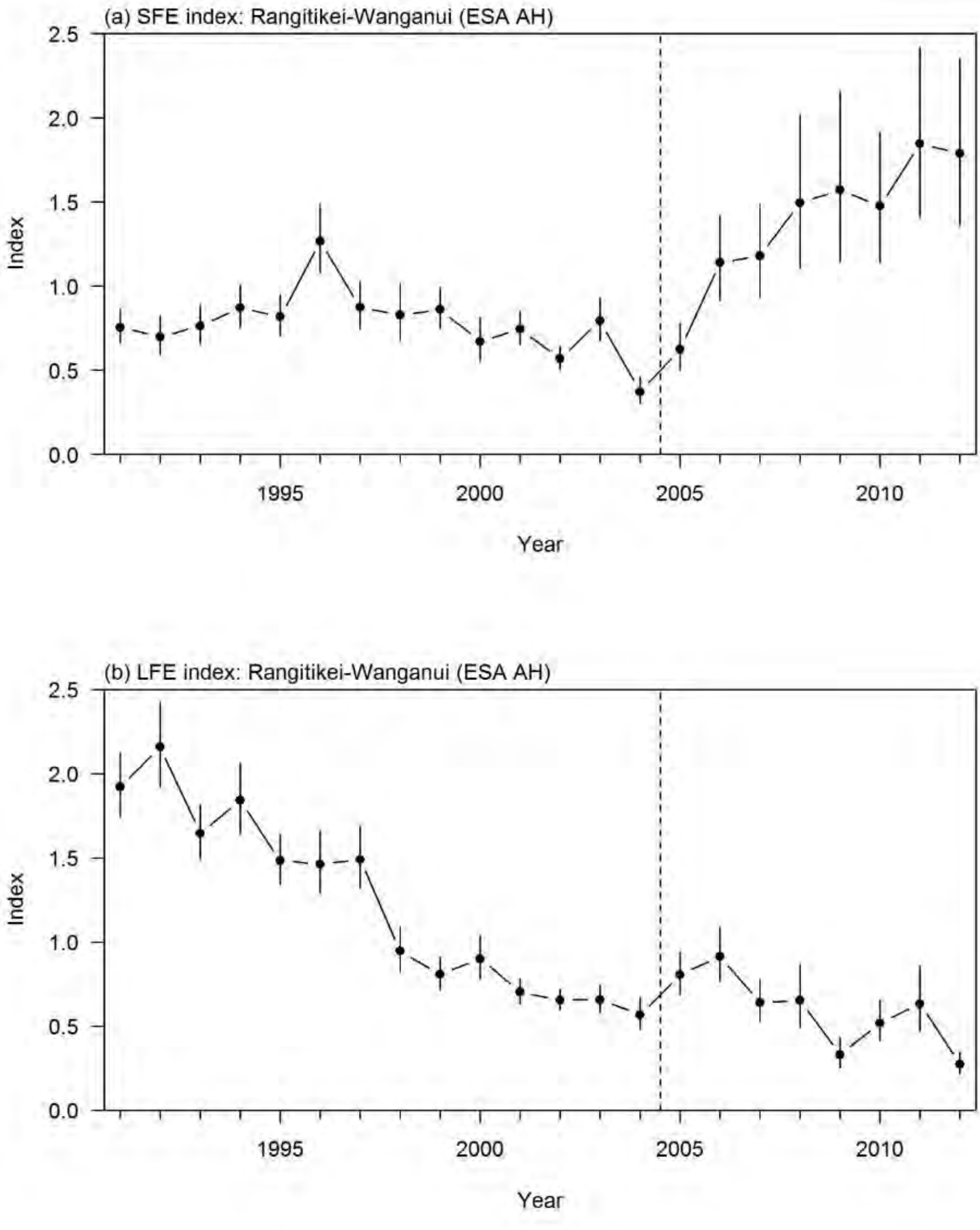

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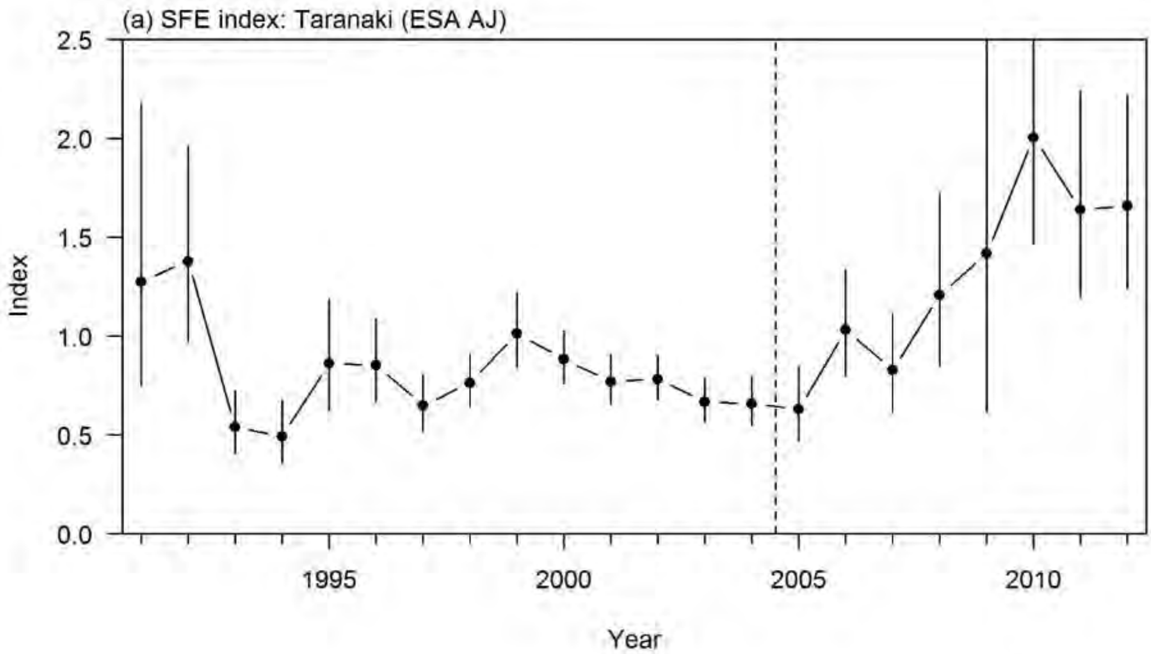

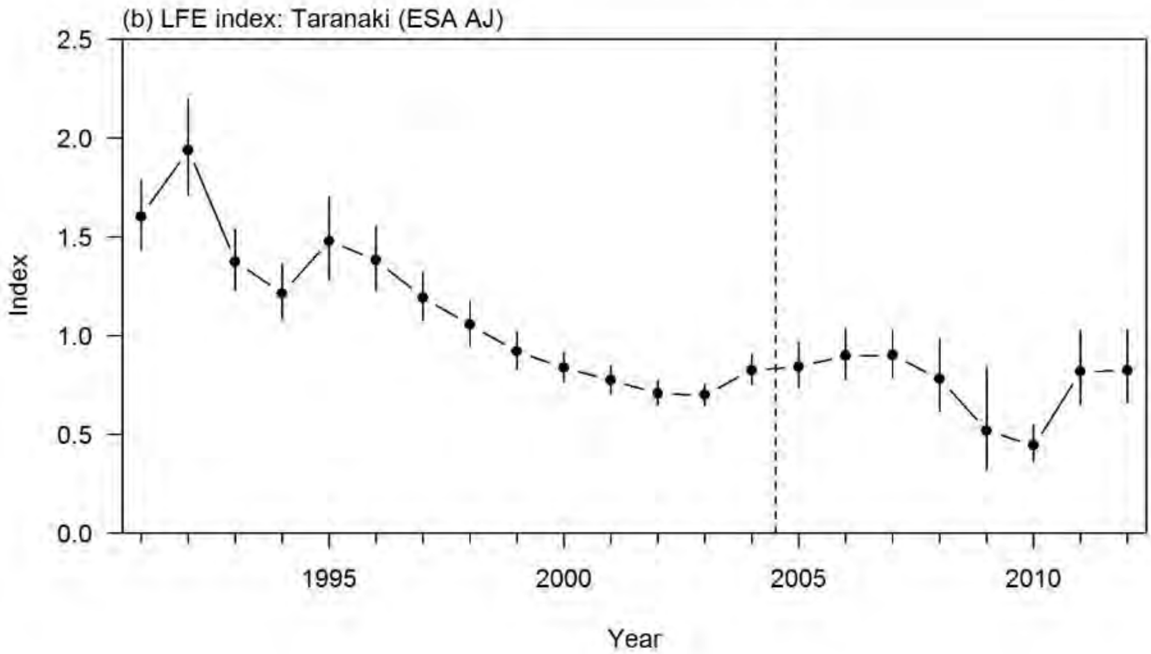

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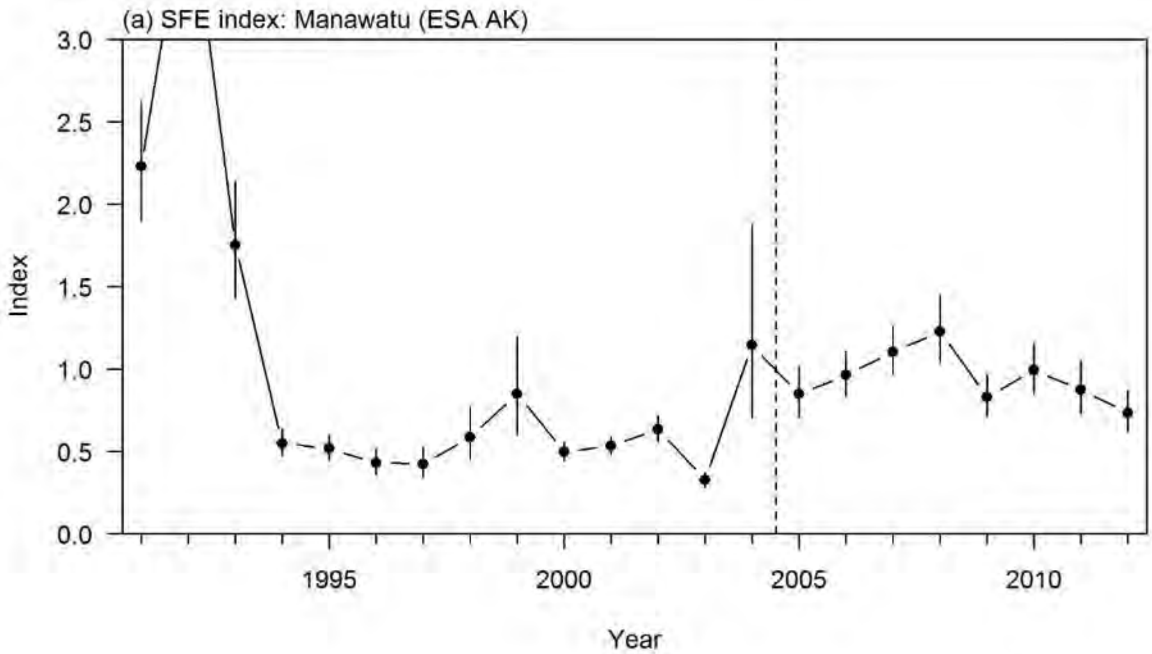


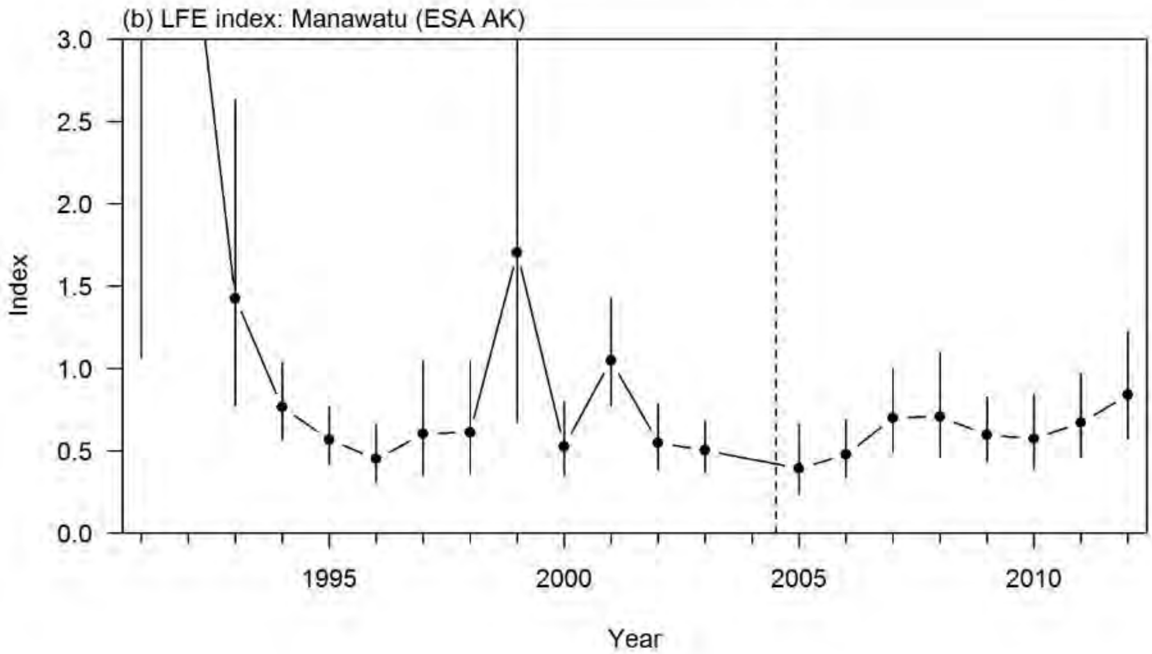
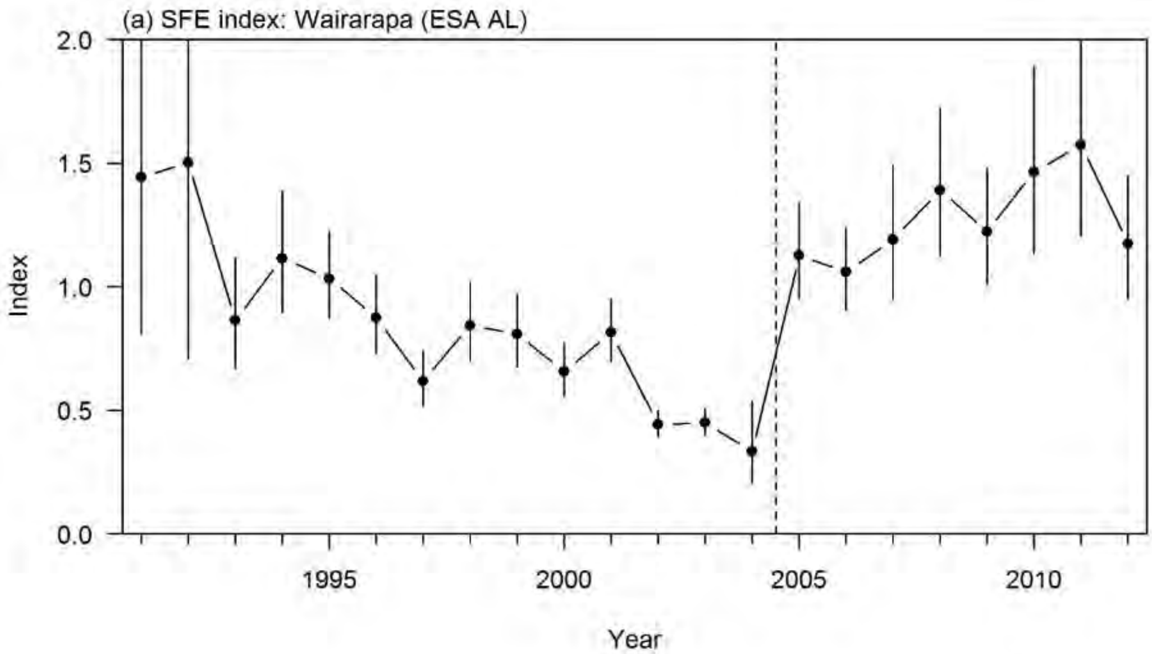


Figure 9 – ***continued***



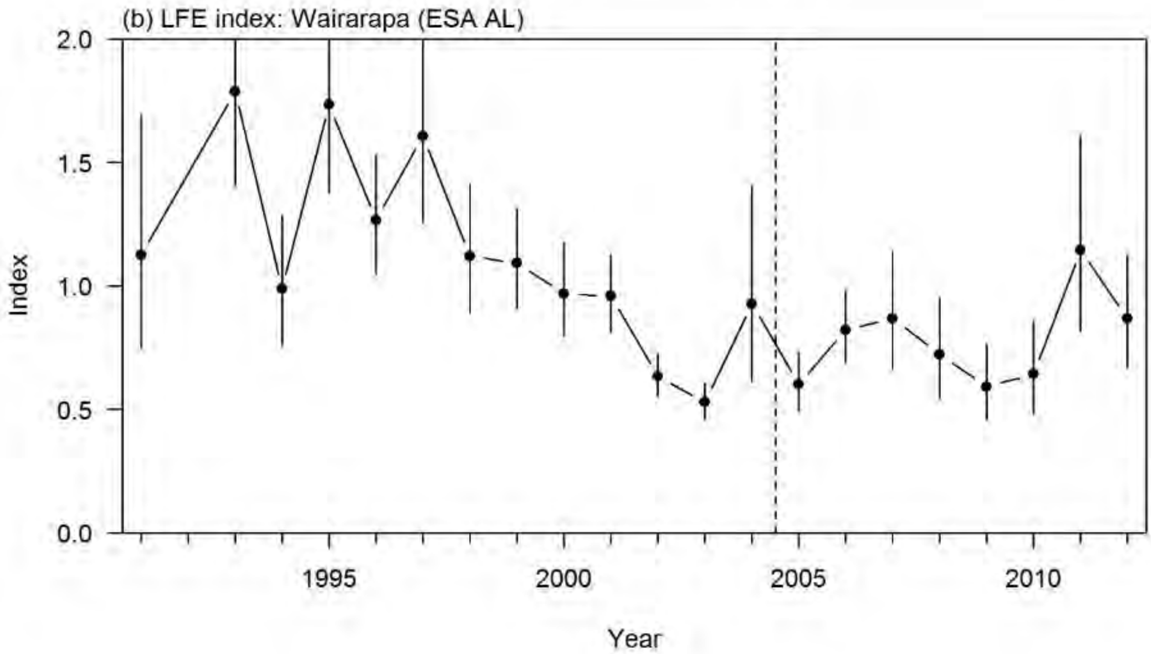


Figure 9 – ***continued***

Appendices A to M: Plots of eel fishery characterisation and CPUE analyses by ESA. The plots relating to shortfin are shown first followed by longfin.

Appendix A: Northland (ESA AA)

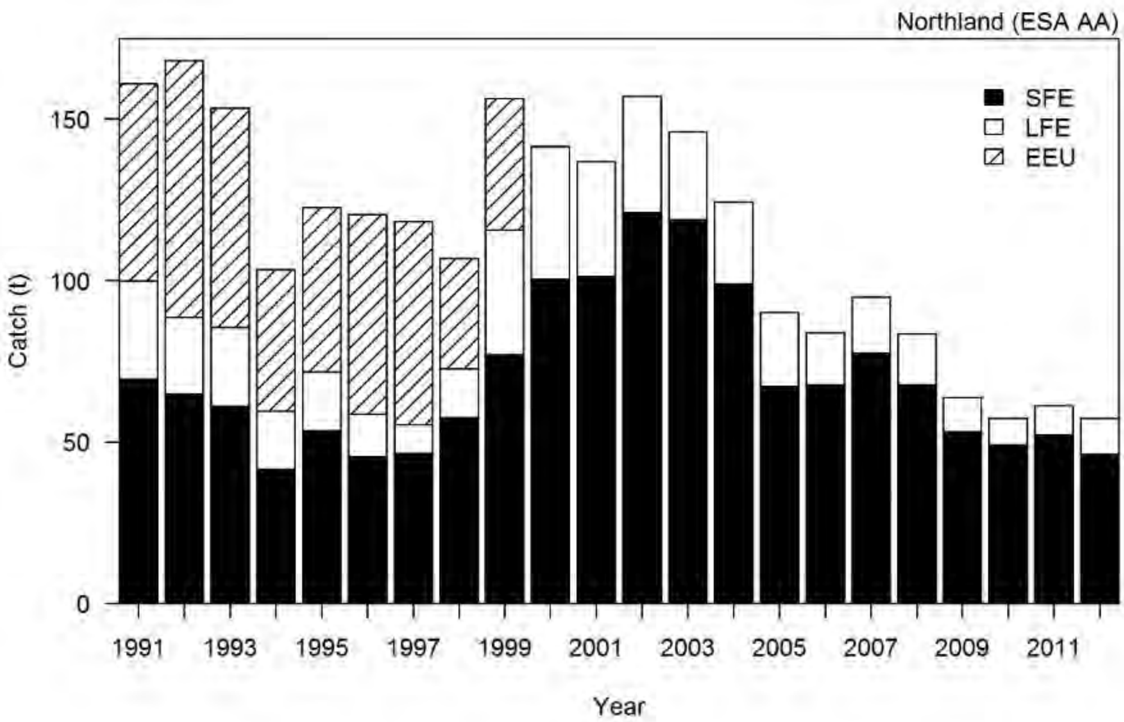


Figure A1: Total estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12 (Northland (ESA AA)).

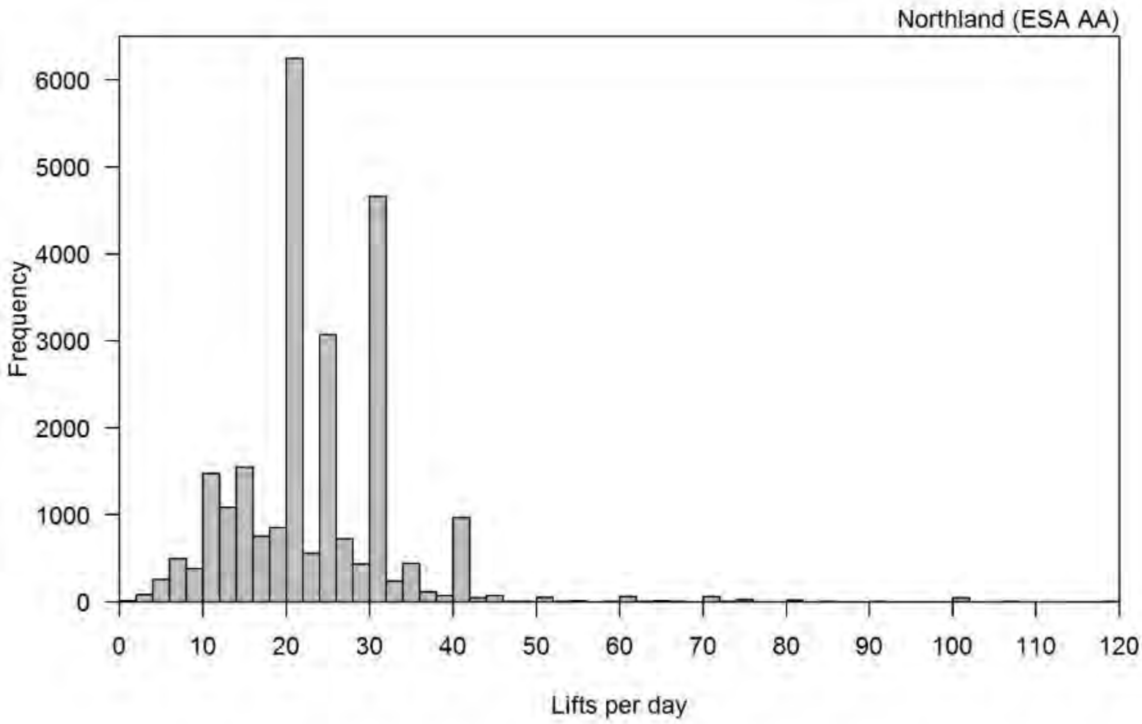


Figure A2: Frequency of total lifts per day for the years 1990–91 to 2011–12 (Northland (ESA AA)).

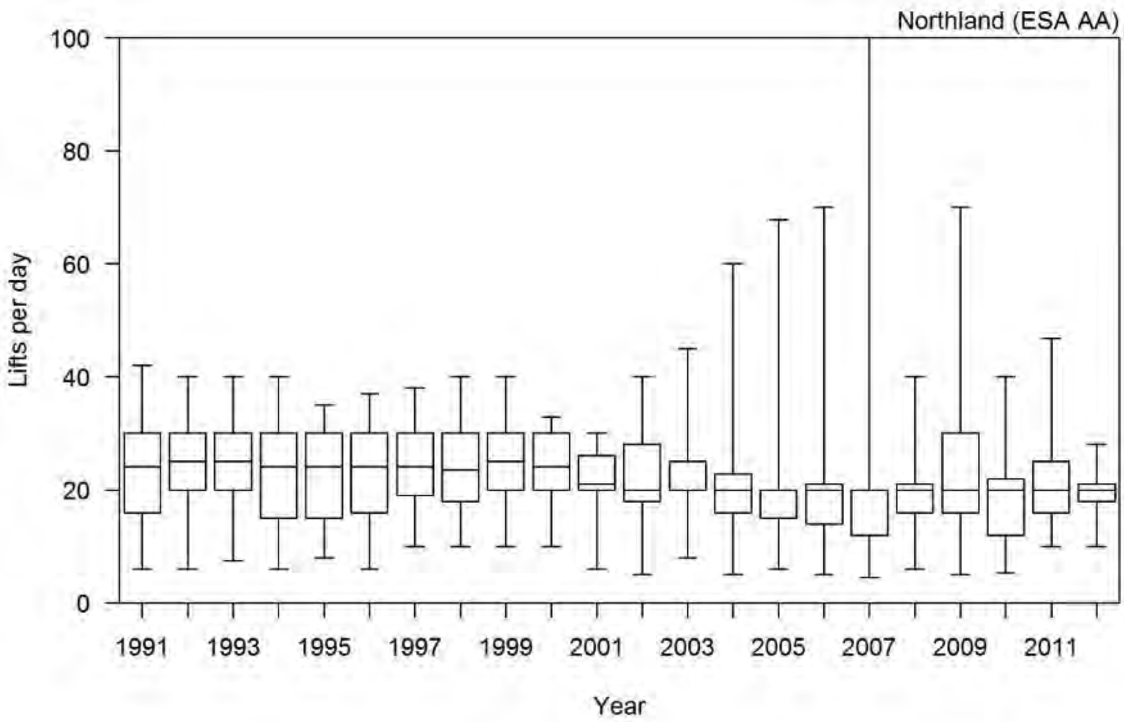


Figure A3: Total lifts per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Northland (ESA AA)).

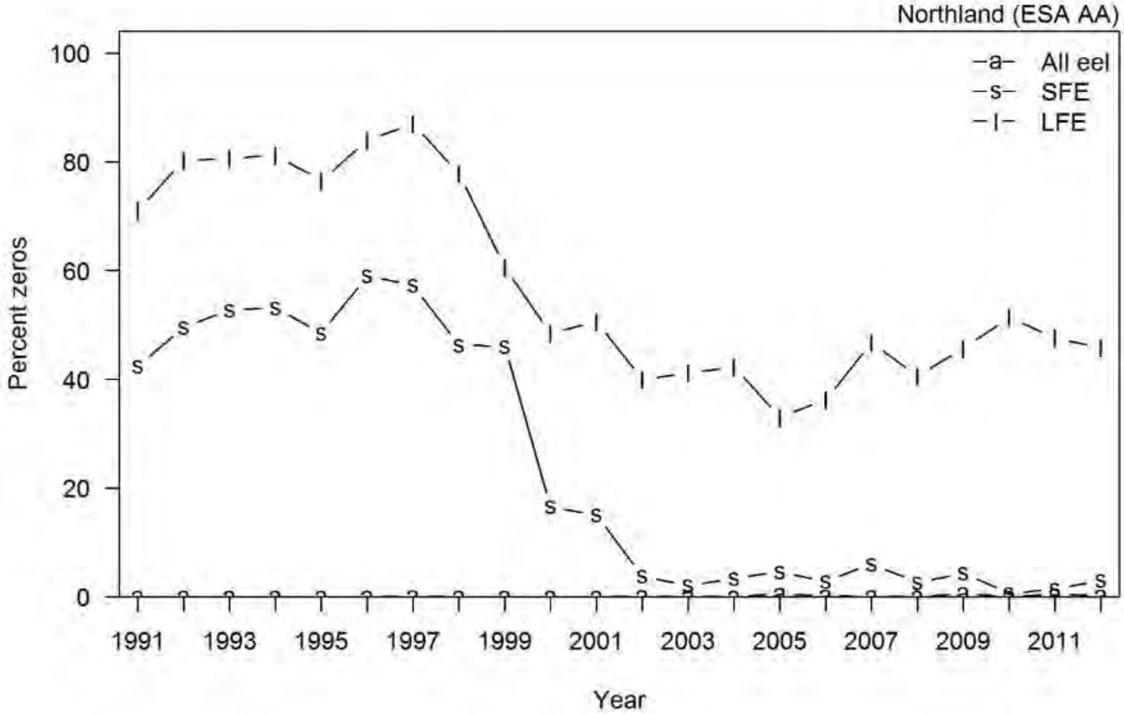


Figure A4: Proportion of zero records for all eel, shortfin (SFE), and longfin (LFE) catch for the years 1990–91 to 2011–12 (Northland (ESA AA)).

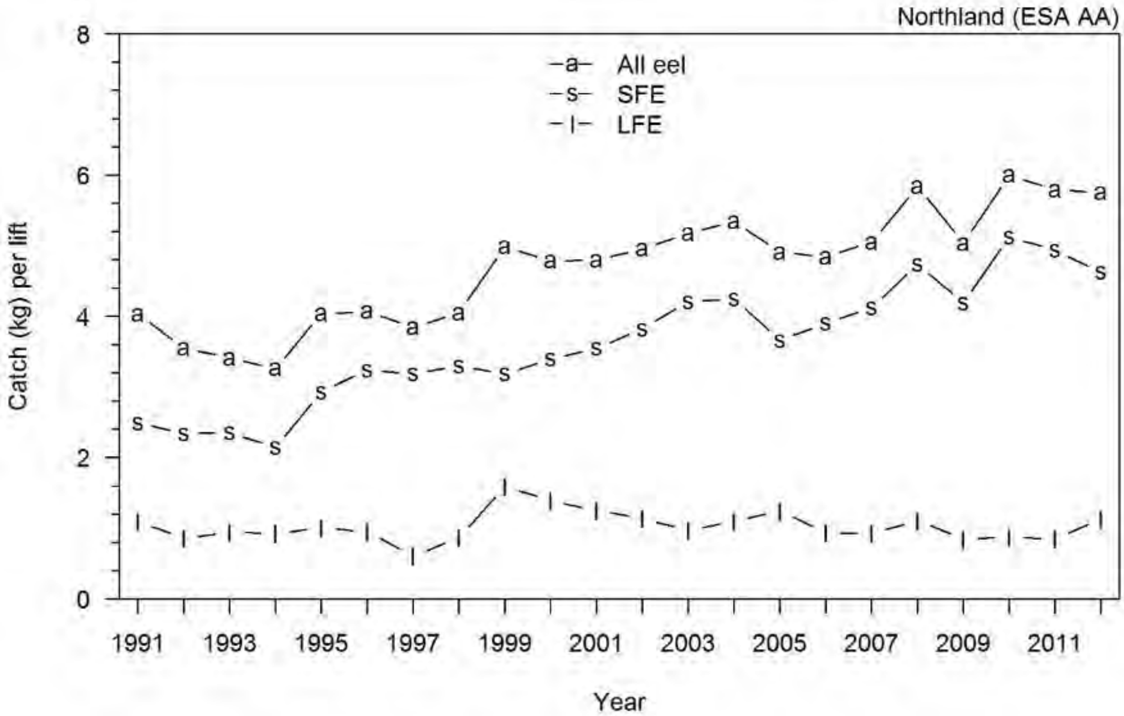


Figure A5: Unstandardised catch per lift (total kg/total lifts) for all eel, shortfin (SFE), and longfin (LFE) for the years 1990–91 to 2011–12 (Northland (ESA AA)).

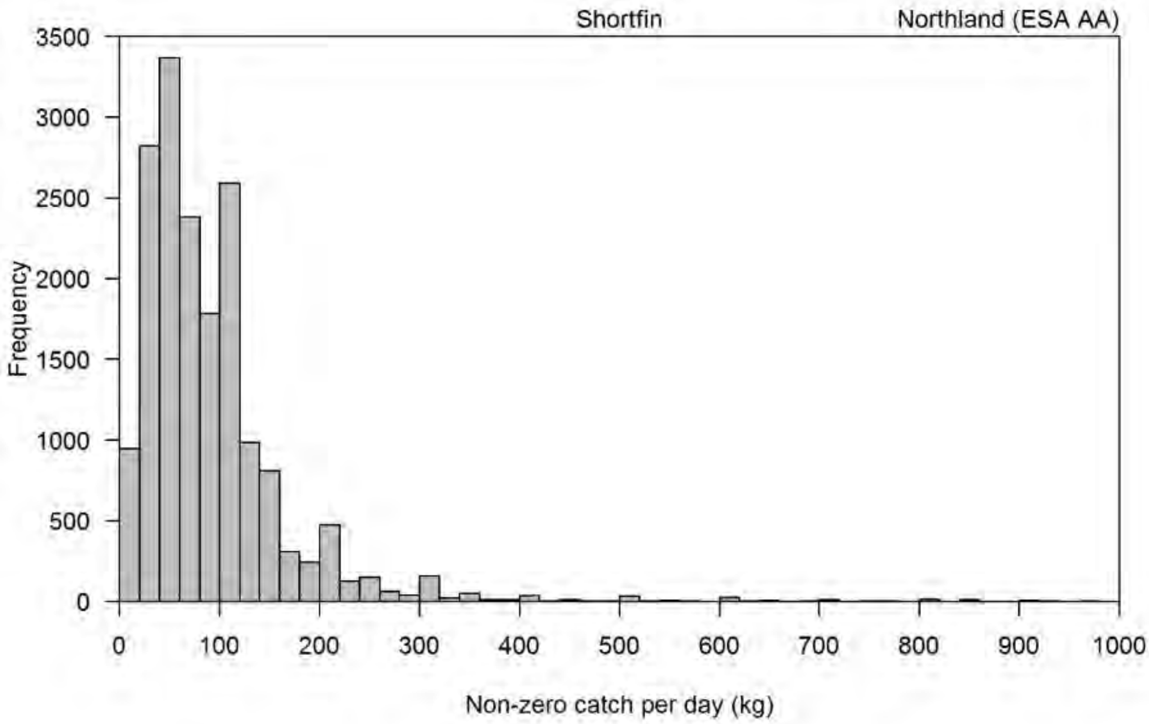


Figure A6: Frequency of shortfin eel catch per day for the years 1990–91 to 2011–12 (Northland (ESA AA)).

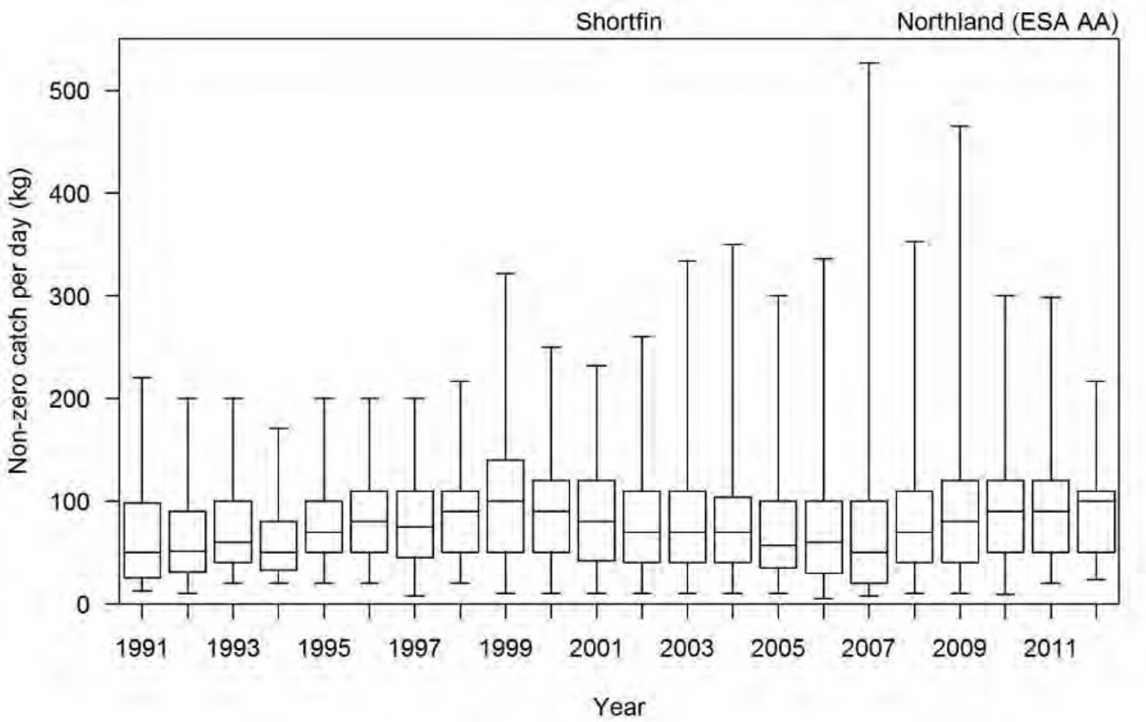


Figure A7: Shortfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Northland (ESA AA)).

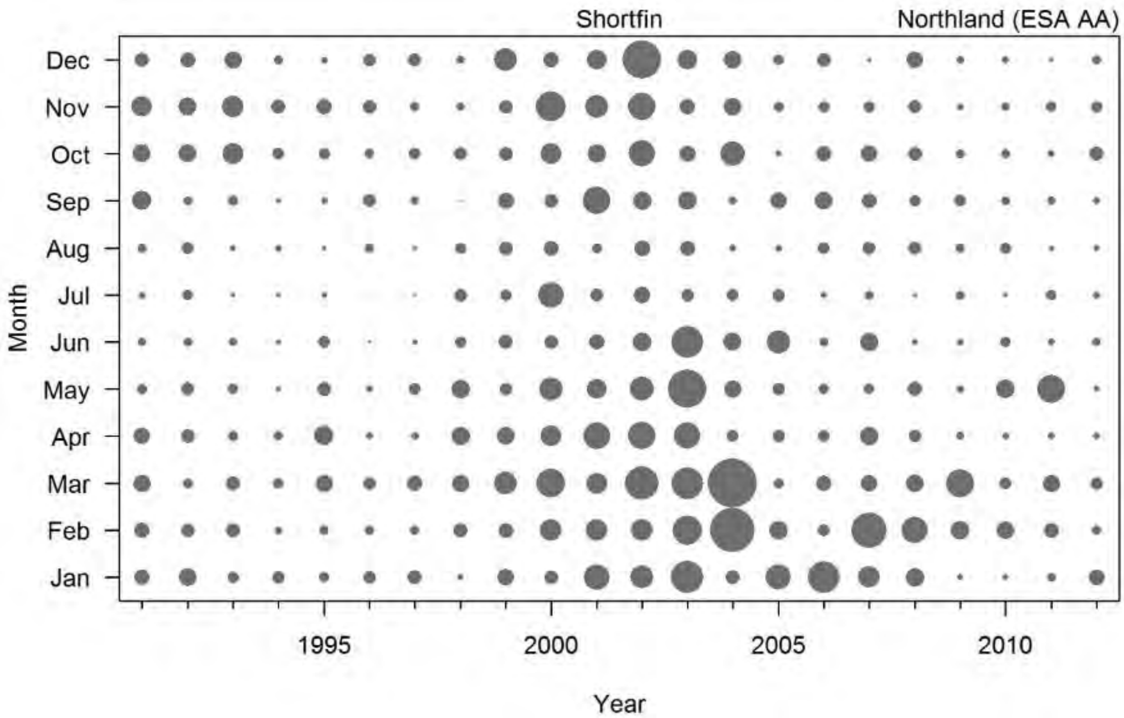


Figure A8: Shortfin eel catch by month for the years 1990–91 to 2011–12 (Northland (ESA AA)).

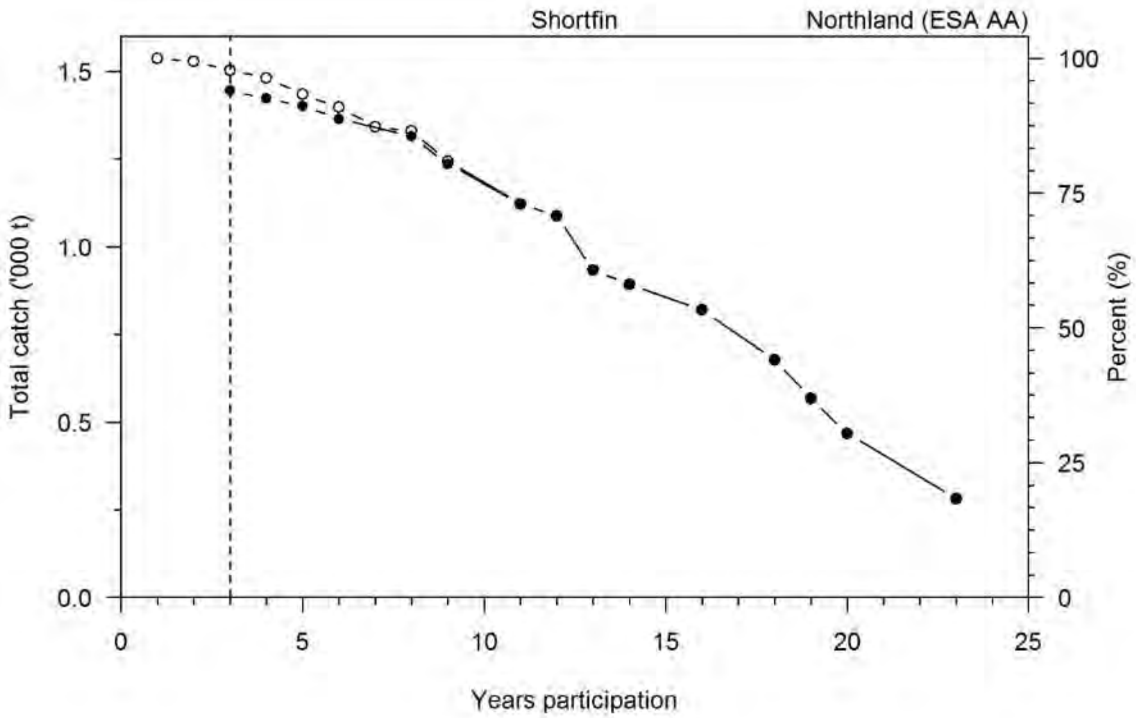


Figure A9: Relationship between years of participation in the fishery and shortfin total catch. The open circles represent all shortfin catch and the closed circles shortfin catch data from fishers who 1) caught shortfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core shortfin fisher analyses for the years 1990–91 to 2011–12 (Northland (ESA AA)).

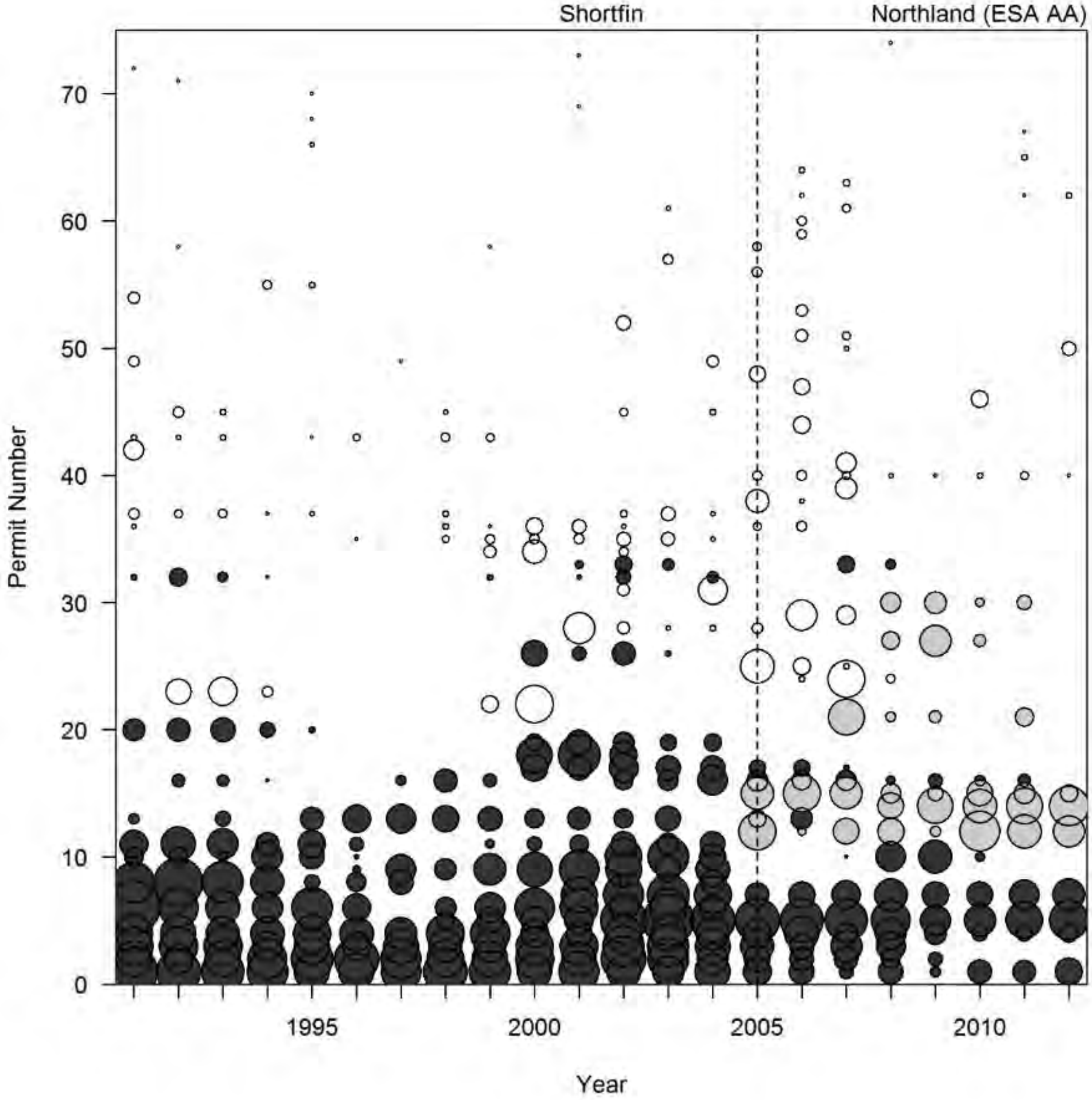


Figure A10: Relative catch of shortfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Northland (ESA AA)).

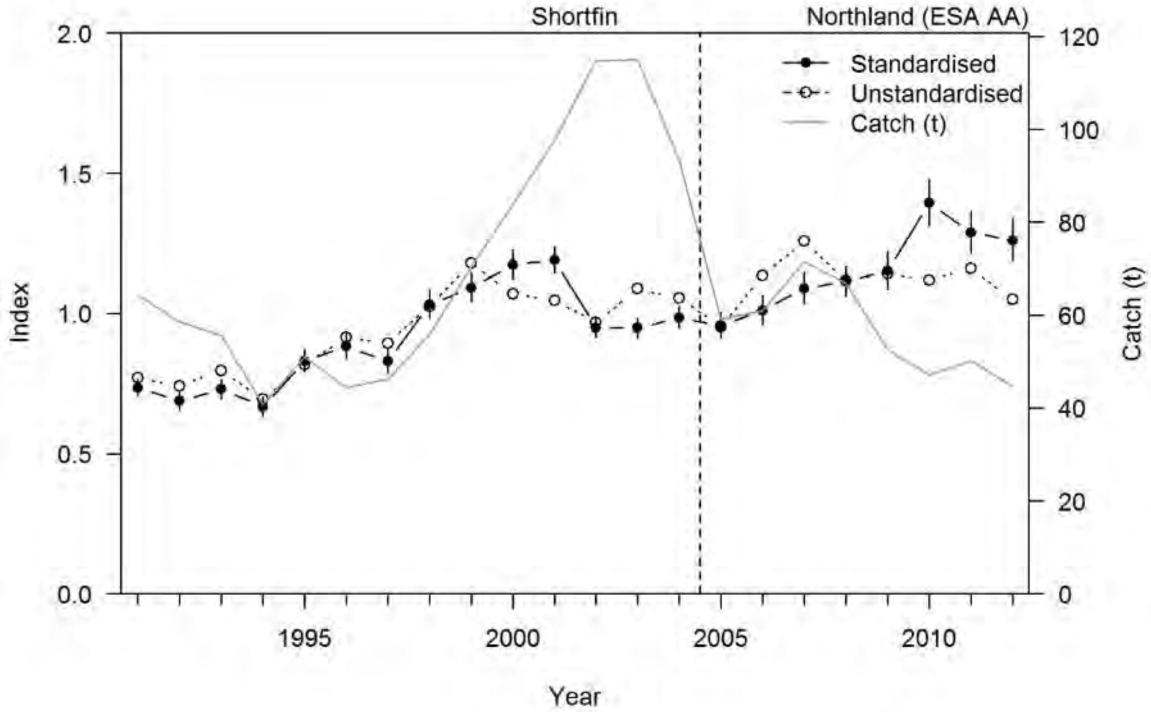


Figure A11: Indices of unstandardised catch per day and standardised CPUE for the core fishers shortfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Northland (ESA AA)).

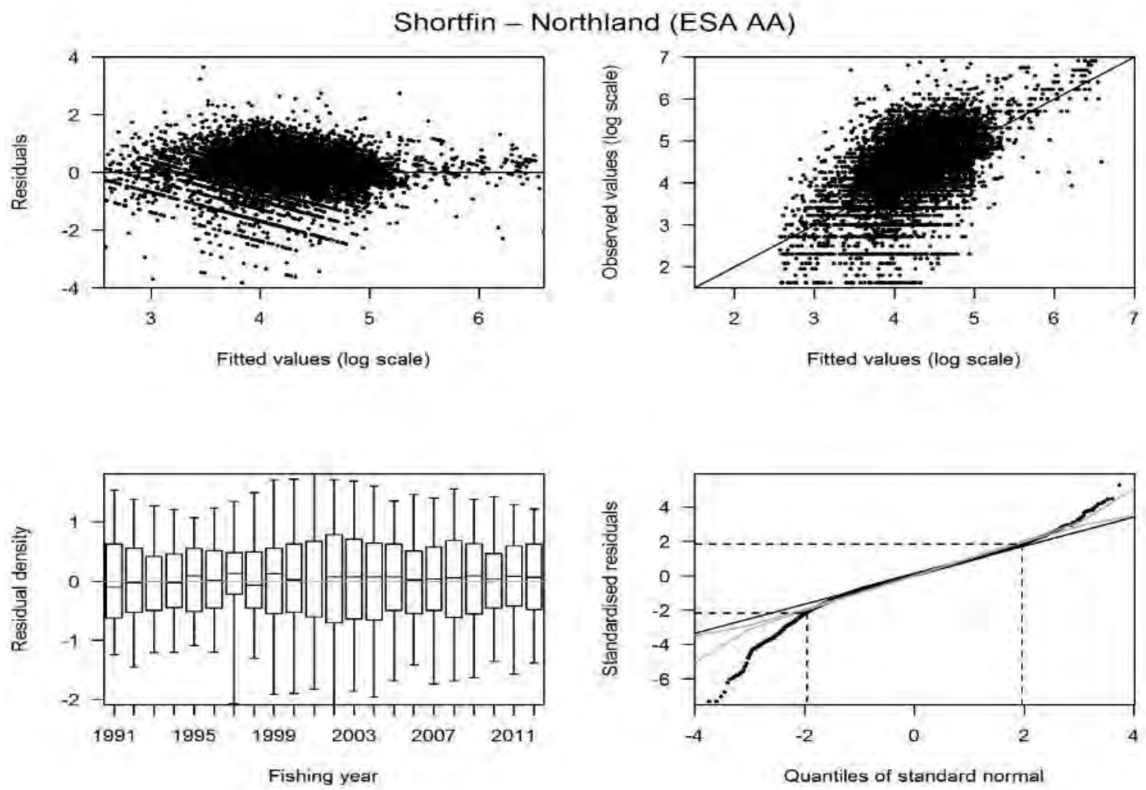


Figure A12: Residual diagnostic plots for the shortfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Northland (ESA AA)).

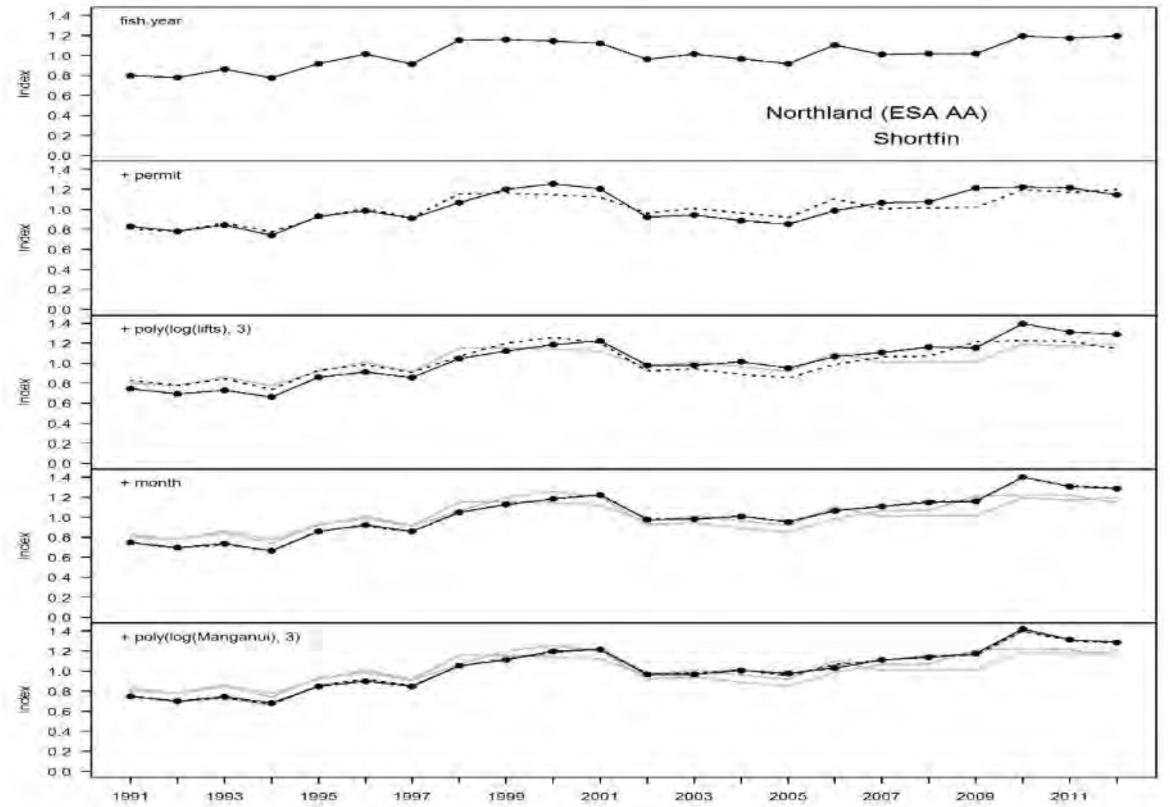


Figure A13: Step plot for the shortfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Northland (ESA AA)).

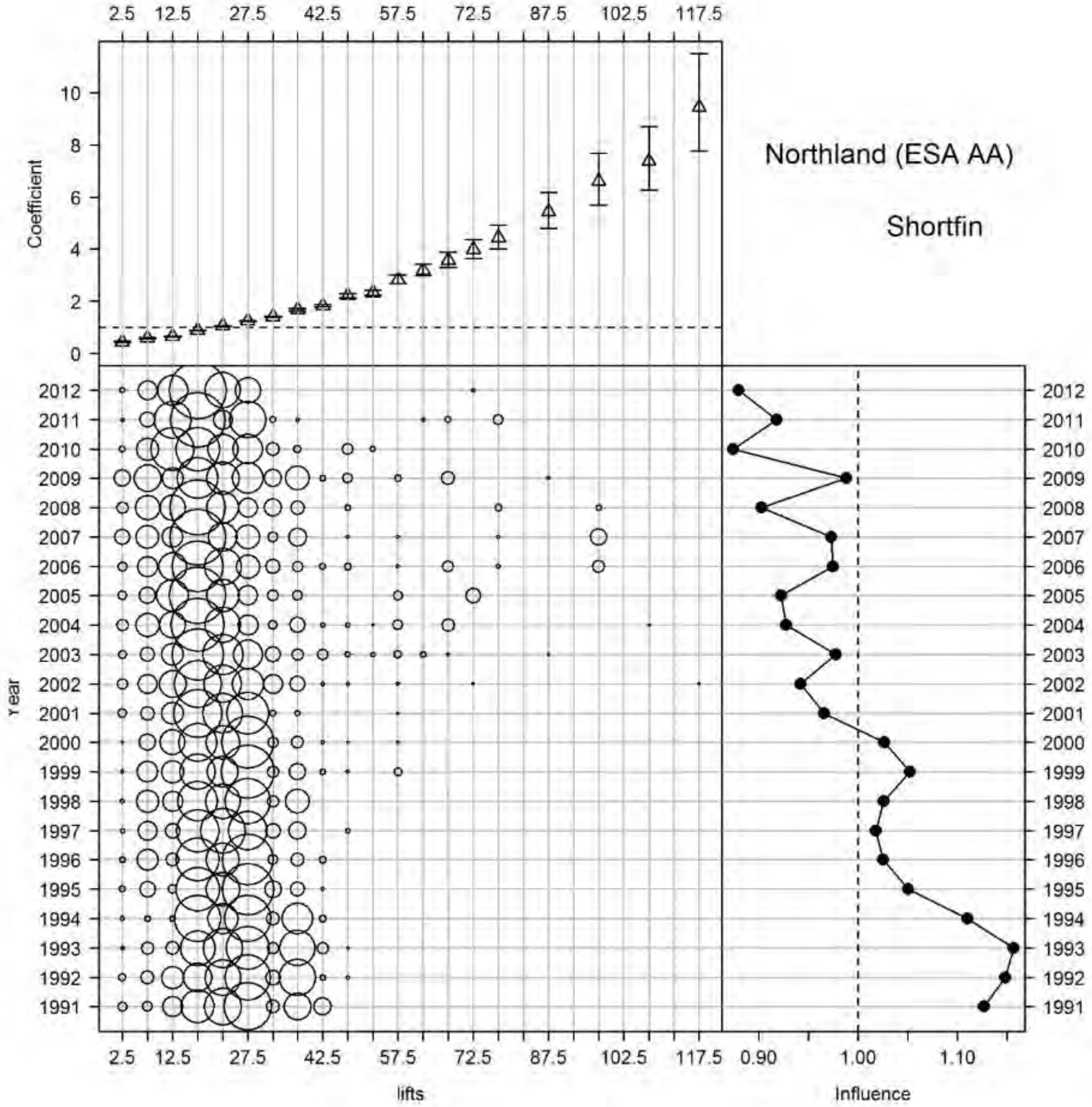


Figure A14: Influence of lifts for the shortfin CPUE model for the years 1990–91 to 2011–12 (Northland (ESA AA)).

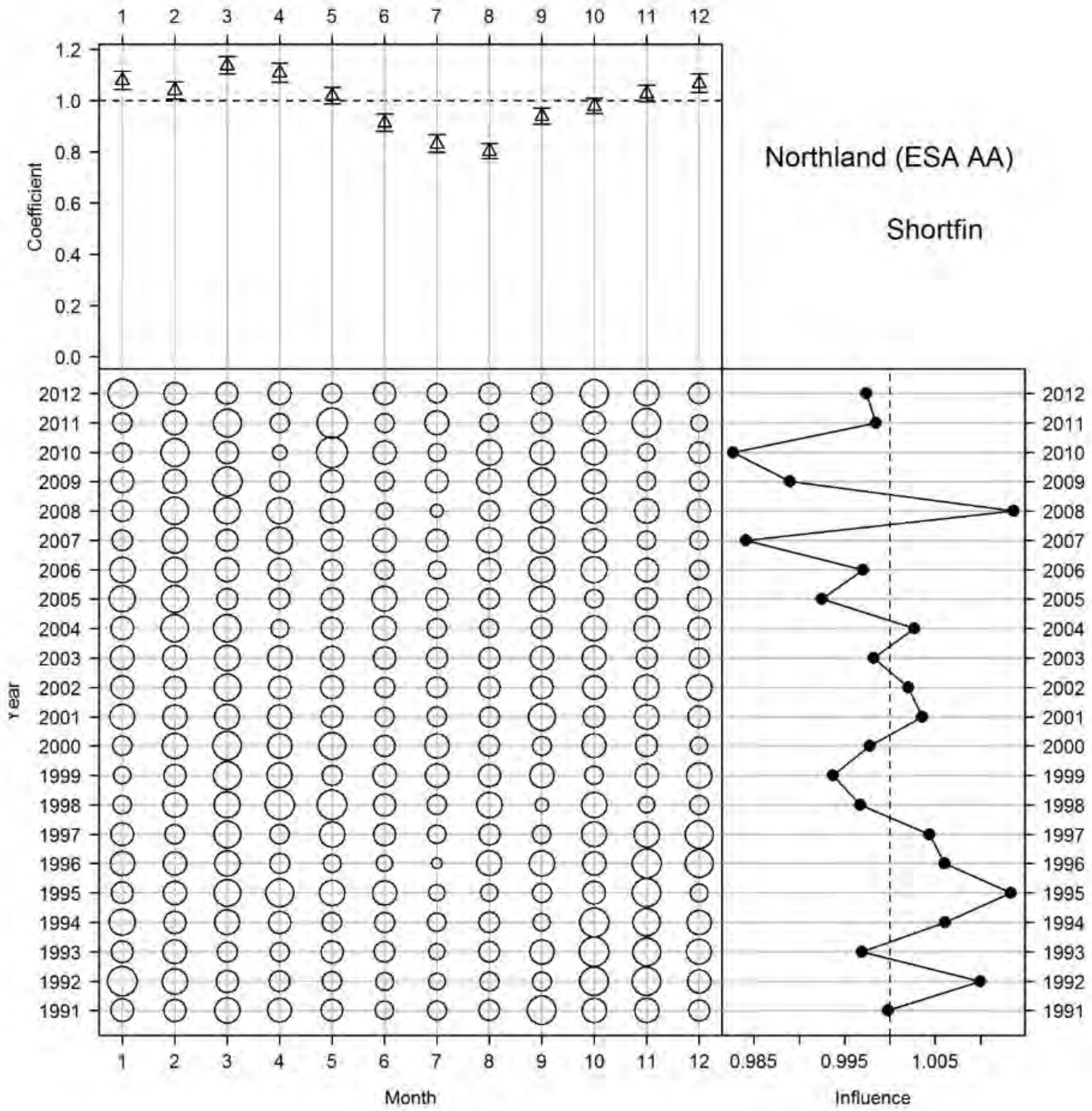


Figure A15: Influence of month for the shortfin CPUE model for the years 1990–91 to 2011–12 (Northland (ESA AA)).

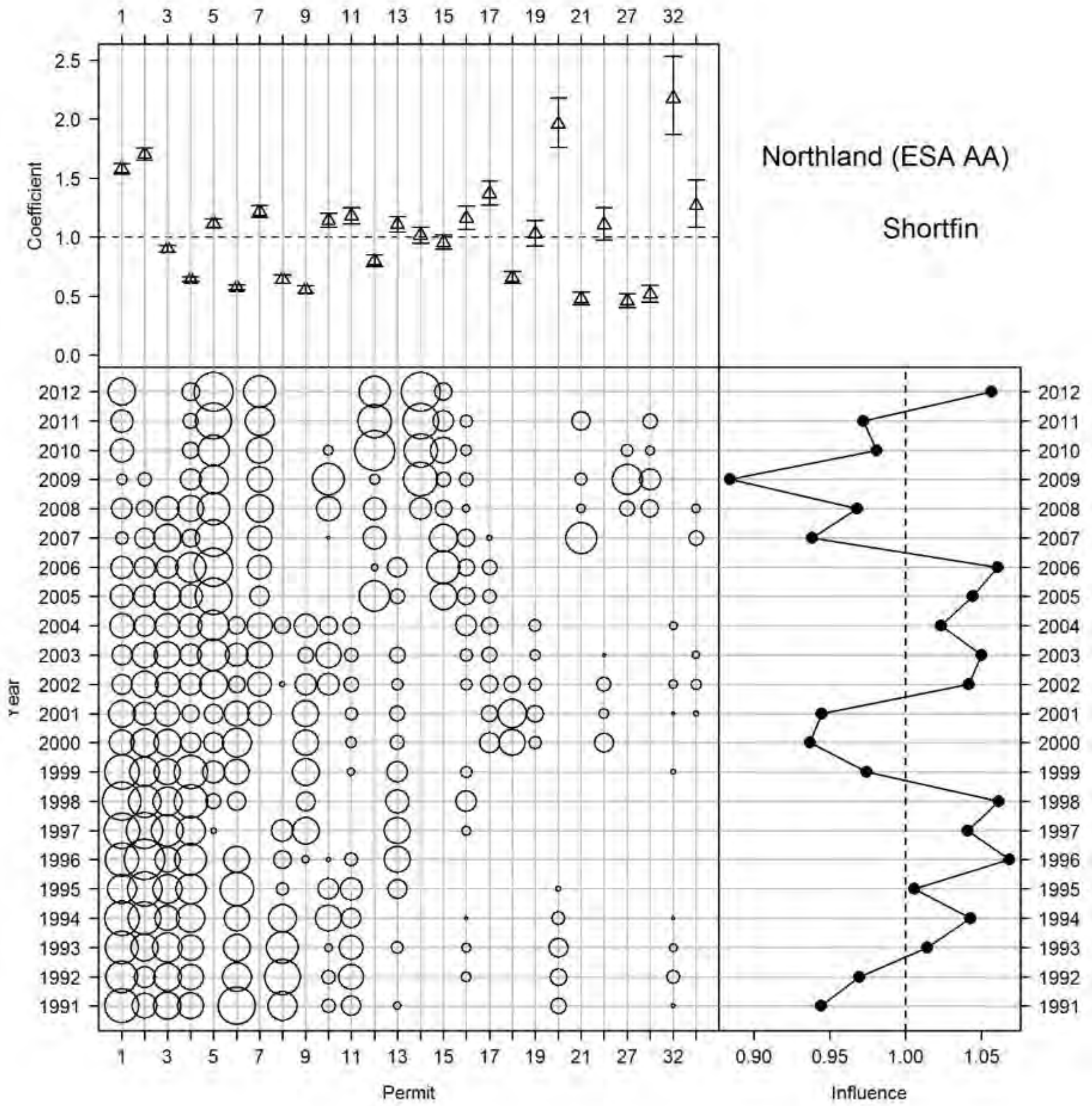


Figure A16: Influence of permit number for the shortfin CPUE model for the years 1990–91 to 2011–12 (Northland (ESA AA)).

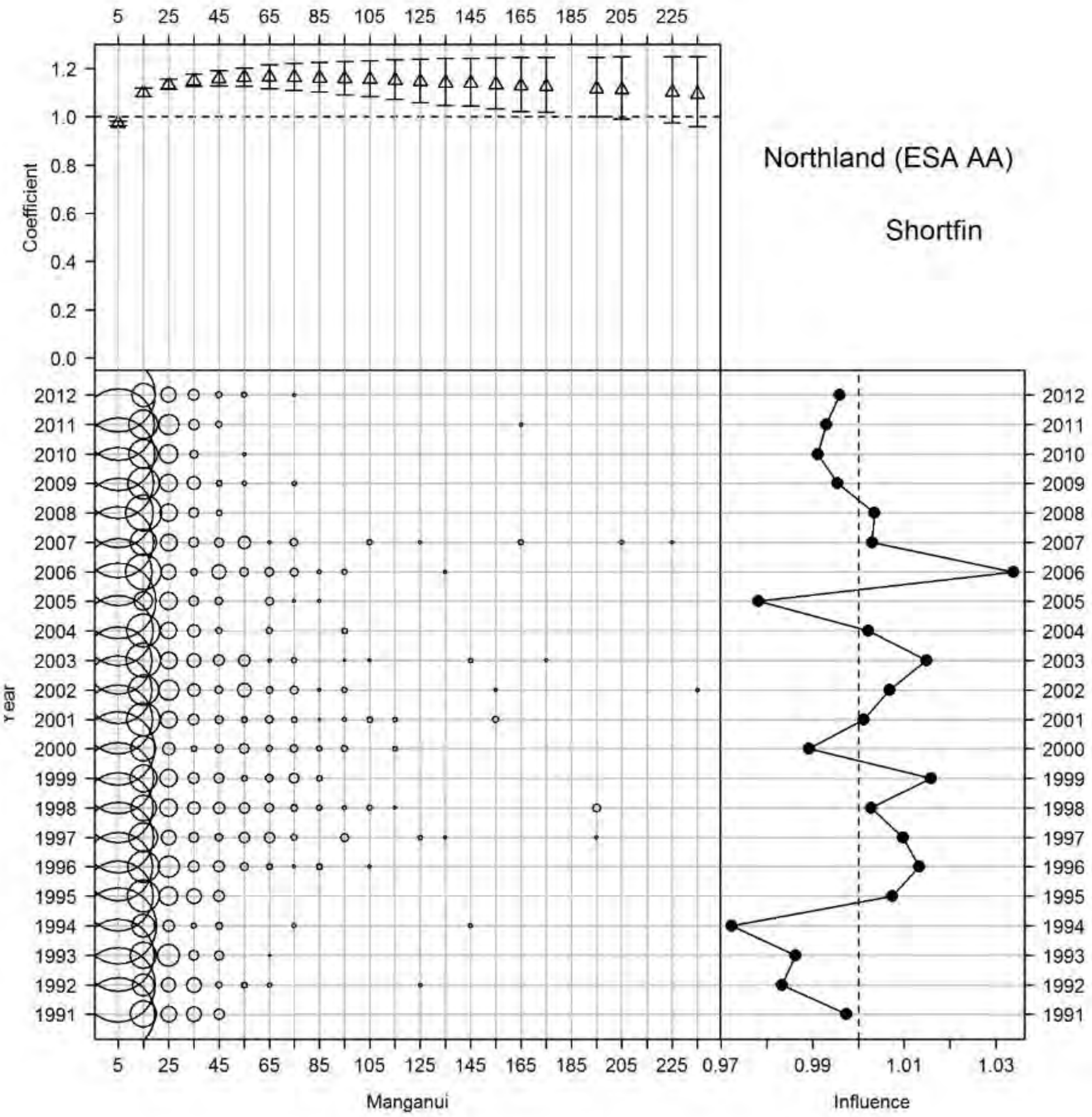


Figure A17: Influence of Manganui River flow for the shortfin CPUE model for the years 1990–91 to 2011–12 (Northland (ESA AA)).

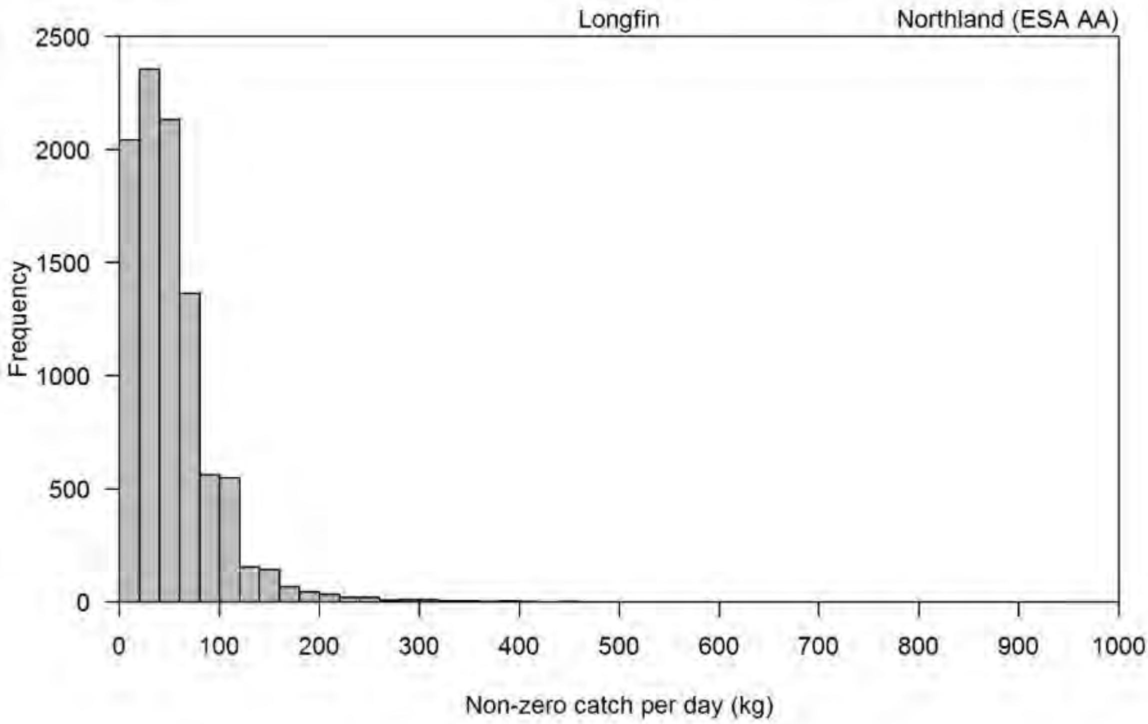


Figure A18: Frequency of longfin eel catch per day for the years 1990–91 to 2011–12 (Northland (ESA AA)).

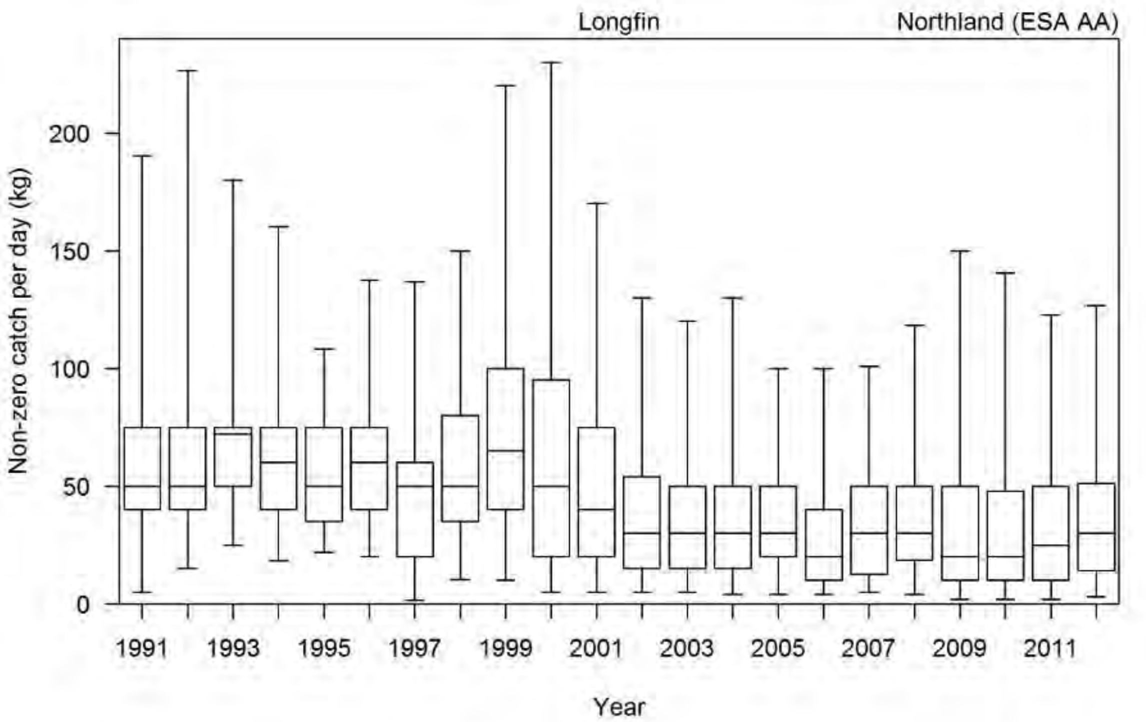


Figure A19: Longfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Northland (ESA AA)).

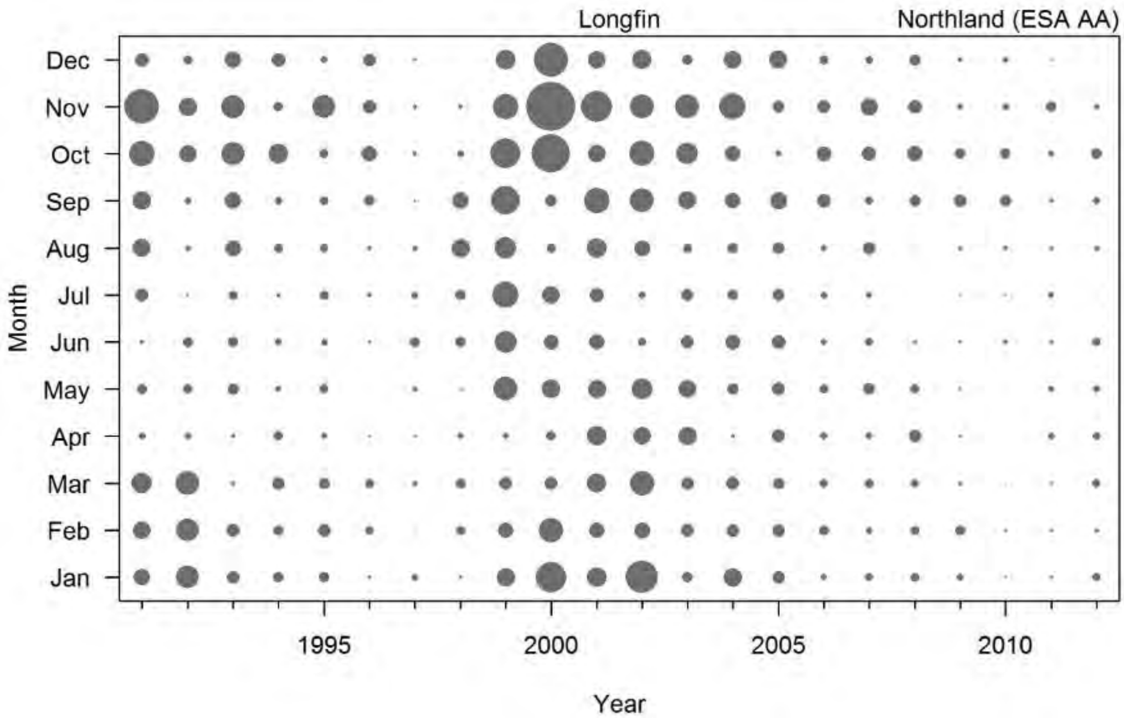


Figure A20: Longfin eel catch by month for the years 1990–91 to 2011–12 (Northland (ESA AA)).

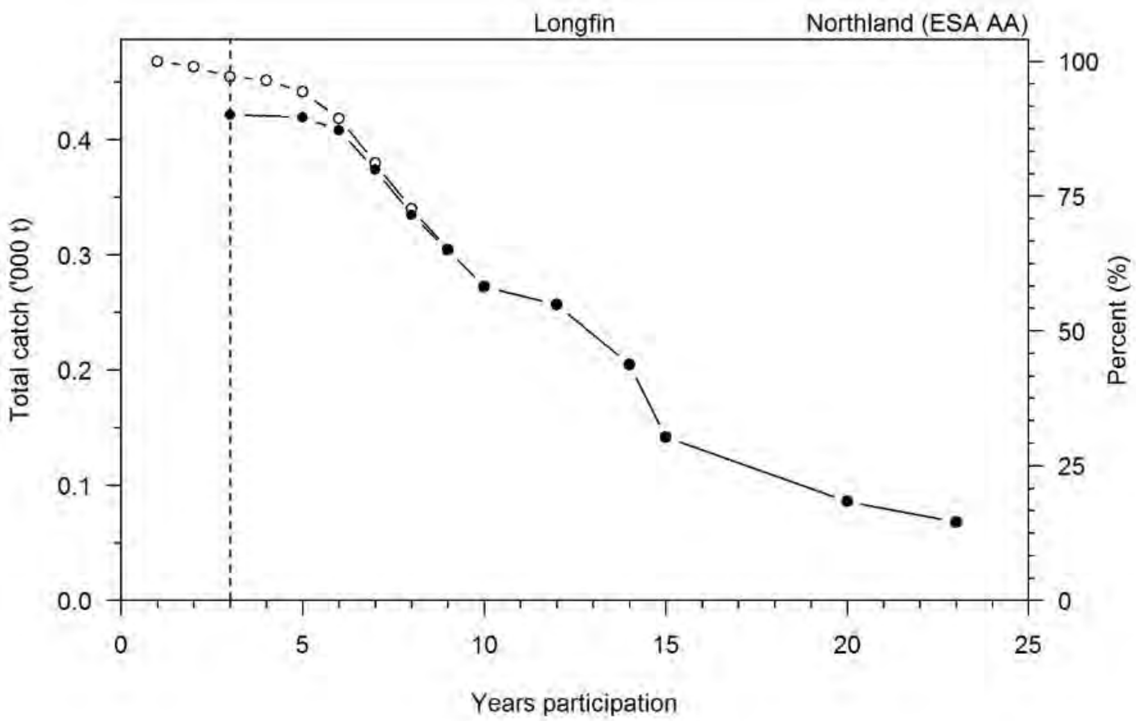


Figure A21: Relationship between years of participation in the fishery and longfin total catch. The open circles represent all longfin catch and the closed circles longfin catch data from fishers who 1) caught longfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core longfin fisher analyses for the years 1990–91 to 2011–12 (Northland (ESA AA)).

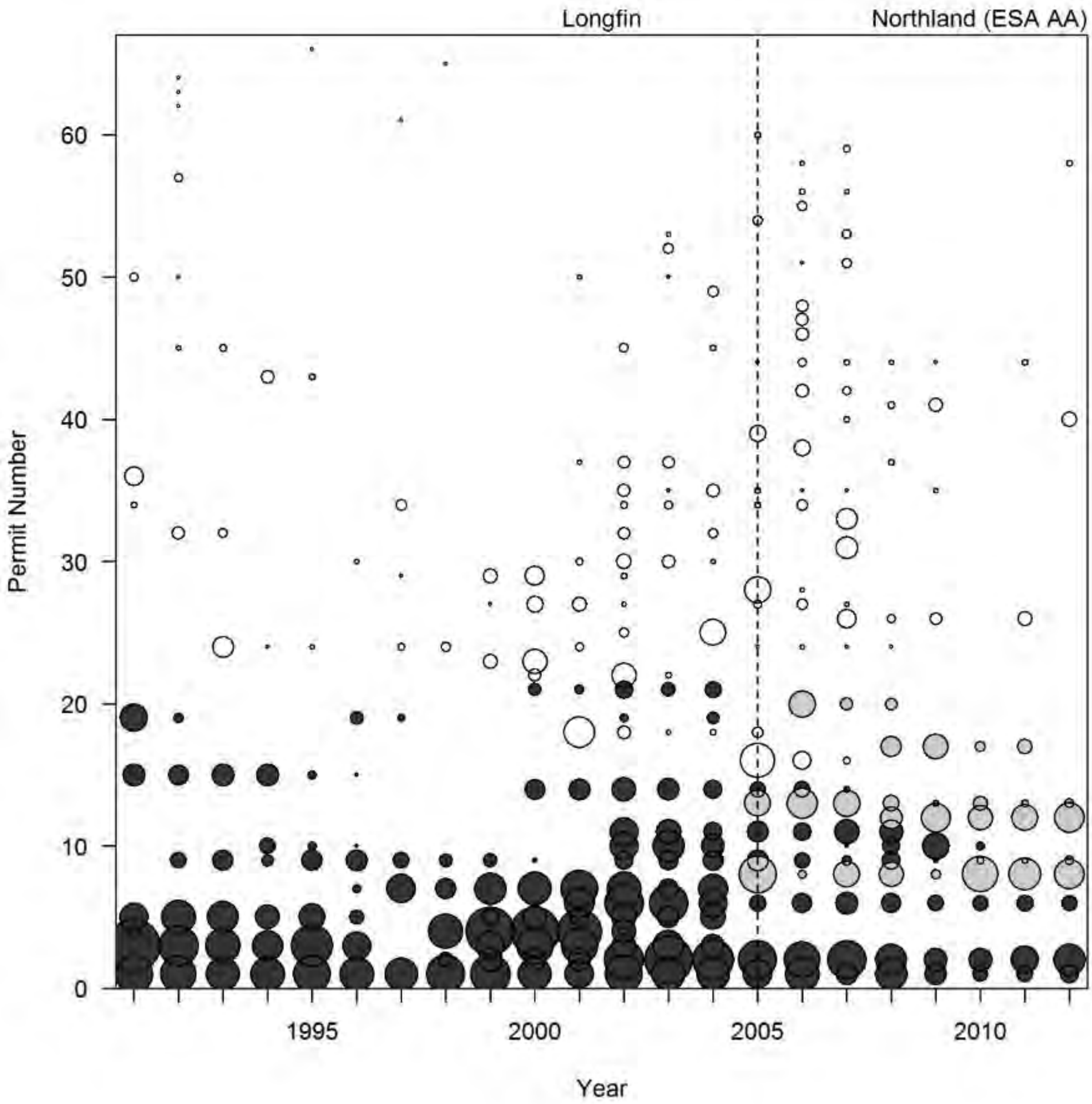


Figure A22: Relative catch of longfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Northland (ESA AA)).

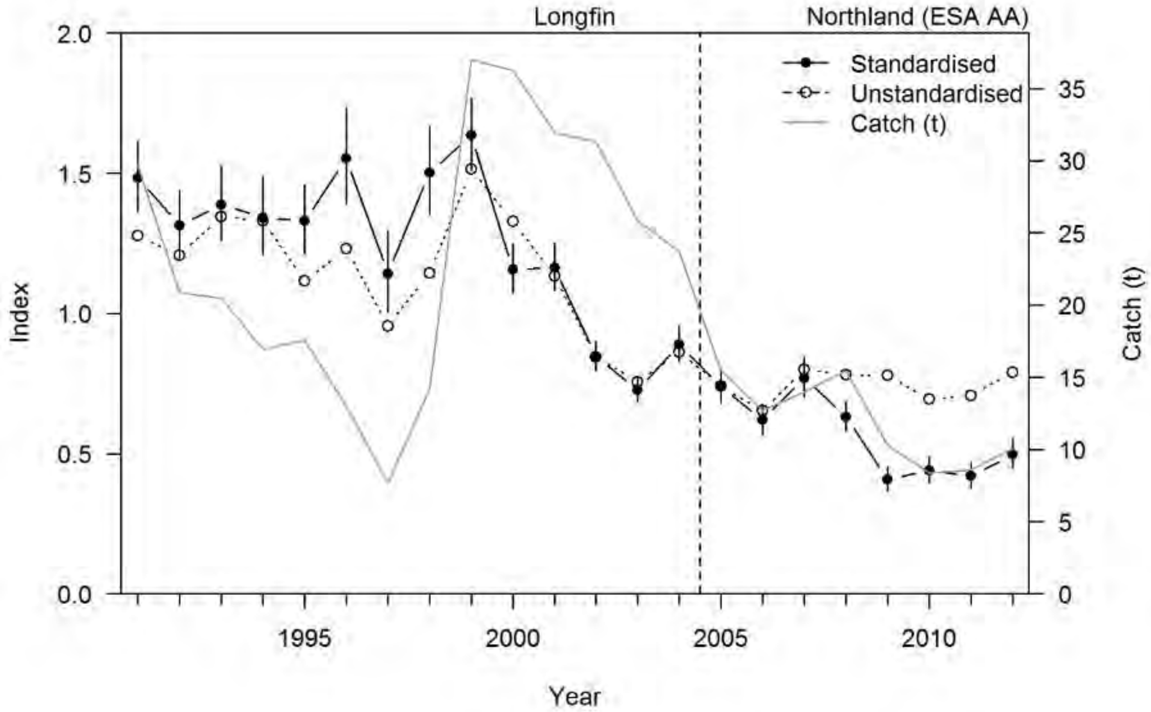


Figure A23: Indices of unstandardised catch per day and standardised CPUE for the core fishers longfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Northland (ESA AA)).

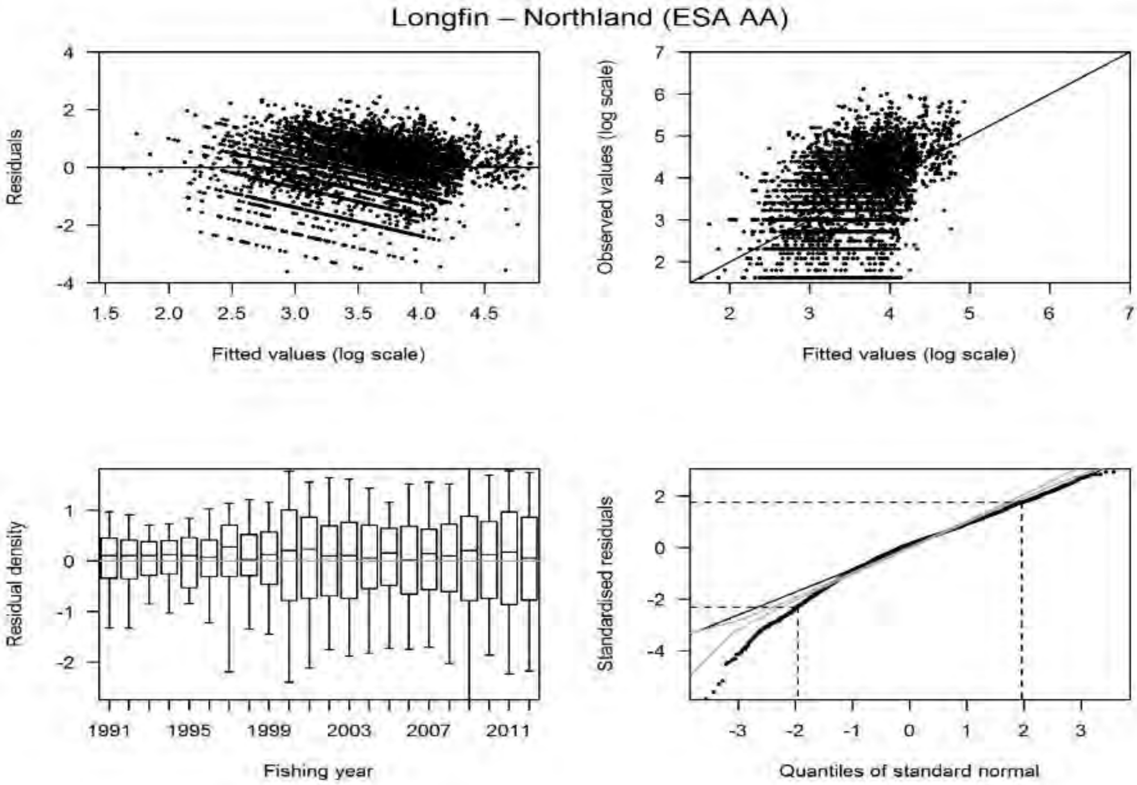


Figure A24: Residual diagnostic plots for the longfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Northland (ESA AA)).

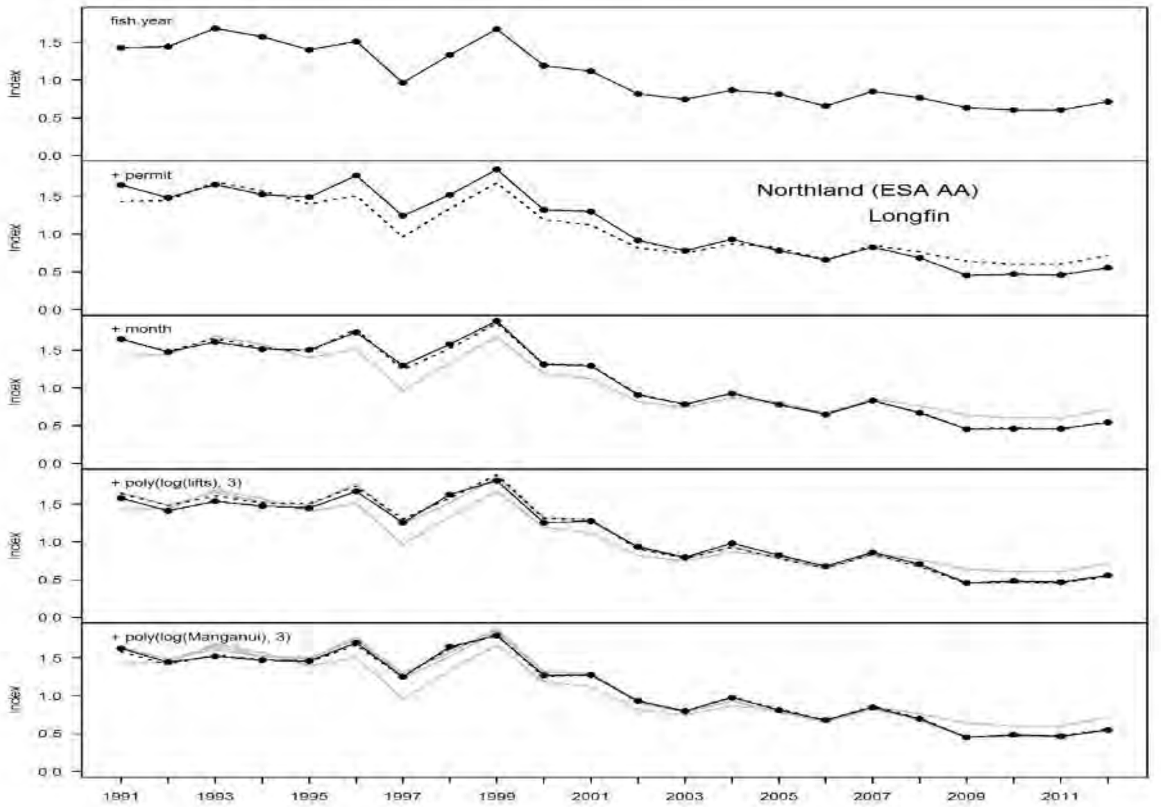


Figure A25: Step plot for the longfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Northland (ESA AA)).

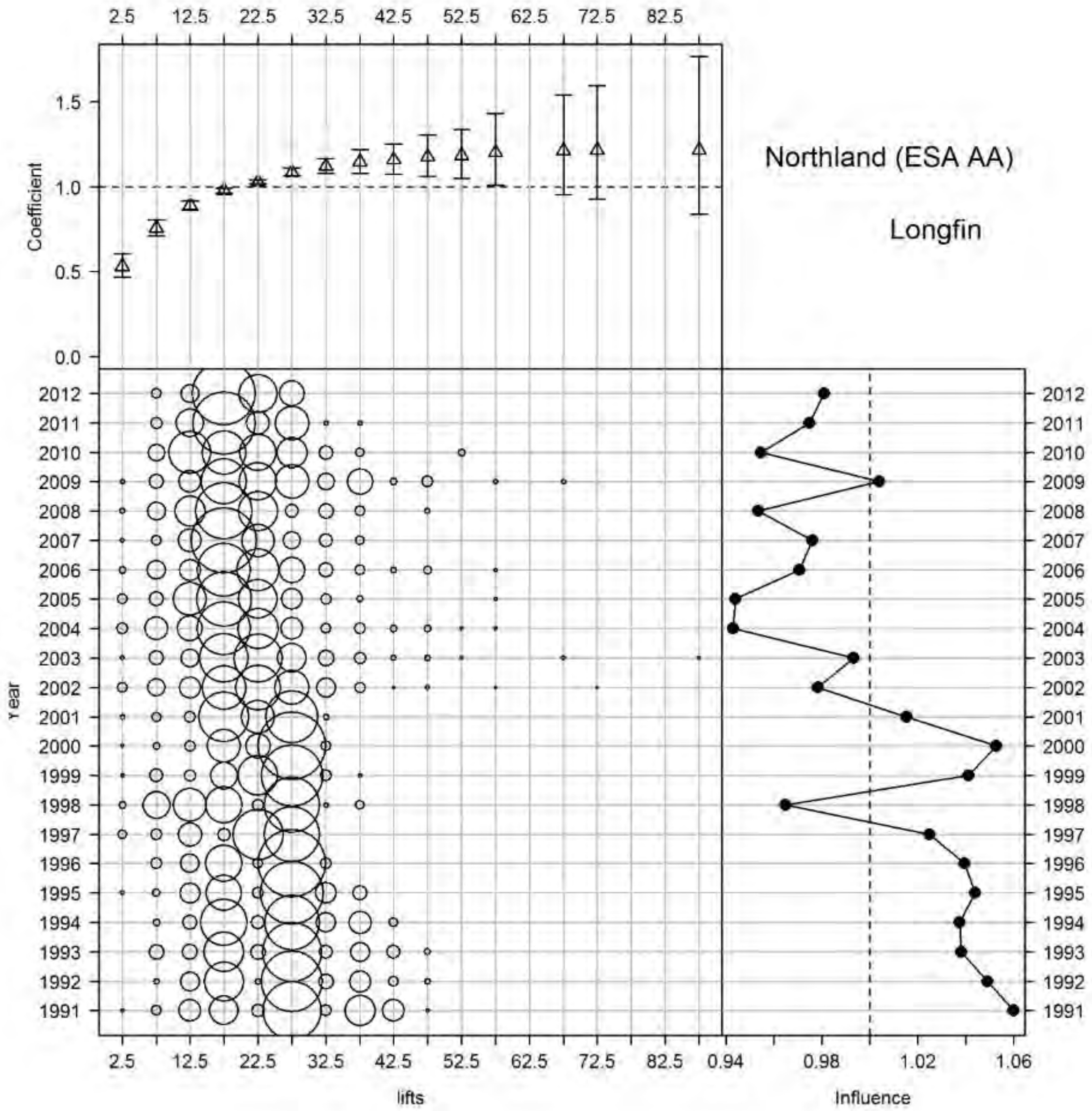


Figure A26: Influence of lifts for the longfin CPUE model for the years 1990–91 to 2011–12 (Northland (ESA AA)).

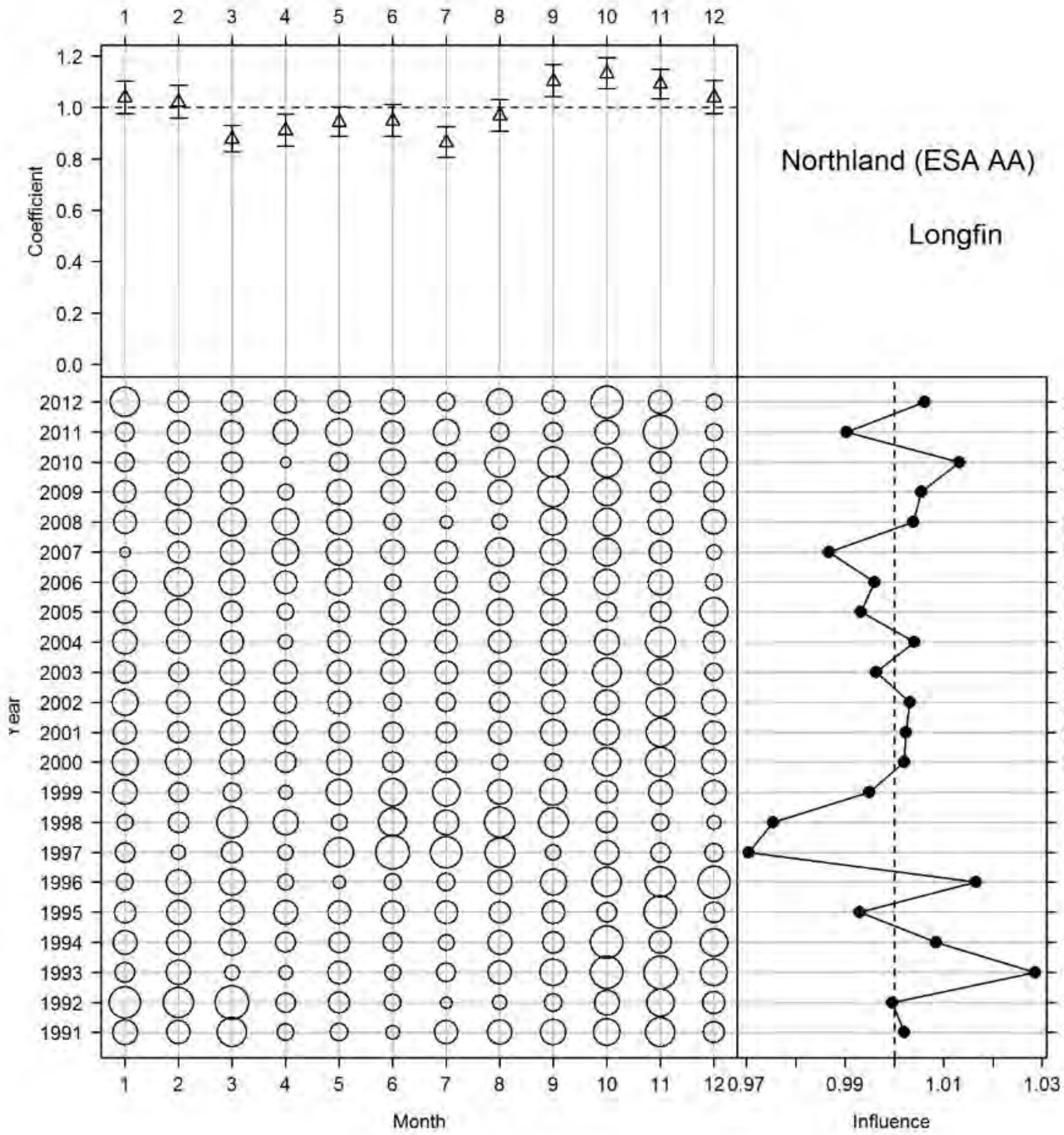


Figure A27: Influence of month for the longfin CPUE model for the years 1990–91 to 2011–12 (Northland (ESA AA)).

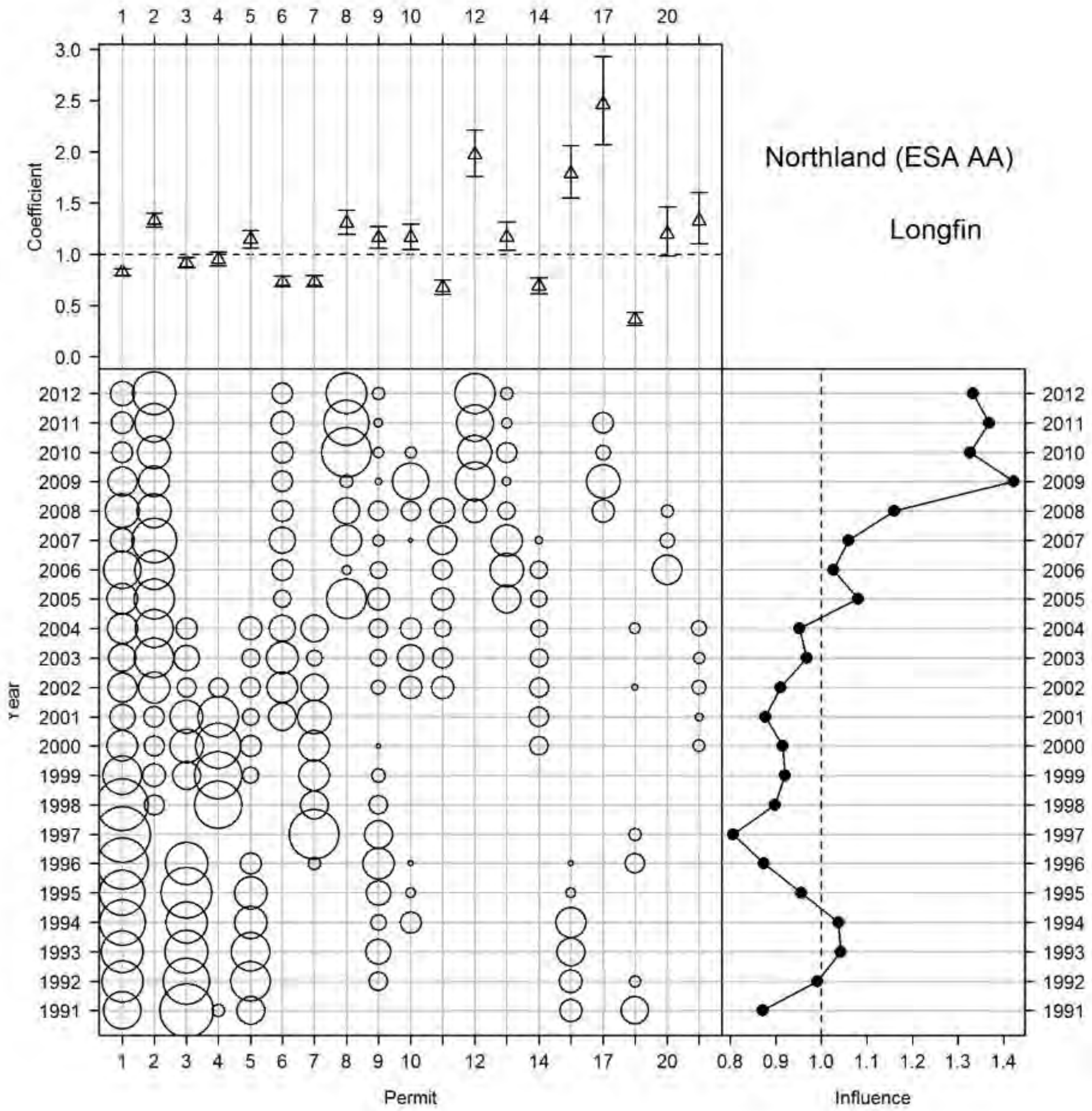


Figure A28: Influence of permit number for the longfin CPUE model for the years 1990–91 to 2011–12 (Northland (ESA AA)).

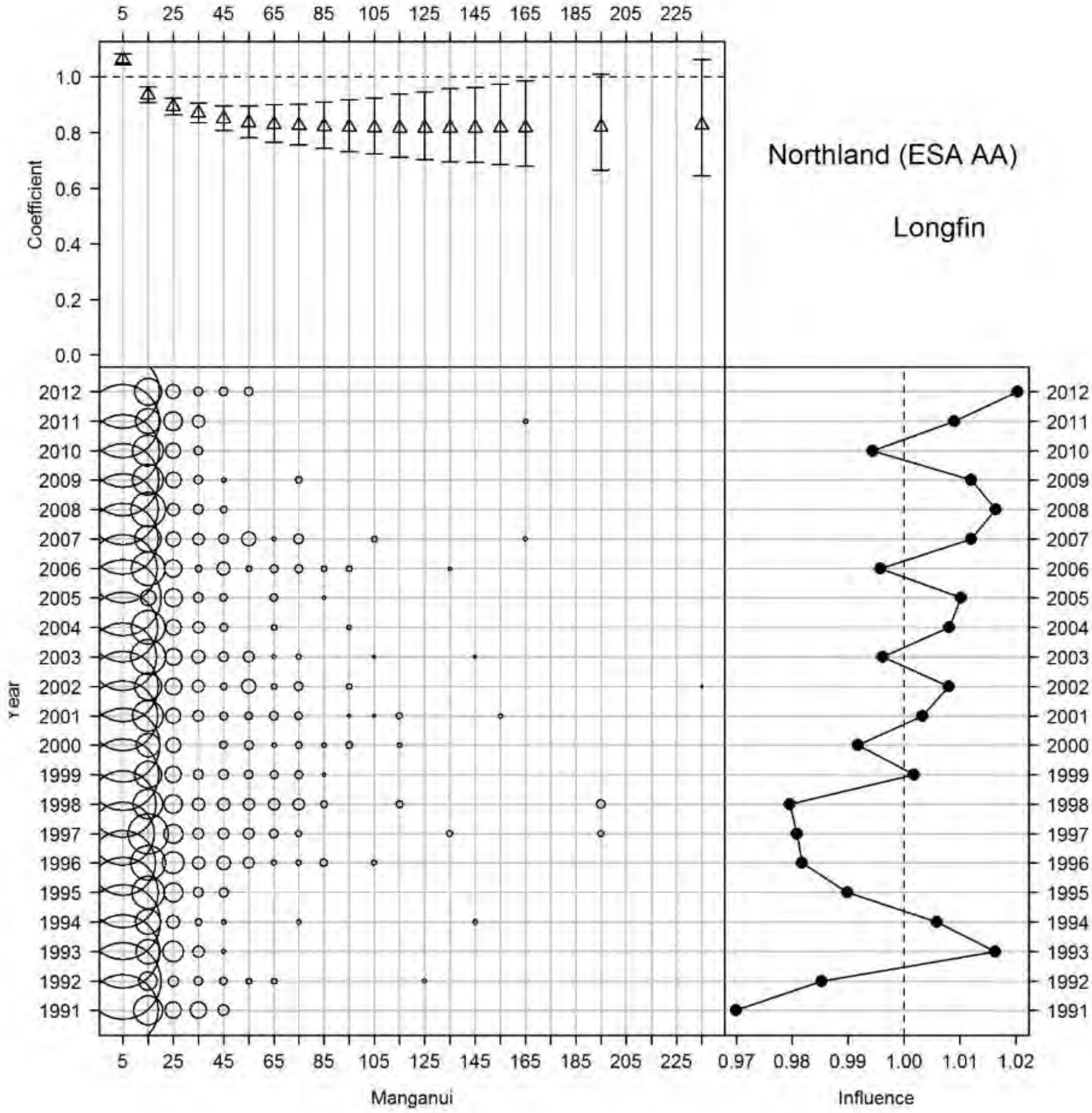


Figure A29: Influence of Manganui River flow for the longfin CPUE model for the years 1990–91 to 2011–12 (Northland (ESA AA)).

Appendix B: Auckland (AB)

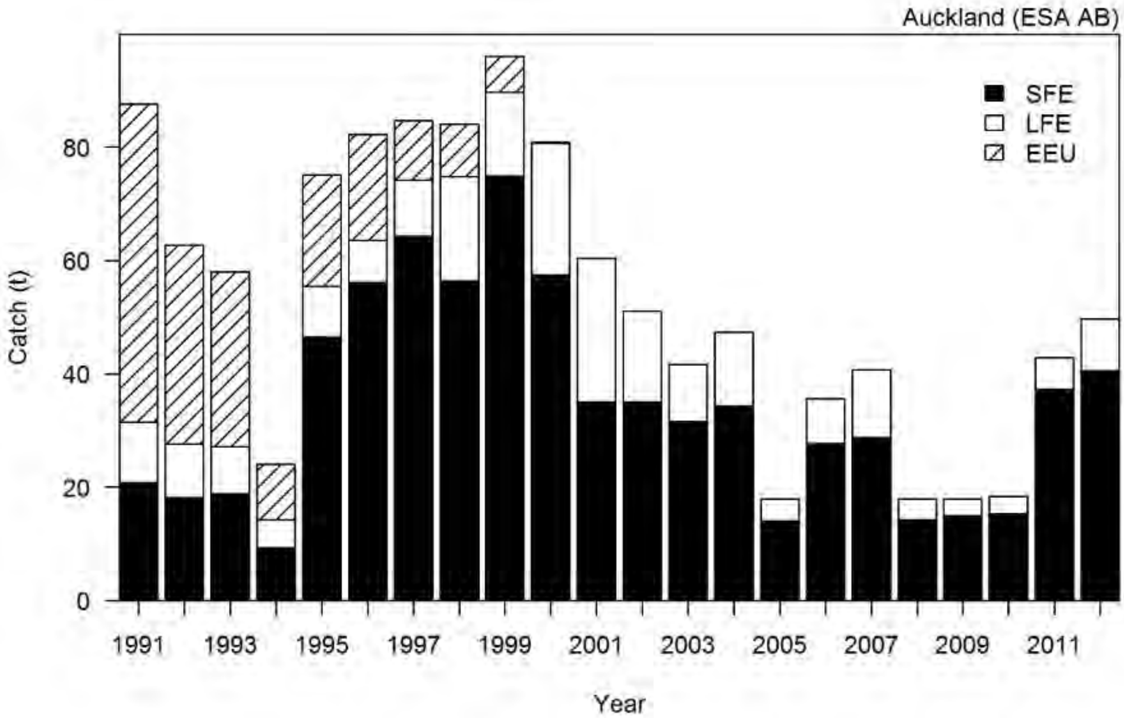


Figure B1: Total estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

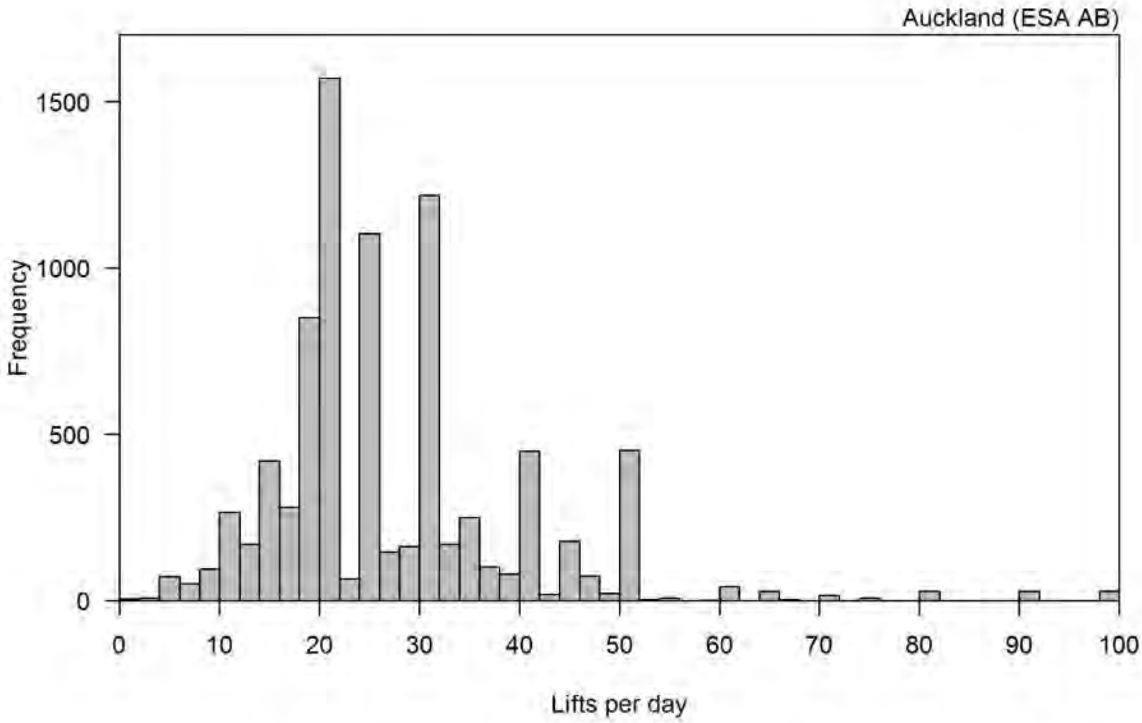


Figure B2: Frequency of total lifts per day for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

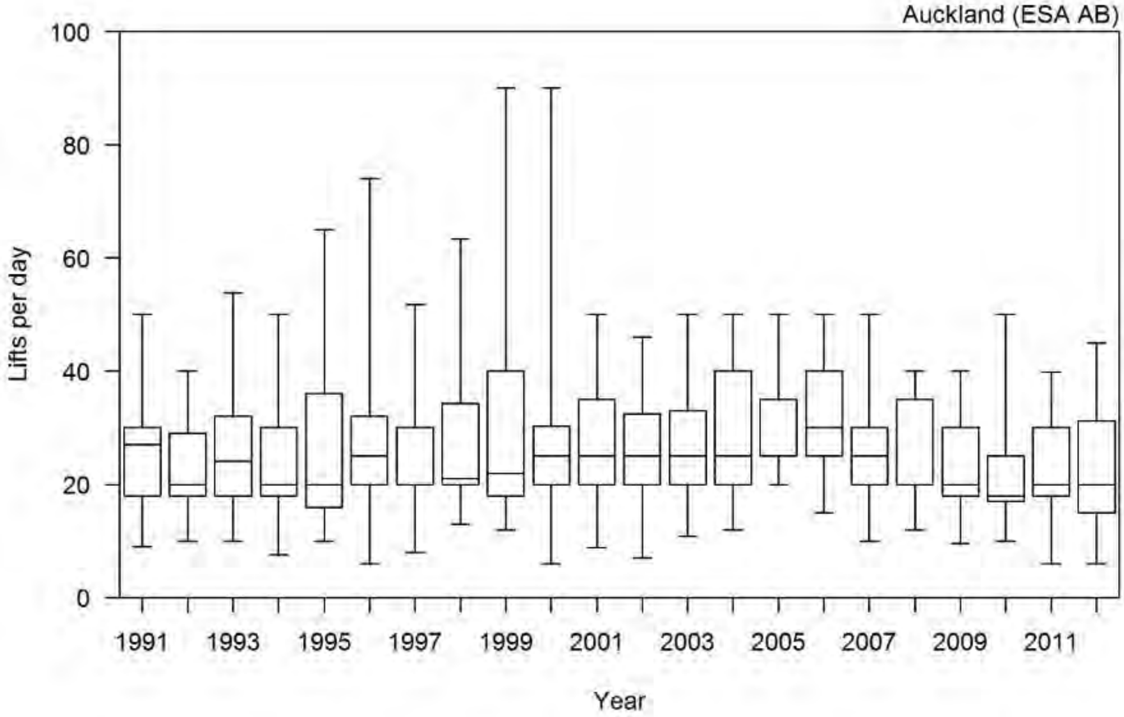


Figure B3: Total lifts per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Auckland (ESA AB)).

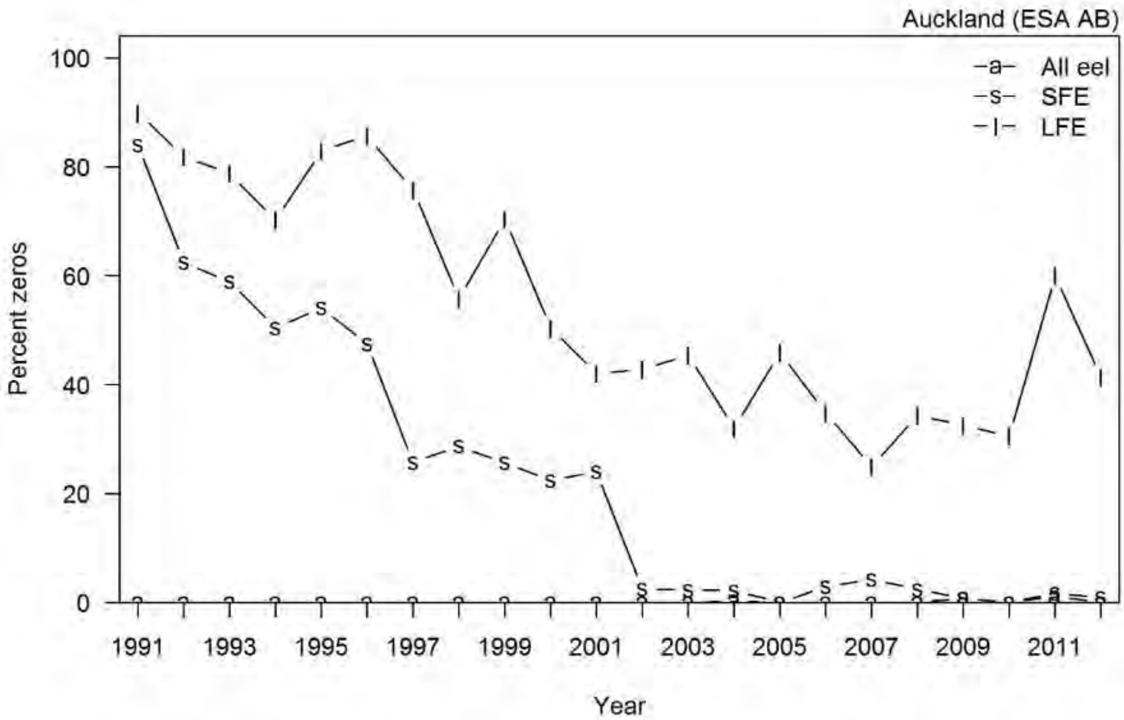


Figure B4: Proportion of zero records for all eel, shortfin (SFE), and longfin (LFE) catch for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

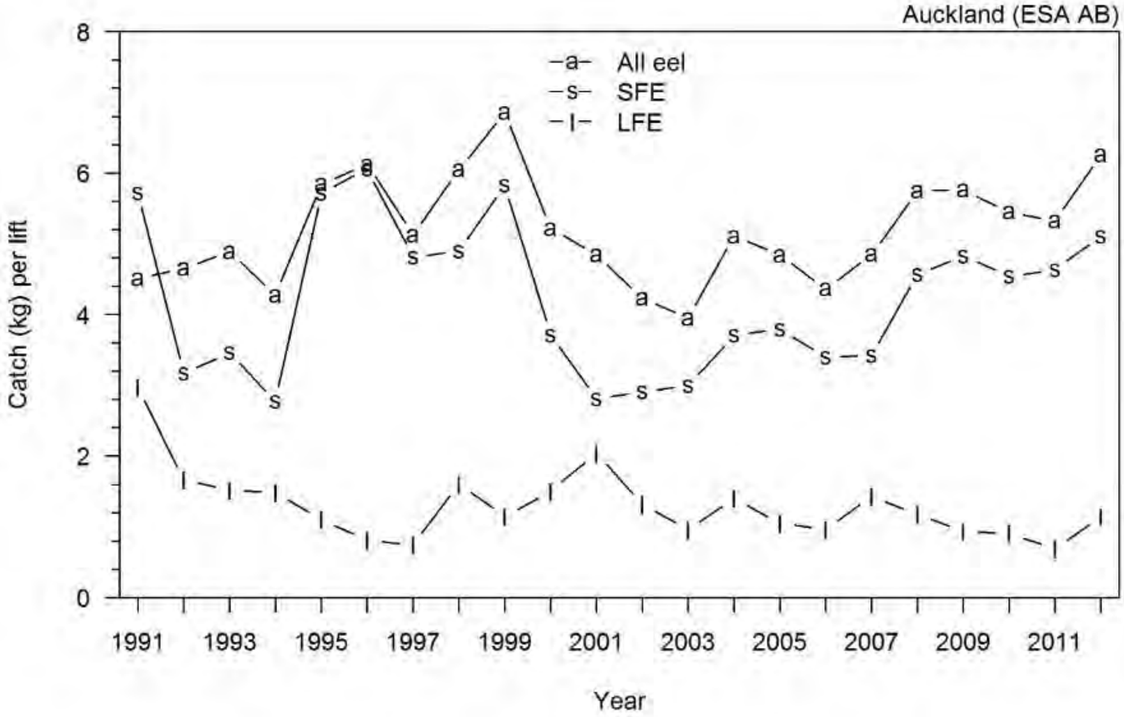


Figure B5: Unstandardised catch per lift (total kg/total lifts) for all eel, shortfin (SFE), and longfin (LFE) for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

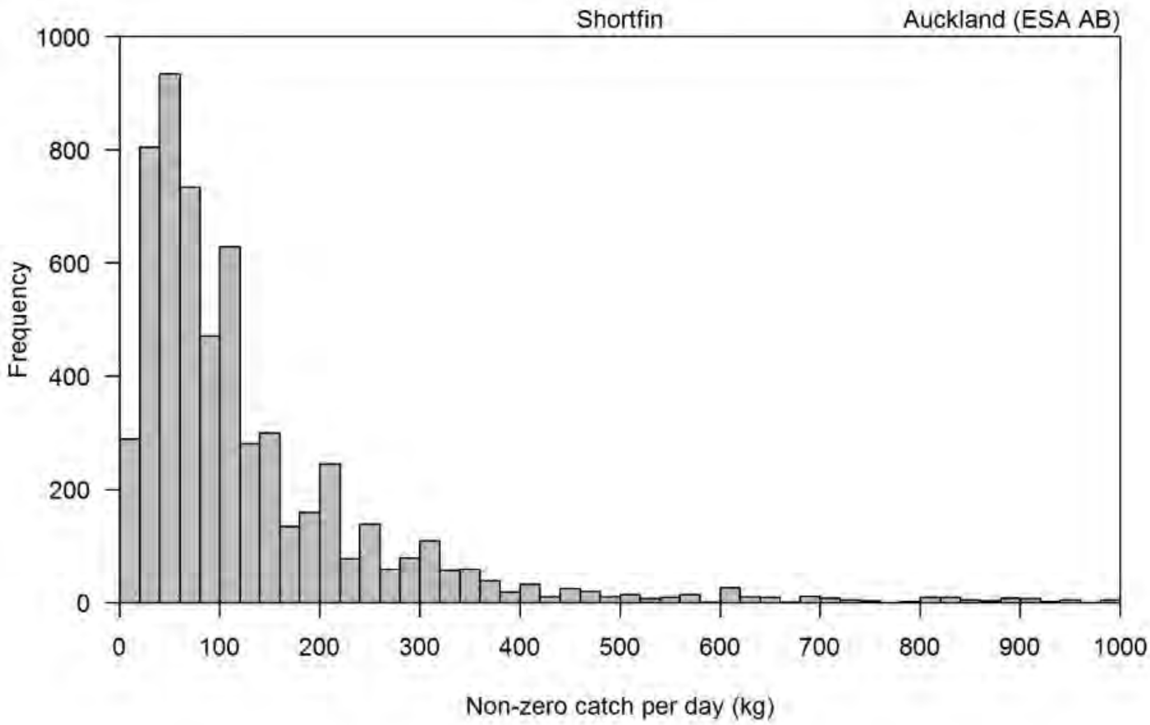


Figure B6: Frequency of shortfin eel catch per day for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

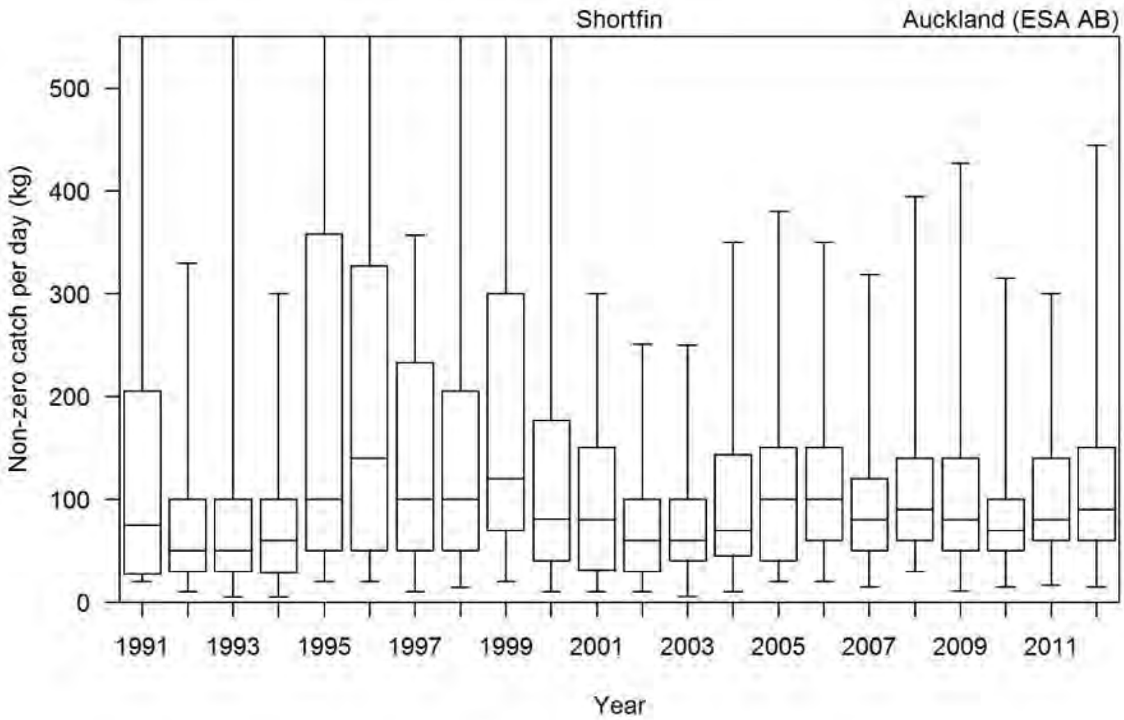


Figure B7: Shortfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Auckland (ESA AB)).

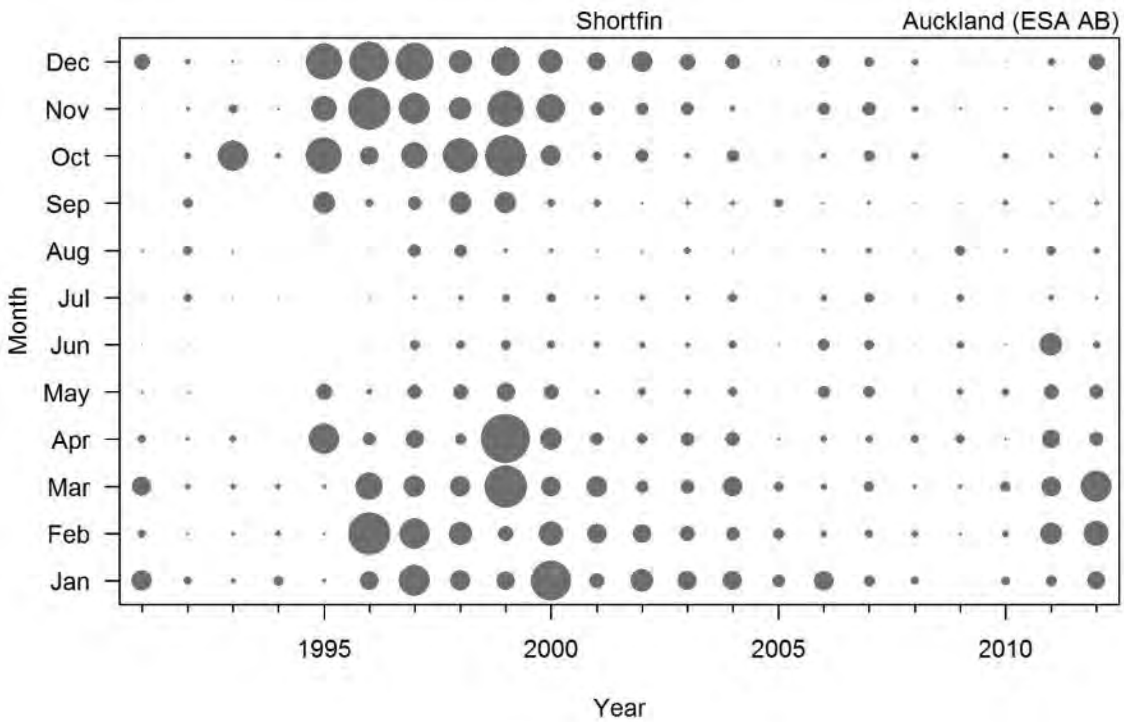


Figure B8: Shortfin eel catch by month for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

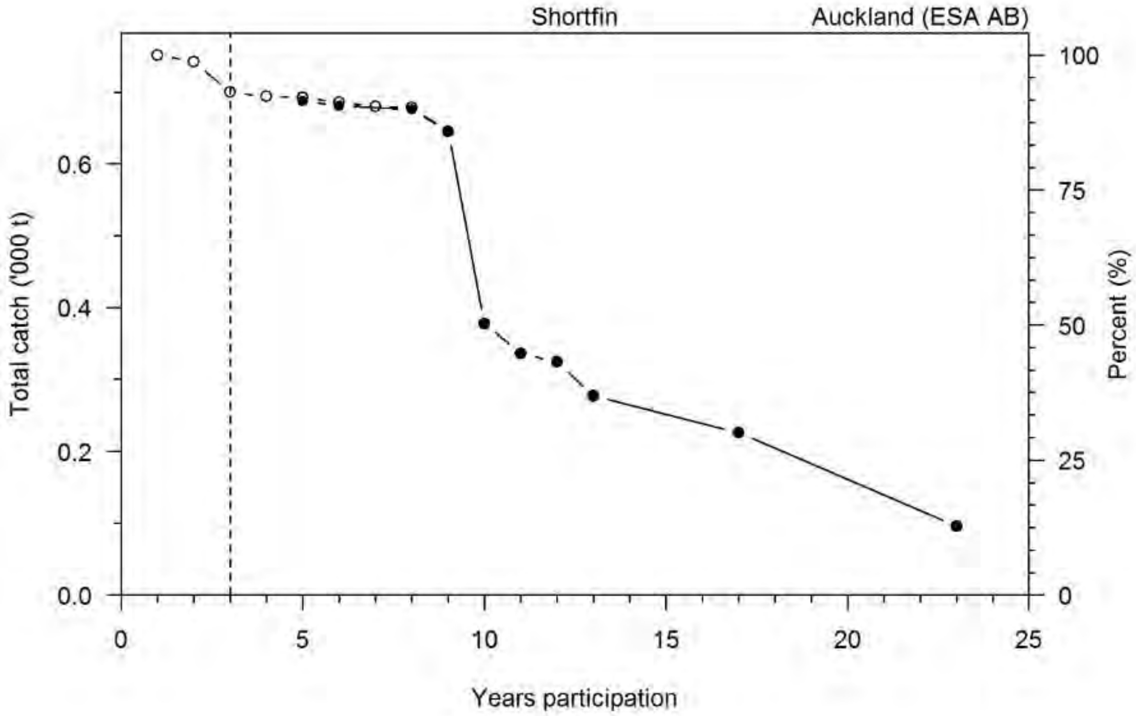


Figure B9: Relationship between years of participation in the fishery and shortfin total catch. The open circles represent all shortfin catch and the closed circles shortfin catch data from fishers who 1) caught shortfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core shortfin fisher analyses for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

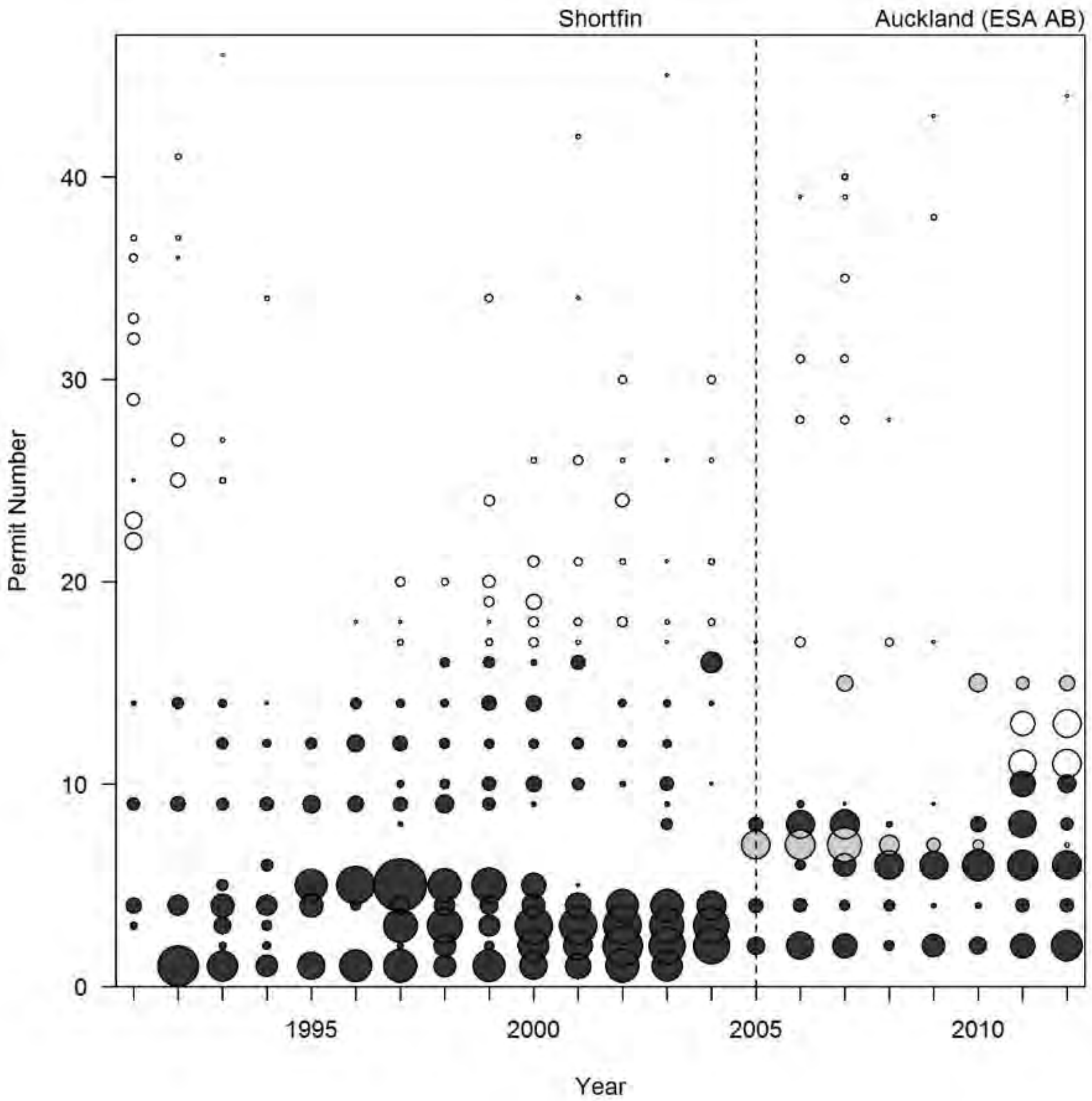


Figure B10: Relative catch of shortfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Auckland (ESA AB)).

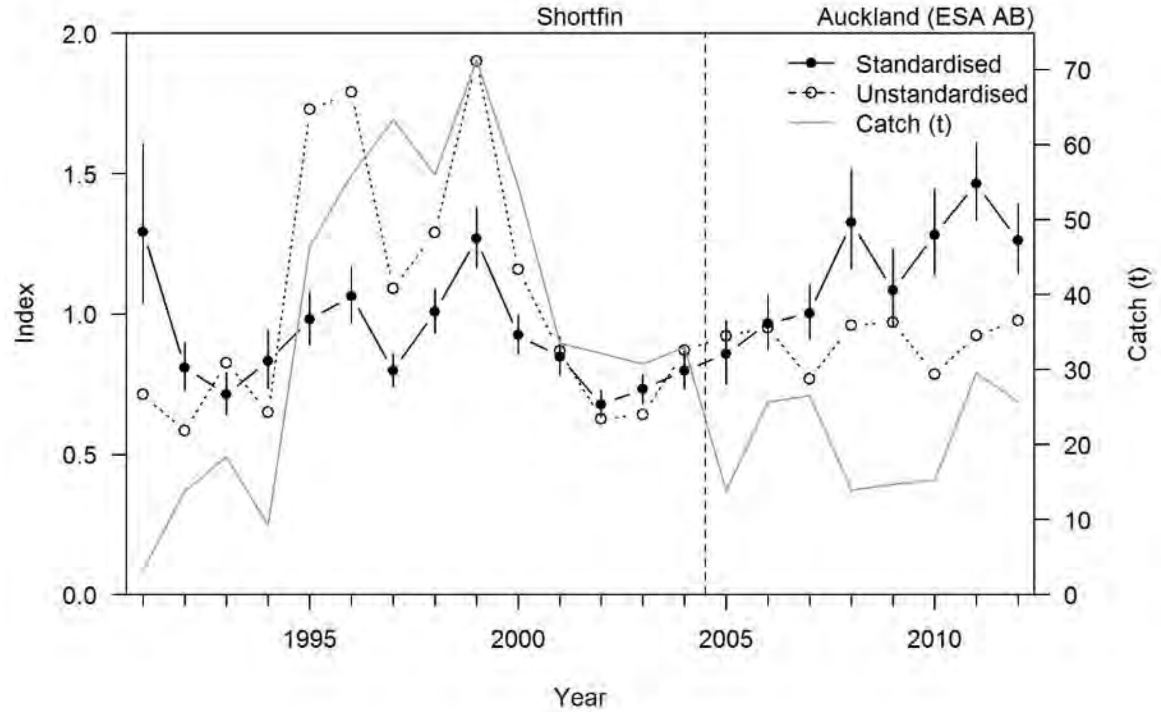


Figure B11: Indices of unstandardised catch per day and standardised CPUE for the core fishers shortfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Auckland (ESA AB)).

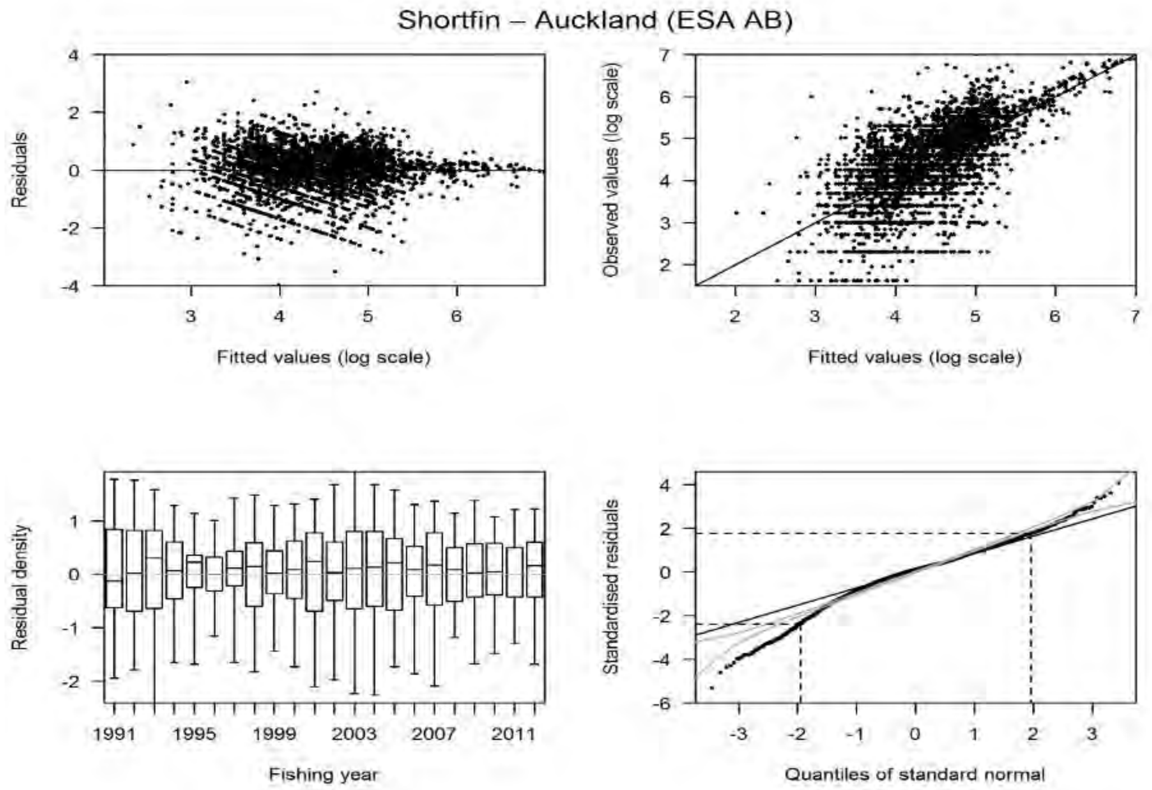


Figure B12: Residual diagnostic plots for the shortfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Auckland (ESA AB)).

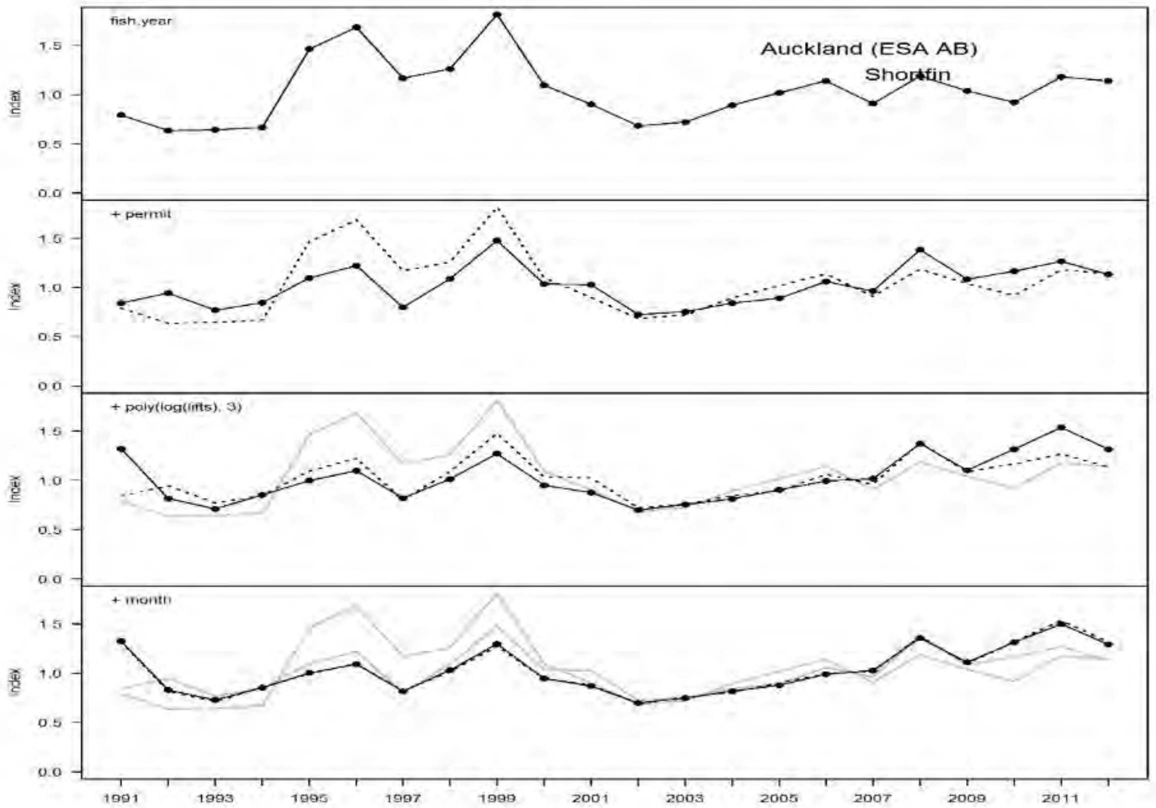


Figure B13: Step plot for the shortfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Auckland (ESA AB)).

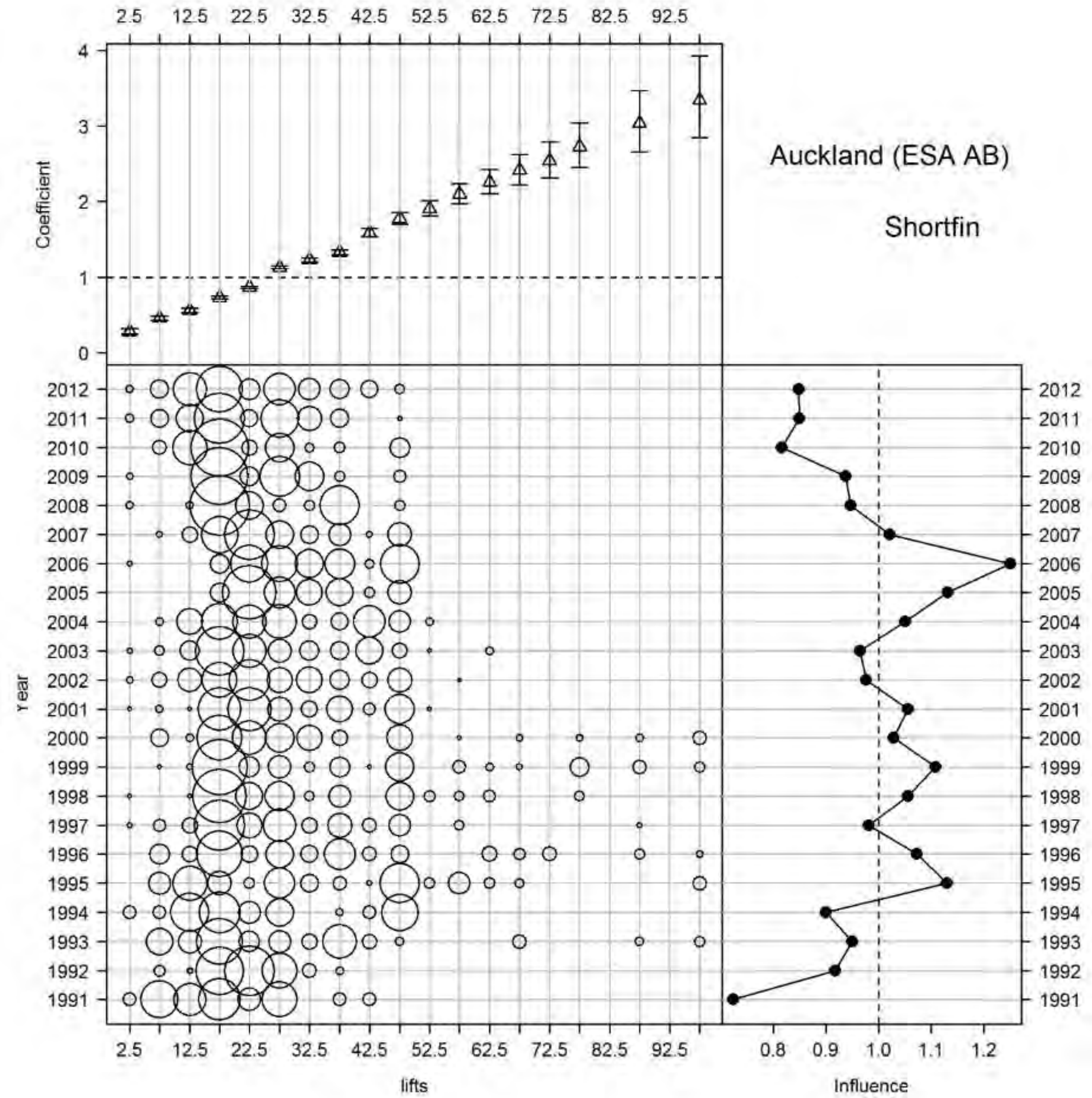


Figure B14: Influence of lifts for the shortfin CPUE model for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

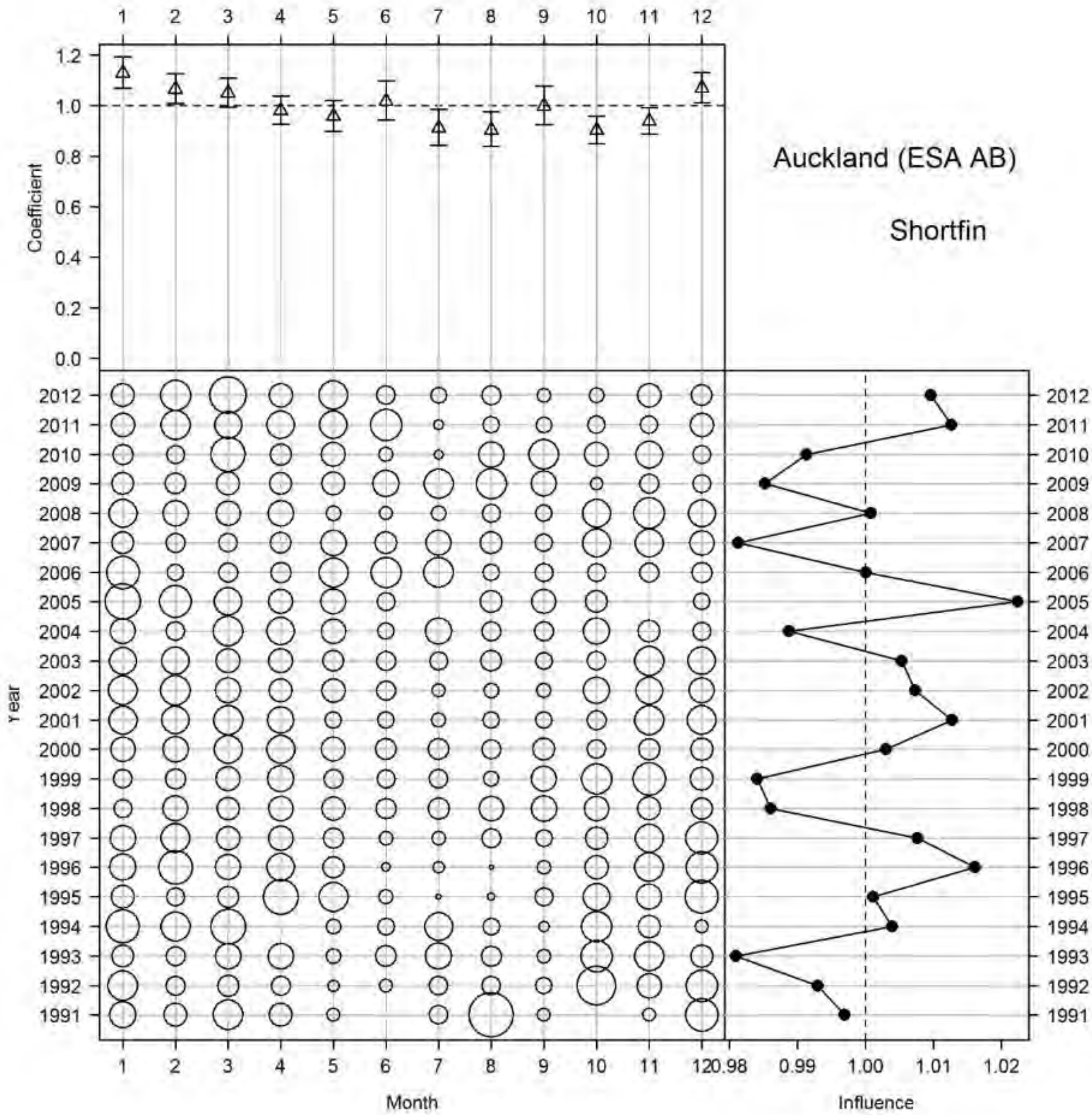


Figure B15: Influence of month for the shortfin CPUE model for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

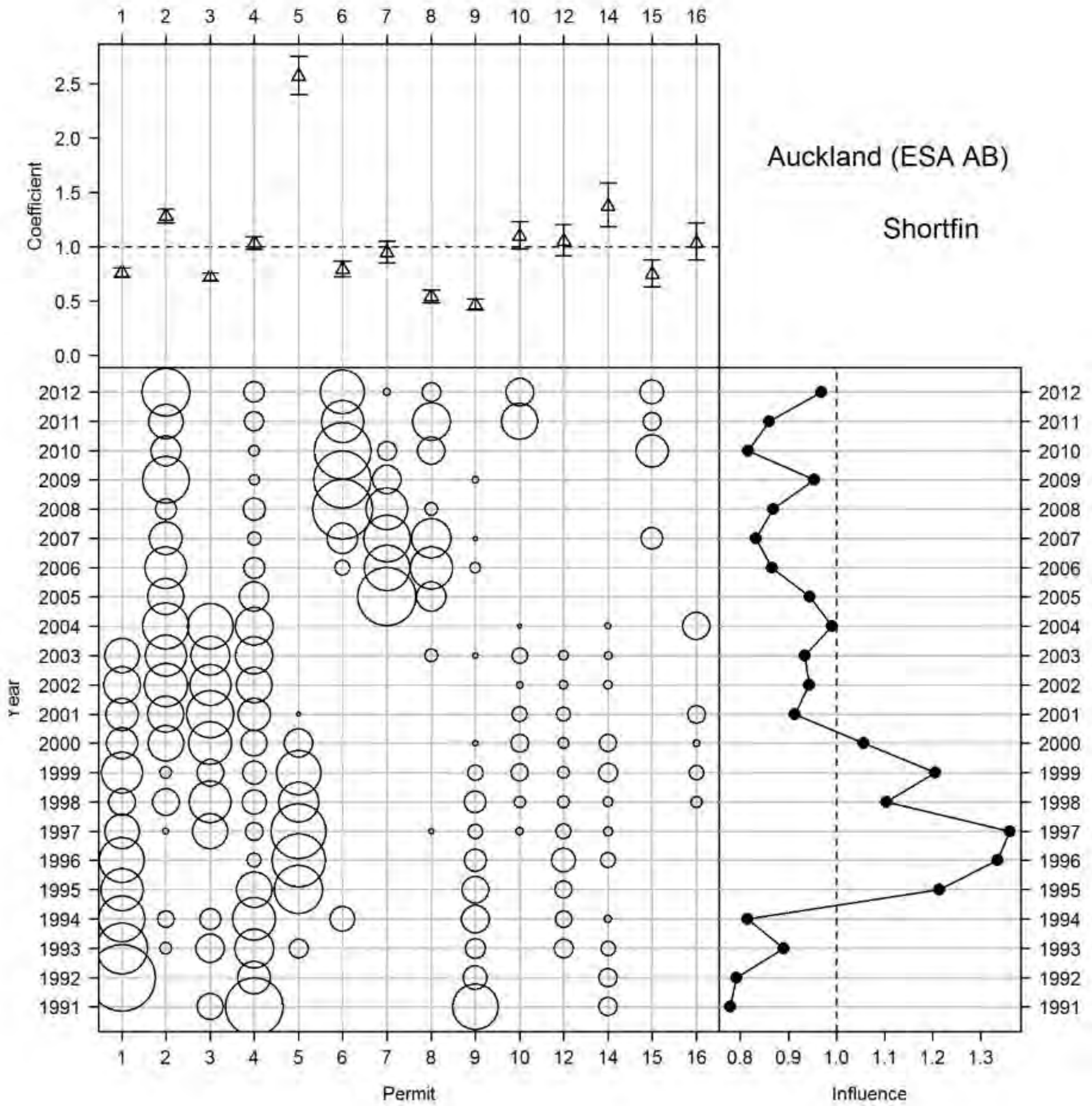


Figure B16: Influence of permit number for the shortfin CPUE model for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

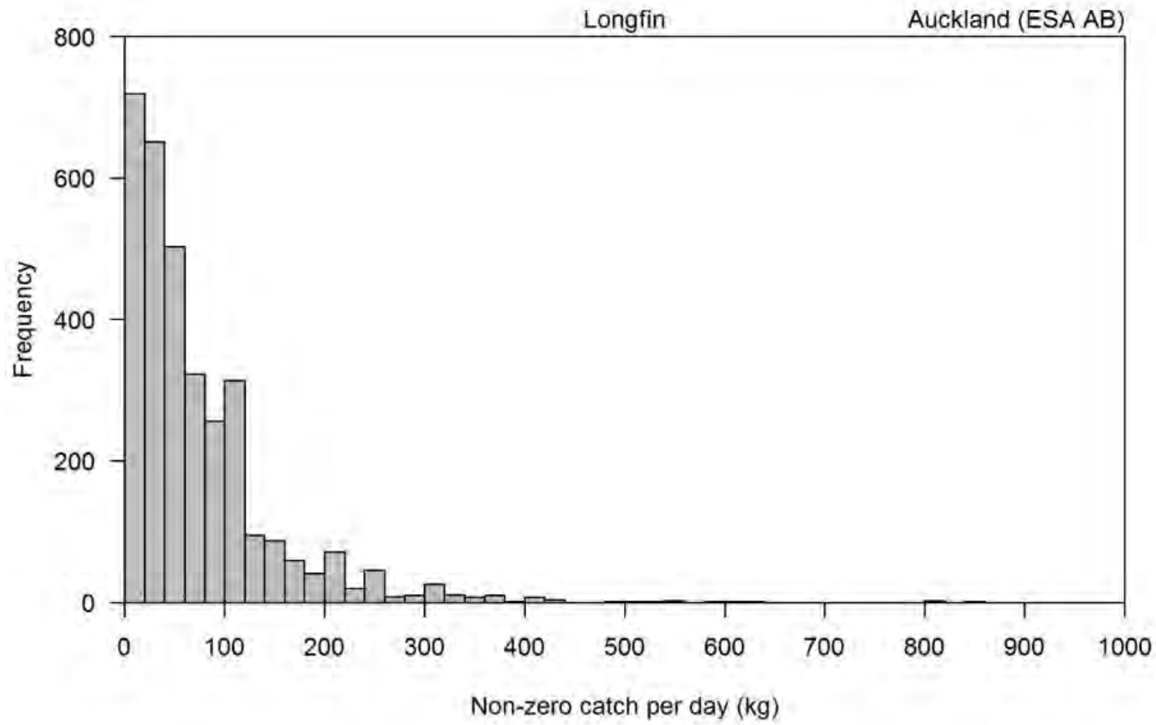


Figure B17: Frequency of longfin eel catch per day for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

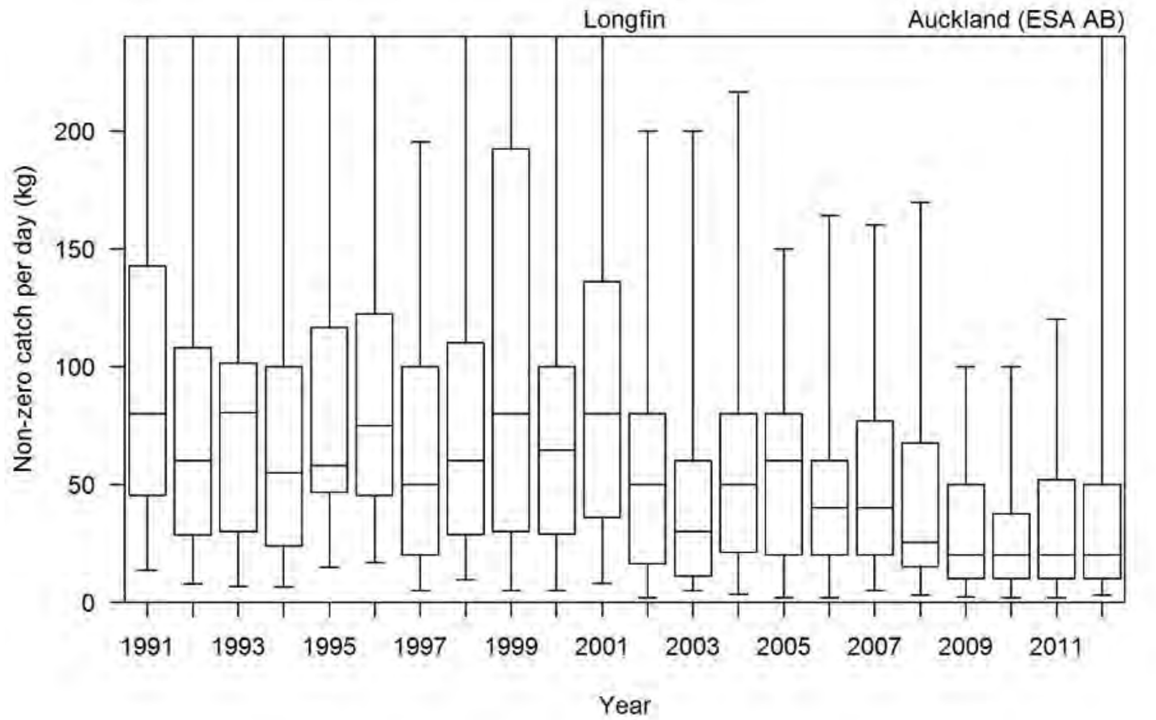


Figure B18: Longfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Auckland (ESA AB)).

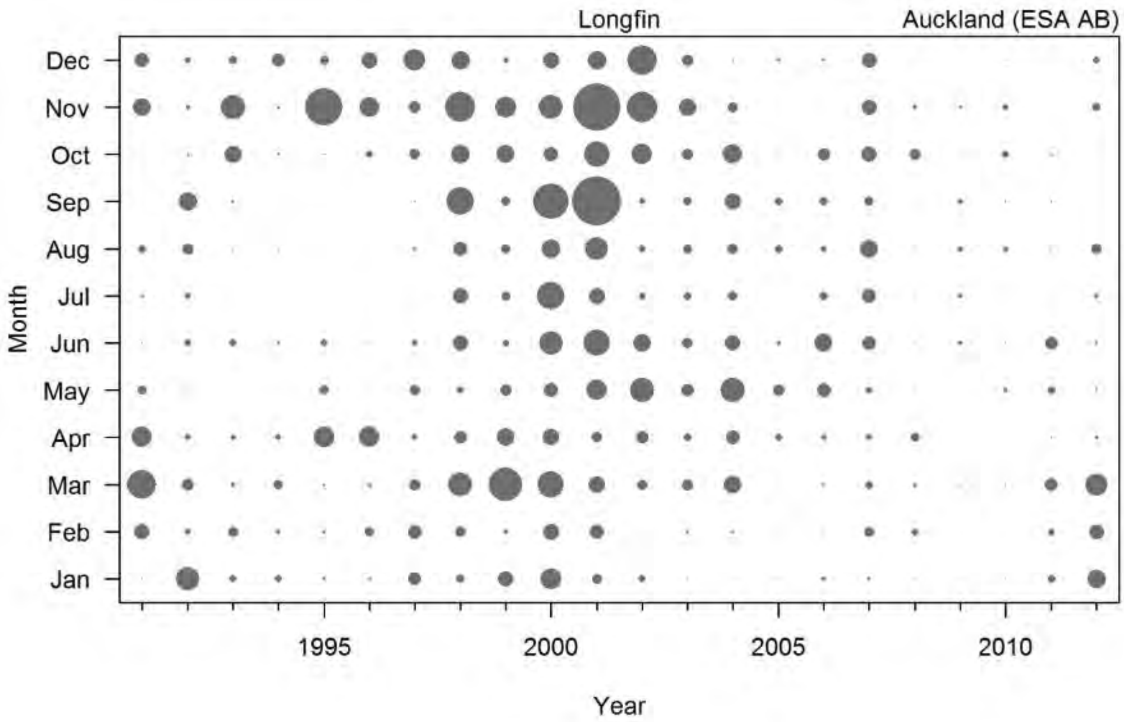


Figure B19: Longfin eel catch by month for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

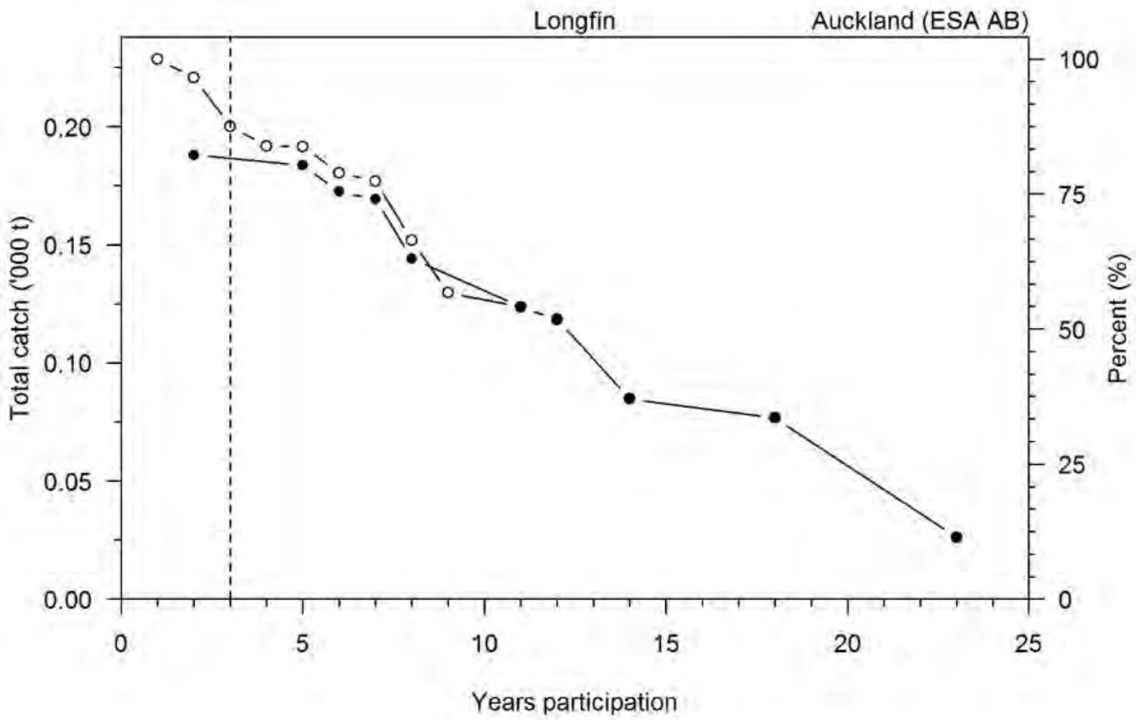


Figure B20: Relationship between years of participation in the fishery and longfin total catch. The open circles represent all longfin catch and the closed circles longfin catch data from fishers who 1) caught longfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core longfin fisher analyses for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

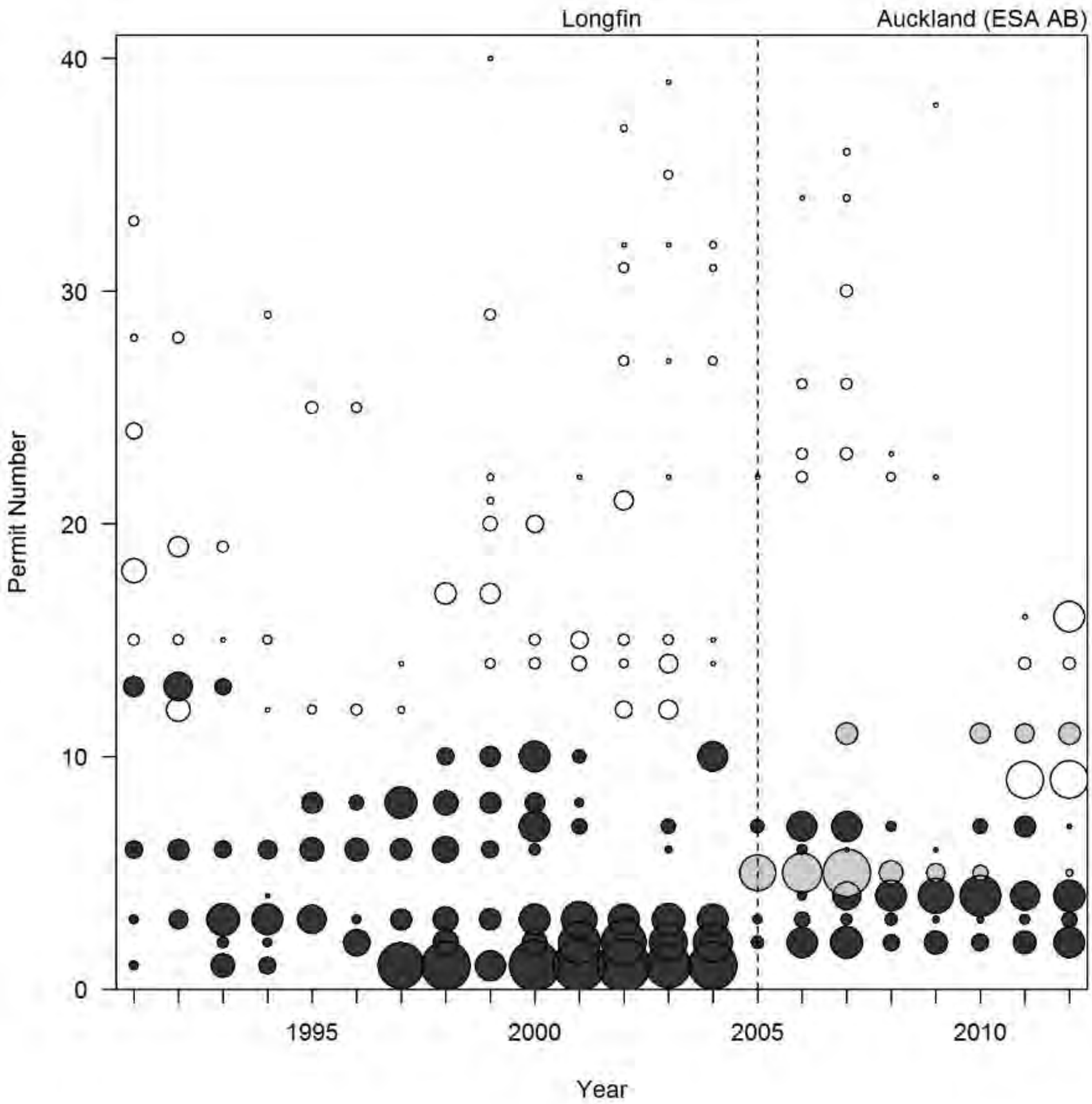


Figure B21: Relative catch of longfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Auckland (ESA AB)).

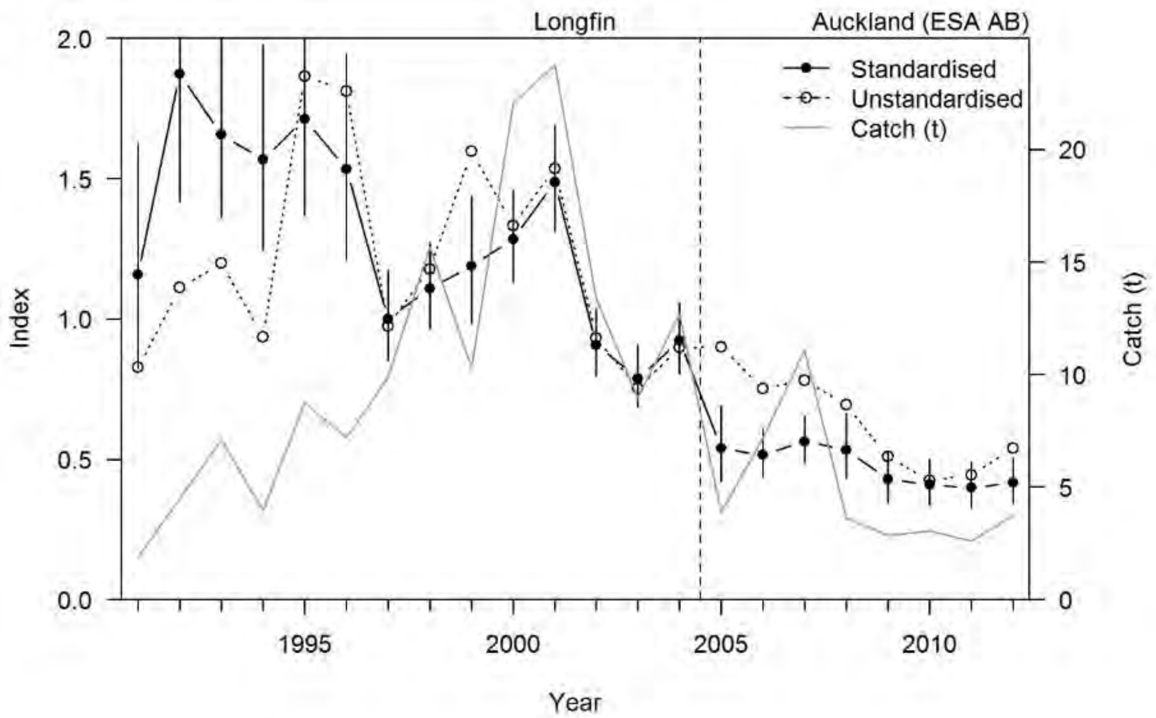


Figure B22: Indices of unstandardised catch per day and standardised CPUE for the core fishers longfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Auckland (ESA AB)).

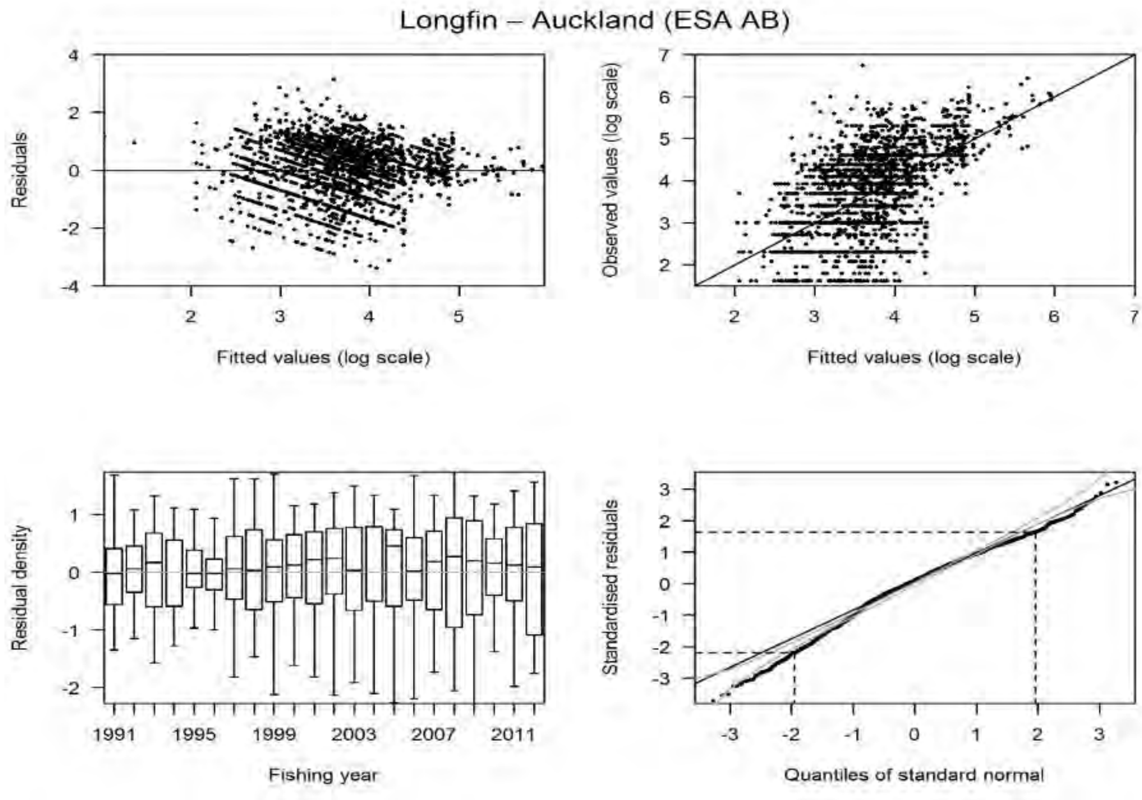


Figure B23: Residual diagnostic plots for the longfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Auckland (ESA AB)).

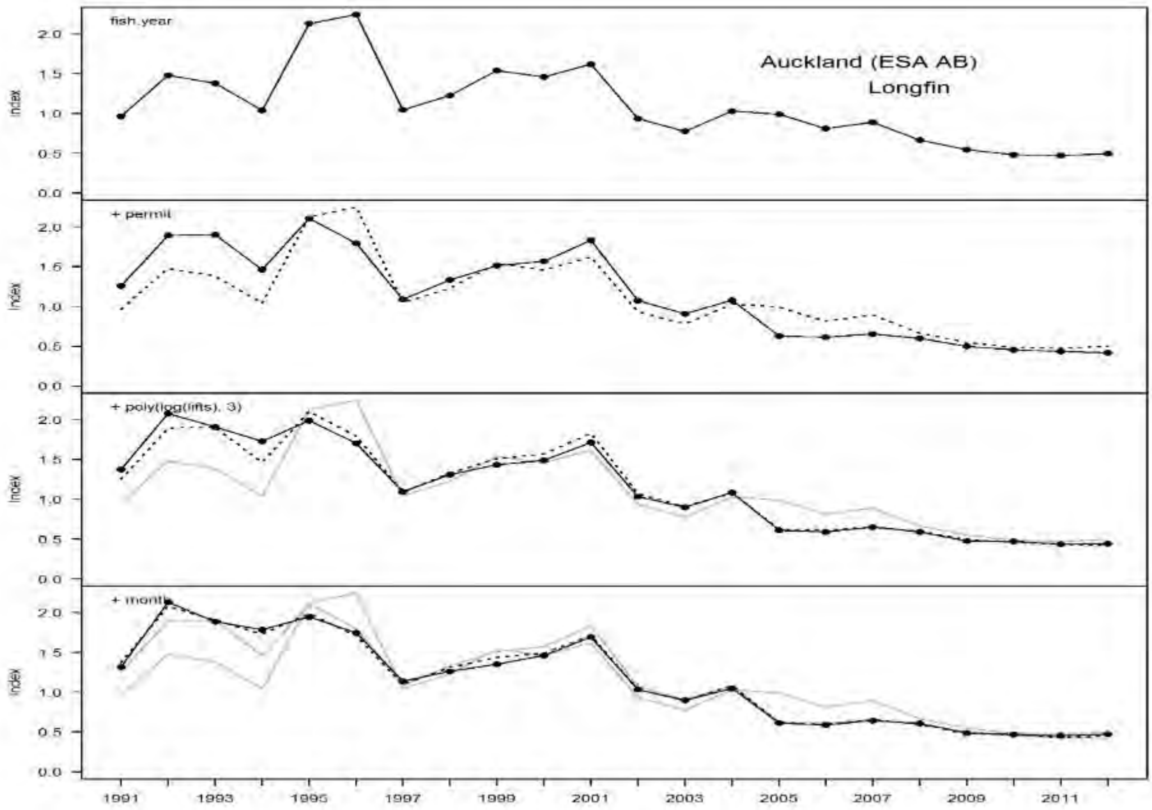


Figure B24: Step plot for the longfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Auckland (ESA AB)).

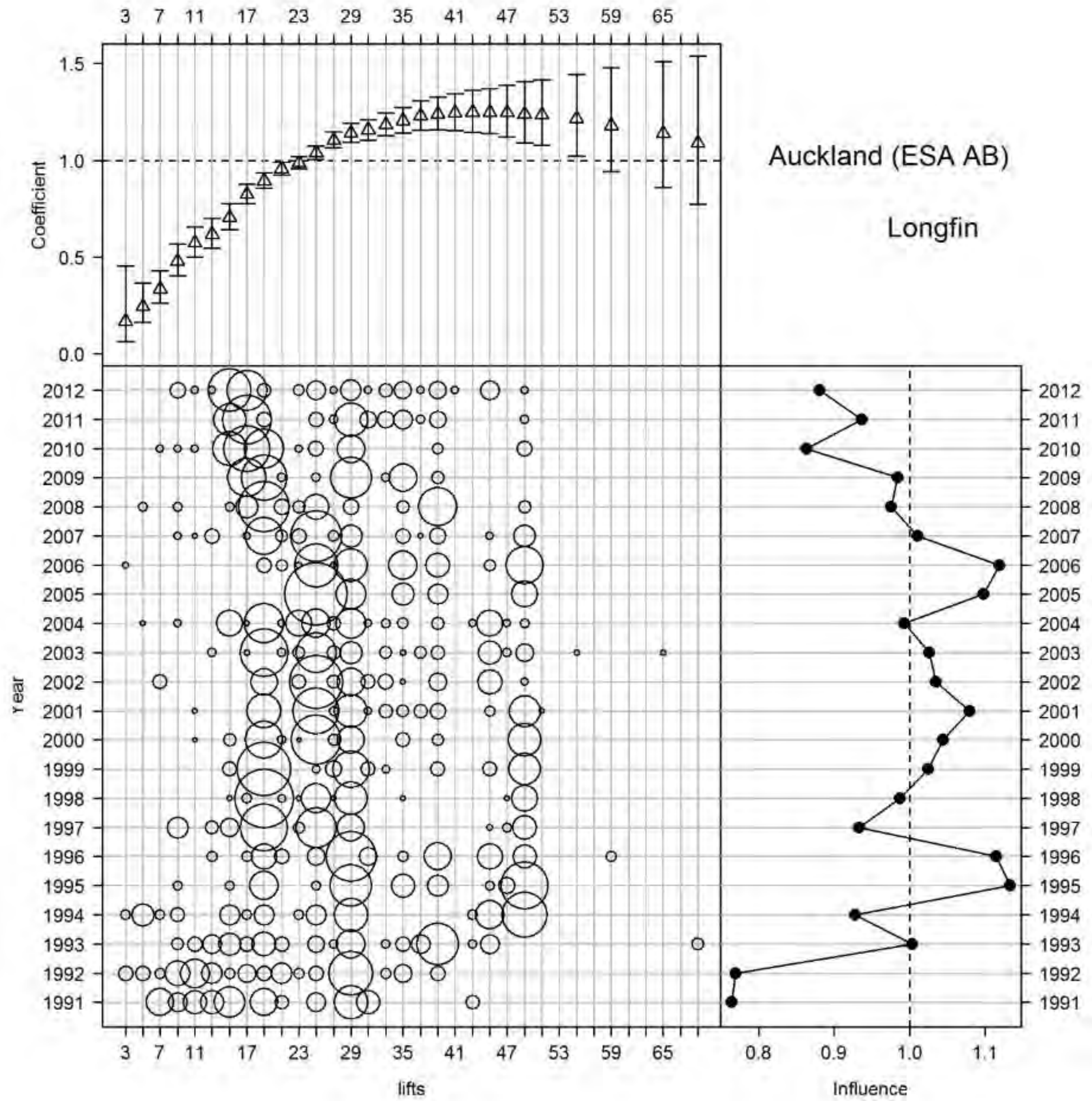


Figure B25: Influence of lifts for the longfin CPUE model for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

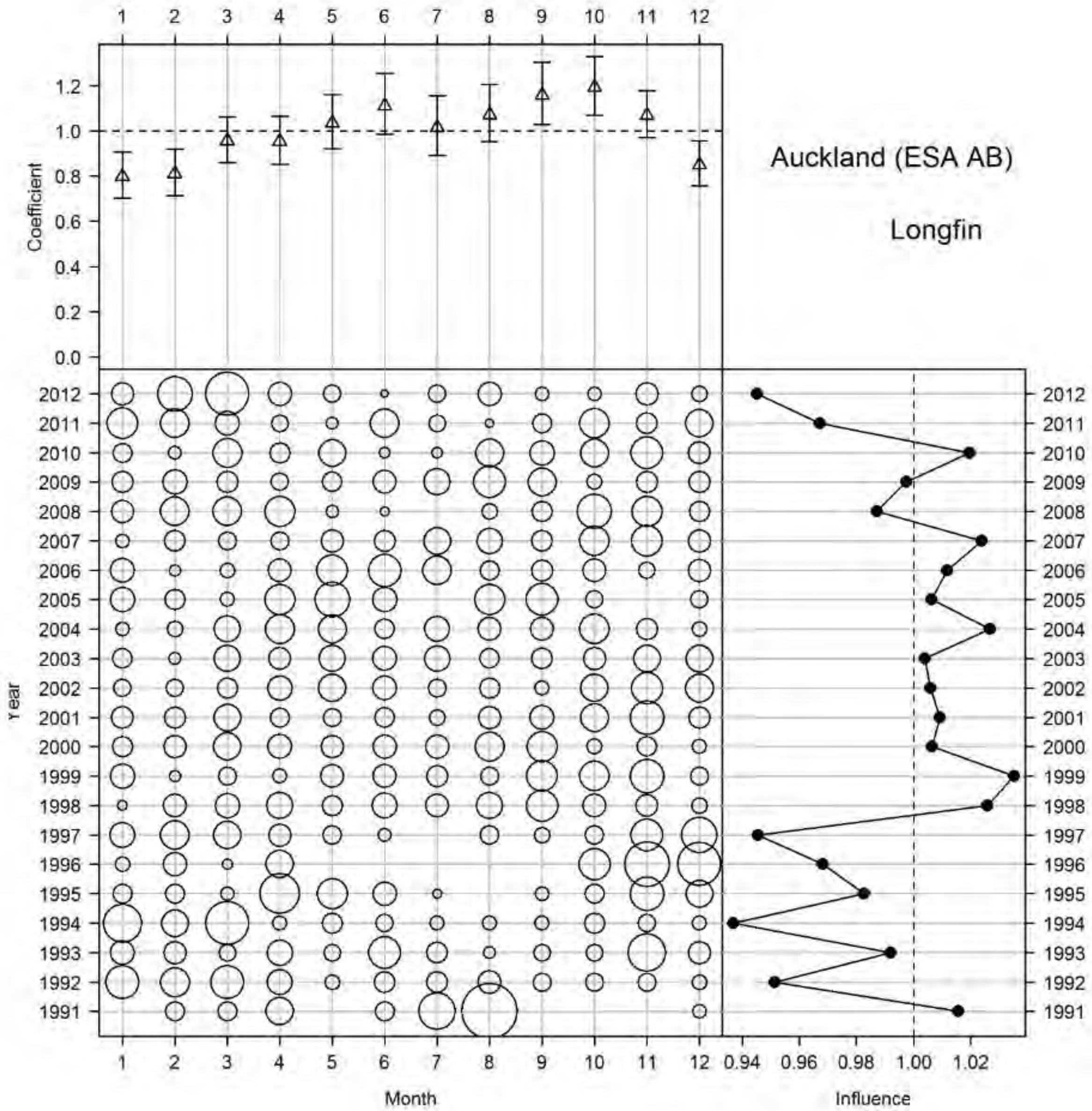


Figure B26: Influence of month for the longfin CPUE model for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

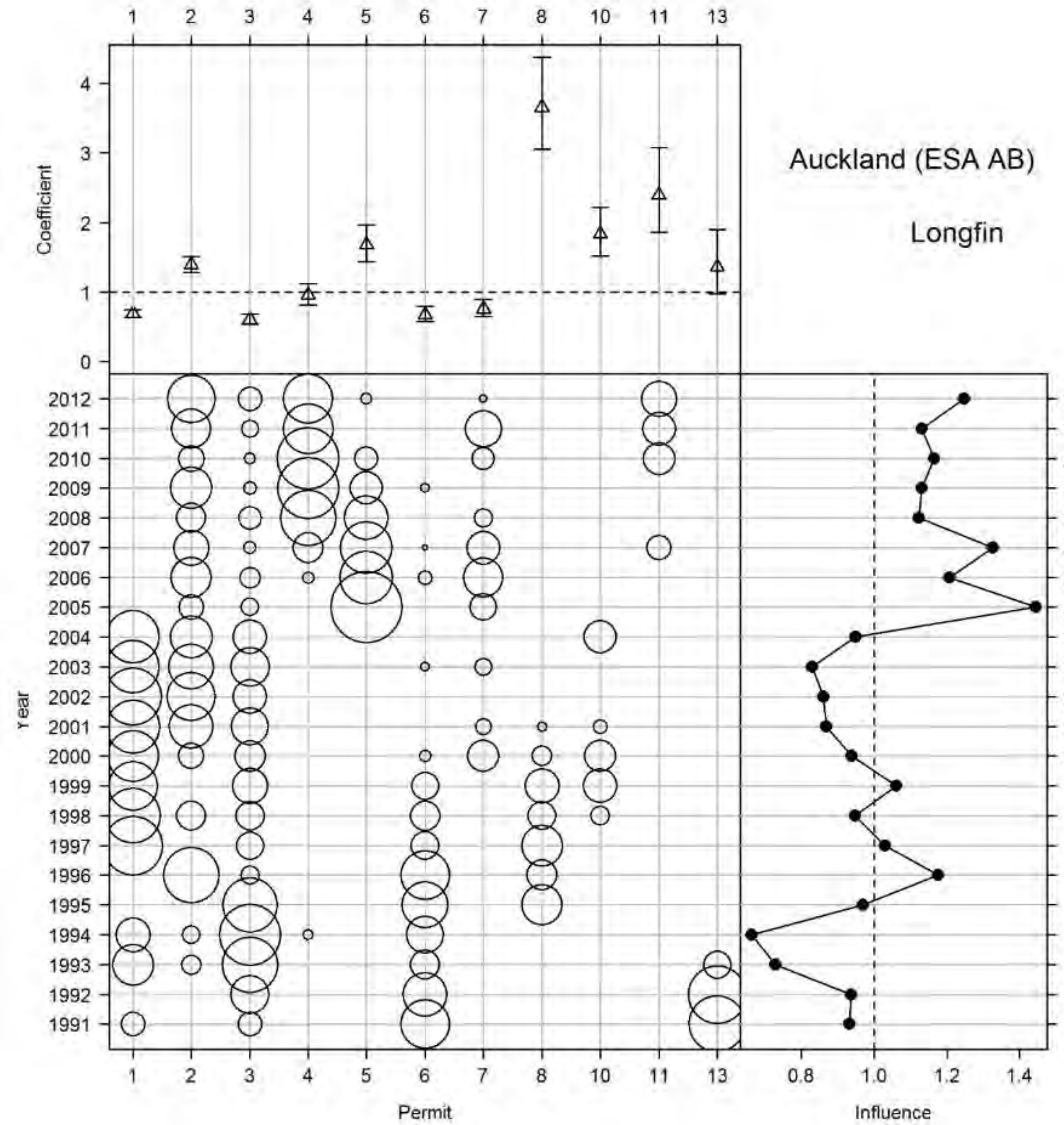


Figure B27: Influence of permit number for the longfin CPUE model for the years 1990–91 to 2011–12 (Auckland (ESA AB)).

Appendix C: Hauraki (ESA AC)

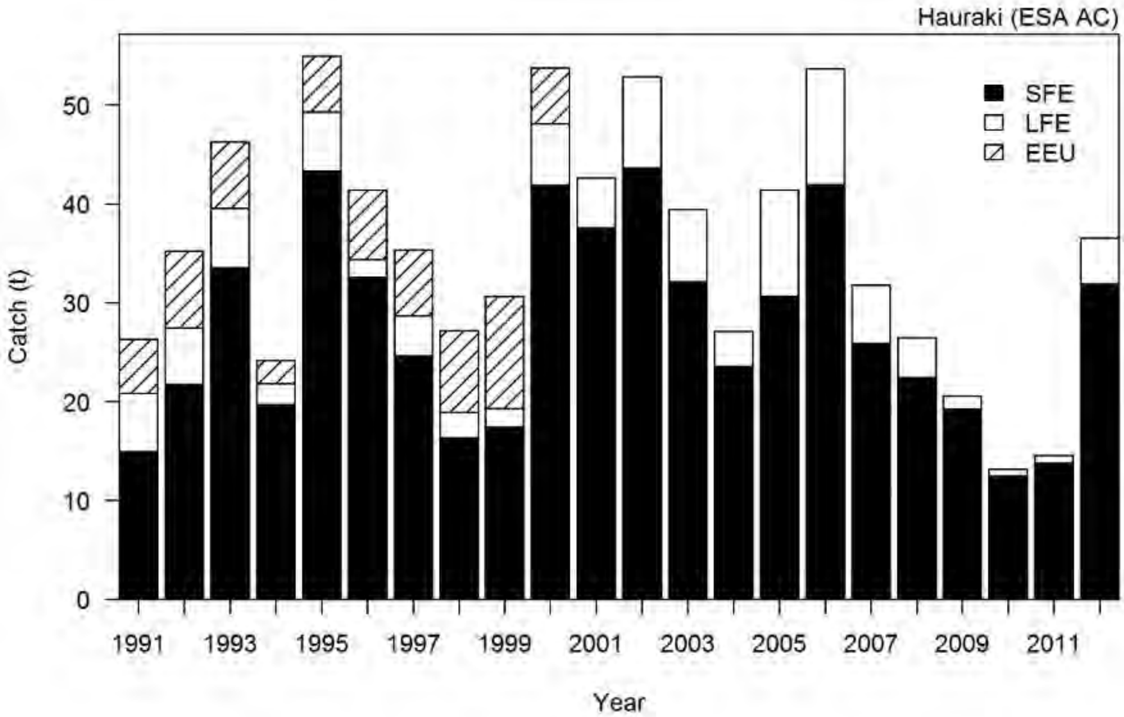


Figure C1: Total estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

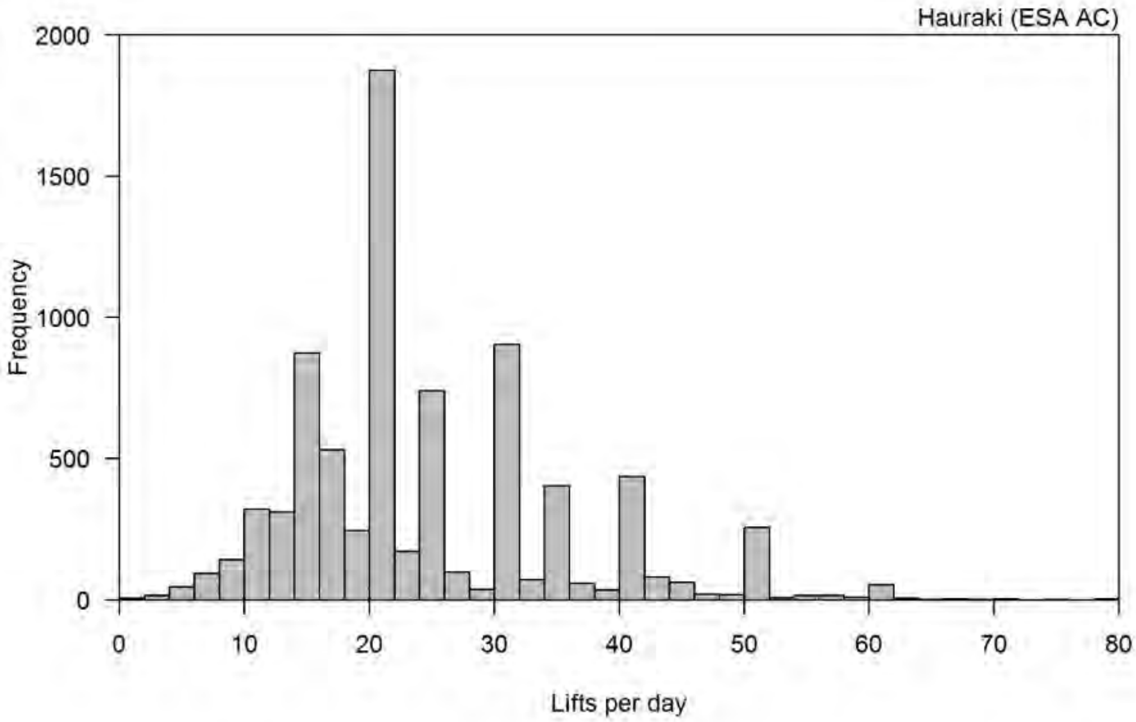


Figure C2: Frequency of total lifts per day for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

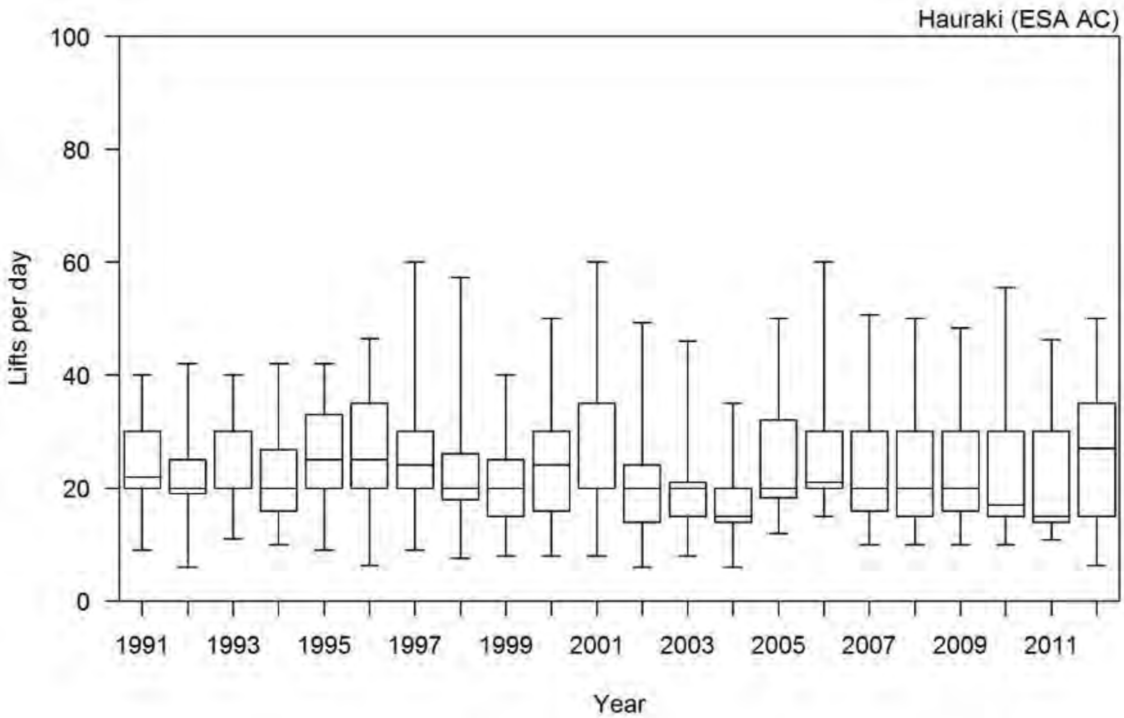


Figure C3: Total lifts per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Hauraki (ESA AC)).

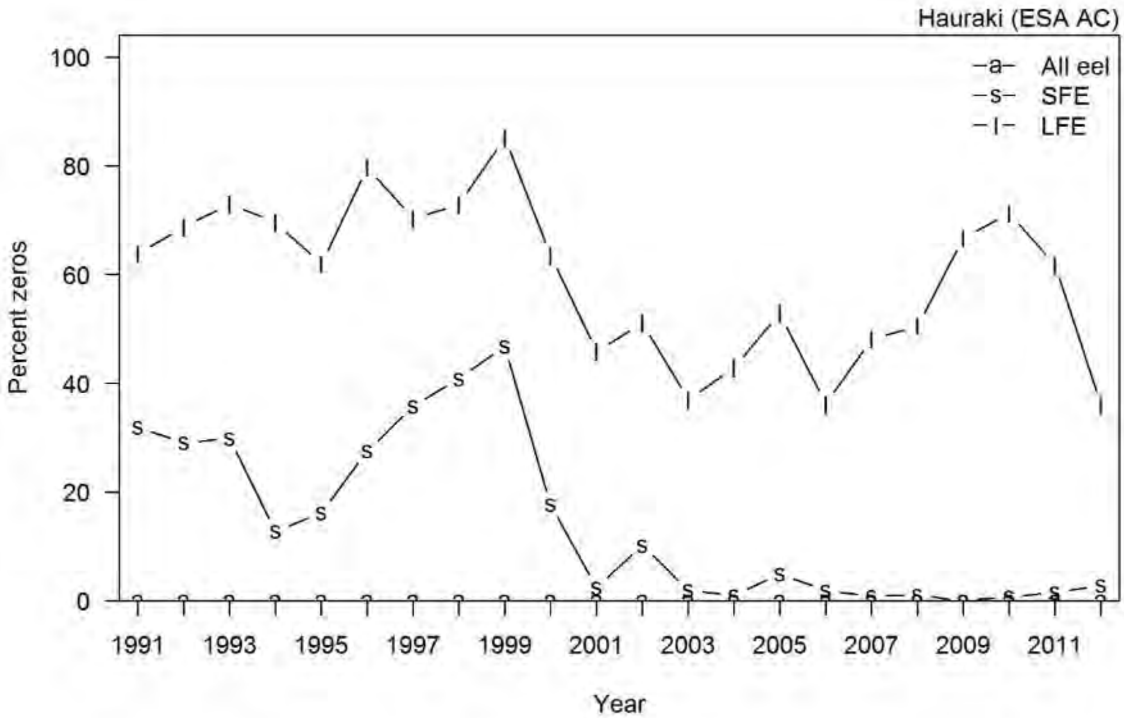


Figure C4: Proportion of zero records for all eel, shortfin (SFE), and longfin (LFE) catch for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

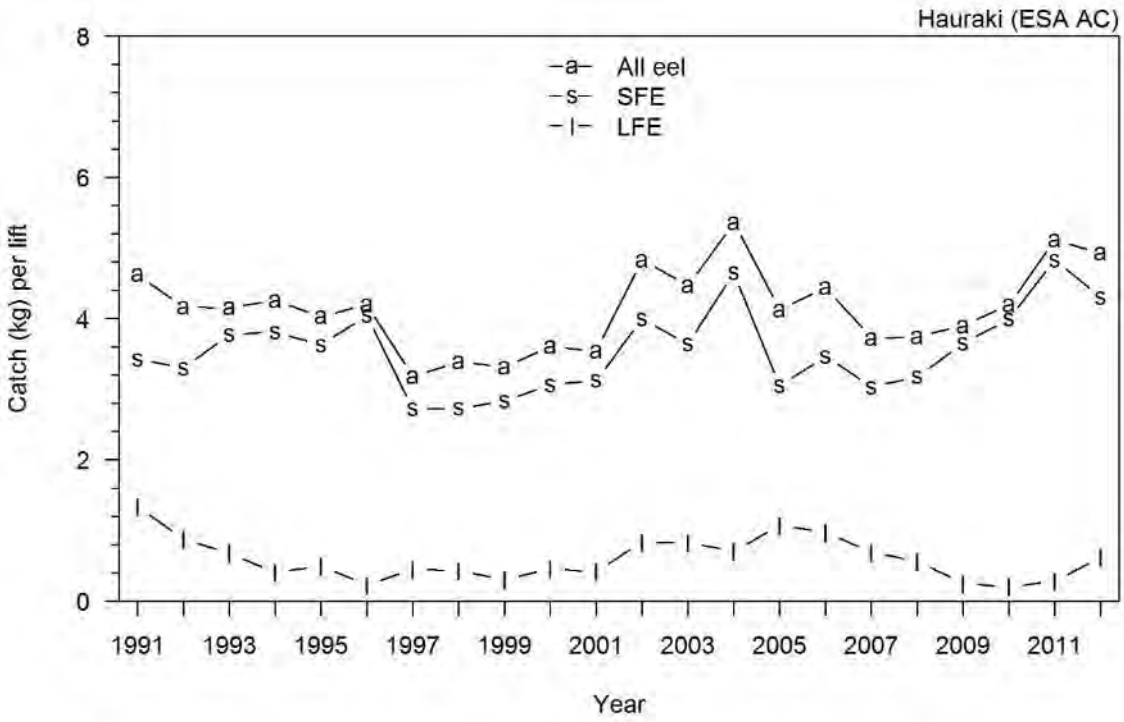


Figure C5: Unstandardised catch per lift (total kg/total lifts) for all eel, shortfin (SFE), and longfin (LFE) for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

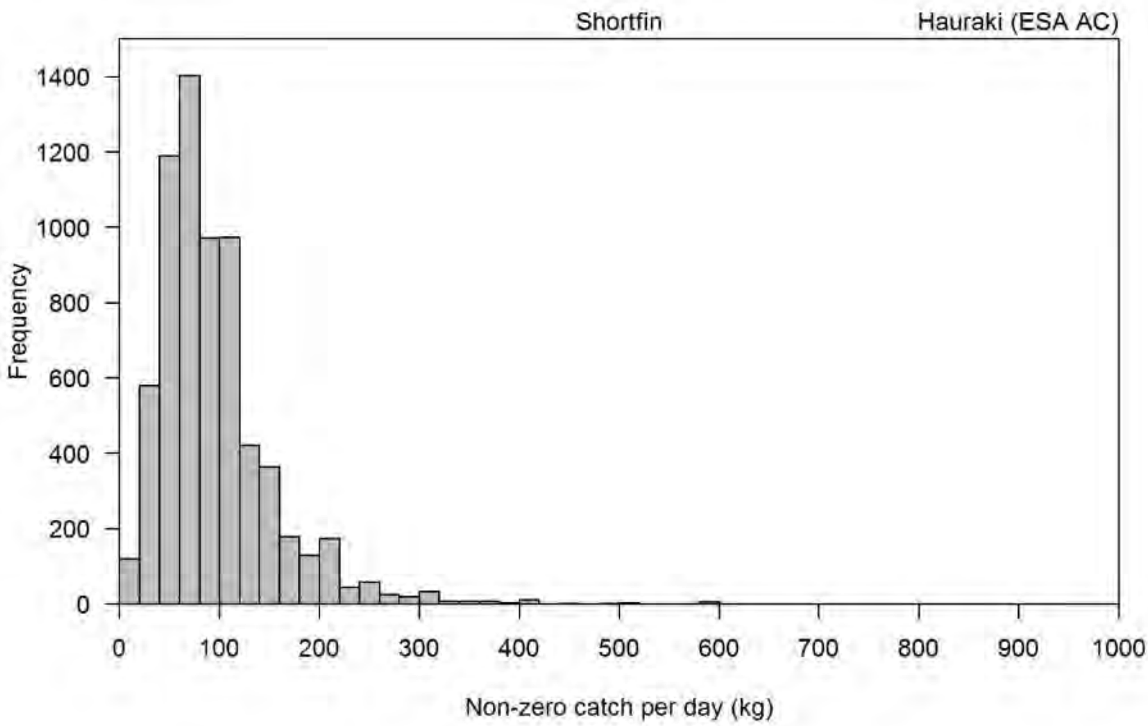


Figure C6: Frequency of shortfin eel catch per day for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

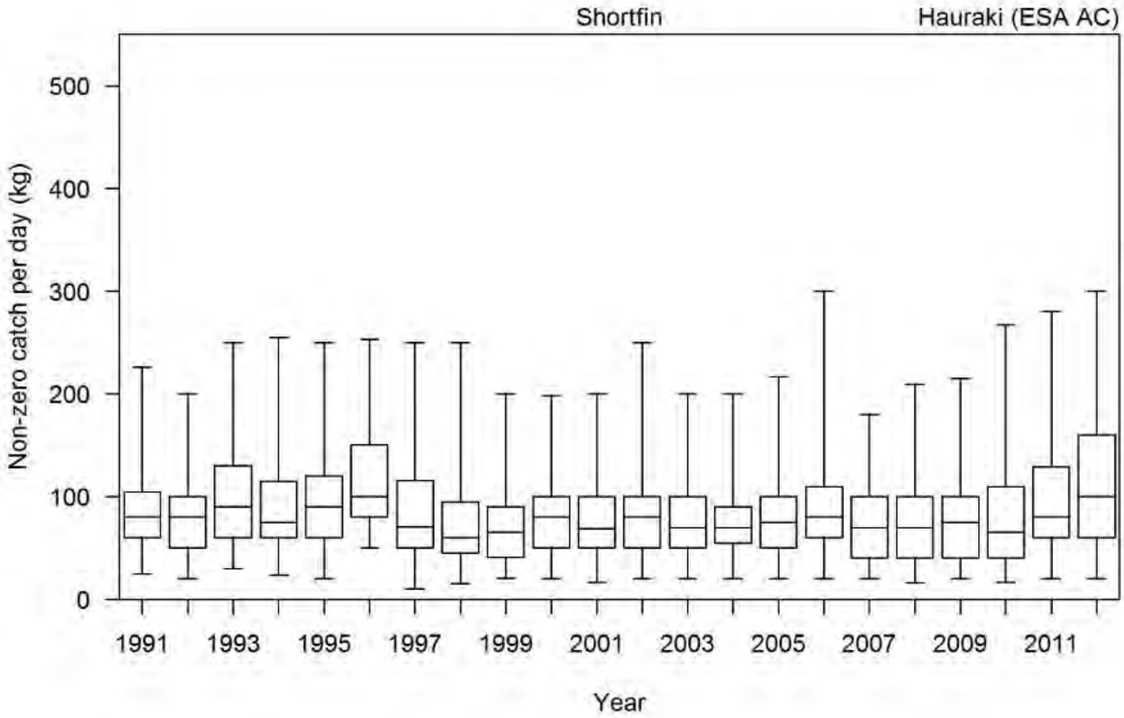


Figure C7: Shortfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Hauraki (ESA AC)).

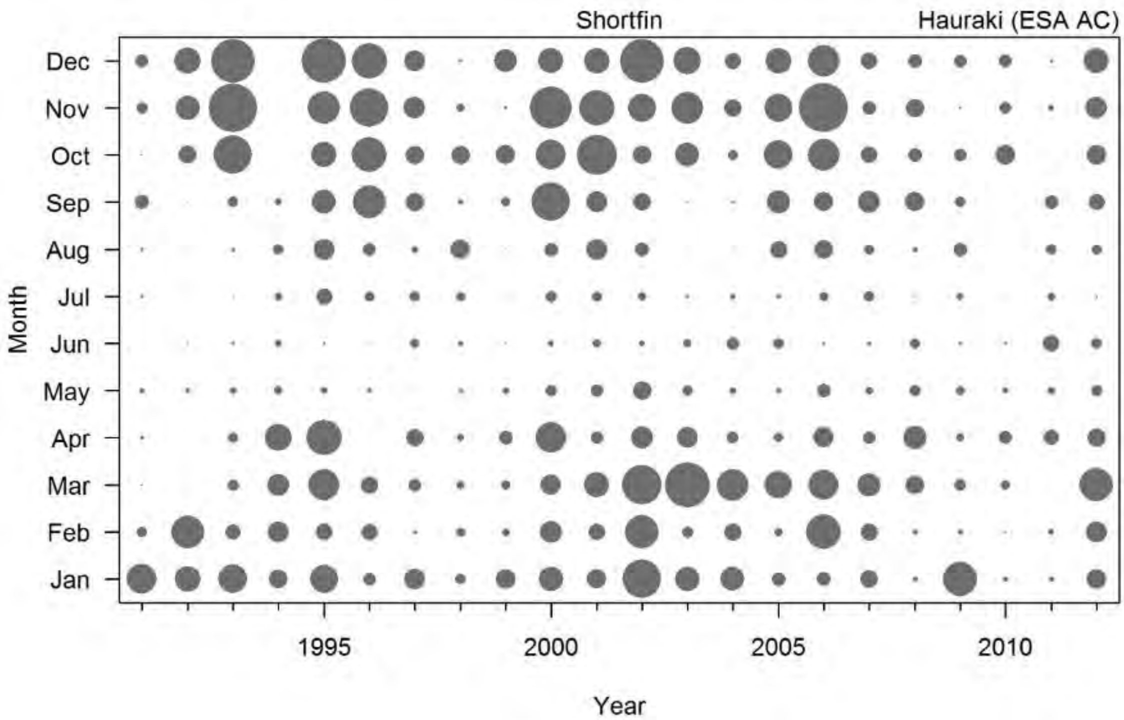


Figure C8: Shortfin eel catch by month for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

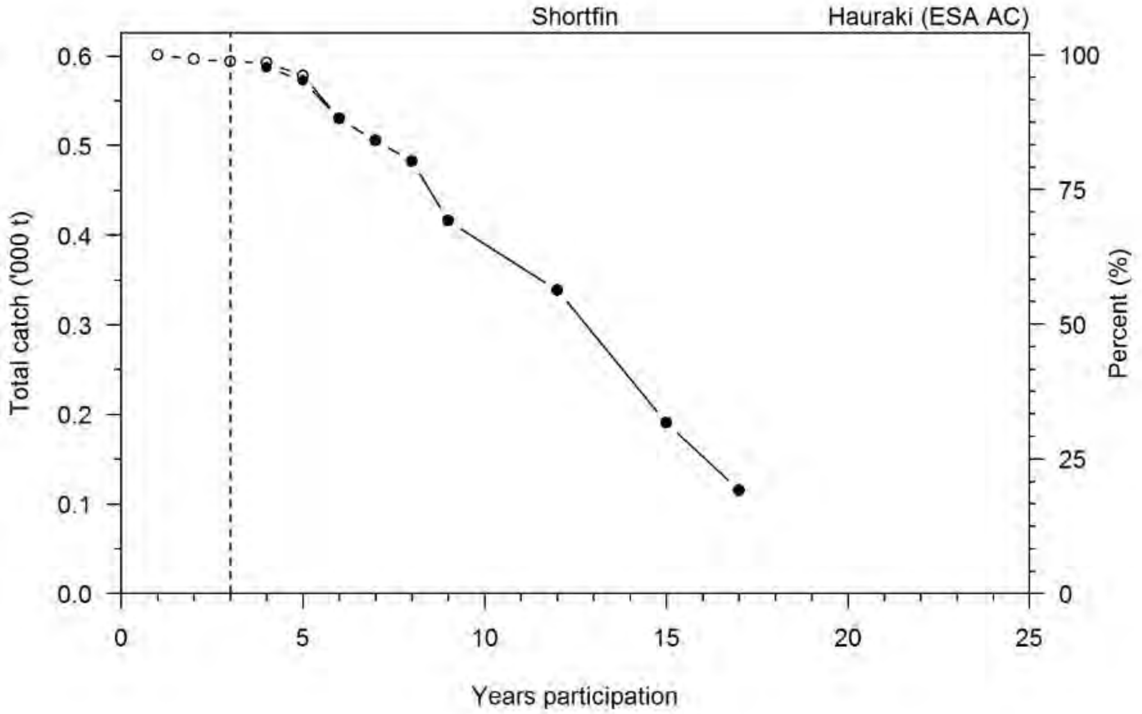


Figure C9: Relationship between years of participation in the fishery and shortfin total catch. The open circles represent all shortfin catch and the closed circles shortfin catch data from fishers who 1) caught shortfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core shortfin fisher analyses for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

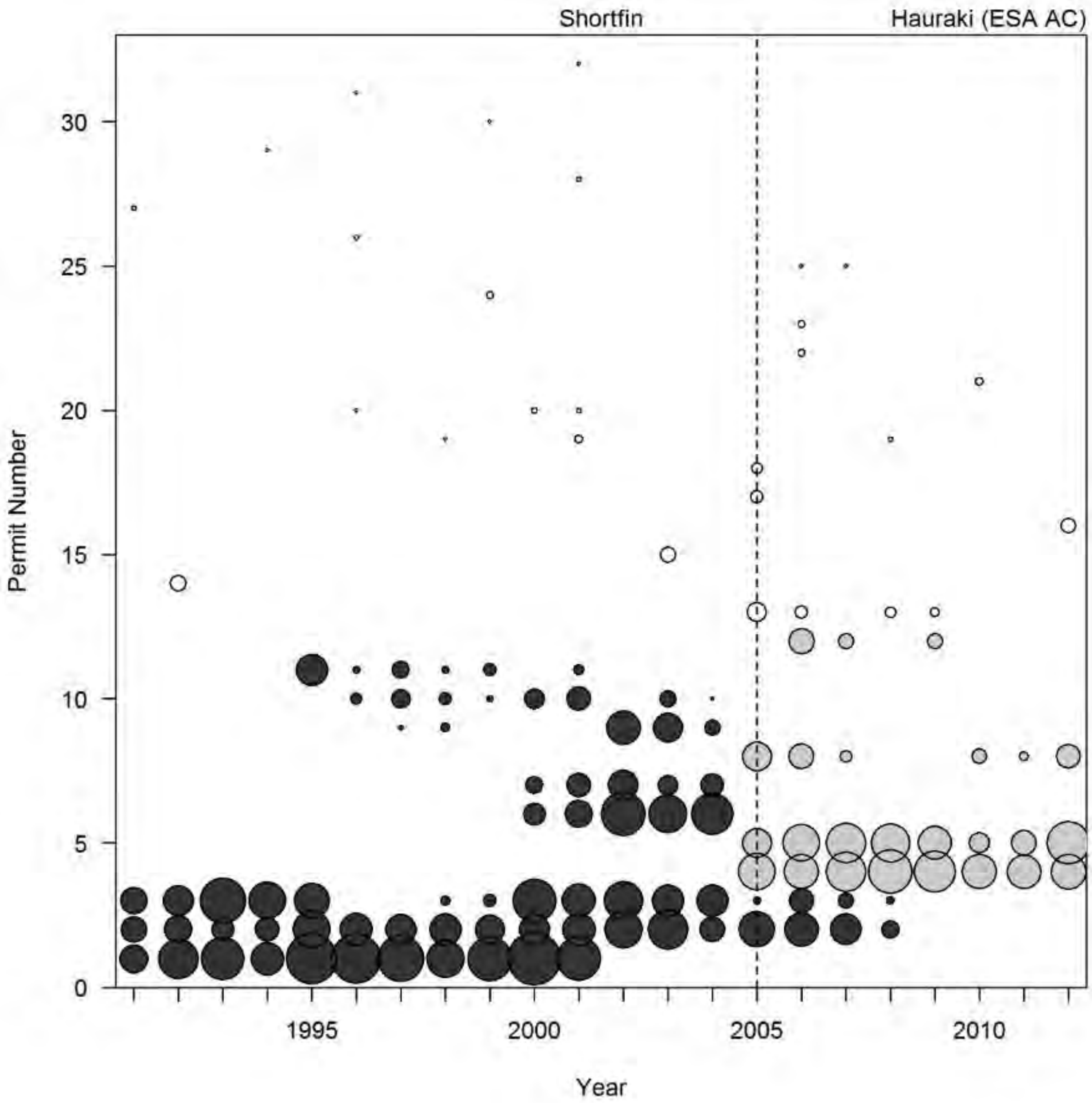


Figure C10: Relative catch of shortfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Hauraki (ESA AC)).

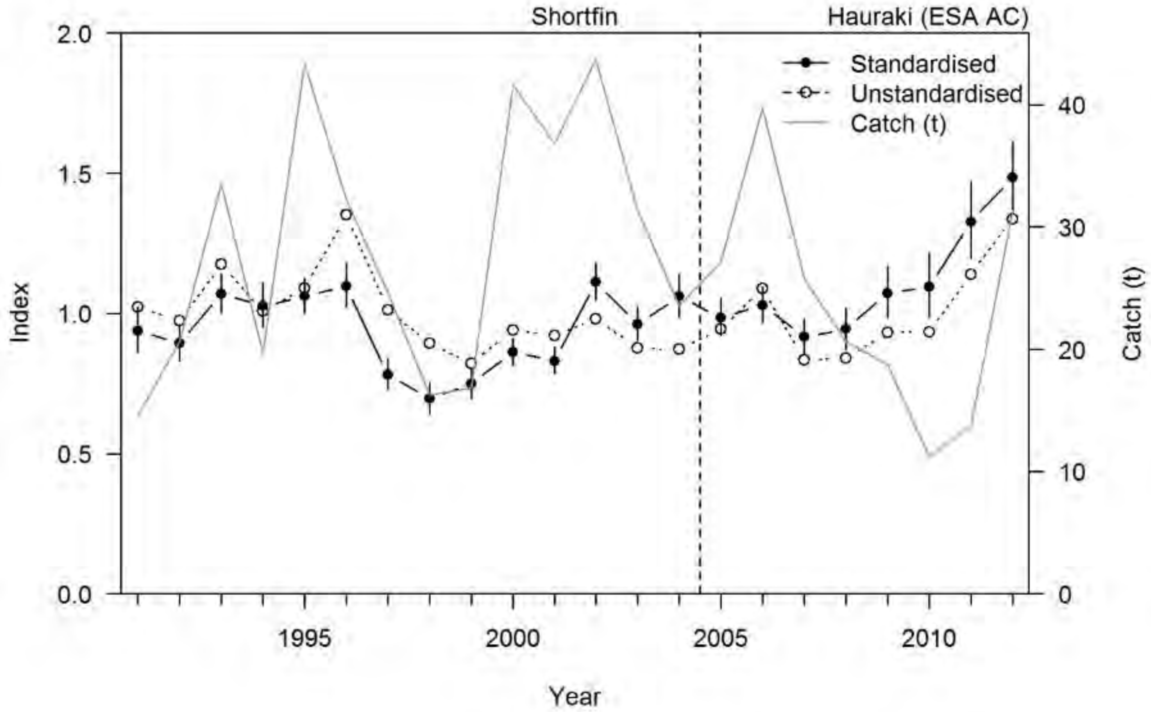


Figure C11: Indices of unstandardised catch per day and standardised CPUE for the core fishers shortfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Hauraki (ESA AC)).

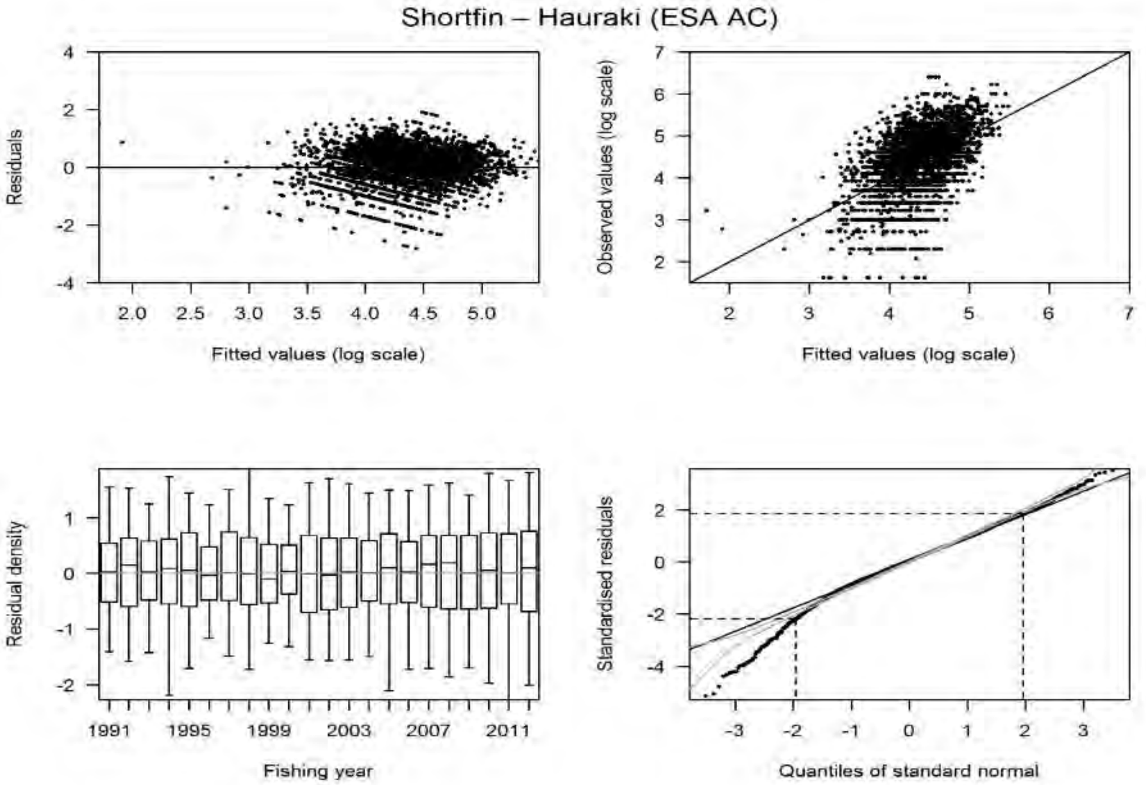


Figure C12: Residual diagnostic plots for the shortfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Hauraki (ESA AC)).

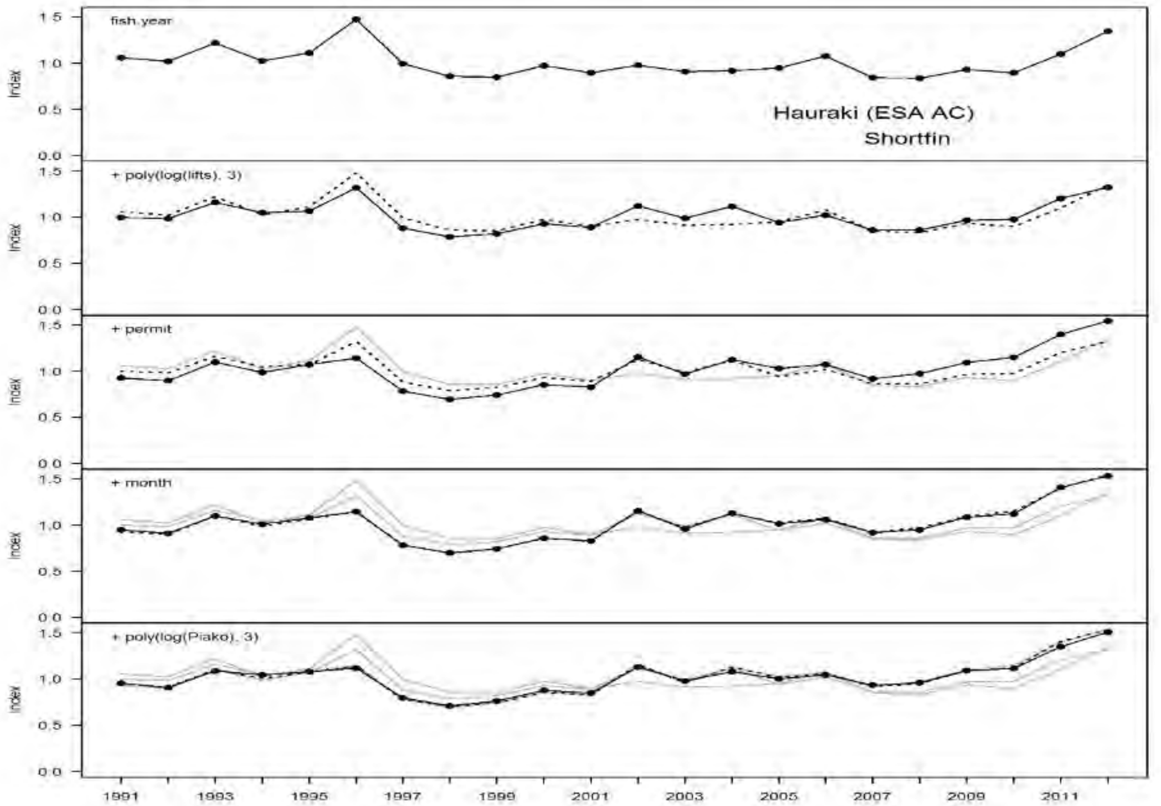


Figure C13: Step plot for the shortfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Hauraki (ESA AC)).

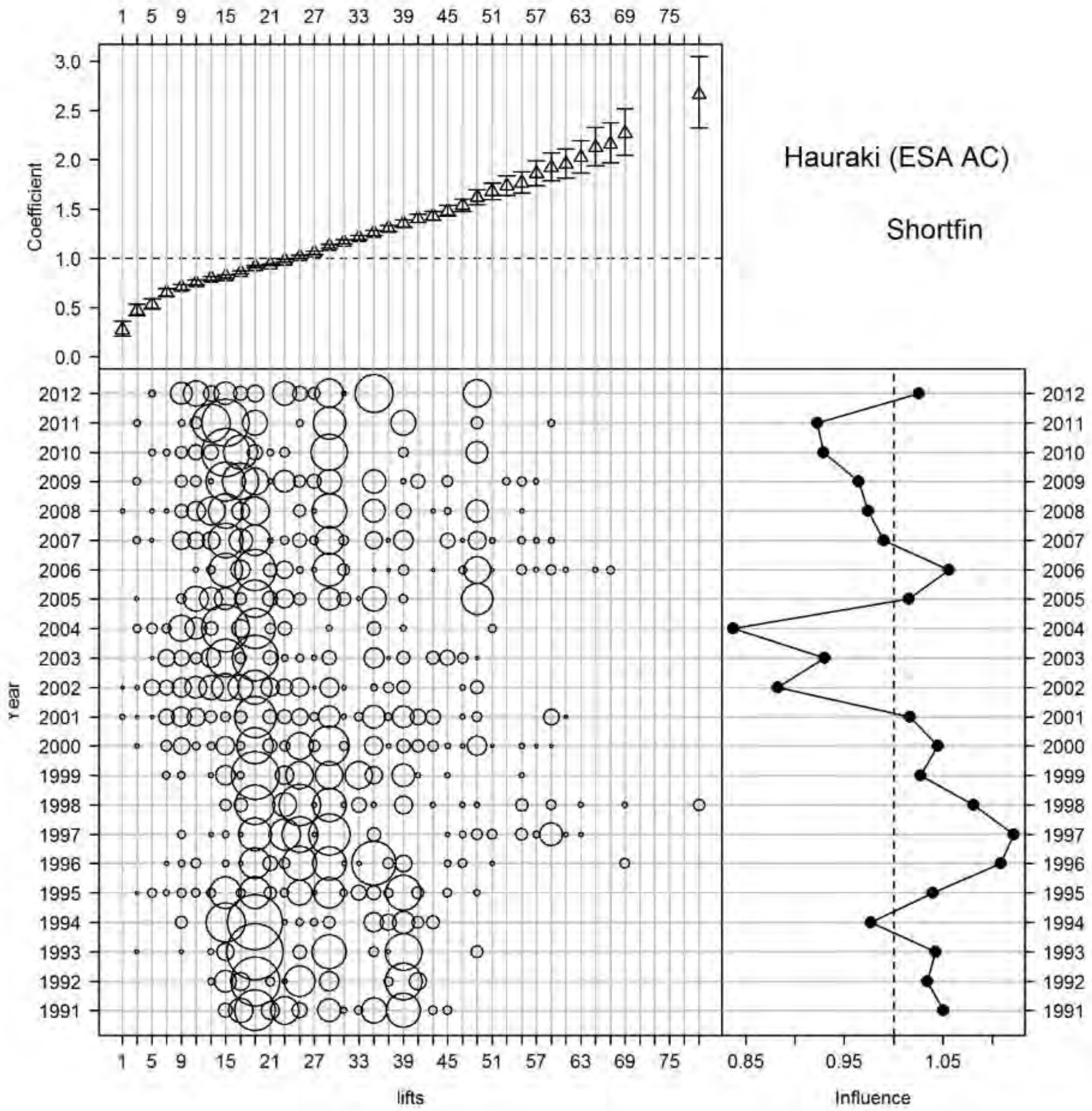


Figure C14: Influence of lifts for the shortfin CPUE model for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

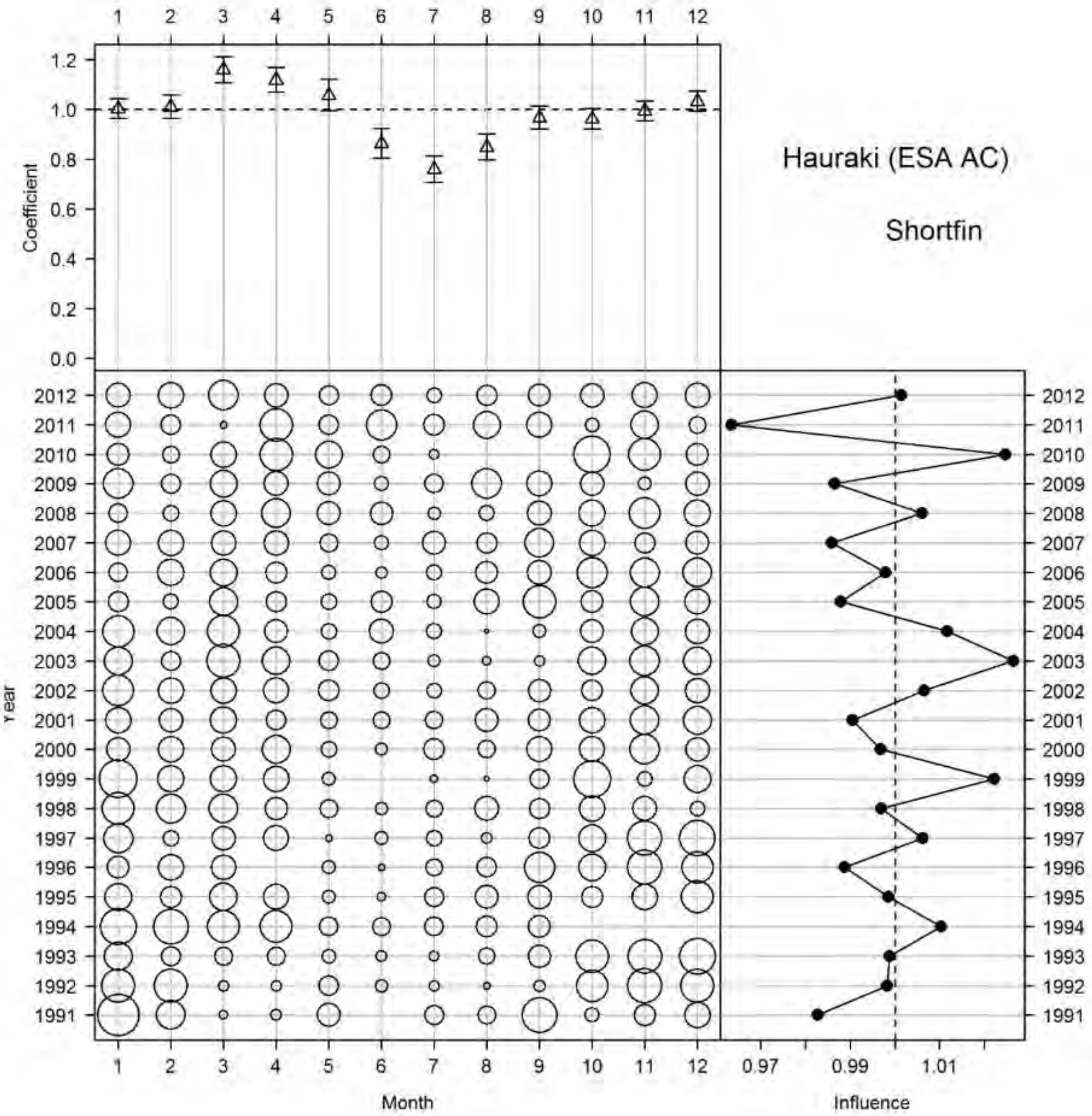


Figure C15: Influence of month for the shortfin CPUE model for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

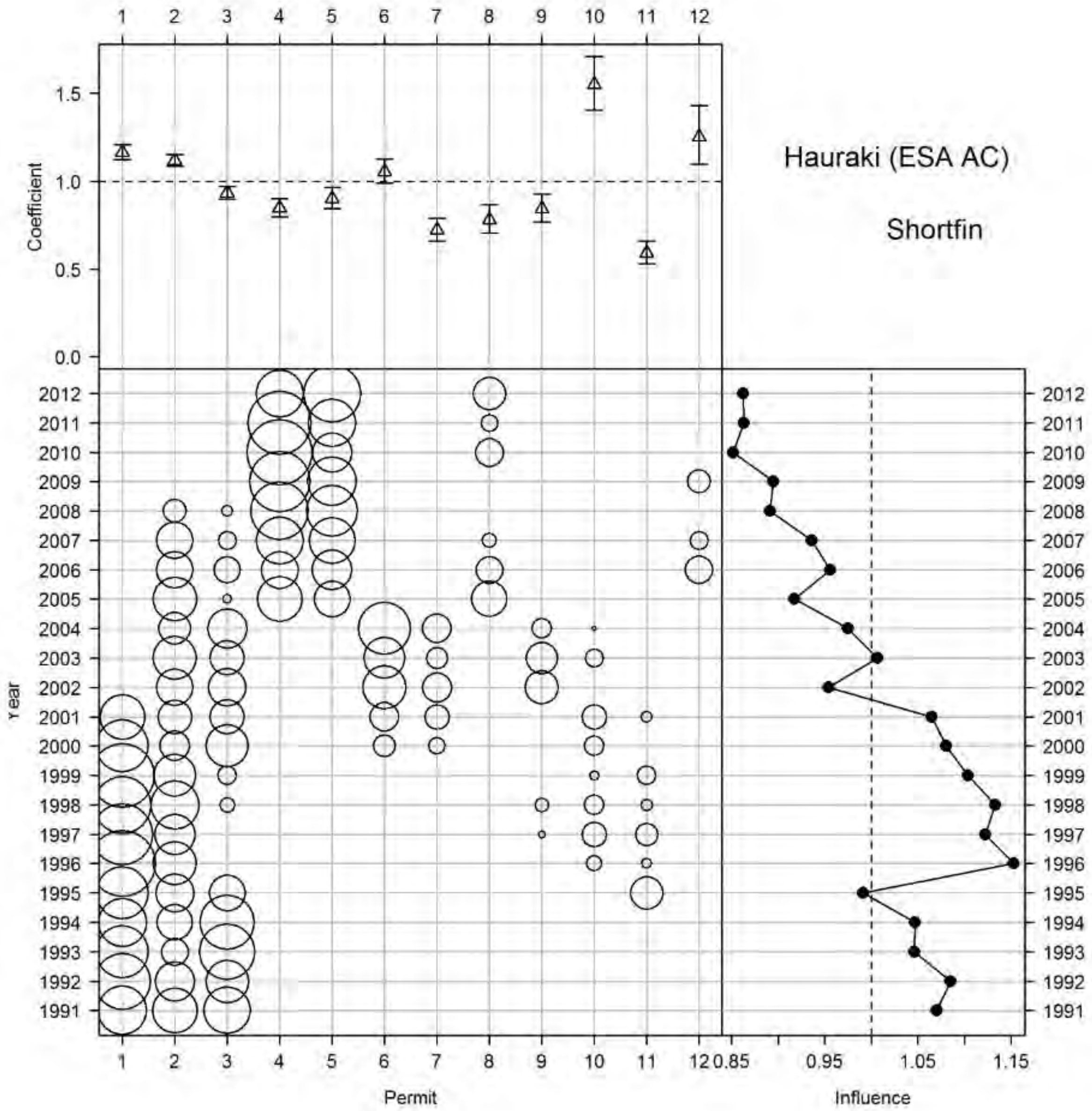


Figure C16: Influence of permit number for the shortfin CPUE model for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

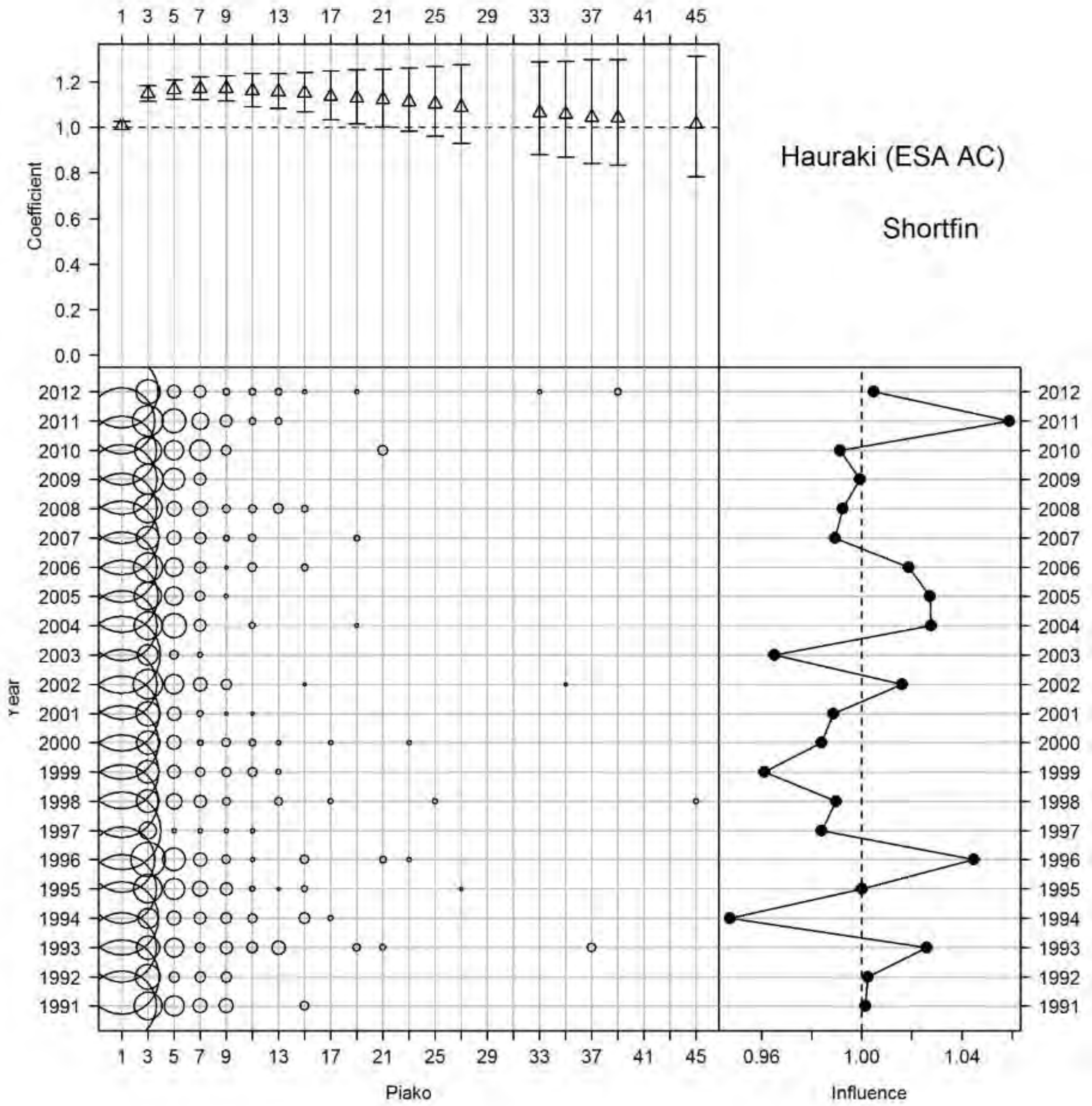


Figure C17: Influence of Piako River flow for the shortfin CPUE model for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

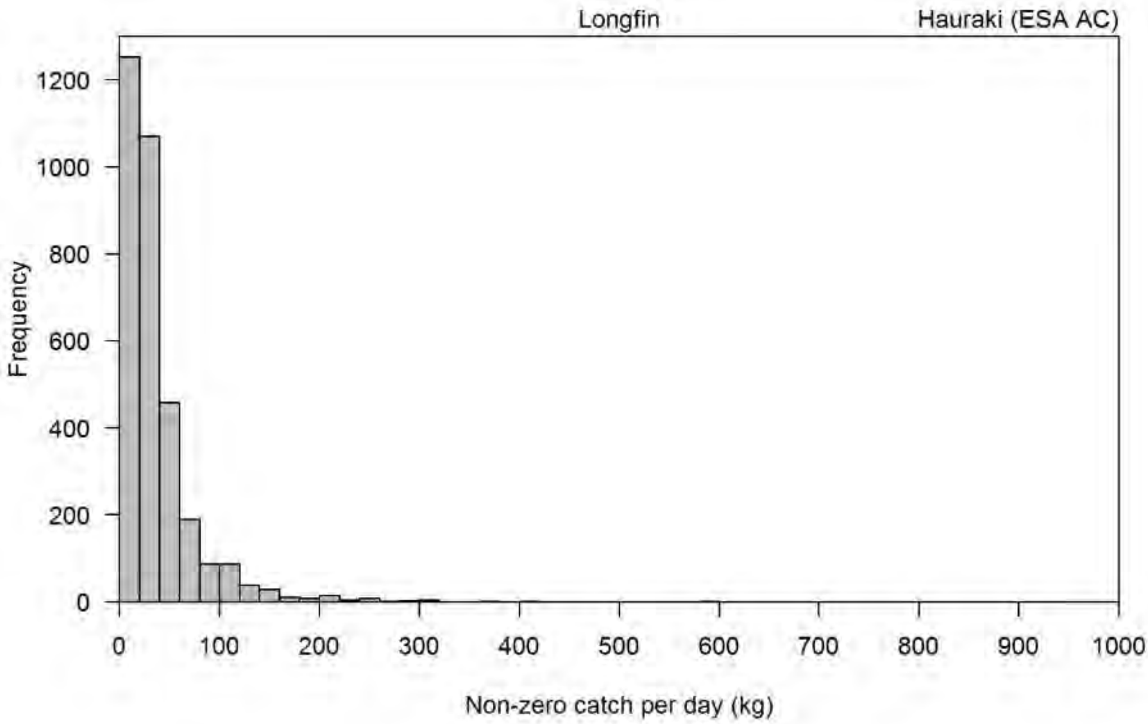


Figure C18: Frequency of longfin eel catch per day for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

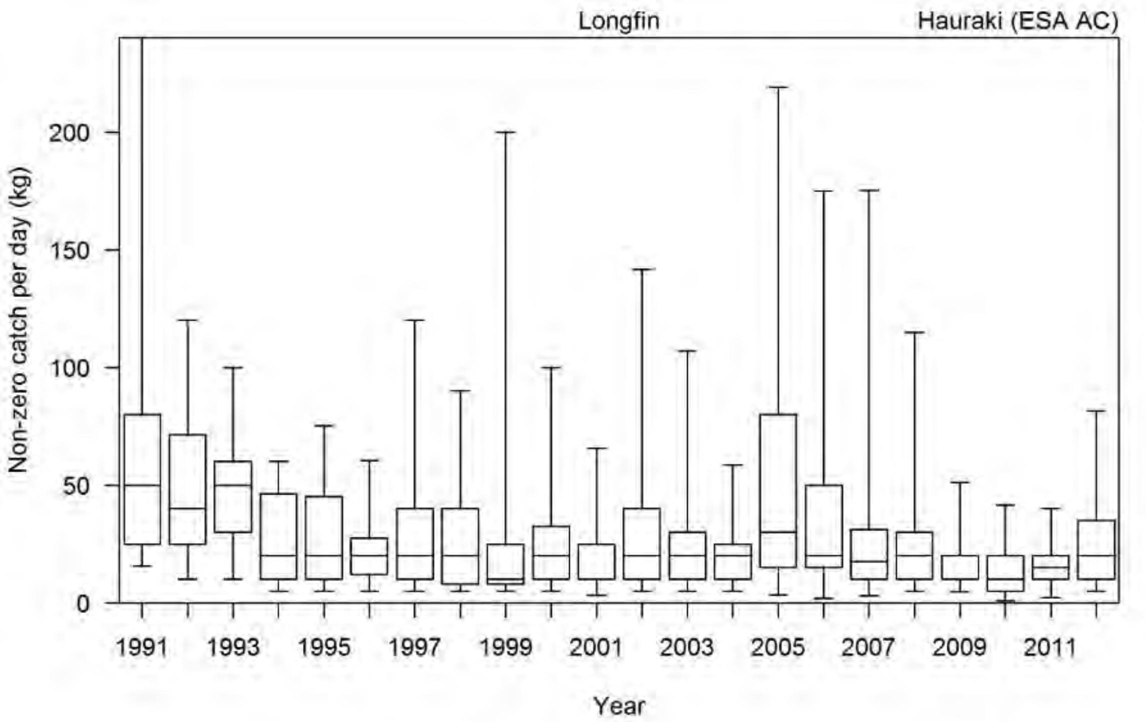


Figure C19: Longfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Hauraki (ESA AC)).

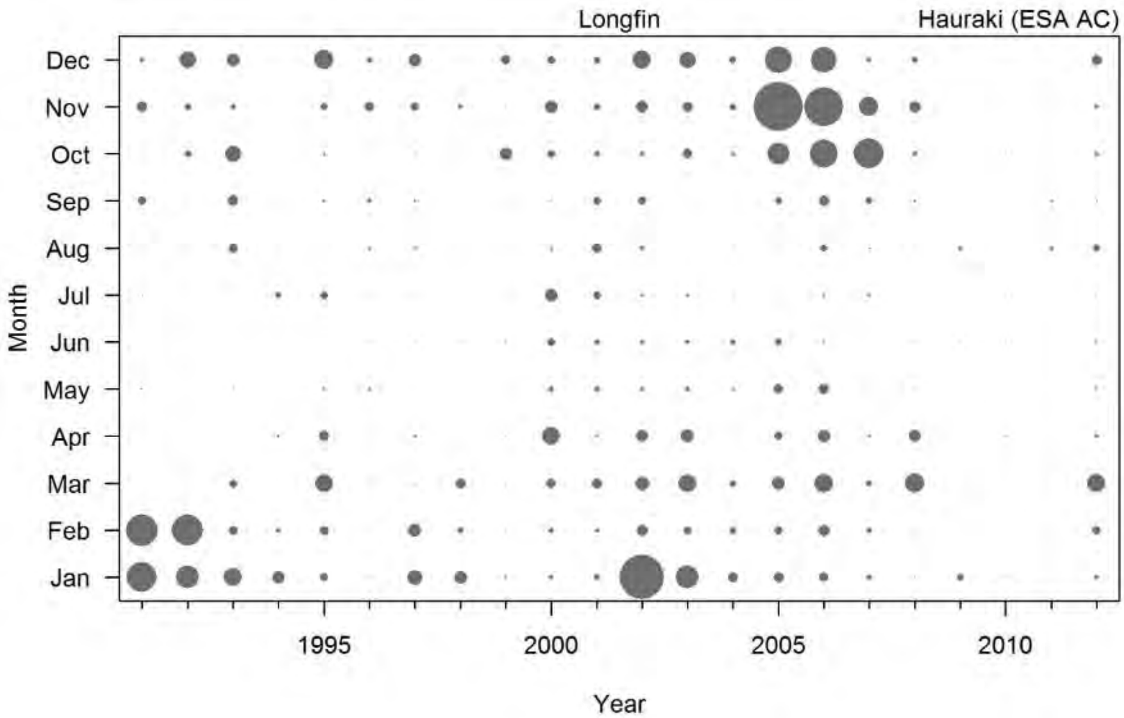


Figure C20: Longfin eel catch by month for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

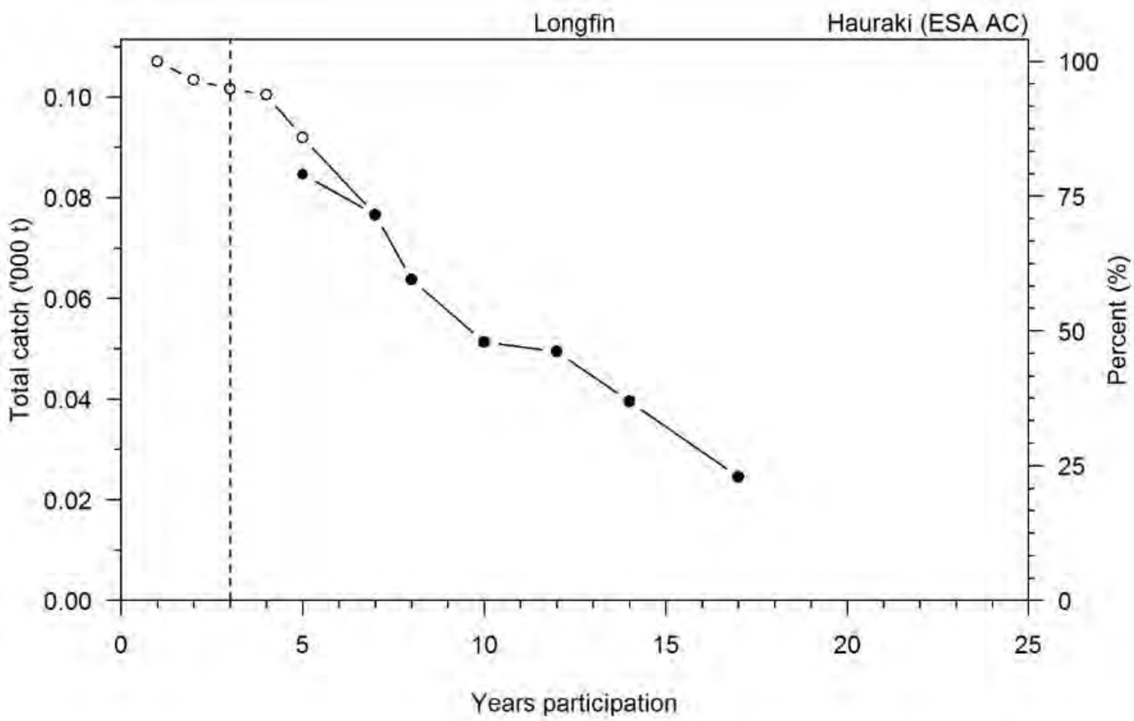


Figure C21: Relationship between years of participation in the fishery and longfin total catch. The open circles represent all longfin catch and the closed circles longfin catch data from fishers who 1) caught longfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core longfin fisher analyses for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

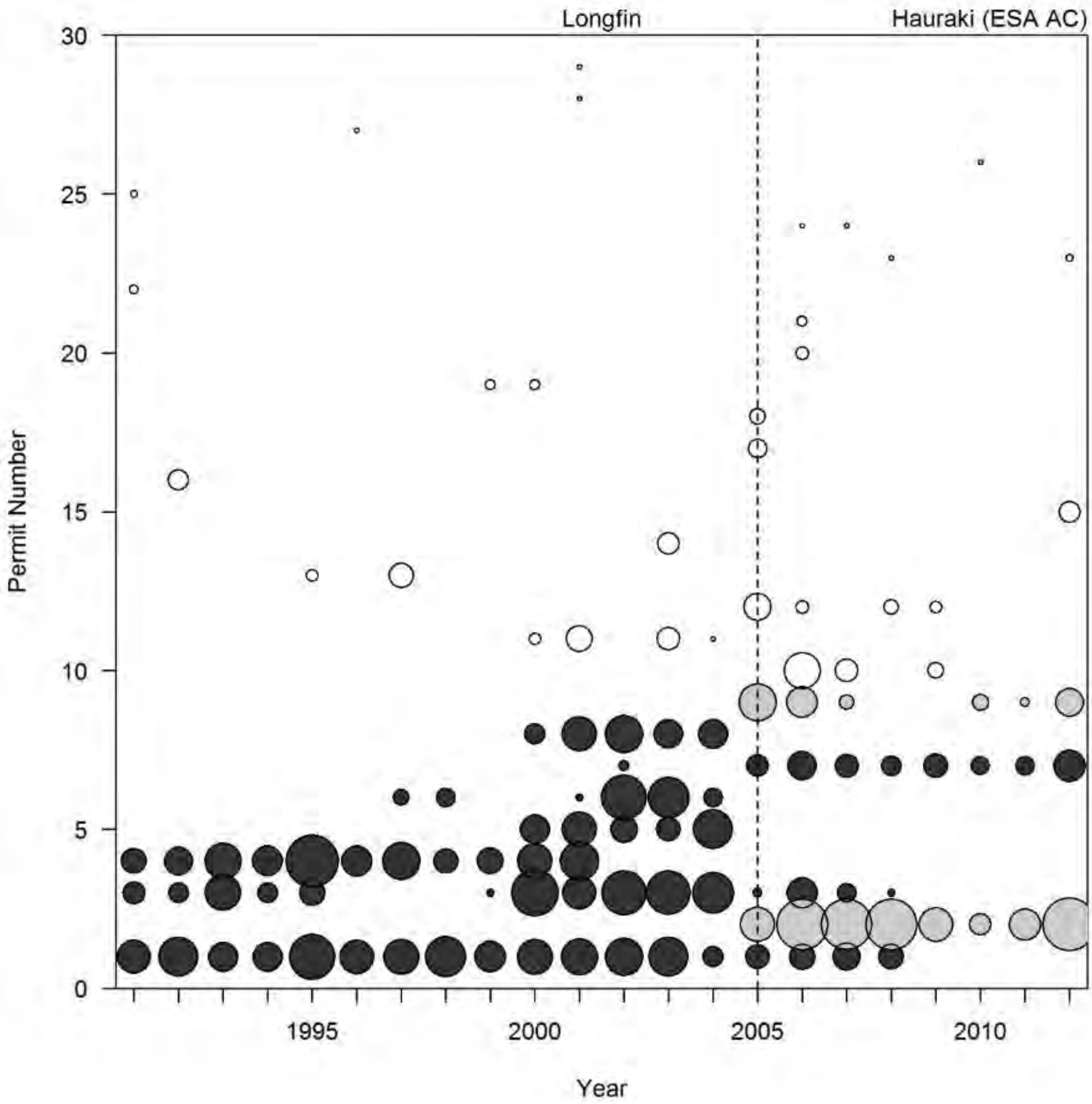


Figure C22: Relative catch of longfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Hauraki (ESA AC)).

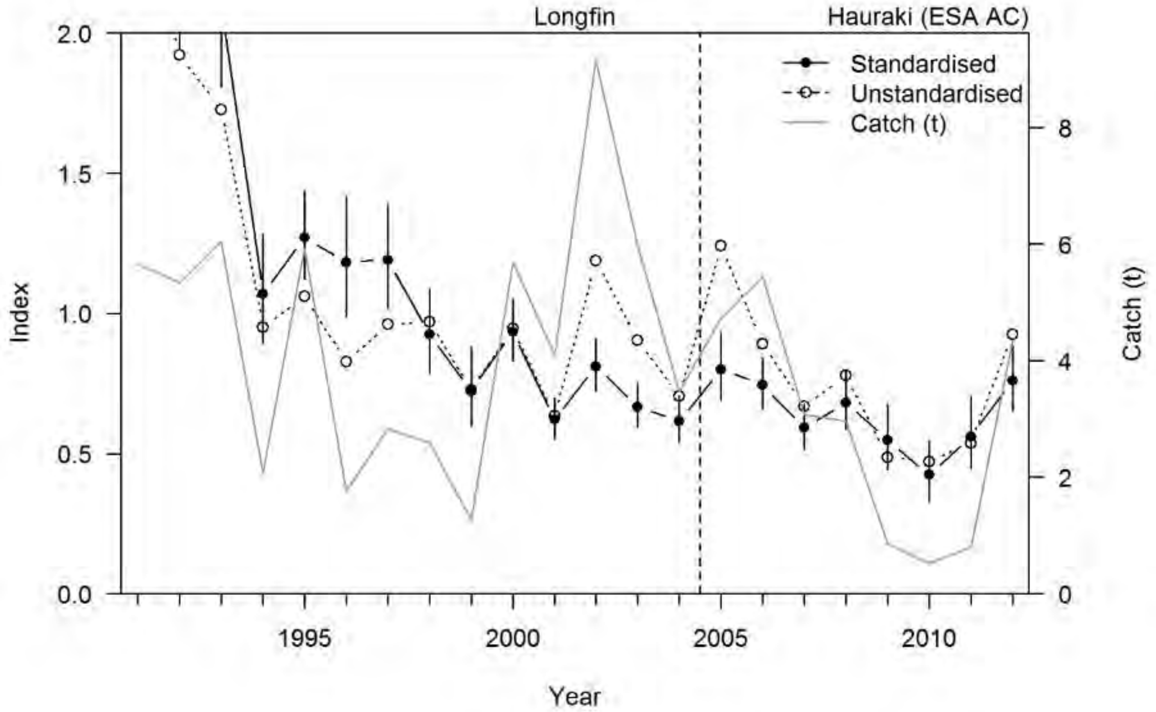


Figure C23: Indices of unstandardised catch per day and standardised CPUE for the core fishers longfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Hauraki (ESA AC)).

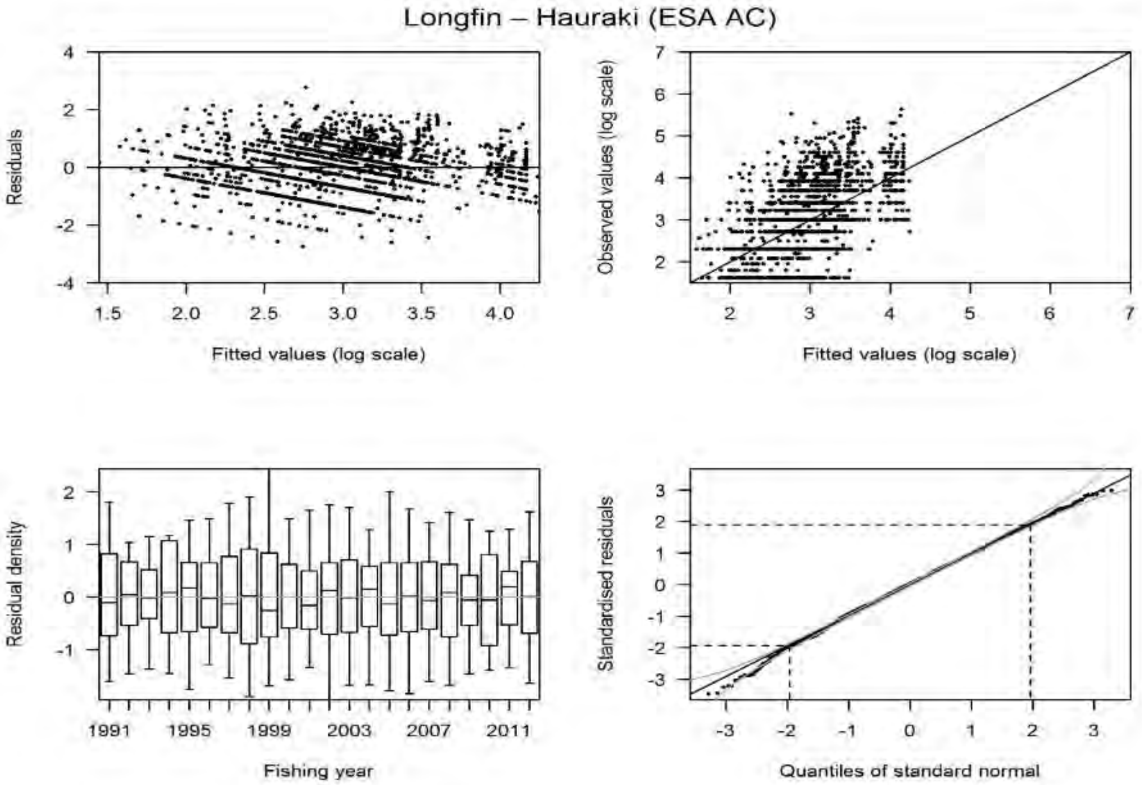


Figure C24: Residual diagnostic plots for the longfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Hauraki (ESA AC)).

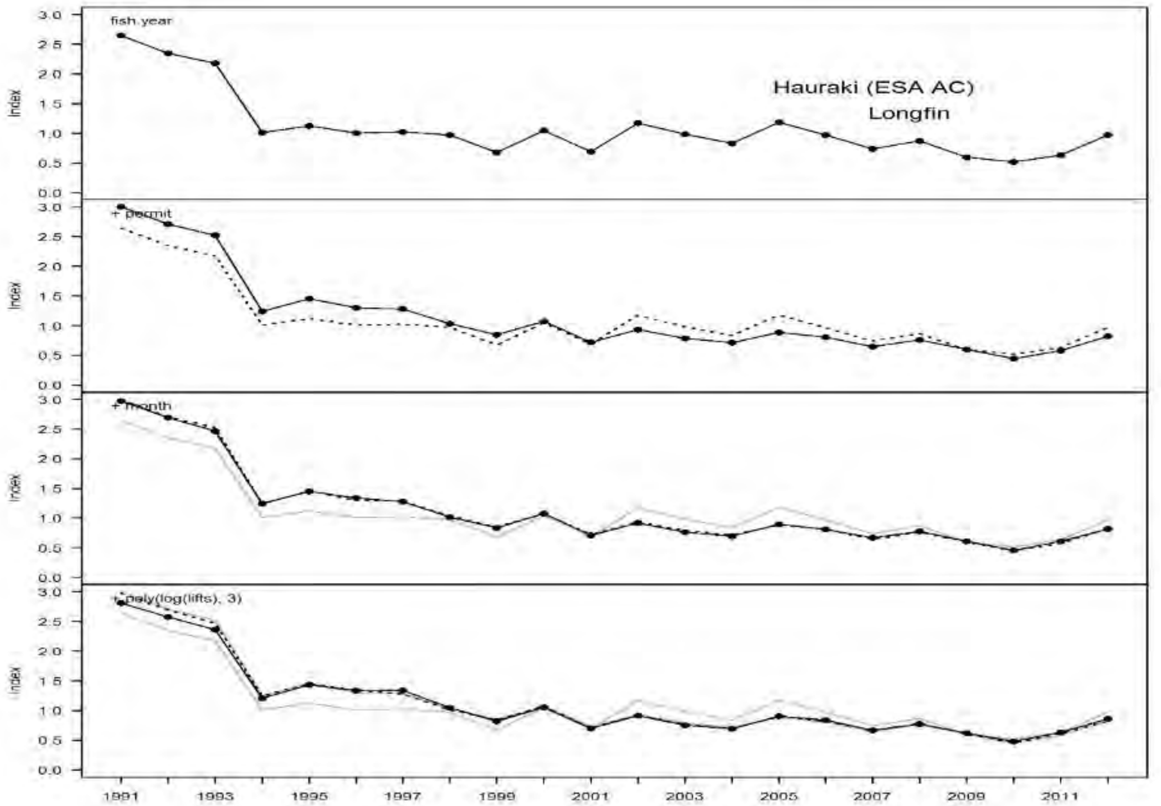


Figure C25: Step plot for the longfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Hauraki (ESA AC)).

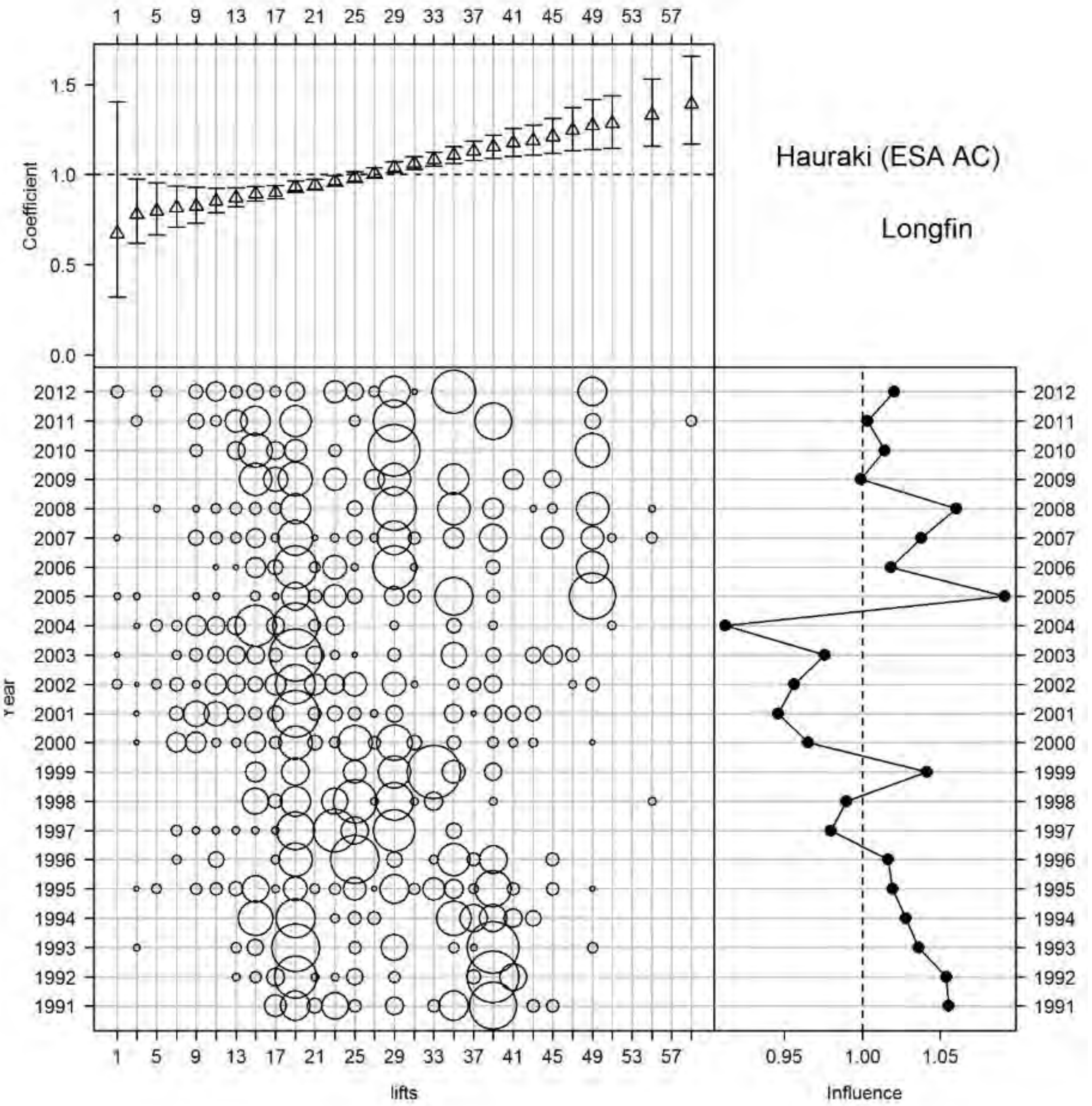


Figure C26: Influence of lifts for the longfin CPUE model for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

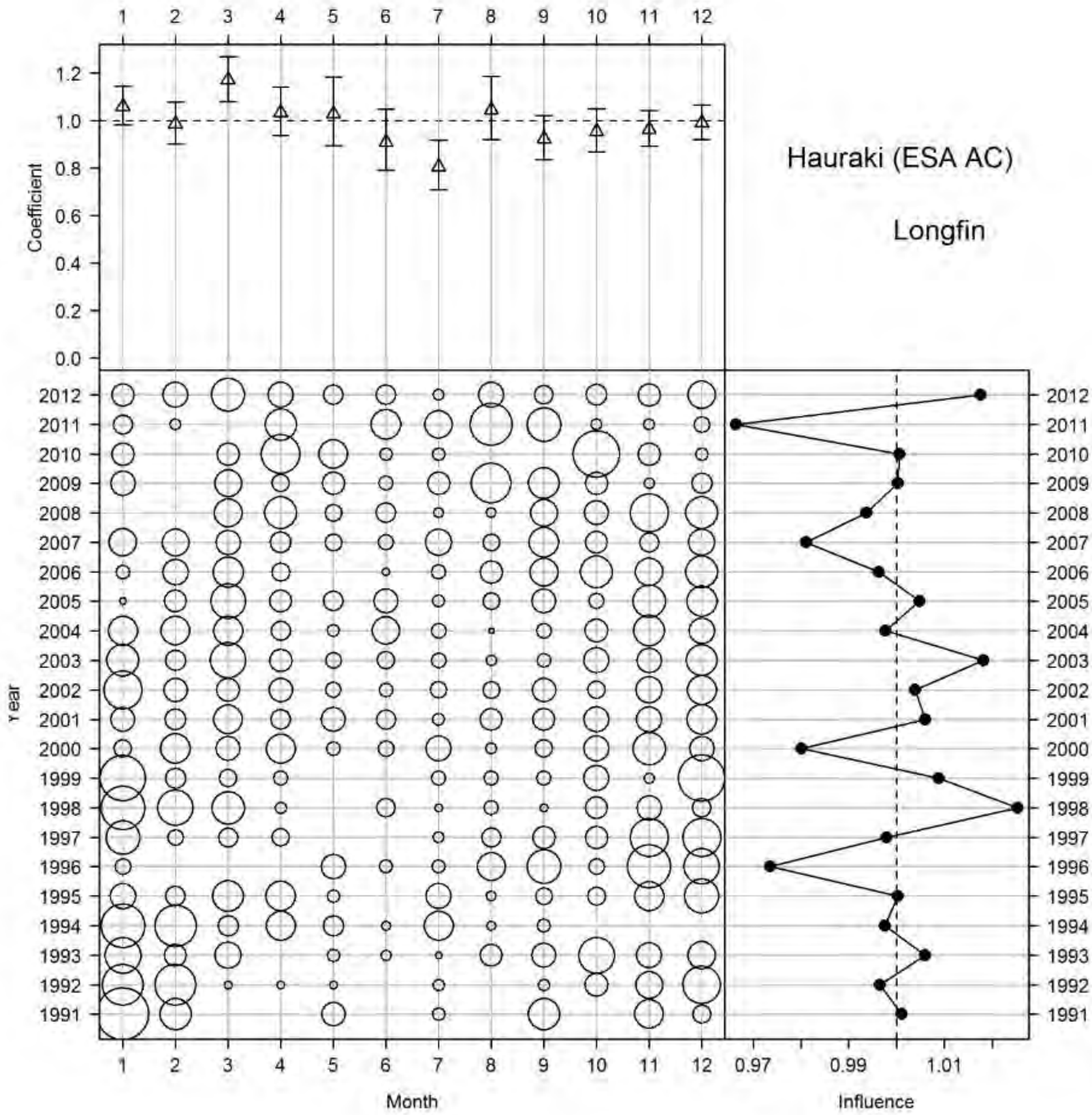


Figure C27: Influence of month for the longfin CPUE model for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

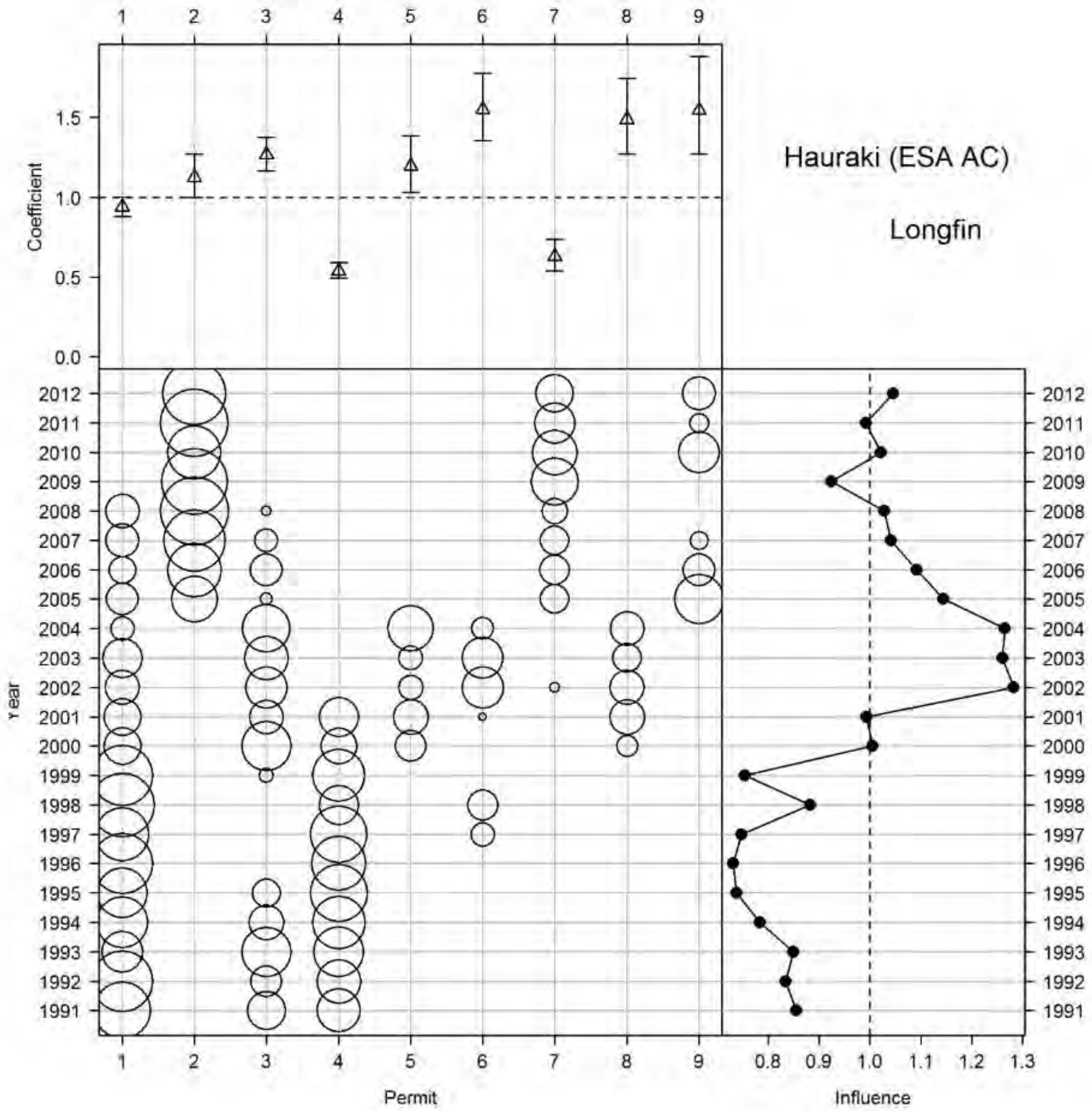


Figure C28: Influence of permit number for the longfin CPUE model for the years 1990–91 to 2011–12 (Hauraki (ESA AC)).

Appendix D: Waikato (ESA AD)

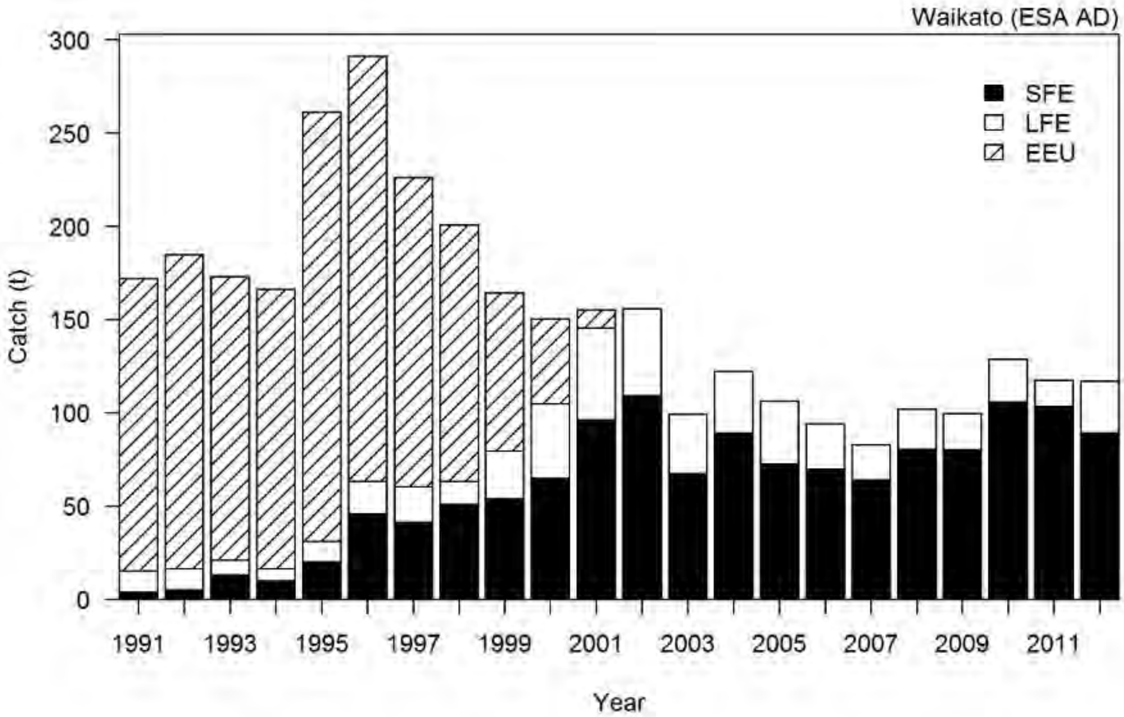


Figure D1: Total estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

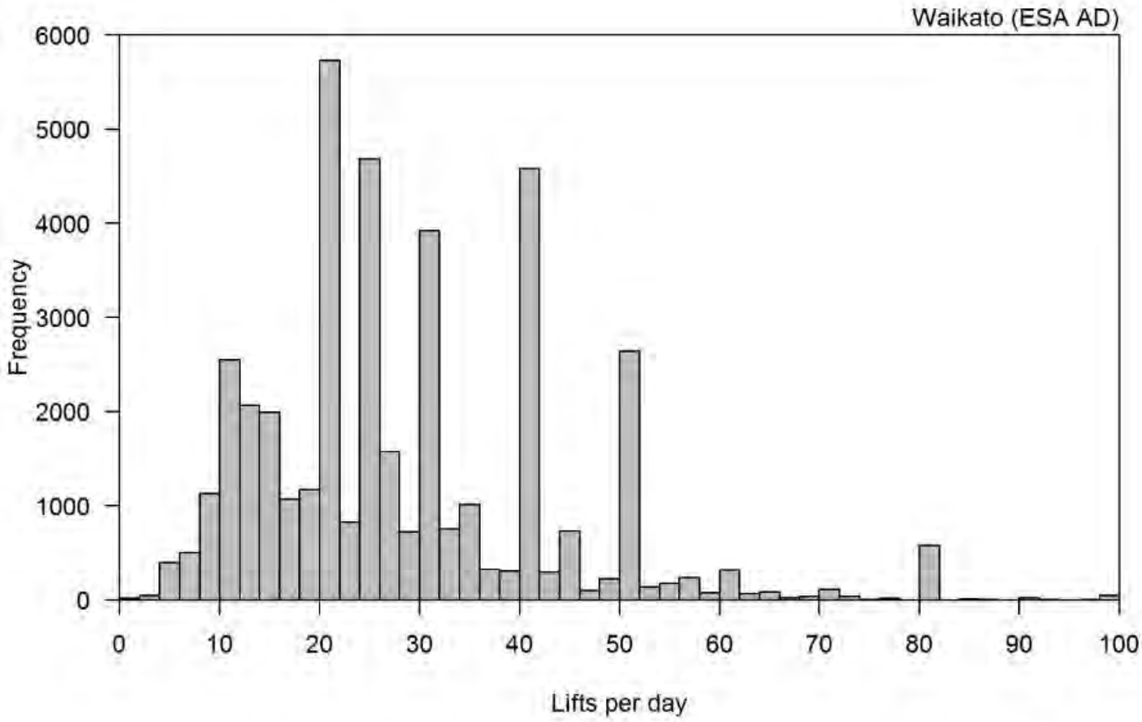


Figure D2: Frequency of total lifts per day for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

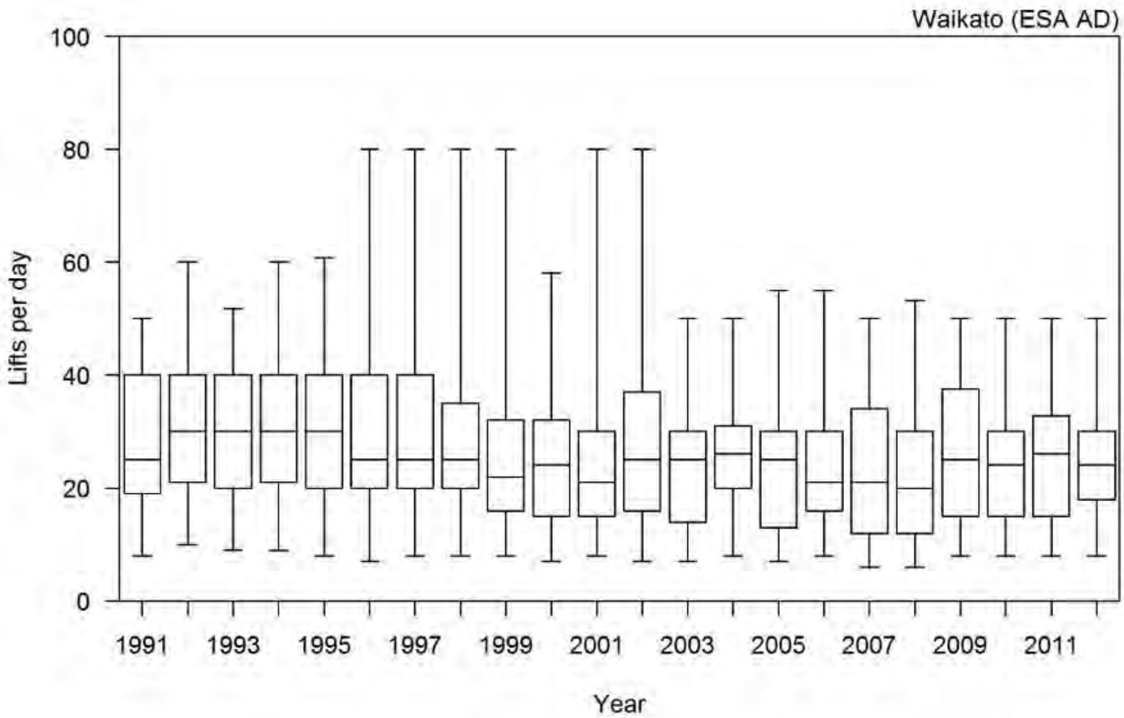


Figure D3: Total lifts per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Waikato (ESA AD)).

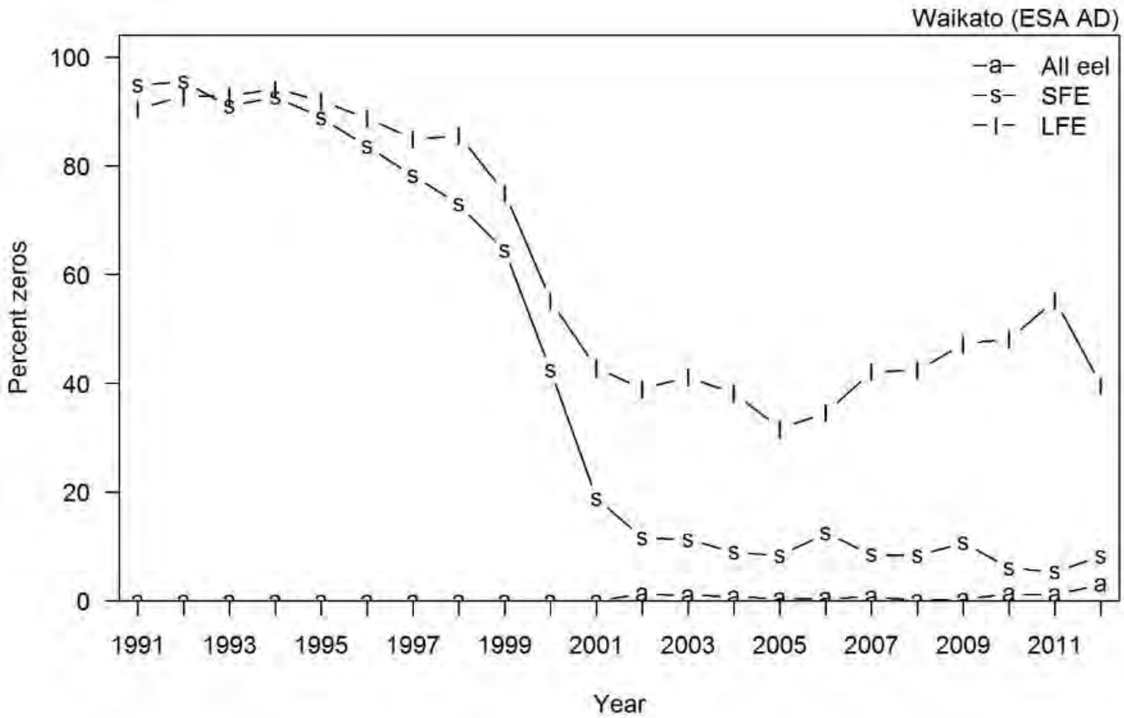


Figure D4: Proportion of zero records for all eel, shortfin (SFE), and longfin (LFE) catch for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

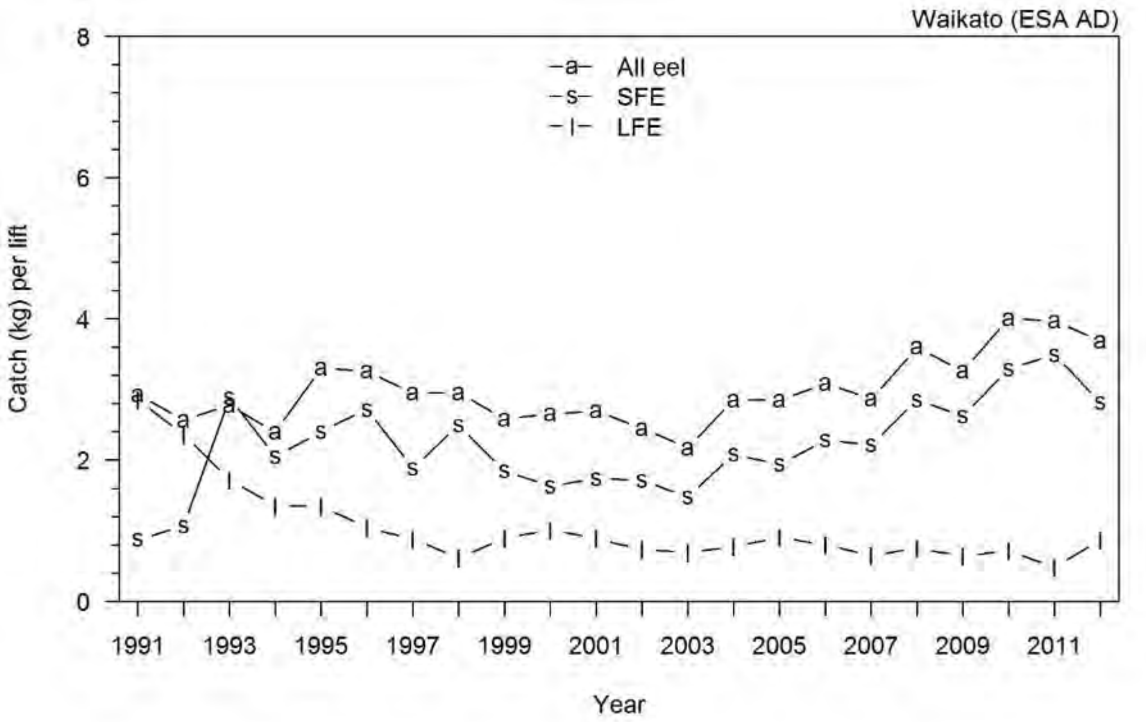


Figure D5: Unstandardised catch per lift (total kg/total lifts) for all eel, shortfin (SFE), and longfin (LFE) for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

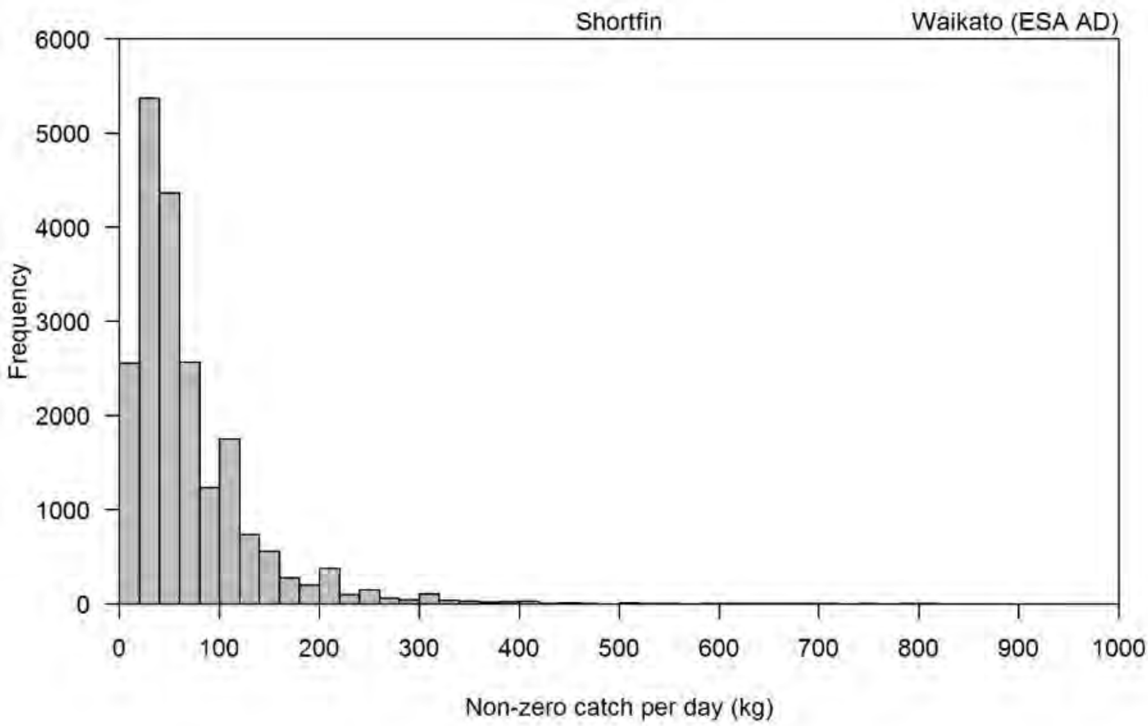


Figure D6: Frequency of shortfin eel catch per day for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

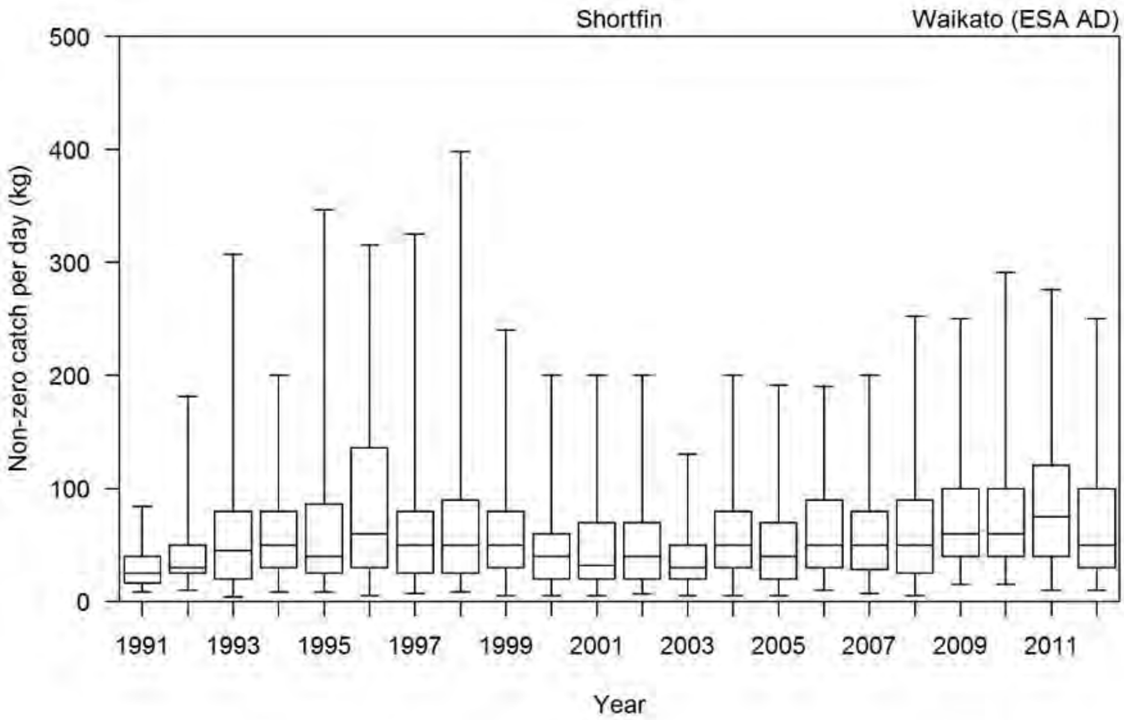


Figure D7: Shortfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Waikato (ESA AD)).

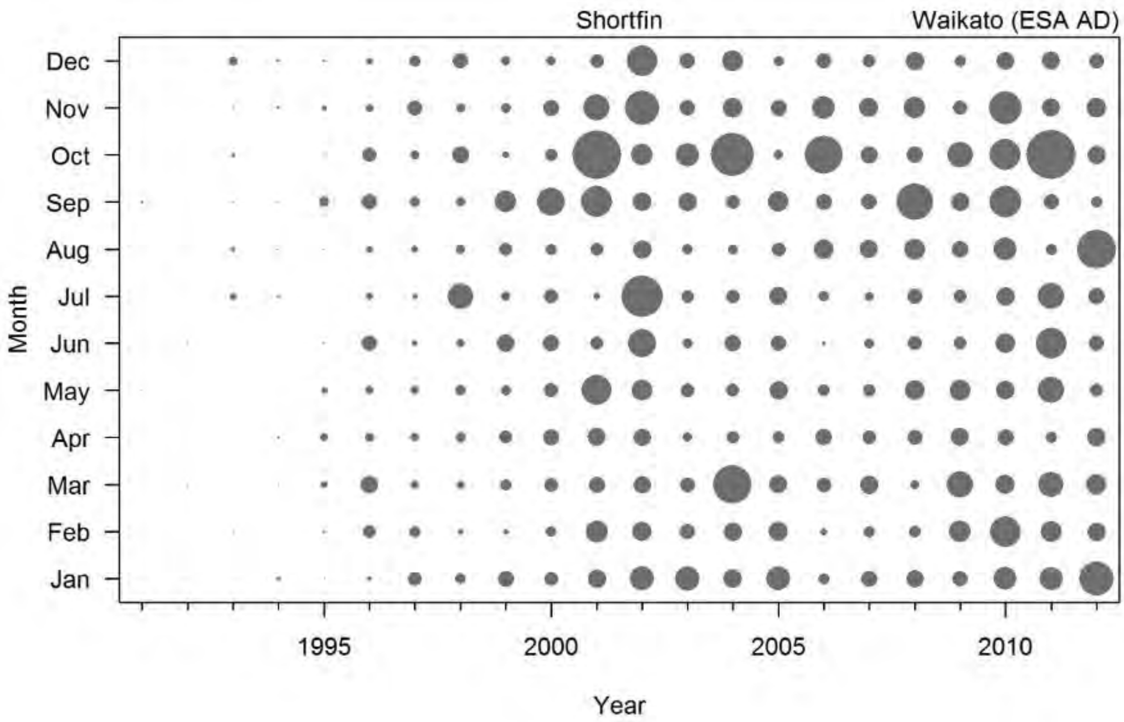


Figure D8: Shortfin eel catch by month for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

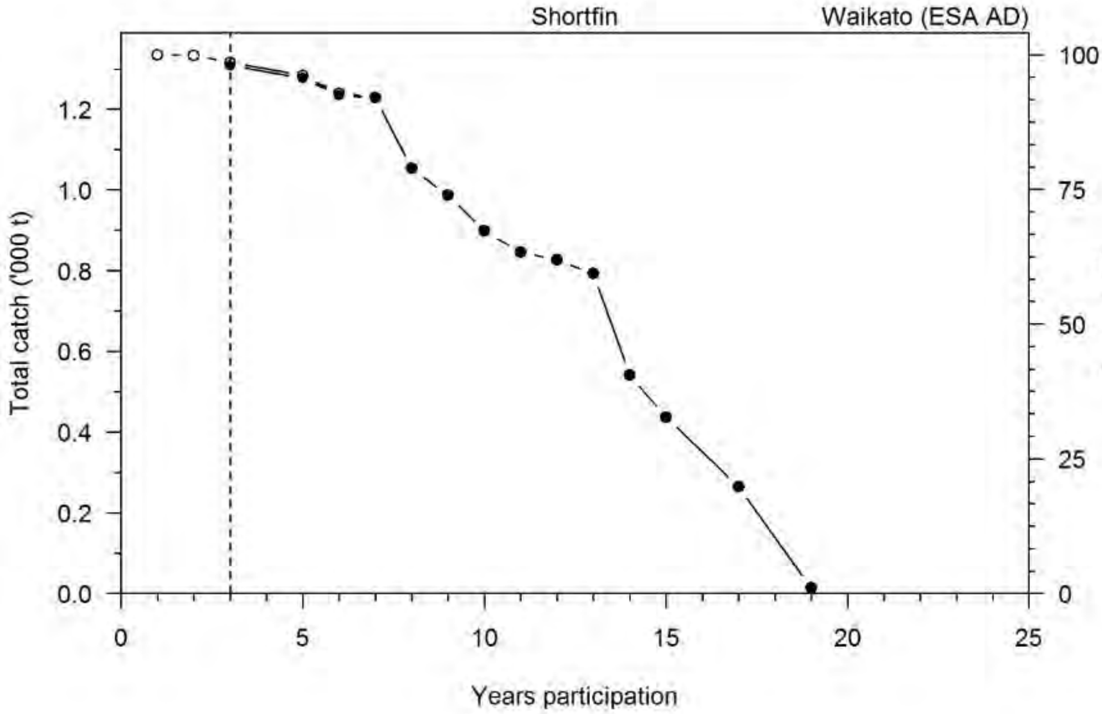


Figure D9: Relationship between years of participation in the fishery and shortfin total catch. The open circles represent all shortfin catch and the closed circles shortfin catch data from fishers who 1) caught shortfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core shortfin fisher analyses for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

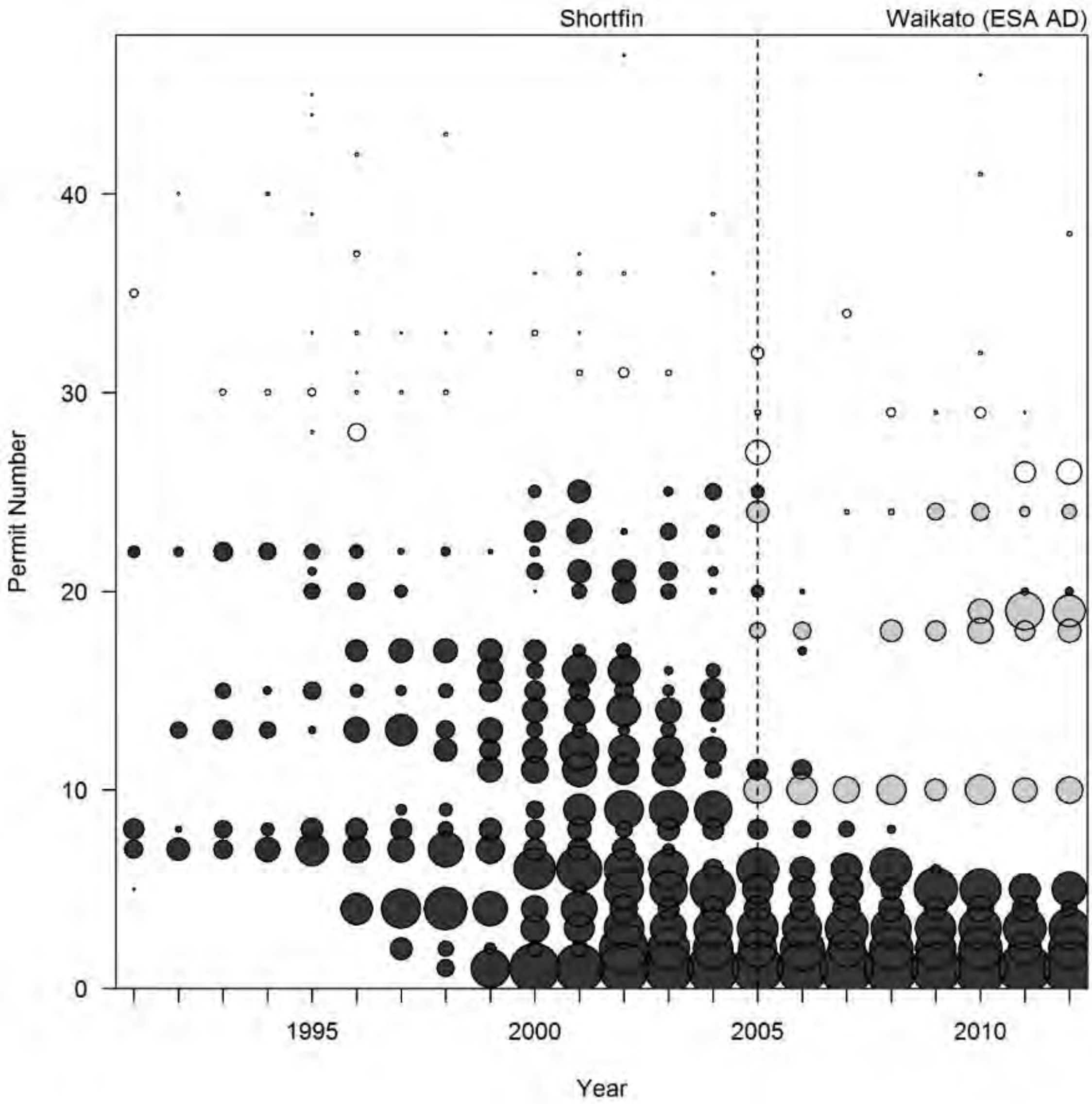


Figure D10: Relative catch of shortfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Waikato (ESA AD)).

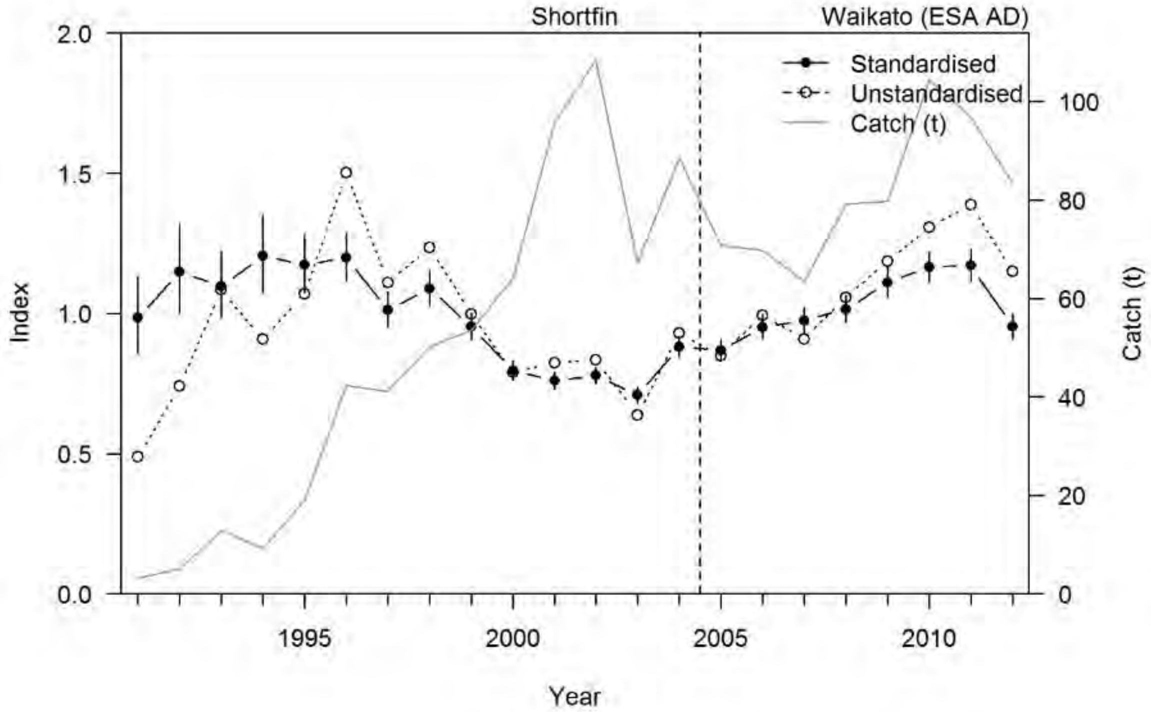


Figure D11: Indices of unstandardised catch per day and standardised CPUE for the core fishers shortfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Waikato (ESA AD)).

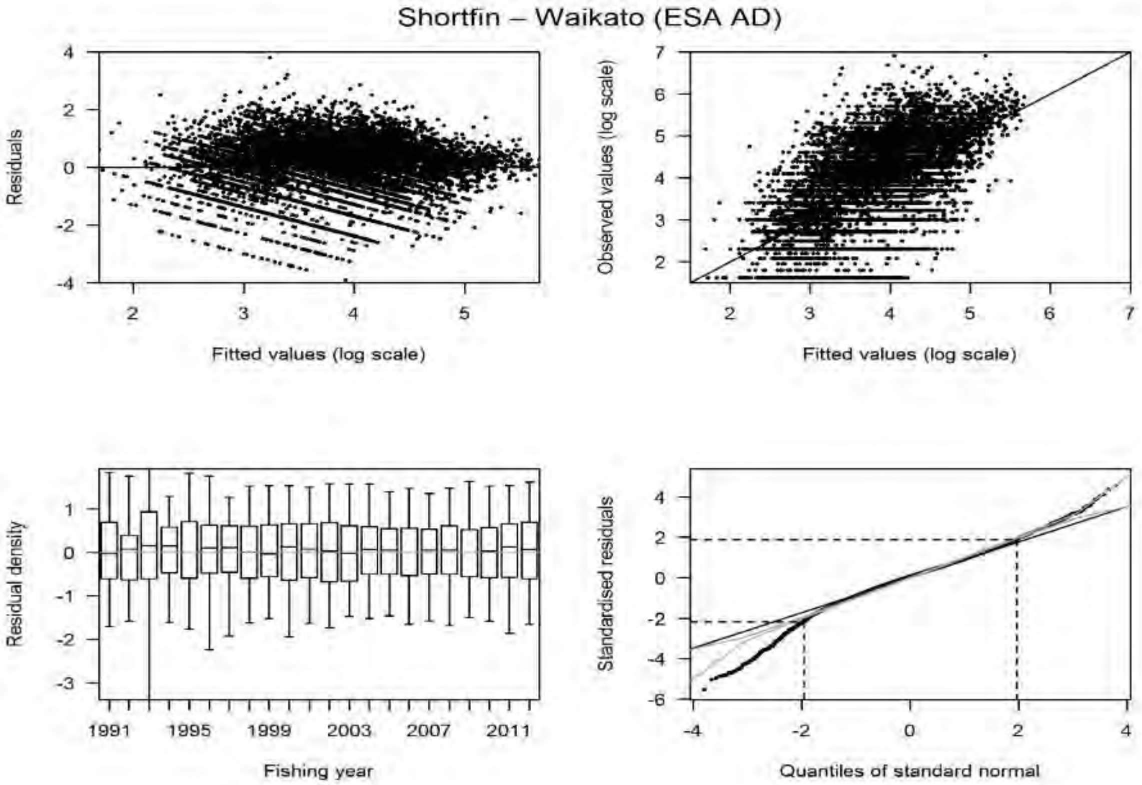


Figure D12: Residual diagnostic plots for the shortfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Waikato (ESA AD)).

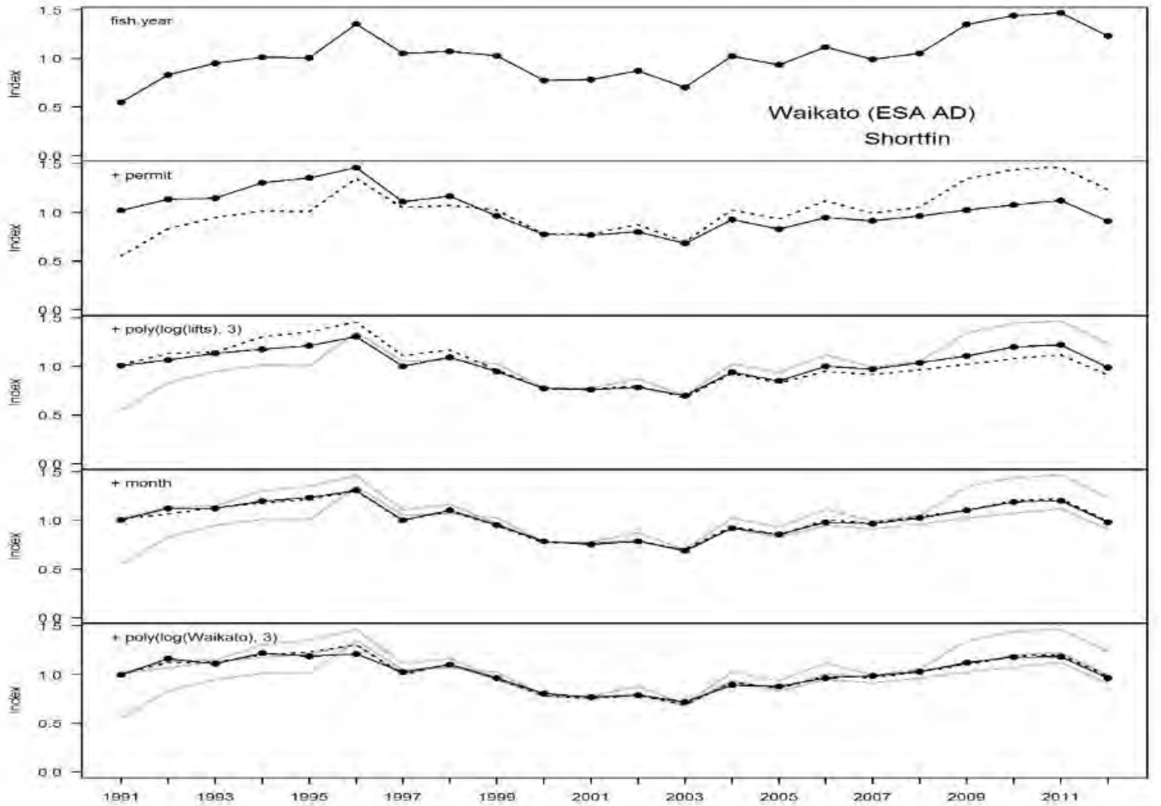


Figure D13: Step plot for the shortfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Waikato (ESA AD)).

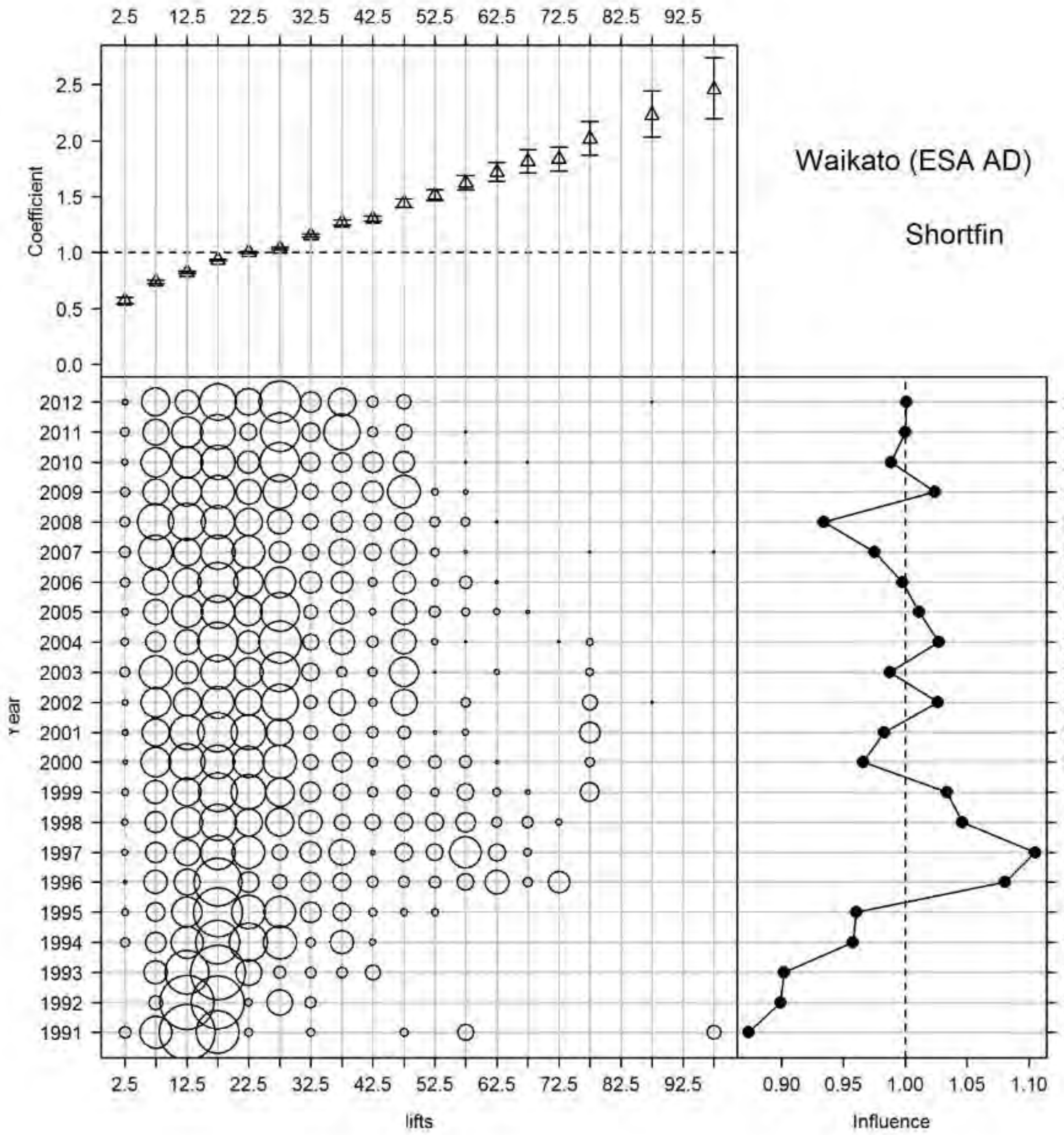


Figure D14: Influence of lifts for the shortfin CPUE model for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

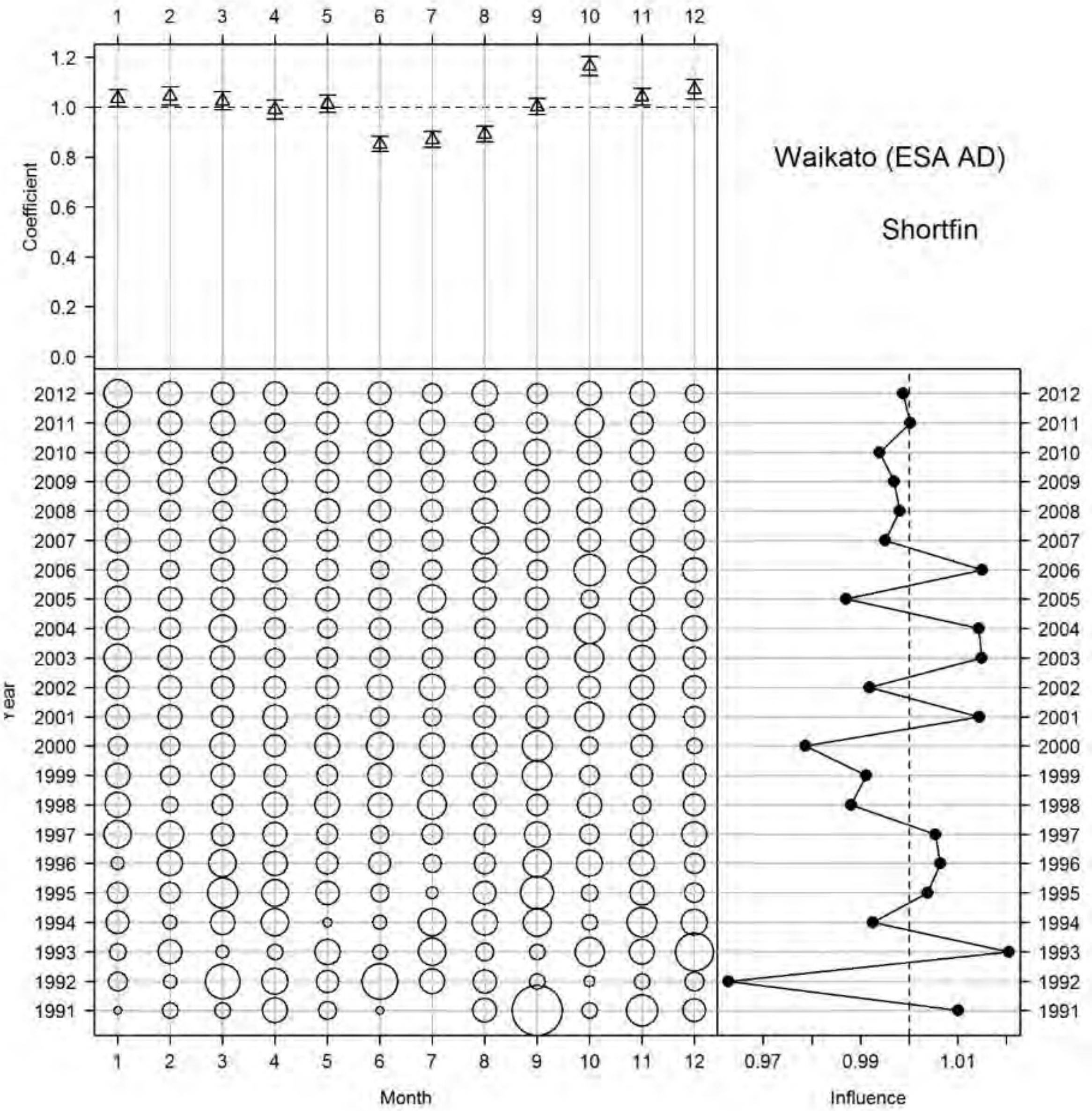


Figure D15: Influence of month for the shortfin CPUE model for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

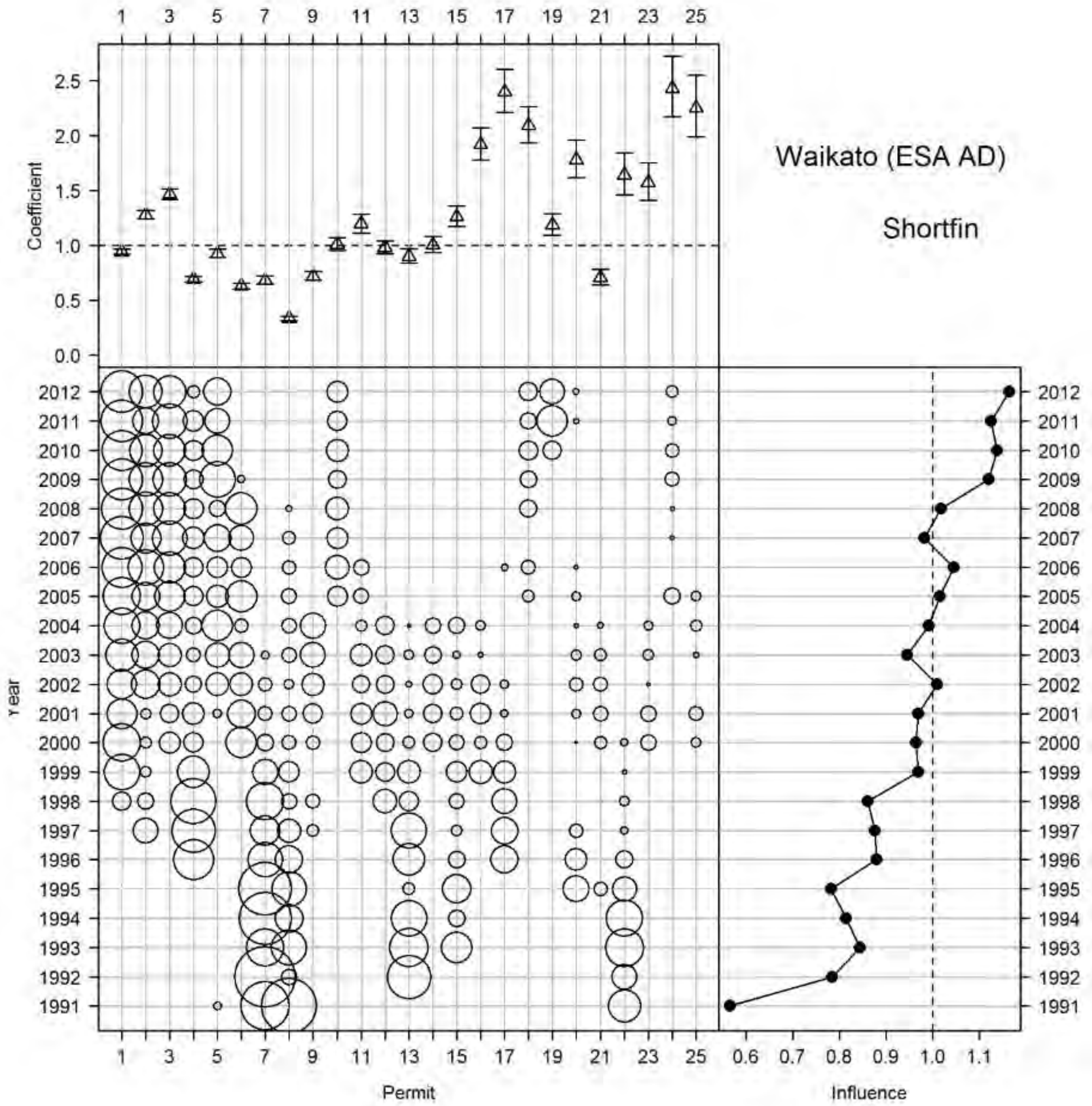


Figure D16: Influence of permit number for the shortfin CPUE model for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

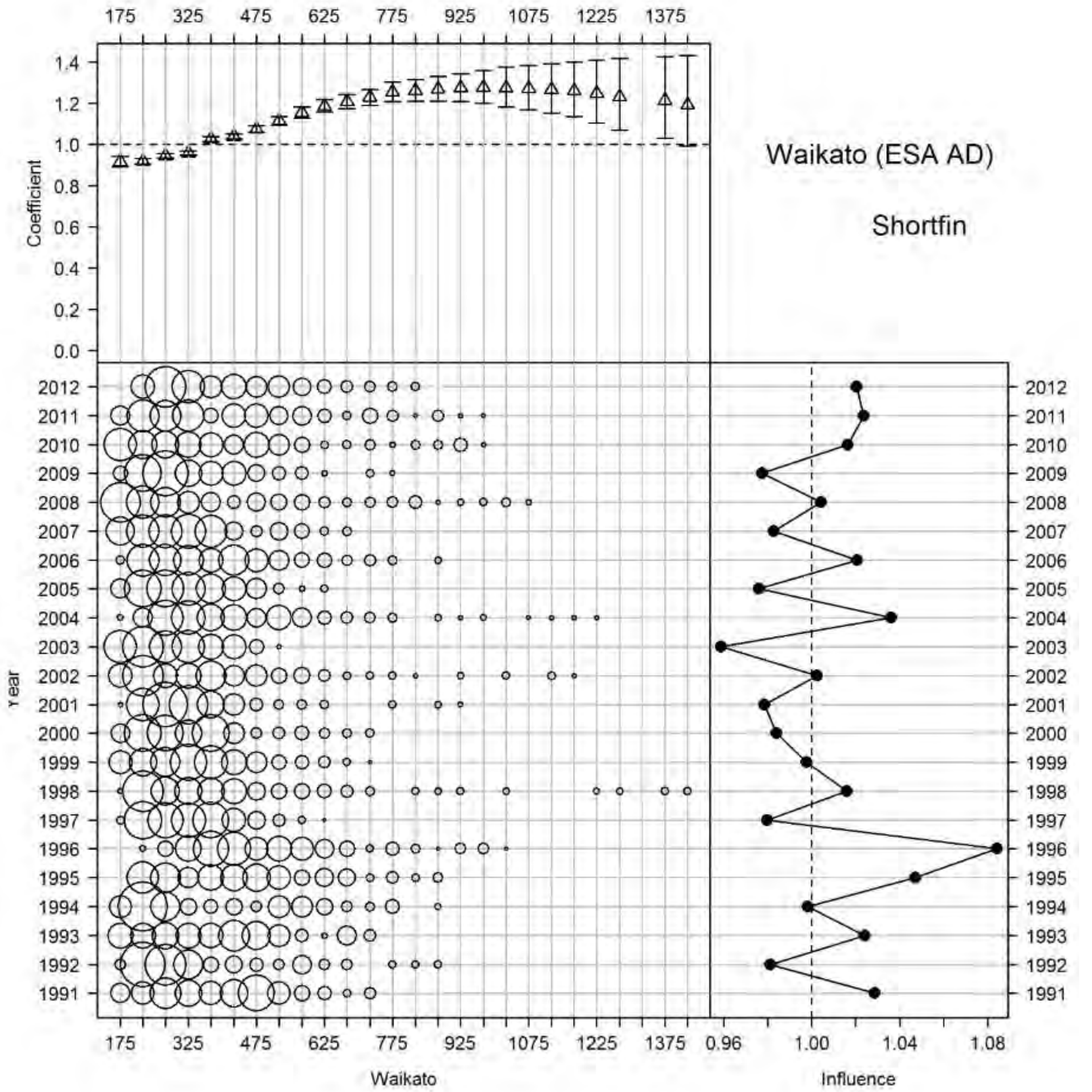


Figure D17: Influence of Waikato River flow for the shortfin CPUE model for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

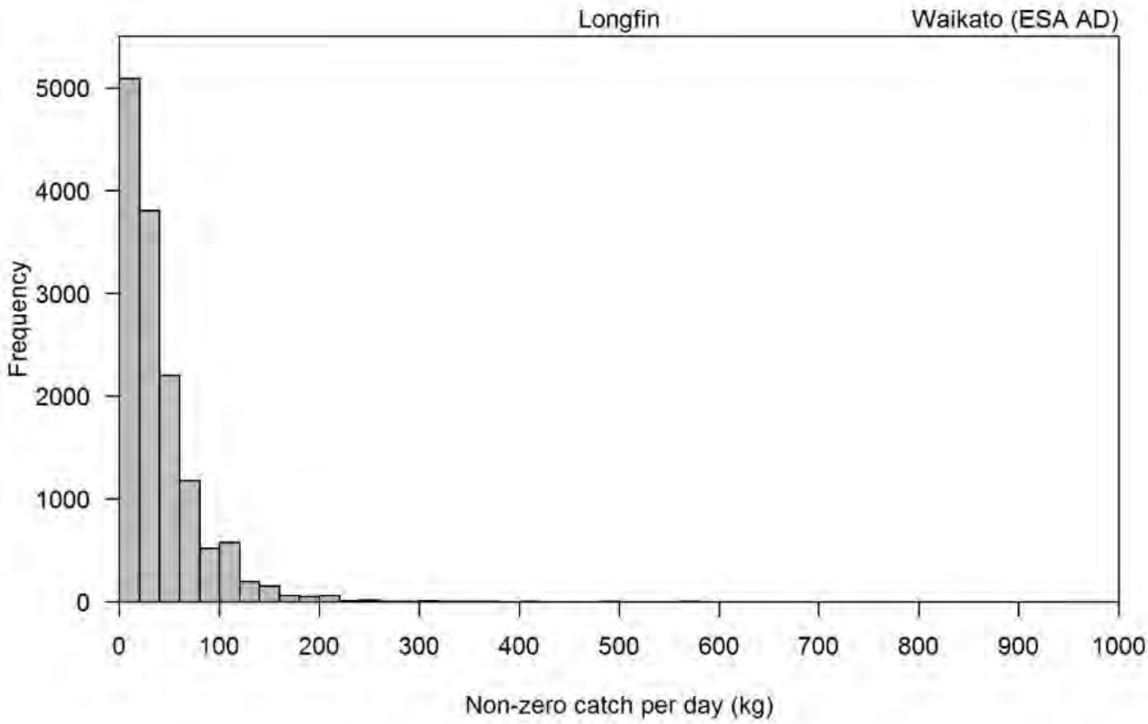


Figure D18: Frequency of longfin eel catch per day for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

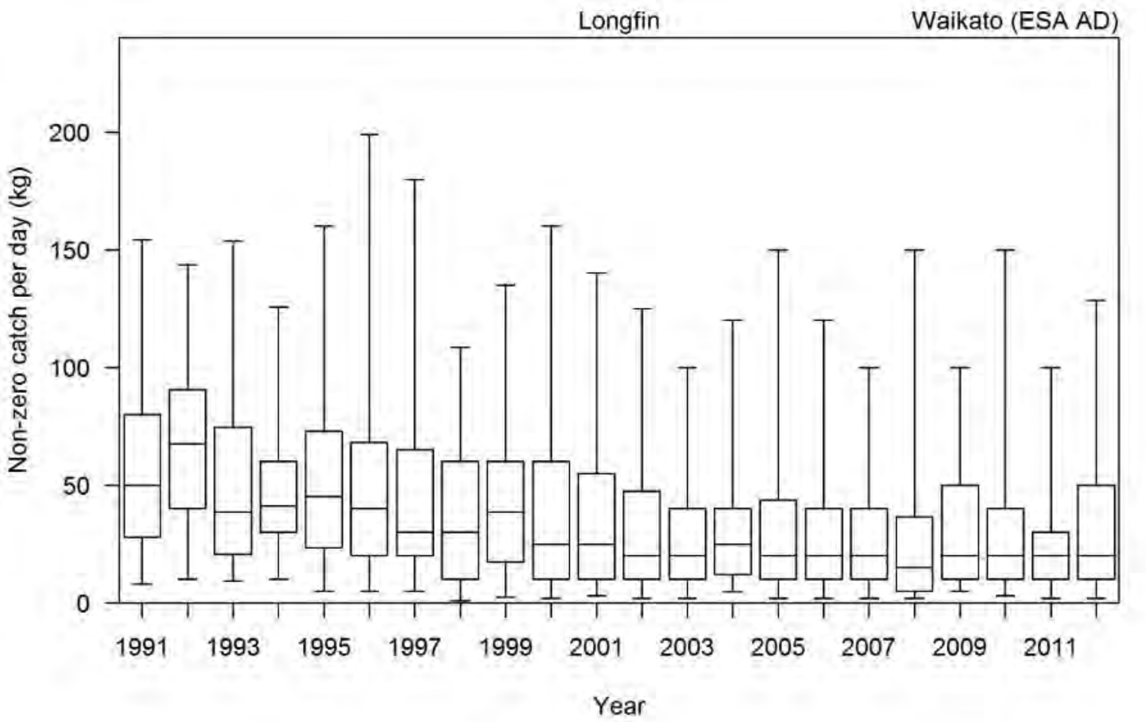


Figure D19: Longfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Waikato (ESA AD)).

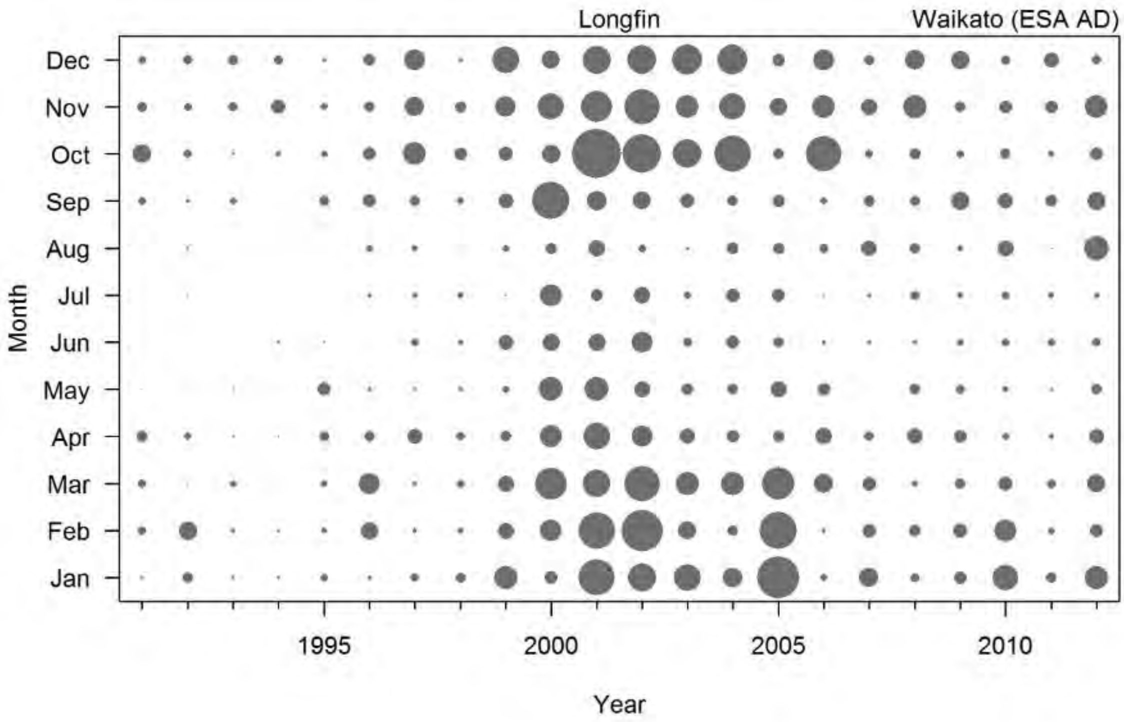


Figure D20: Longfin eel catch by month for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

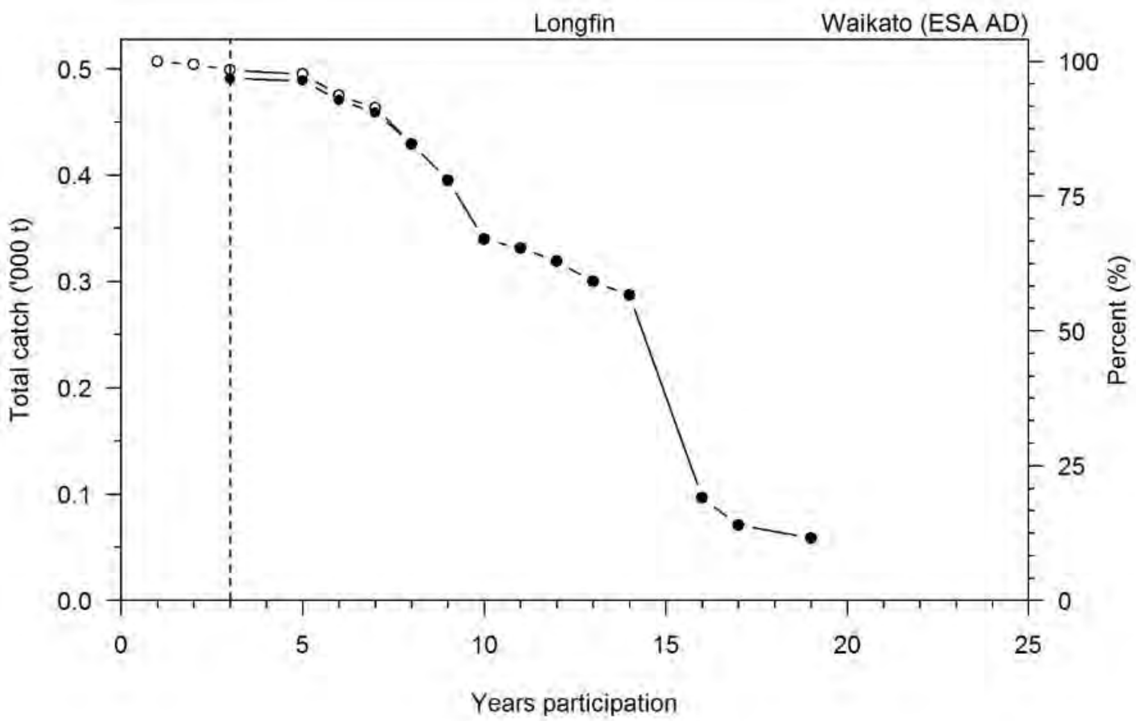


Figure D21: Relationship between years of participation in the fishery and longfin total catch. The open circles represent all longfin catch and the closed circles longfin catch data from fishers who 1) caught longfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core longfin fisher analyses for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

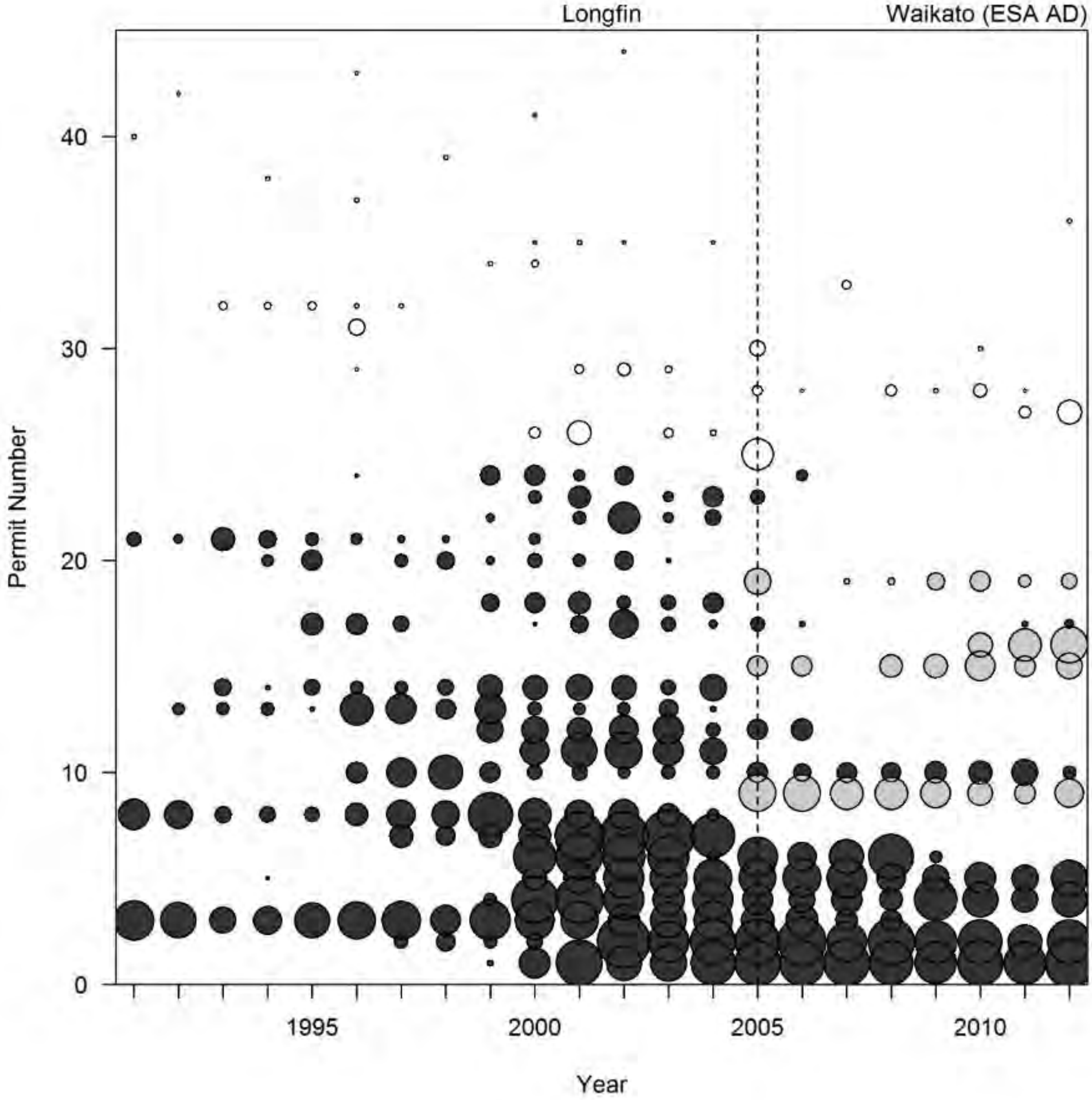


Figure D22: Relative catch of longfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Waikato (ESA AD)).

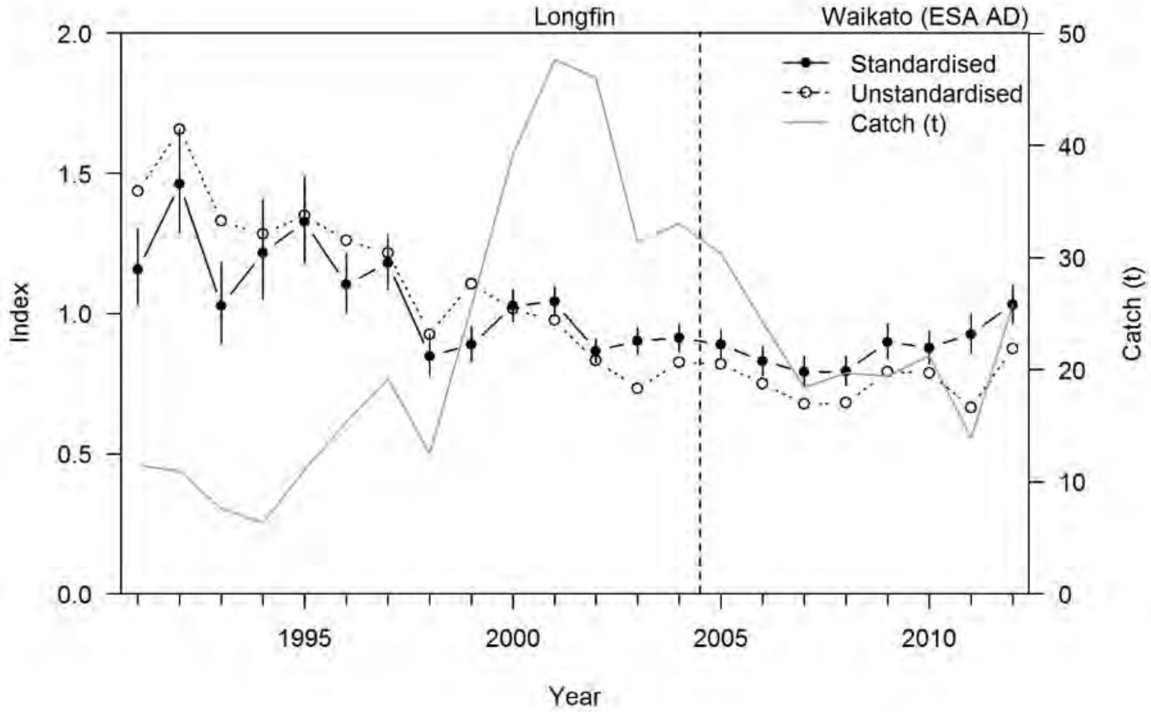


Figure D23: Indices of unstandardised catch per day and standardised CPUE for the core fishers longfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Waikato (ESA AD)).

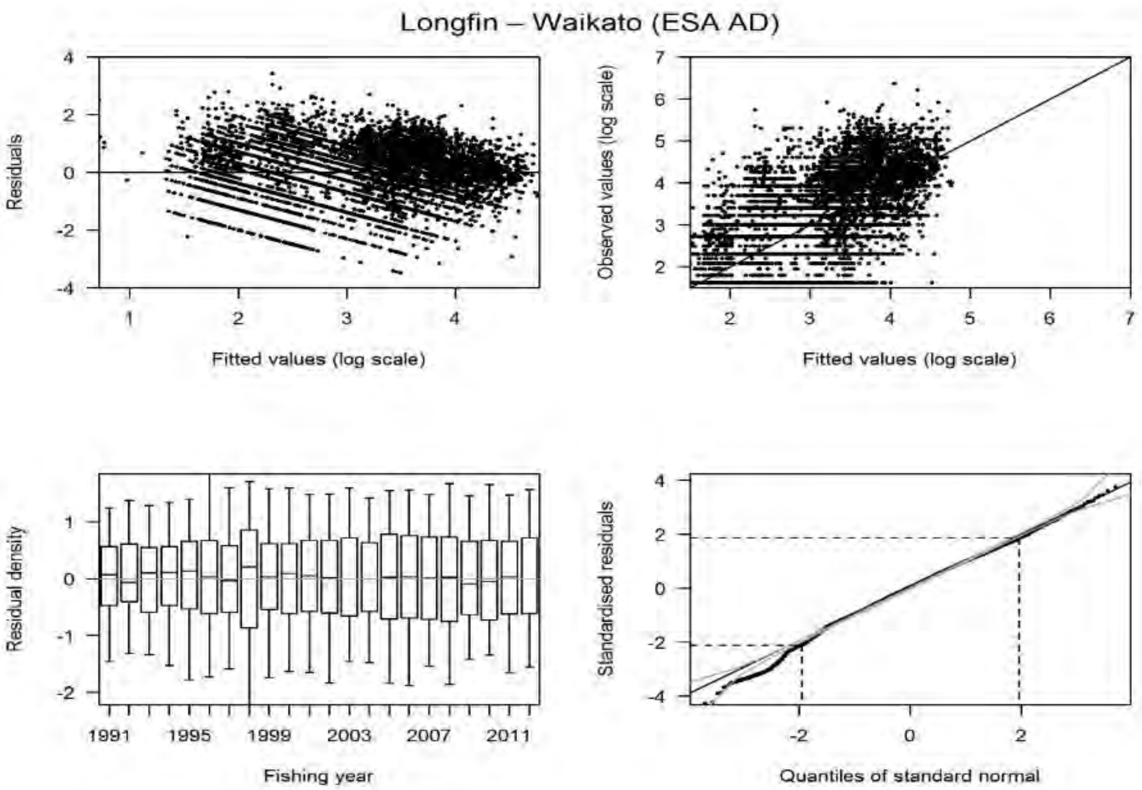


Figure D24: Residual diagnostic plots for the longfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Waikato (ESA AD)).

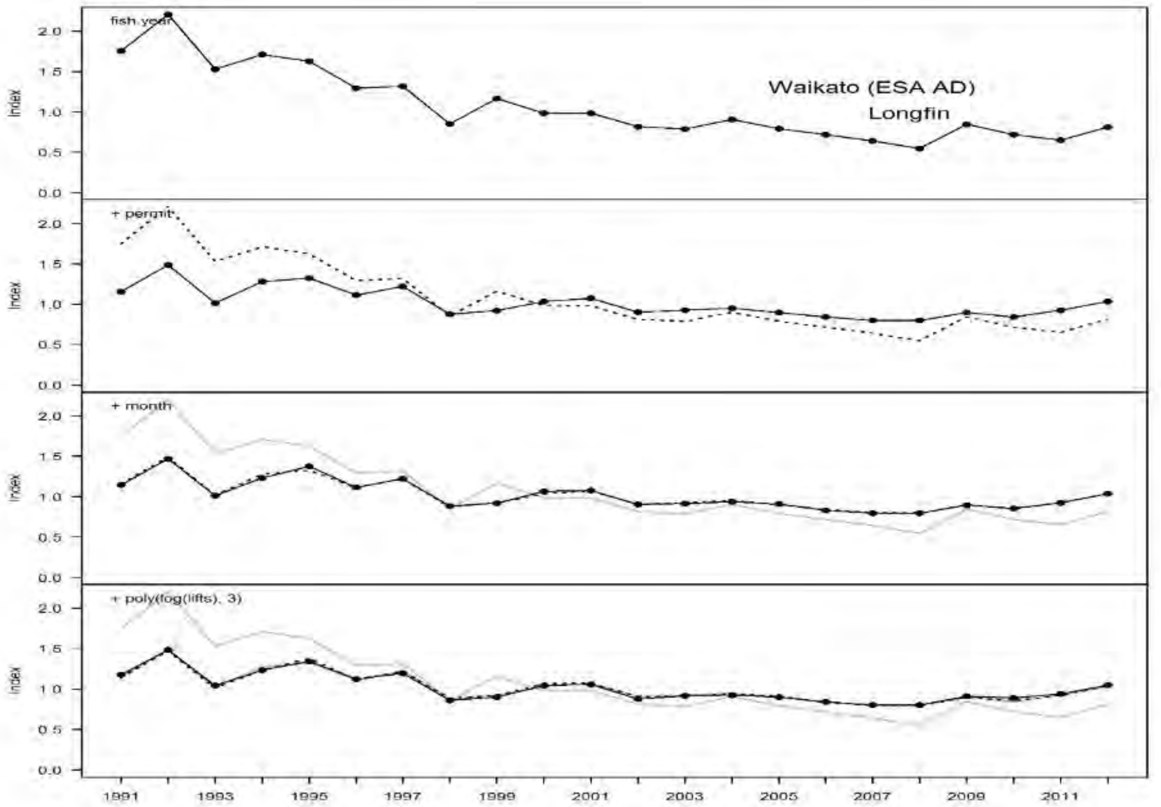


Figure D25: Step plot for the longfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Waikato (ESA AD)).

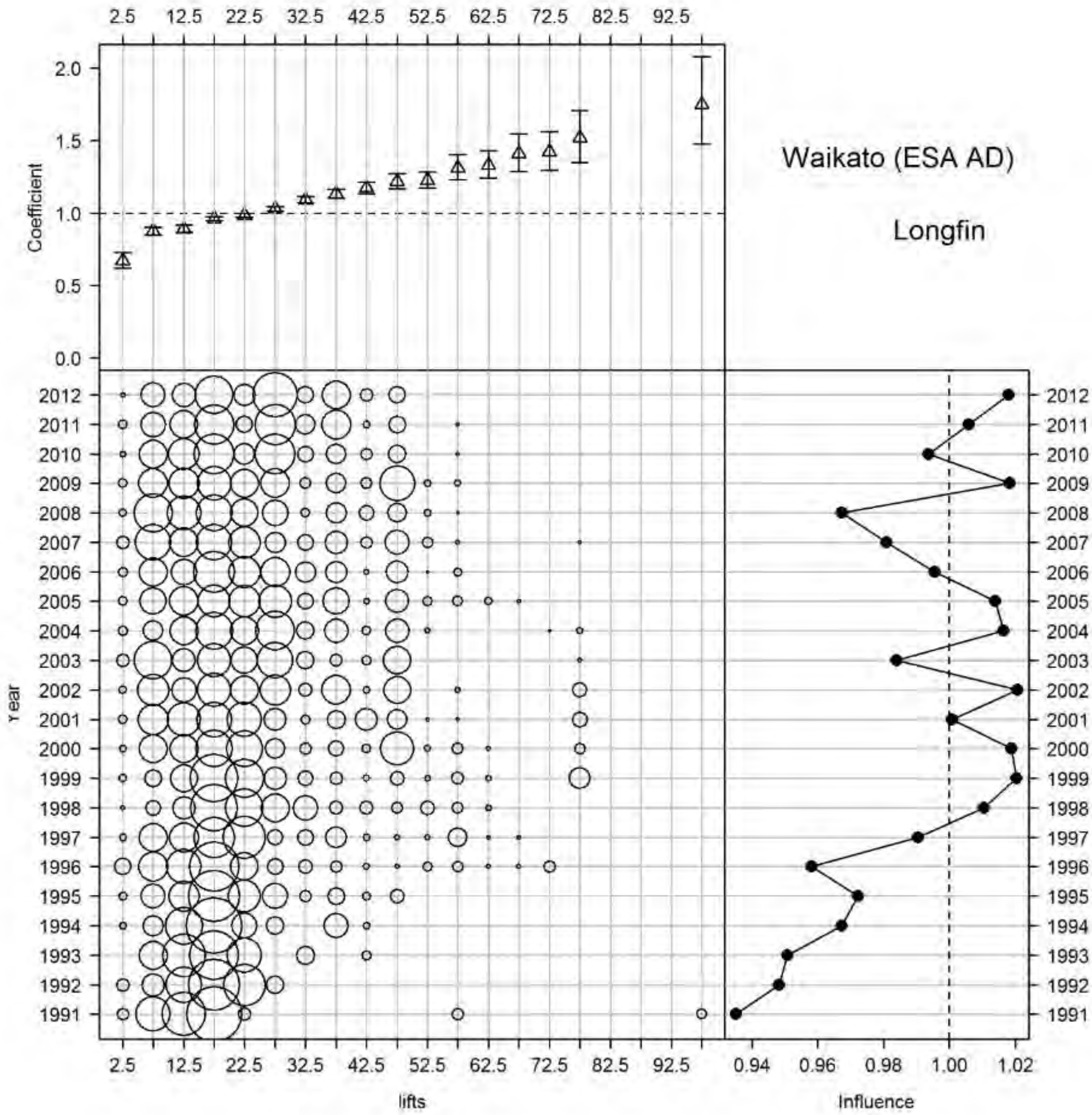


Figure D26: Influence of lifts for the longfin CPUE model for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

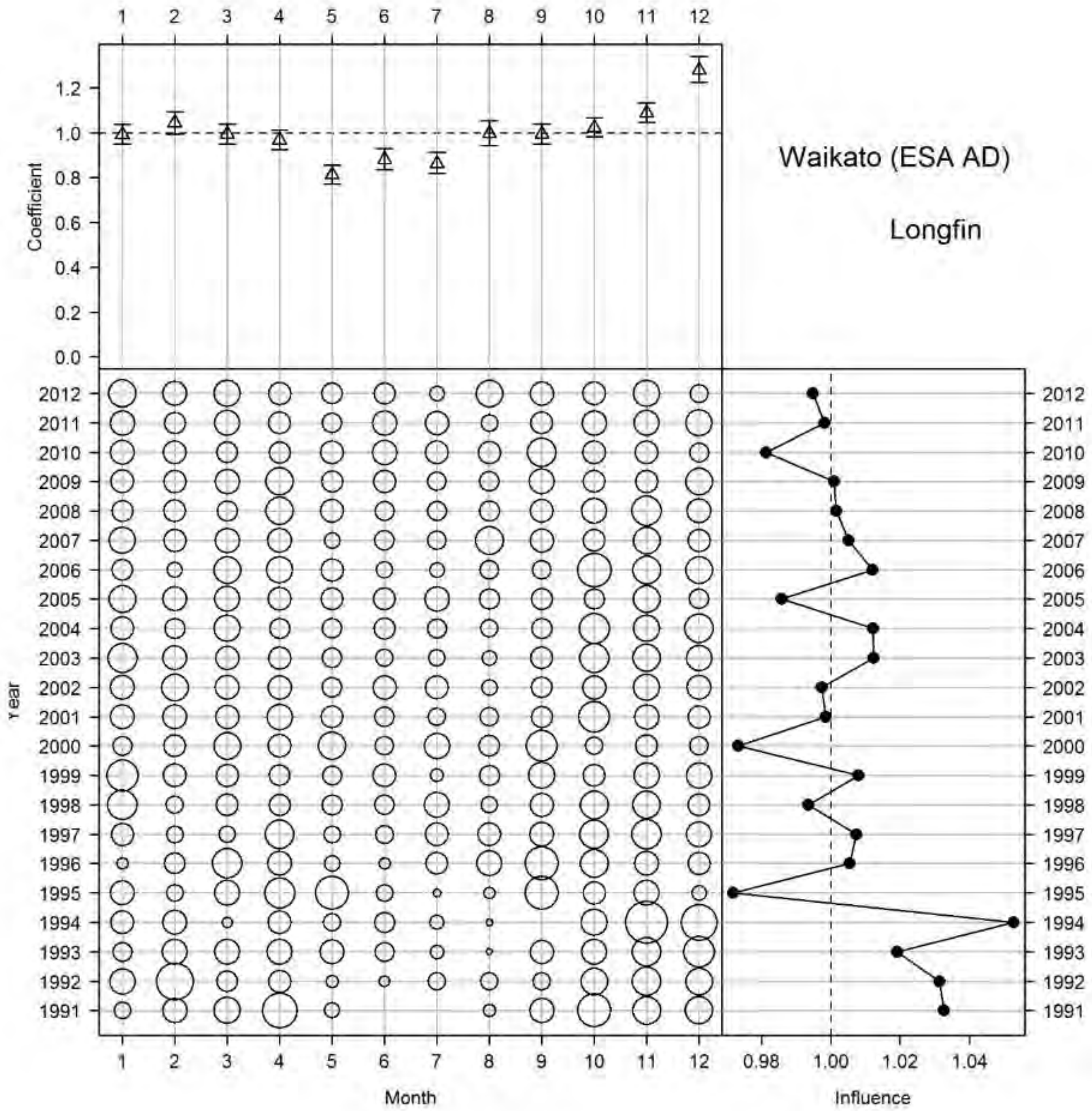


Figure D27: Influence of month for the longfin CPUE model for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

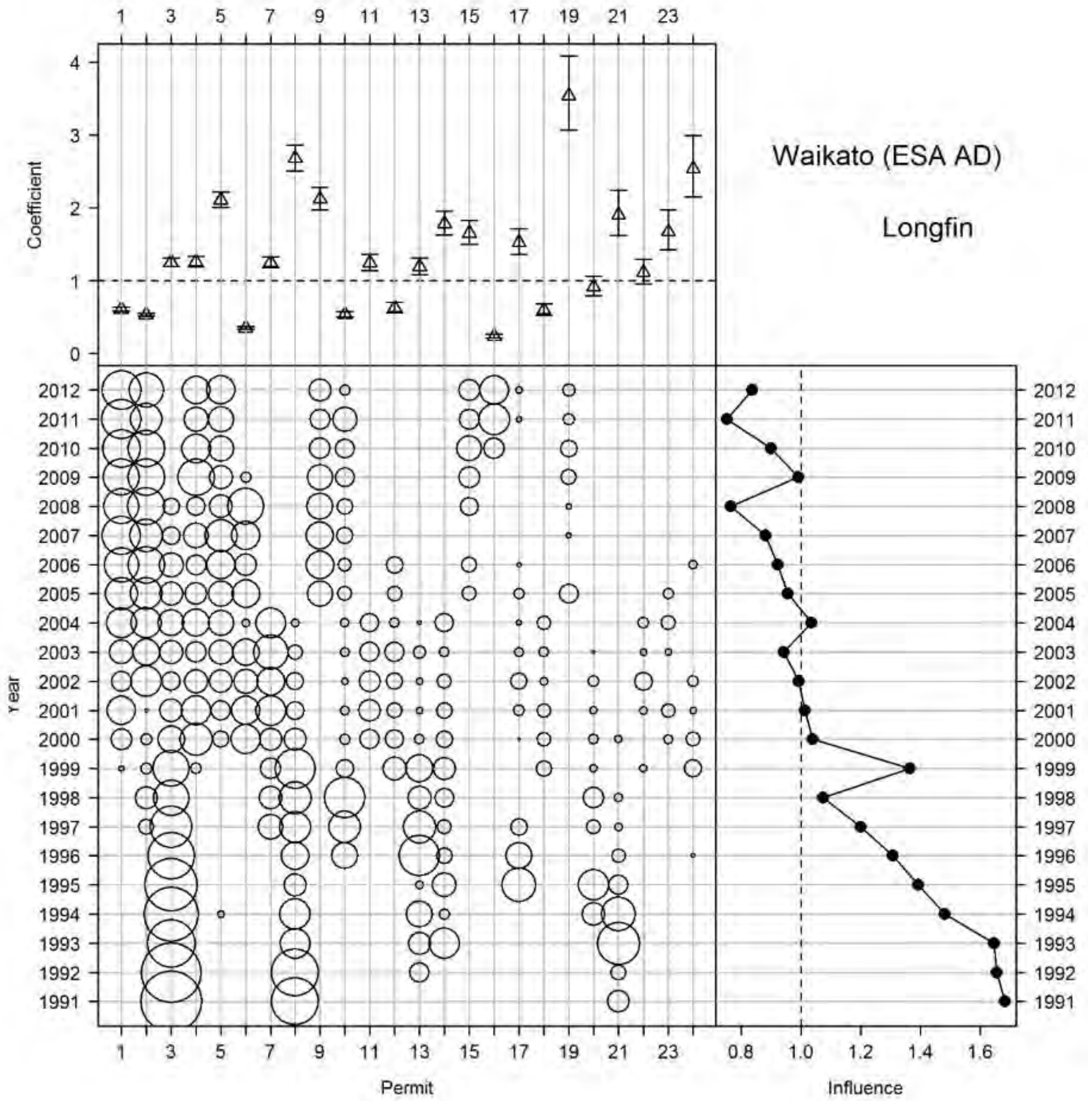


Figure D28: Influence of permit number for the longfin CPUE model for the years 1990–91 to 2011–12 (Waikato (ESA AD)).

Appendix E: Bay of Plenty (ESA AE)

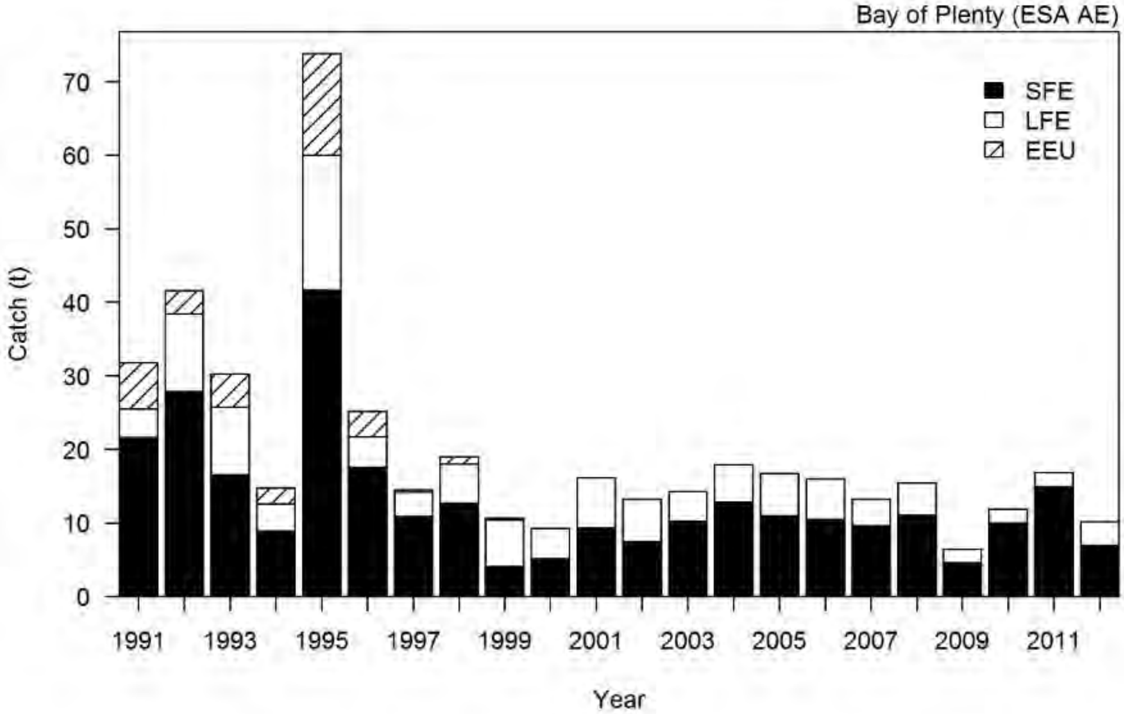


Figure E1: Total estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

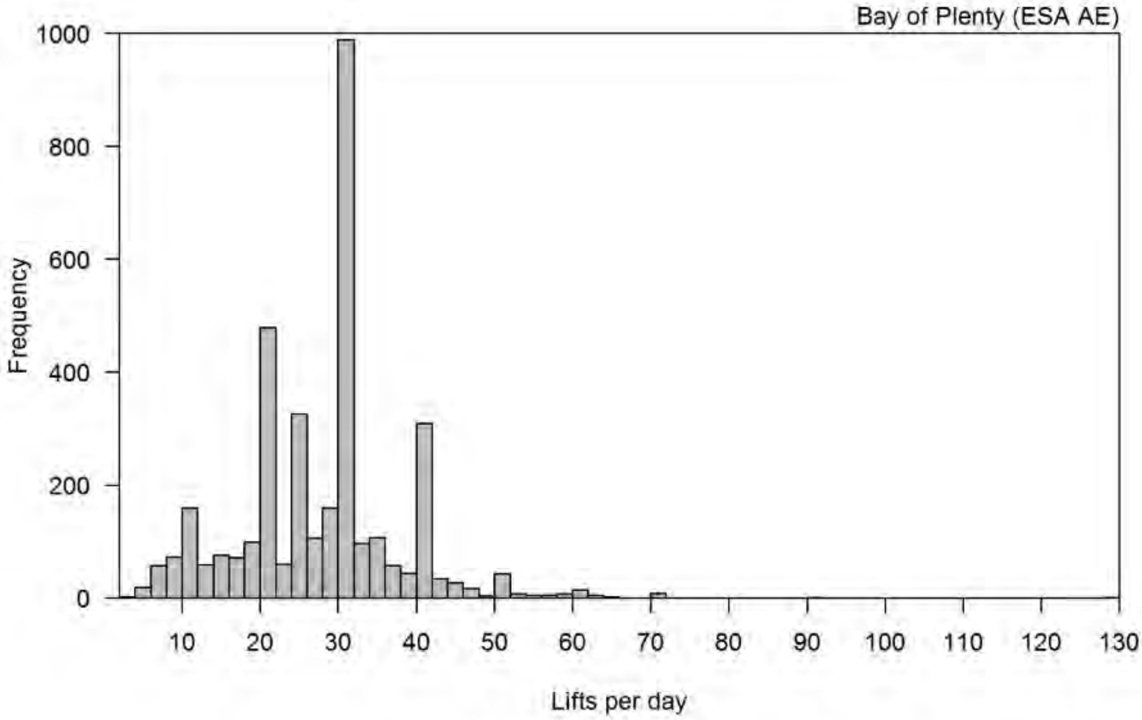


Figure E2: Frequency of total lifts per day for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

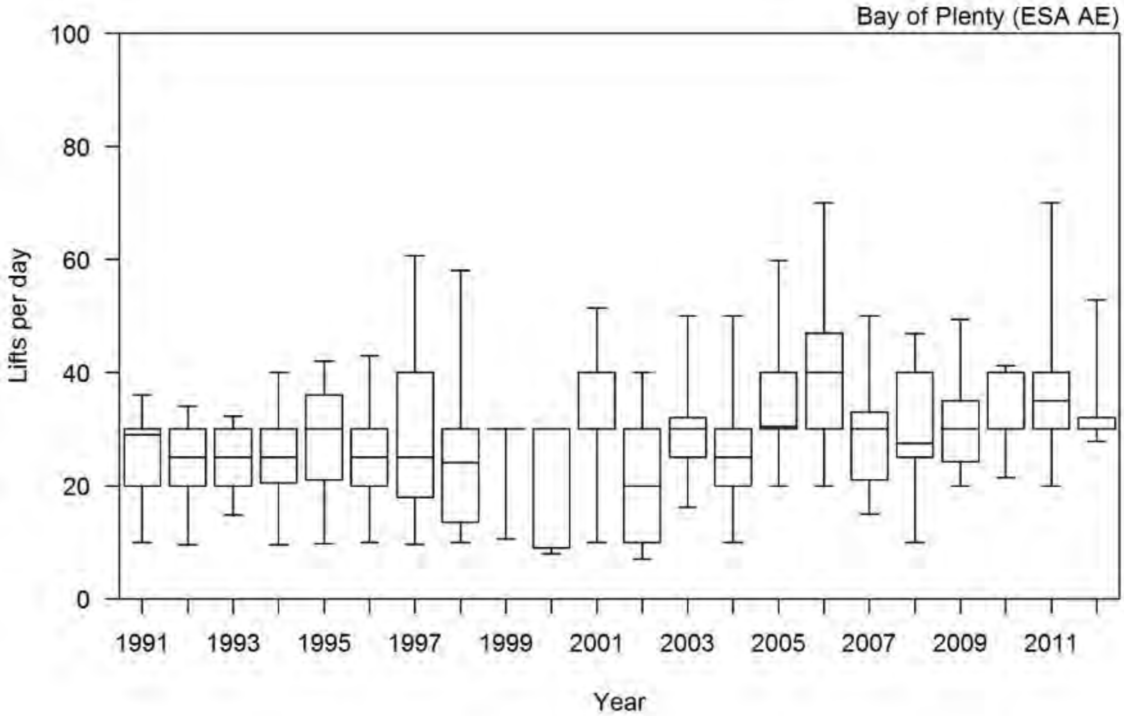


Figure E3: Total lifts per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Bay of Plenty (ESA AE)).

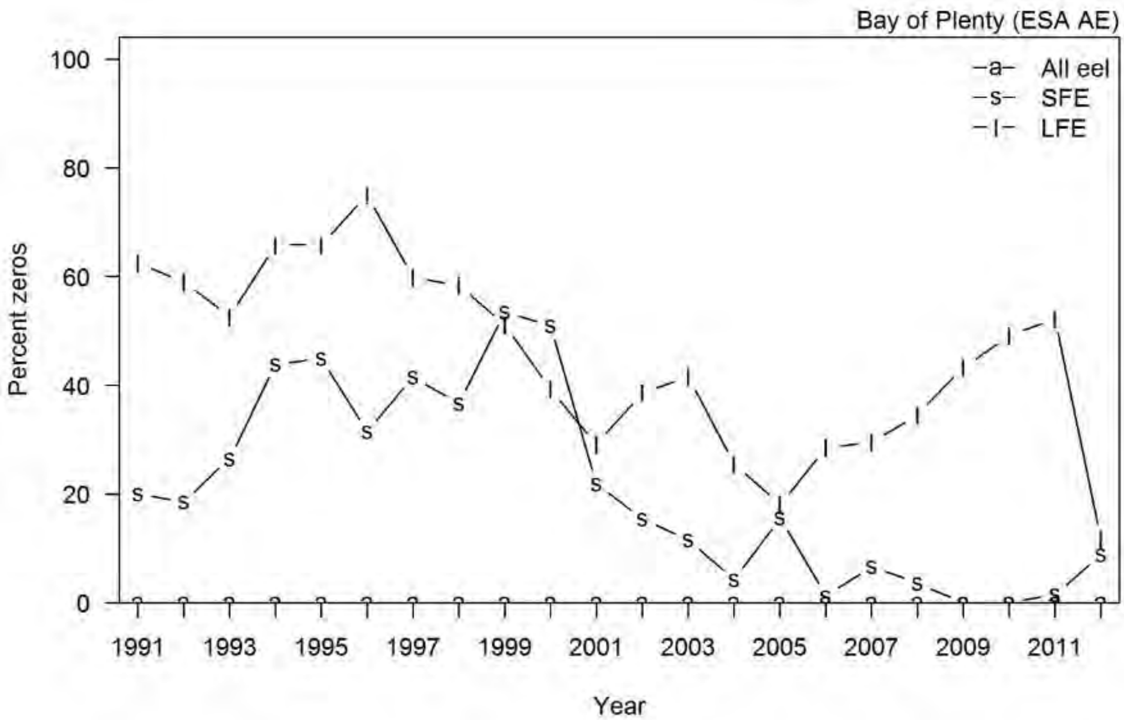


Figure E4: Proportion of zero records for all eel, shortfin (SFE), and longfin (LFE) catch for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

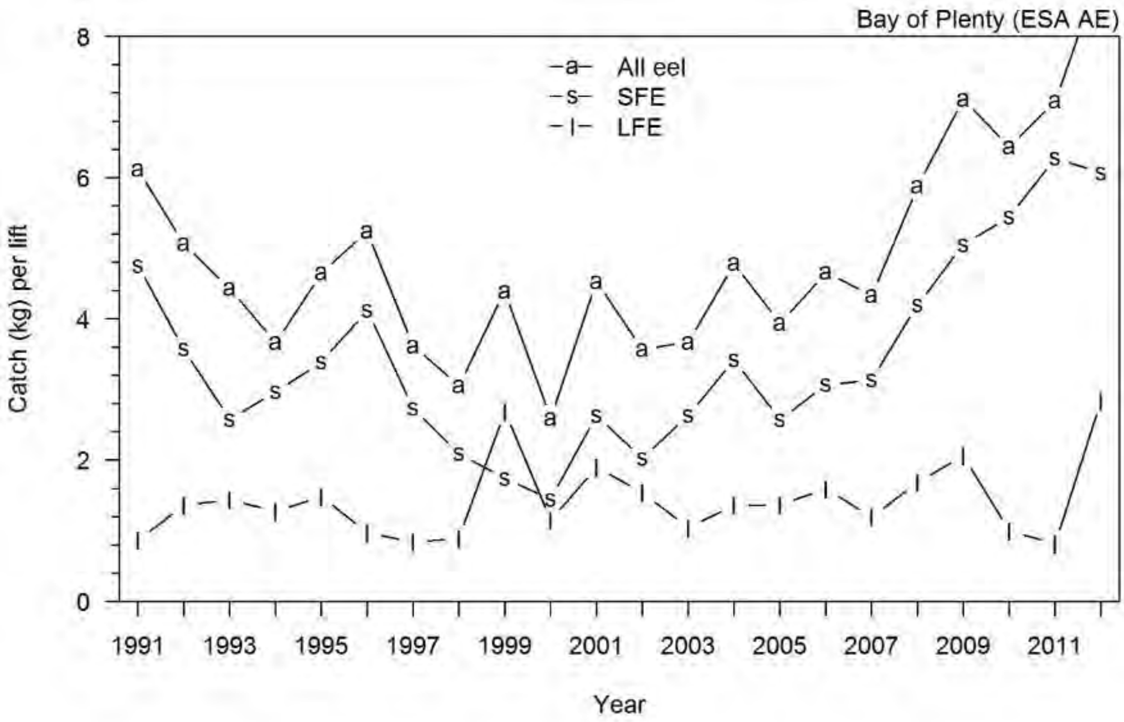


Figure E5: Unstandardised catch per lift (total kg/total lifts) for all eel, shortfin (SFE), and longfin (LFE) for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

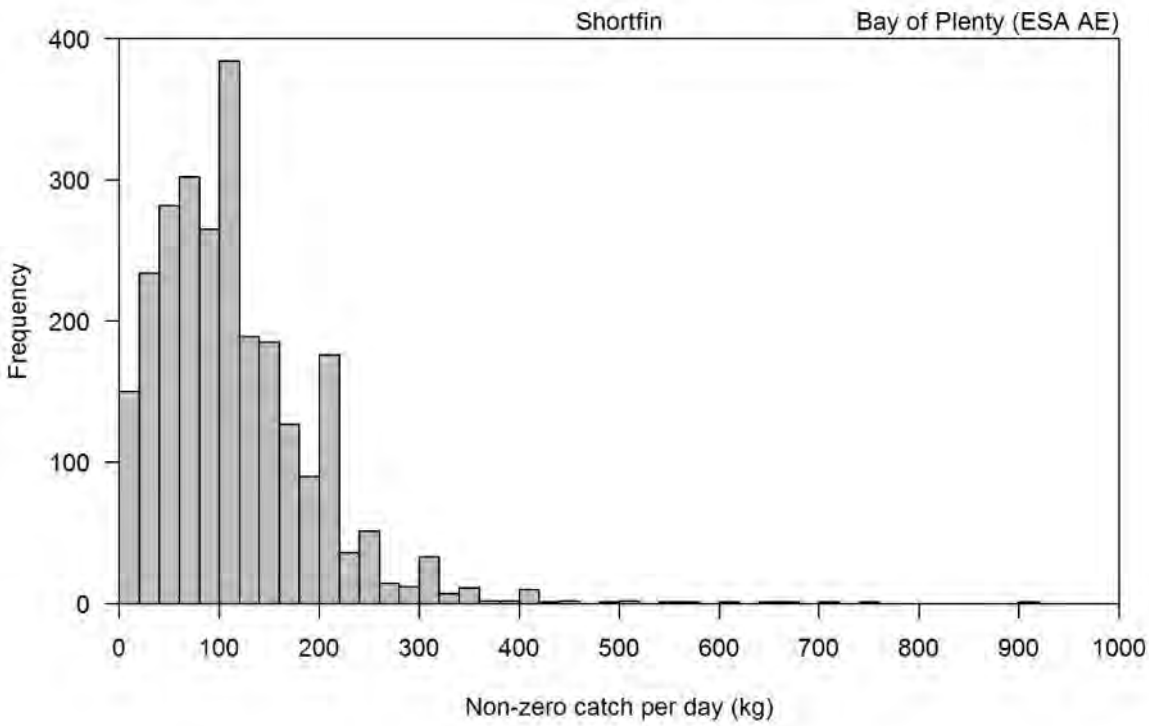


Figure E6: Frequency of shortfin eel catch per day for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

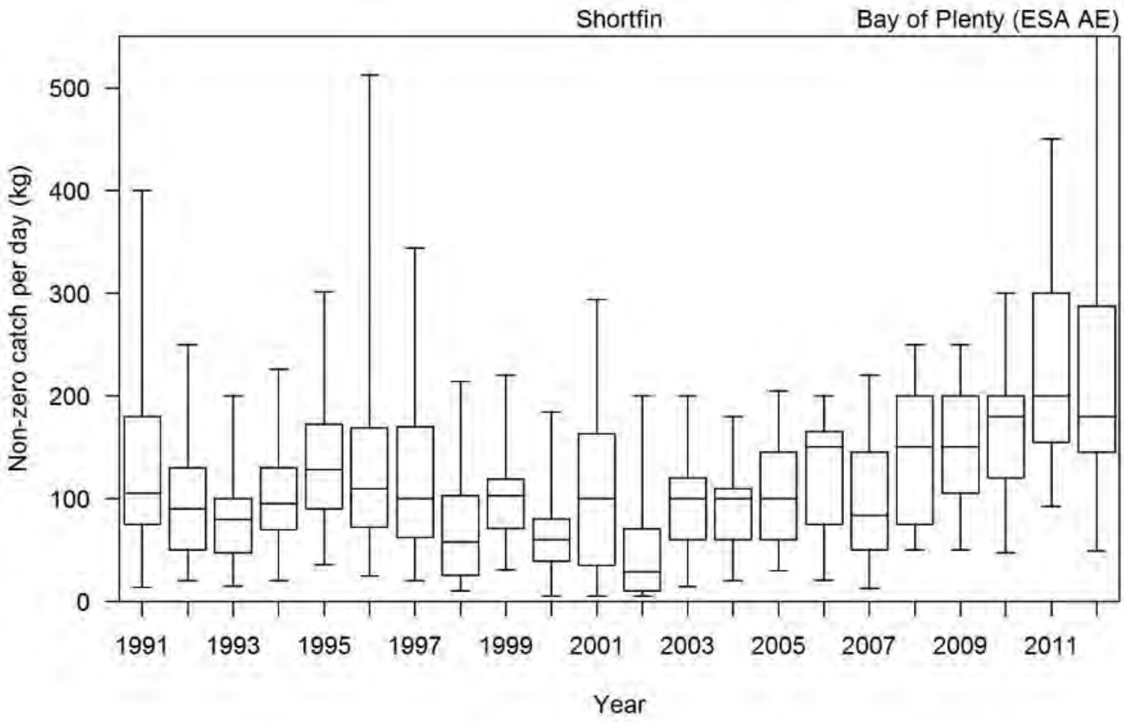


Figure E7: Shortfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Bay of Plenty (ESA AE)).

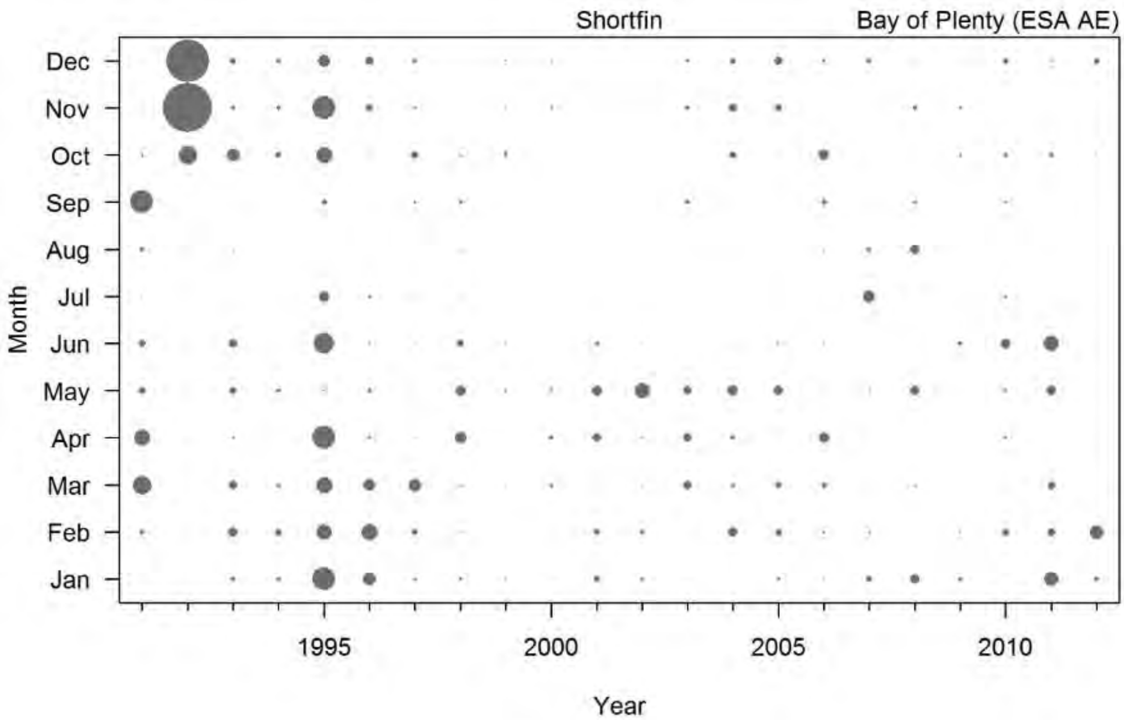


Figure E8: Shortfin eel catch by month for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

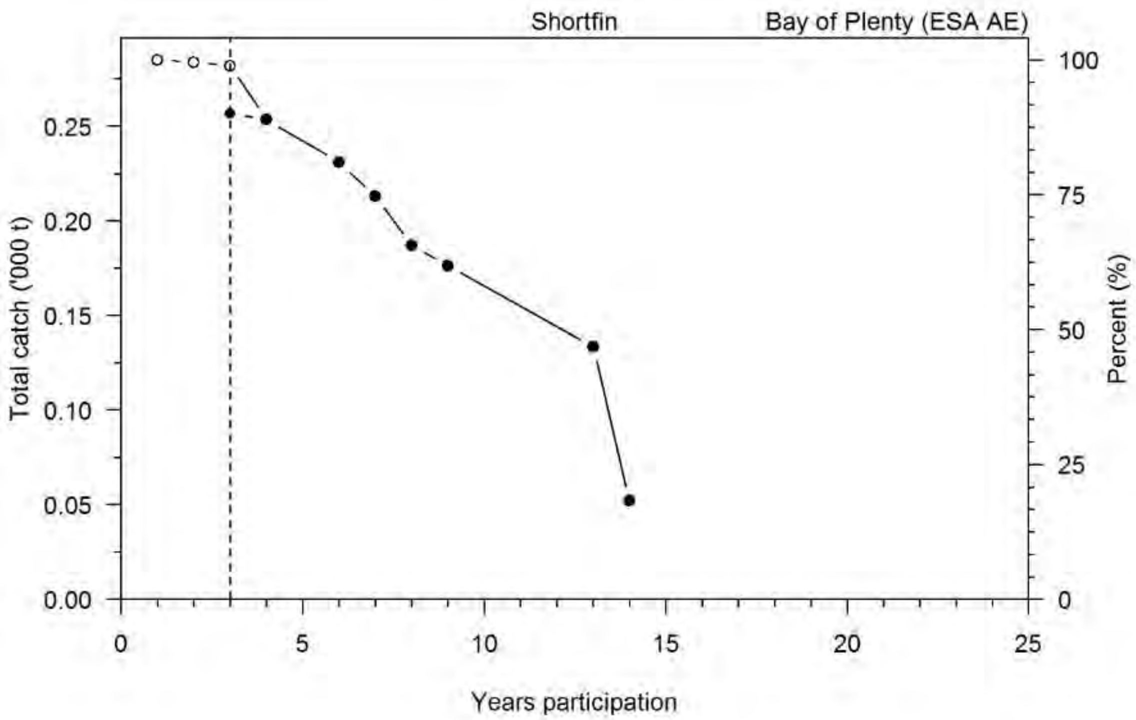


Figure E9: Relationship between years of participation in the fishery and shortfin total catch. The open circles represent all shortfin catch and the closed circles shortfin catch data from fishers who 1) caught shortfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core shortfin fisher analyses for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

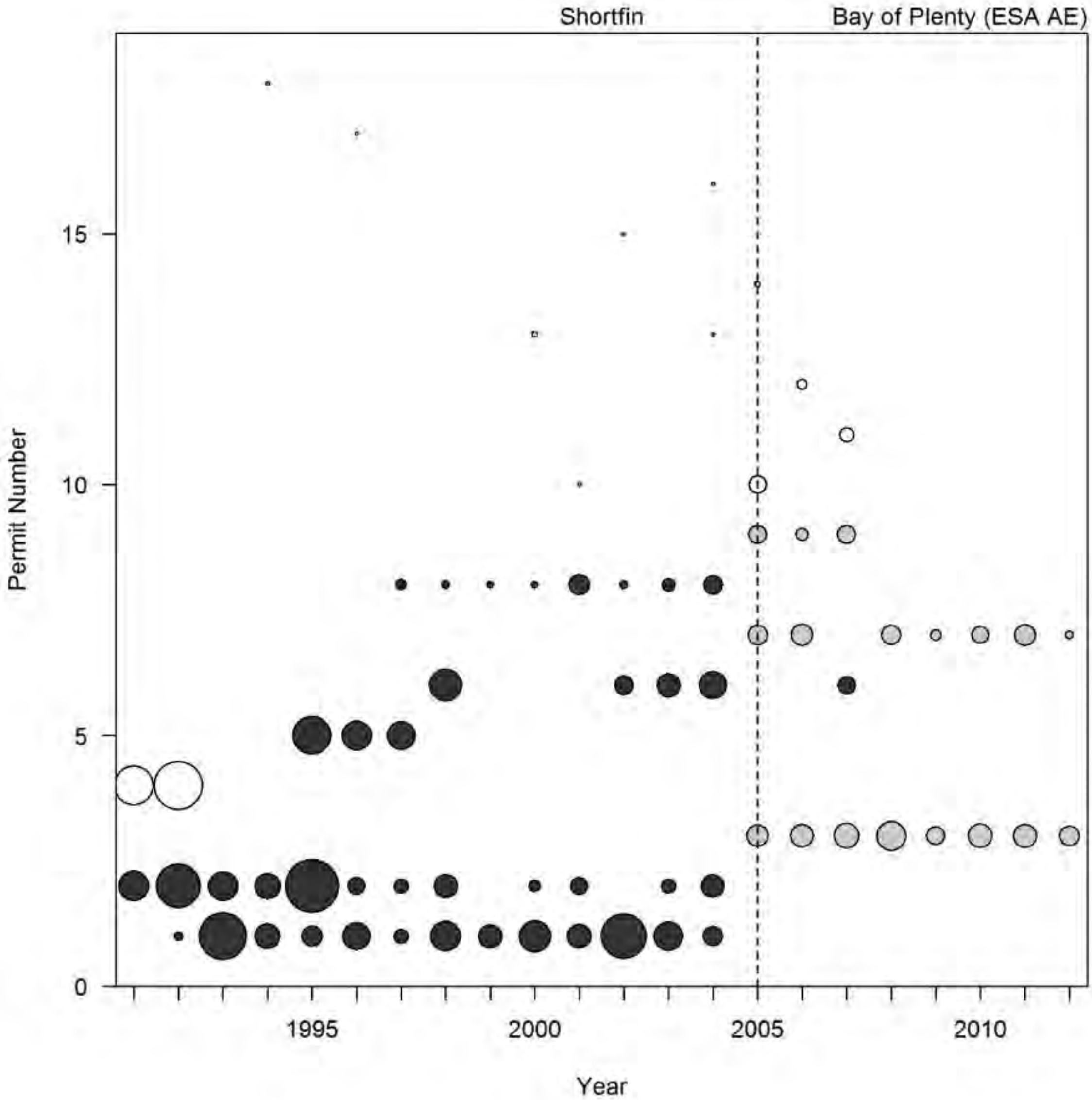


Figure E10: Relative catch of shortfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Bay of Plenty (ESA AE)).

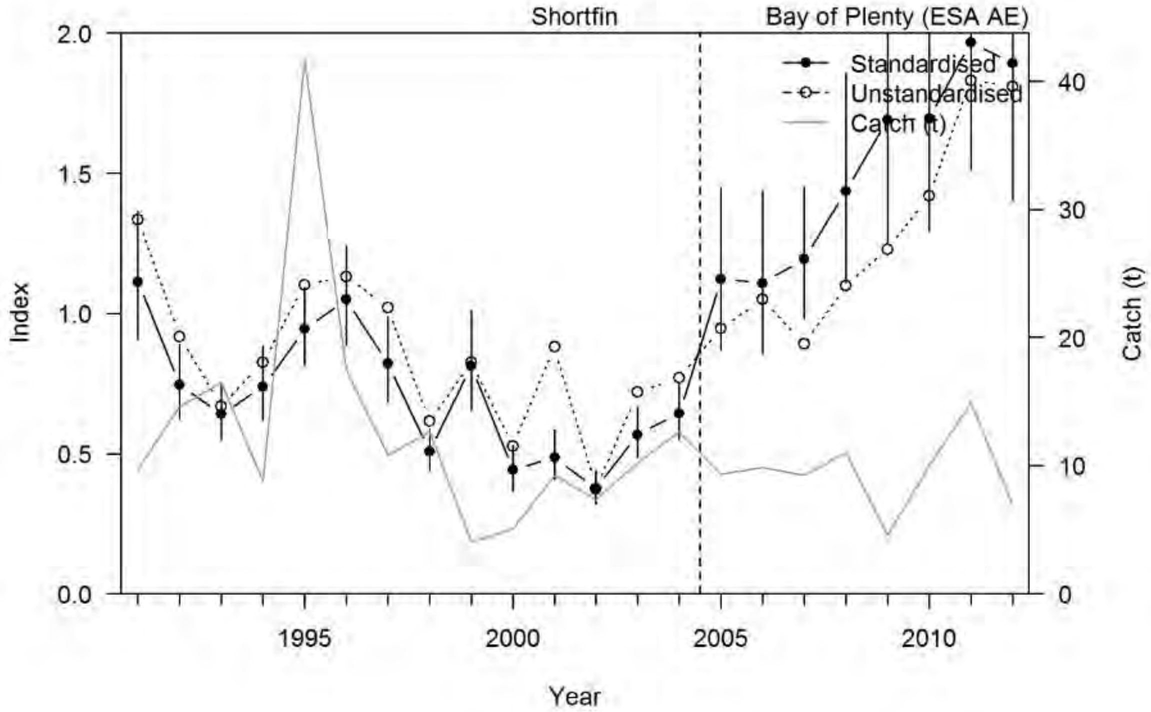


Figure E11: Indices of unstandardised catch per day and standardised CPUE for the core fishers shortfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Bay of Plenty (ESA AE)).

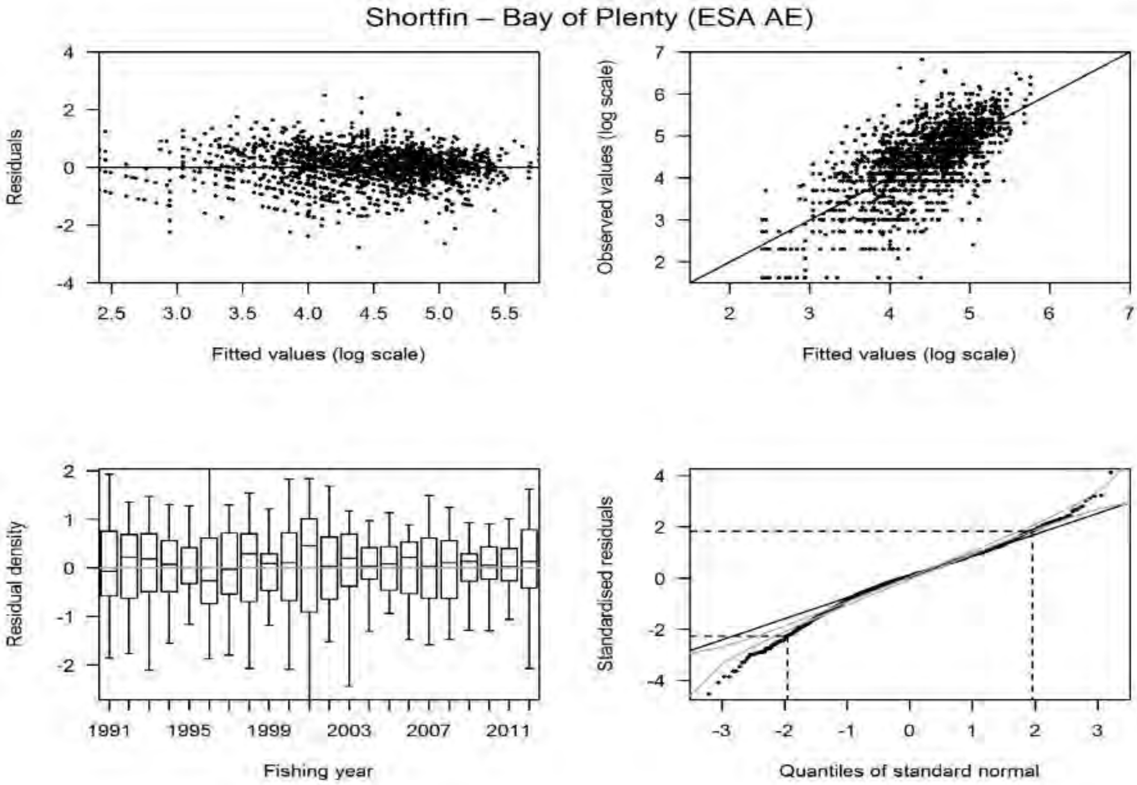


Figure E12: Residual diagnostic plots for the shortfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Bay of Plenty (ESA AE)).

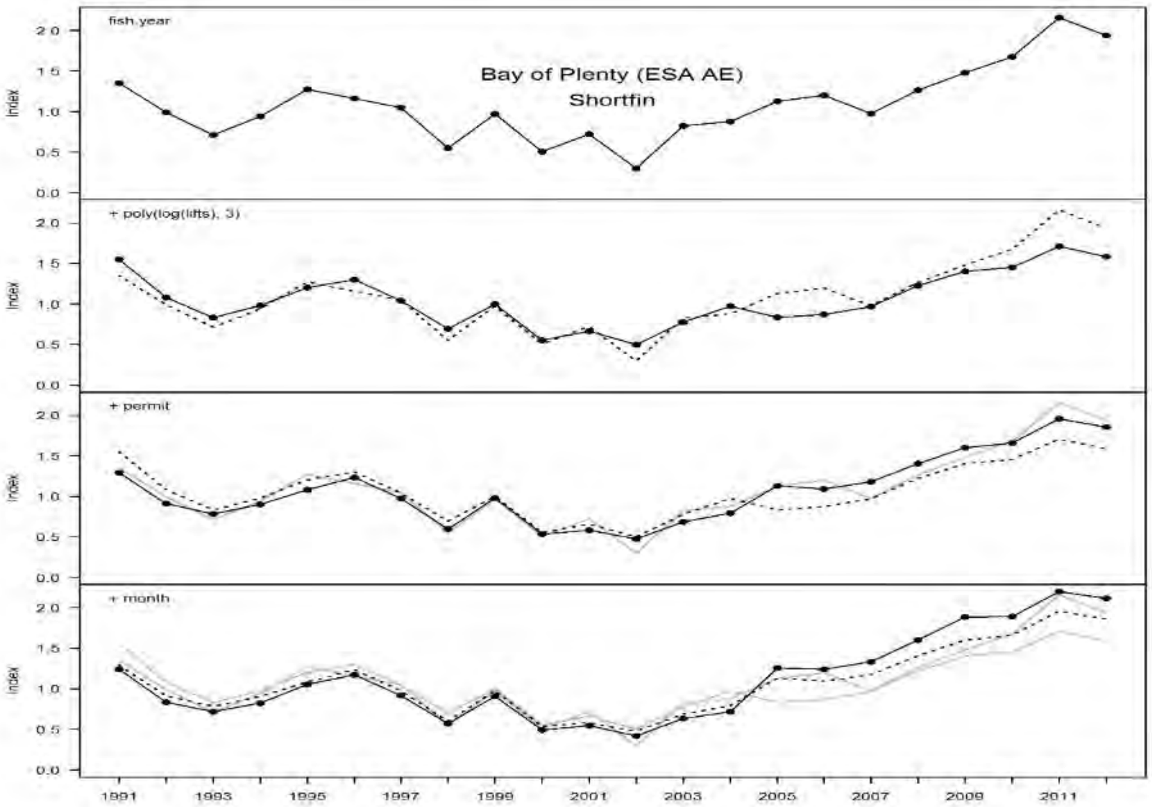


Figure E13: Step plot for the shortfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Bay of Plenty (ESA AE)).

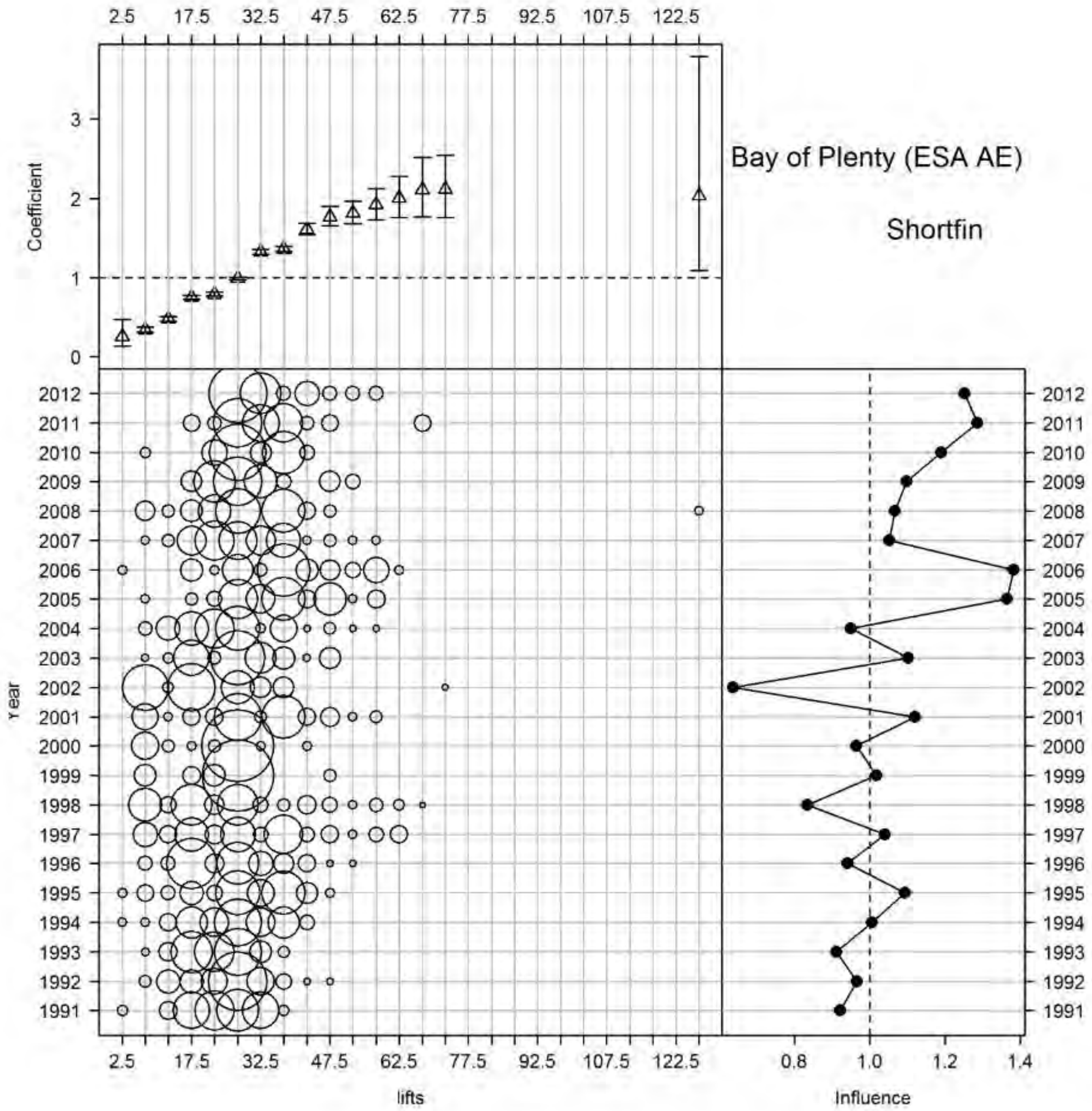


Figure E14: Influence of lifts for the shortfin CPUE model for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

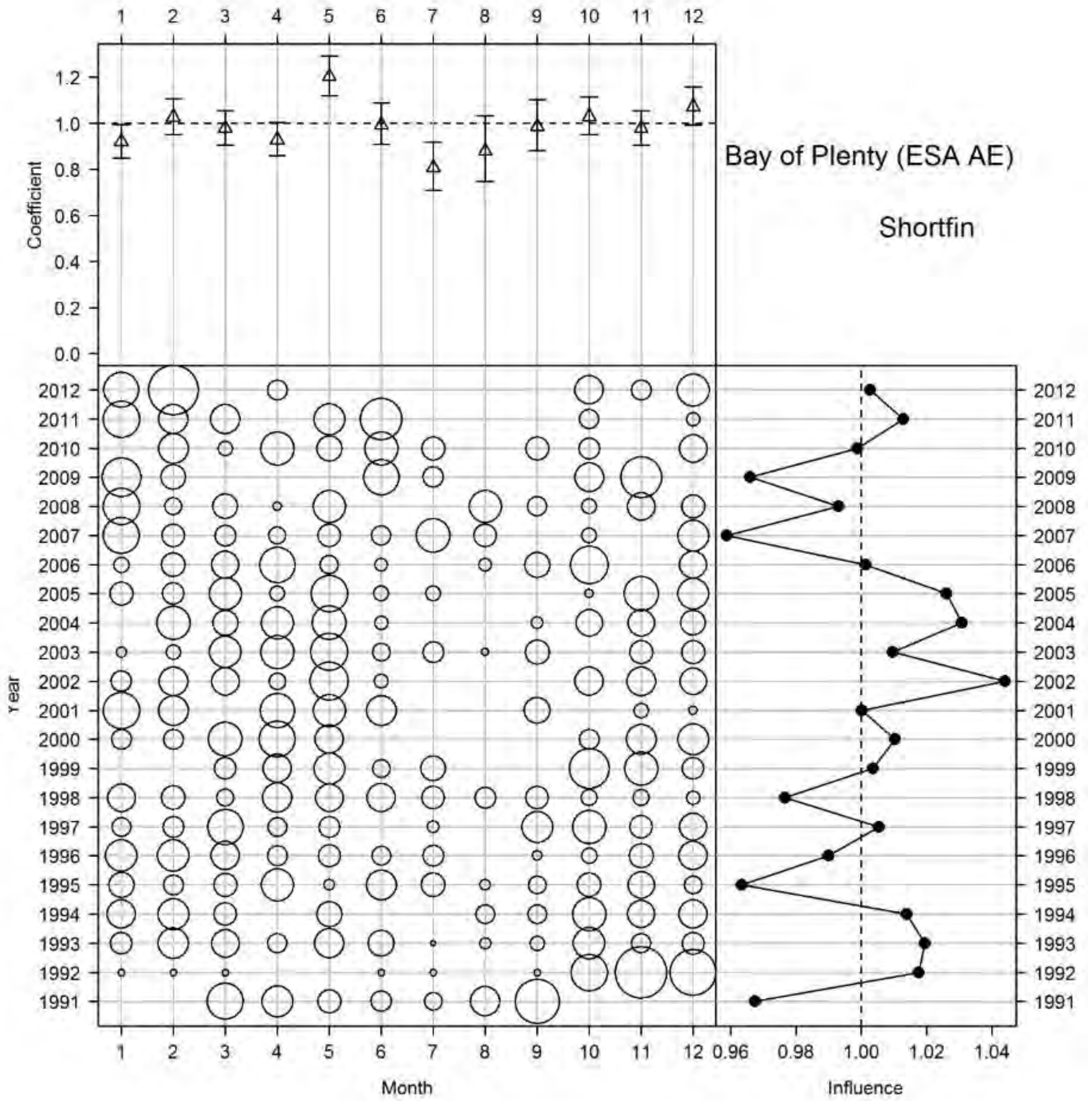


Figure E15: Influence of month for the shortfin CPUE model for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

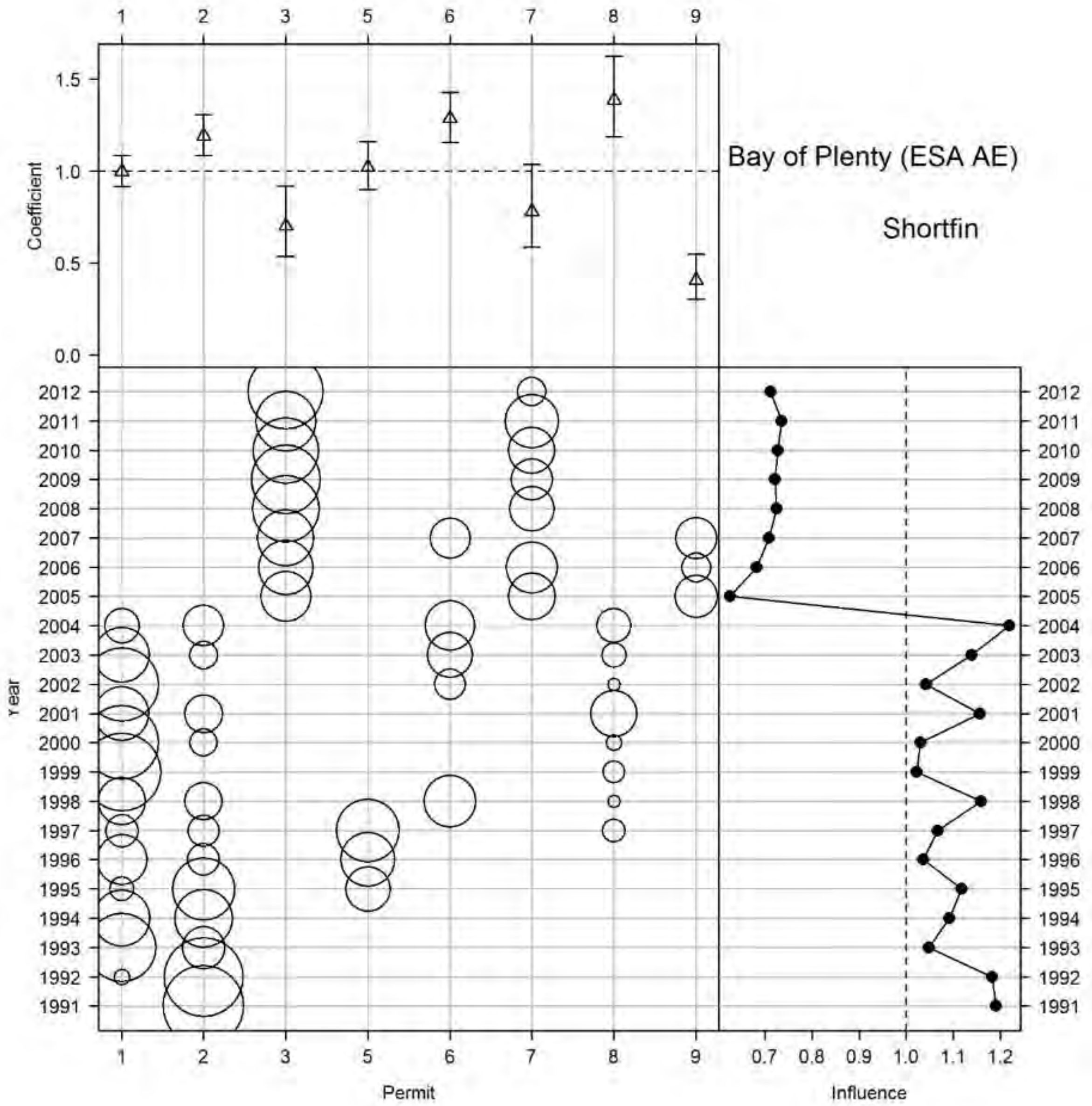


Figure E16: Influence of permit number for the shortfin CPUE model for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

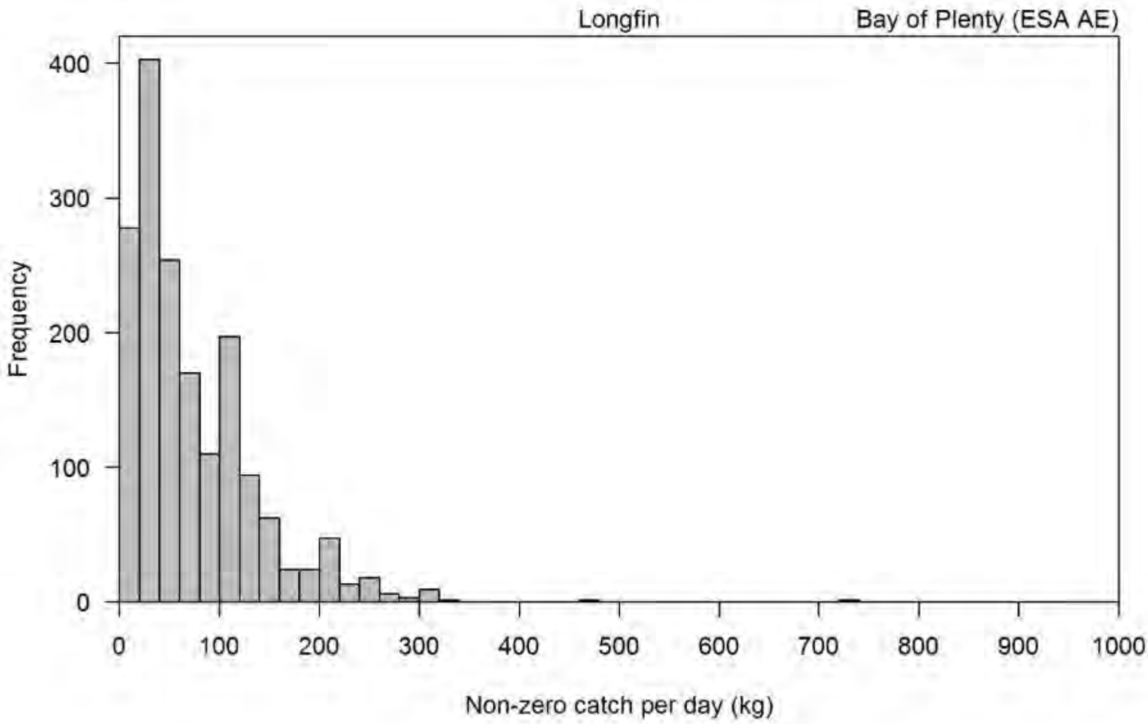


Figure E17: Frequency of longfin eel catch per day for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

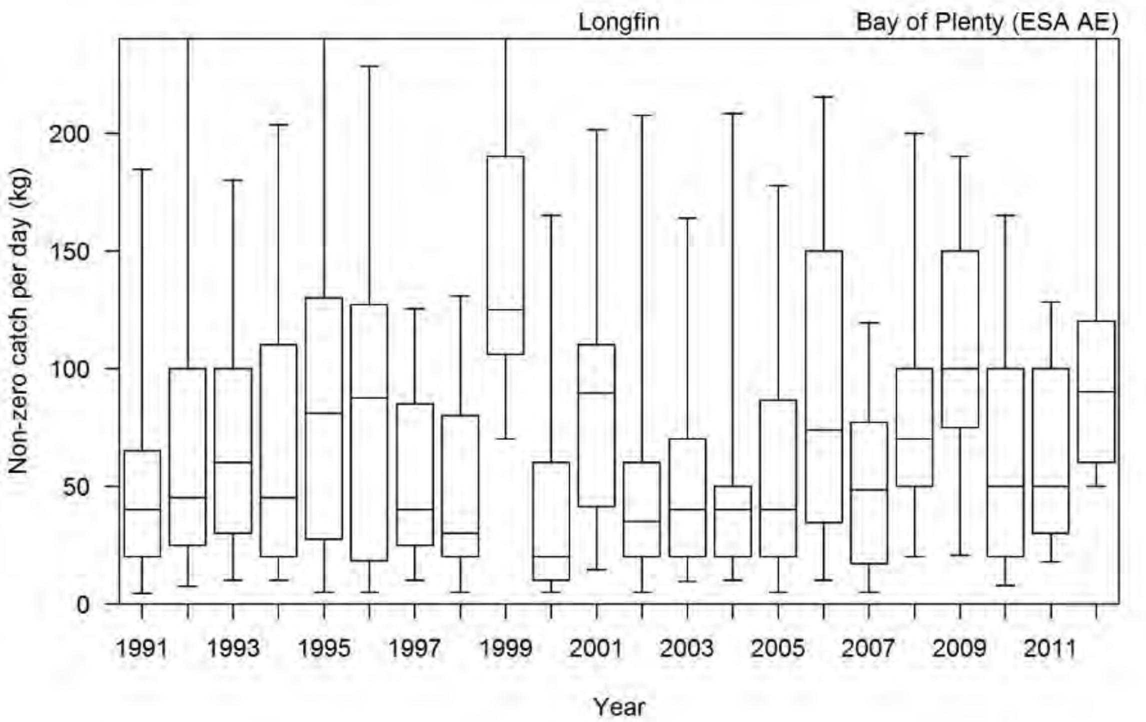


Figure E18: Longfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Bay of Plenty (ESA AE)).

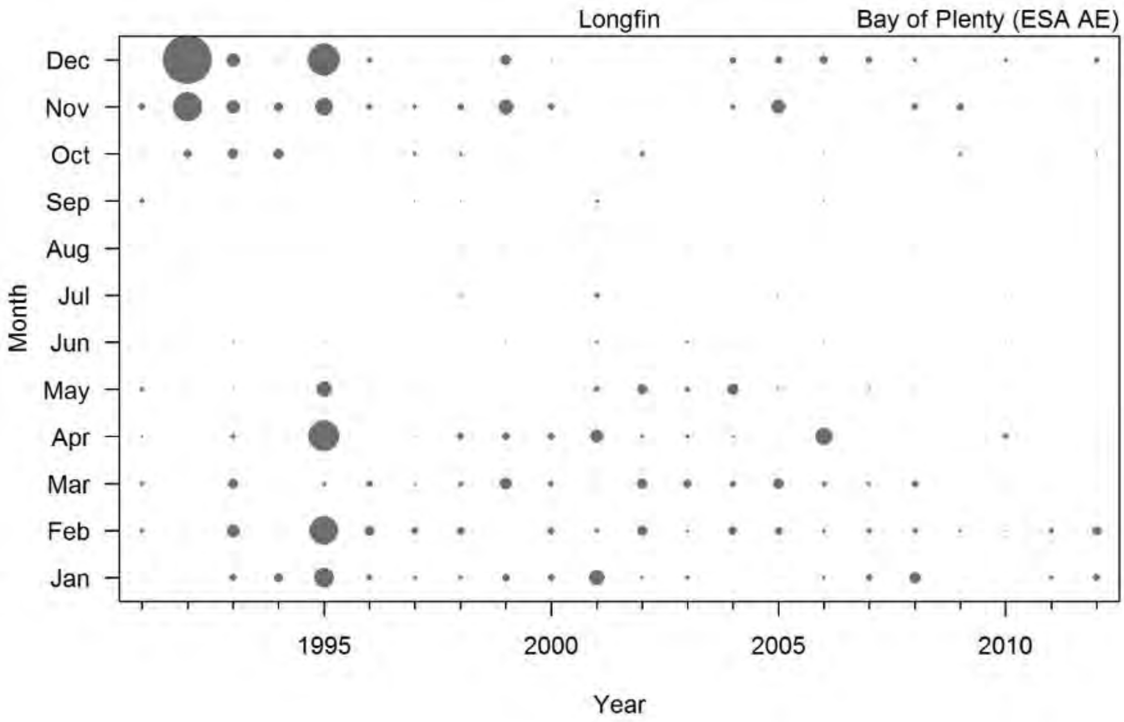


Figure E19: Longfin eel catch by month for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

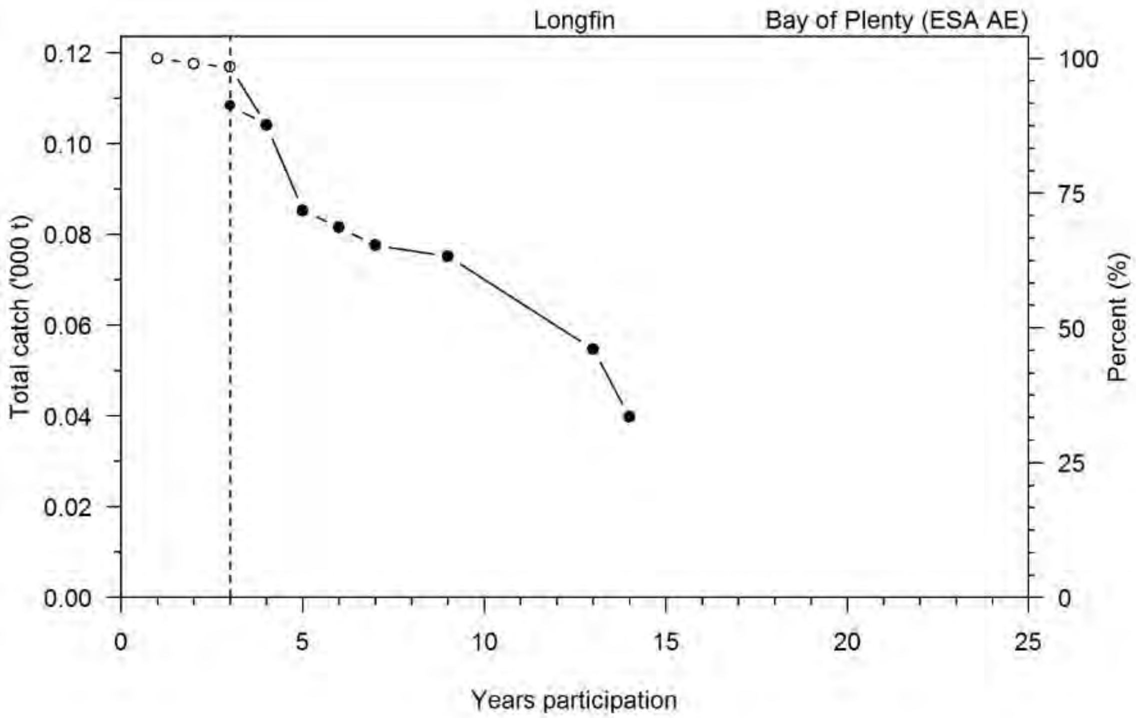


Figure E20: Relationship between years of participation in the fishery and longfin total catch. The open circles represent all longfin catch and the closed circles longfin catch data from fishers who 1) caught longfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core longfin fisher analyses for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

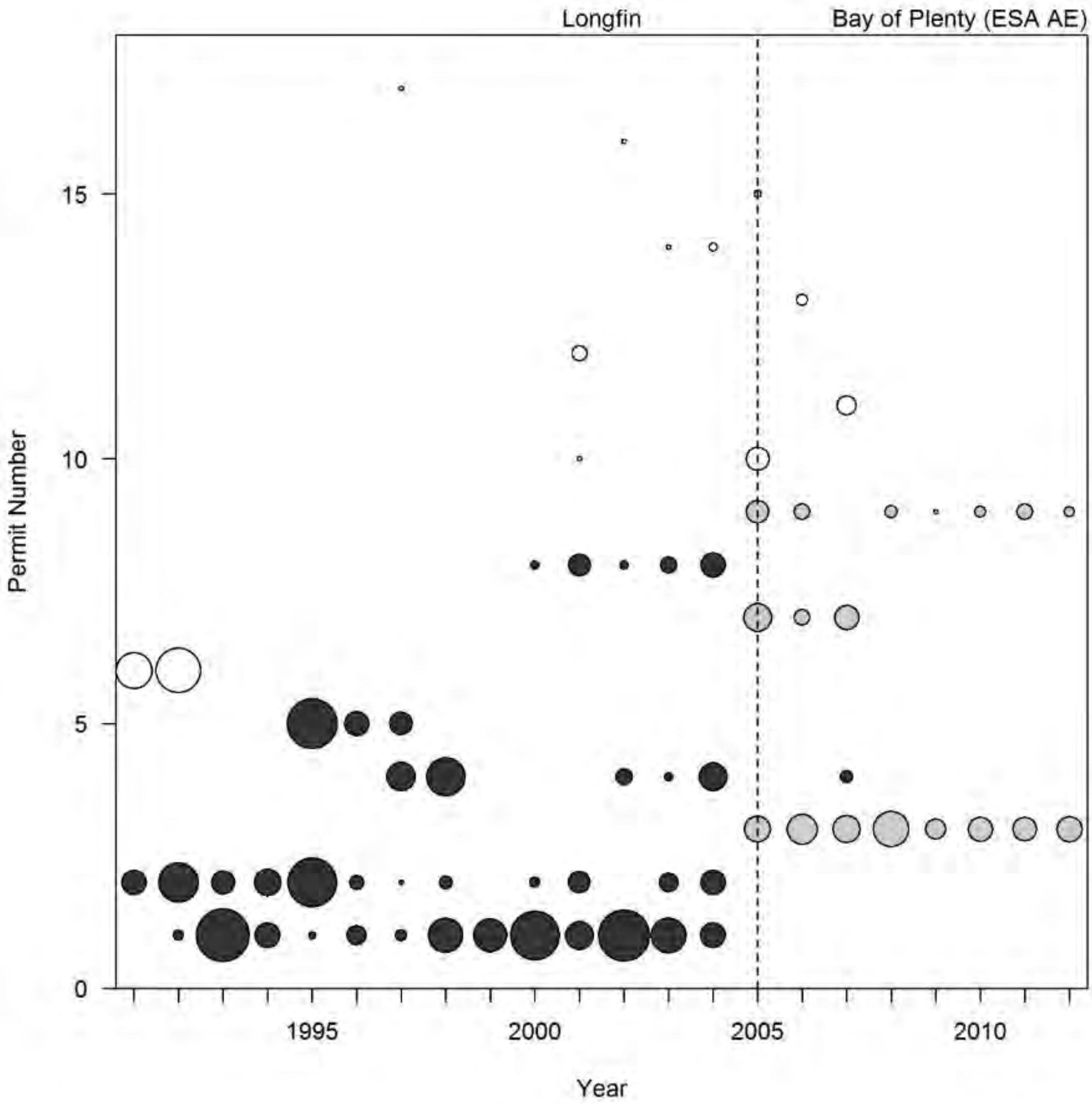


Figure E21: Relative catch of longfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Bay of Plenty (ESA AE)).

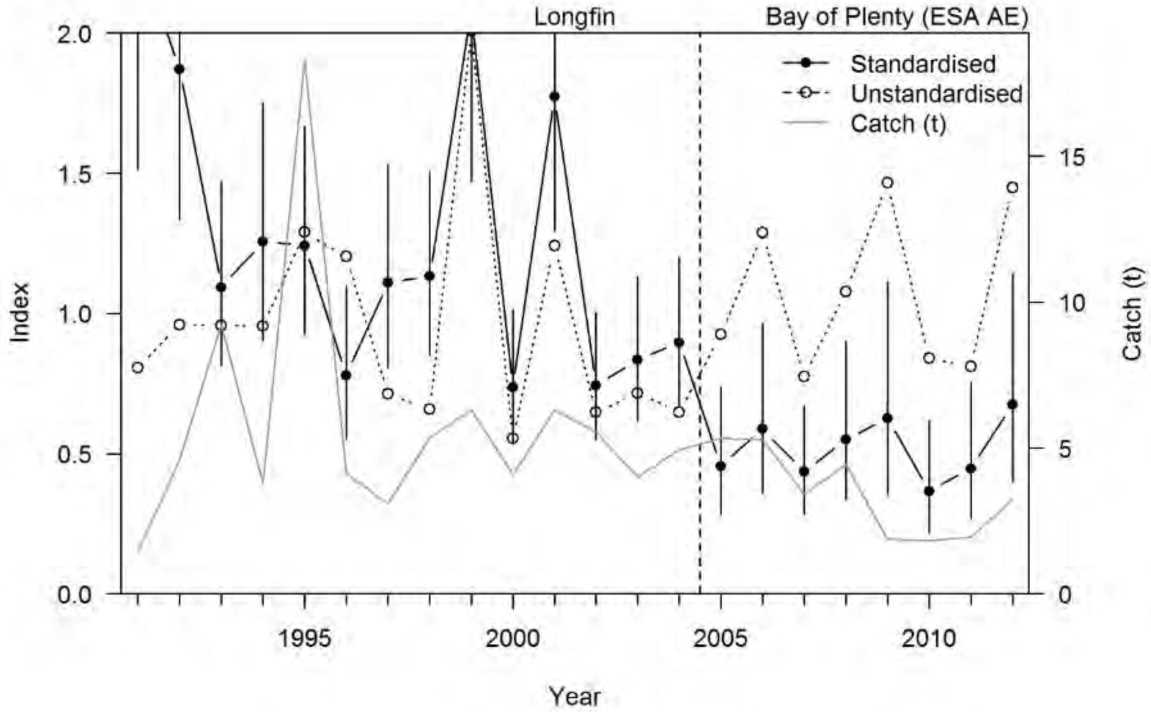


Figure E22: Indices of unstandardised catch per day and standardised CPUE for the core fishers longfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Bay of Plenty (ESA AE)).

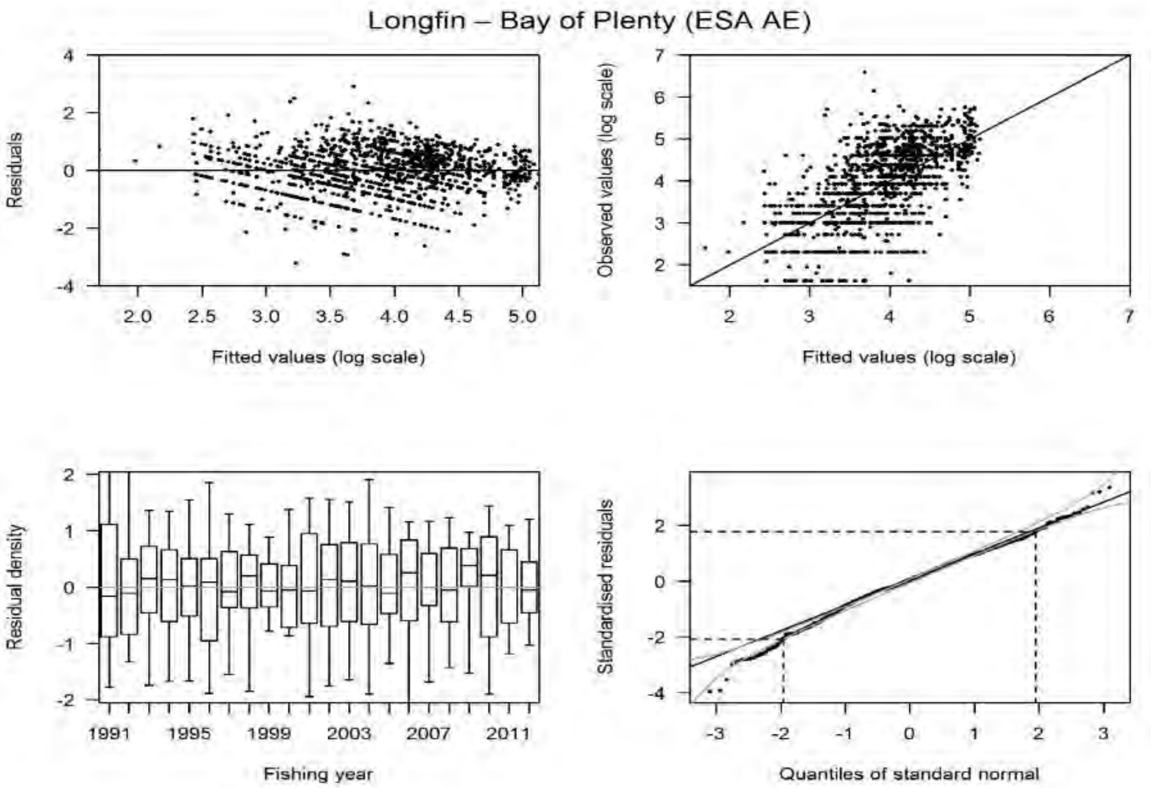


Figure E23: Residual diagnostic plots for the longfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Bay of Plenty (ESA AE)).

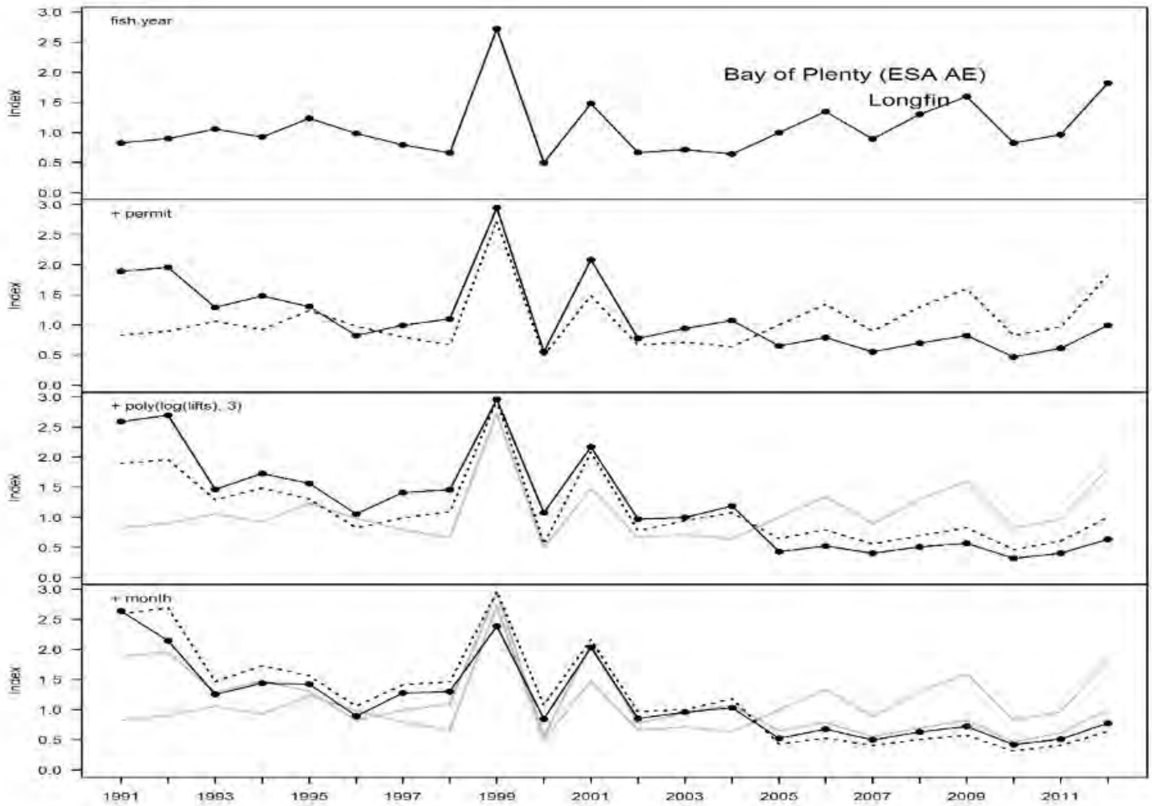


Figure E24: Step plot for the longfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Bay of Plenty (ESA AE)).

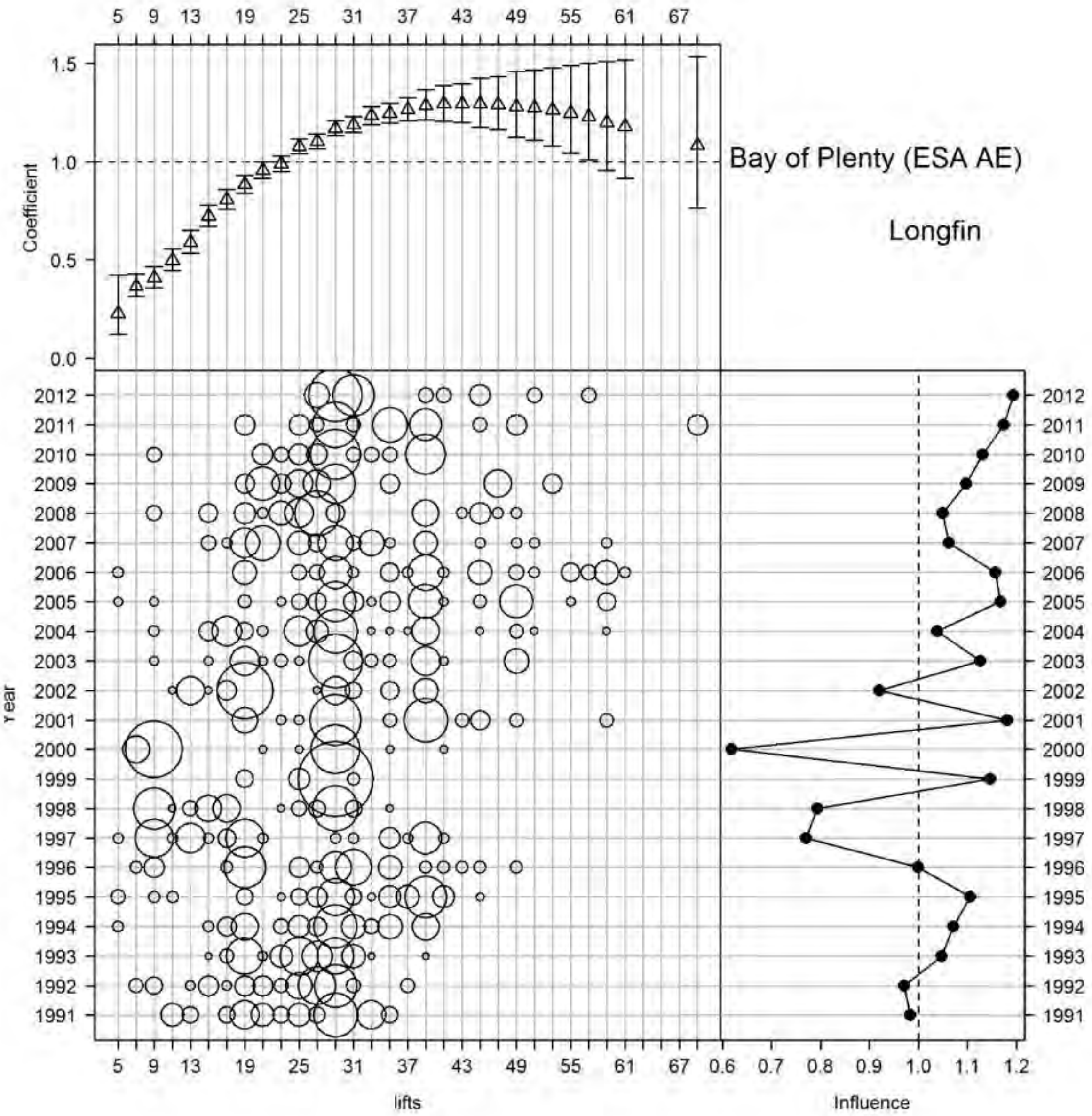


Figure E25: Influence of lifts for the longfin CPUE model for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

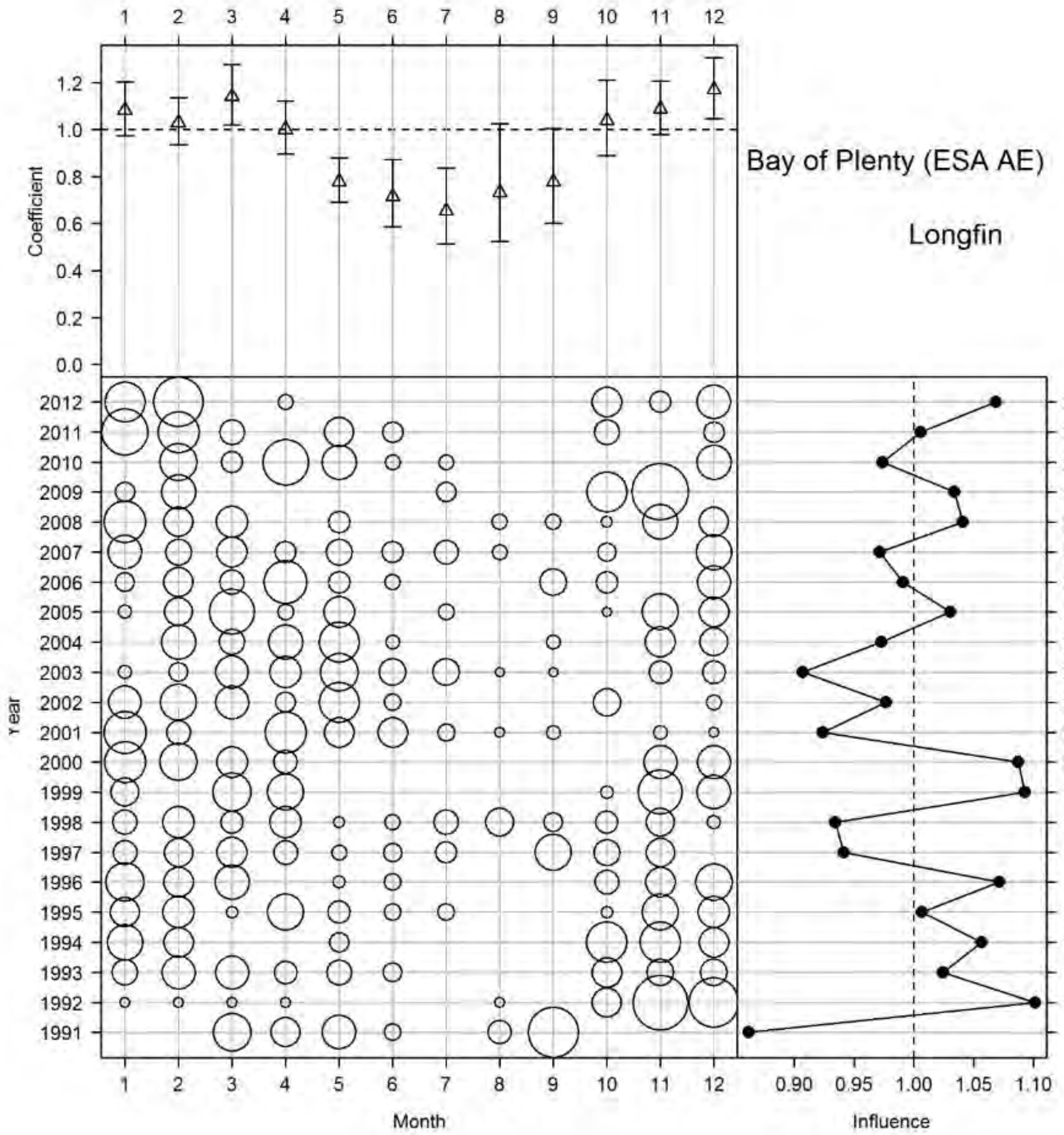


Figure E26: Influence of month for the longfin CPUE model for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

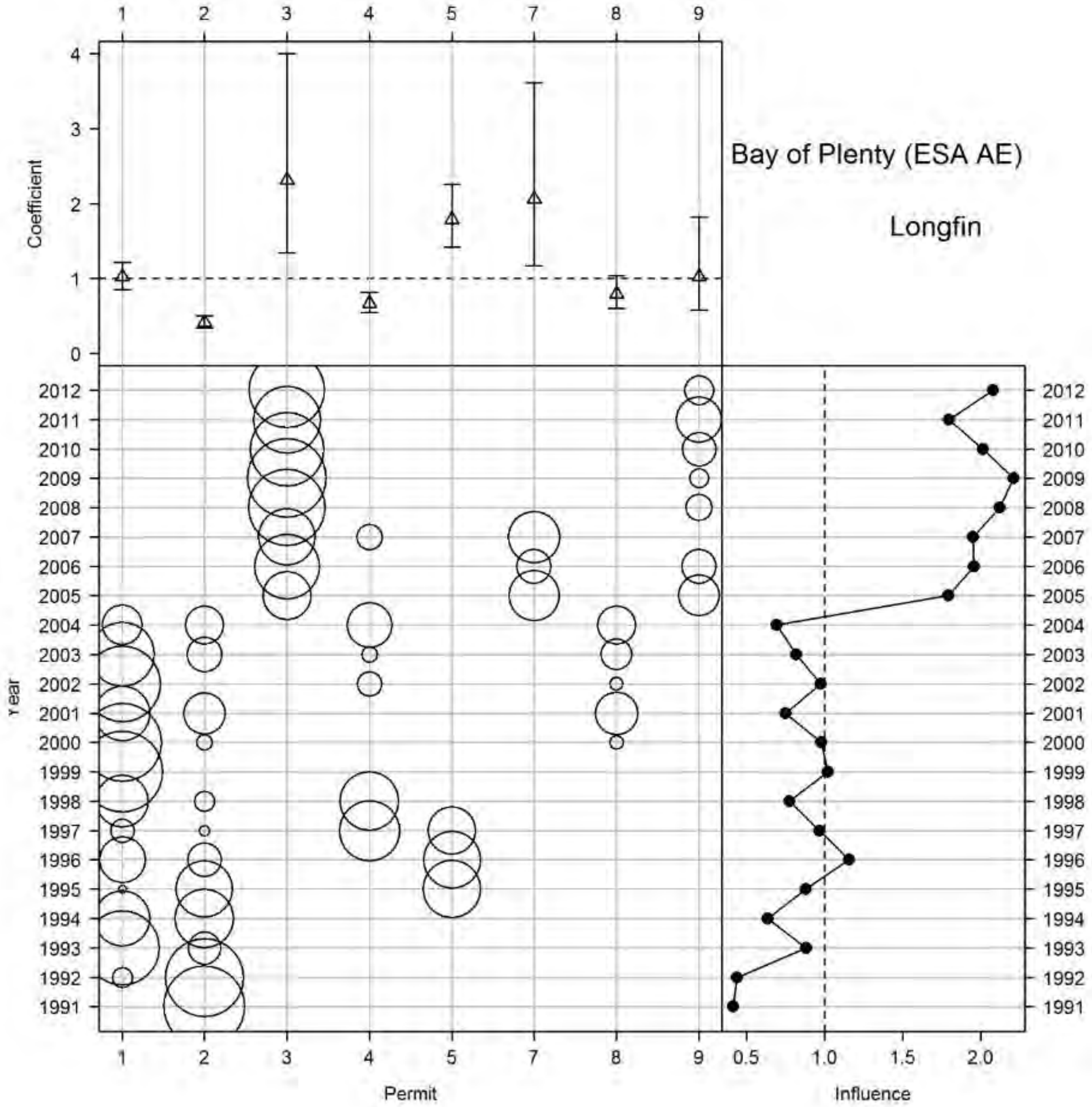


Figure E27: Influence of permit number for the longfin CPUE model for the years 1990–91 to 2011–12 (Bay of Plenty (ESA AE)).

Appendix F: Poverty Bay (ESA AF)

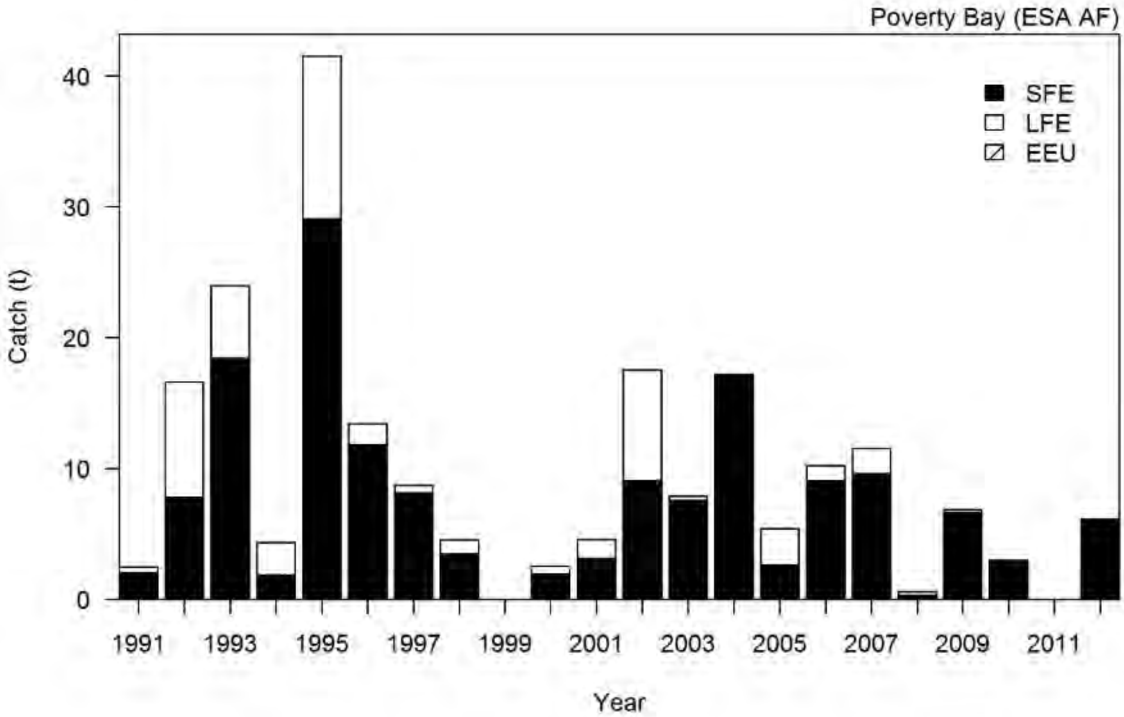


Figure F1: Total estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

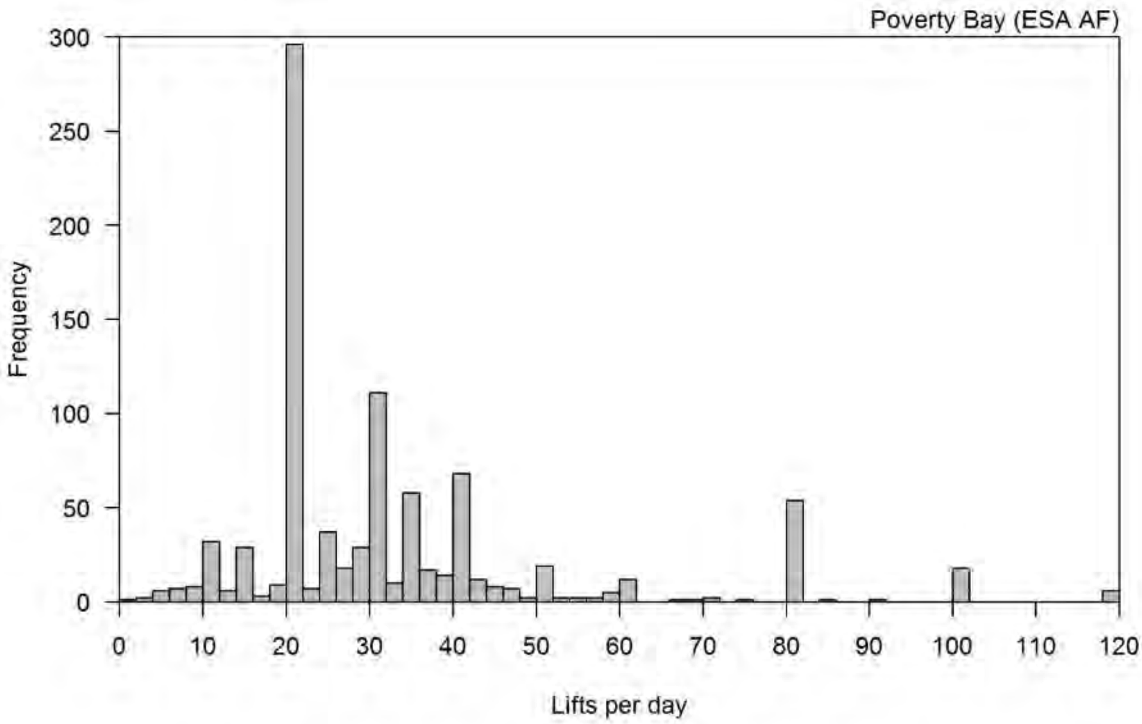


Figure F2: Frequency of total lifts per day for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

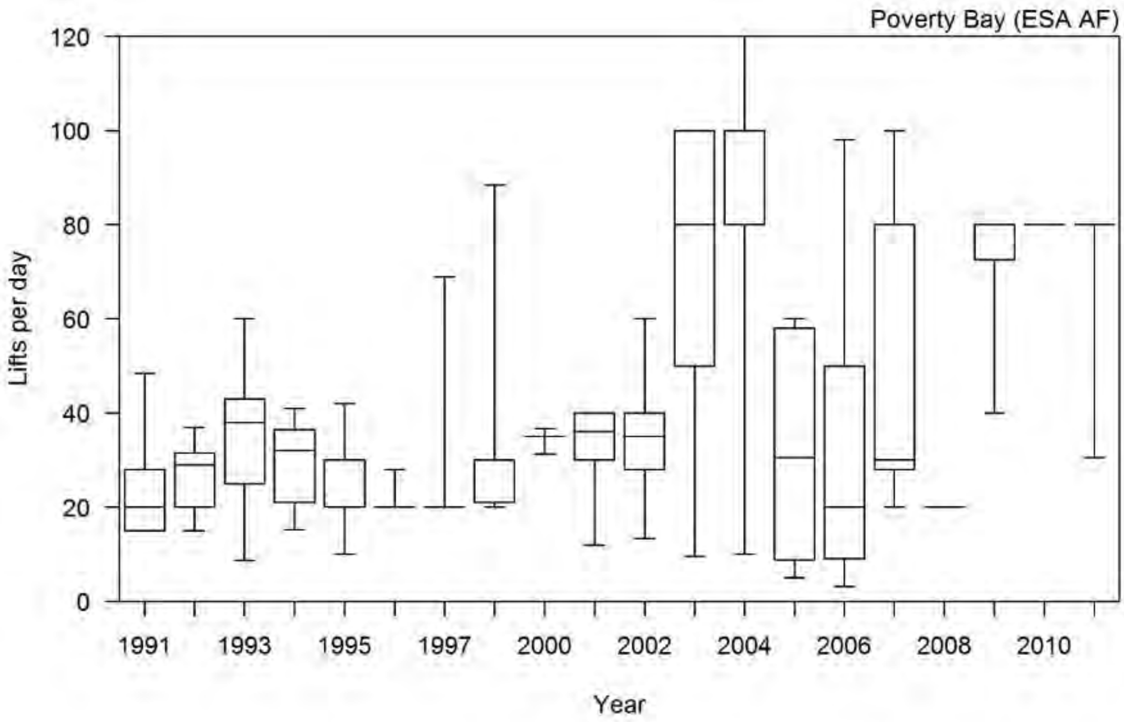


Figure F3: Total lifts per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Poverty Bay (ESA AF)).

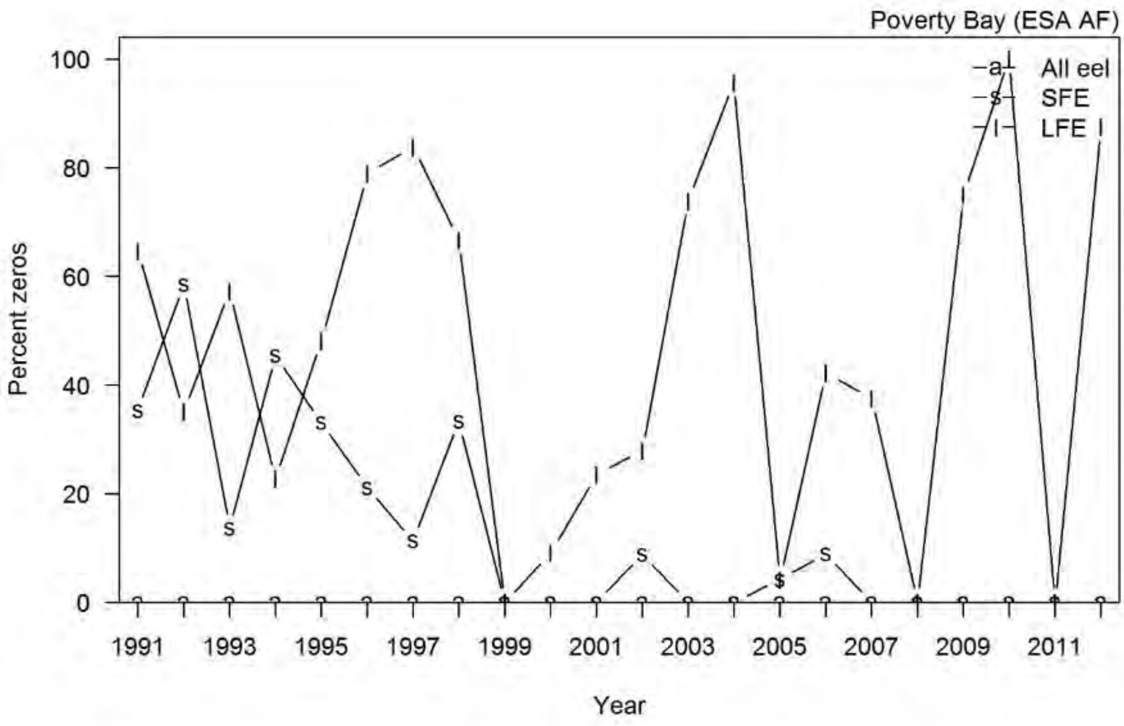


Figure F4: Proportion of zero records for all eel, shortfin (SFE), and longfin (LFE) catch for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

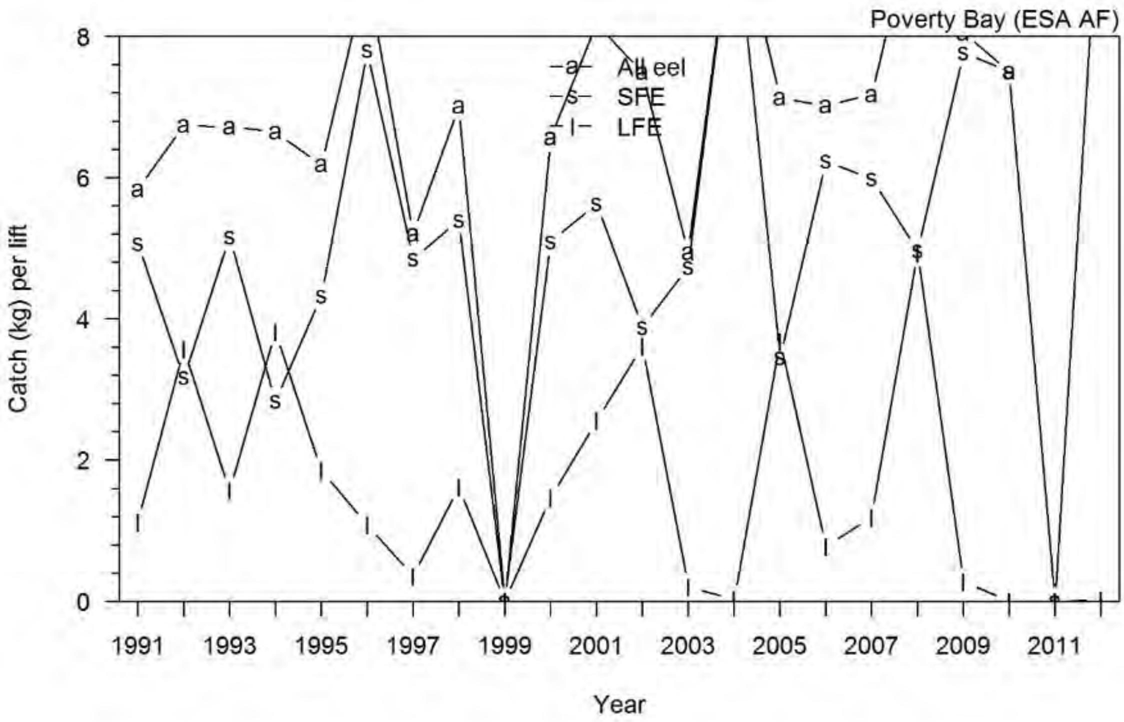


Figure F5: Unstandardised catch per lift (total kg/total lifts) for all eel, shortfin (SFE), and longfin (LFE) for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

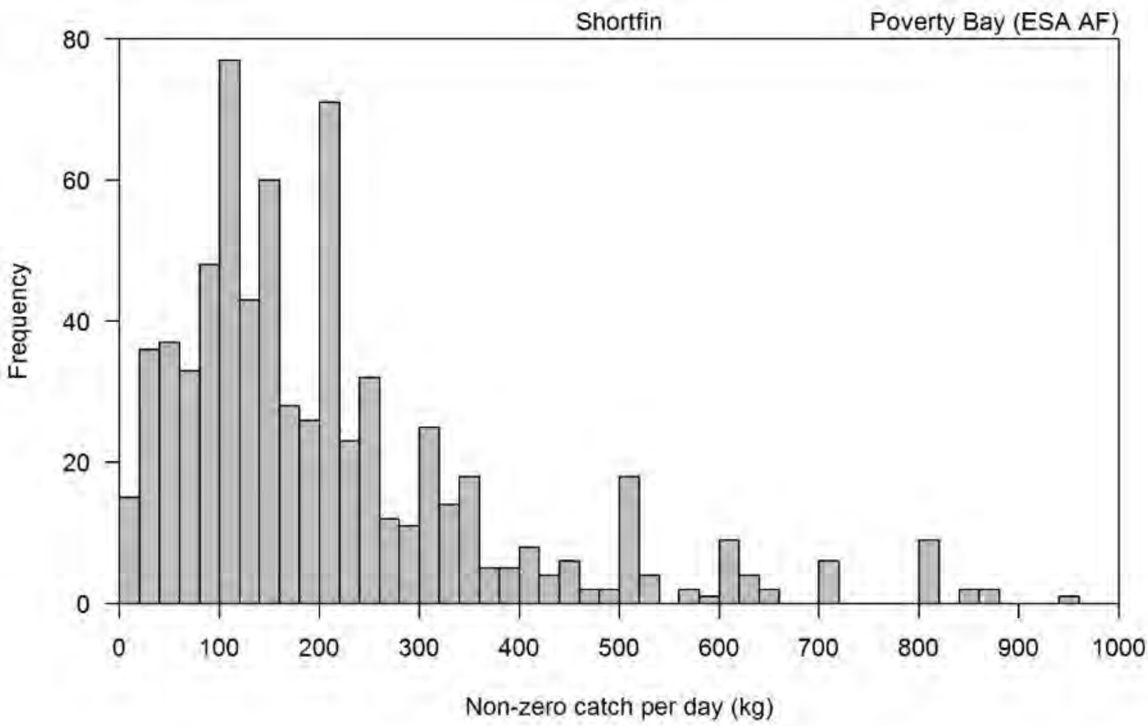


Figure F6: Frequency of shortfin eel catch per day for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

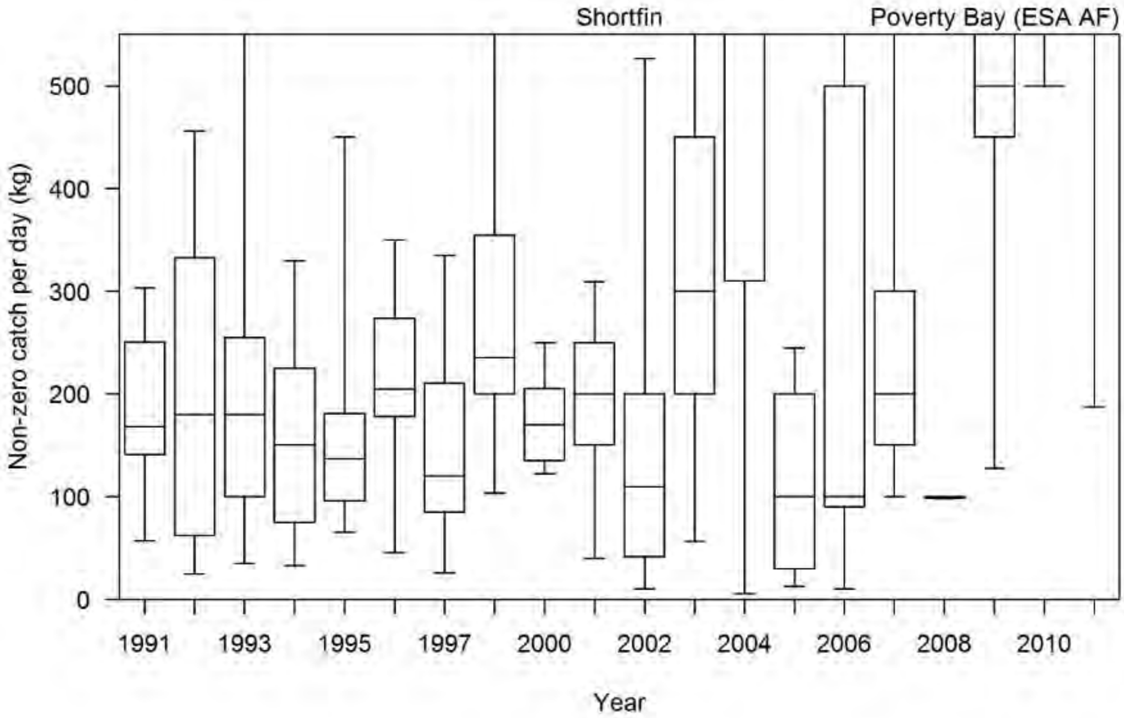


Figure F7: Shortfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Poverty Bay (ESA AF)).

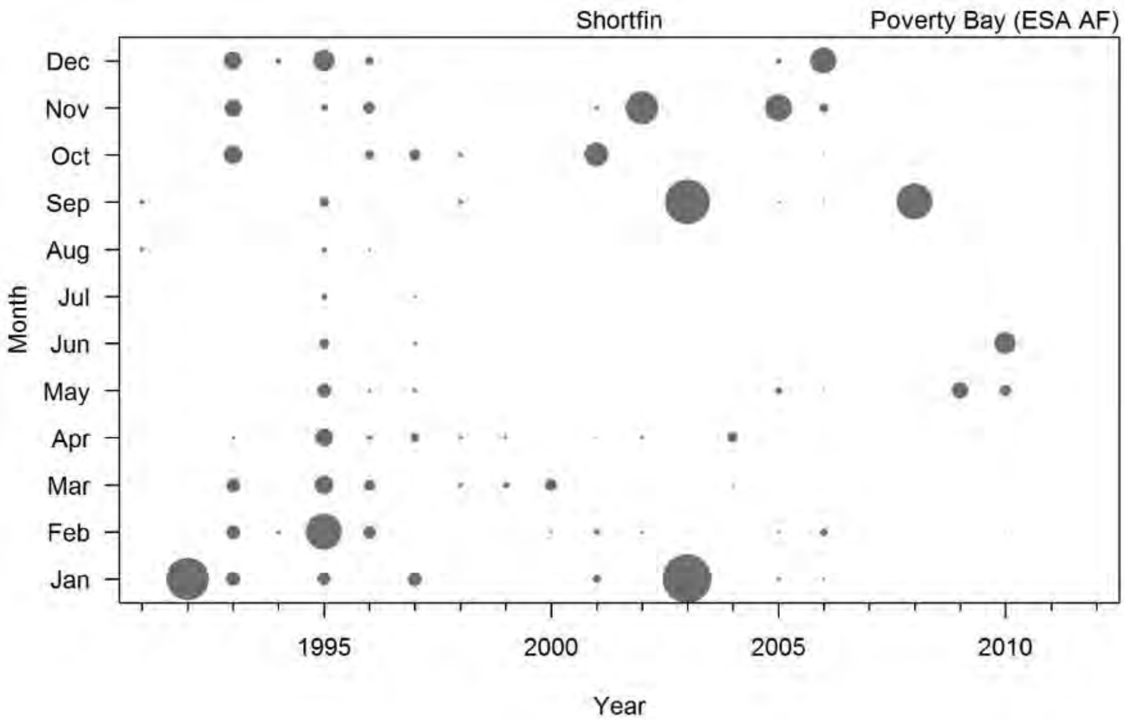


Figure F8: Shortfin eel catch by month for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

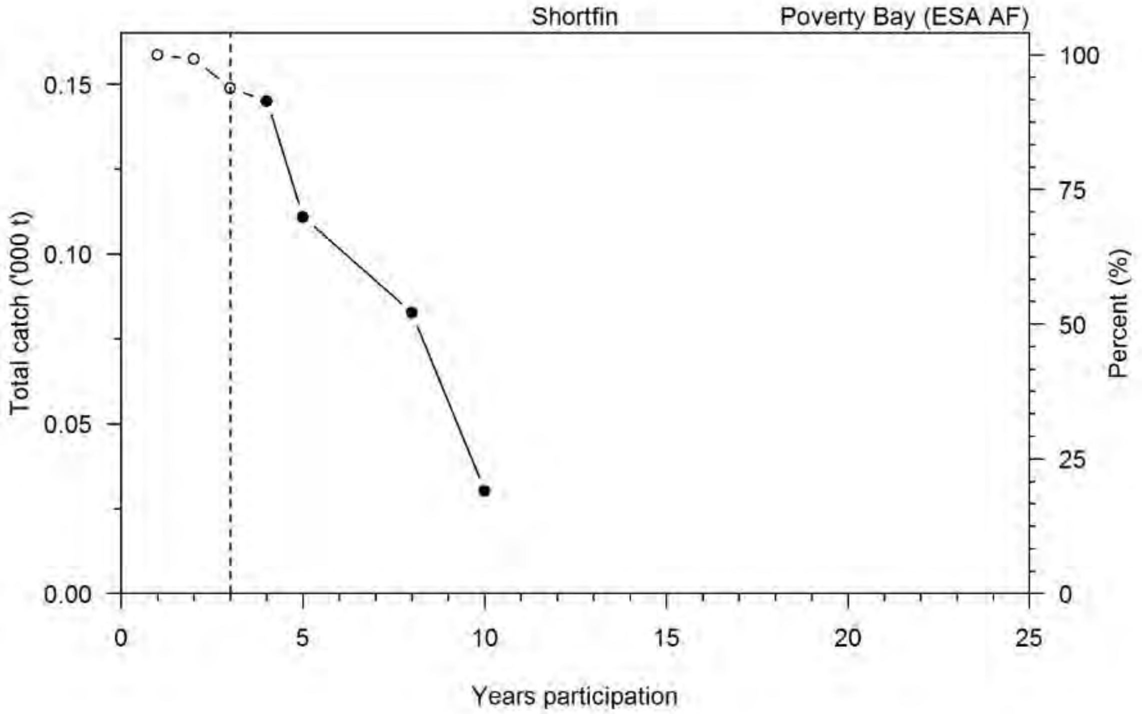


Figure F9: Relationship between years of participation in the fishery and shortfin total catch. The open circles represent all shortfin catch and the closed circles shortfin catch data from fishers who 1) caught shortfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core shortfin fisher analyses for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

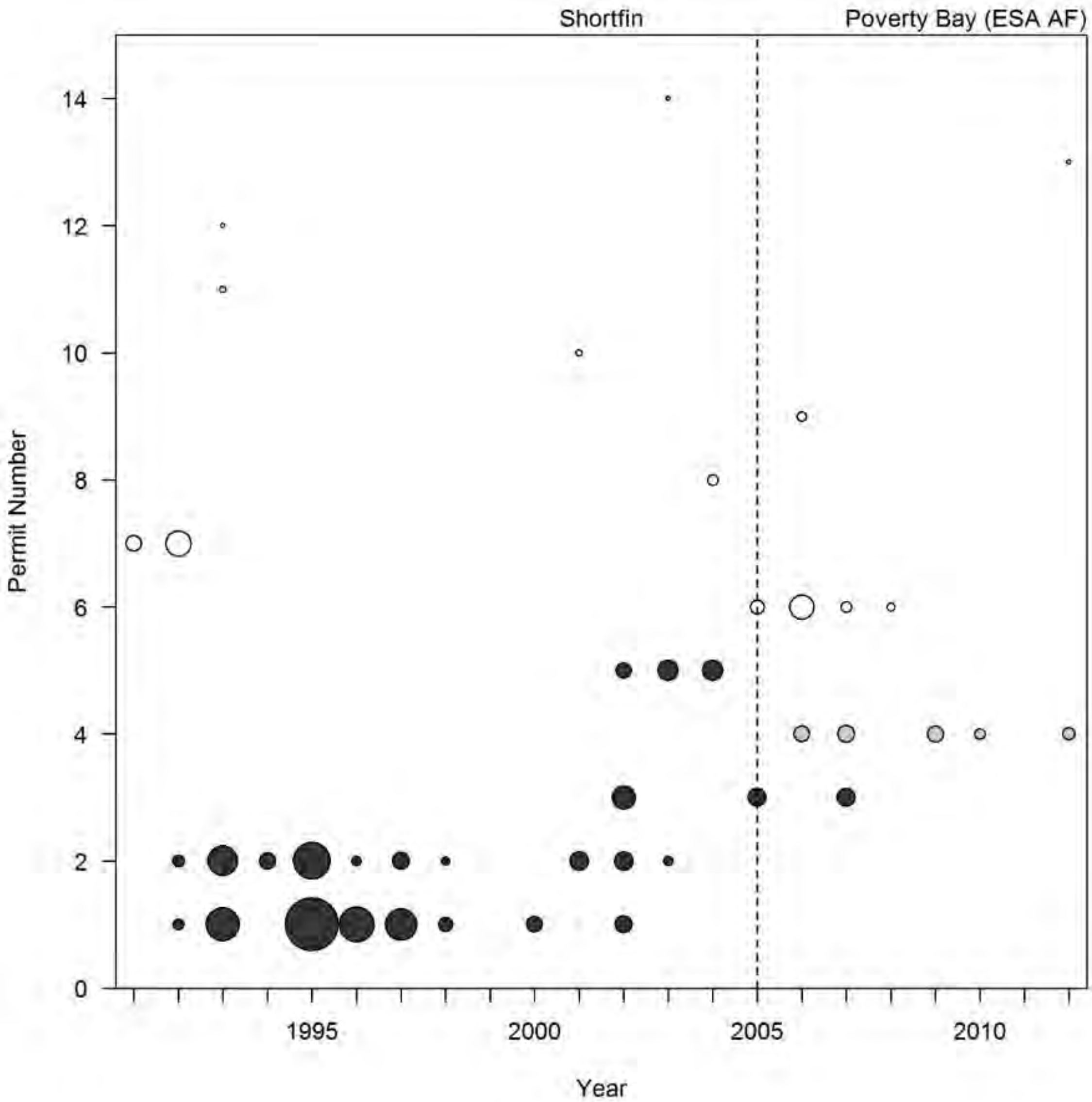


Figure F10: Relative catch of shortfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Poverty Bay (ESA AF)).

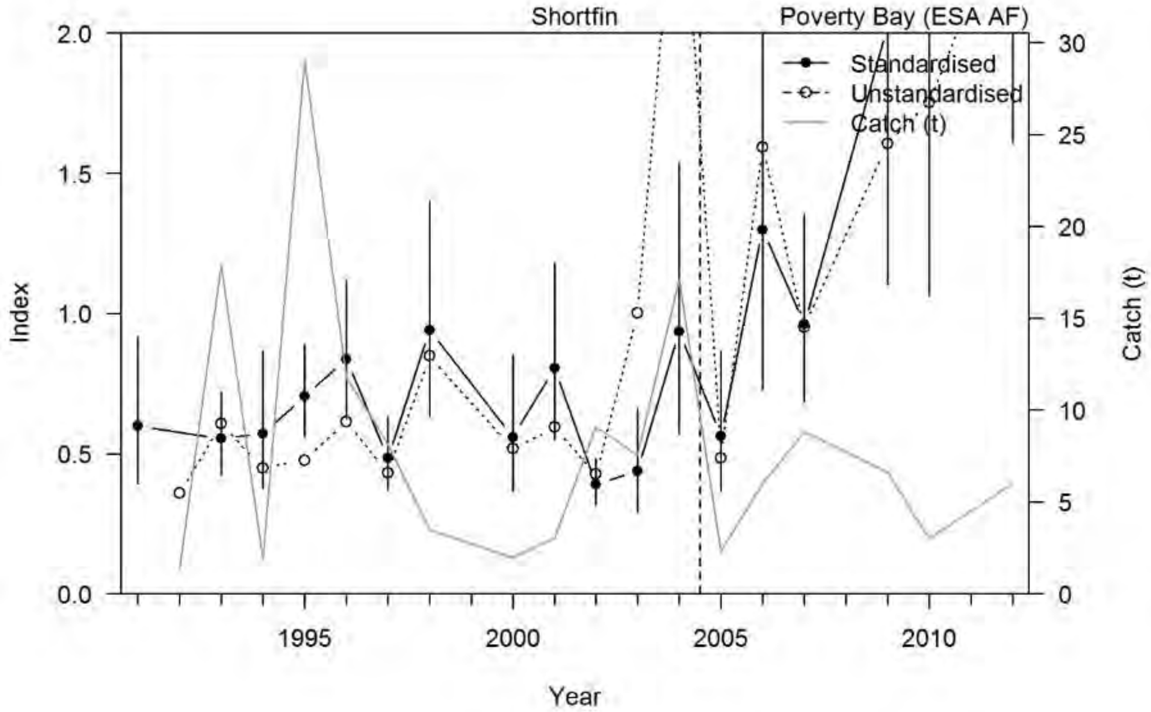


Figure F11: Indices of unstandardised catch per day and standardised CPUE for the core fishers shortfin CPUE model for the years 1990–91 to 2011–12. Catch by core fishers is also plotted (Poverty Bay (ESA AF)).

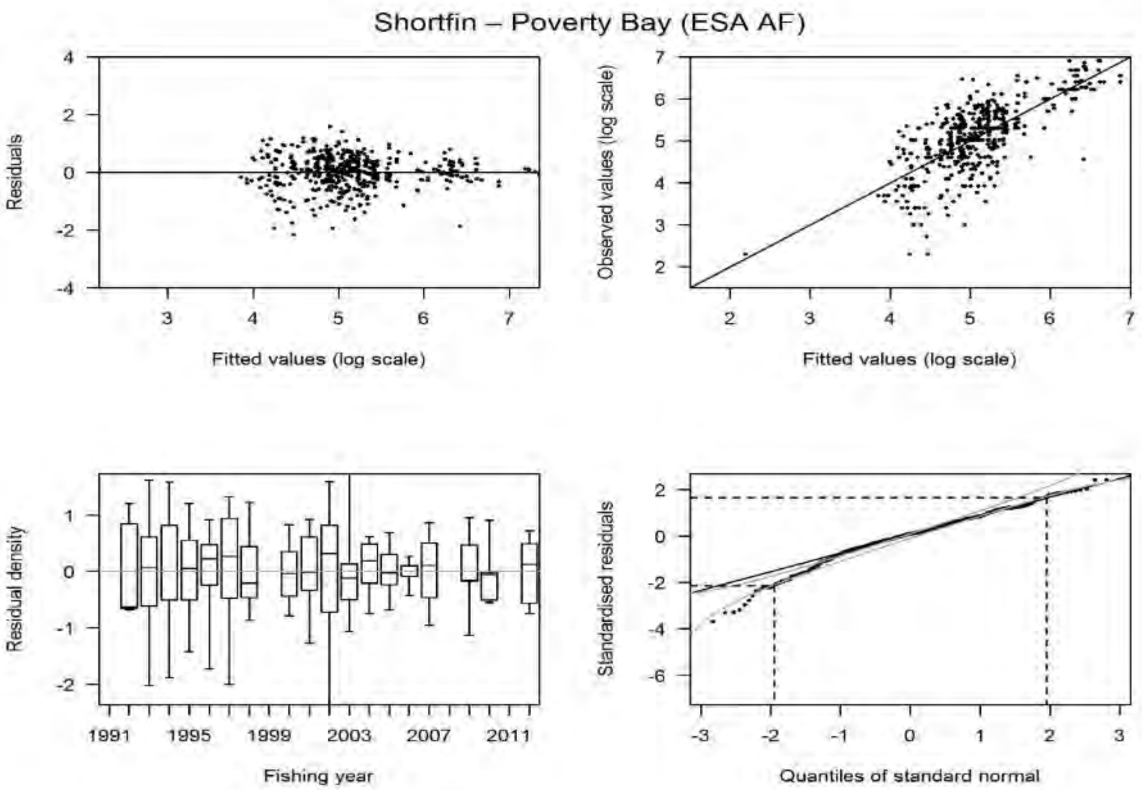


Figure F12: Residual diagnostic plots for the shortfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Poverty Bay (ESA AF)).

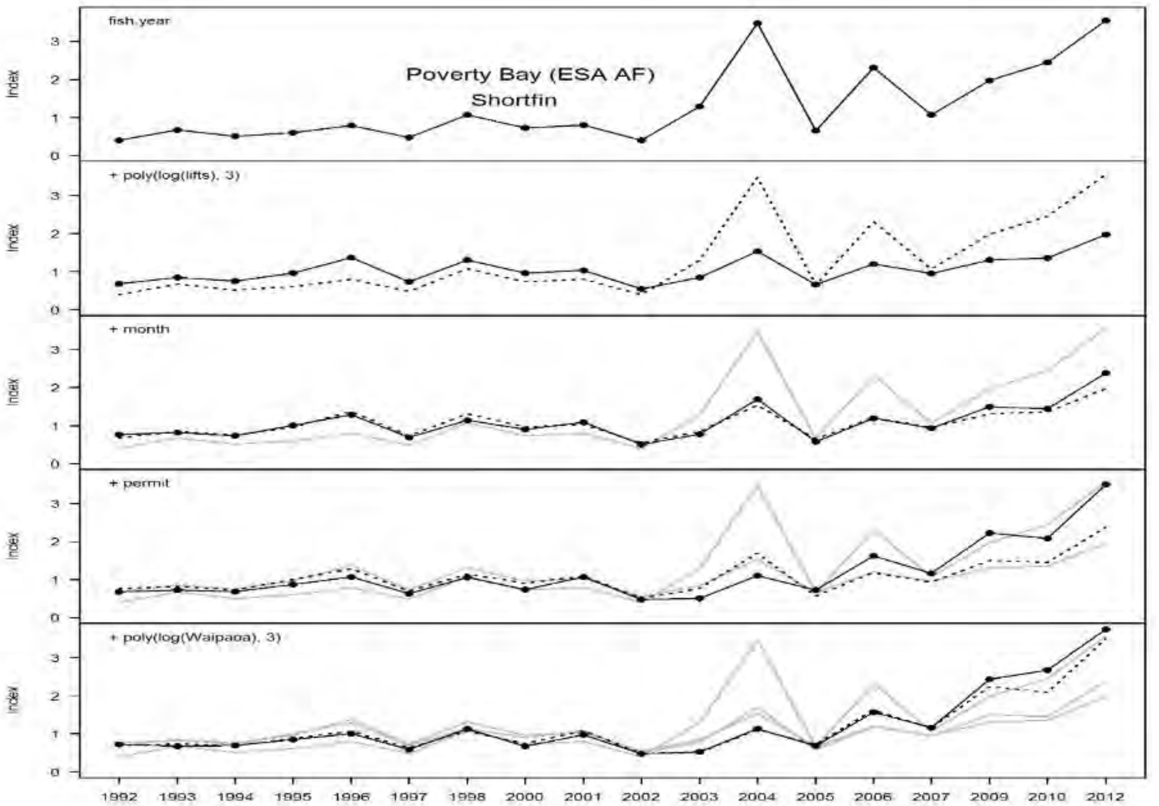


Figure F13: Step plot for the shortfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Poverty Bay (ESA AF)).

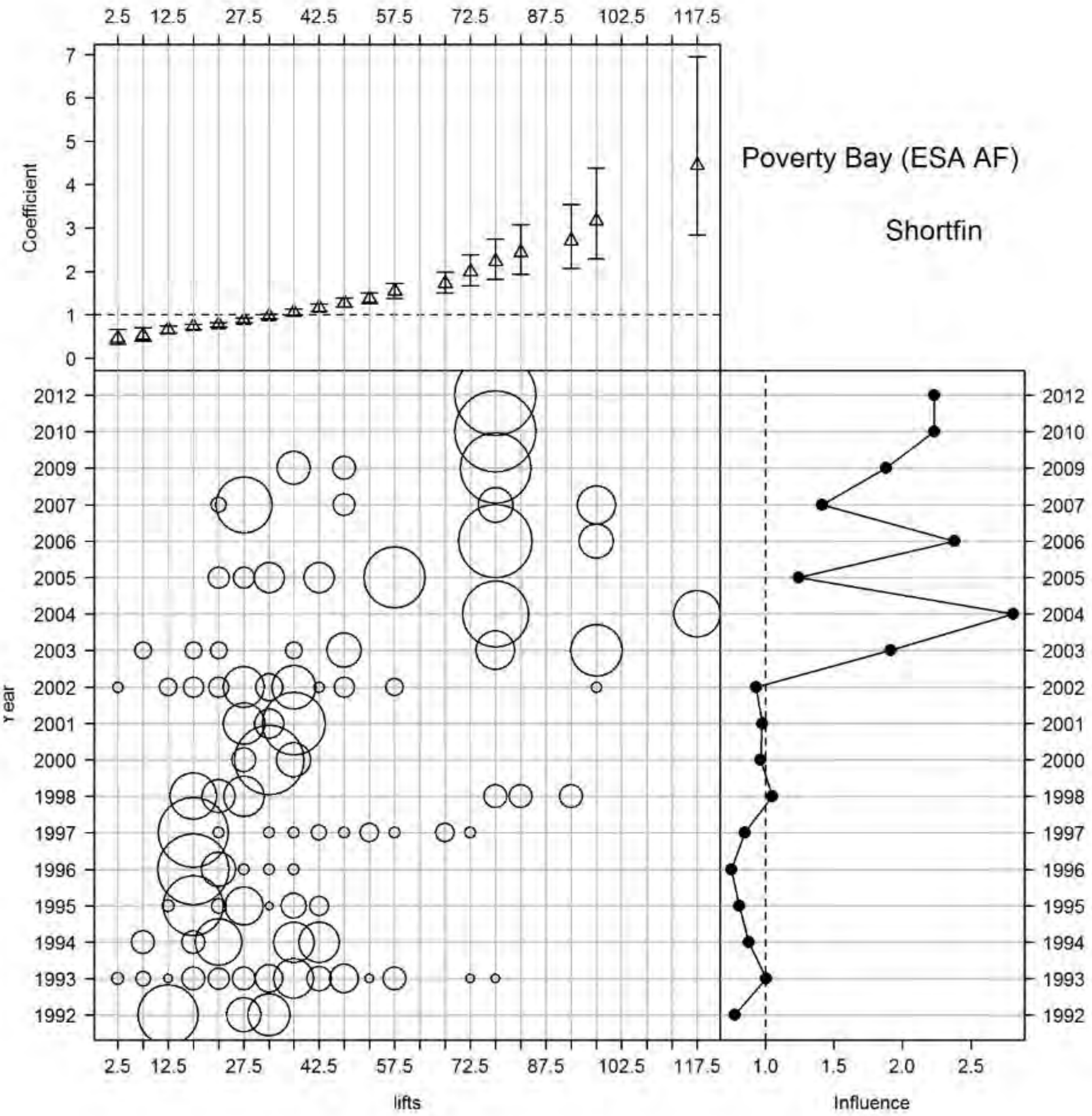


Figure F14: Influence of lifts for the shortfin CPUE model for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

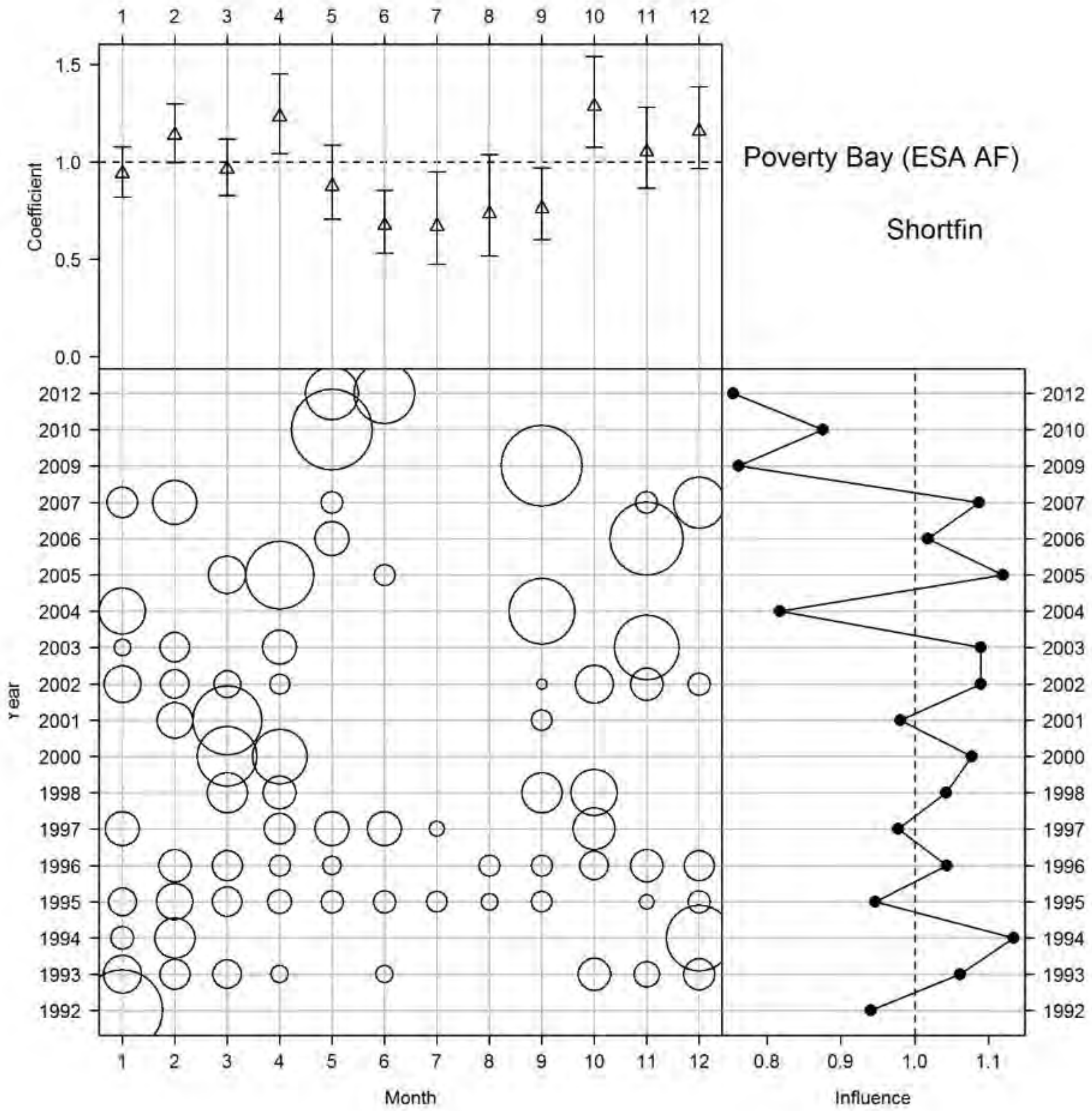


Figure F15: Influence of month for the shortfin CPUE model for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

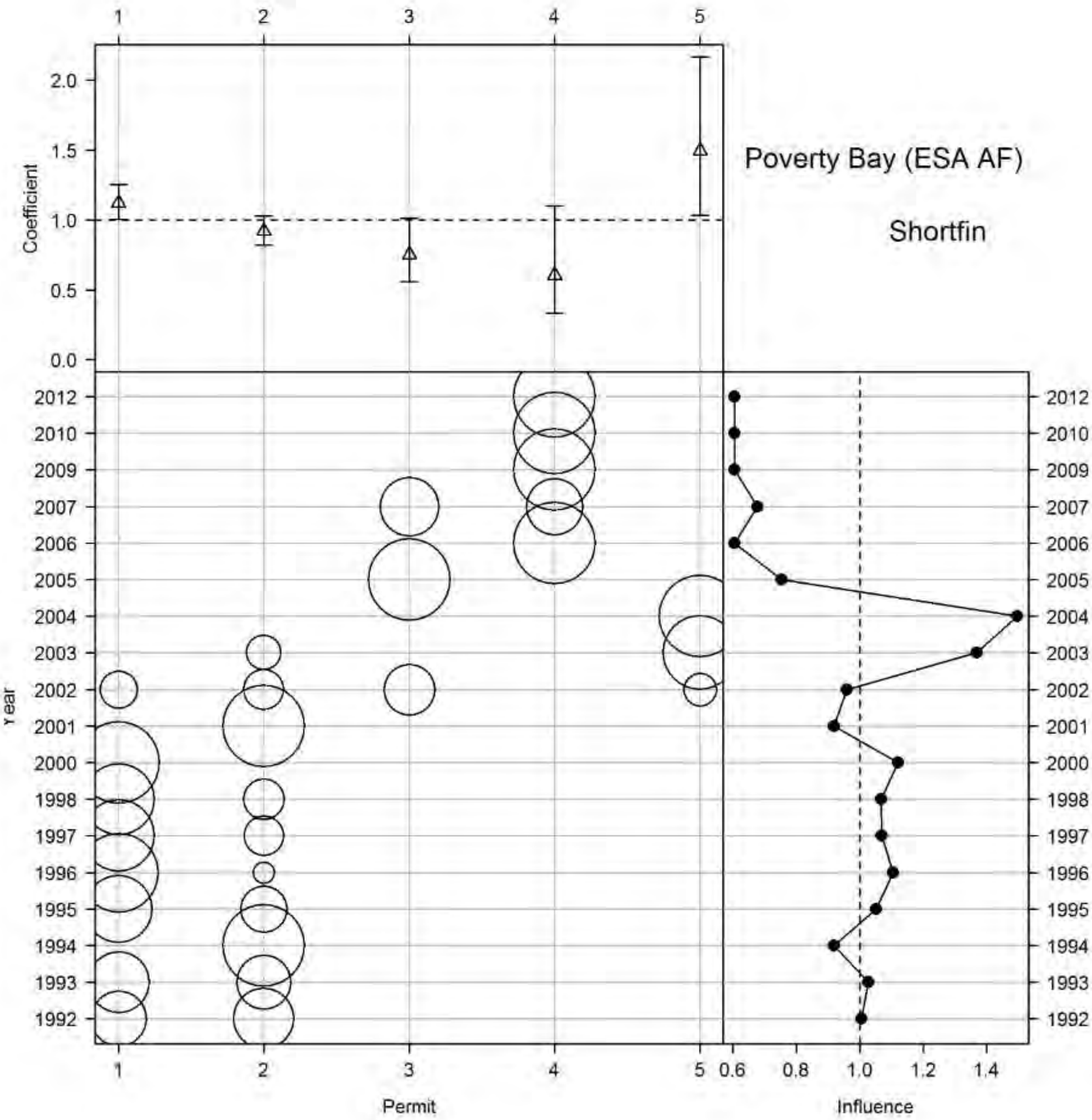


Figure F16: Influence of permit number for the shortfin CPUE model for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

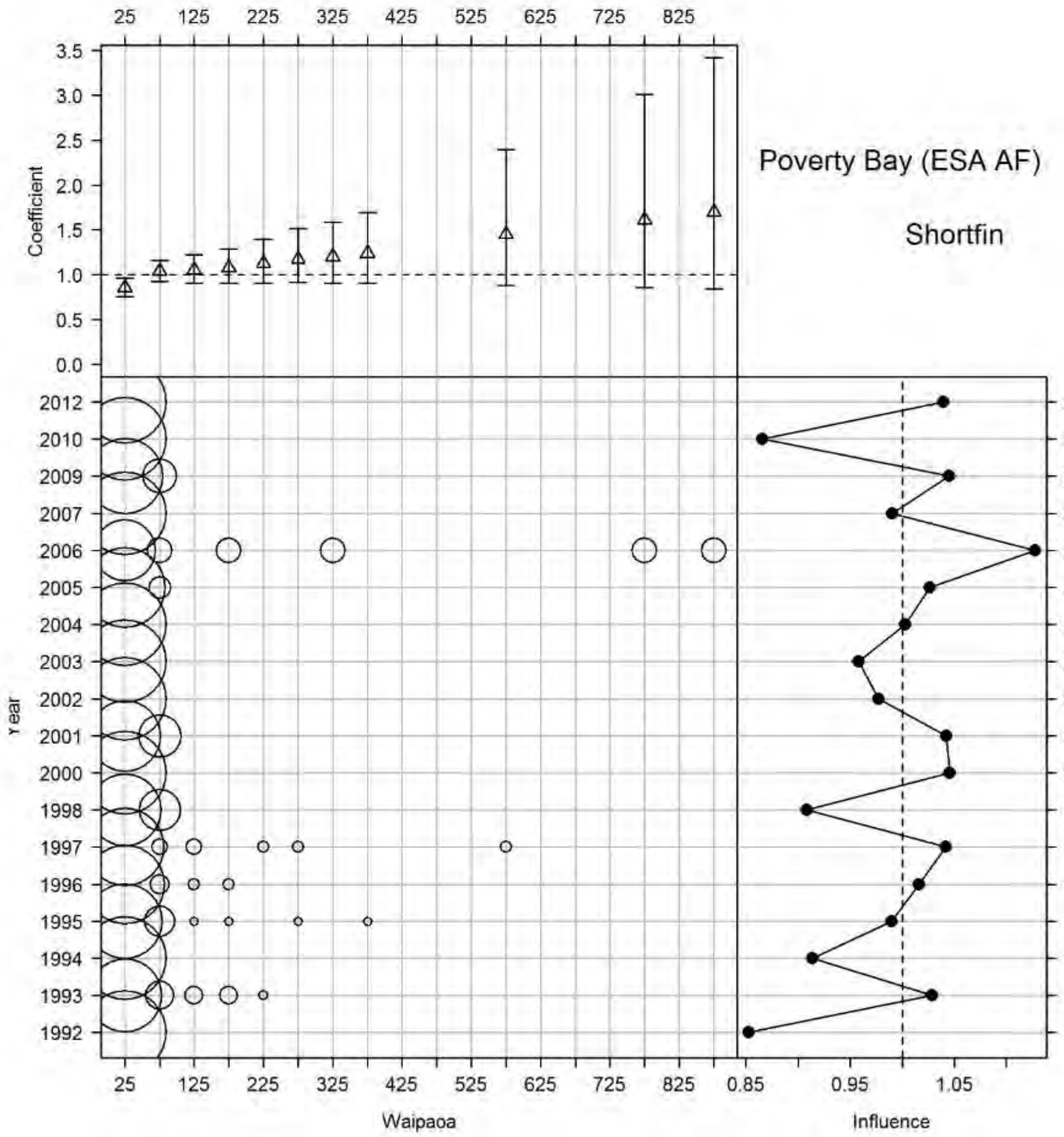


Figure F17: Influence of Waipaoa River flow for the shortfin CPUE model for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

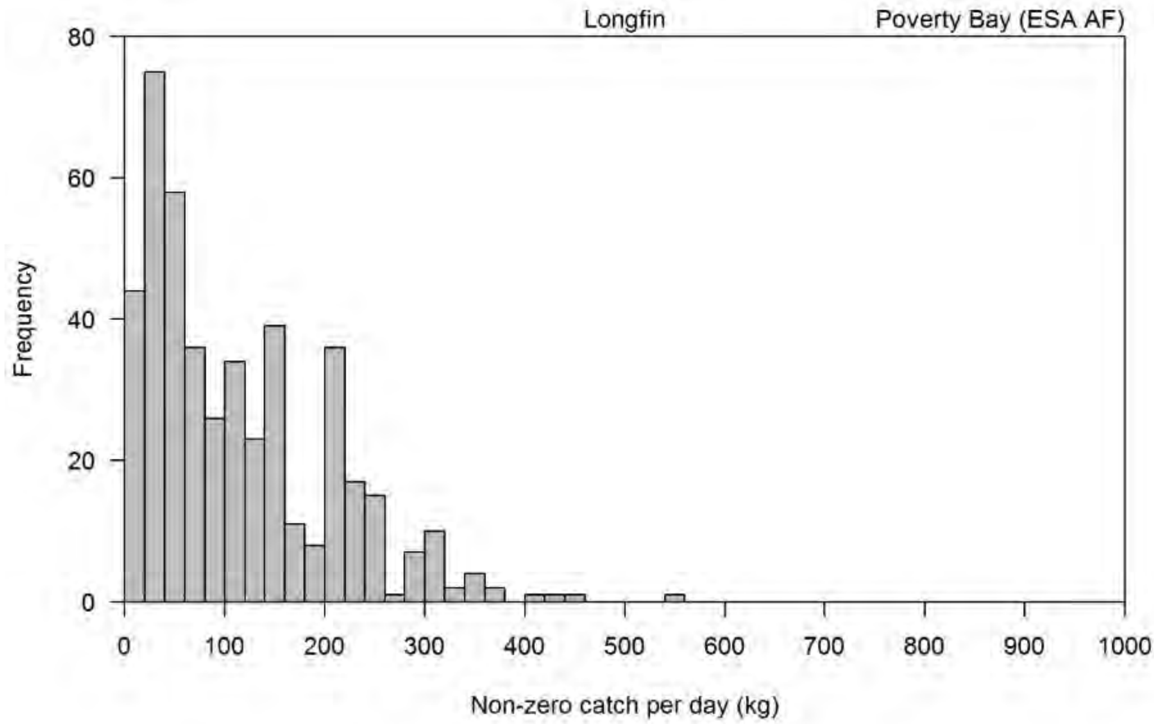


Figure F18: Frequency of longfin eel catch per day for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

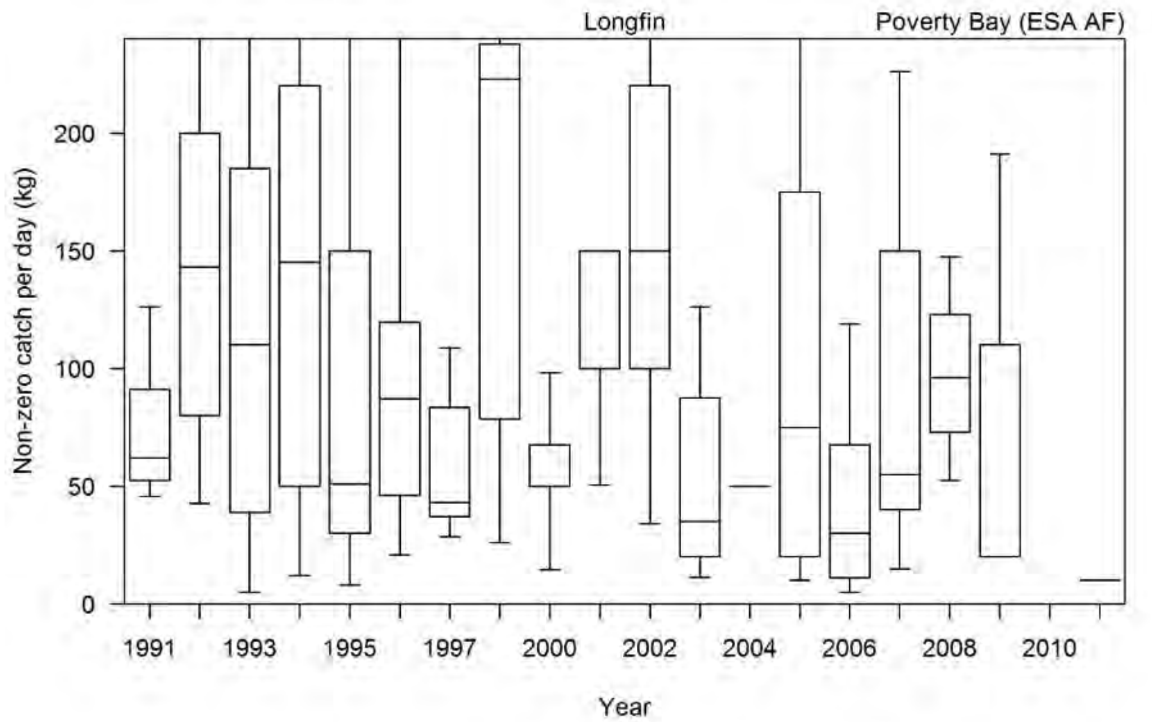


Figure F19: Longfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Poverty Bay (ESA AF)).

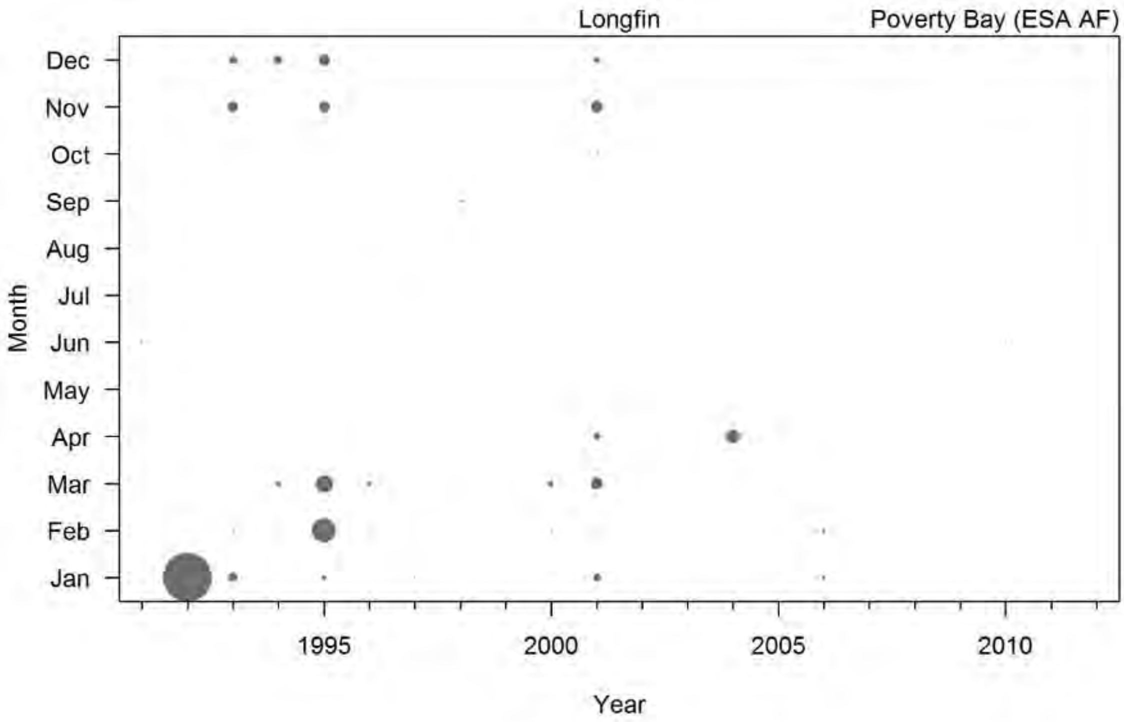


Figure F20: Longfin eel catch by month for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

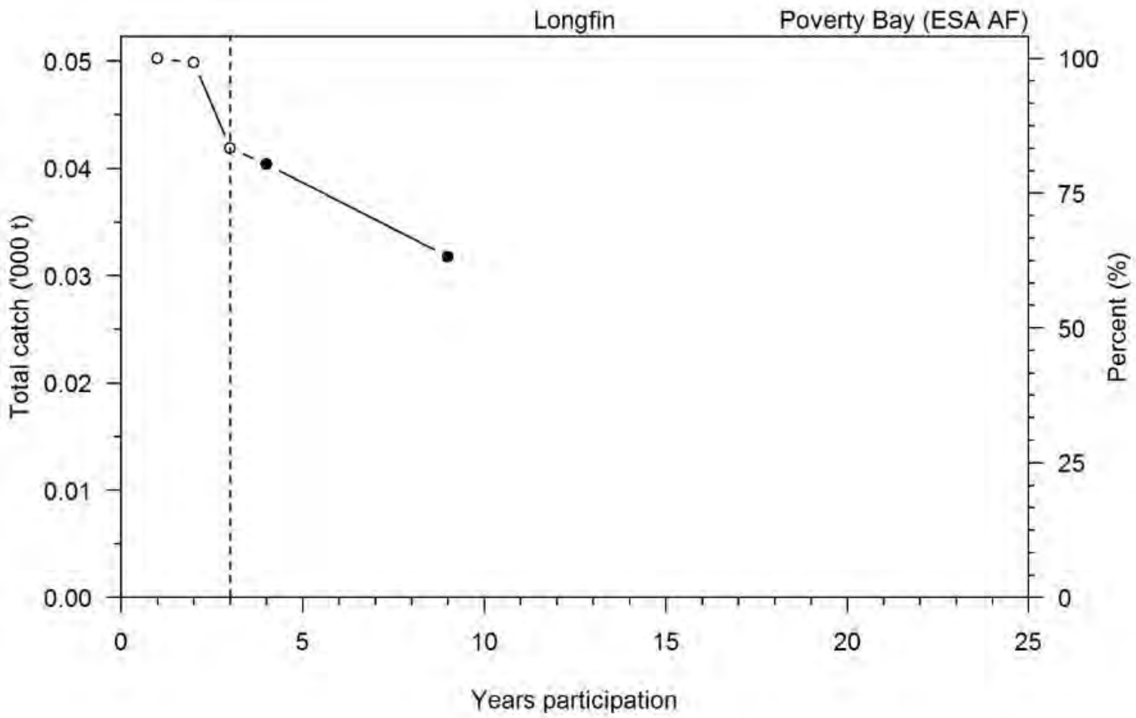


Figure F21: Relationship between years of participation in the fishery and longfin total catch. The open circles represent all longfin catch and the closed circles longfin catch data from fishers who 1) caught longfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core longfin fisher analyses for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

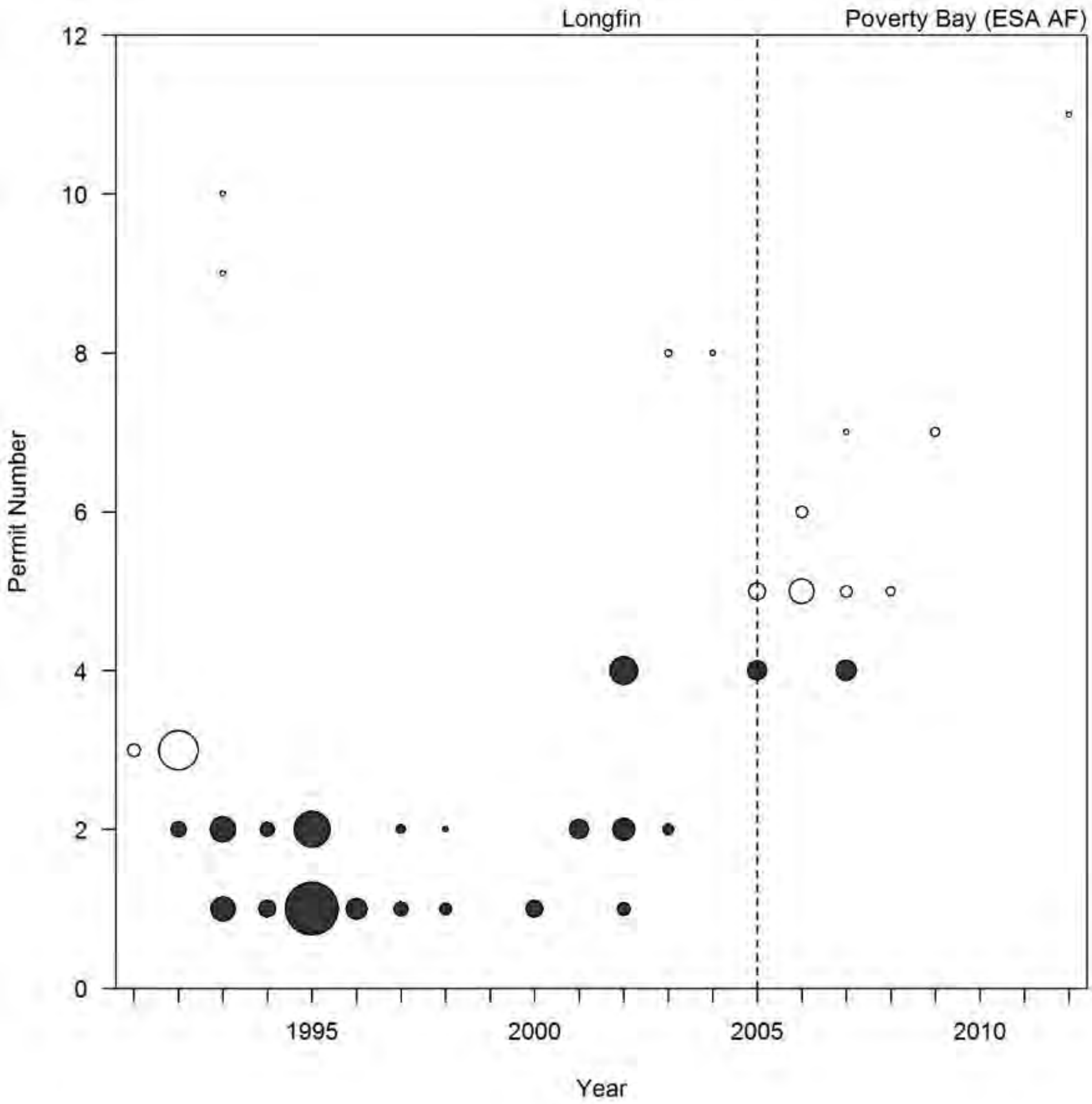


Figure F22: Relative catch of longfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Poverty Bay (ESA AF)).

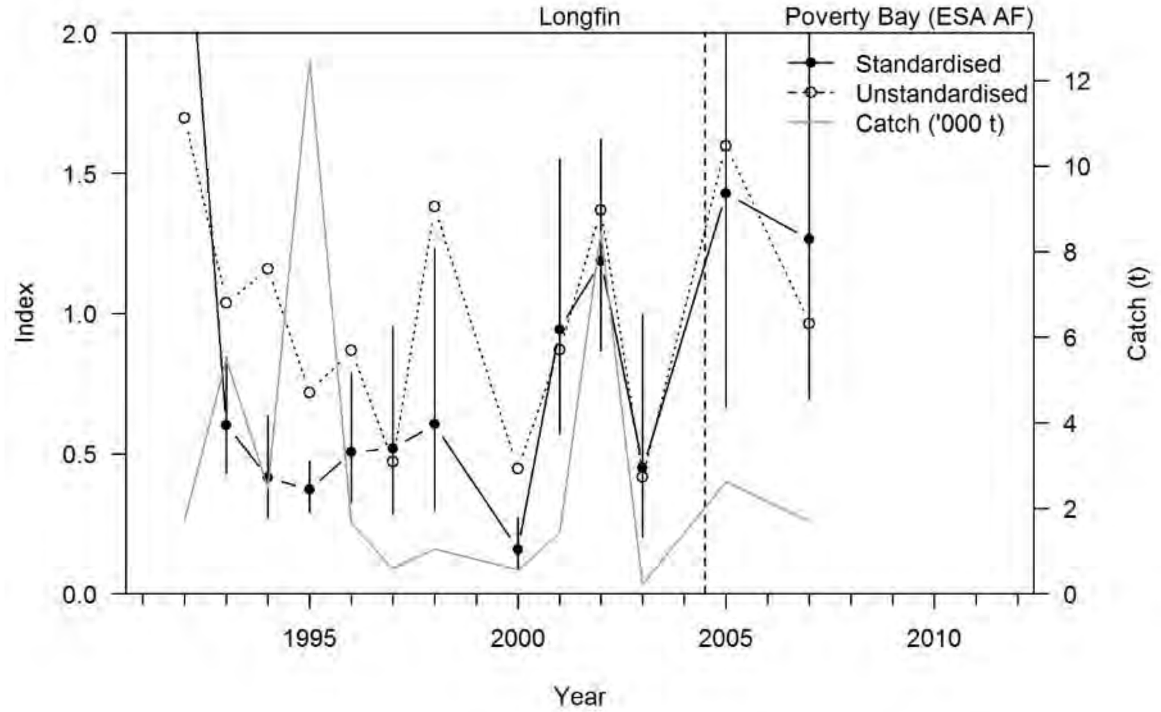


Figure F23: Indices of unstandardised catch per day and standardised CPUE for the core fishers longfin CPUE model for the years 1990–91 to 2011–12. Catch by core fishers is also plotted (Poverty Bay (ESA AF)).

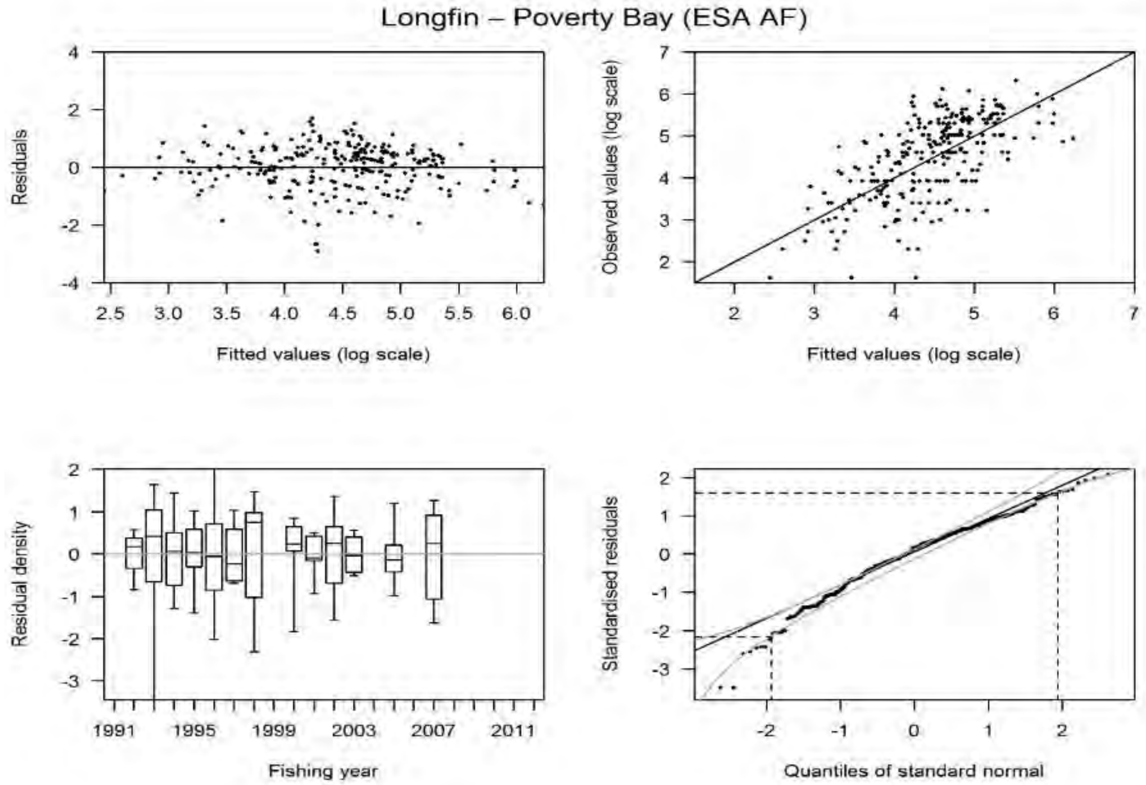


Figure F24: Residual diagnostic plots for the longfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Poverty Bay (ESA AF)).

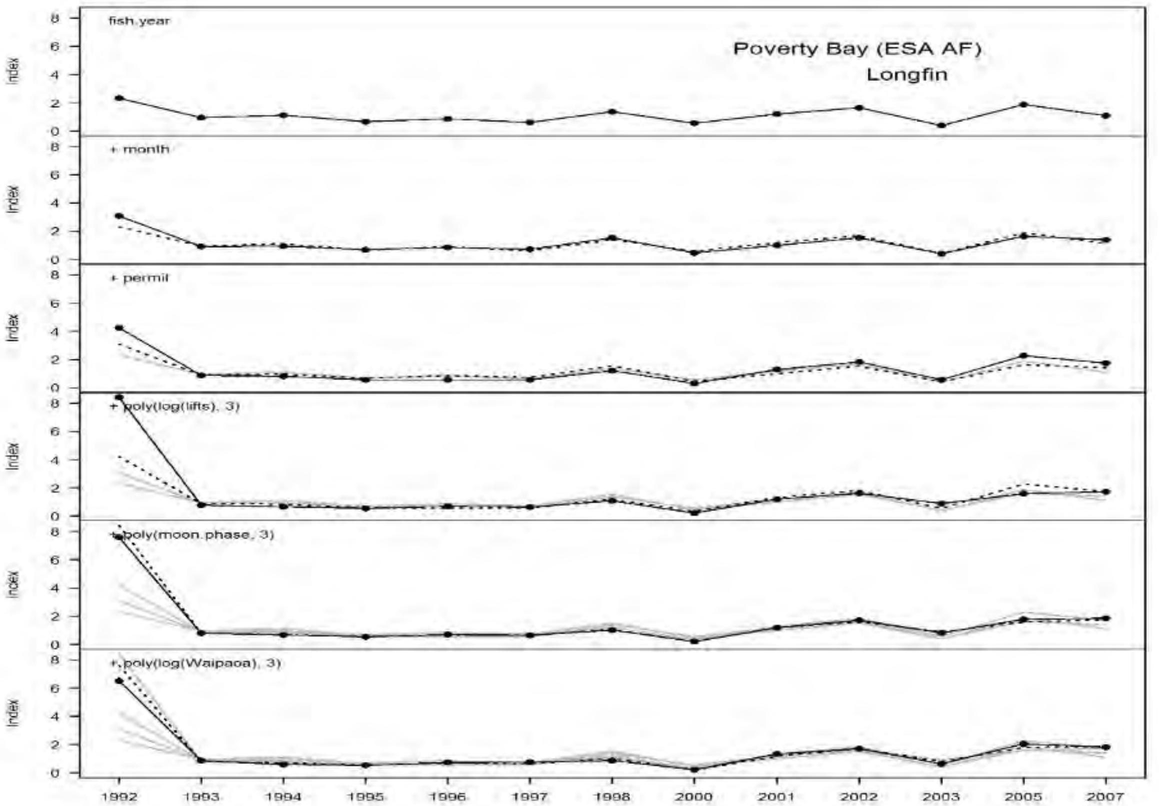


Figure F25: Step plot for the longfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Poverty Bay (ESA AF)).

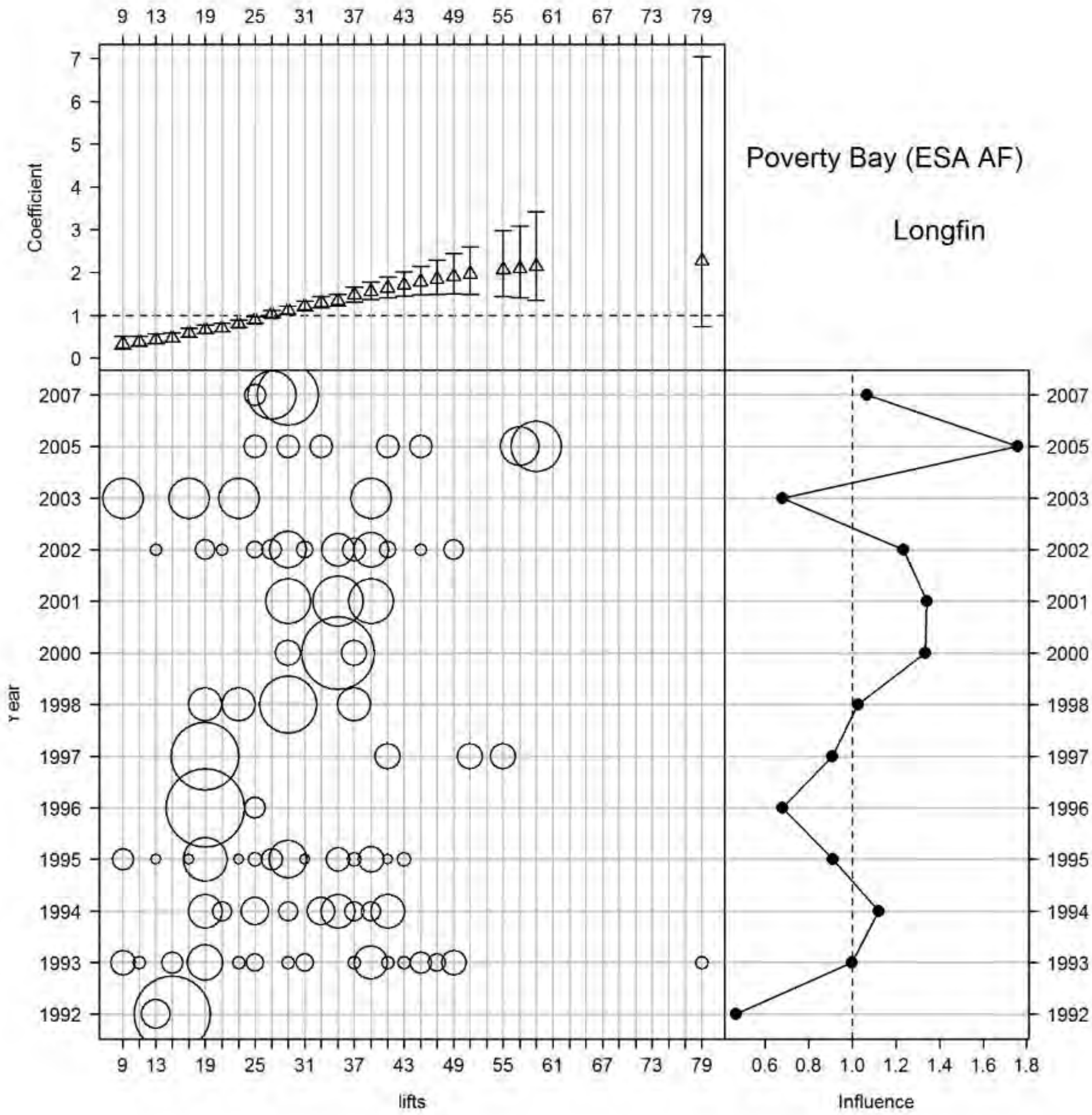


Figure F26: Influence of lifts for the longfin CPUE model for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

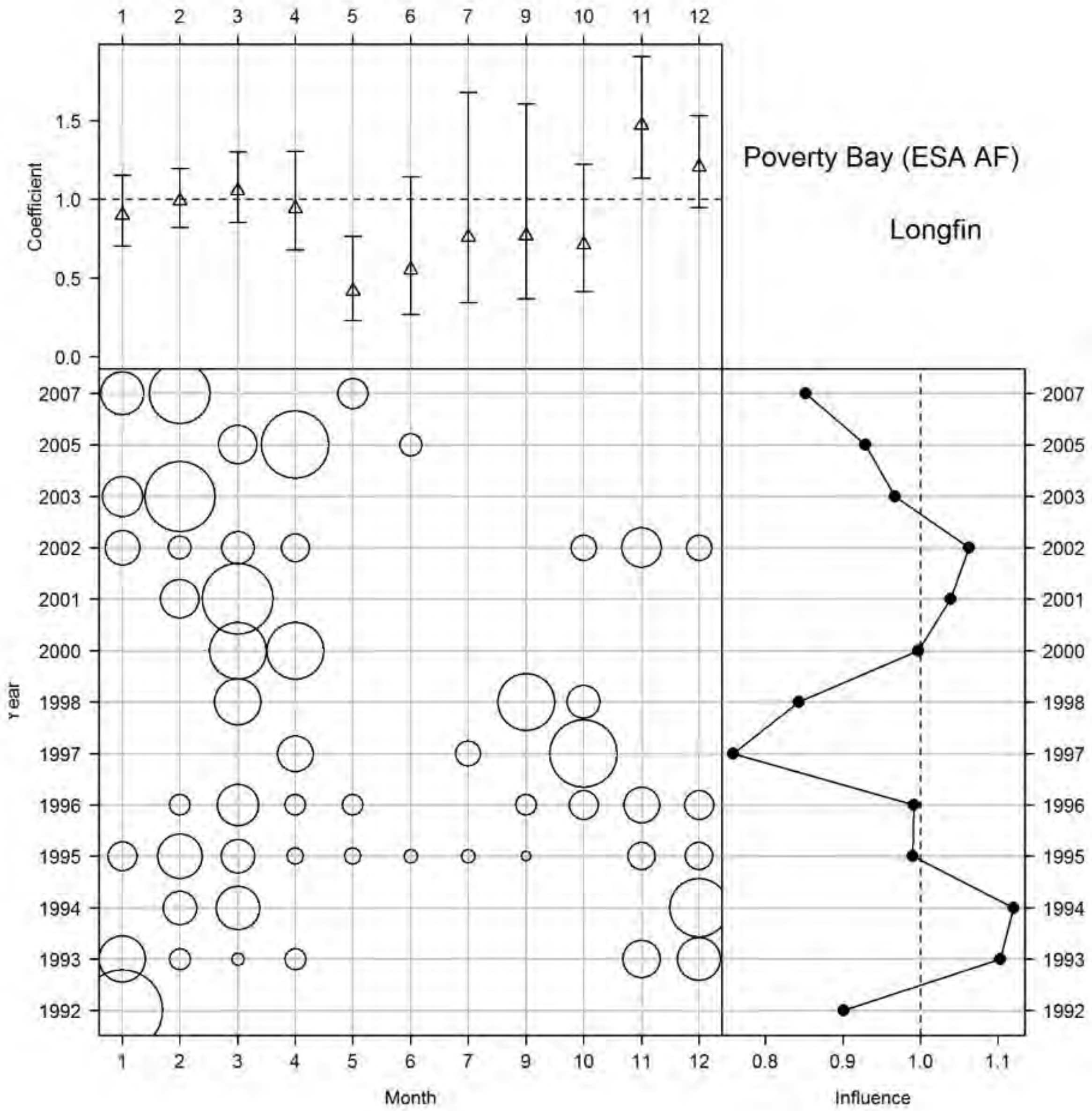


Figure F27: Influence of month for the longfin CPUE model for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

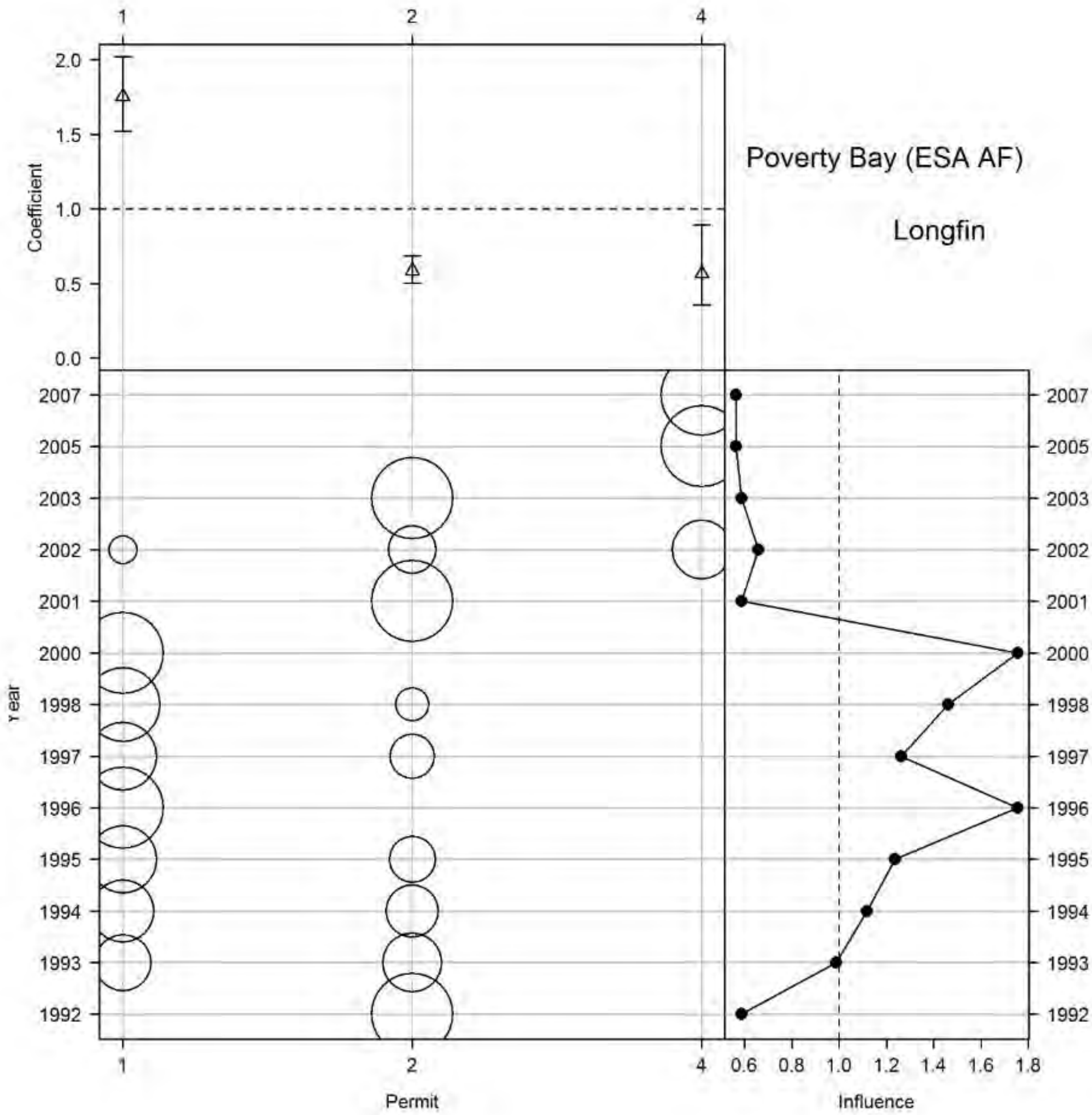


Figure F28: Influence of permit number for the longfin CPUE model for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

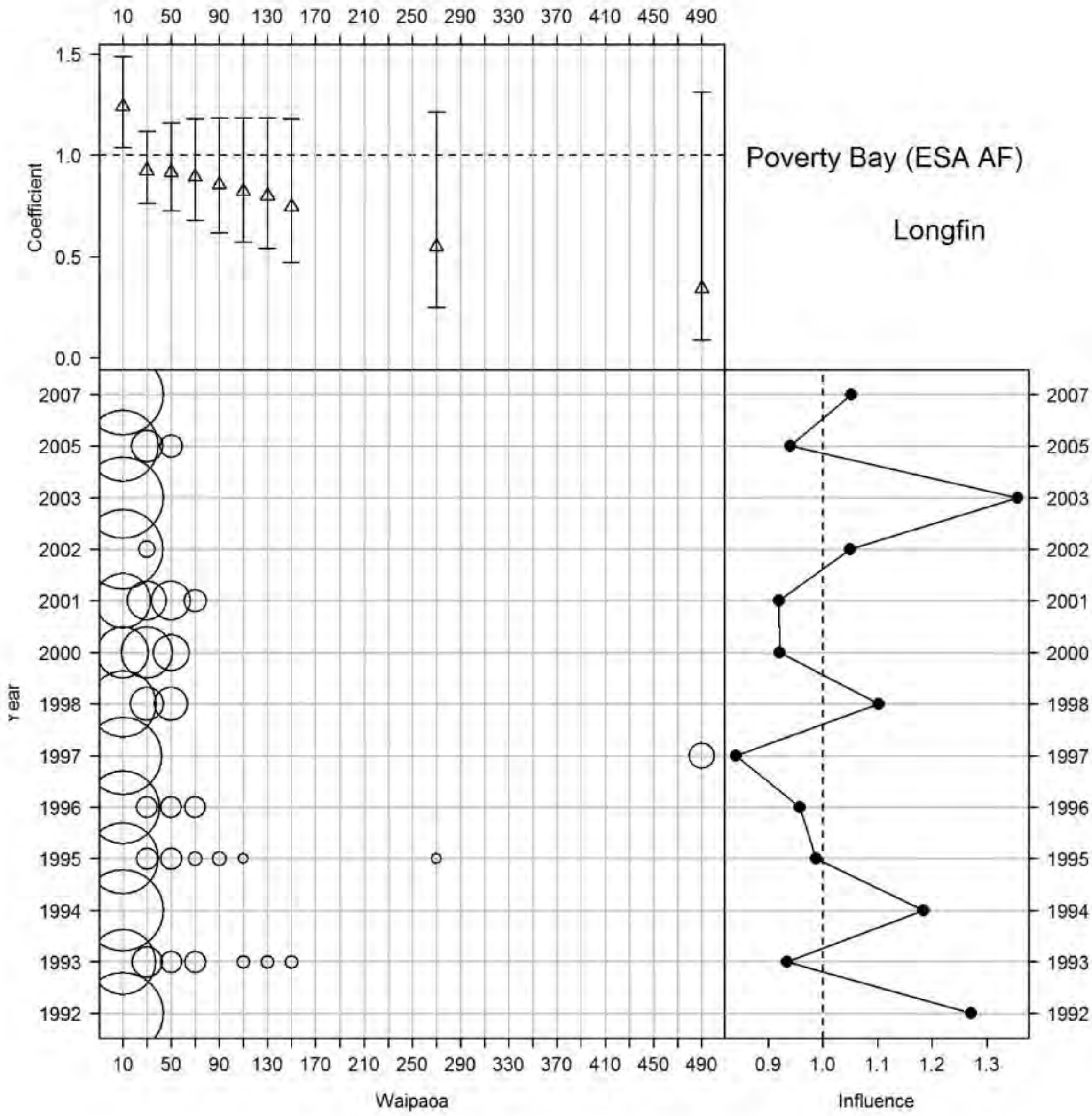


Figure F29: Influence of Waipaoa River flow for the longfin CPUE model for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

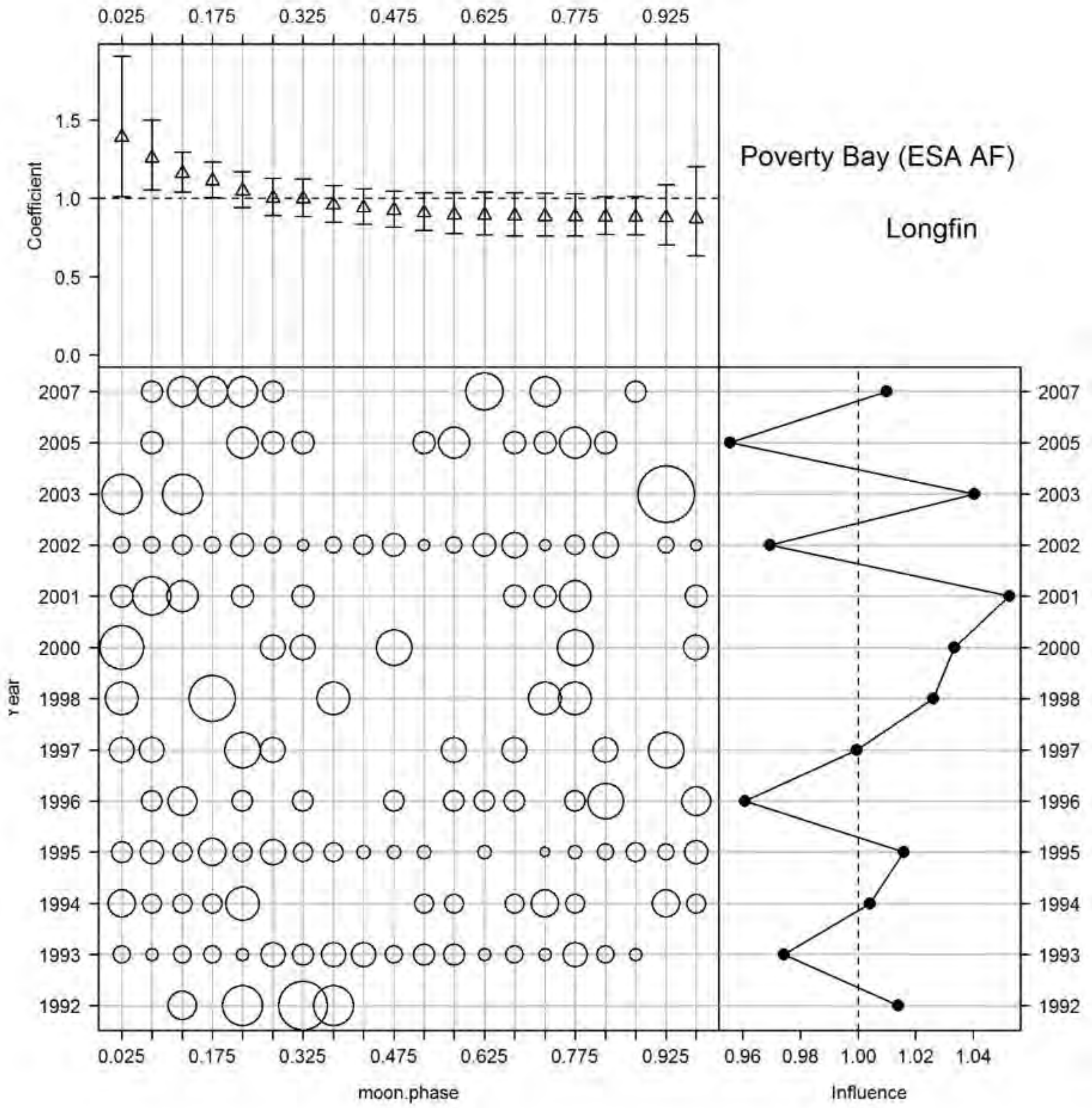


Figure F30: Influence of moon phase for the longfin CPUE model for the years 1990–91 to 2011–12 (Poverty Bay (ESA AF)).

Appendix G: Hawke's Bay (ESA AG)

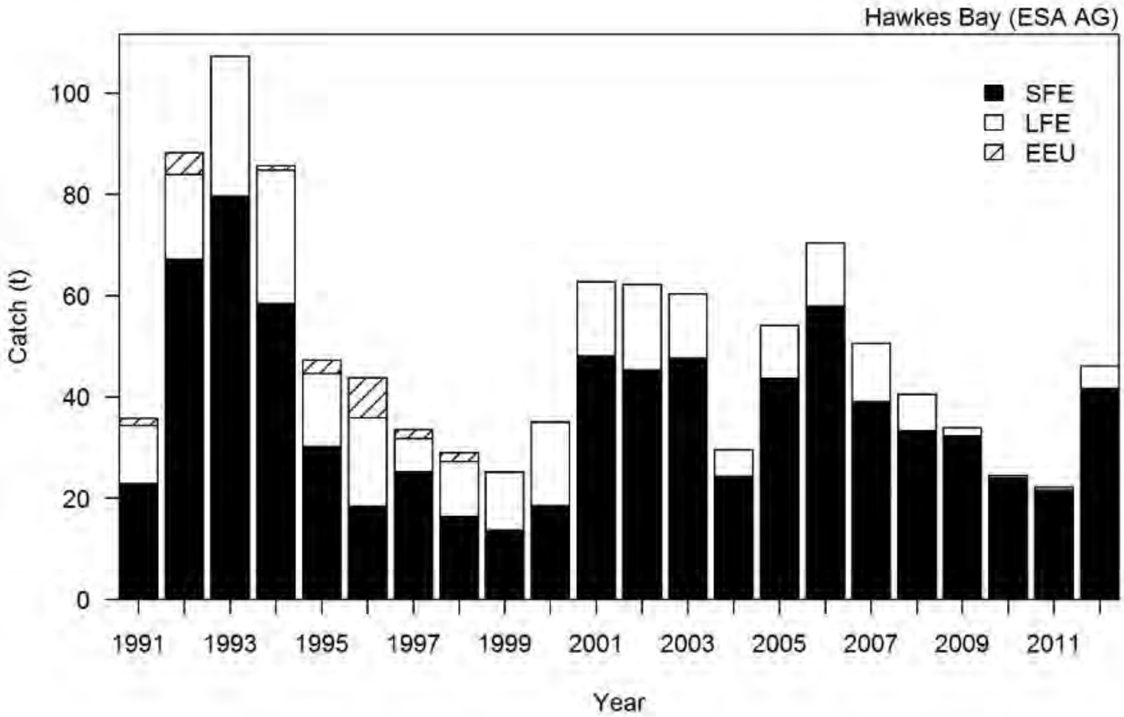


Figure G1: Total estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

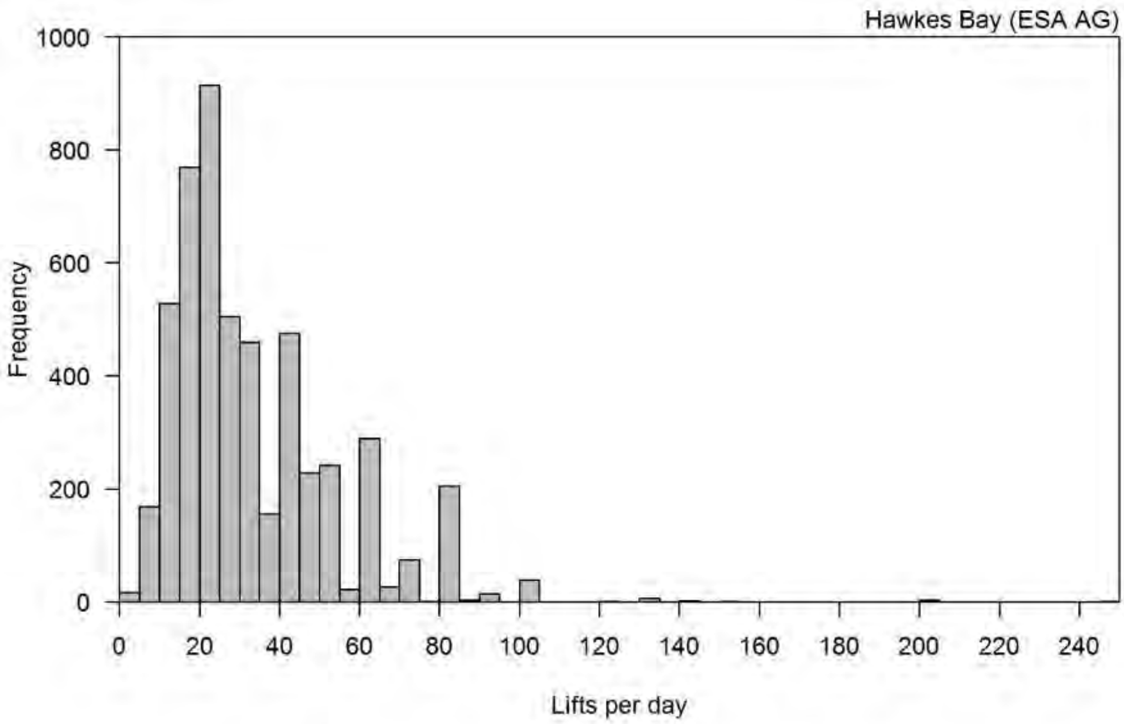


Figure G2: Frequency of total lifts per day for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

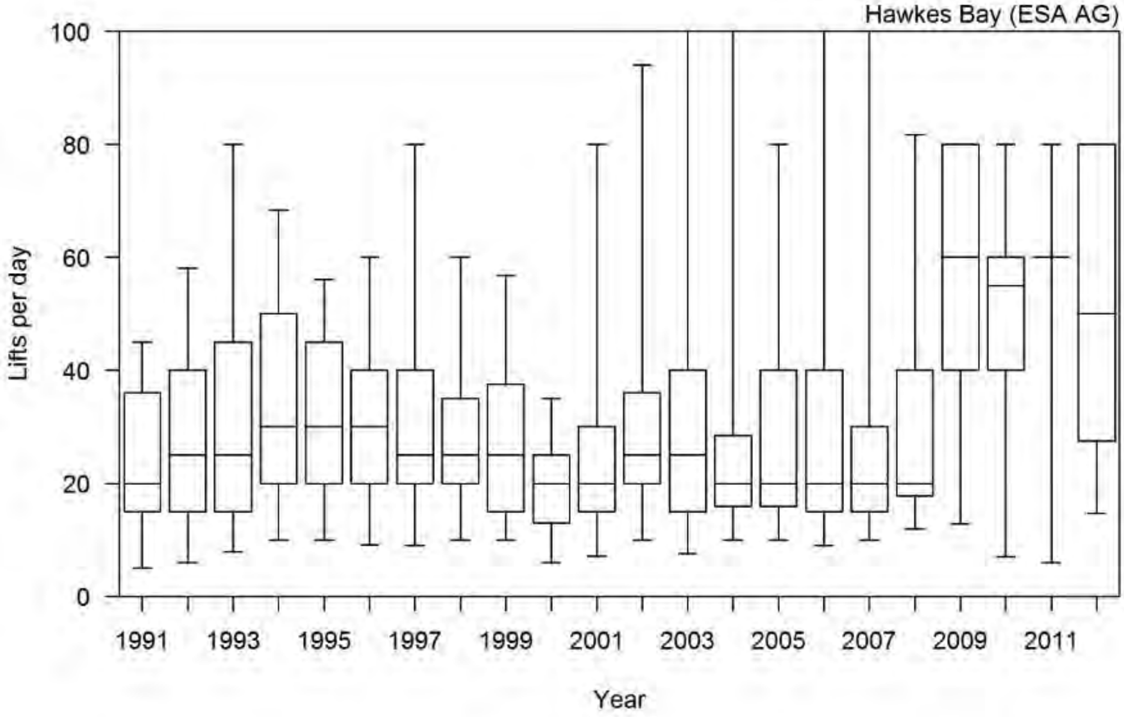


Figure G3: Total lifts per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Hawkes Bay (ESA AG)).

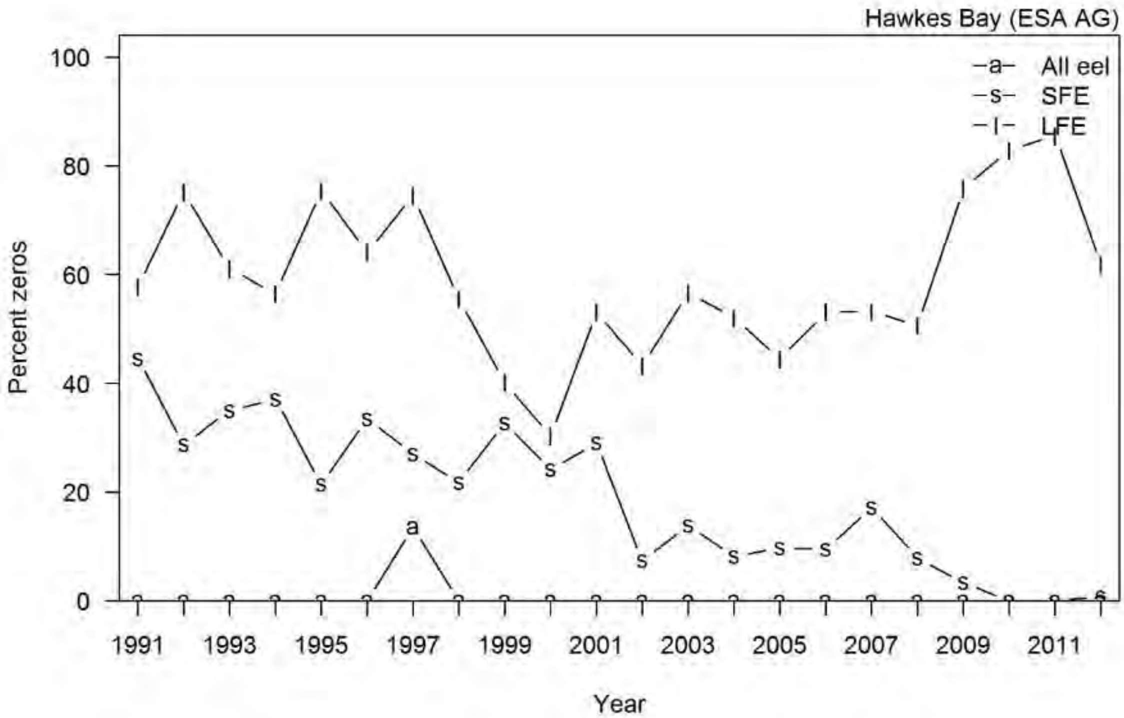


Figure G4: Proportion of zero records for all eel, shortfin (SFE), and longfin (LFE) catch for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

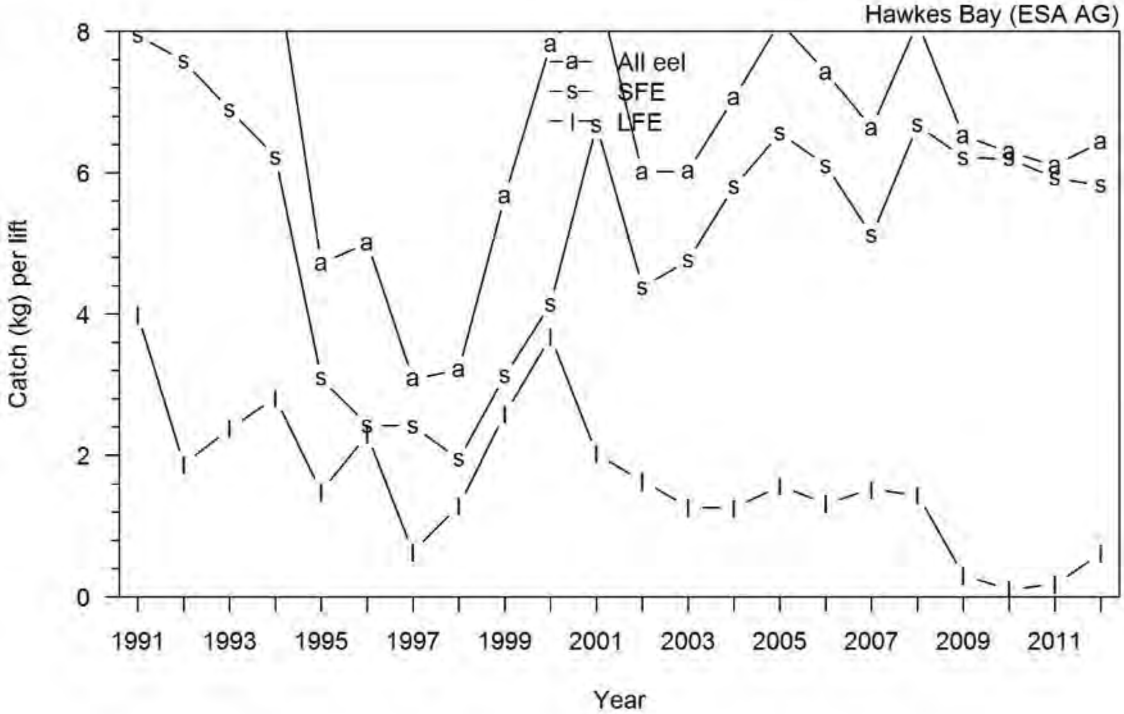


Figure G5: Unstandardised catch per lift (total kg/total lifts) for all eel, shortfin (SFE), and longfin (LFE) for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

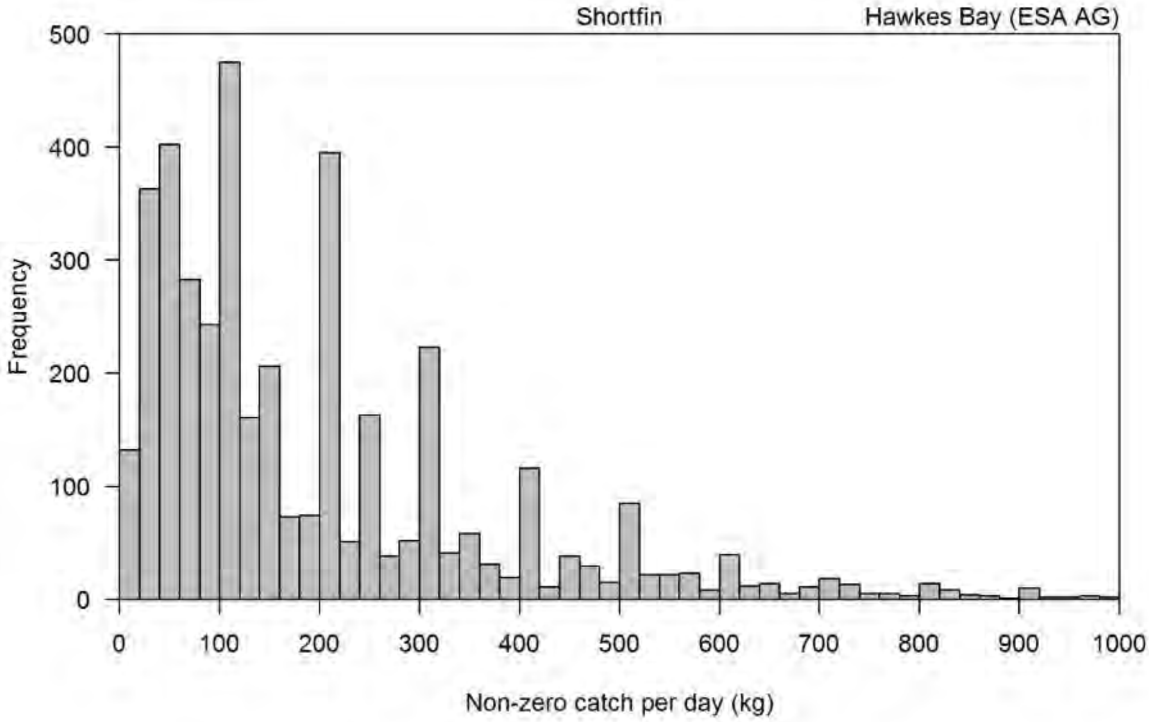


Figure G6: Frequency of shortfin eel catch per day for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

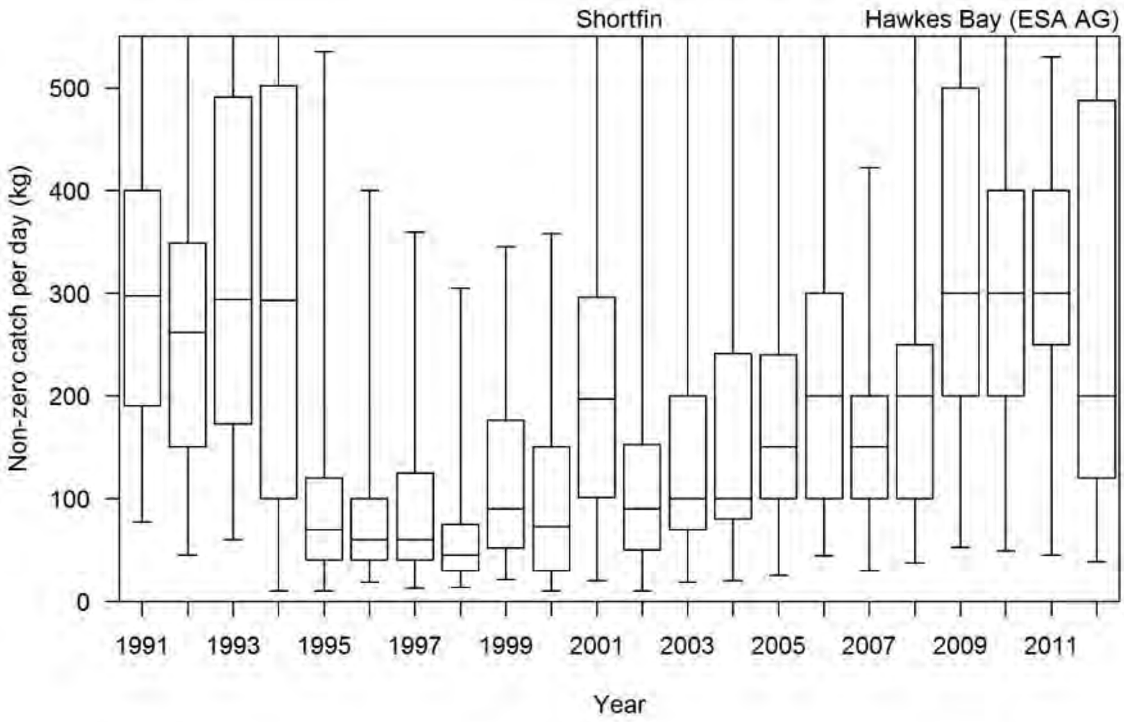


Figure G7: Shortfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Hawkes Bay (ESA AG)).

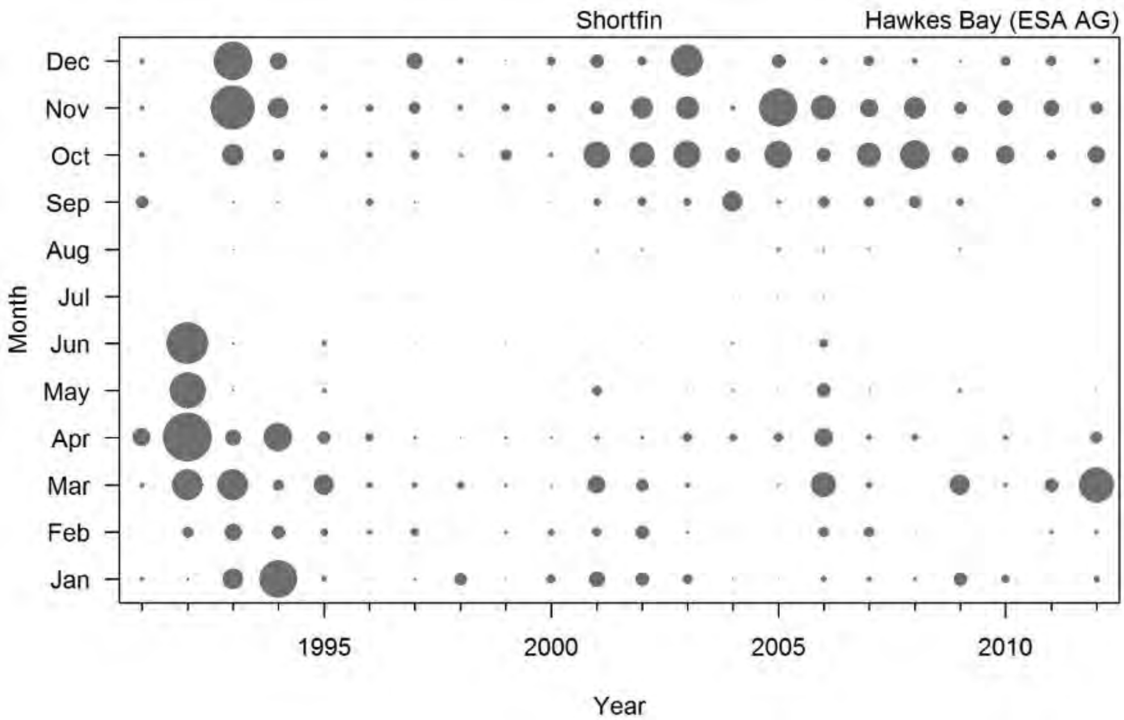


Figure G8: Shortfin eel catch by month for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

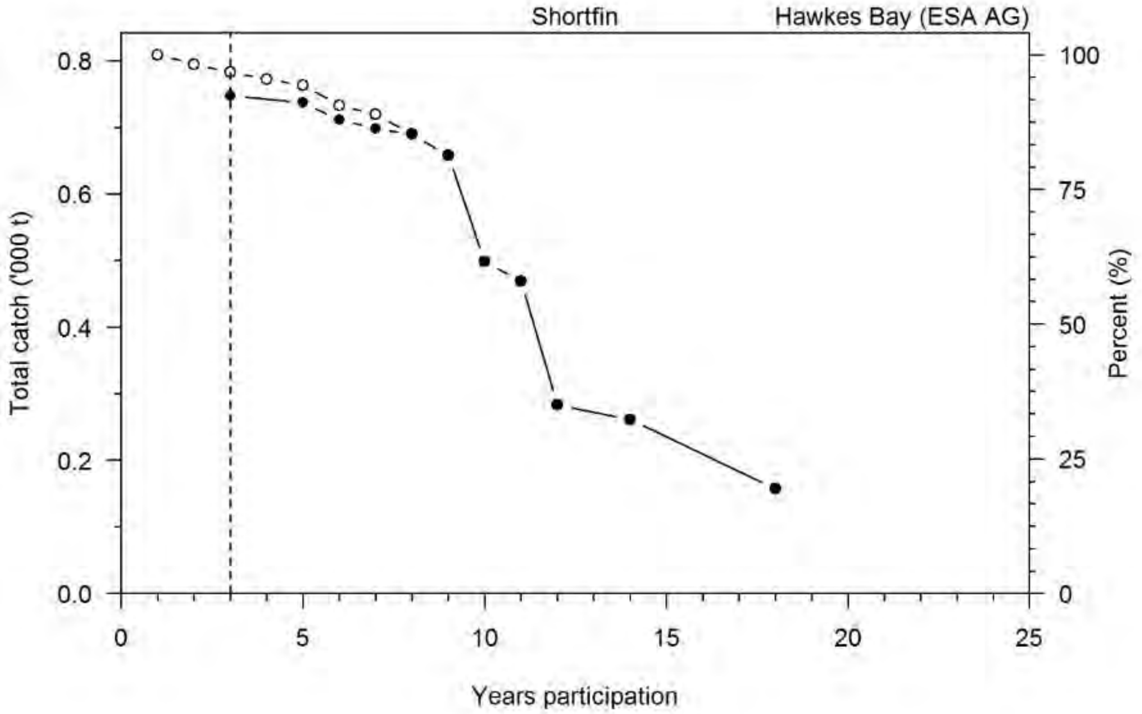


Figure G9: Relationship between years of participation in the fishery and shortfin total catch. The open circles represent all shortfin catch and the closed circles shortfin catch data from fishers who 1) caught shortfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core shortfin fisher analyses for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

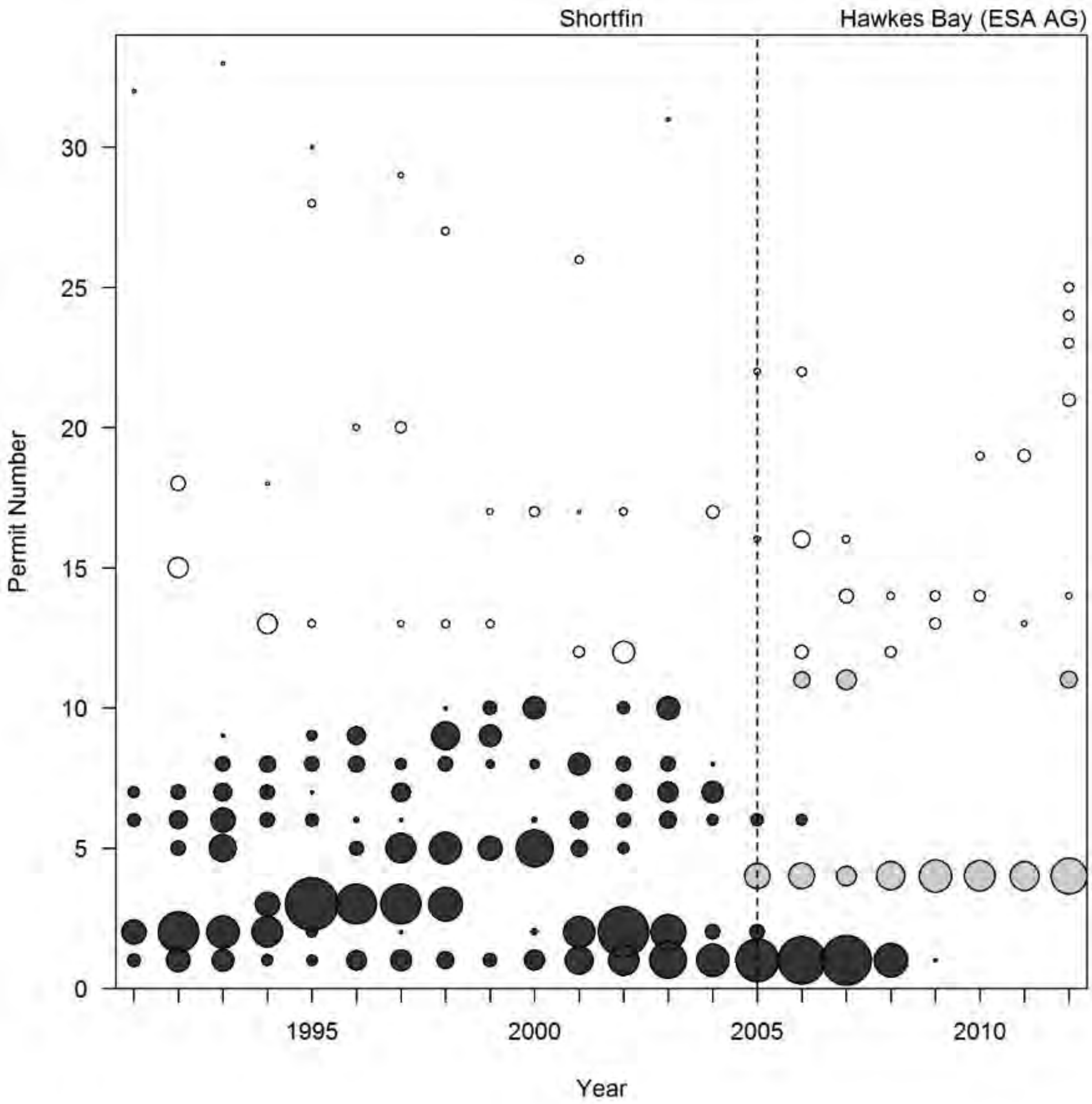


Figure G10: Relative catch of shortfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Hawkes Bay (ESA AG)).

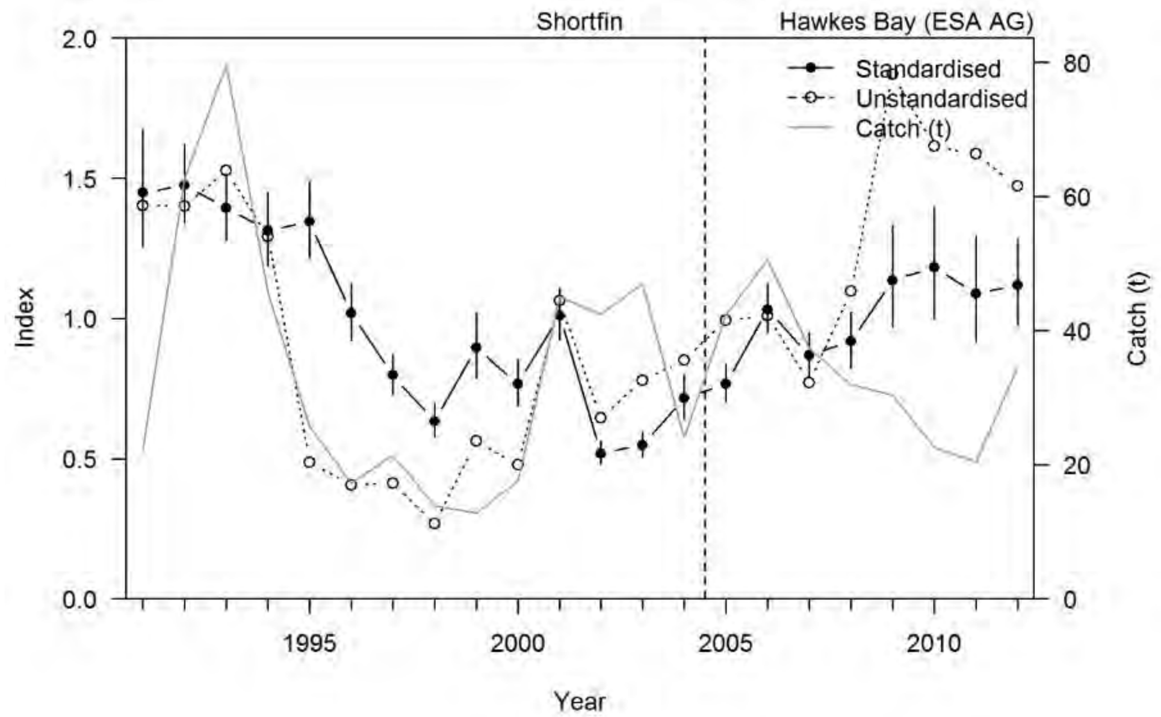


Figure G11: Indices of unstandardised catch per day and standardised CPUE for the core fishers shortfin CPUE model for the years 1990–91 to 2011–12. Catch by core fishers is also plotted (Hawkes Bay (ESA AG)).

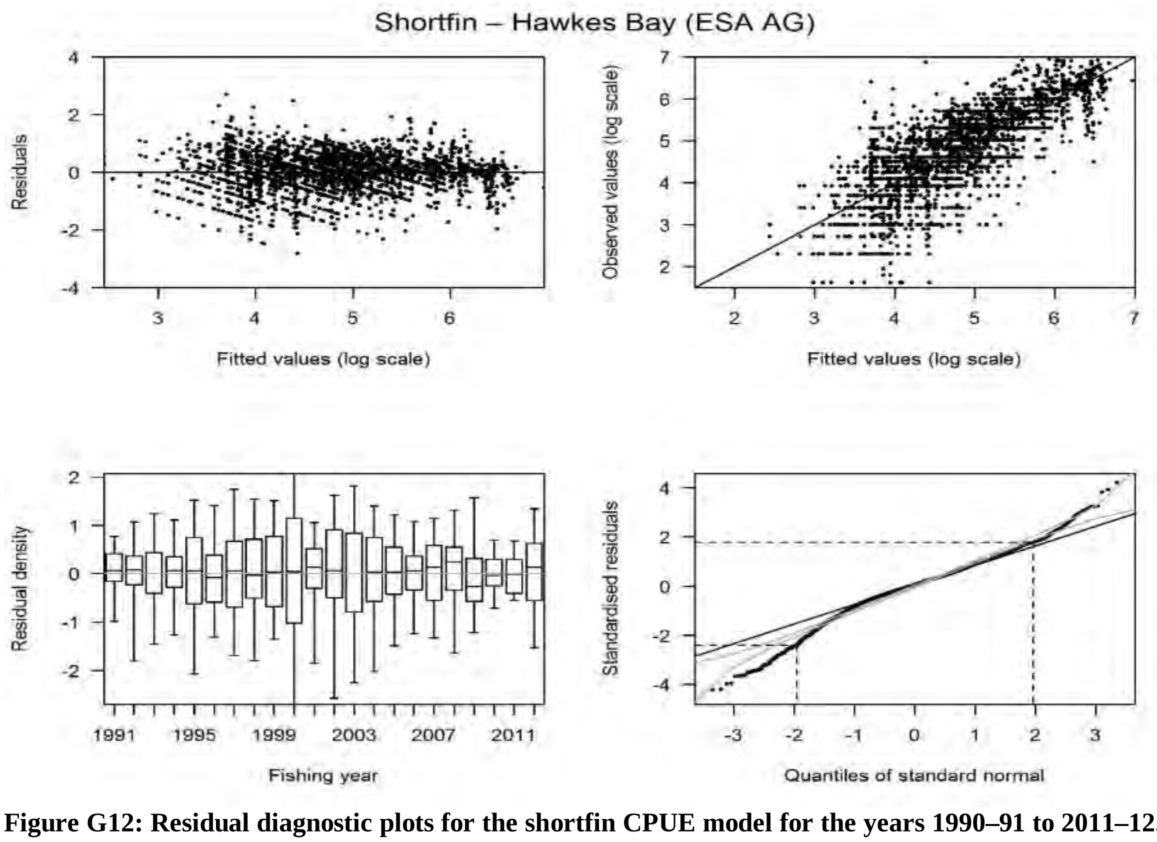


Figure G12: Residual diagnostic plots for the shortfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Hawkes Bay (ESA AG)).

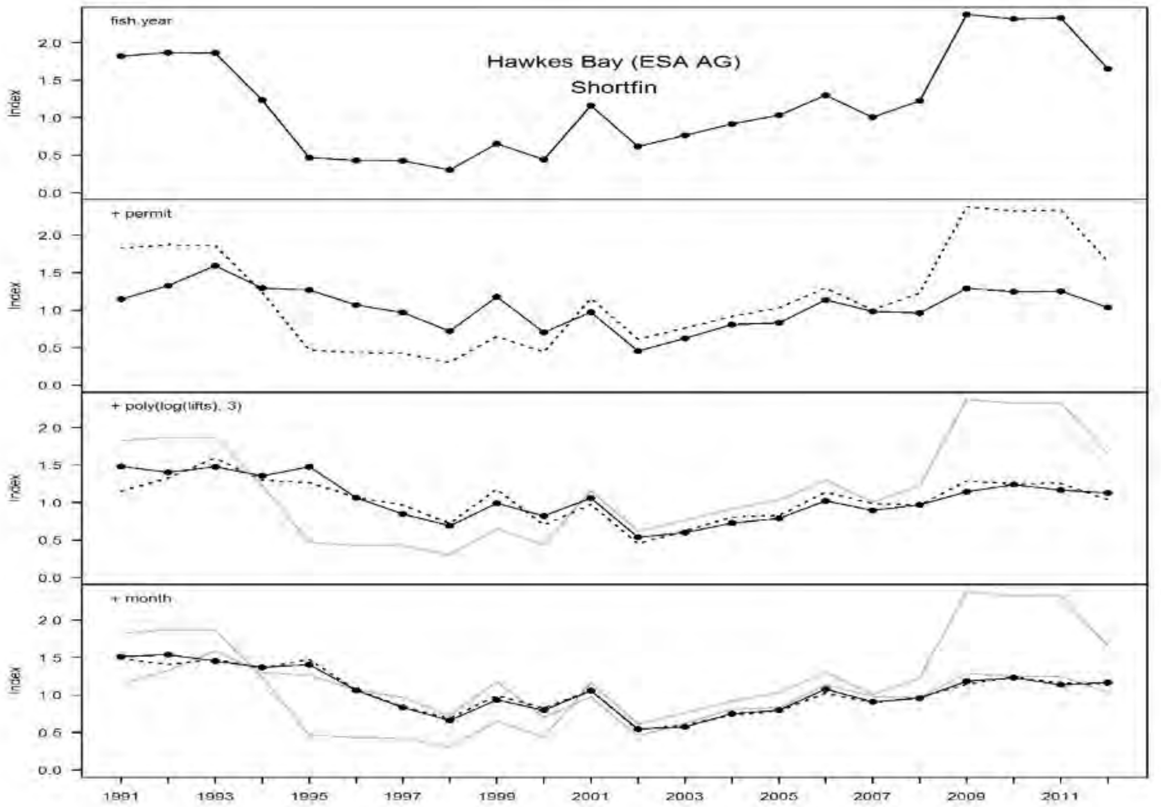


Figure G13: Step plot for the shortfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Hawkes Bay (ESA AG)).

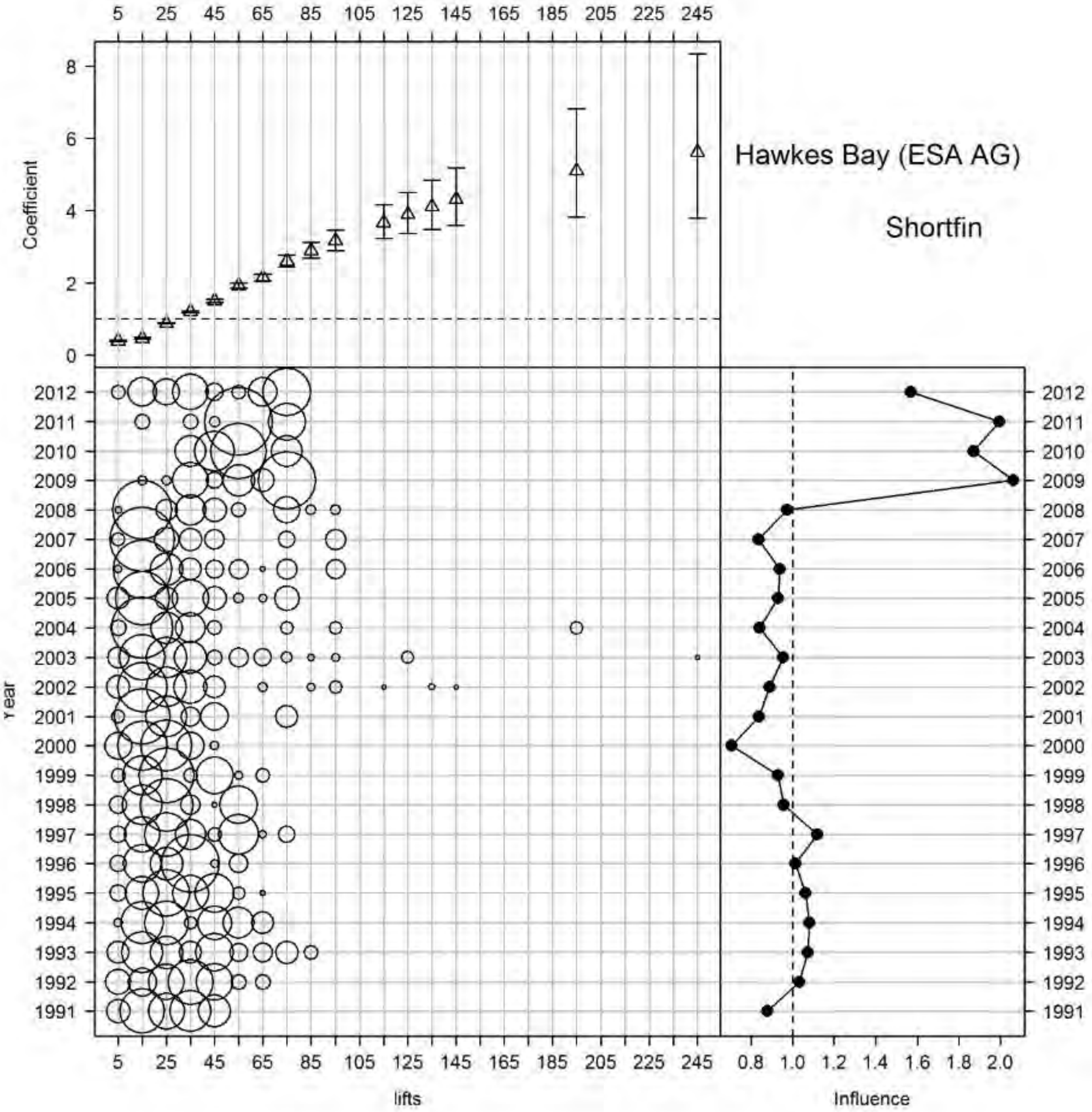


Figure G14: Influence of lifts for the shortfin CPUE model for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

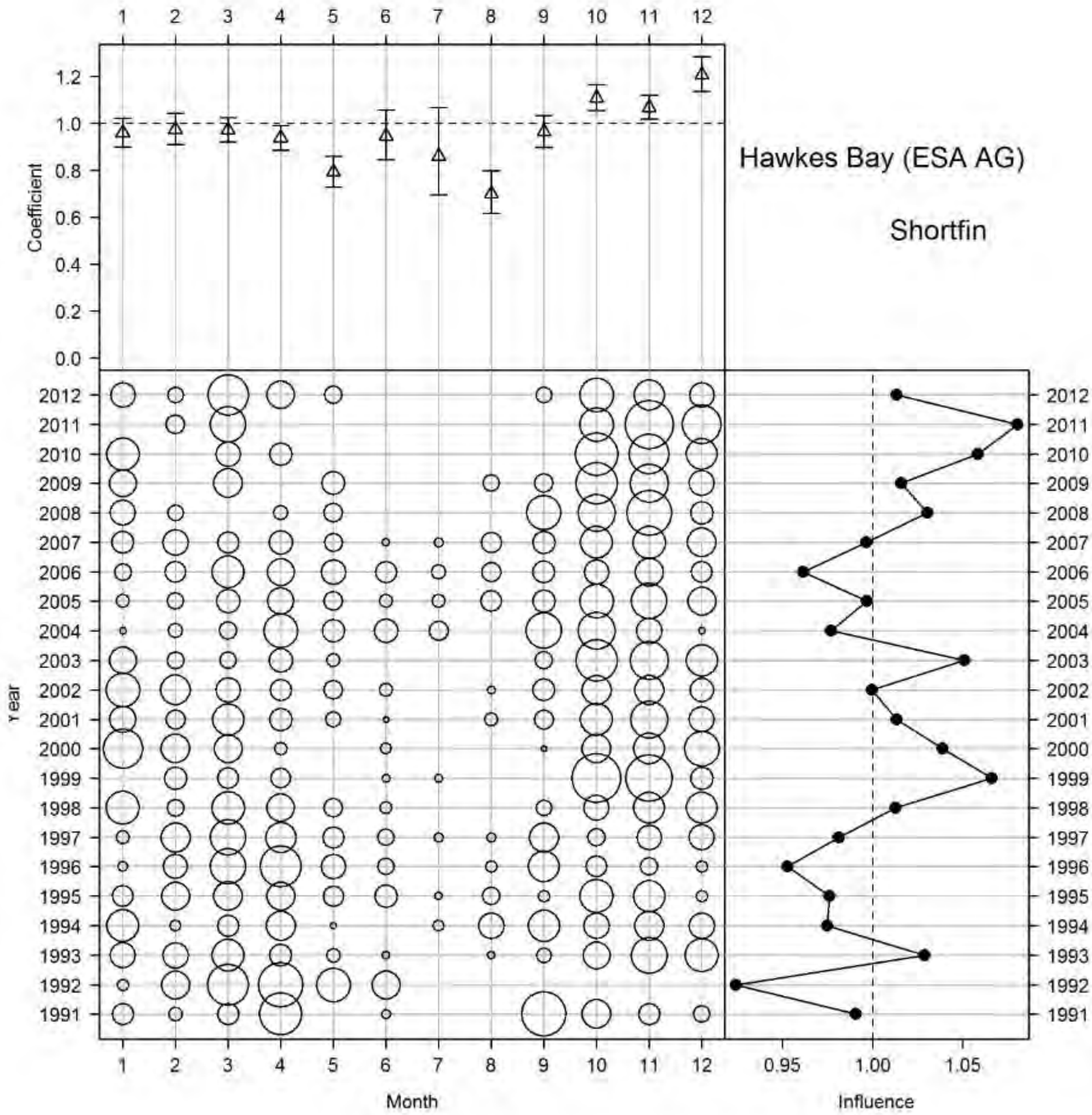


Figure G15: Influence of month for the shortfin CPUE model for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

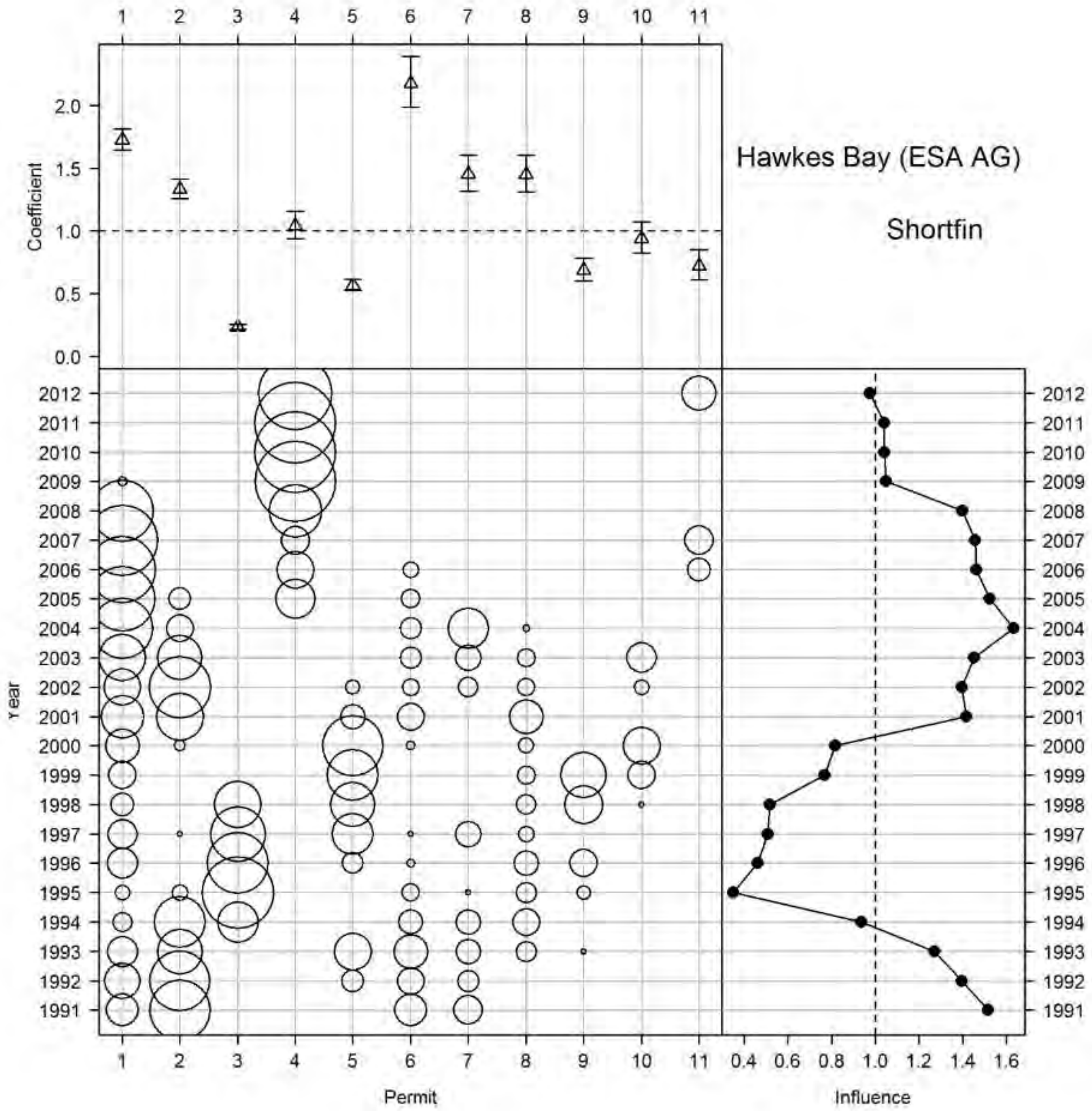


Figure G16: Influence of permit number for the shortfin CPUE model for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

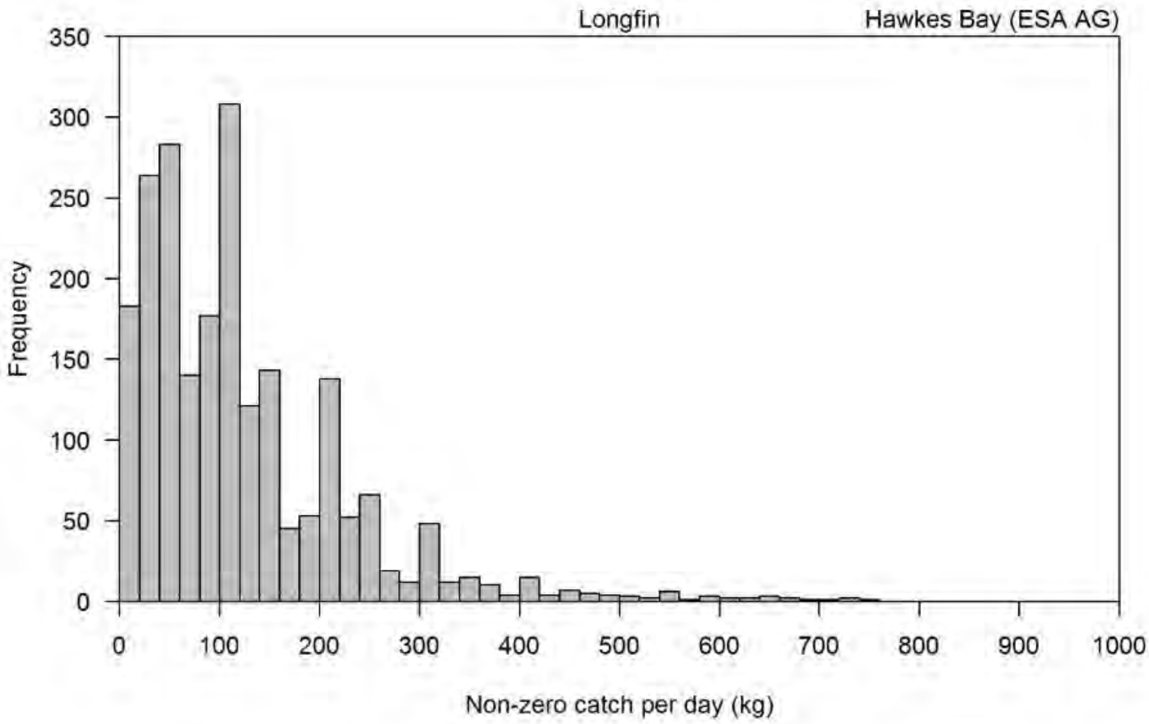


Figure G17: Frequency of longfin eel catch per day for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

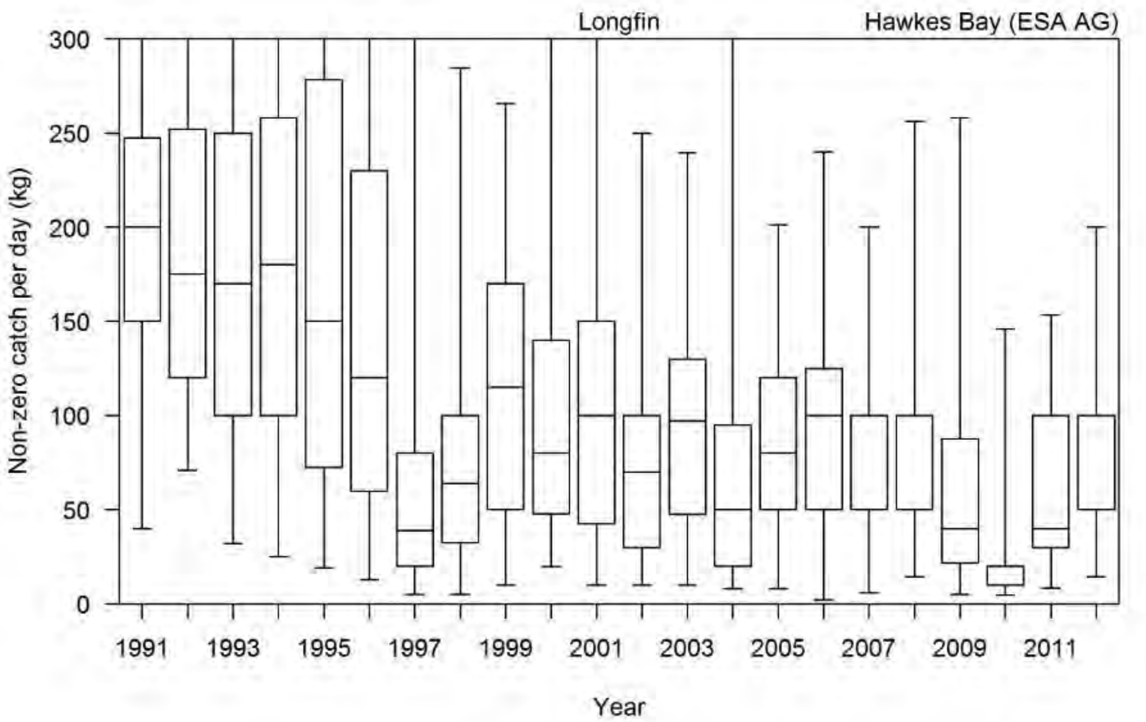


Figure G18: Longfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Hawkes Bay (ESA AG)).

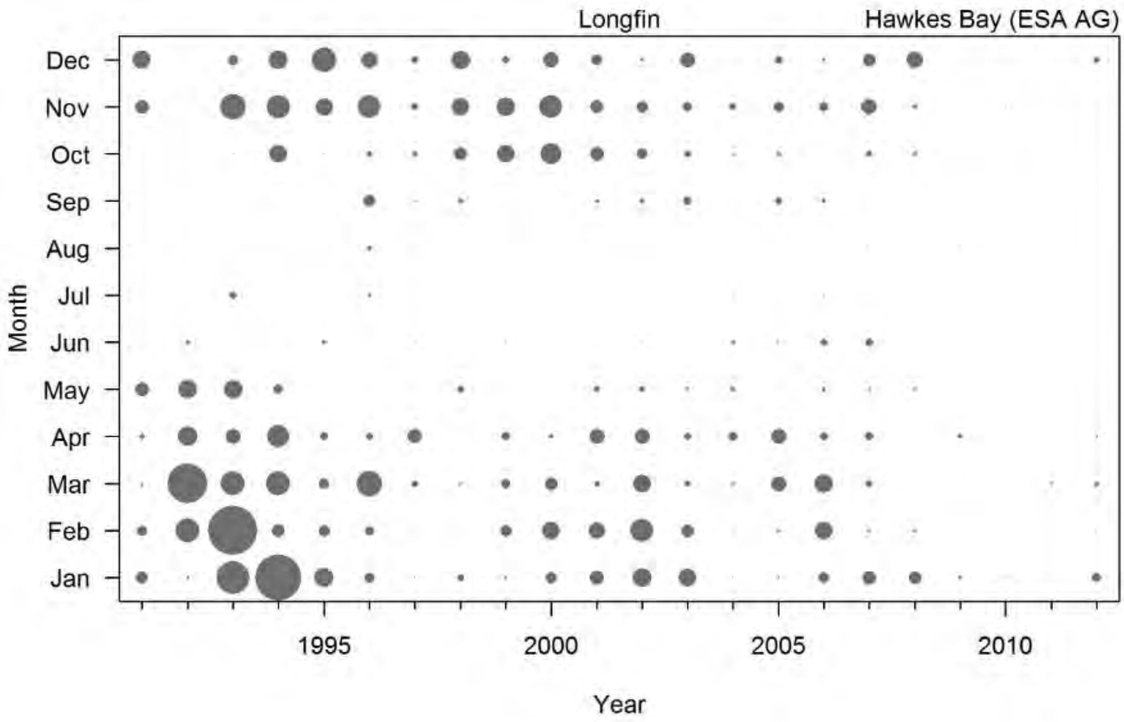


Figure G19: Longfin eel catch by month for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

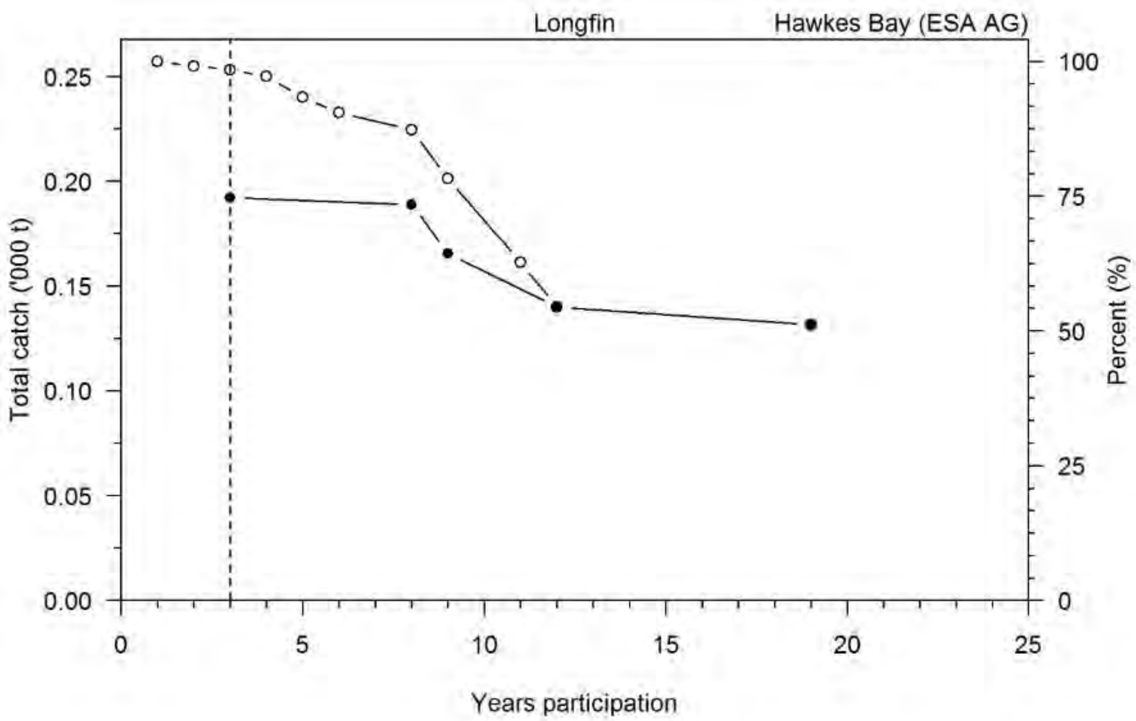


Figure G20: Relationship between years of participation in the fishery and longfin total catch. The open circles represent all longfin catch and the closed circles longfin catch data from fishers who 1) caught longfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core longfin fisher analyses for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

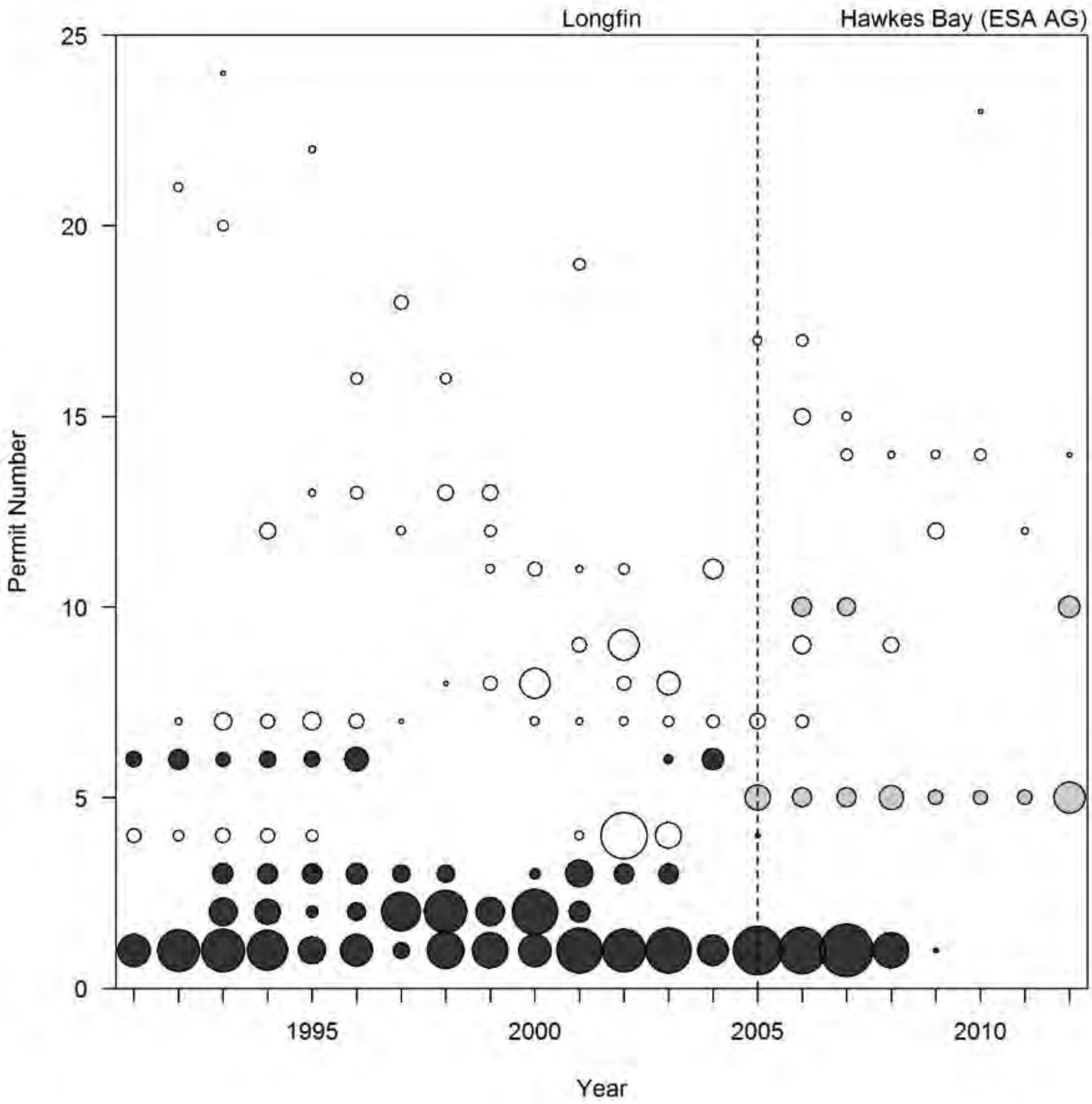


Figure G21: Relative catch of longfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Hawkes Bay (ESA AG)).

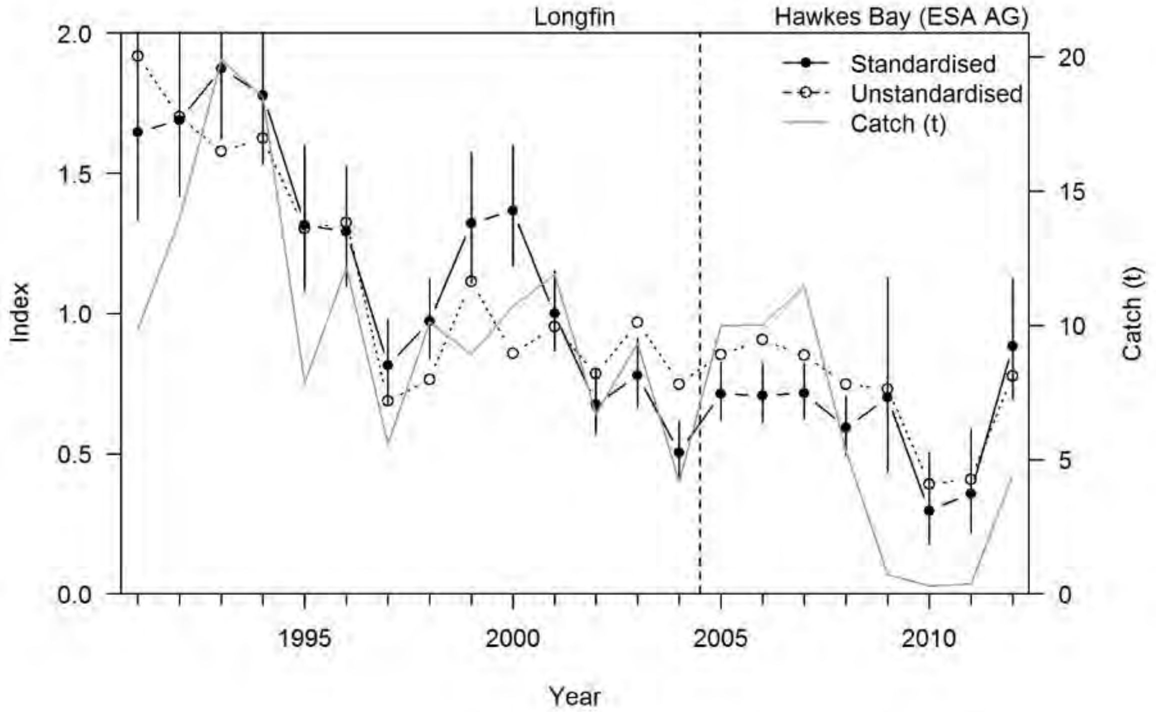


Figure G22: Indices of unstandardised catch per day and standardised CPUE for the core fishers longfin CPUE model for the years 1990–91 to 2011–12. Catch by core fishers is also plotted (Hawkes Bay (ESA AG)).

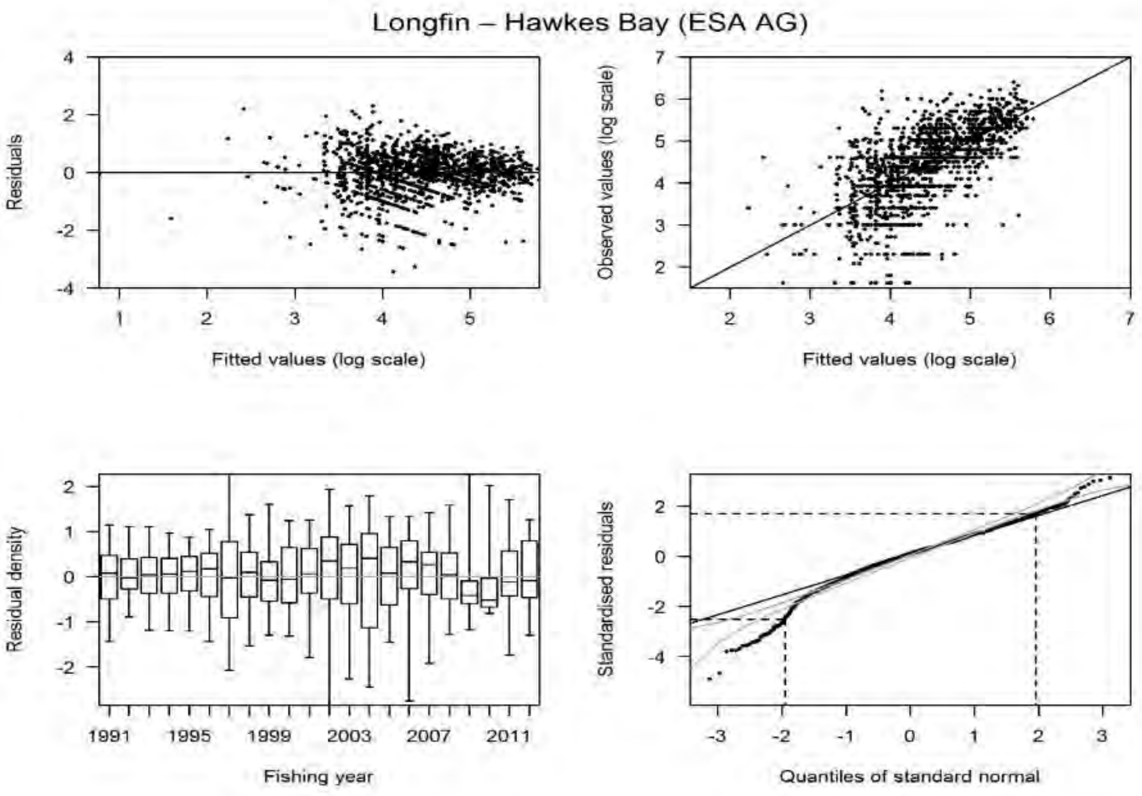


Figure G23: Residual diagnostic plots for the longfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Hawkes Bay (ESA AG)).

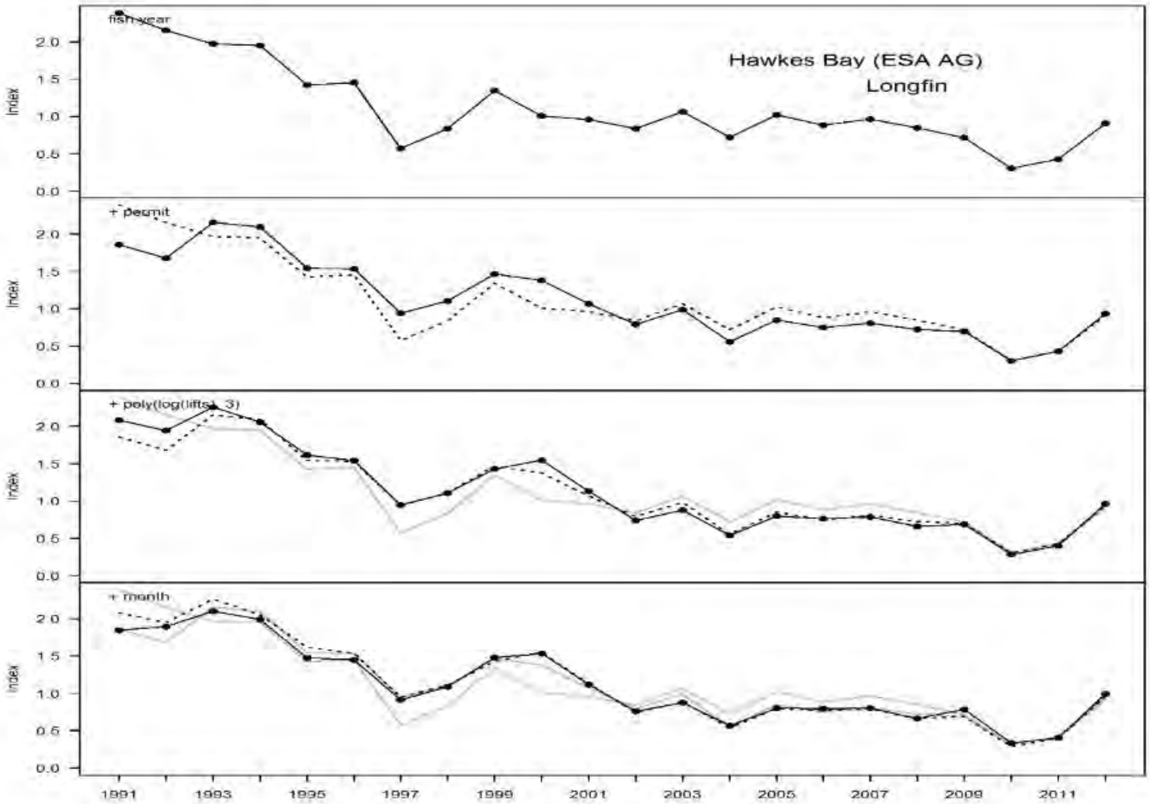


Figure G24: Step plot for the longfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Hawkes Bay (ESA AG)).

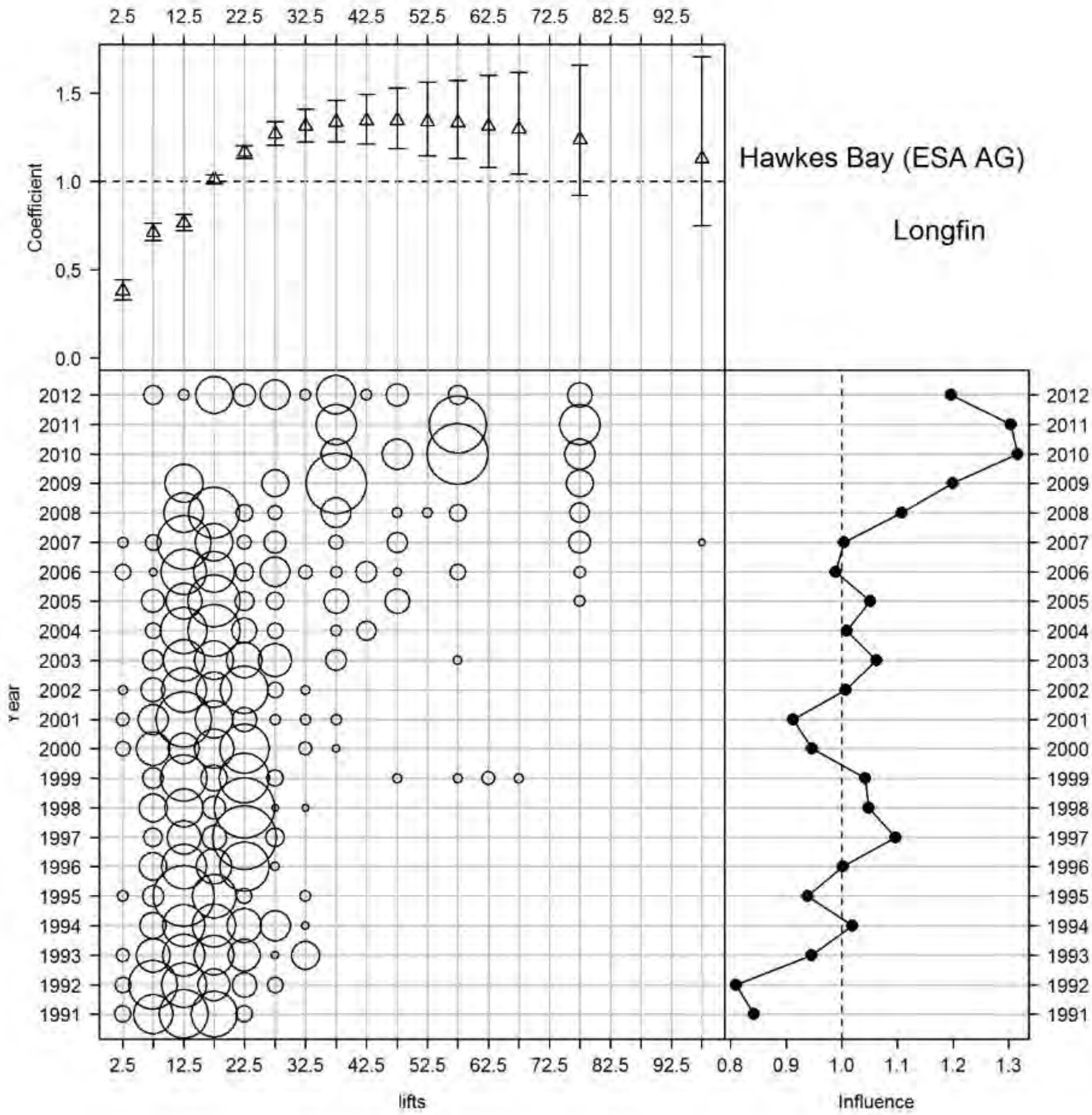


Figure G25: Influence of lifts for the longfin CPUE model for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

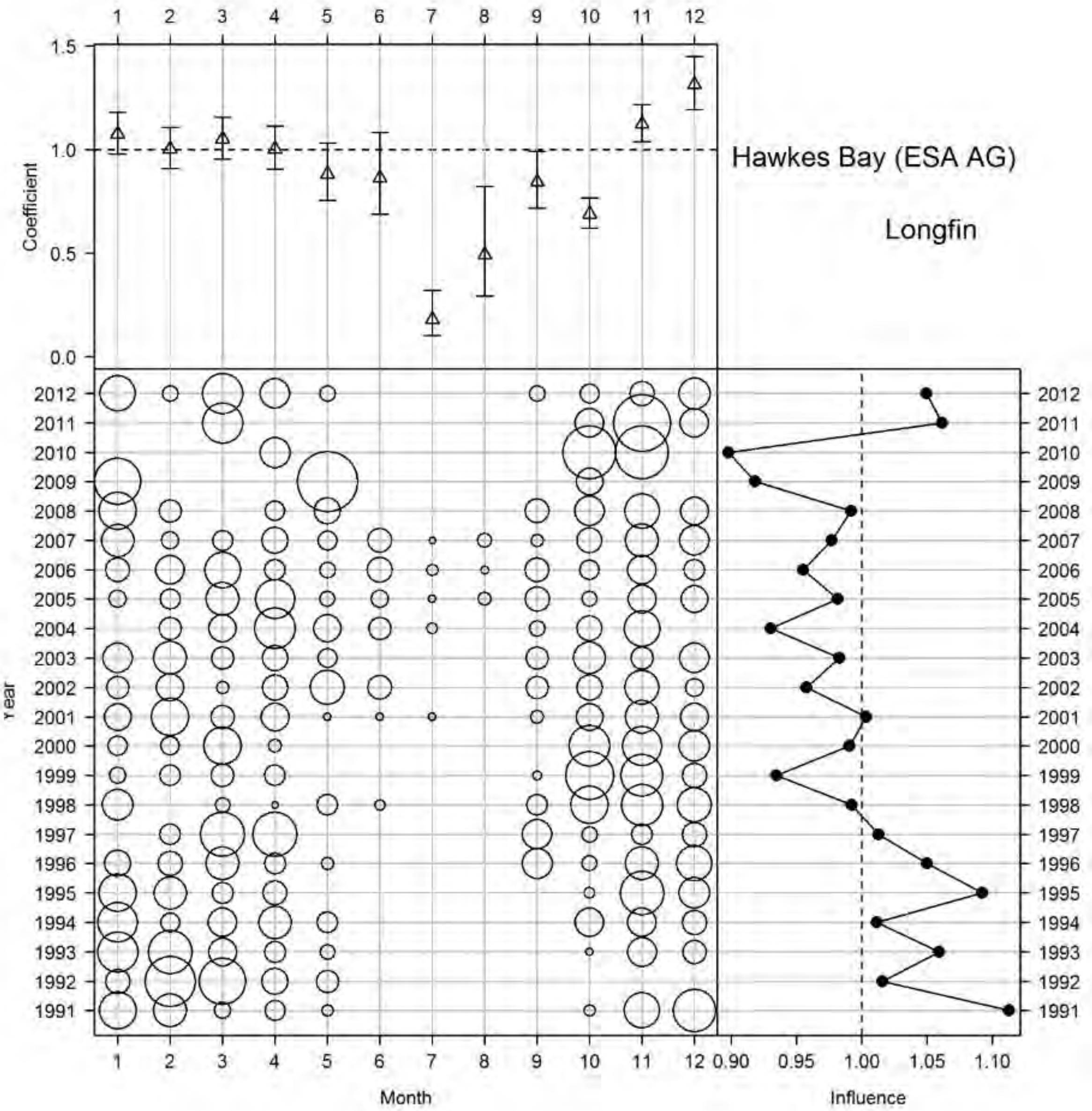


Figure G26: Influence of month for the longfin CPUE model for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

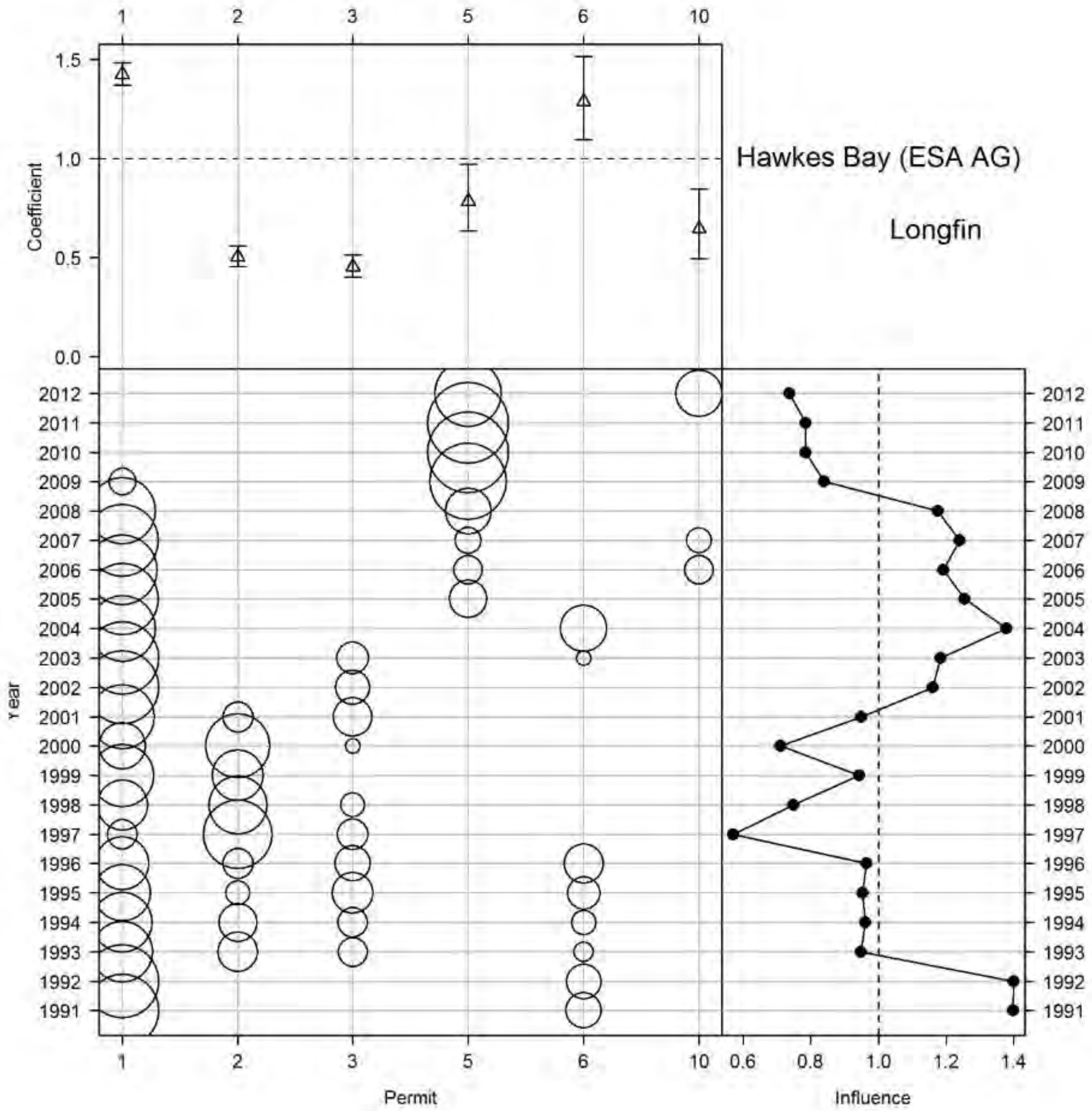


Figure G27: Influence of permit number for the longfin CPUE model for the years 1990–91 to 2011–12 (Hawkes Bay (ESA AG)).

Appendix H: Rangitikei-Whanganui (ESA AH)

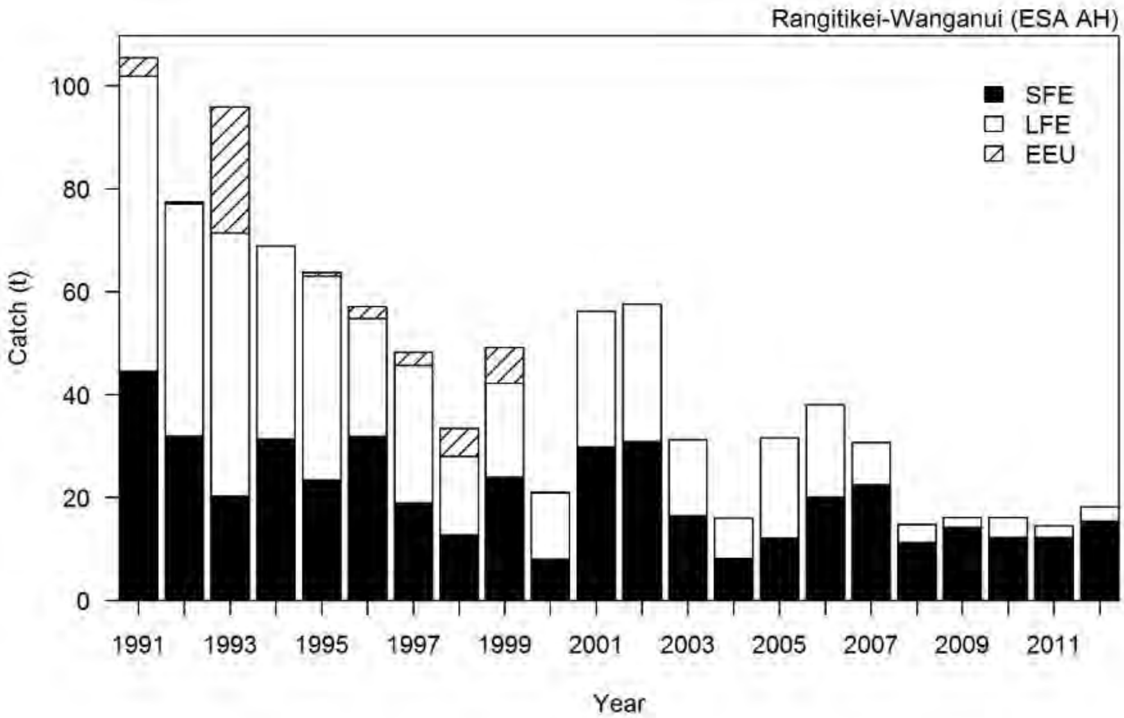


Figure H1: Total estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

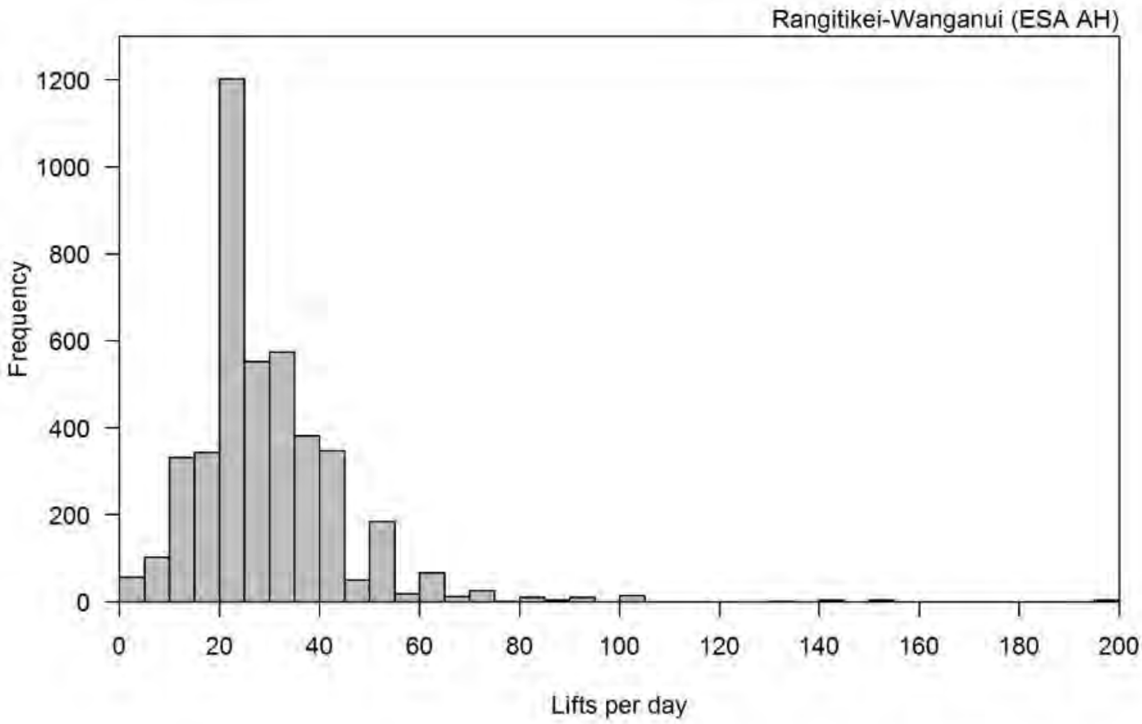


Figure H2: Frequency of total lifts per day for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

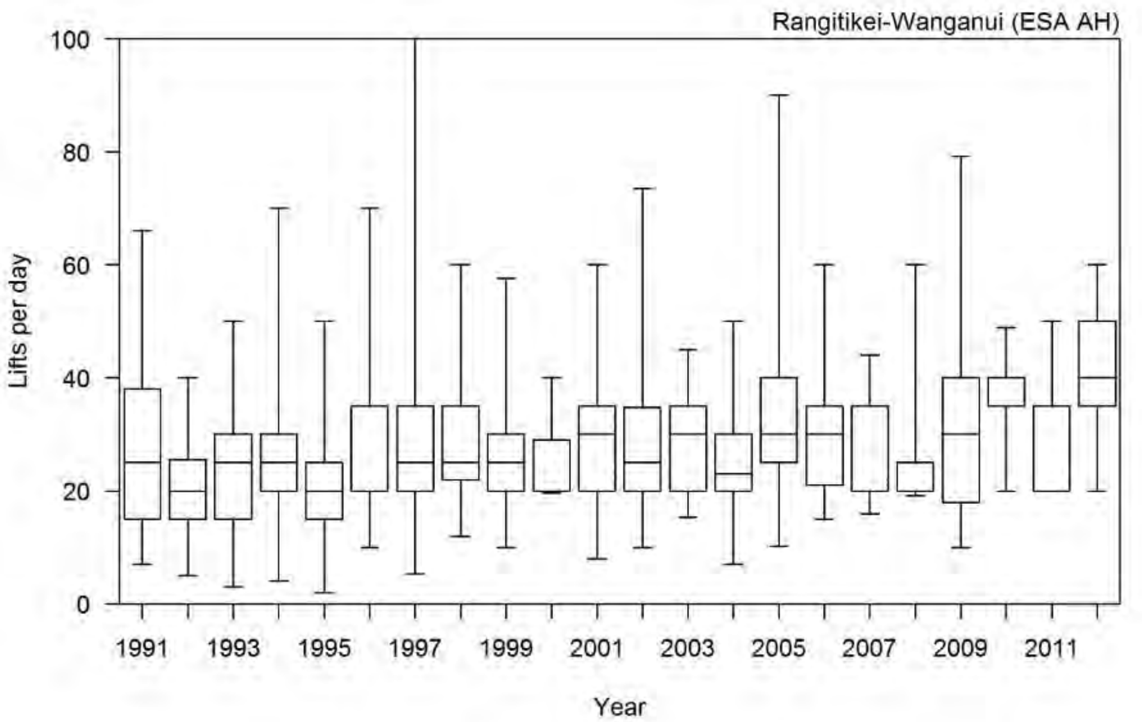


Figure H3: Total lifts per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Rangitikei-Wanganui (ESA AH)).

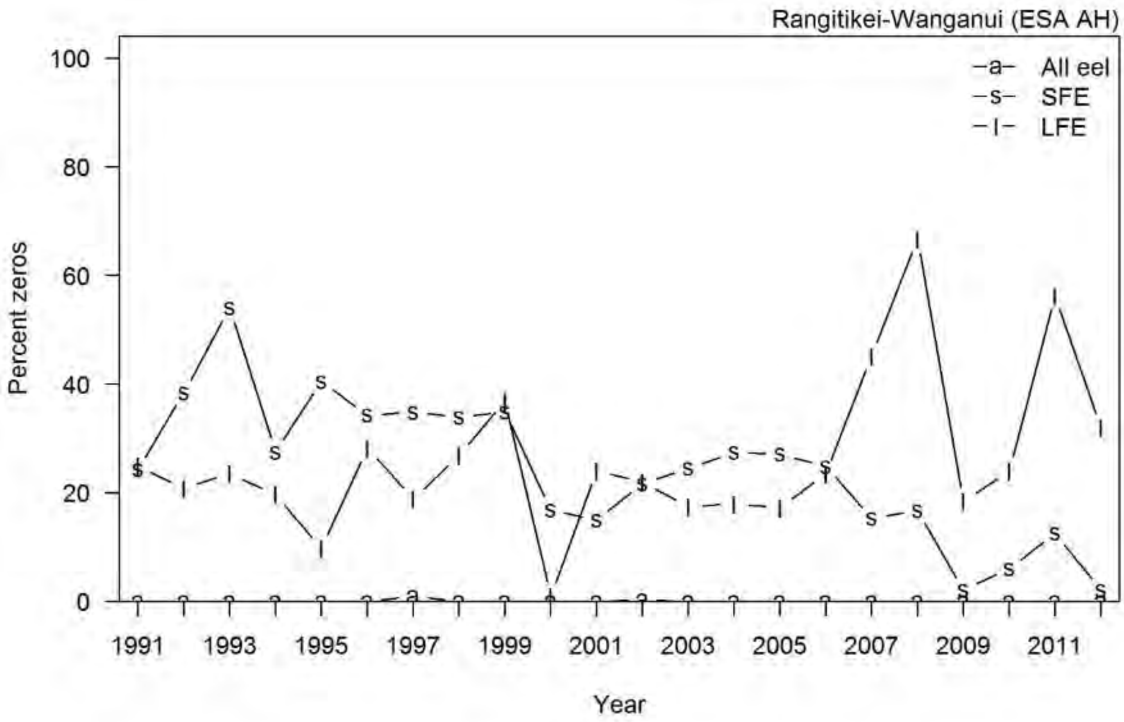


Figure H4: Proportion of zero records for all eel, shortfin (SFE), and longfin (LFE) catch for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

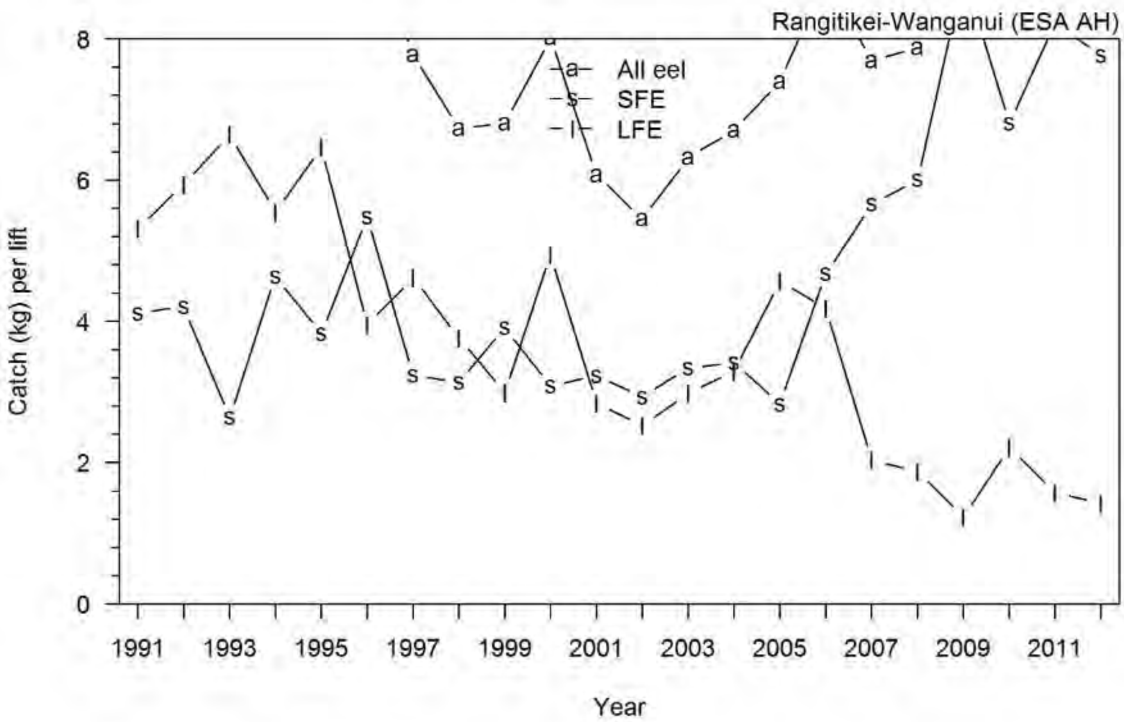


Figure H5: Unstandardised catch per lift (total kg/total lifts) for all eel, shortfin (SFE), and longfin (LFE) for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

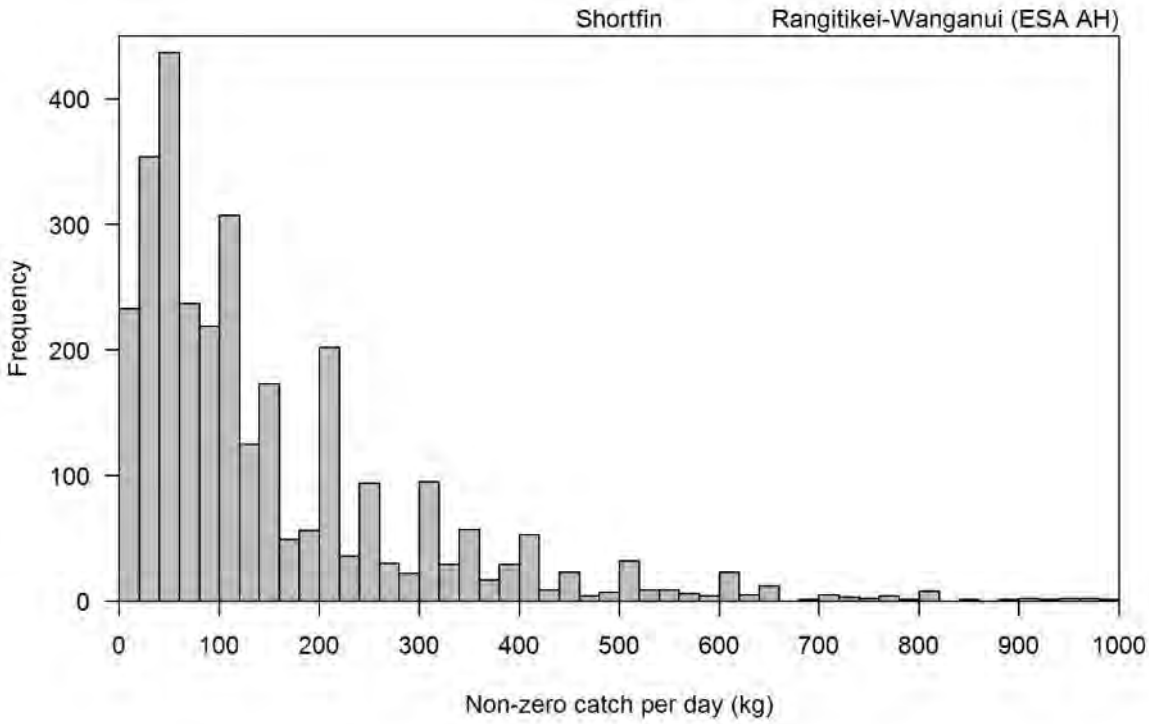


Figure H6: Frequency of shortfin eel catch per day for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

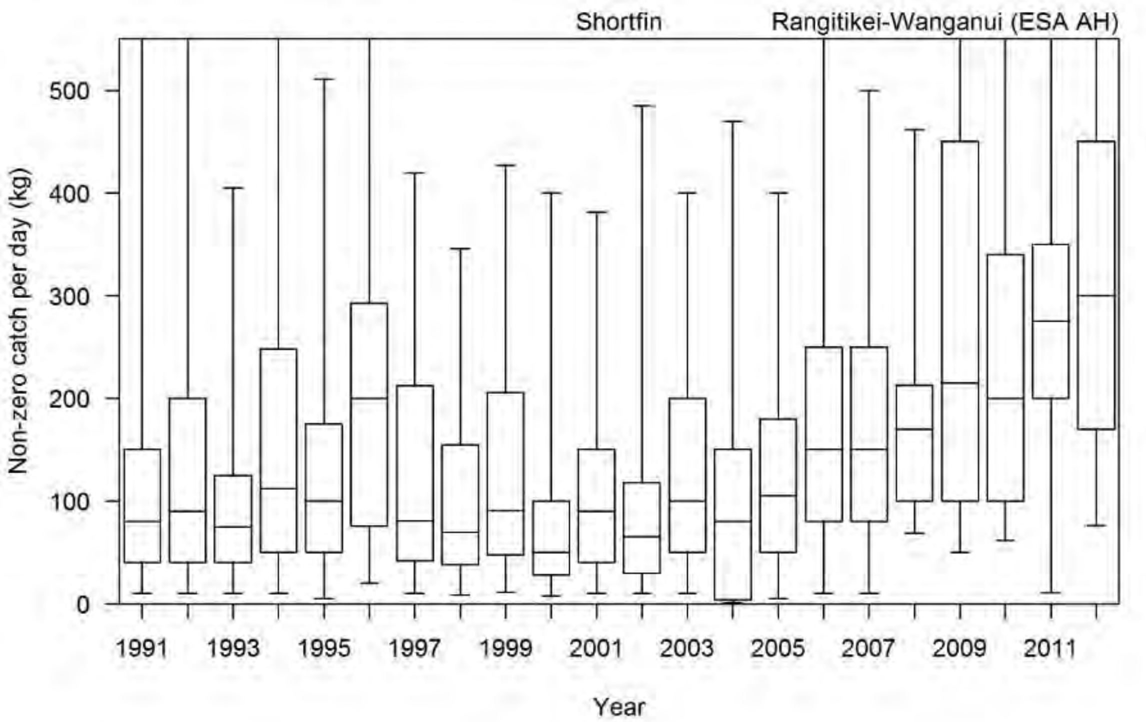


Figure H7: Shortfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Rangitikei-Wanganui (ESA AH)).

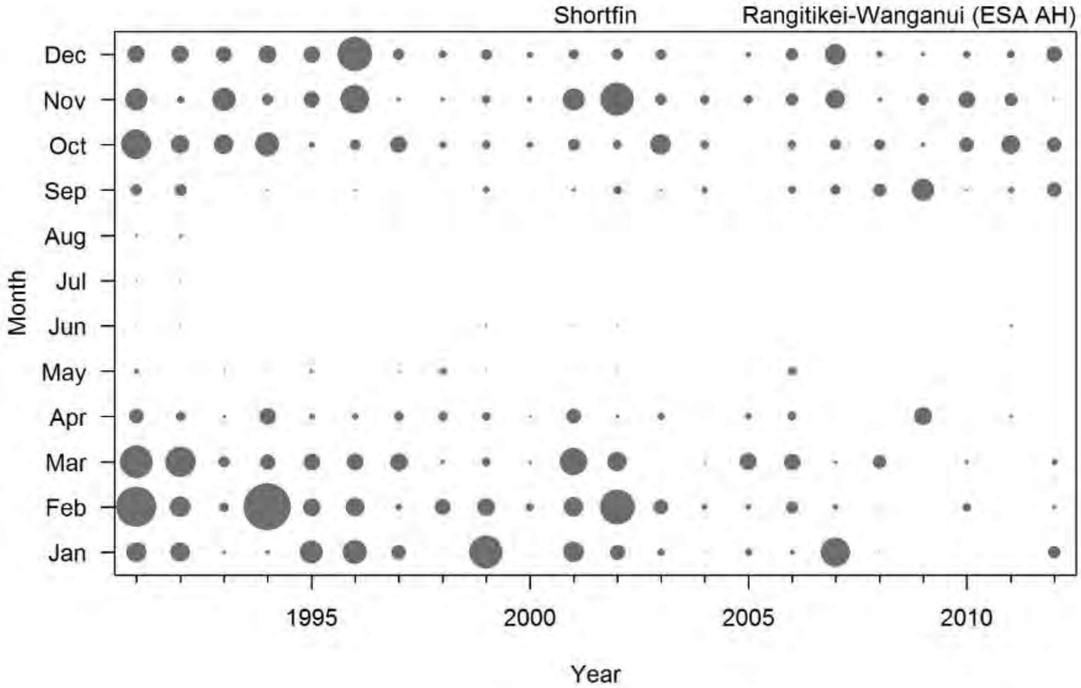


Figure H8: Shortfin eel catch by month for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

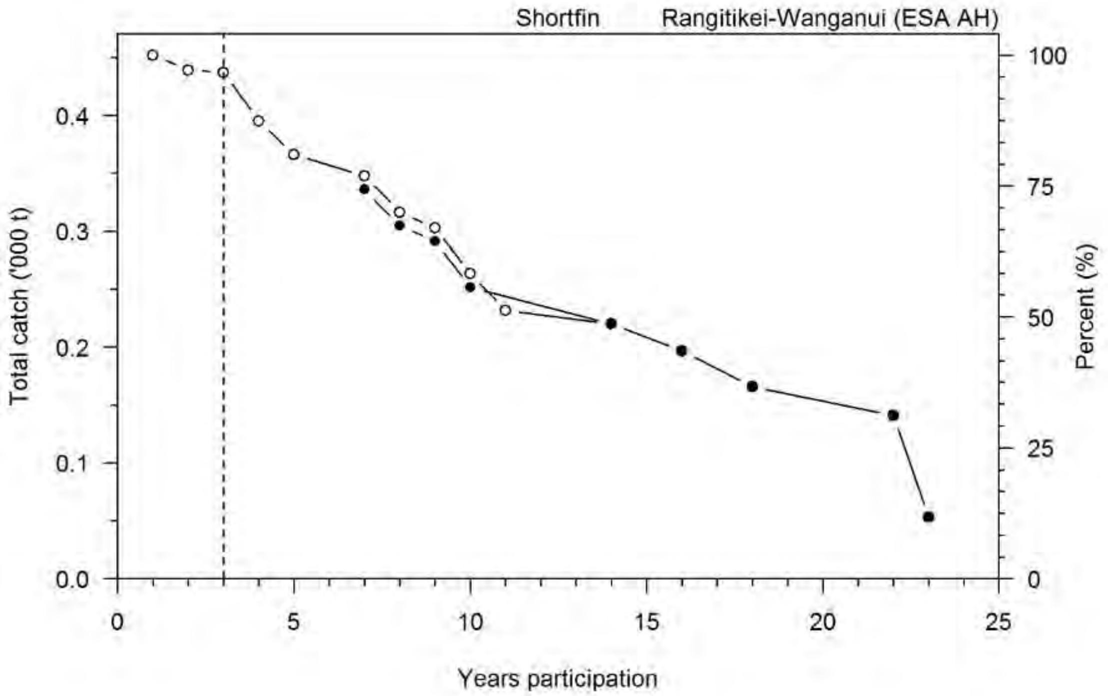


Figure H9: Relationship between years of participation in the fishery and shortfin total catch. The open circles represent all shortfin catch and the closed circles shortfin catch data from fishers who 1) caught shortfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core shortfin fisher analyses for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

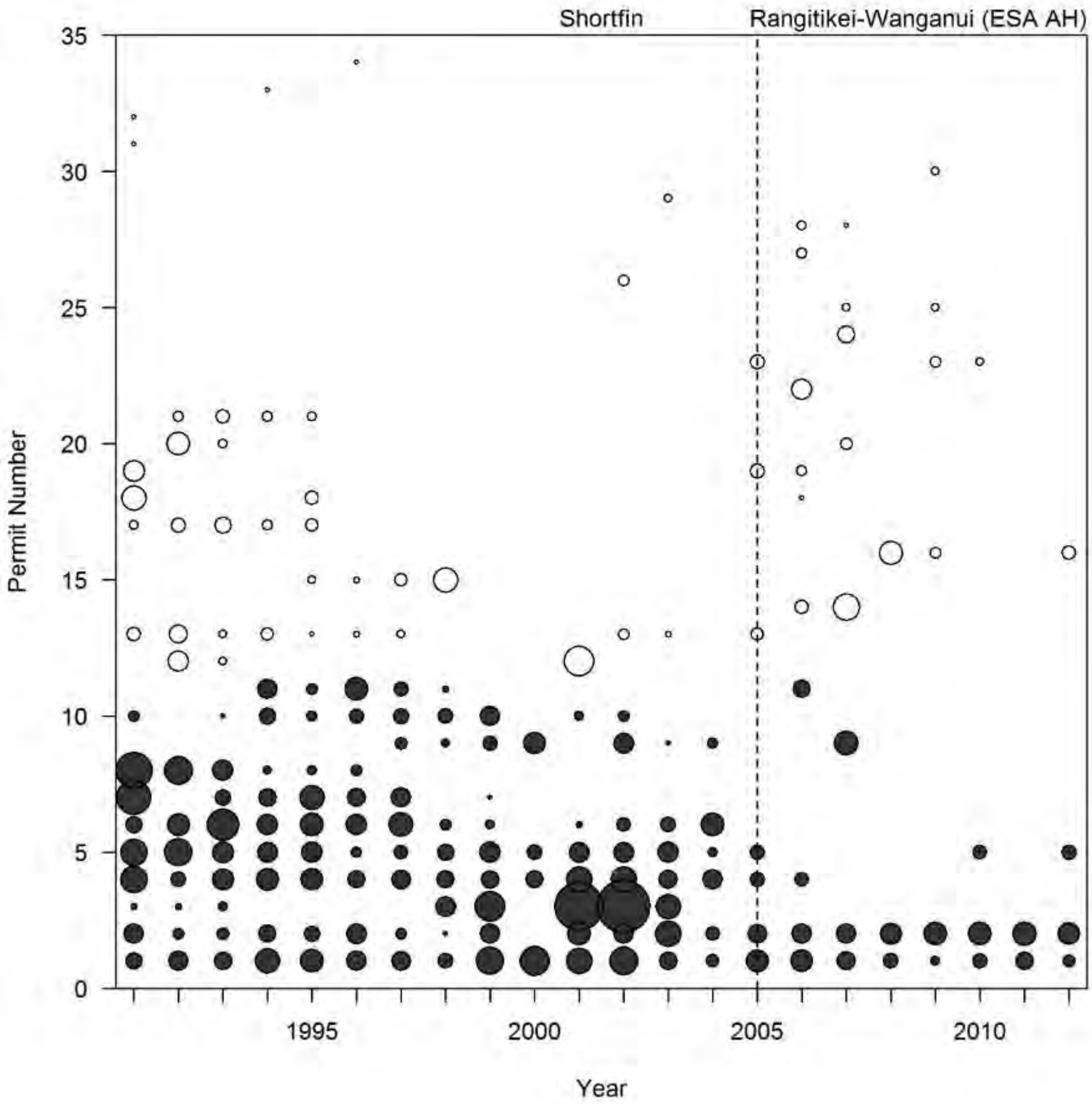


Figure H10: Relative catch of shortfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Rangitikei-Wanganui (ESA AH)).

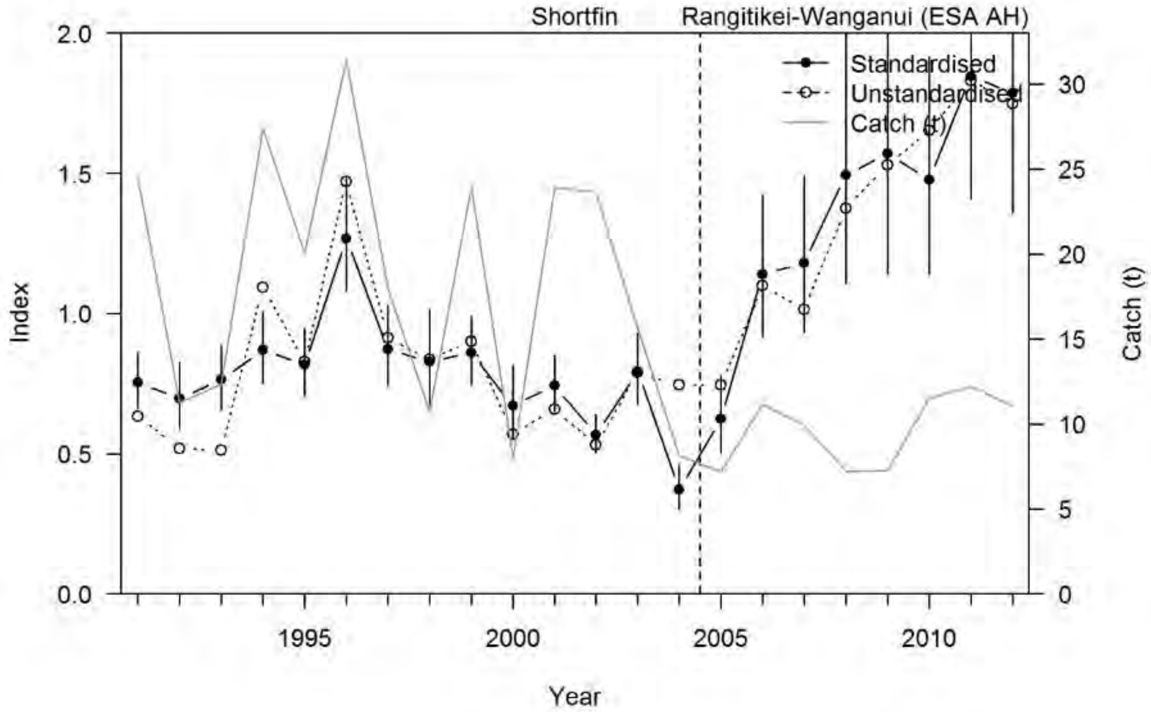


Figure H11: Indices of unstandardised catch per day and standardised CPUE for the core fishers shortfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Rangitikei-Wanganui (ESA AH)).

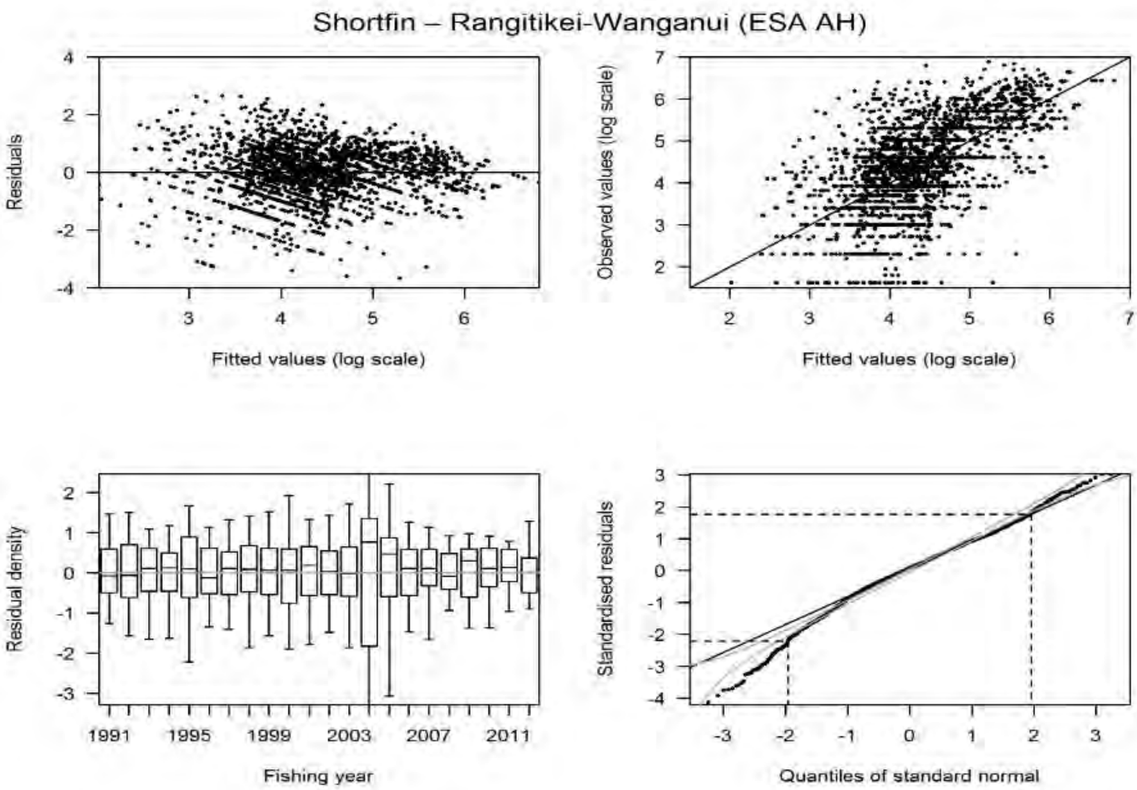


Figure H12: Residual diagnostic plots for the shortfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Rangitikei-Wanganui (ESA AH)).

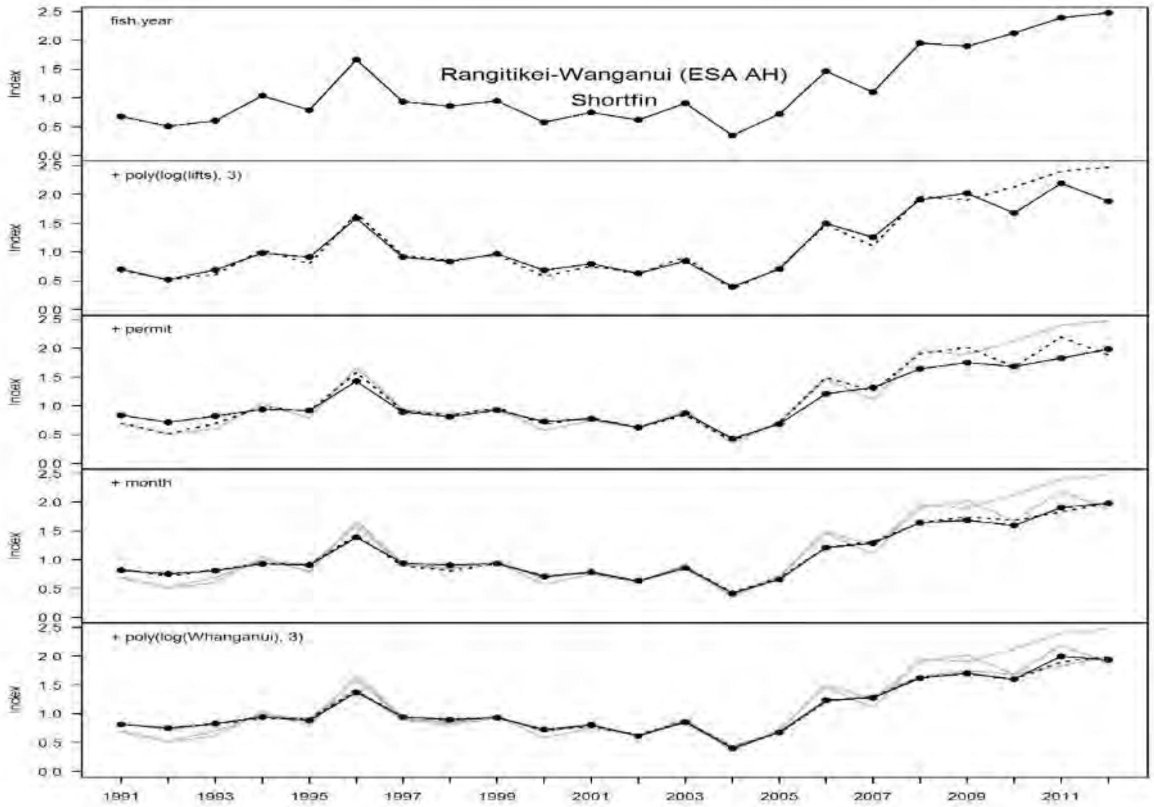


Figure H13: Step plot for the shortfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Rangitikei-Wanganui (ESA AH)).

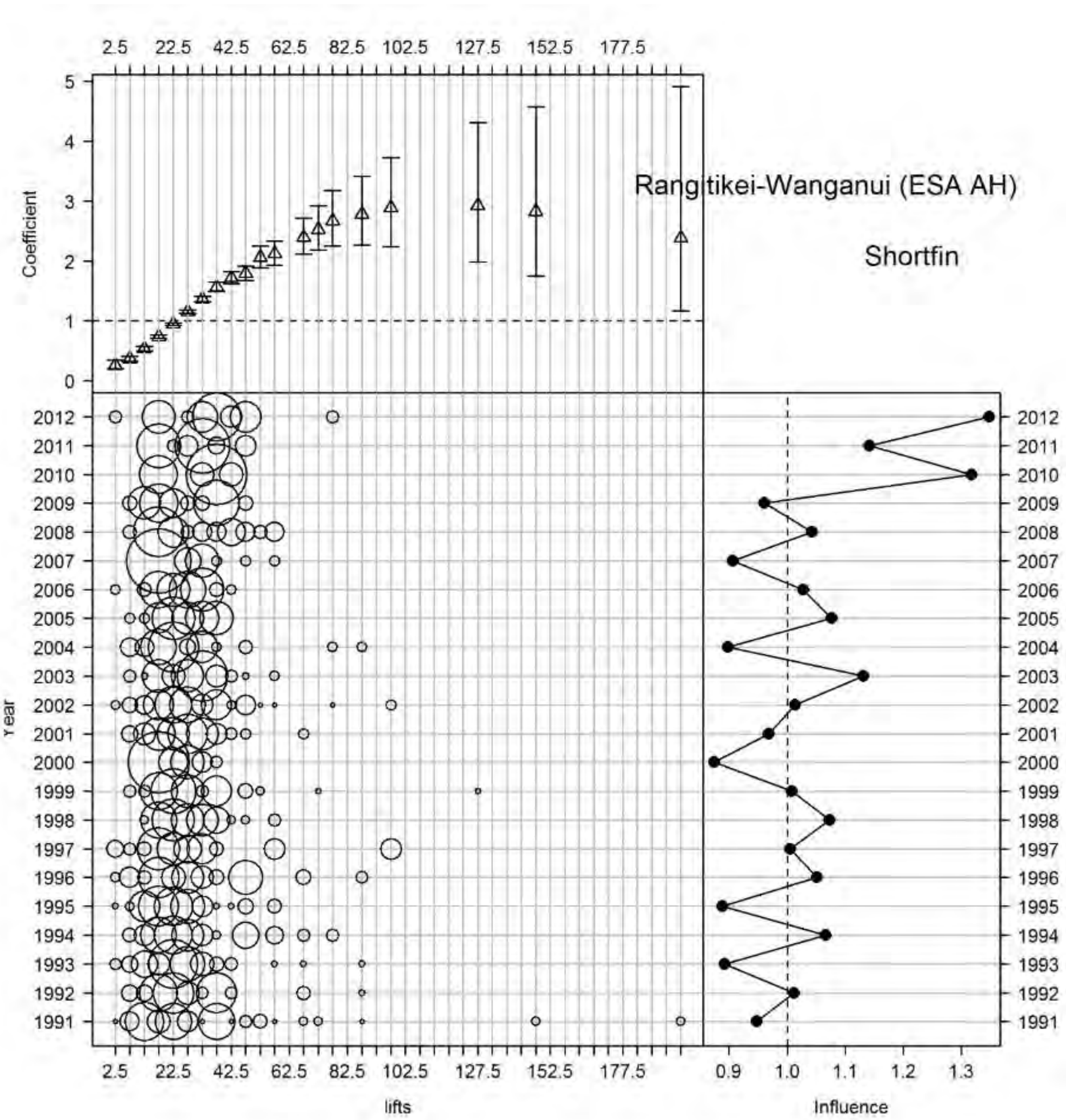


Figure H14: Influence of lifts for the shortfin CPUE model for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

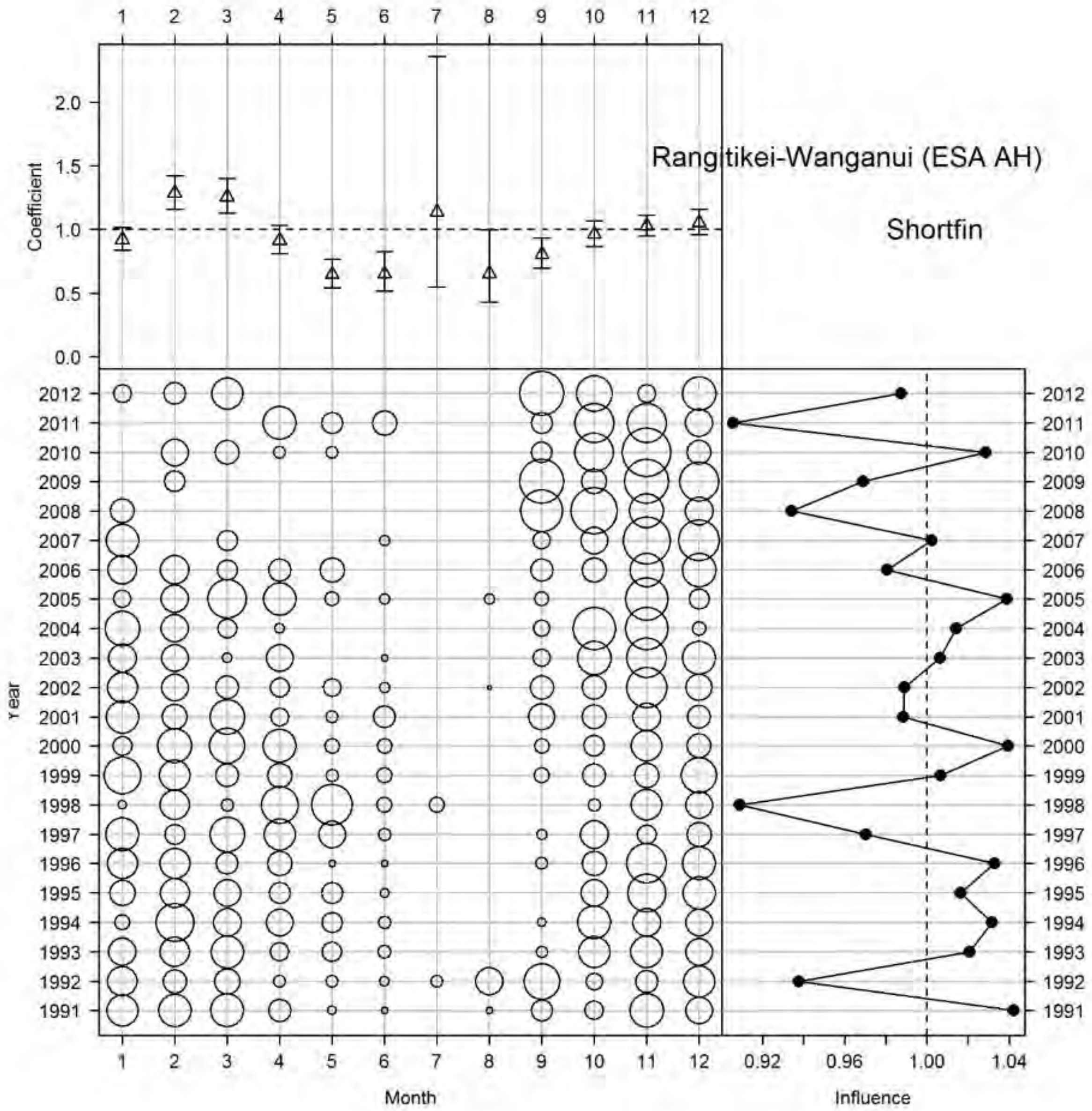


Figure H15: Influence of month for the shortfin CPUE model for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

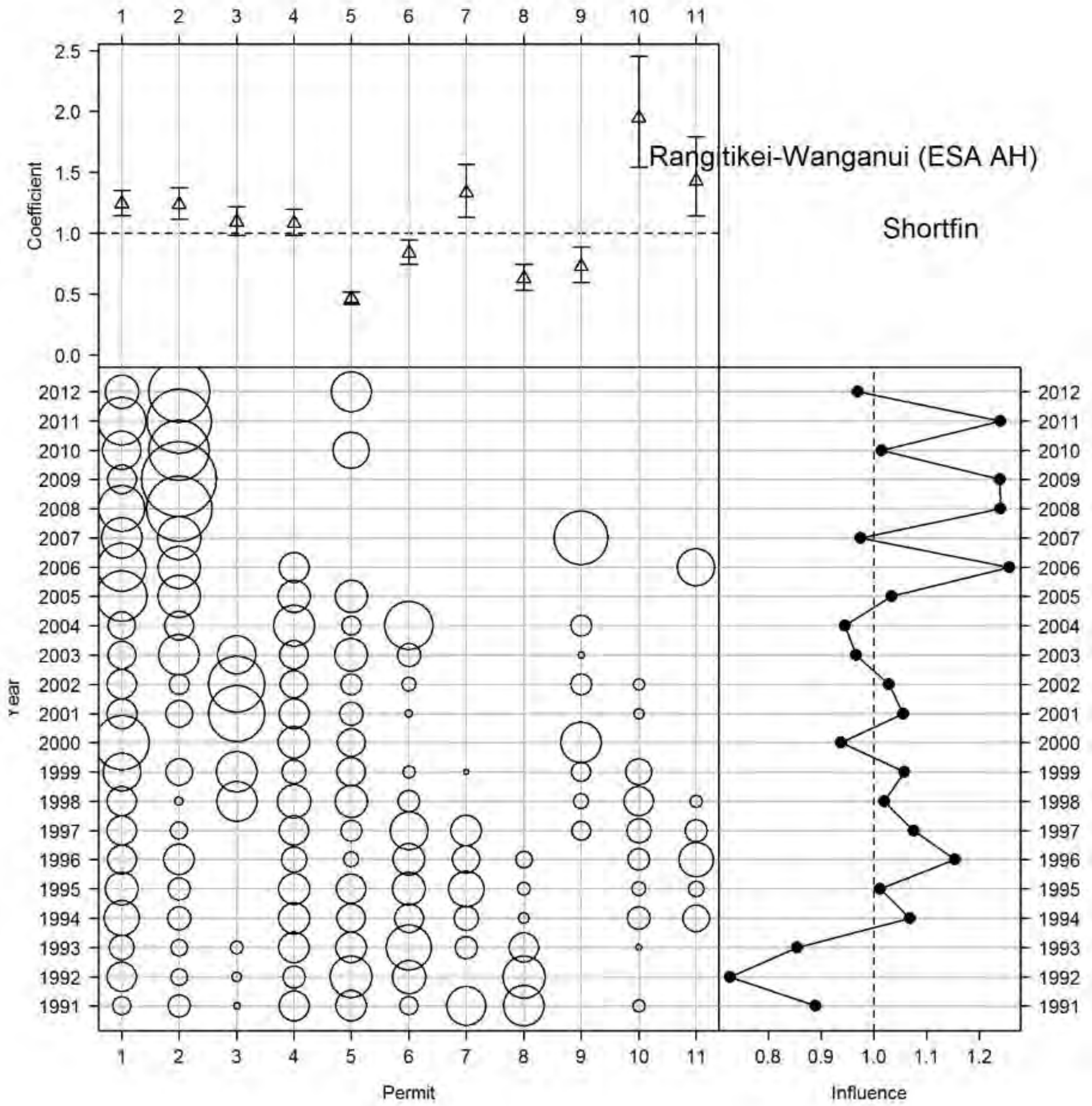


Figure H16: Influence of permit number for the shortfin CPUE model for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

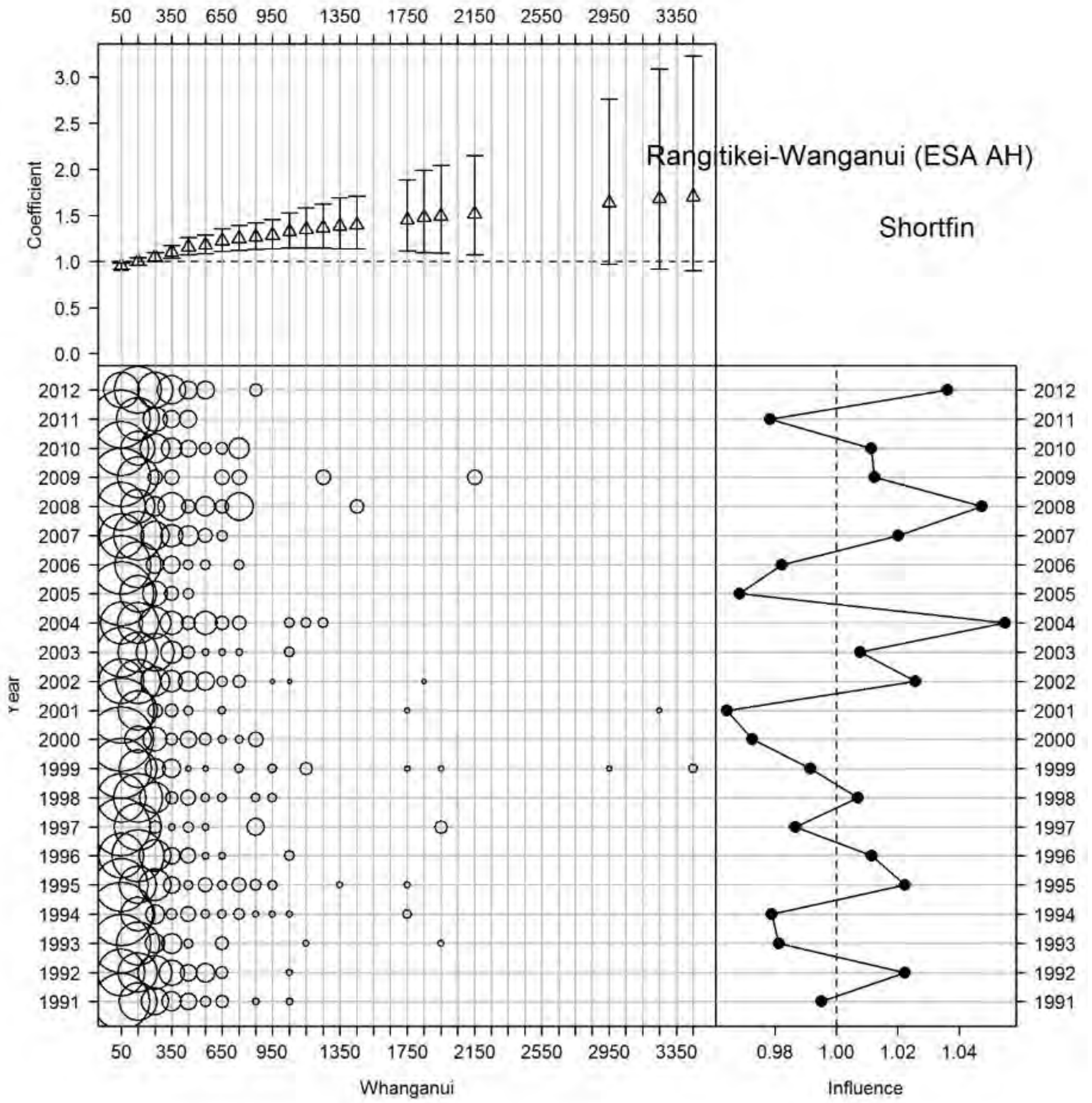


Figure H17: Influence of Whanganui River flow for the shortfin CPUE model for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

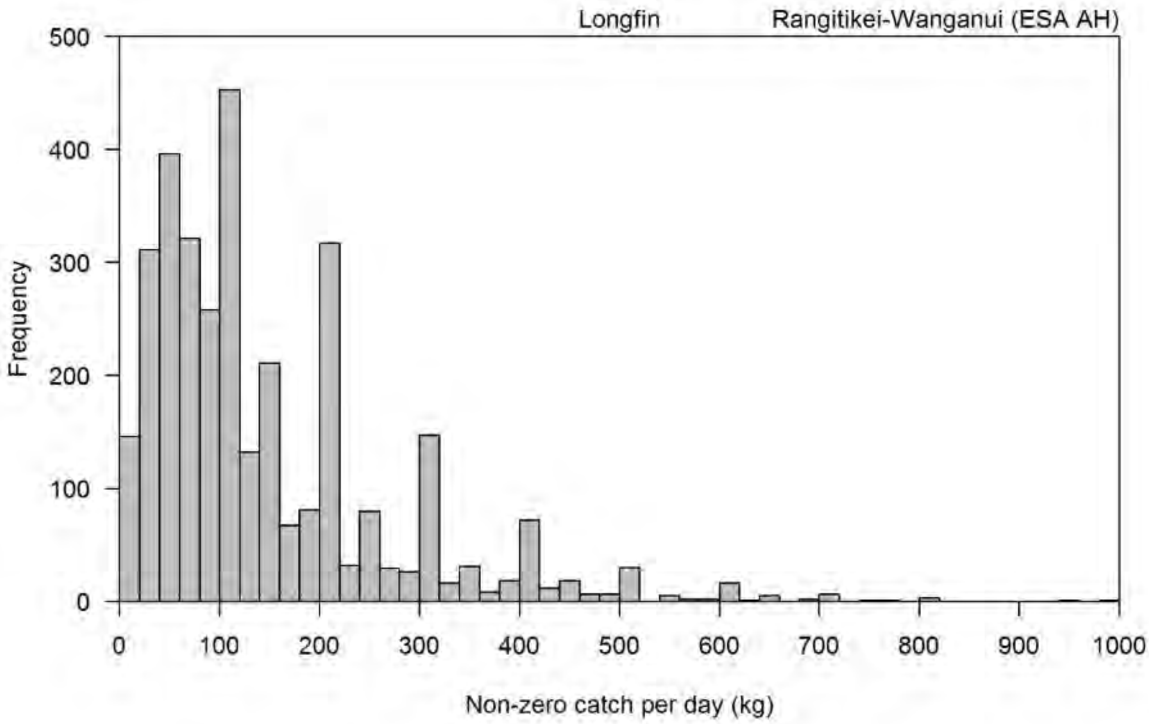


Figure H18: Frequency of longfin eel catch per day for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

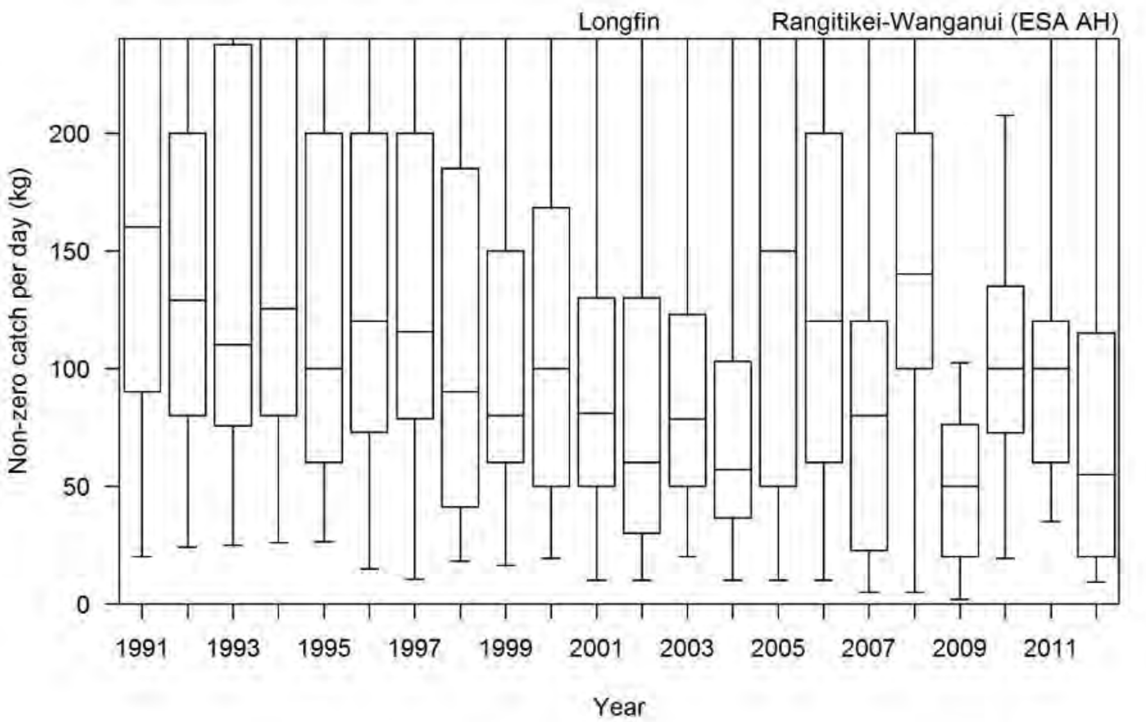


Figure H19: Longfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Rangitikei-Wanganui (ESA AH)).

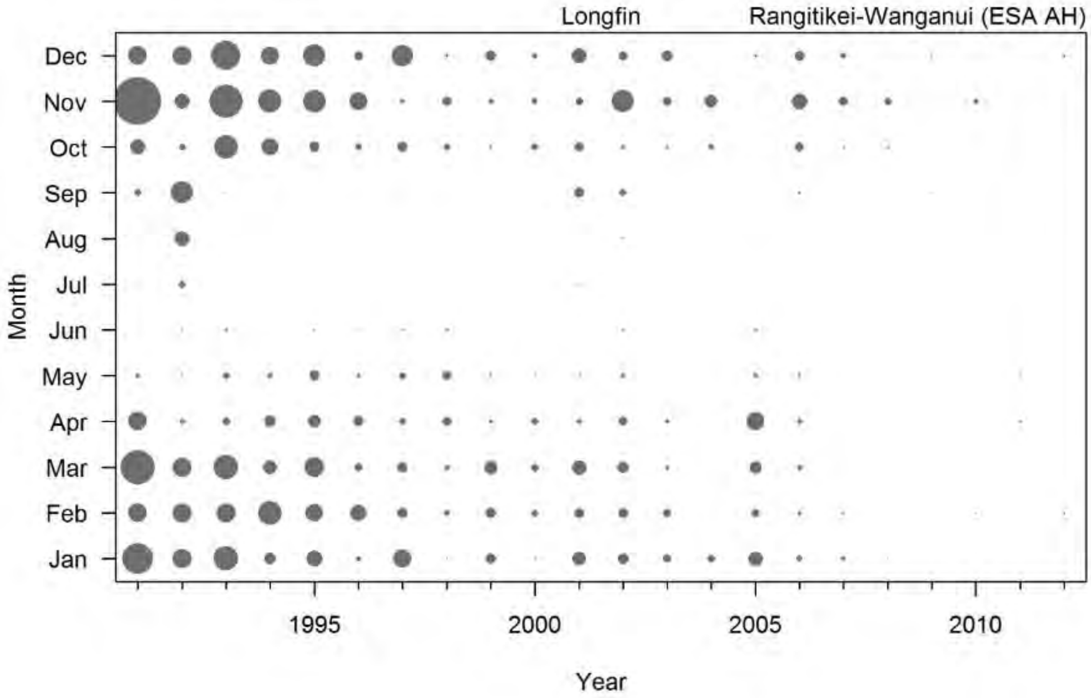


Figure H20: Longfin eel catch by month for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

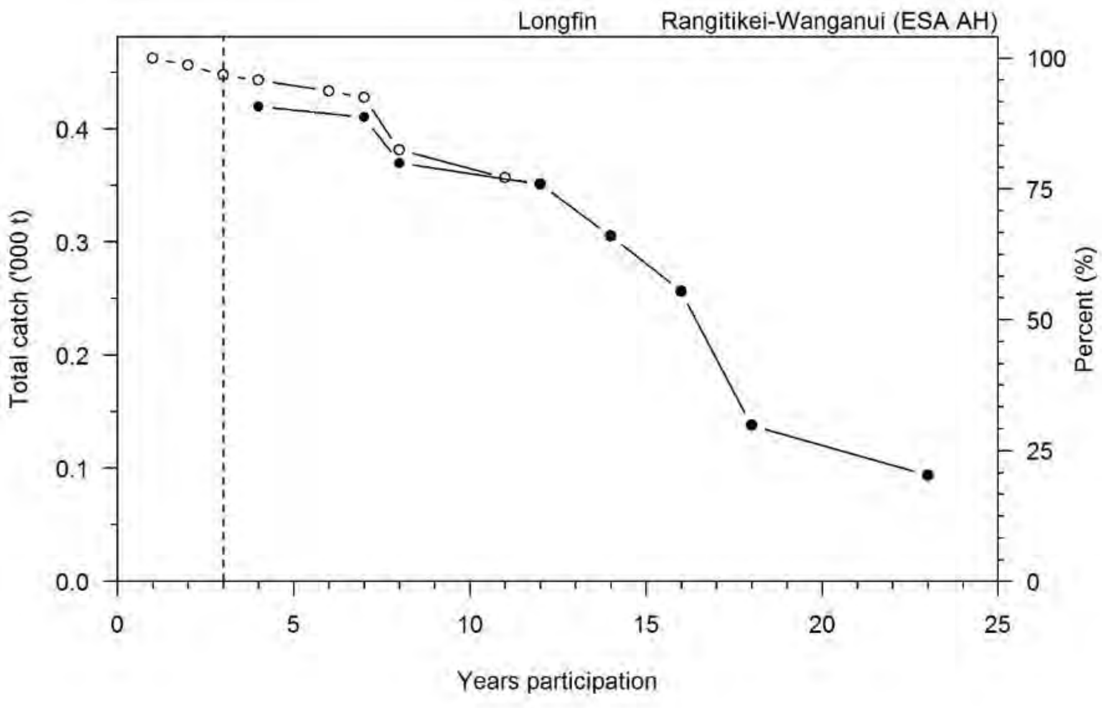


Figure H21: Relationship between years of participation in the fishery and longfin total catch. The open circles represent all longfin catch and the closed circles longfin catch data from fishers who 1) caught longfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core longfin fisher analyses for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

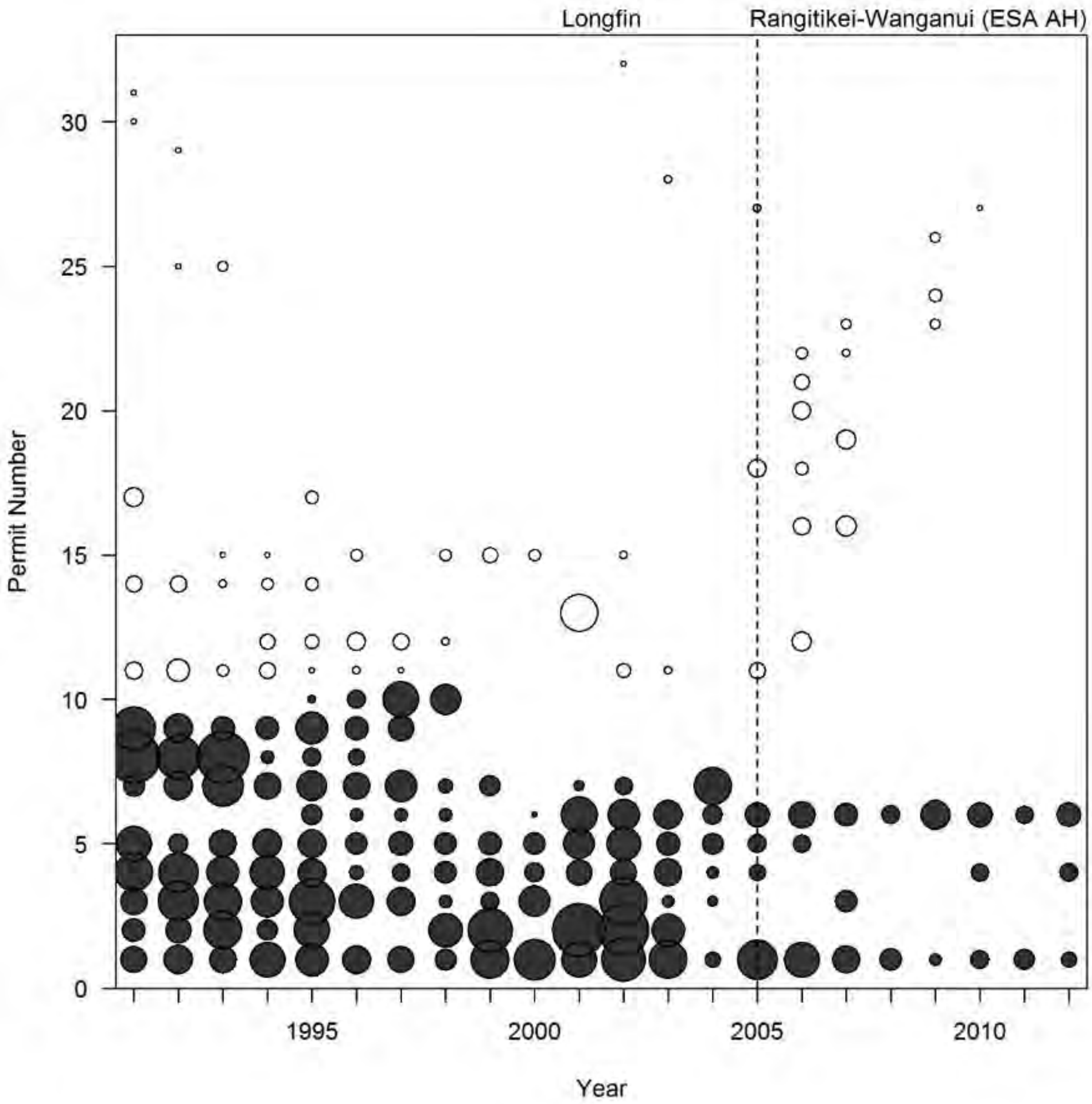


Figure H22: Relative catch of longfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Rangitikei-Wanganui (ESA AH)).

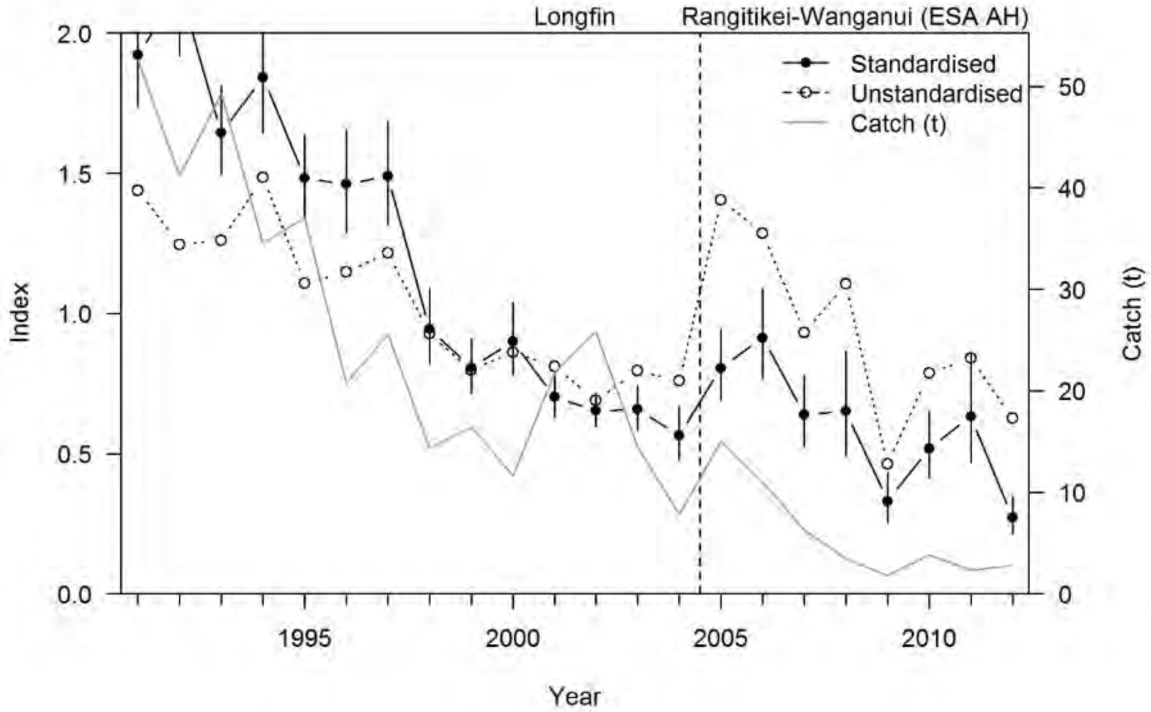


Figure H23: Indices of unstandardised catch per day and standardised CPUE for the core fishers longfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Rangitikei-Wanganui (ESA AH)).

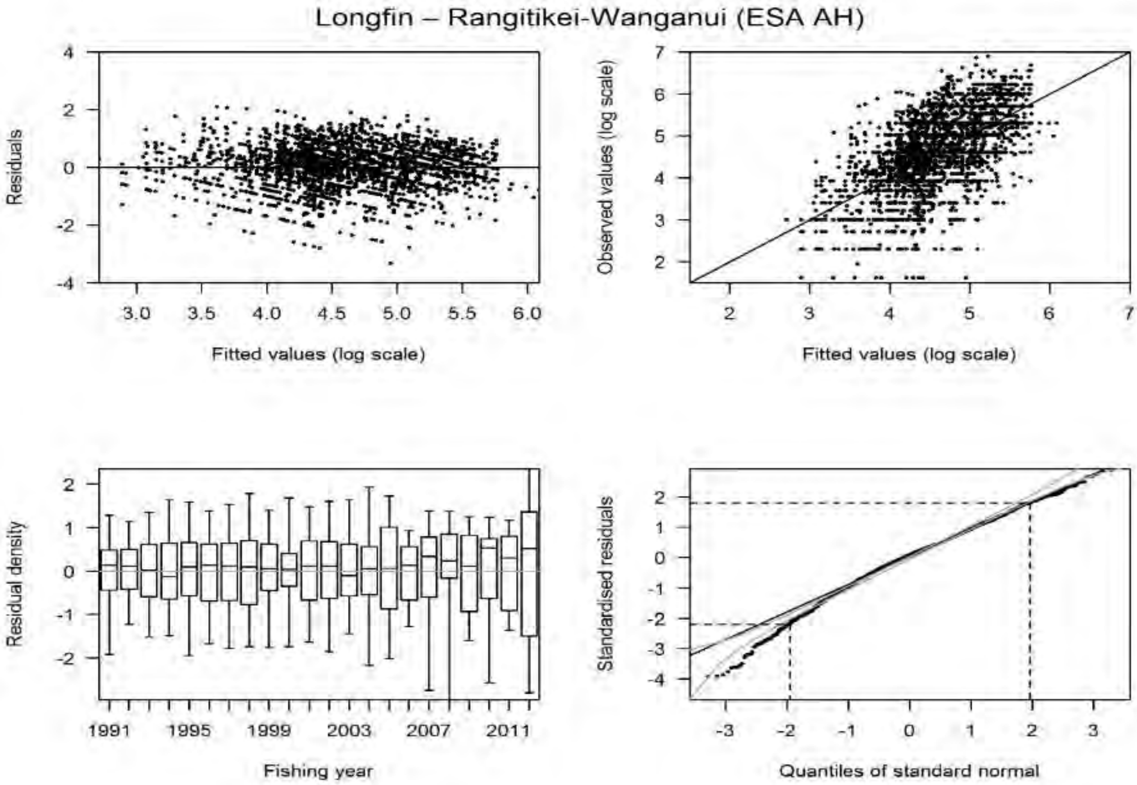


Figure H24: Residual diagnostic plots for the longfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Rangitikei-Wanganui (ESA AH)).

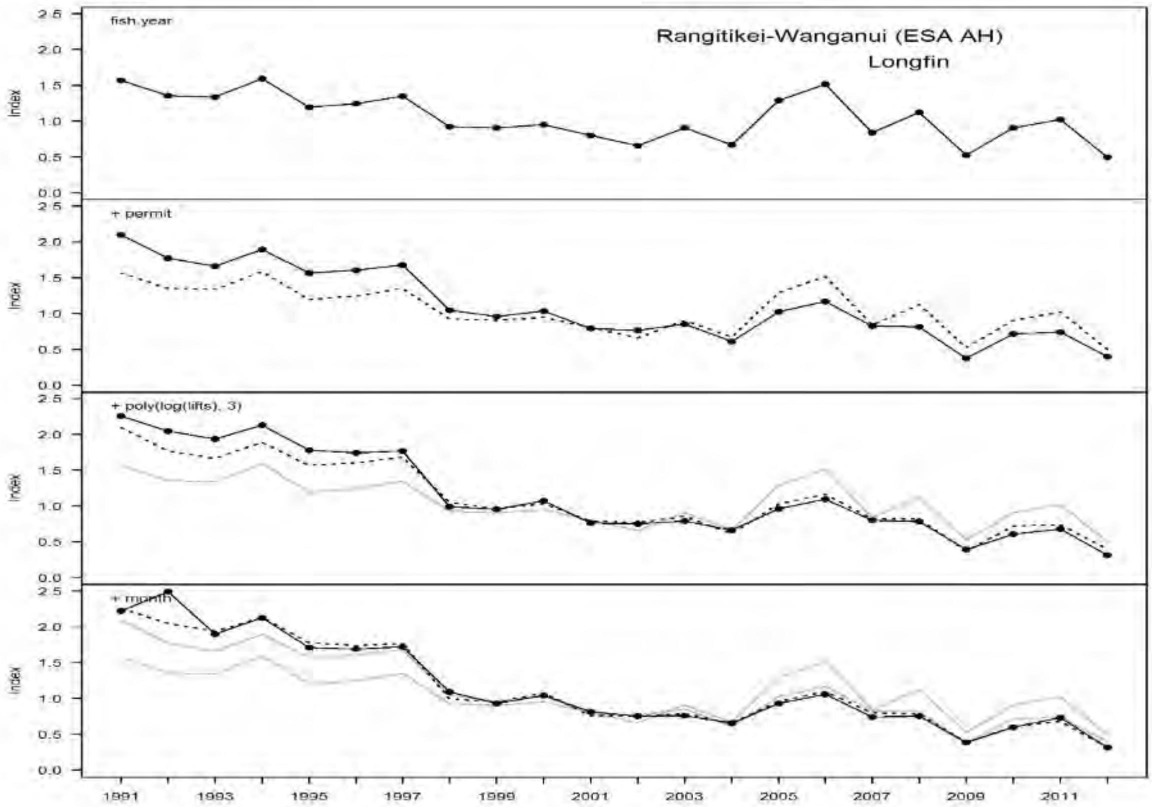


Figure H25: Step plot for the longfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Rangitikei-Wanganui (ESA AH)).

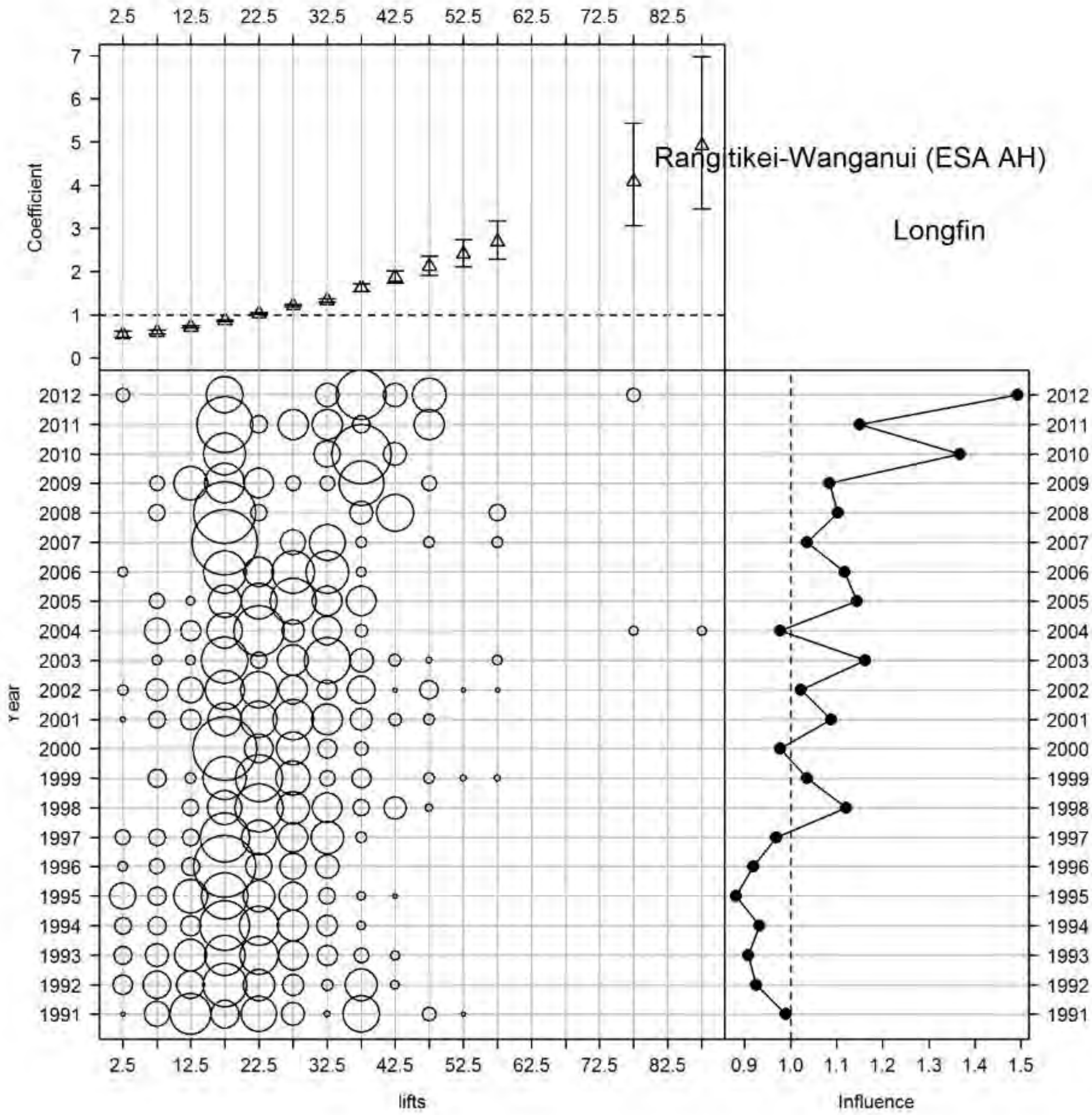


Figure H26: Influence of lifts for the longfin CPUE model for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

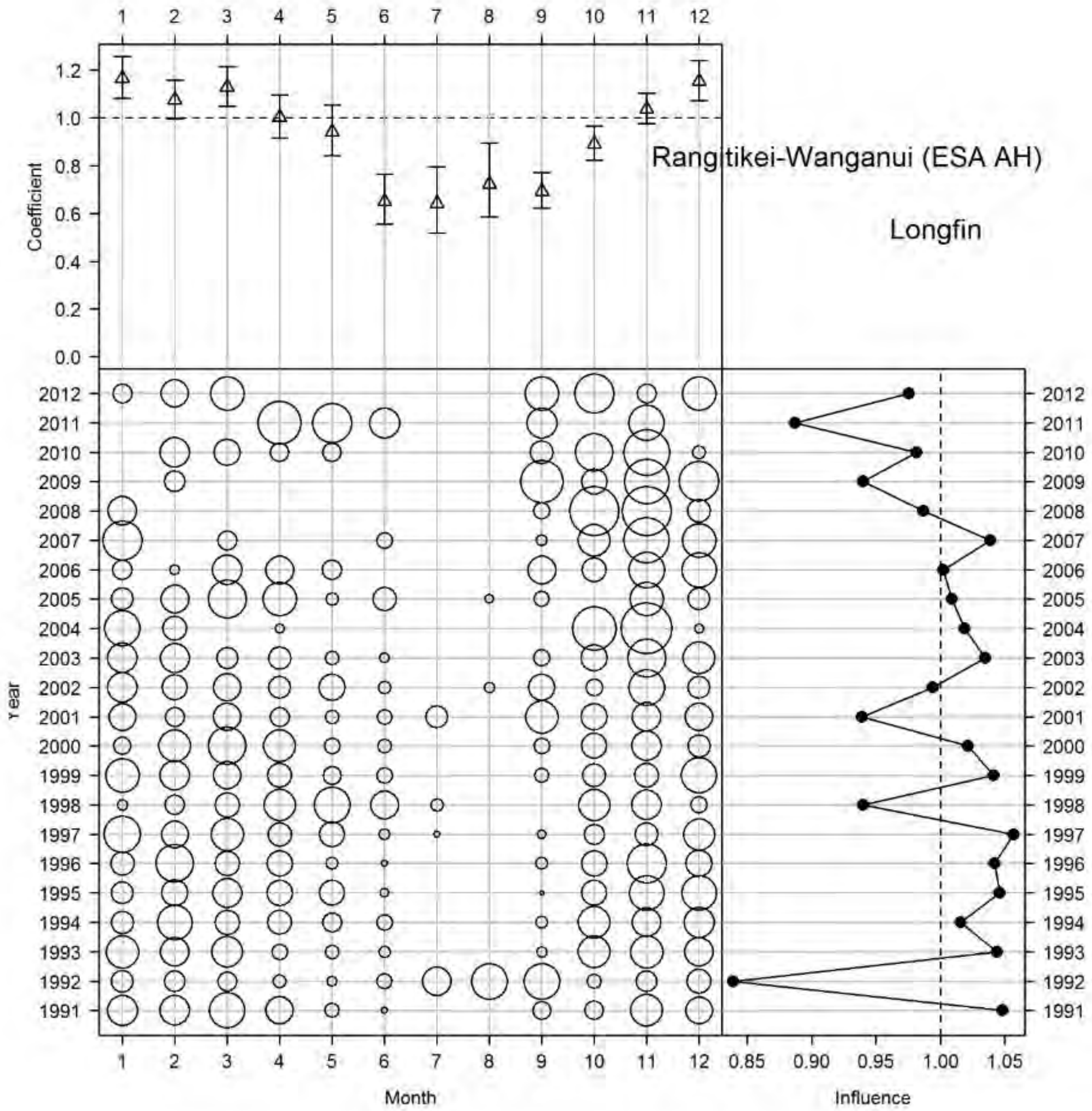


Figure H27: Influence of month for the longfin CPUE model for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

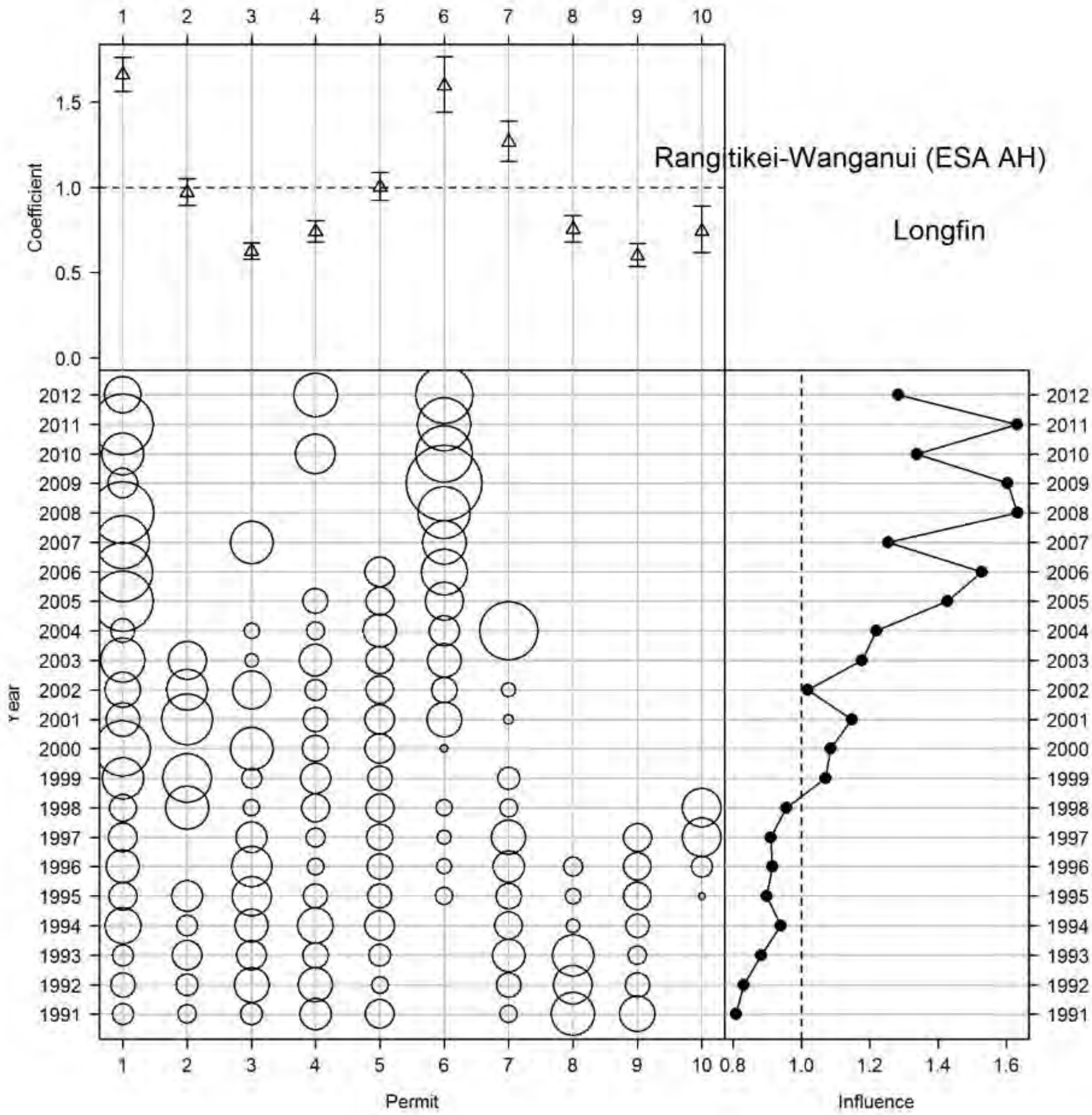


Figure H28: Influence of permit number for the longfin CPUE model for the years 1990–91 to 2011–12 (Rangitikei-Wanganui (ESA AH)).

Appendix J: Taranaki (ESA AJ)

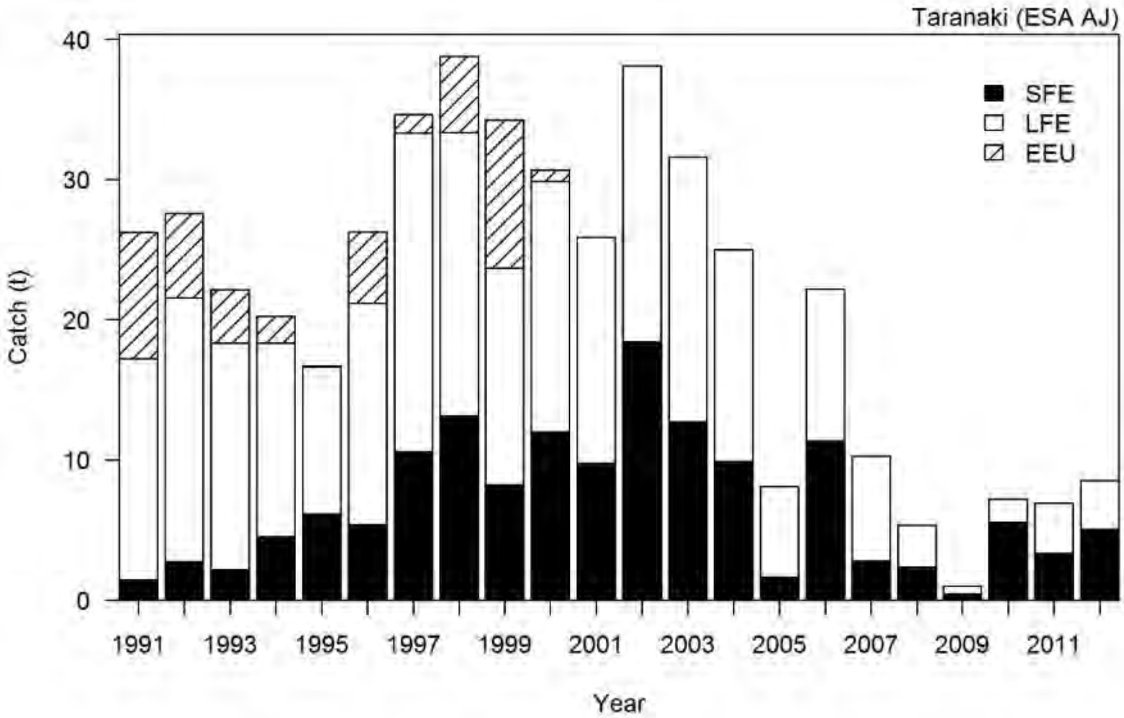


Figure J1: Total estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

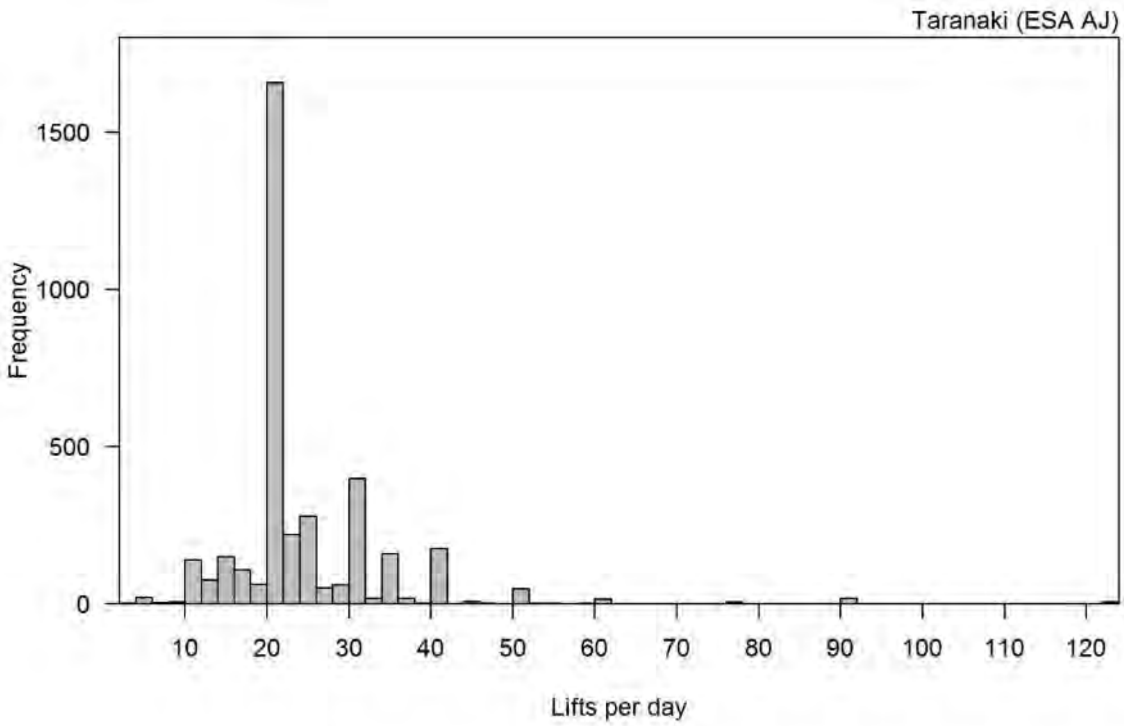


Figure J2: Frequency of total lifts per day for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

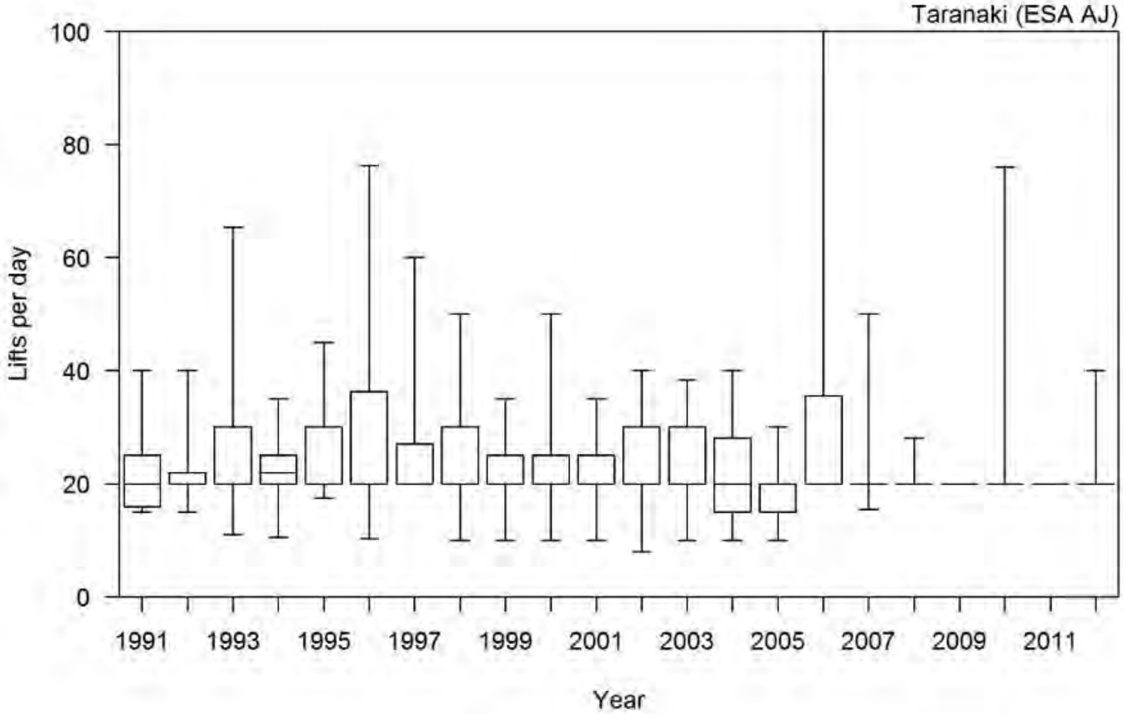


Figure J3: Total lifts per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Taranaki (ESA AJ)).

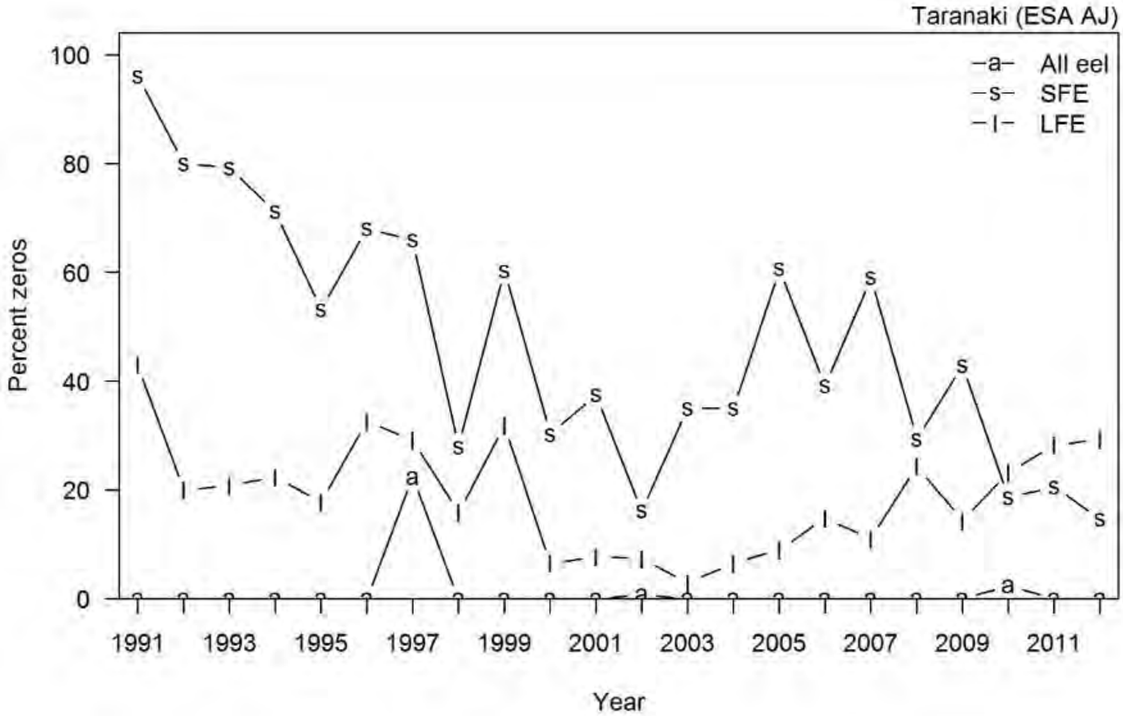


Figure J4: Proportion of zero records for all eel, shortfin (SFE), and longfin (LFE) catch for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

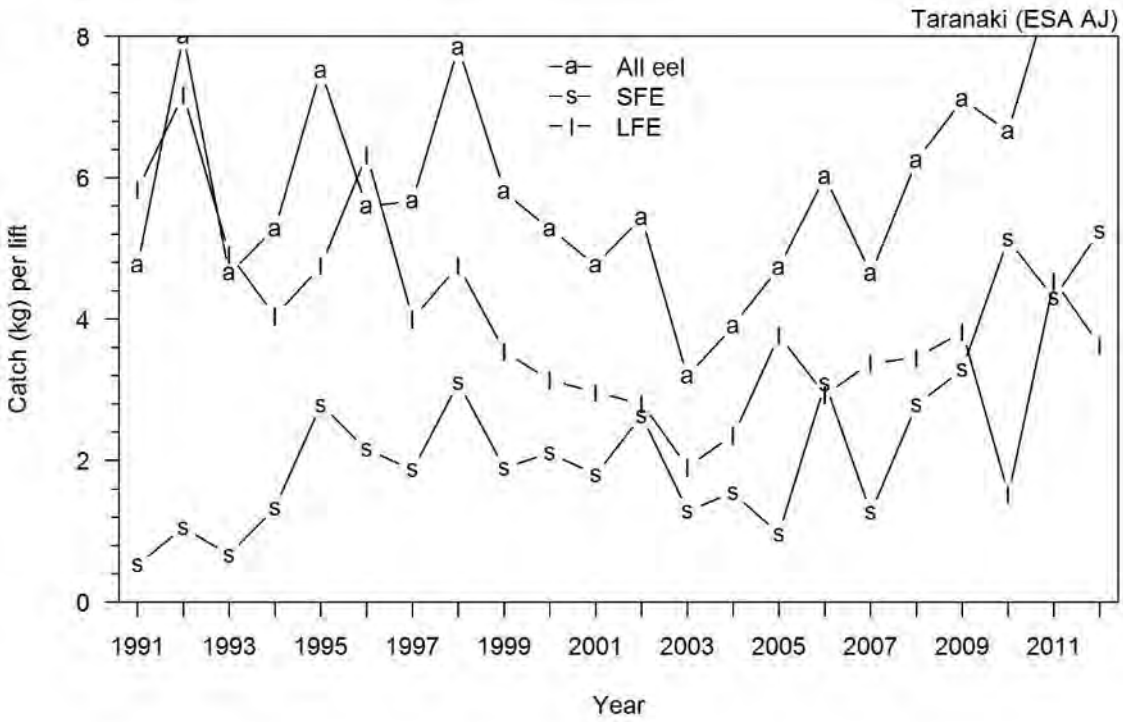


Figure J5: Unstandardised catch per lift (total kg/total lifts) for all eel, shortfin (SFE), and longfin (LFE) for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

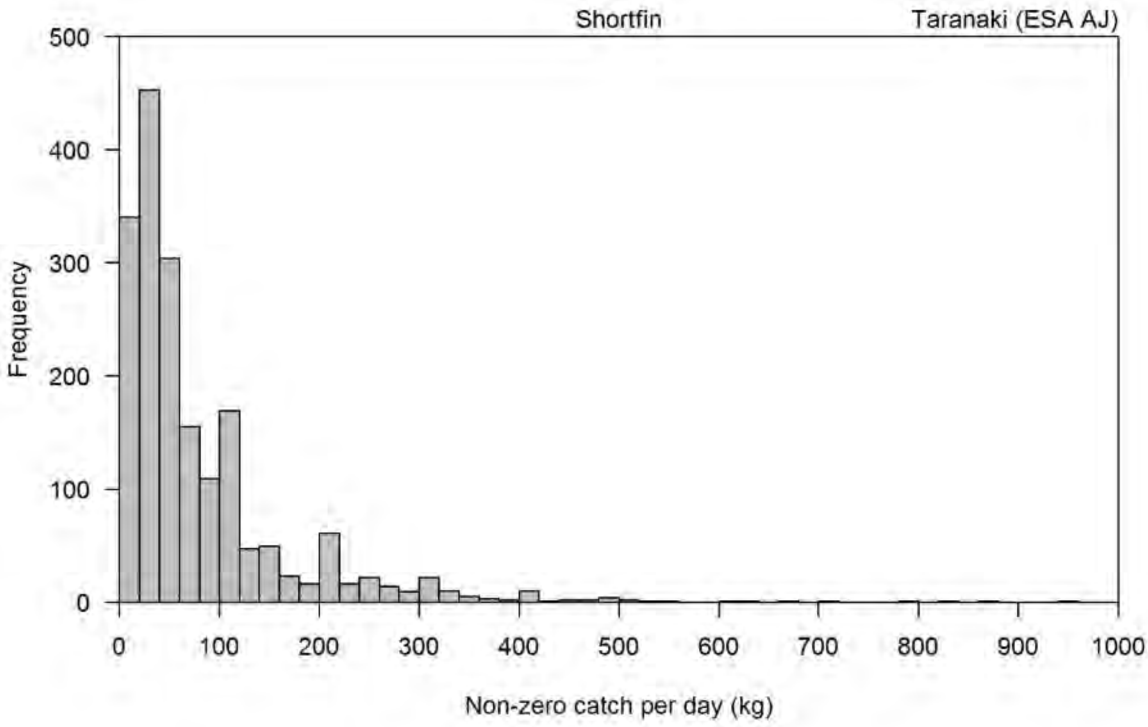


Figure J6: Frequency of shortfin eel catch per day for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

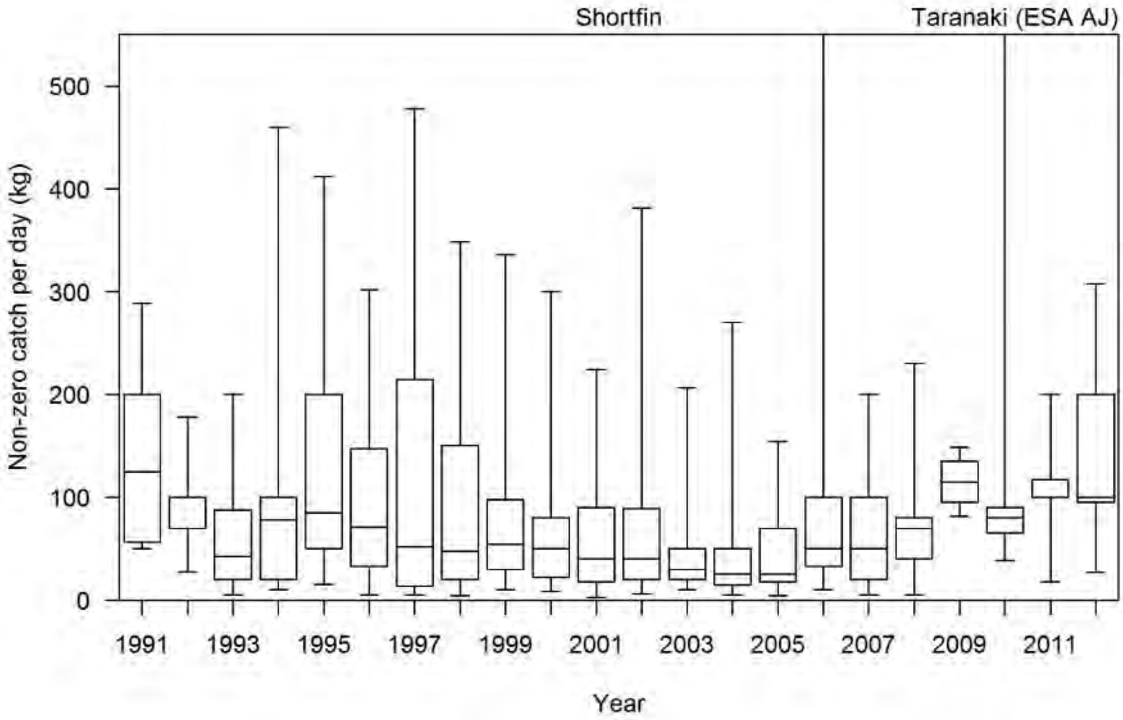


Figure J7: Shortfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Taranaki (ESA AJ)).

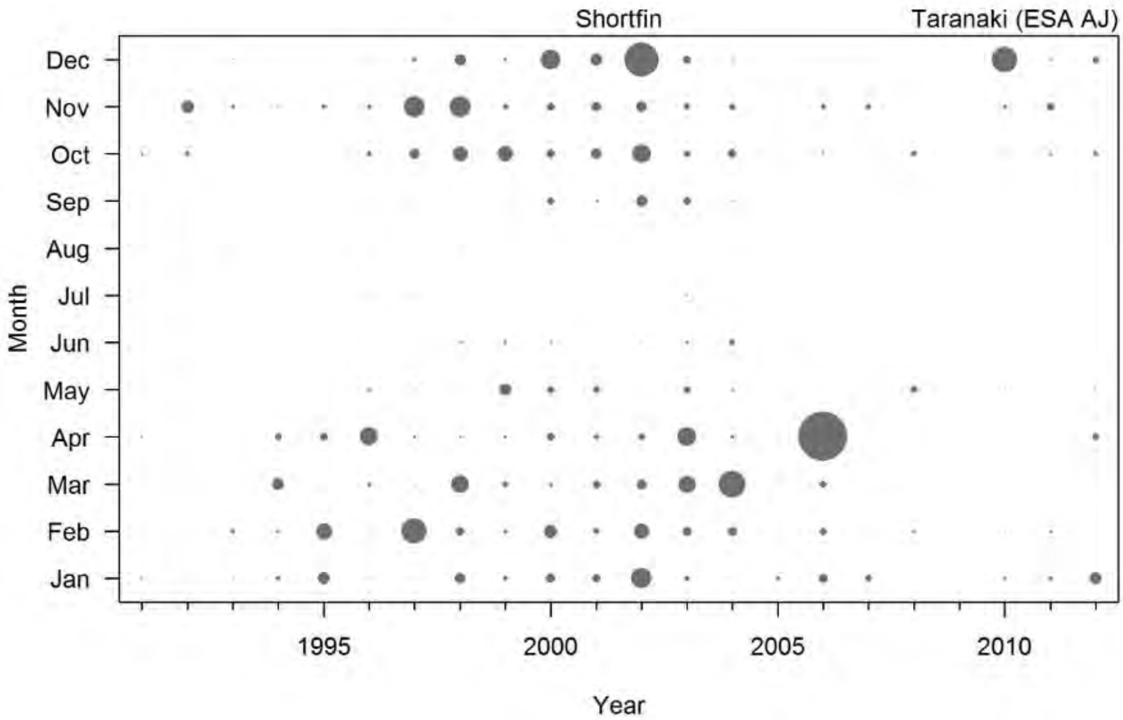


Figure J8: Shortfin eel catch by month for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

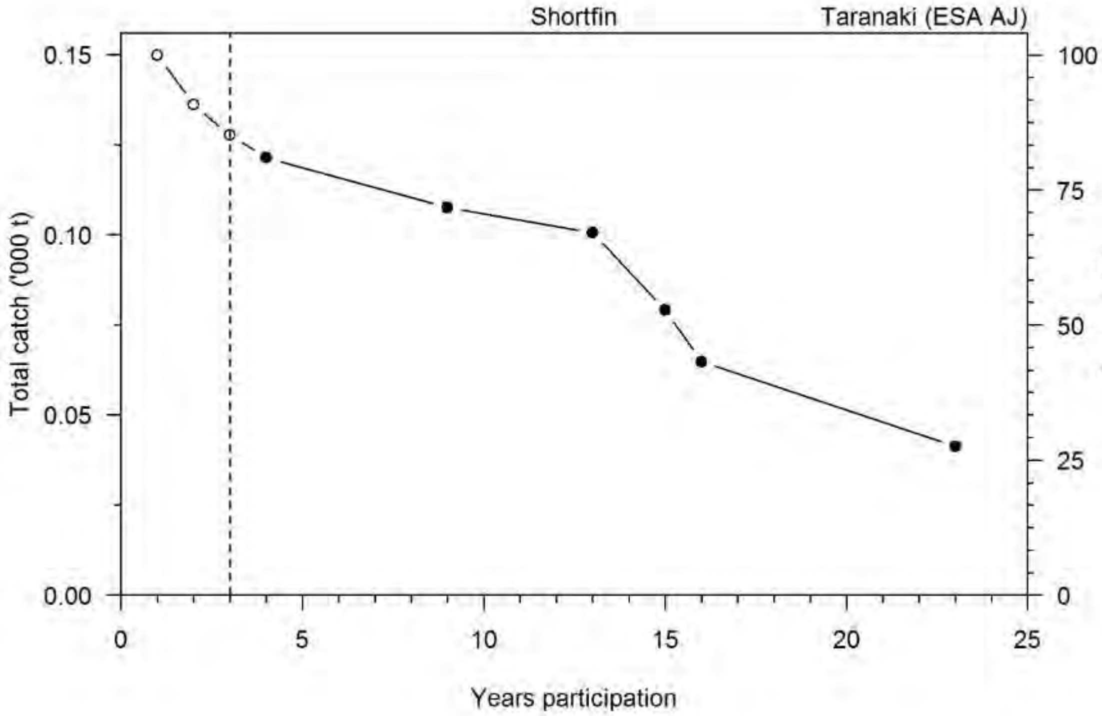


Figure J9: Relationship between years of participation in the fishery and shortfin total catch. The open circles represent all shortfin catch and the closed circles shortfin catch data from fishers who 1) caught shortfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core shortfin fisher analyses for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

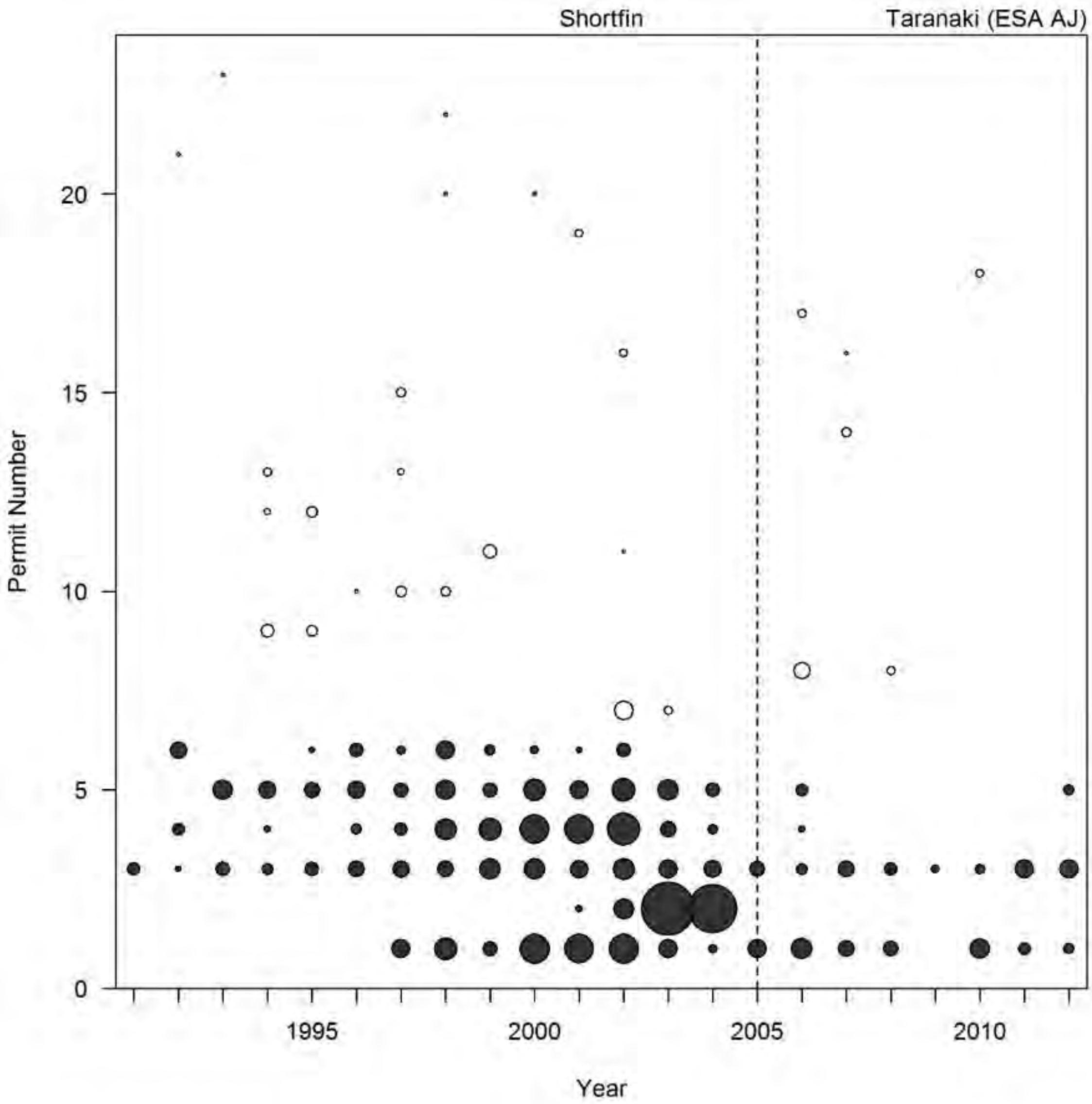


Figure J10: Relative catch of shortfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Taranaki (ESA AJ)).

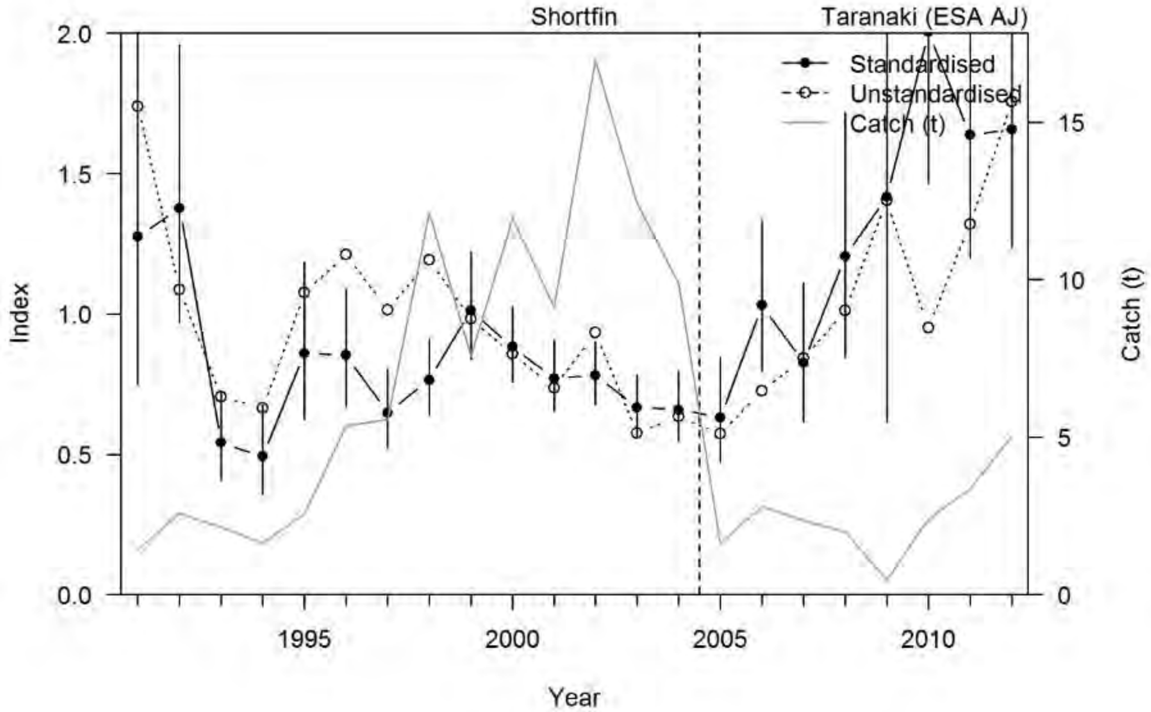


Figure J11: Indices of unstandardised catch per day and standardised CPUE for the core fishers shortfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Taranaki (ESA AJ)).

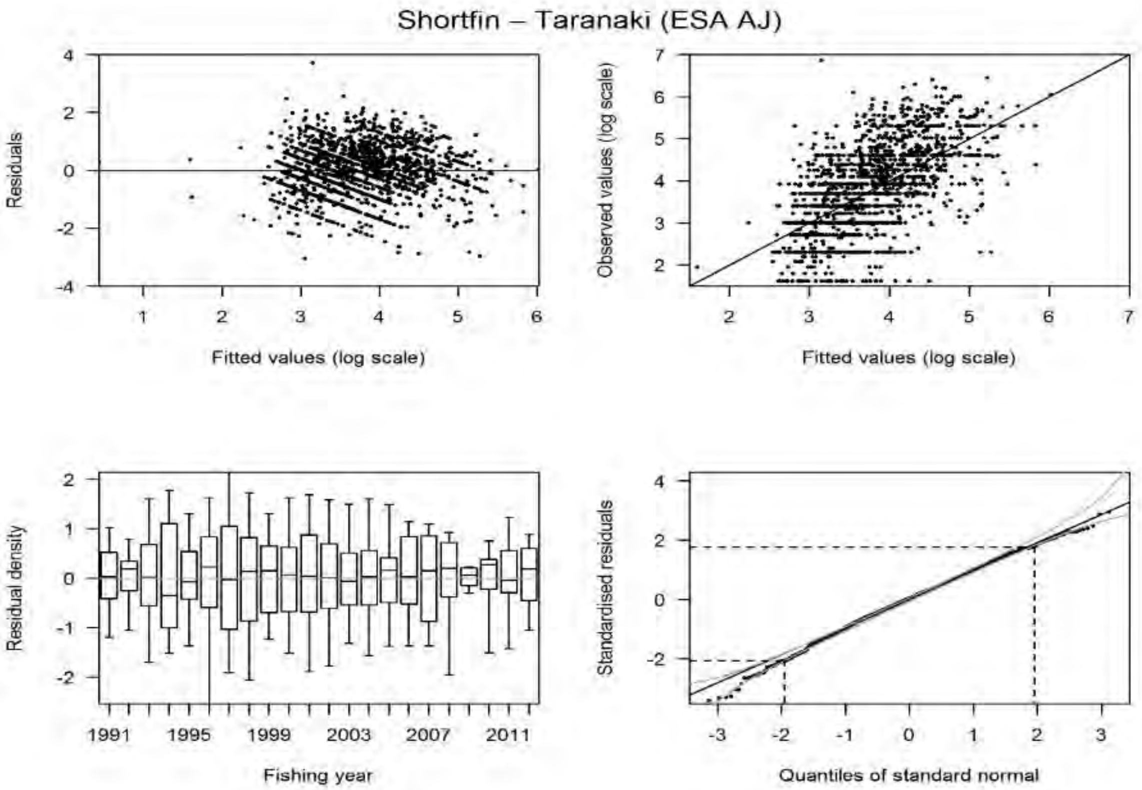


Figure J12: Residual diagnostic plots for the shortfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Taranaki (ESA AJ)).

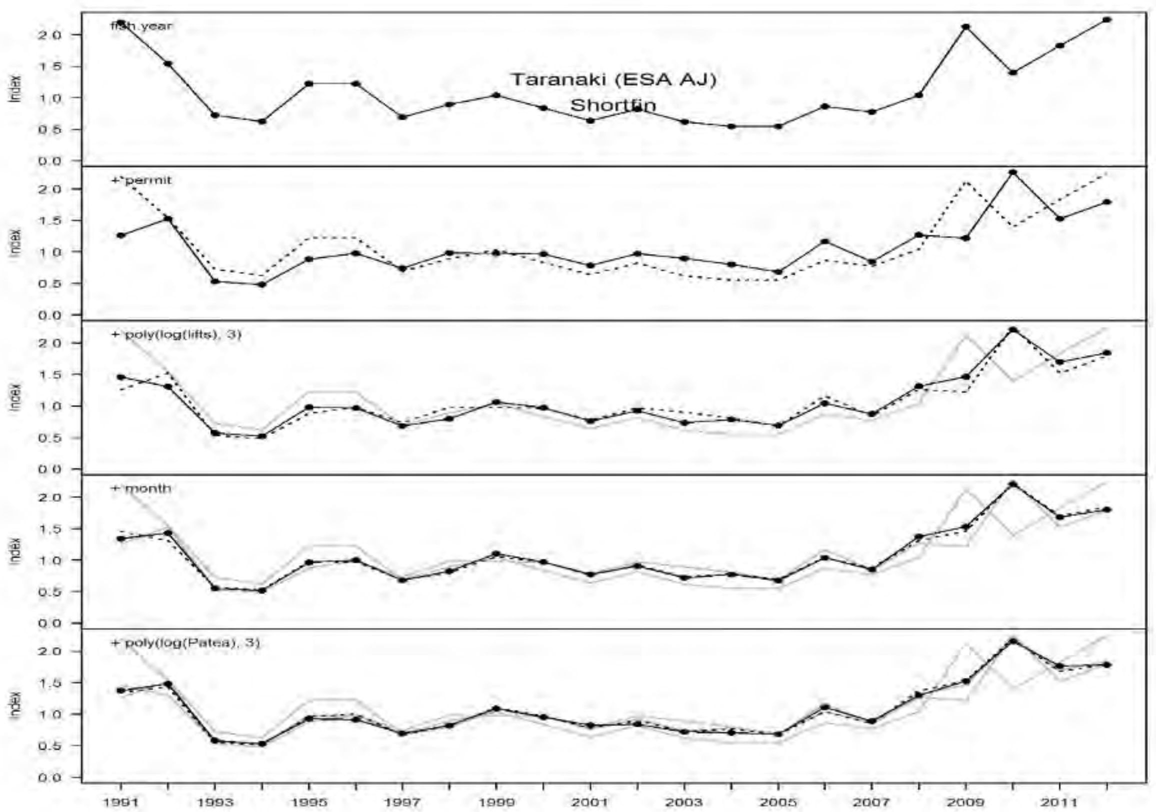


Figure J13: Step plot for the shortfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Taranaki (ESA AJ)).

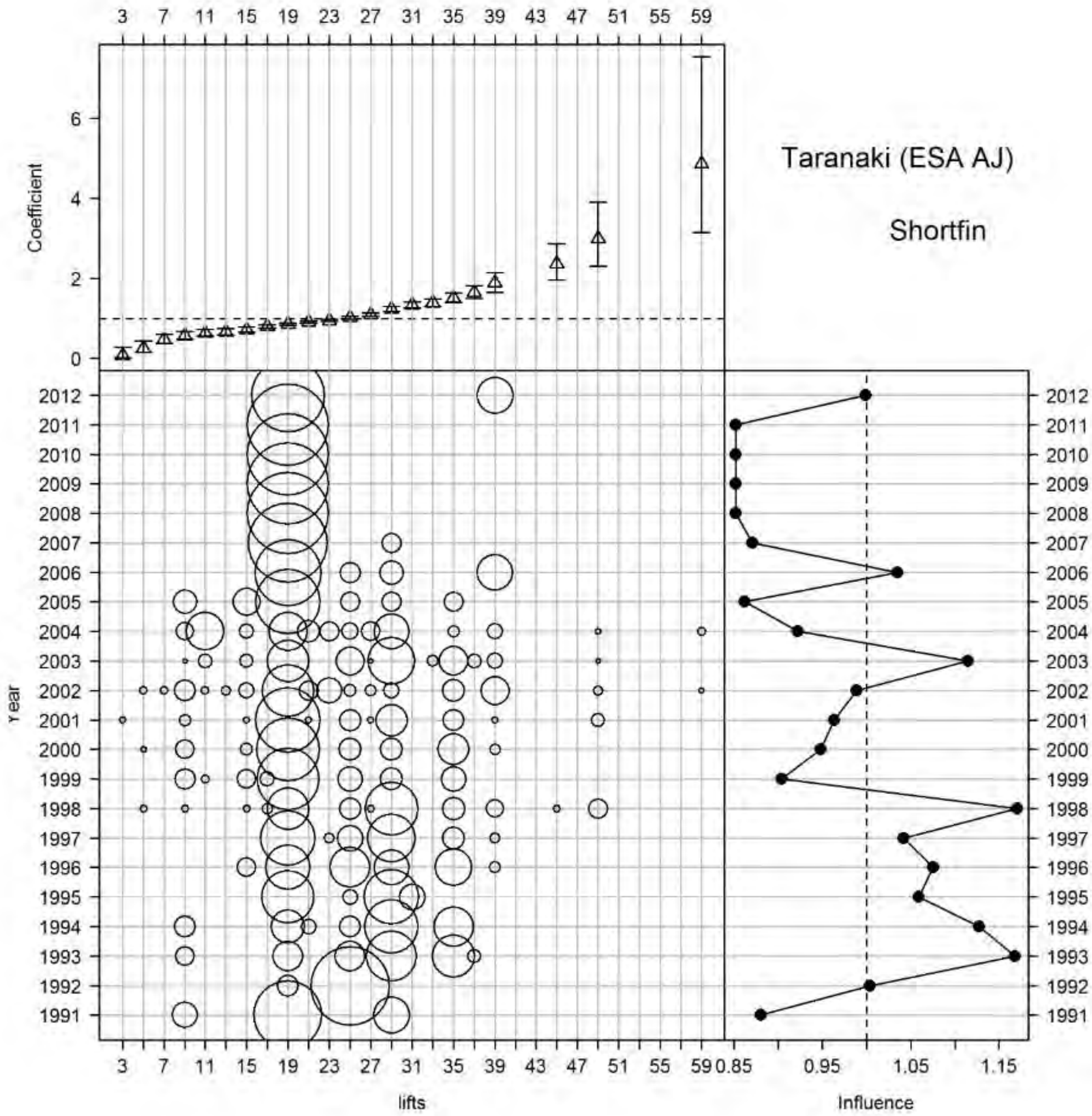


Figure J14: Influence of lifts for the shortfin CPUE model for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

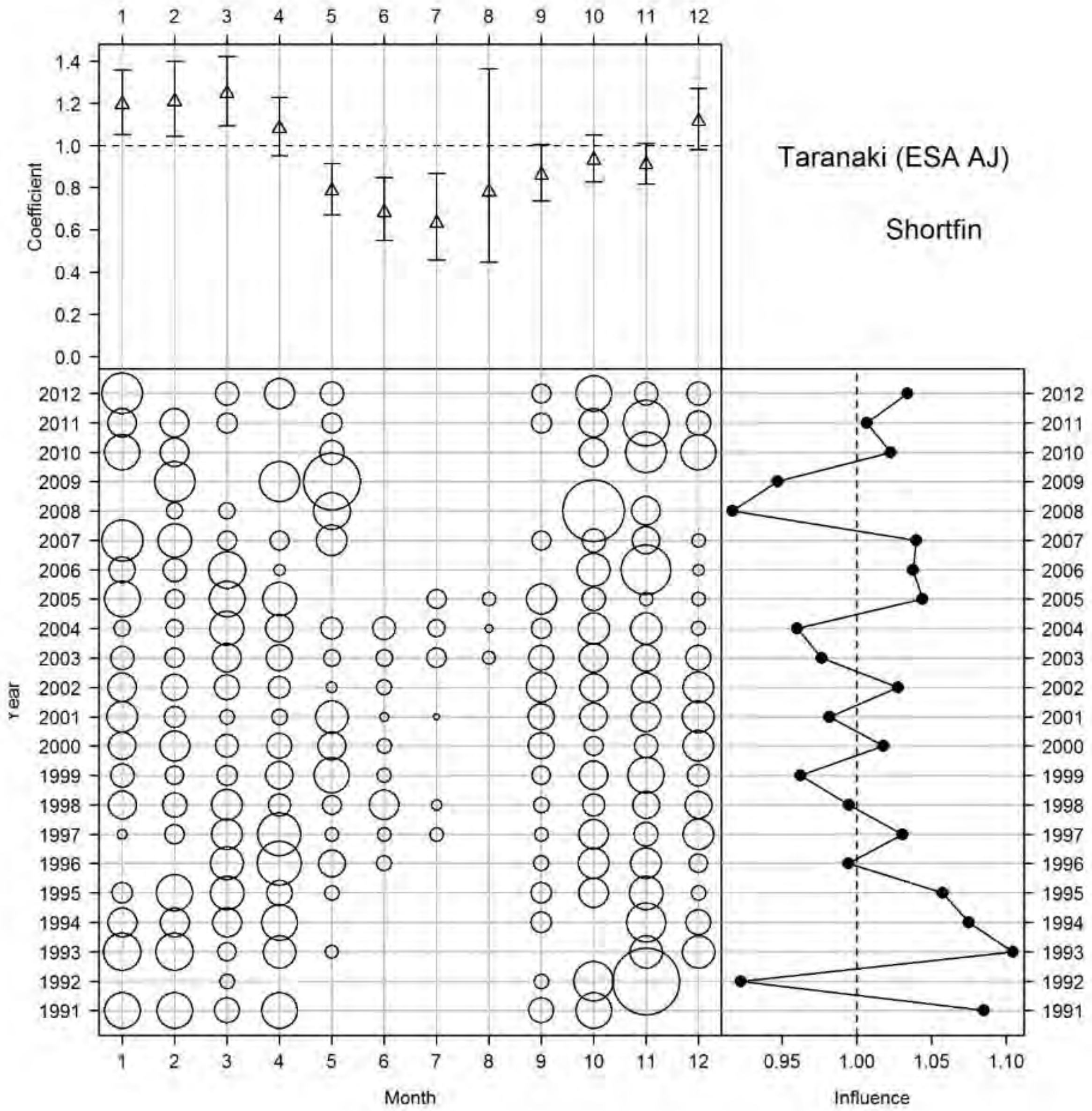


Figure J15: Influence of month for the shortfin CPUE model for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

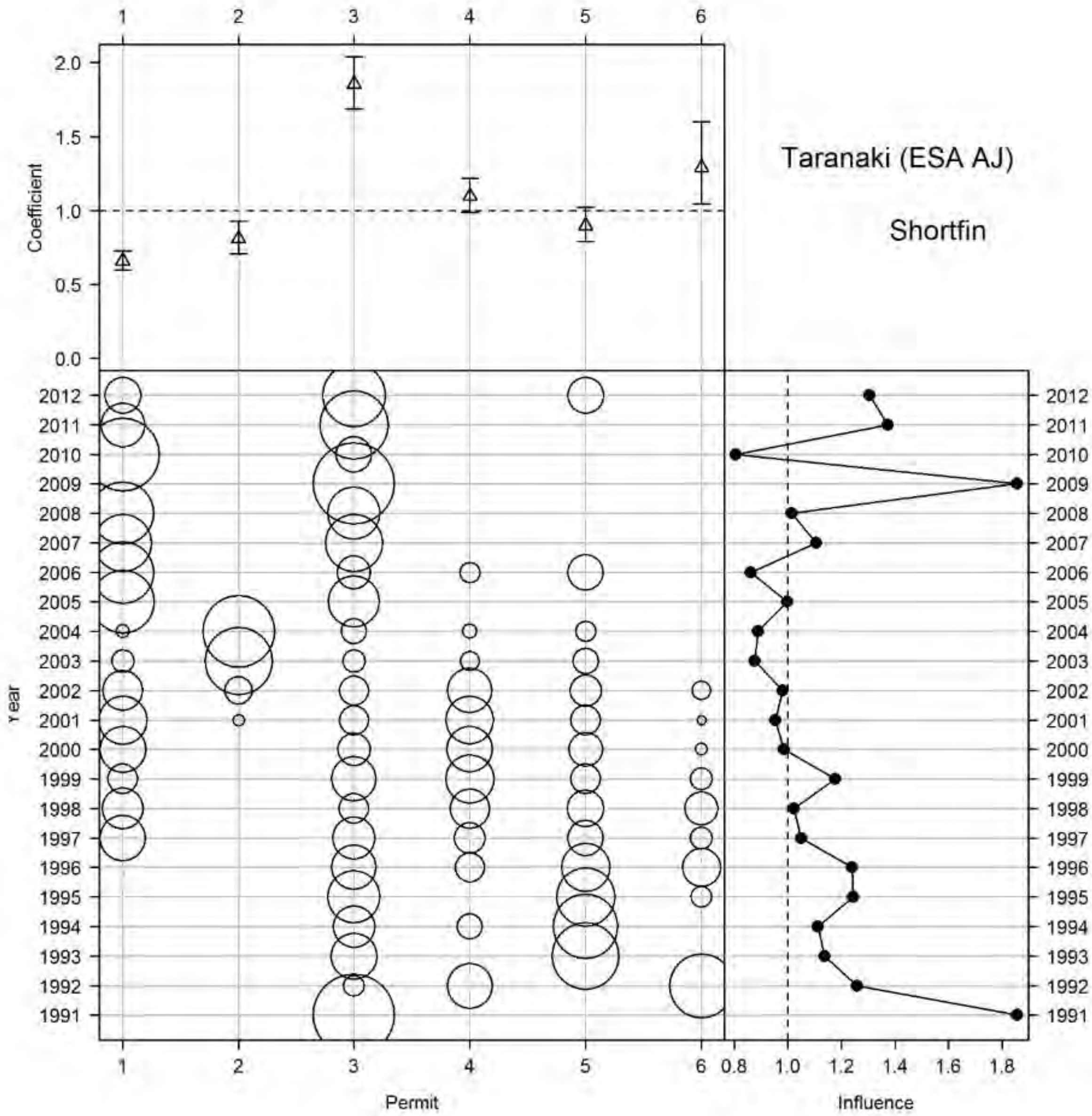


Figure J16: Influence of permit number for the shortfin CPUE model for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

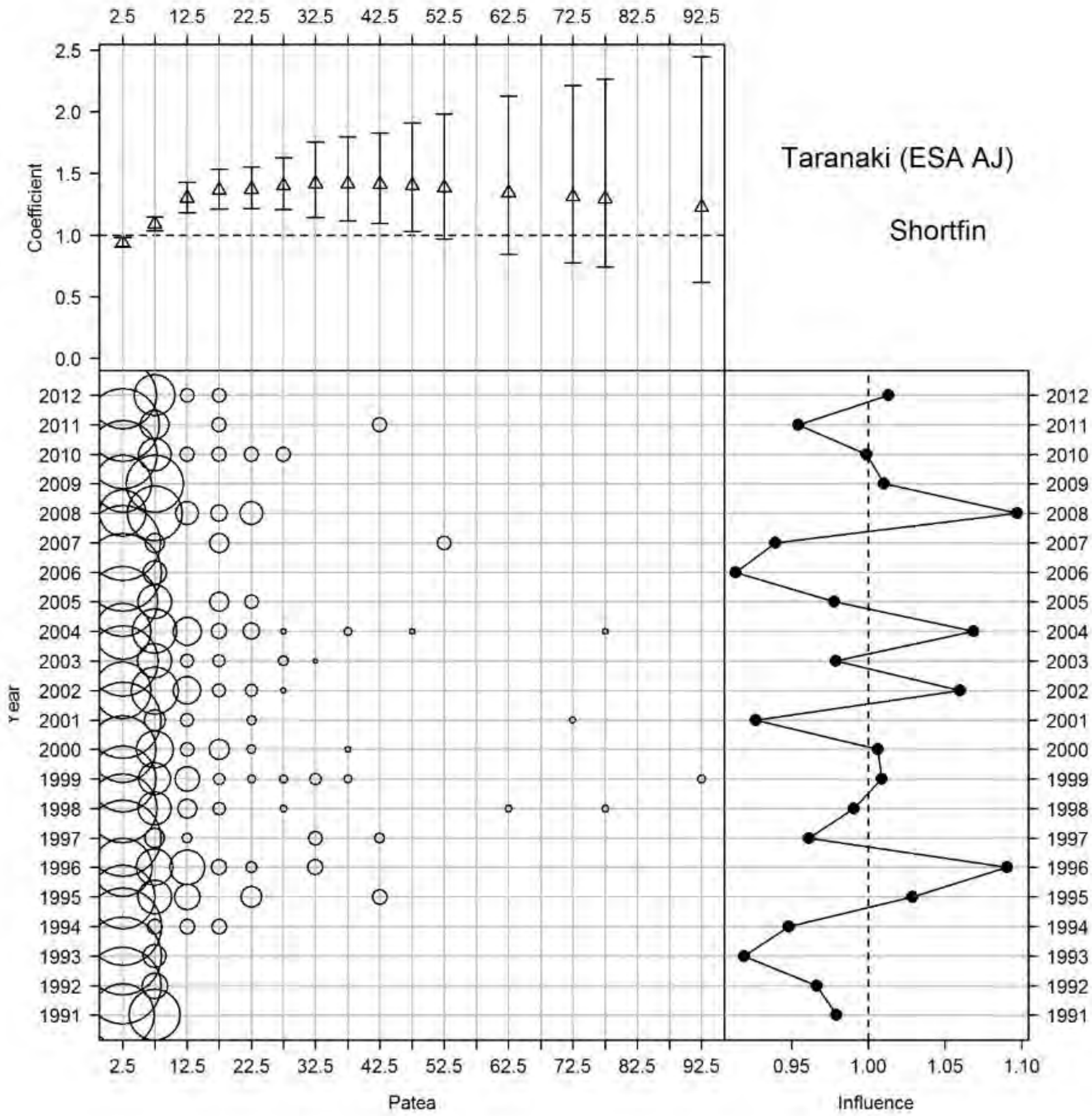


Figure J17: Influence of Patea River flow for the shortfin CPUE model for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

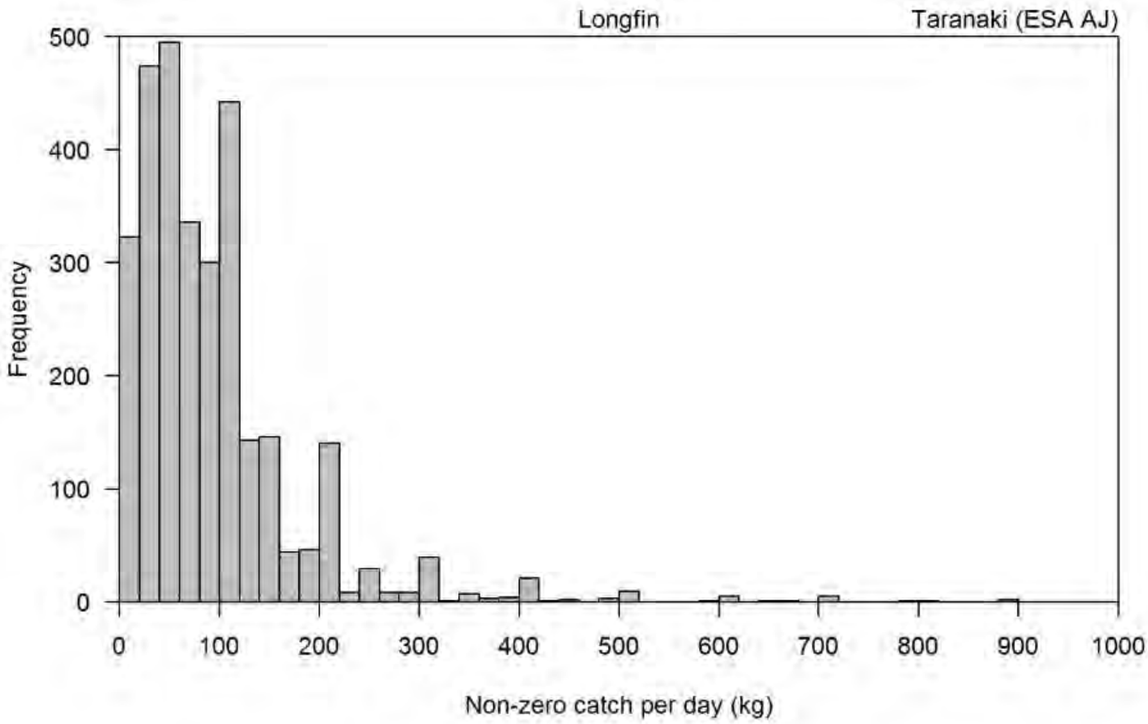


Figure J18: Frequency of longfin eel catch per day for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

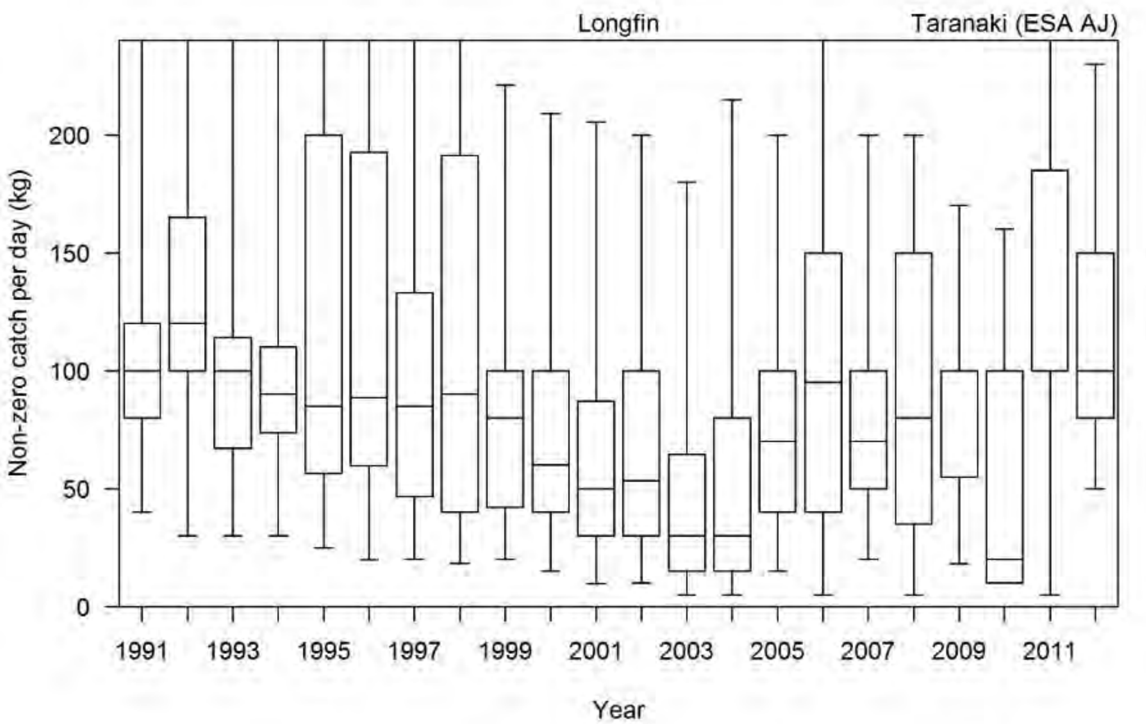


Figure J19: Longfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Taranaki (ESA AJ)).

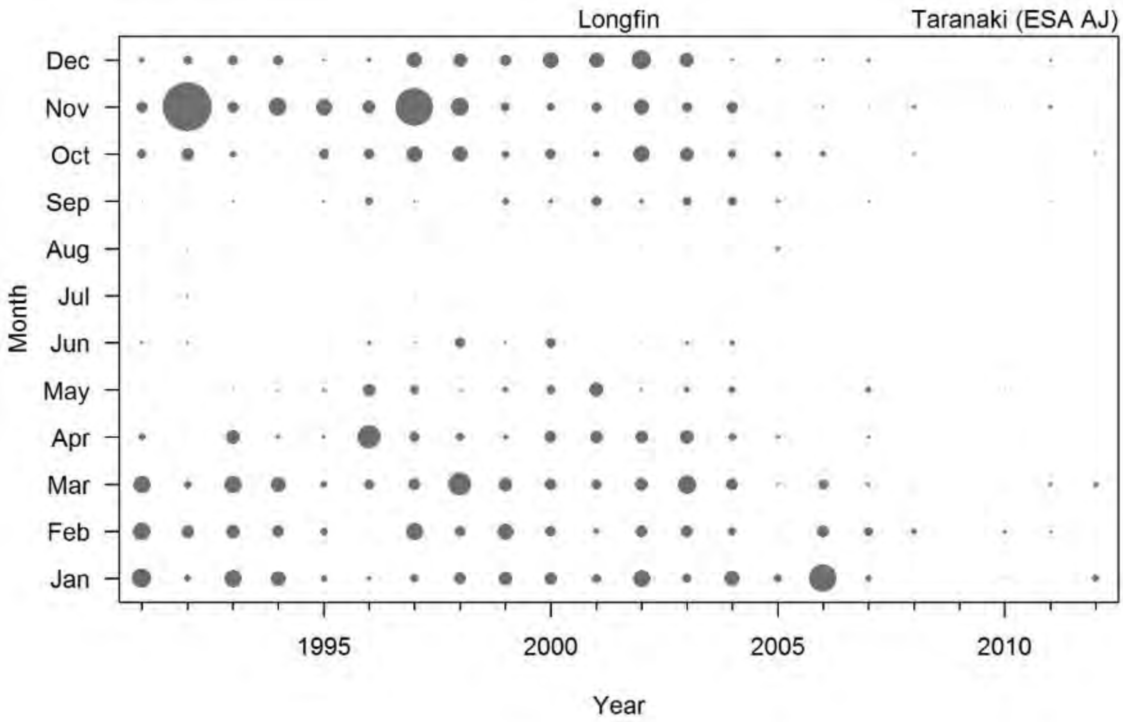


Figure J20: Longfin eel catch by month for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

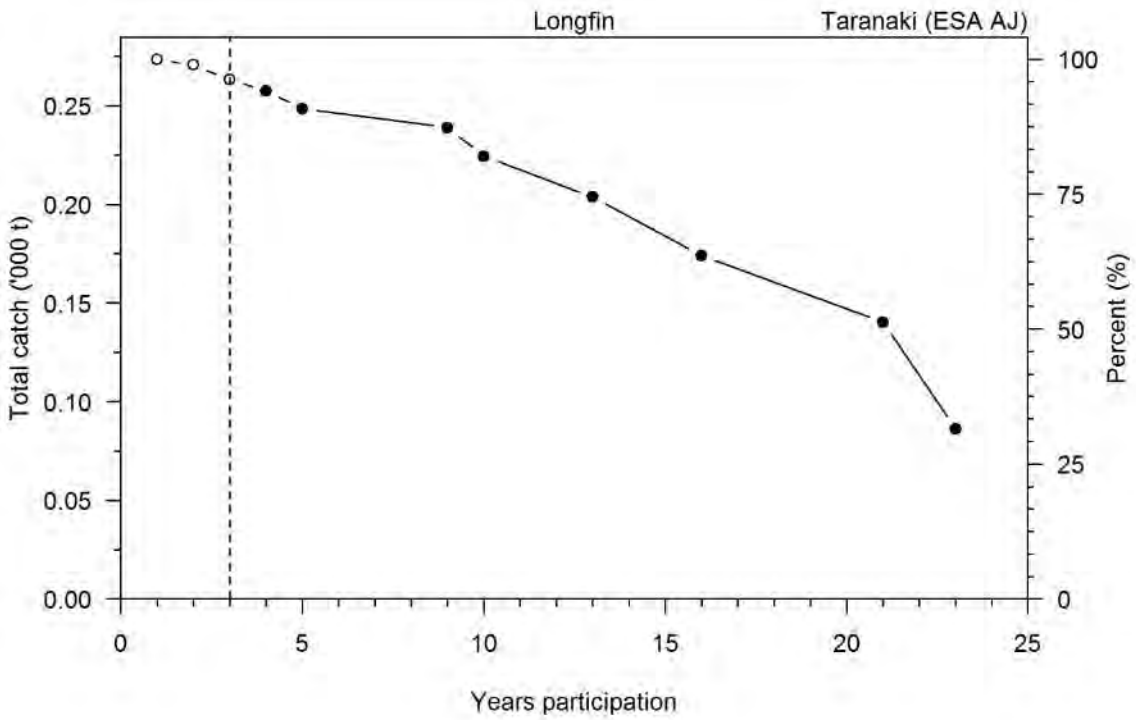


Figure J21: Relationship between years of participation in the fishery and longfin total catch. The open circles represent all longfin catch and the closed circles longfin catch data from fishers who 1) caught longfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core longfin fisher analyses for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

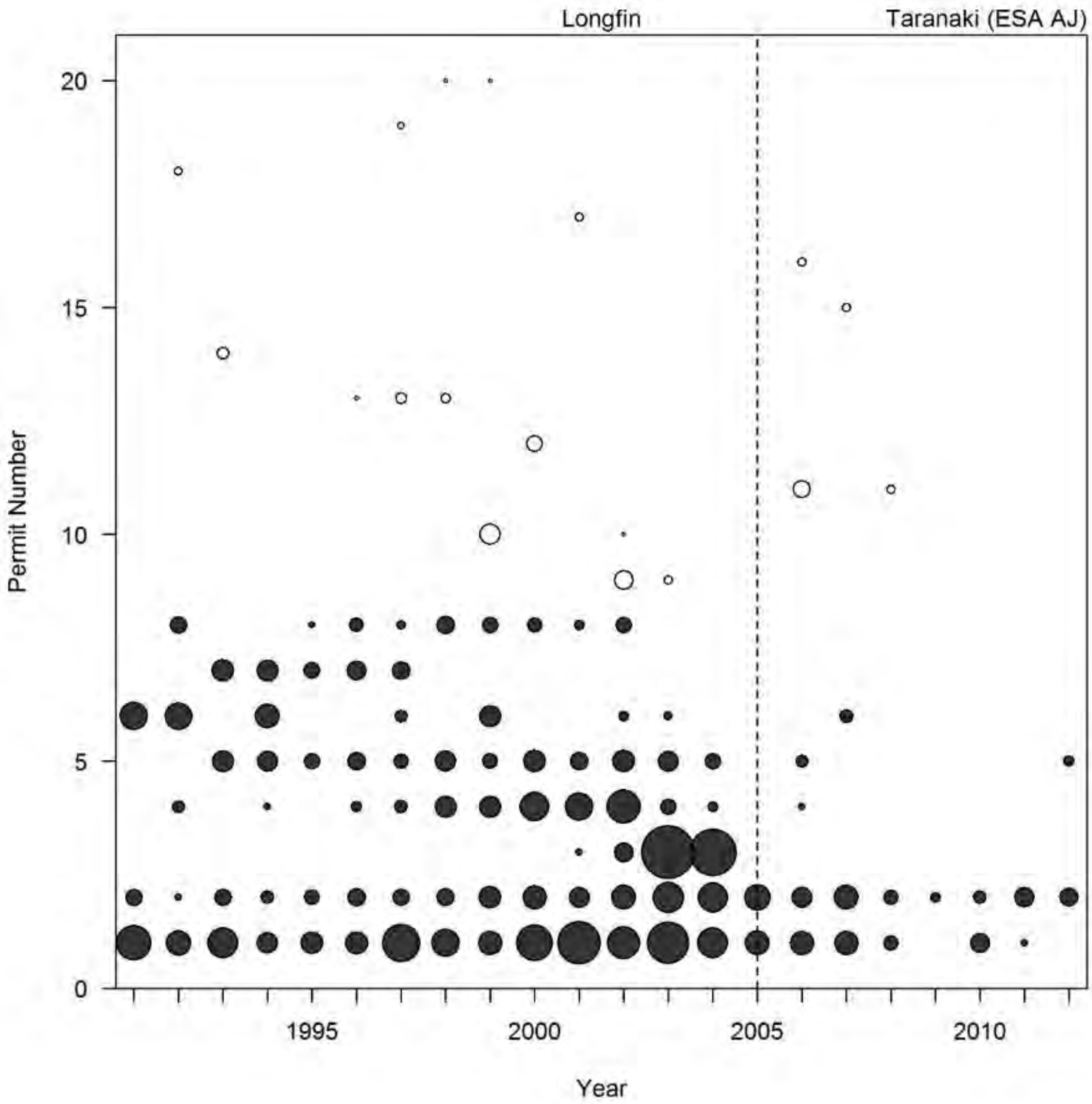


Figure J22: Relative catch of longfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Taranaki (ESA AJ)).

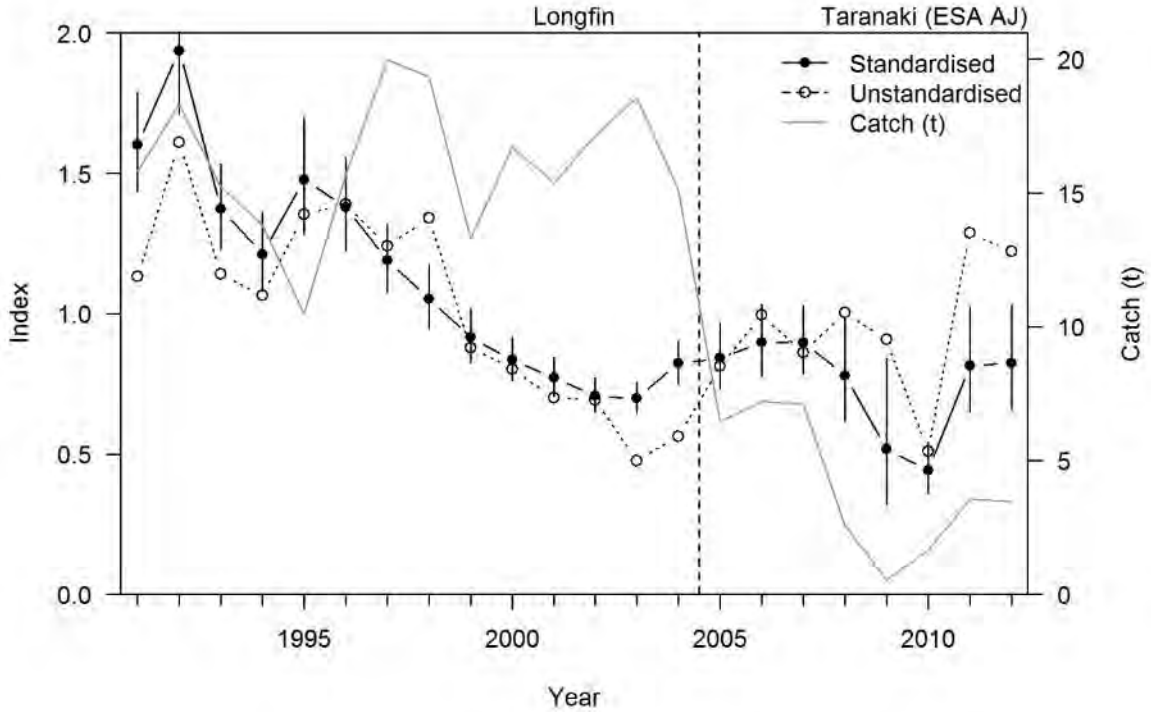


Figure J23: Indices of unstandardised catch per day and standardised CPUE for the core fishers longfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Taranaki (ESA AJ)).

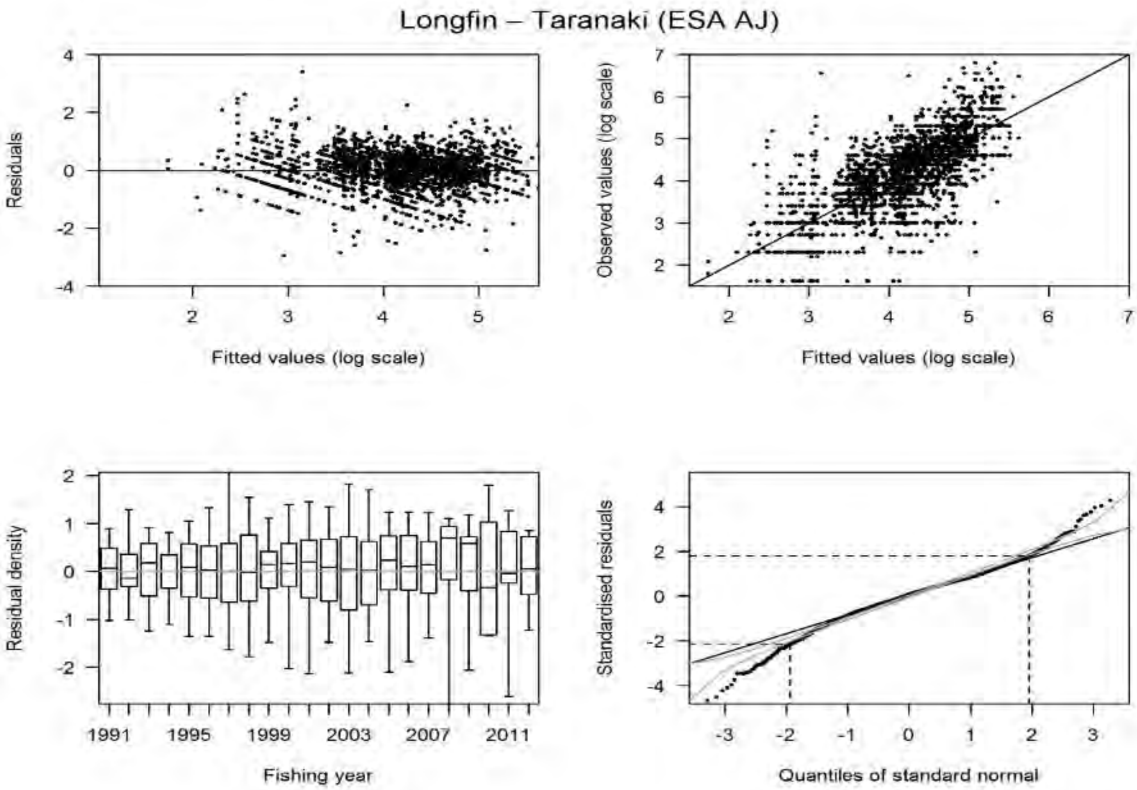


Figure J24: Residual diagnostic plots for the longfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Taranaki (ESA AJ)).

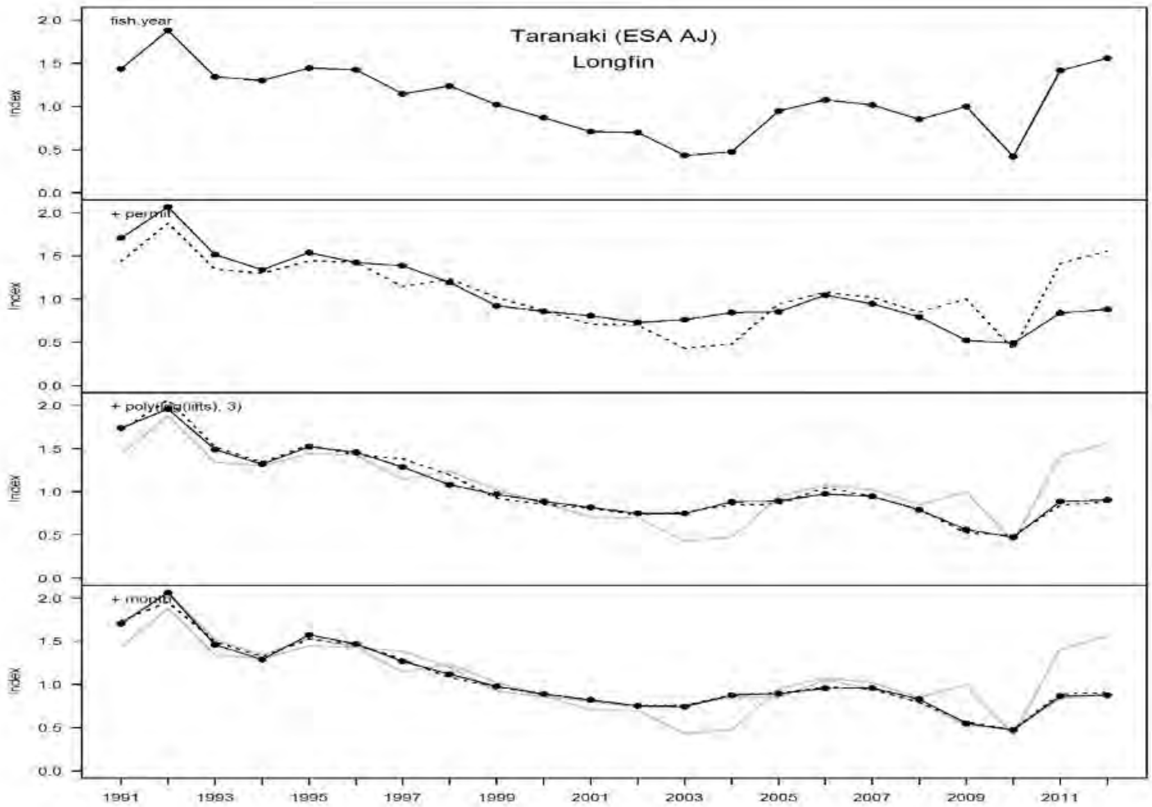


Figure J25: Step plot for the longfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Taranaki (ESA AJ)).

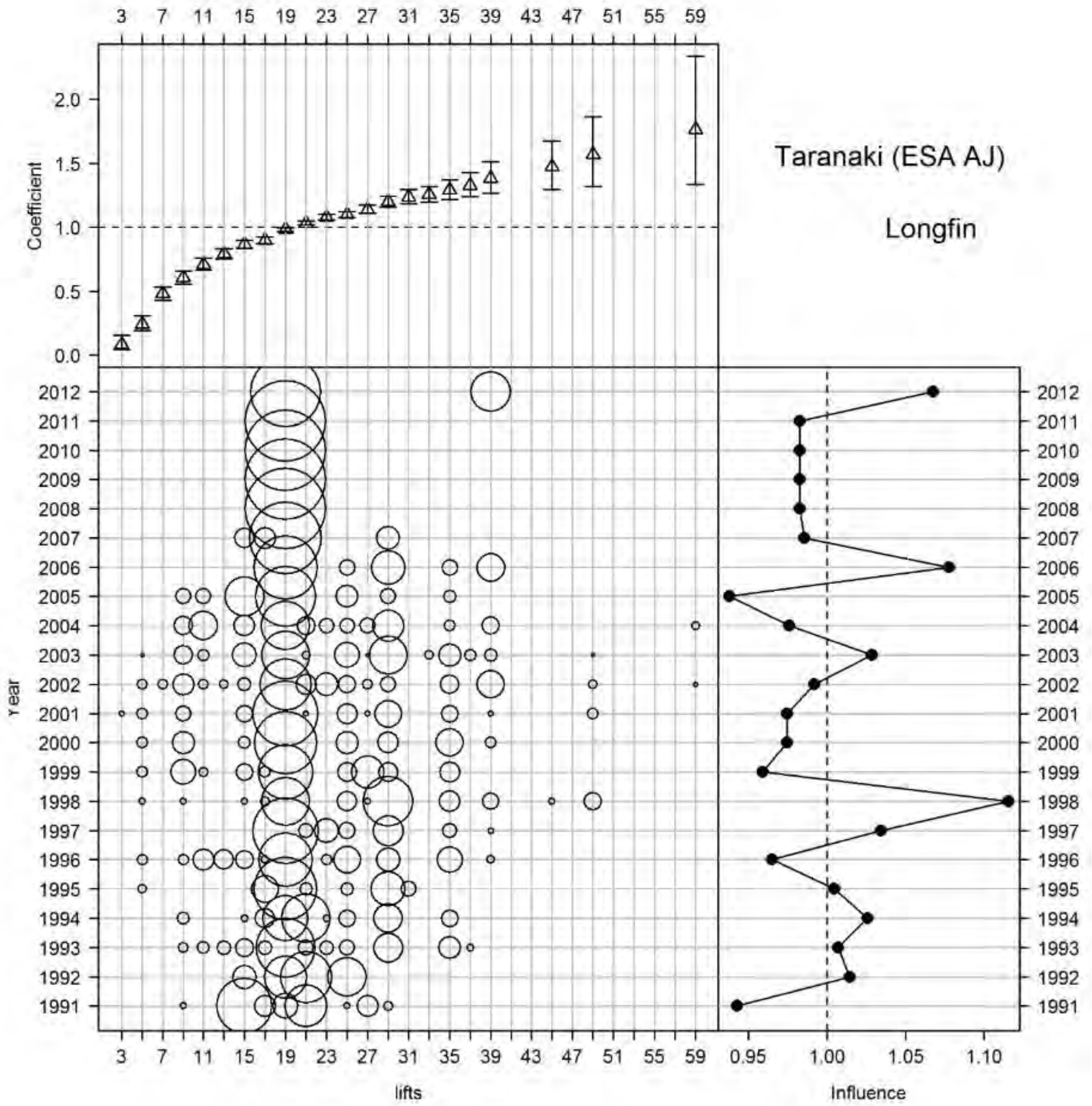


Figure J26: Influence of lifts for the longfin CPUE model for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

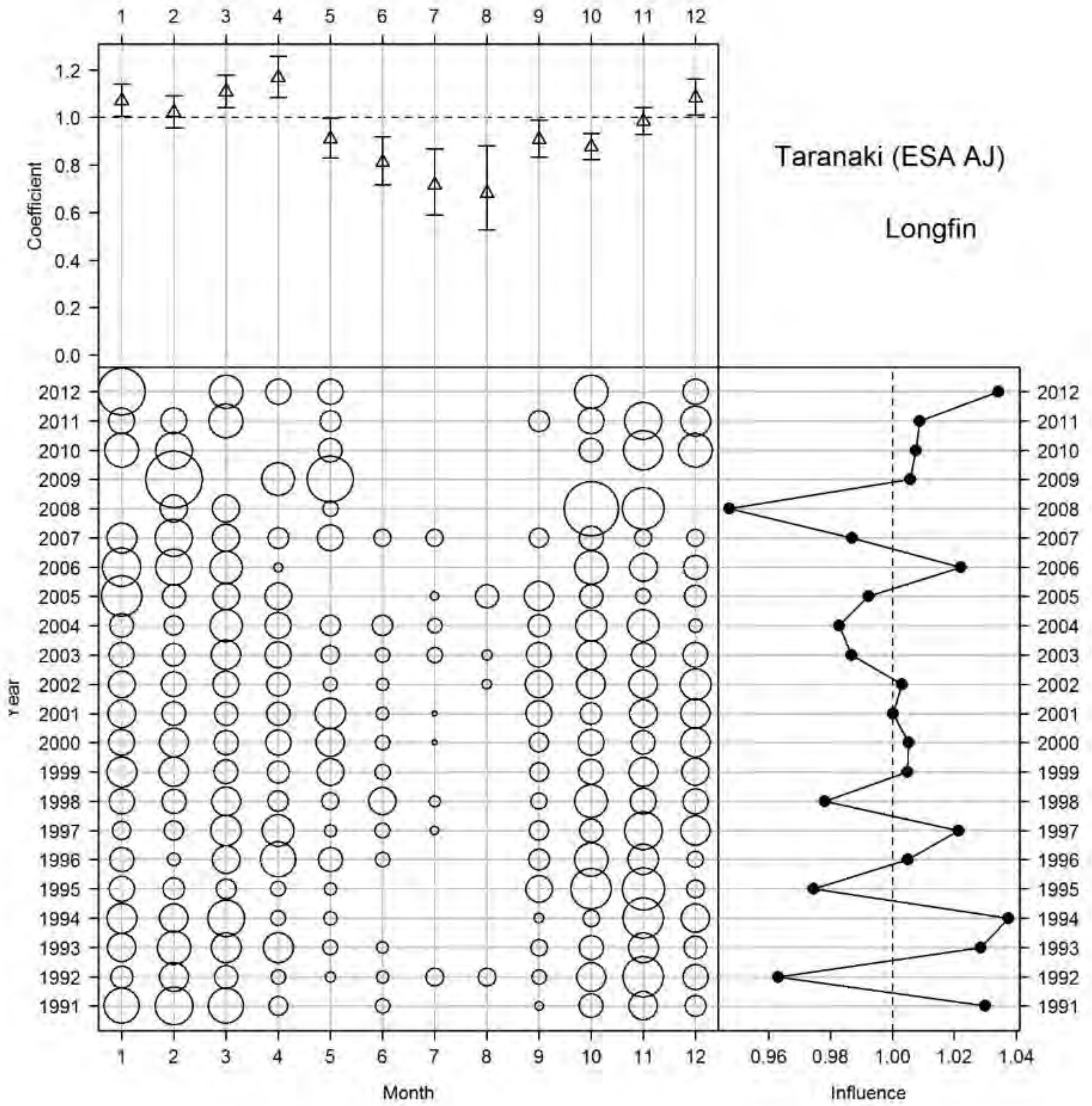


Figure J27: Influence of month for the longfin CPUE model for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

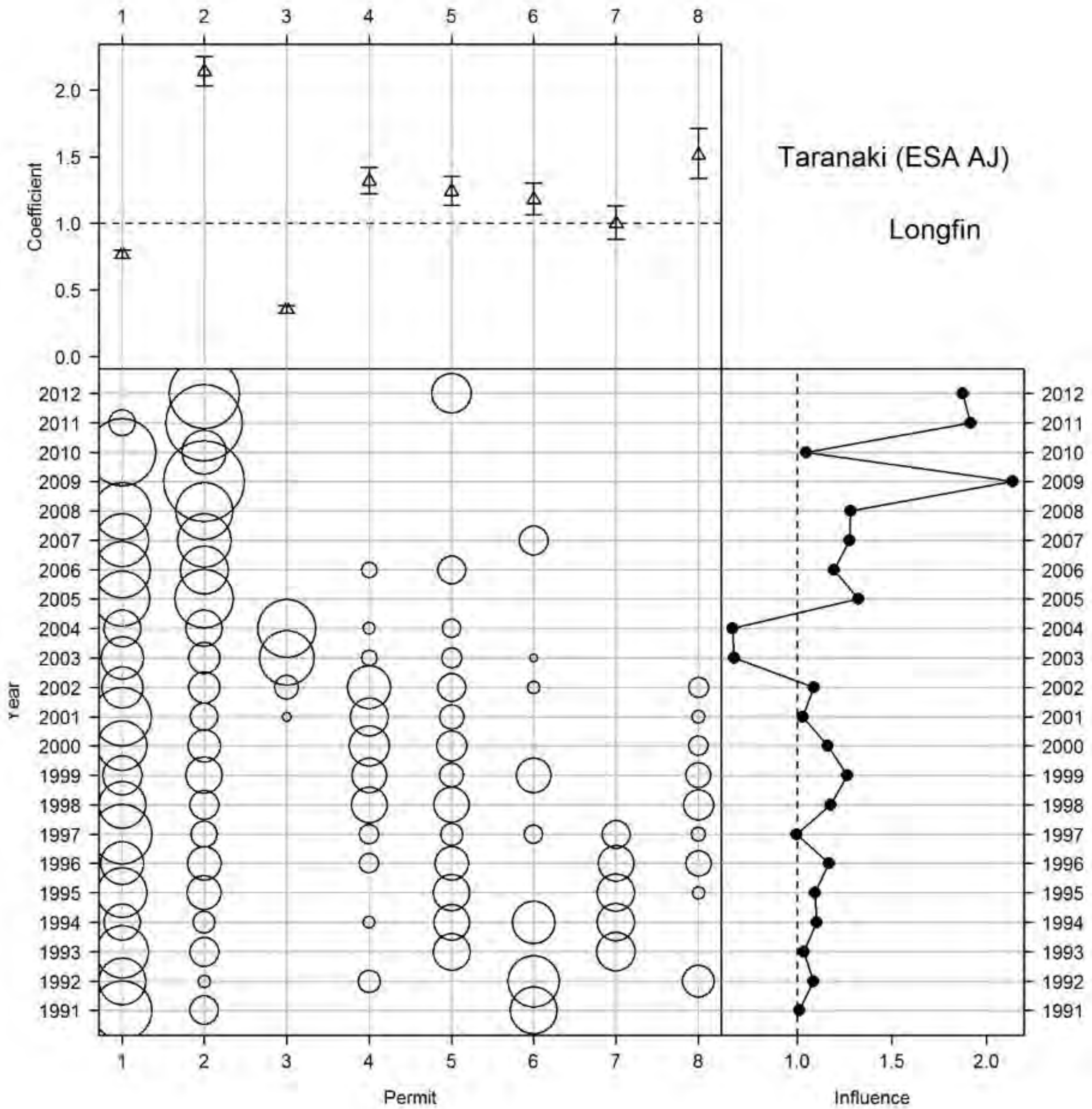


Figure J28: Influence of permit number for the longfin CPUE model for the years 1990–91 to 2011–12 (Taranaki (ESA AJ)).

Appendix K: Manawatu (ESA AK)

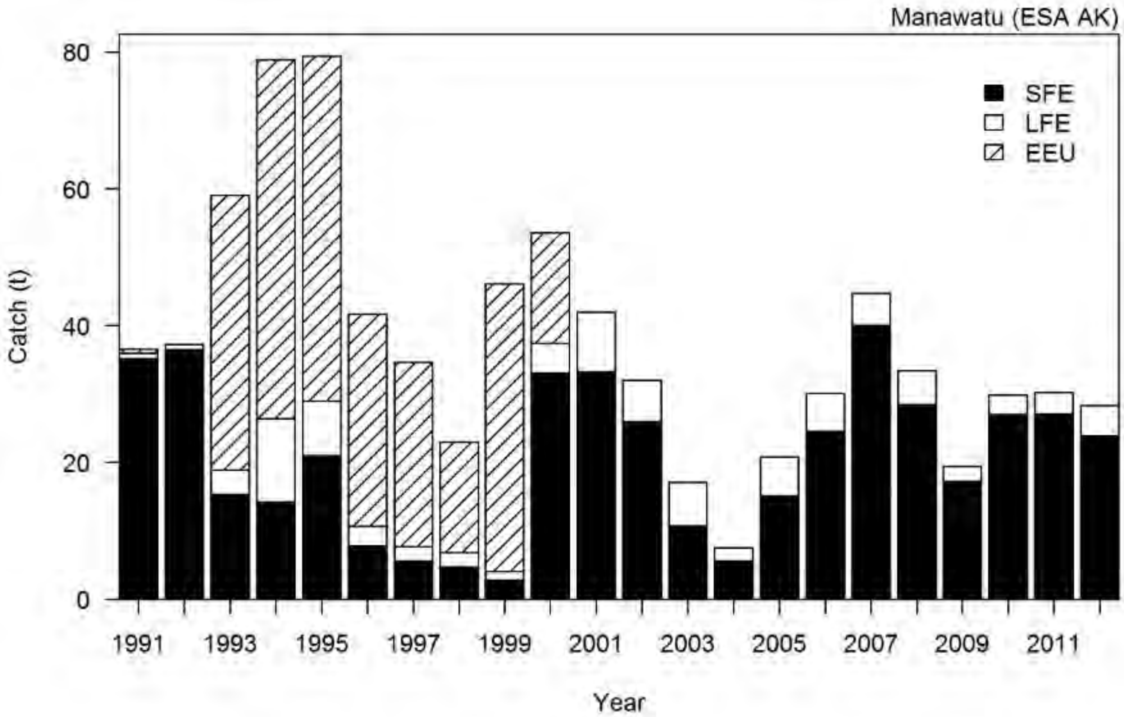


Figure K1: Total estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

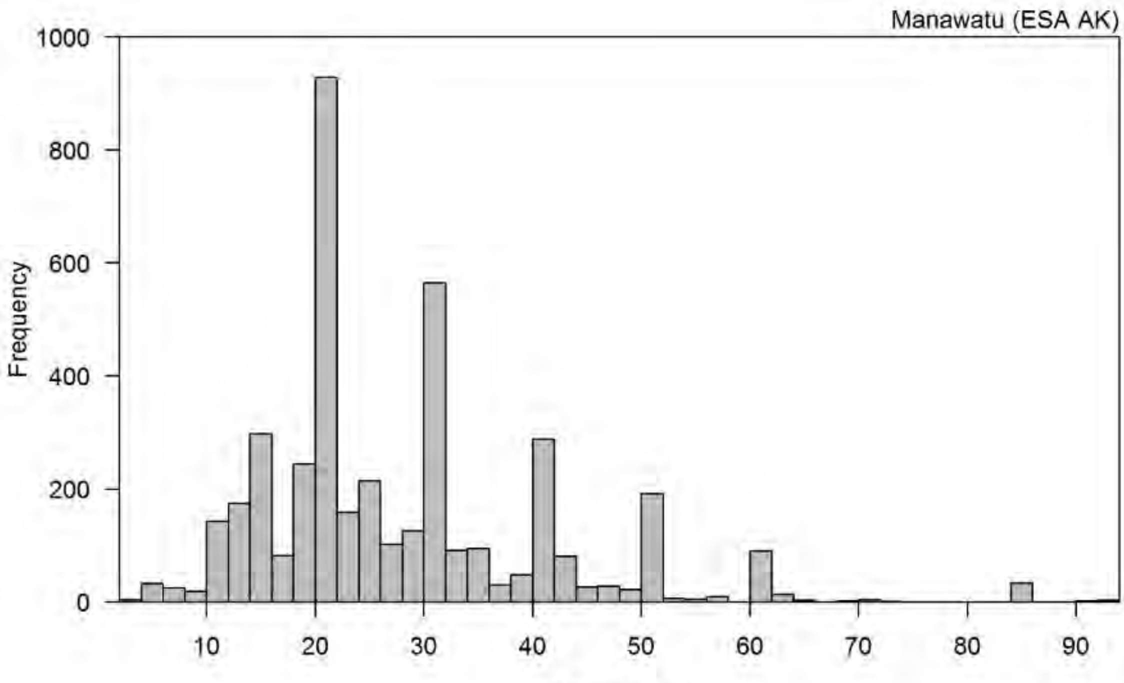


Figure K2: Frequency of total lifts per day for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

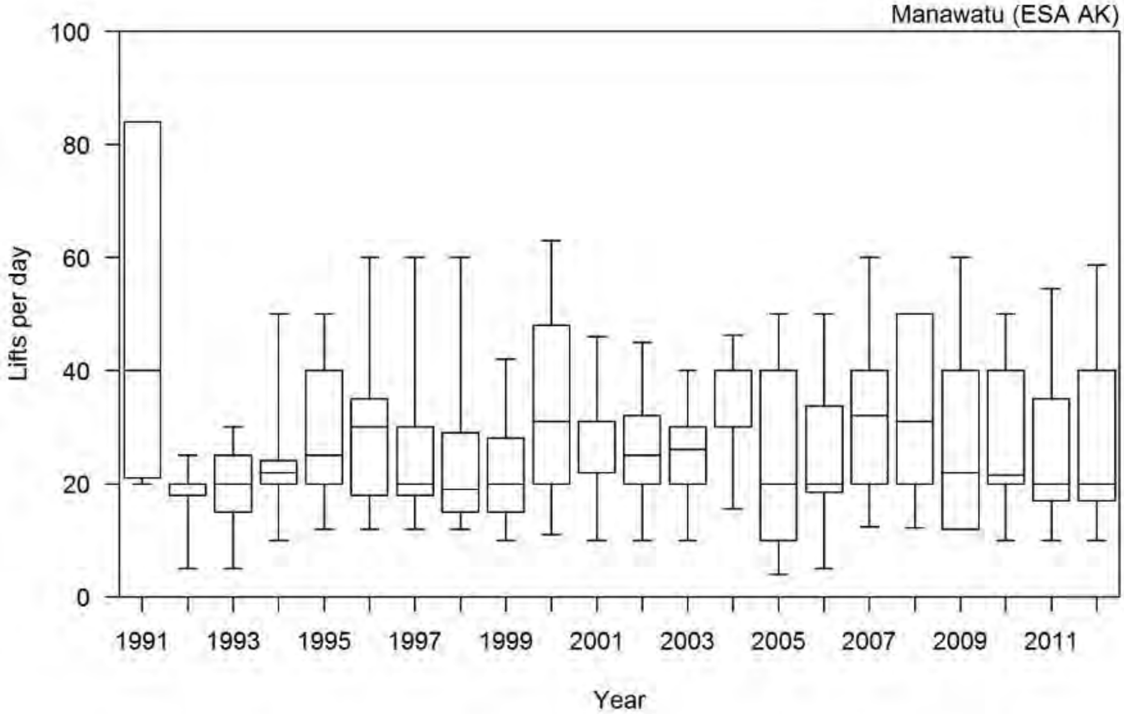


Figure K3: Total lifts per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Manawatu (ESA AK)).

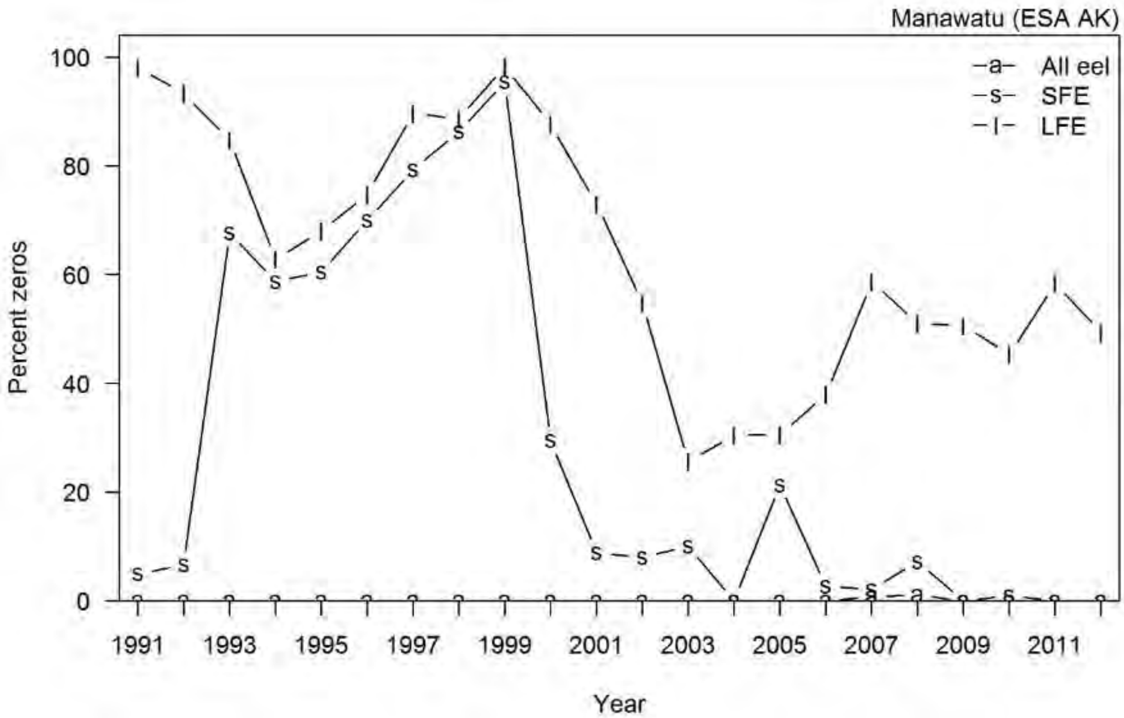


Figure K4: Proportion of zero records for all eel, shortfin (SFE), and longfin (LFE) catch for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

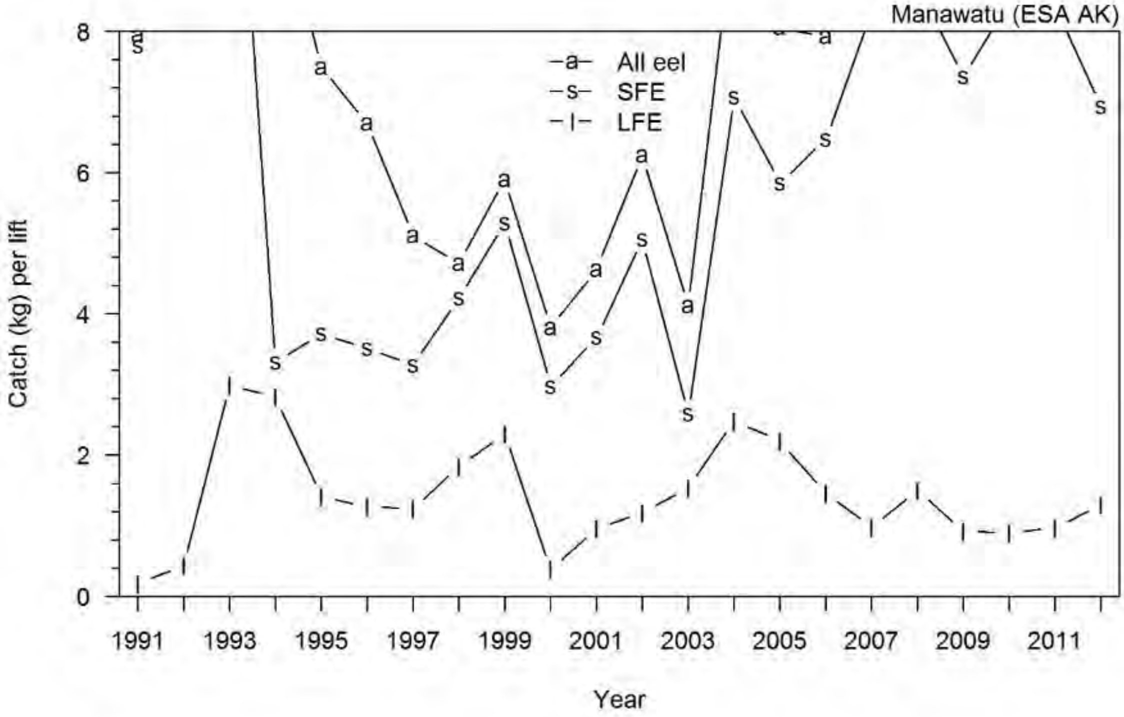


Figure K5: Unstandardised catch per lift (total kg/total lifts) for all eel, shortfin (SFE), and longfin (LFE) for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

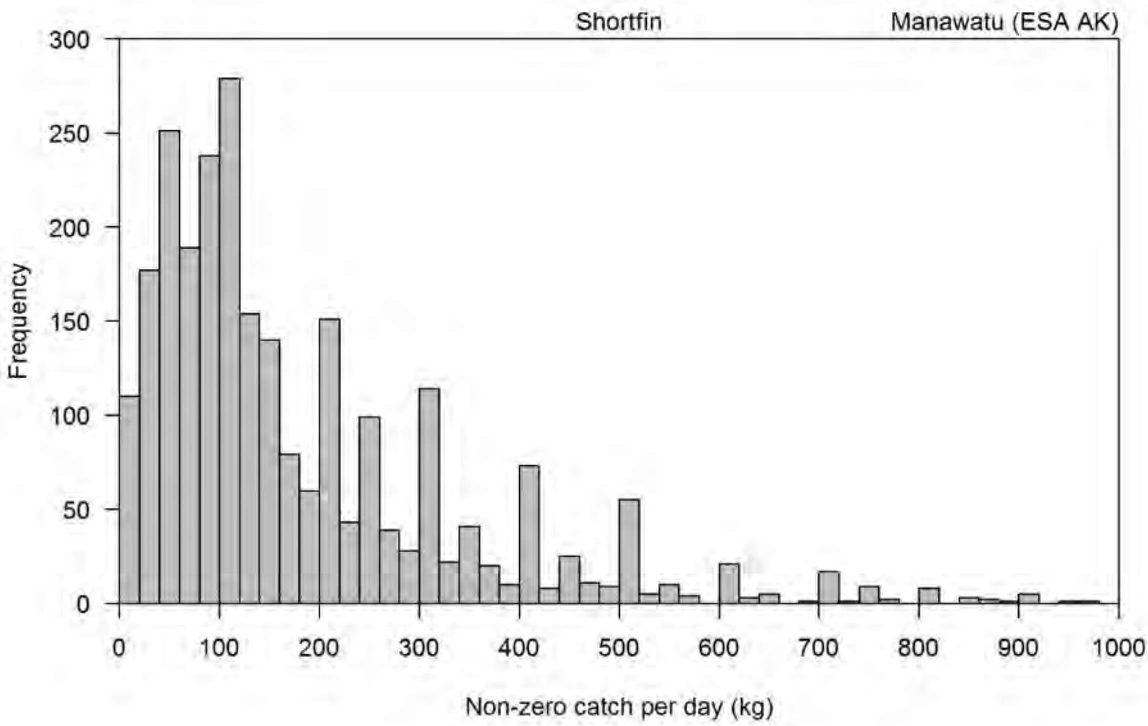


Figure K6: Frequency of shortfin eel catch per day for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

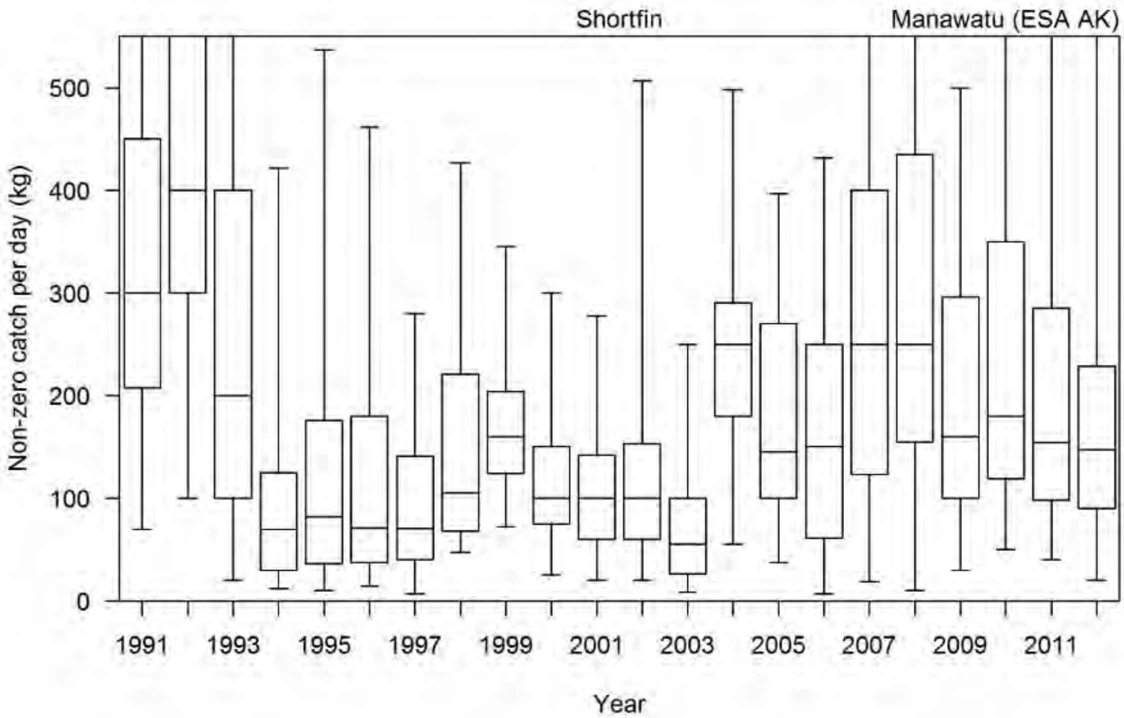


Figure K7: Shortfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Manawatu (ESA AK)).

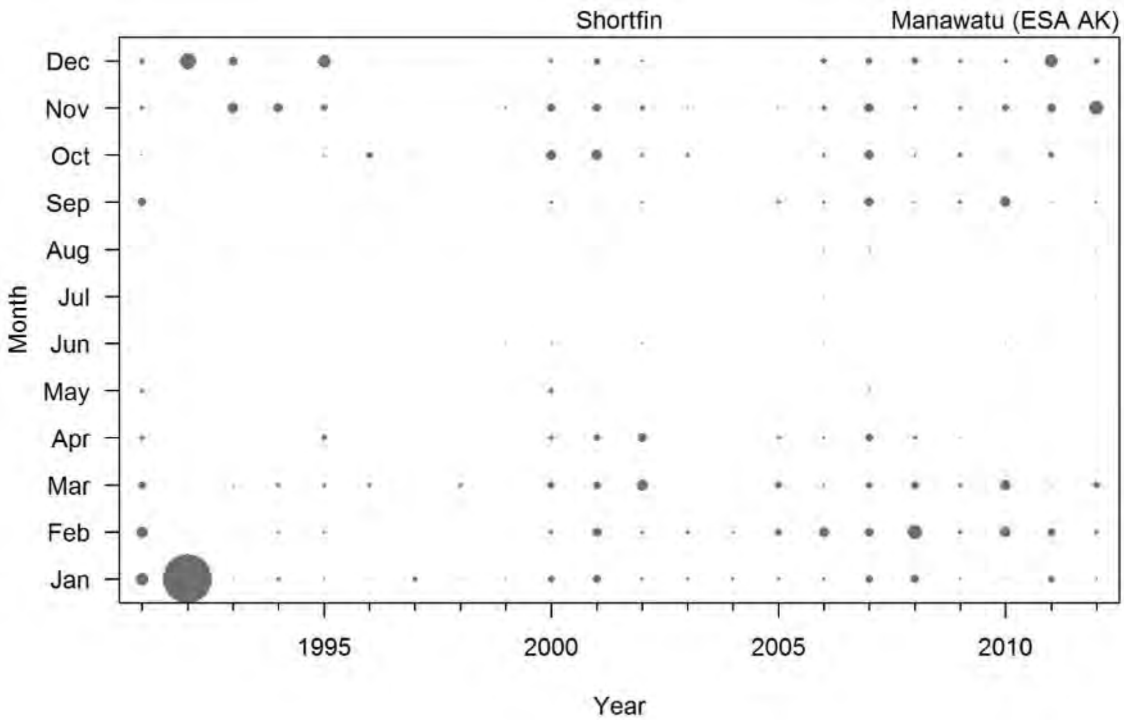


Figure K8: Shortfin eel catch by month for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

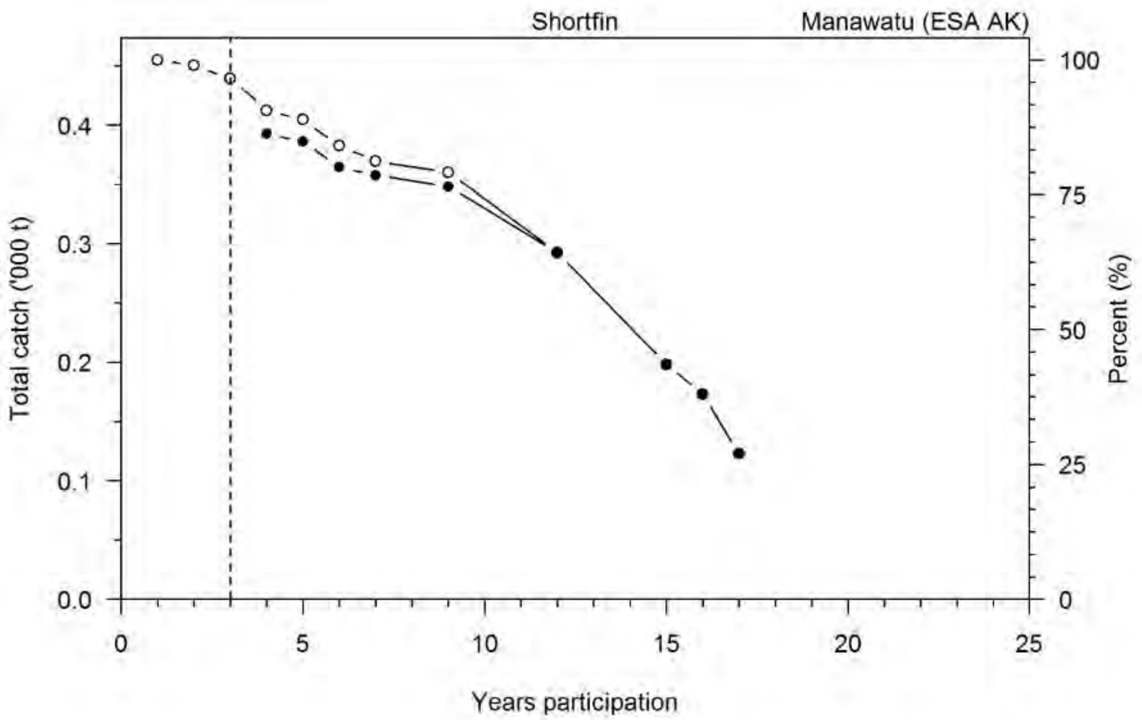


Figure K9: Relationship between years of participation in the fishery and shortfin total catch. The open circles represent all shortfin catch and the closed circles shortfin catch data from fishers who 1) caught shortfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core shortfin fisher analyses for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

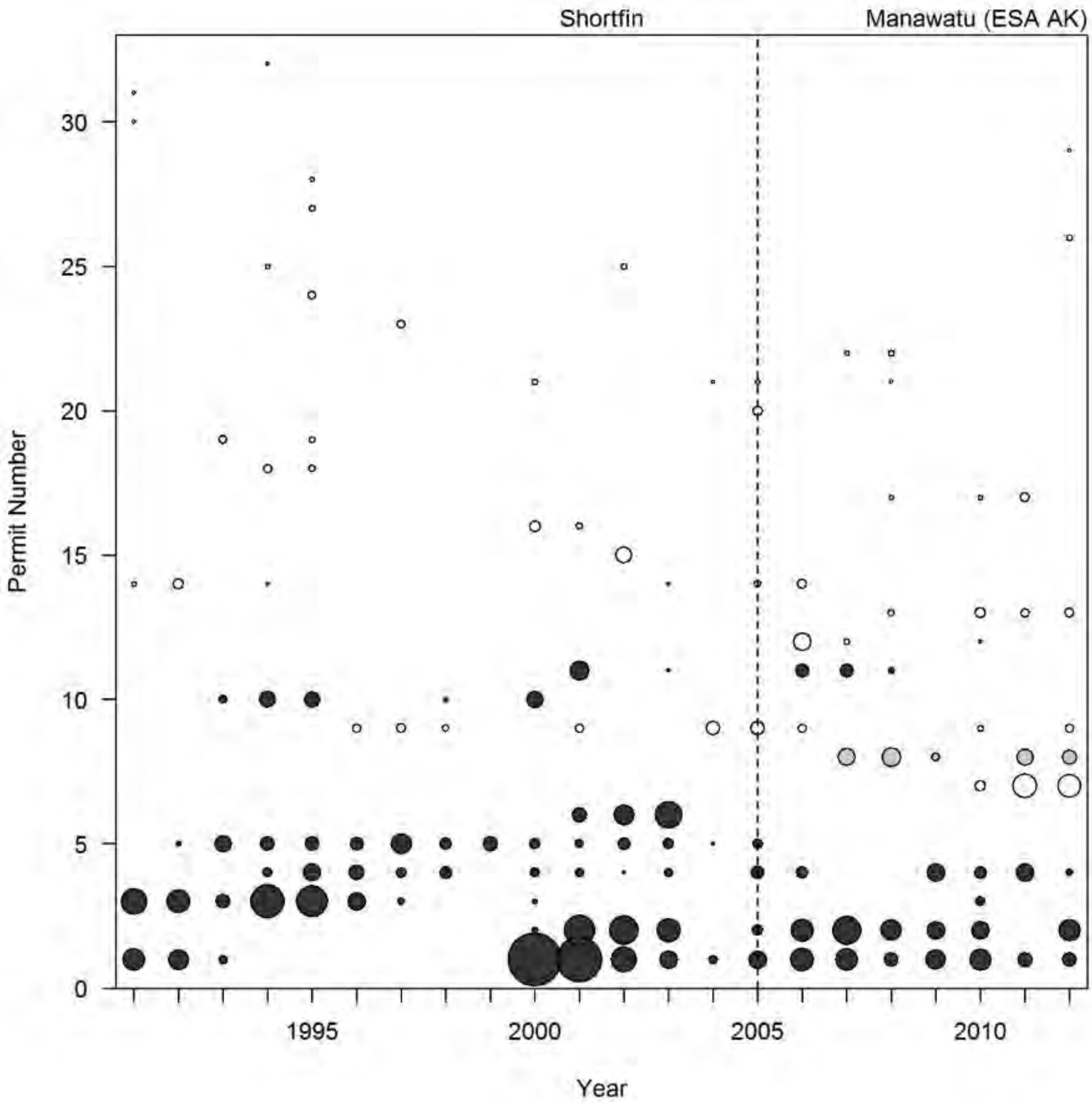


Figure K10: Relative catch of shortfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Manawatu (ESA AK)).

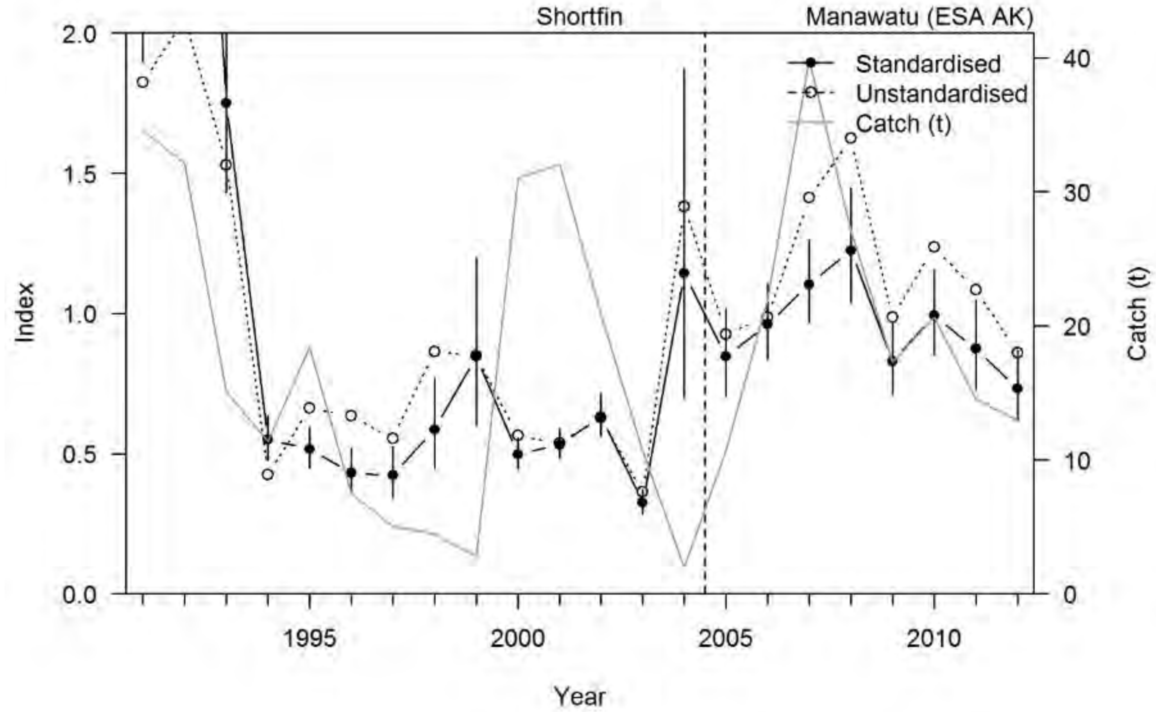


Figure K11: Indices of unstandardised catch per day and standardised CPUE for the core fishers shortfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Manawatu (ESA AK)).

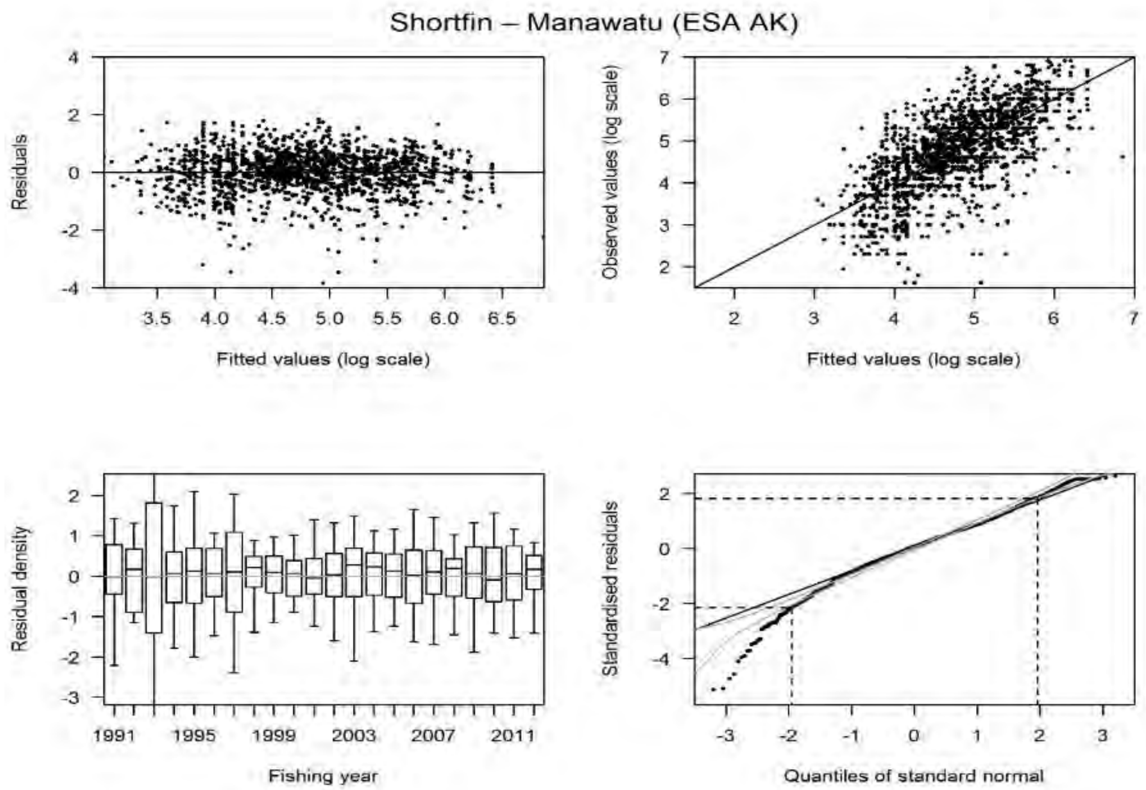


Figure K12: Residual diagnostic plots for the shortfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Manawatu (ESA AK)).

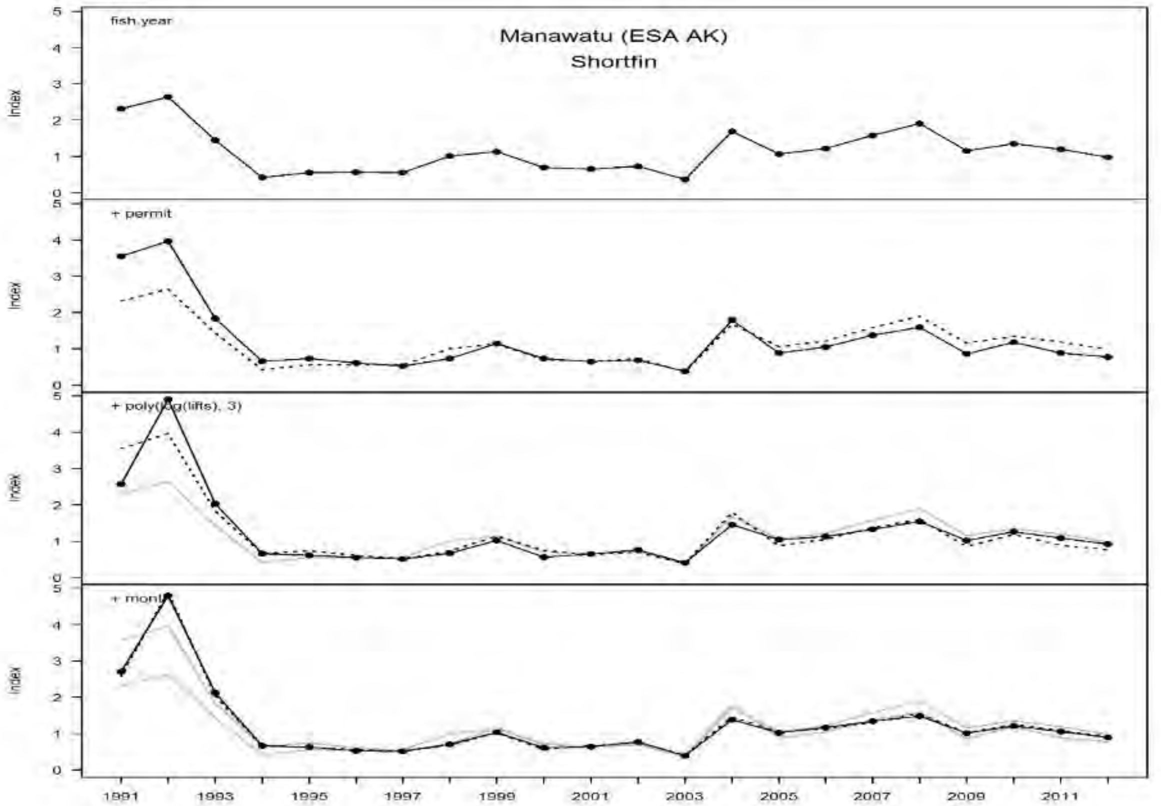


Figure K13: Step plot for the shortfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Manawatu (ESA AK)).

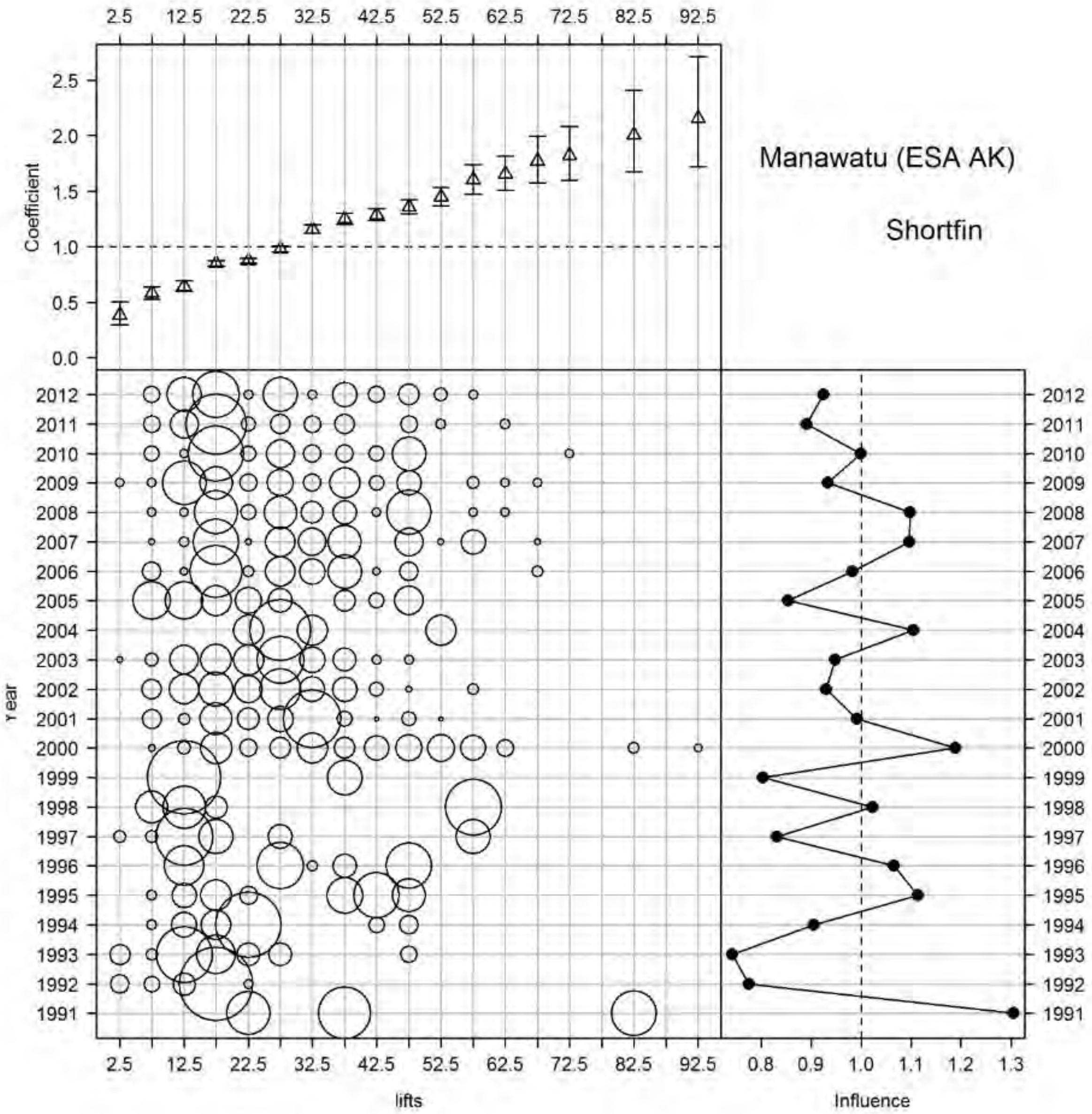


Figure K14: Influence of lifts for the shortfin CPUE model for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

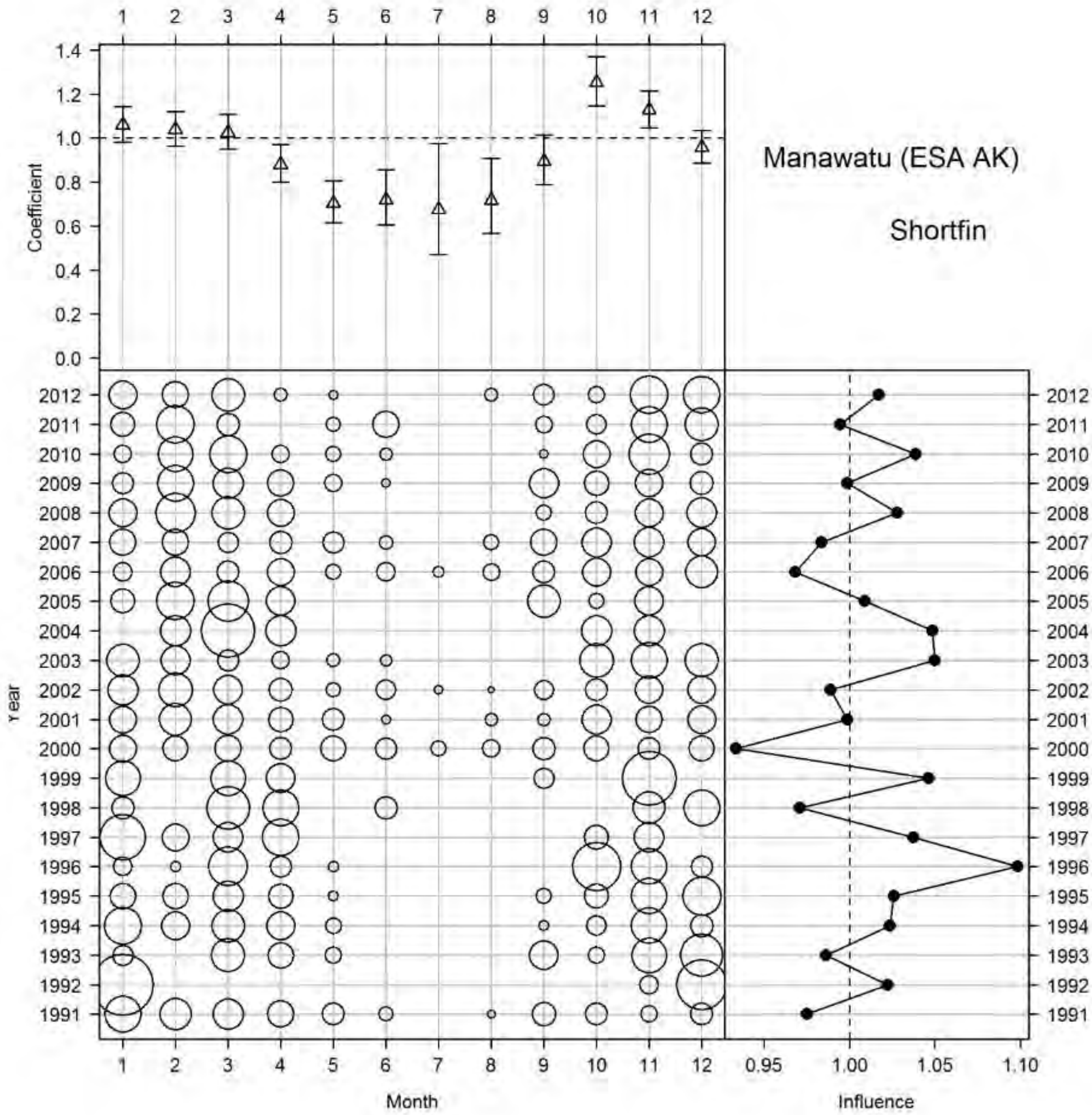


Figure K15: Influence of month for the shortfin CPUE model for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

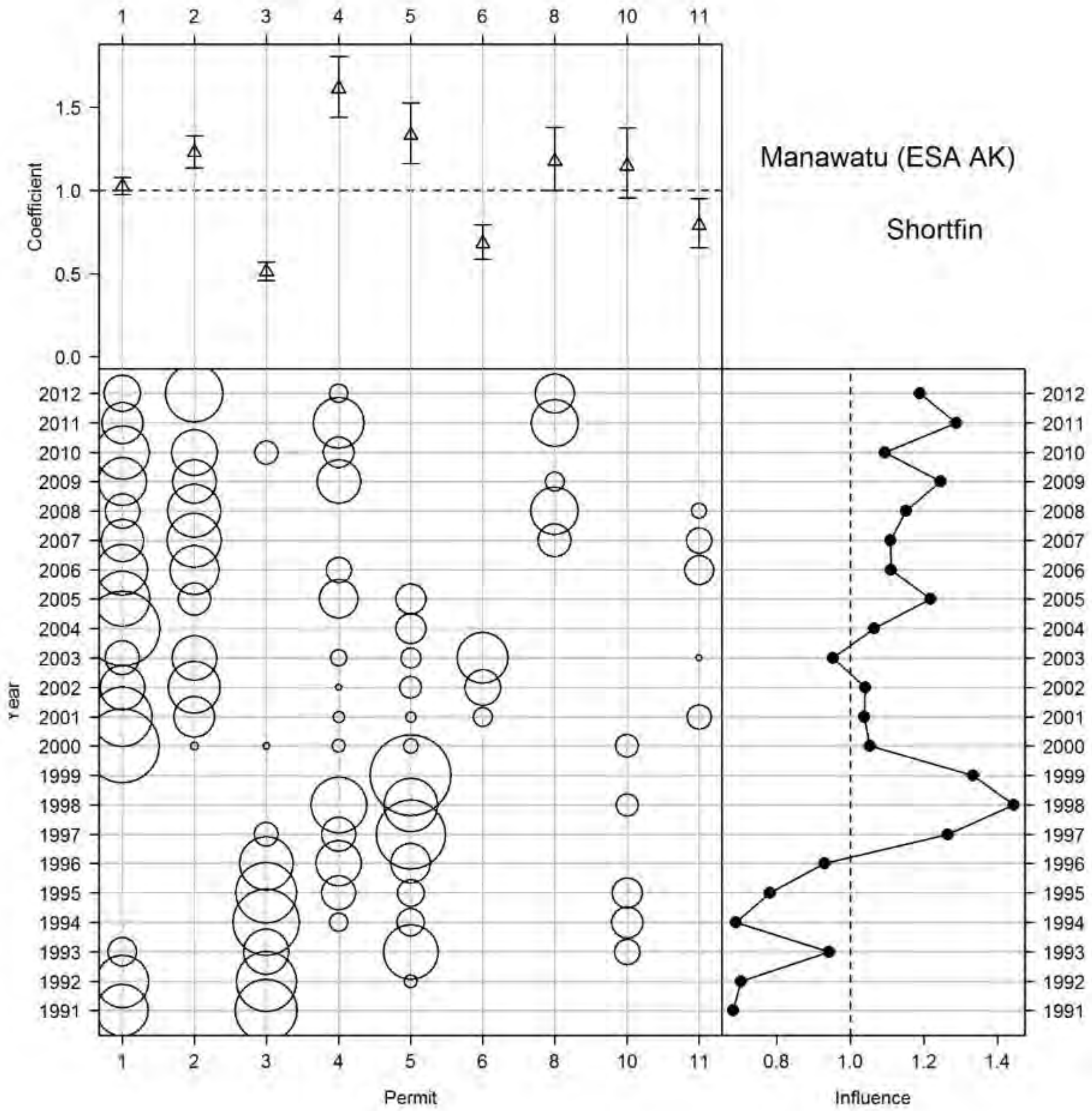


Figure K16: Influence of permit number for the shortfin CPUE model for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

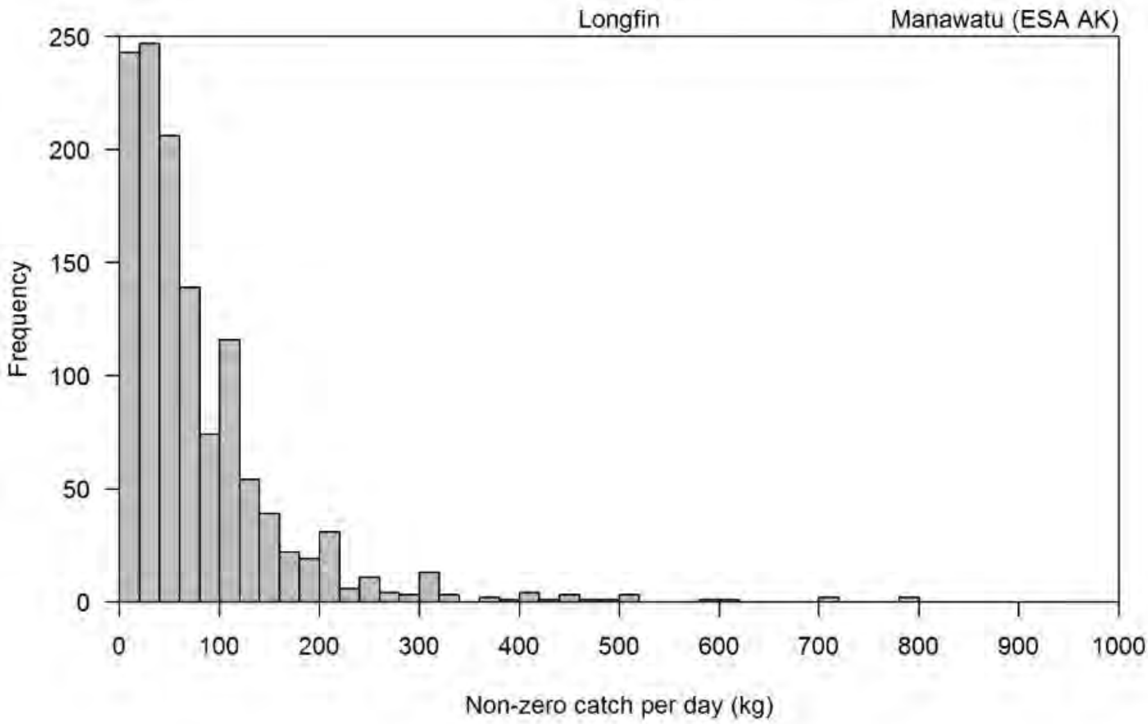


Figure K17: Frequency of longfin eel catch per day for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

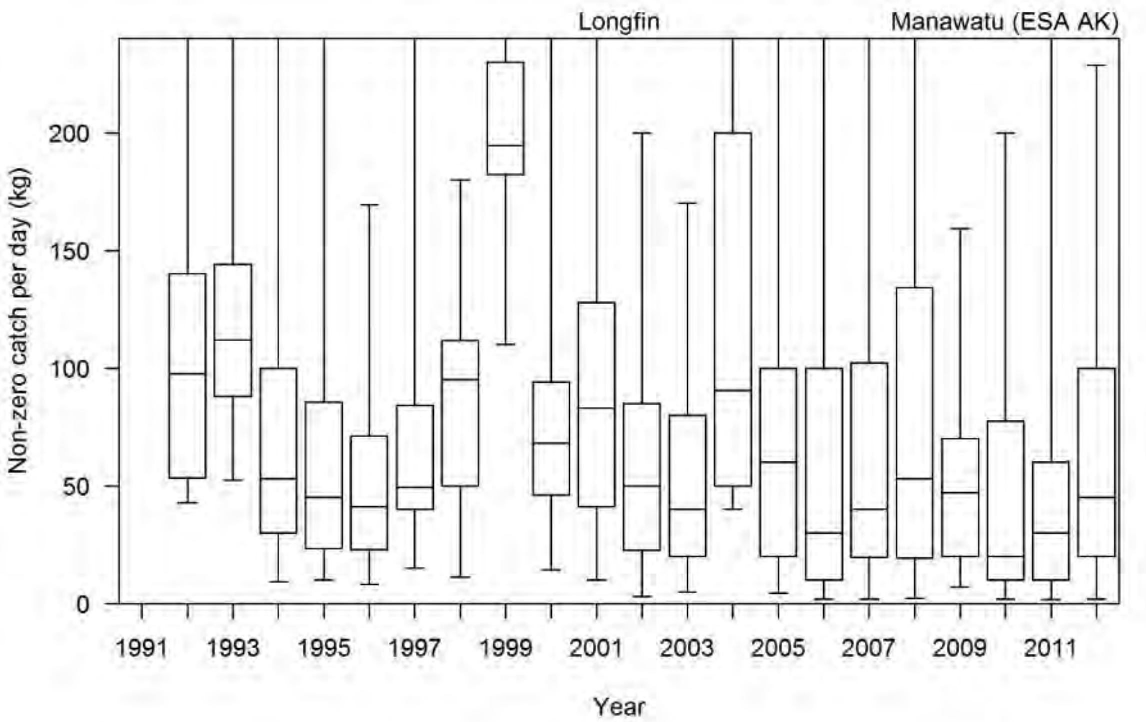


Figure K18: Longfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Manawatu (ESA AK)).

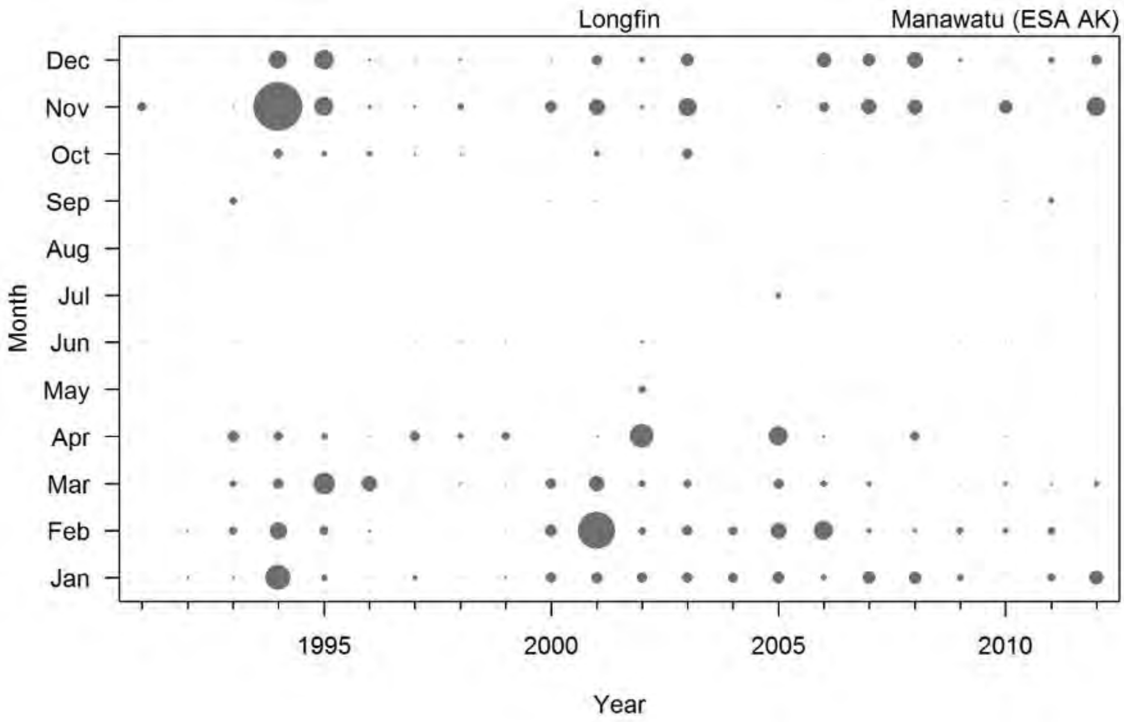


Figure K19: Longfin eel catch by month for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

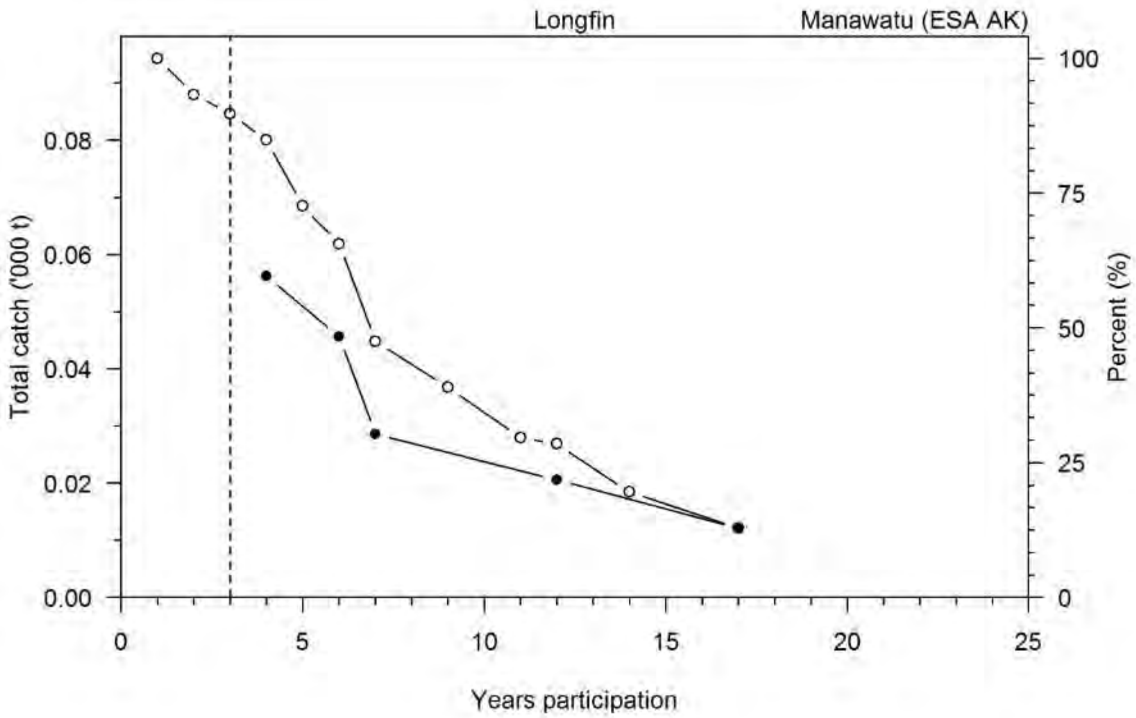


Figure K20: Relationship between years of participation in the fishery and longfin total catch. The open circles represent all longfin catch and the closed circles longfin catch data from fishers who 1) caught longfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core longfin fisher analyses for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

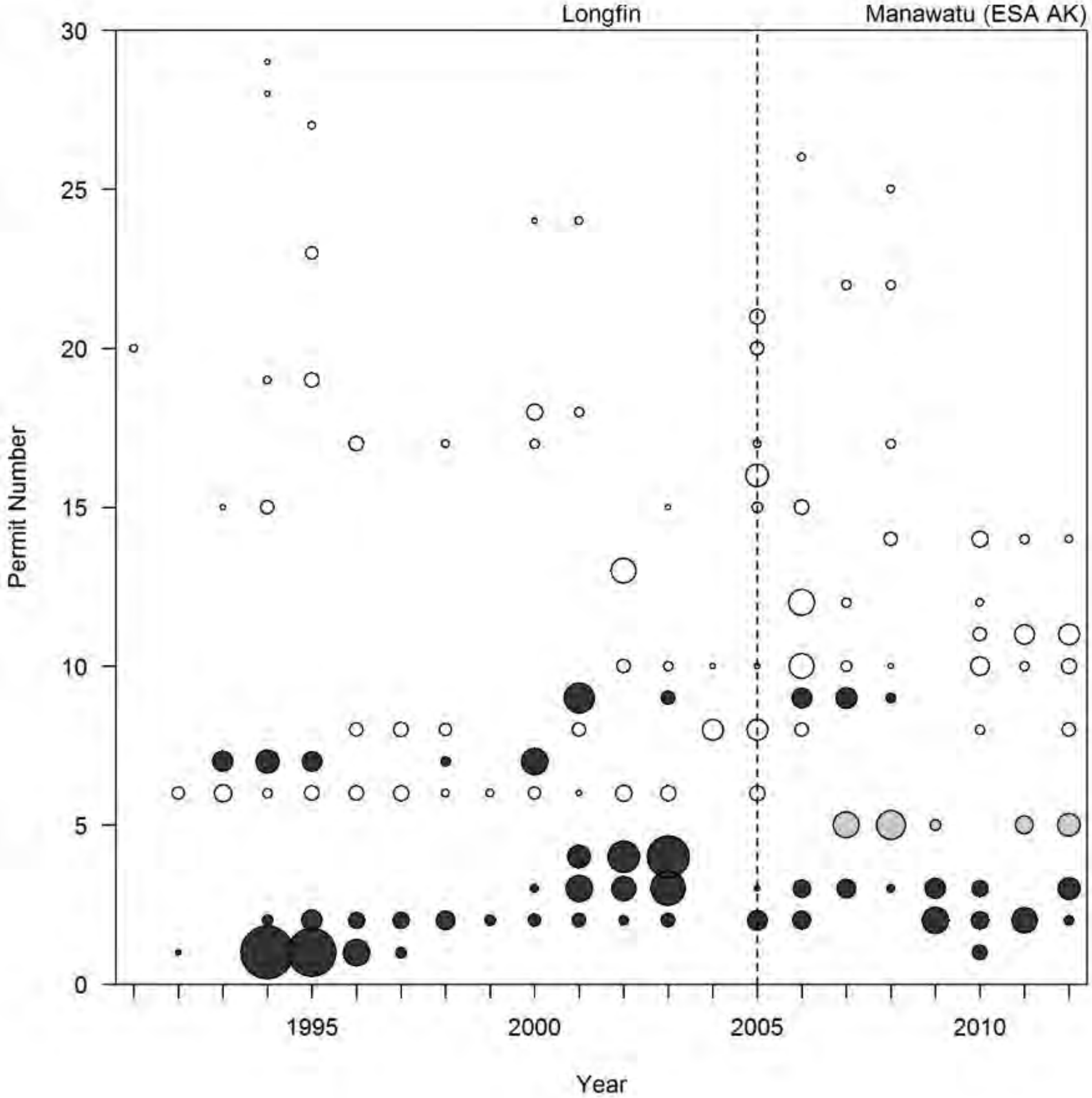


Figure K21: Relative catch of longfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Manawatu (ESA AK)).

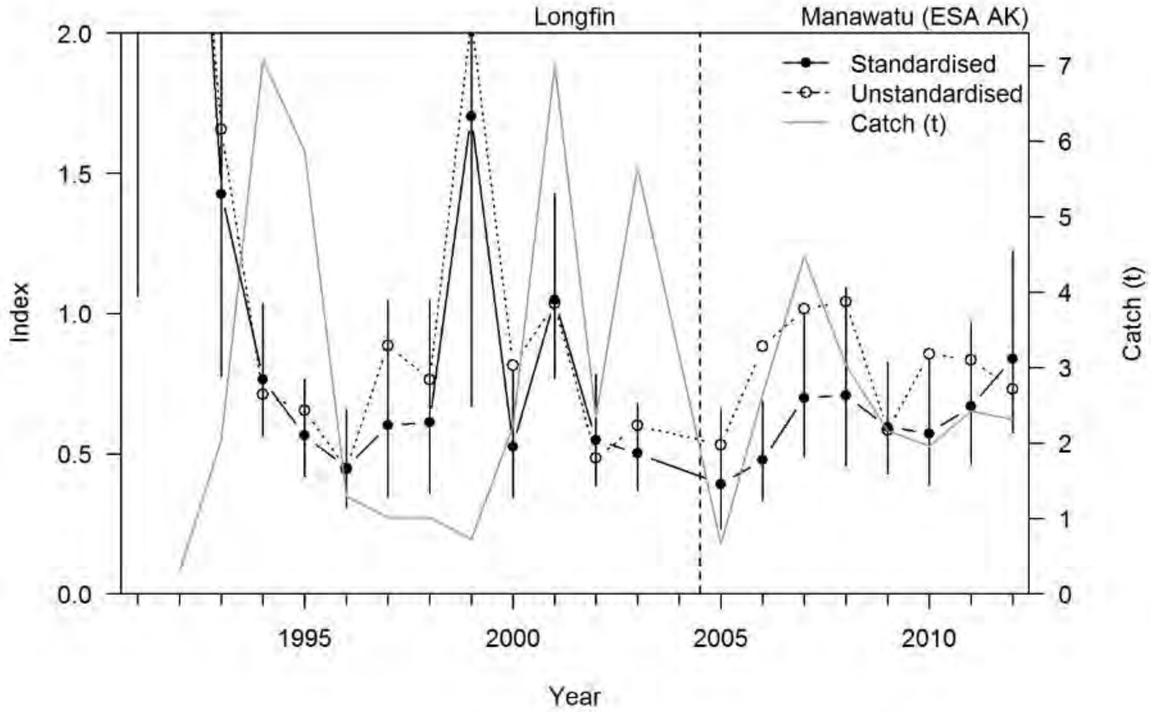


Figure K22: Indices of unstandardised catch per day and standardised CPUE for the core fishers longfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Manawatu (ESA AK)).

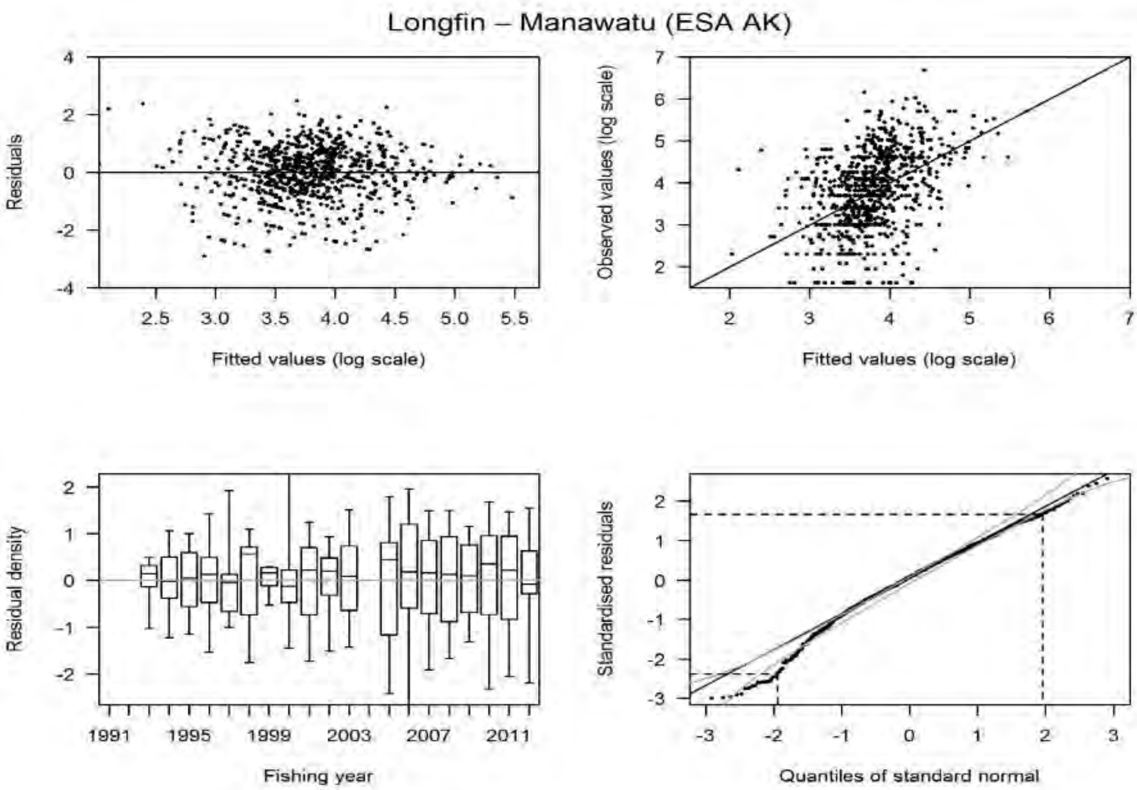


Figure K23: Residual diagnostic plots for the longfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Manawatu (ESA AK)).

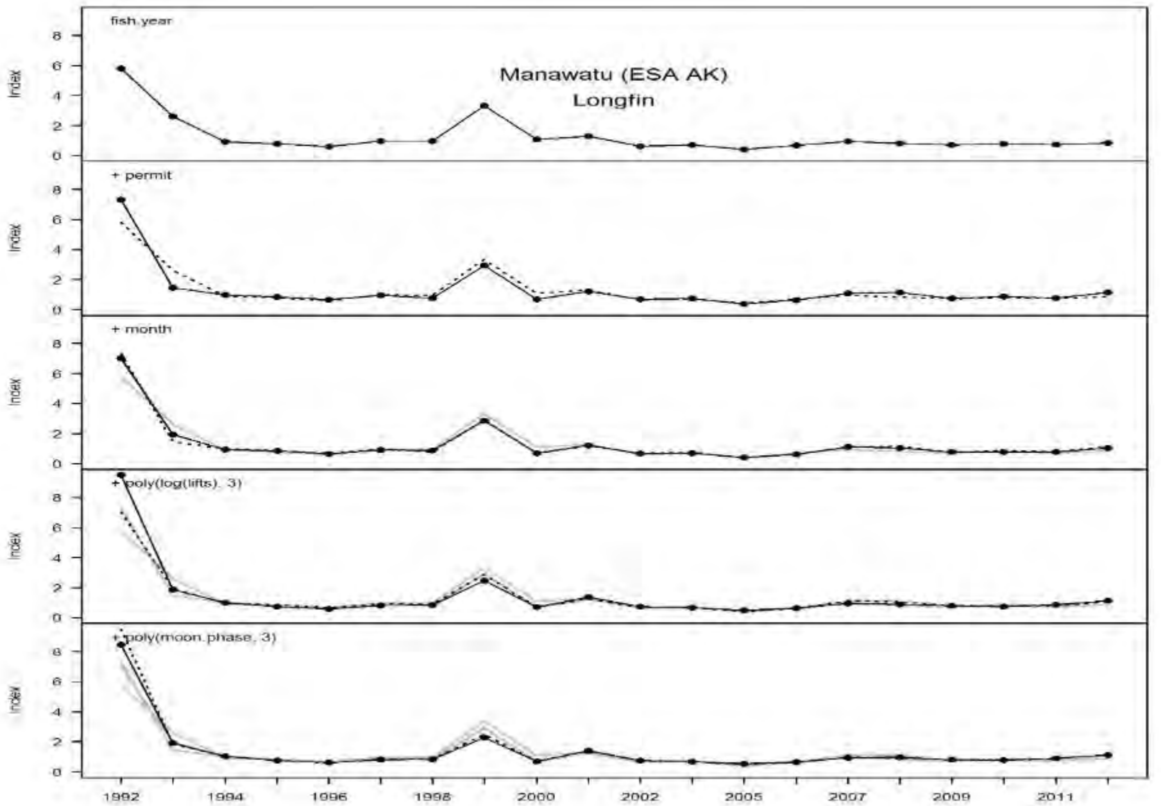


Figure K24: Step plot for the longfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Manawatu (ESA AK)).

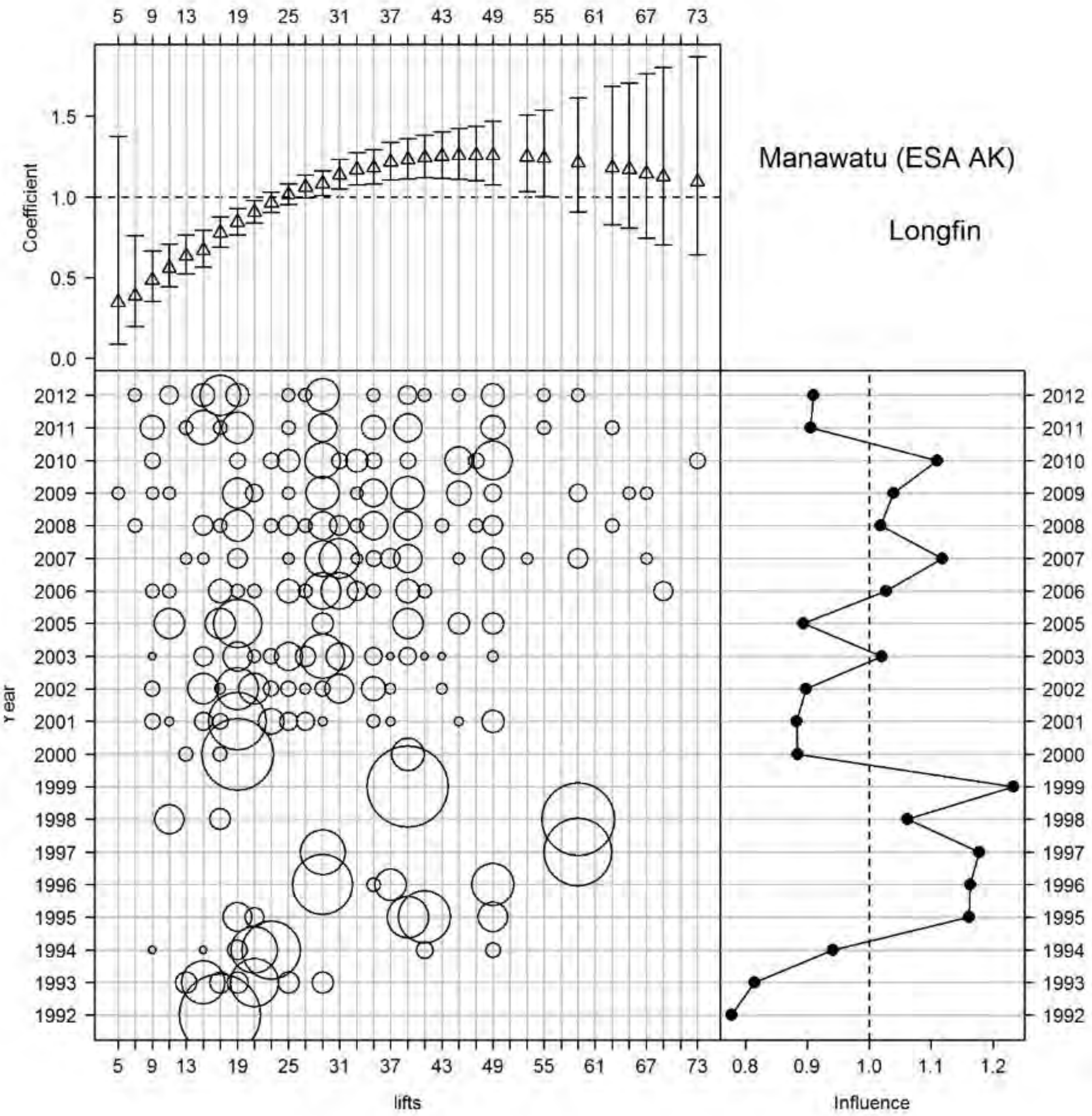


Figure K25: Influence of lifts for the longfin CPUE model for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

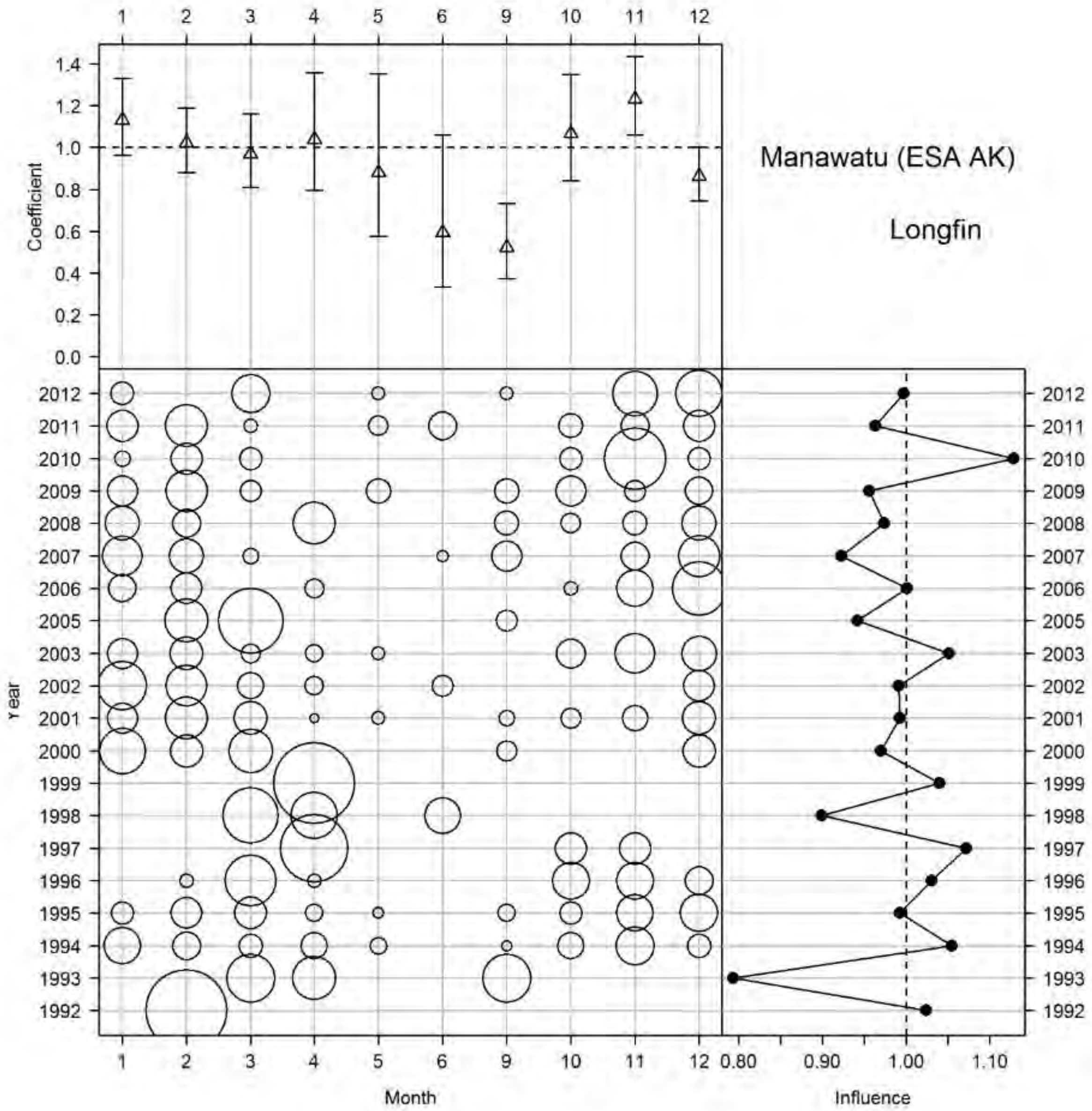


Figure K26: Influence of month for the longfin CPUE model for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

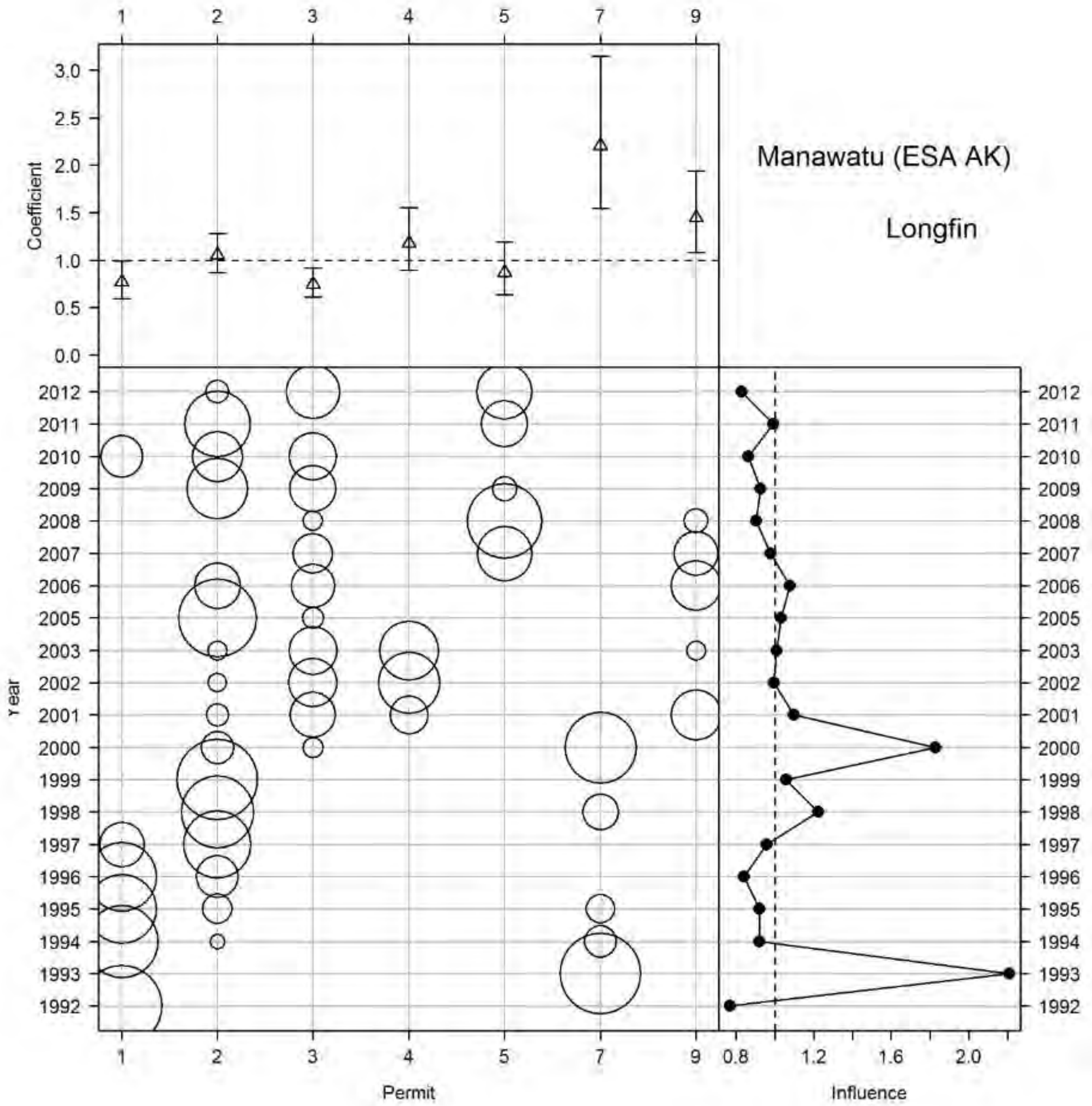


Figure K27: Influence of permit number for the longfin CPUE model for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

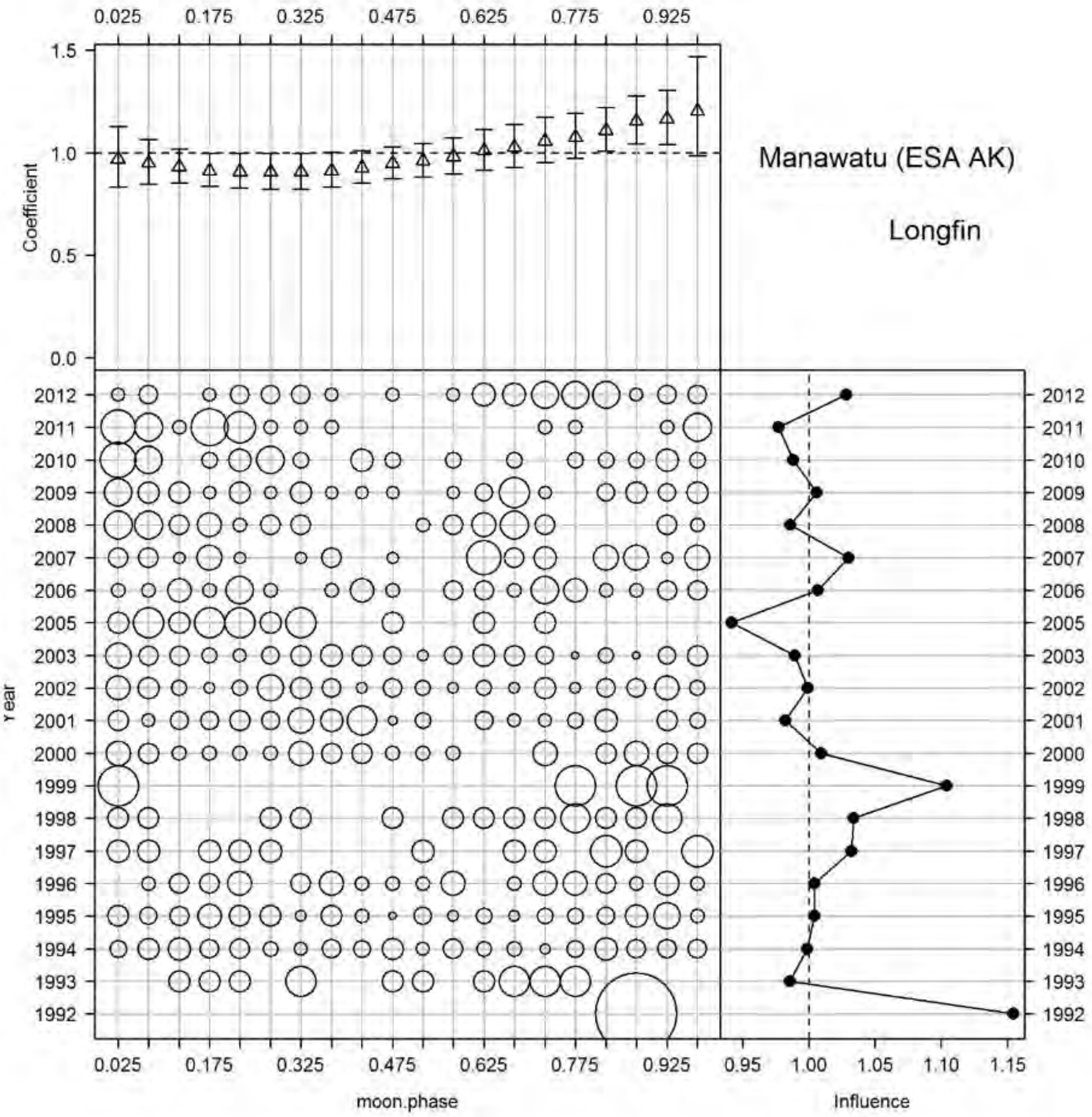


Figure K28: Influence of moon phase for the longfin CPUE model for the years 1990–91 to 2011–12 (Manawatu (ESA AK)).

Appendix L: Wairarapa (ESA AL)

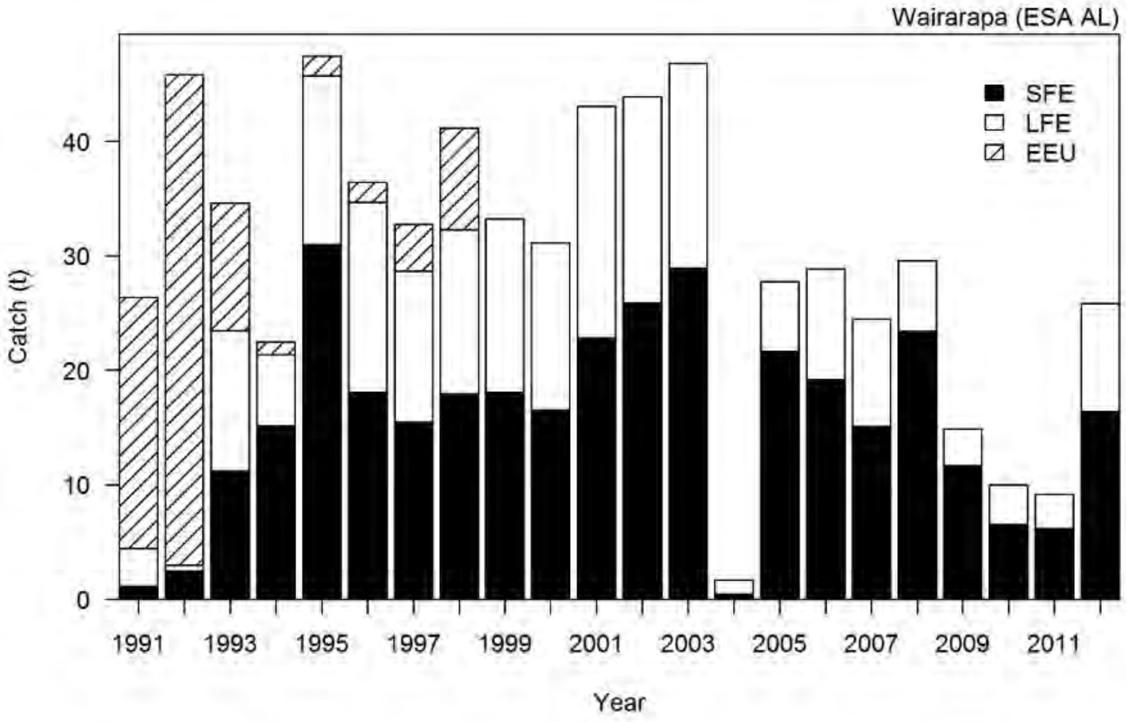


Figure L1: Total estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

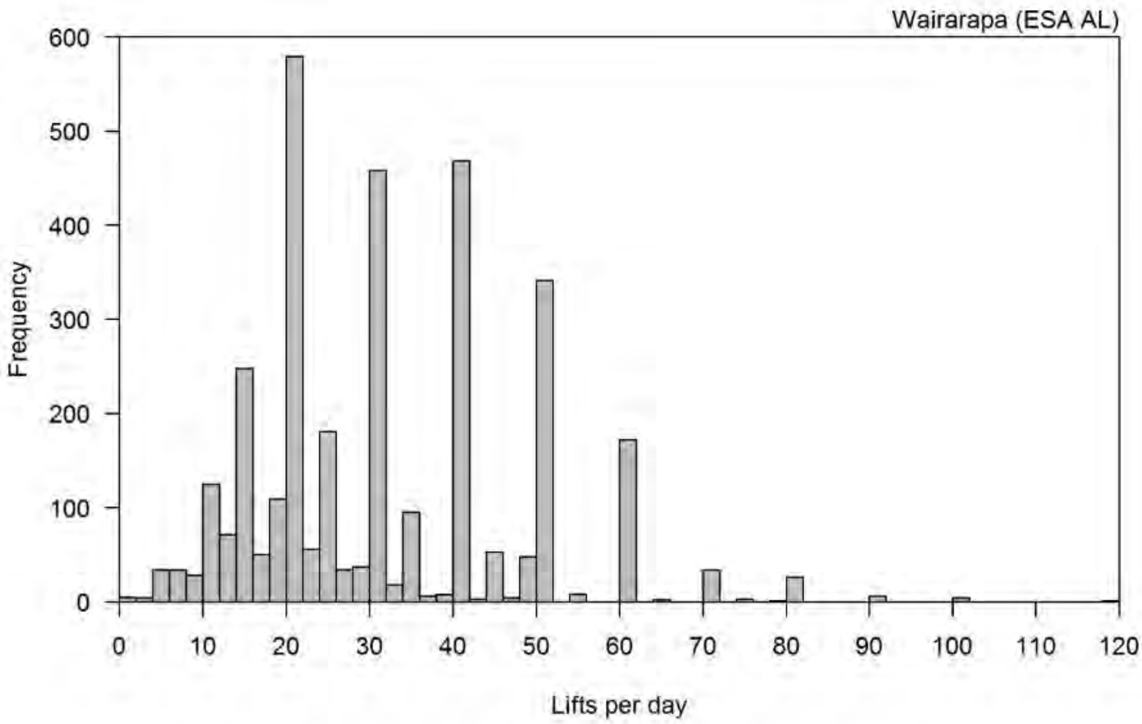


Figure L2: Frequency of total lifts per day for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

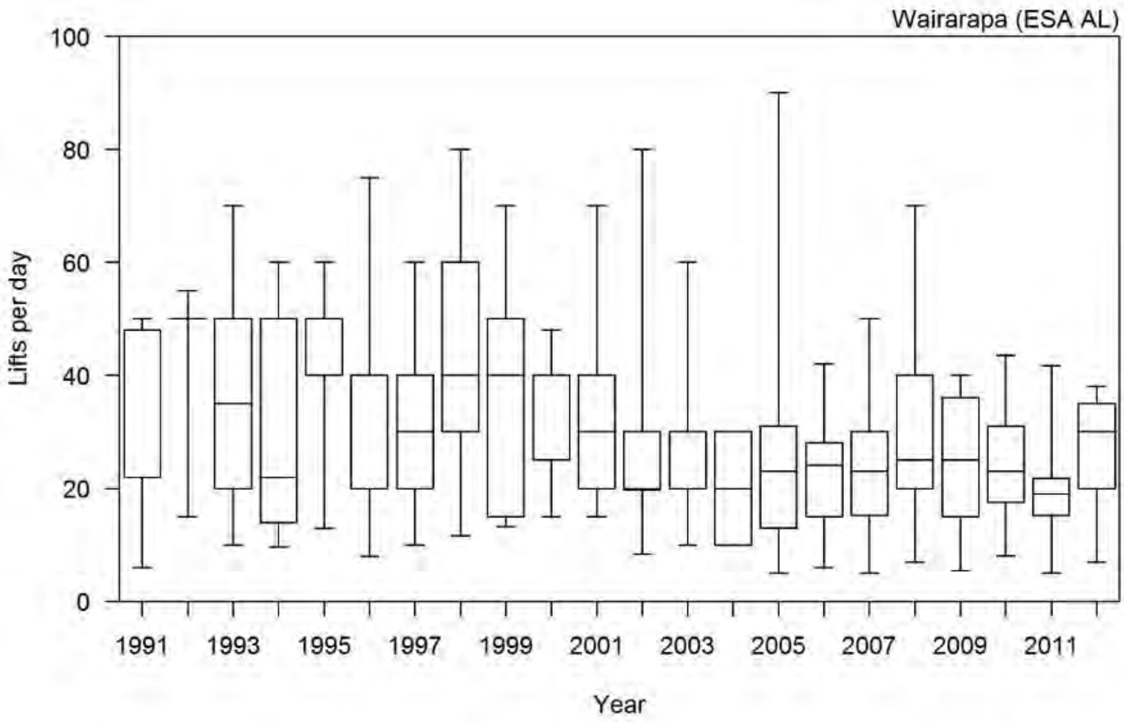


Figure L3: Total lifts per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Wairarapa (ESA AL)).

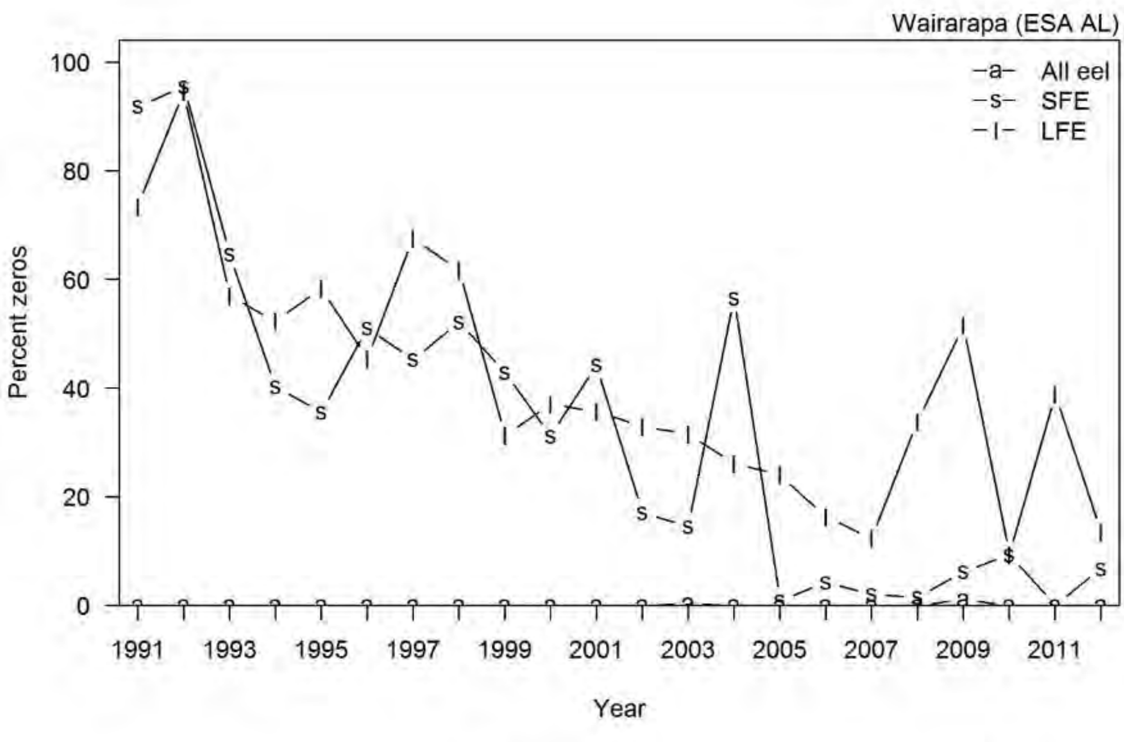


Figure L4: Proportion of zero records for all eel, shortfin (SFE), and longfin (LFE) catch for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

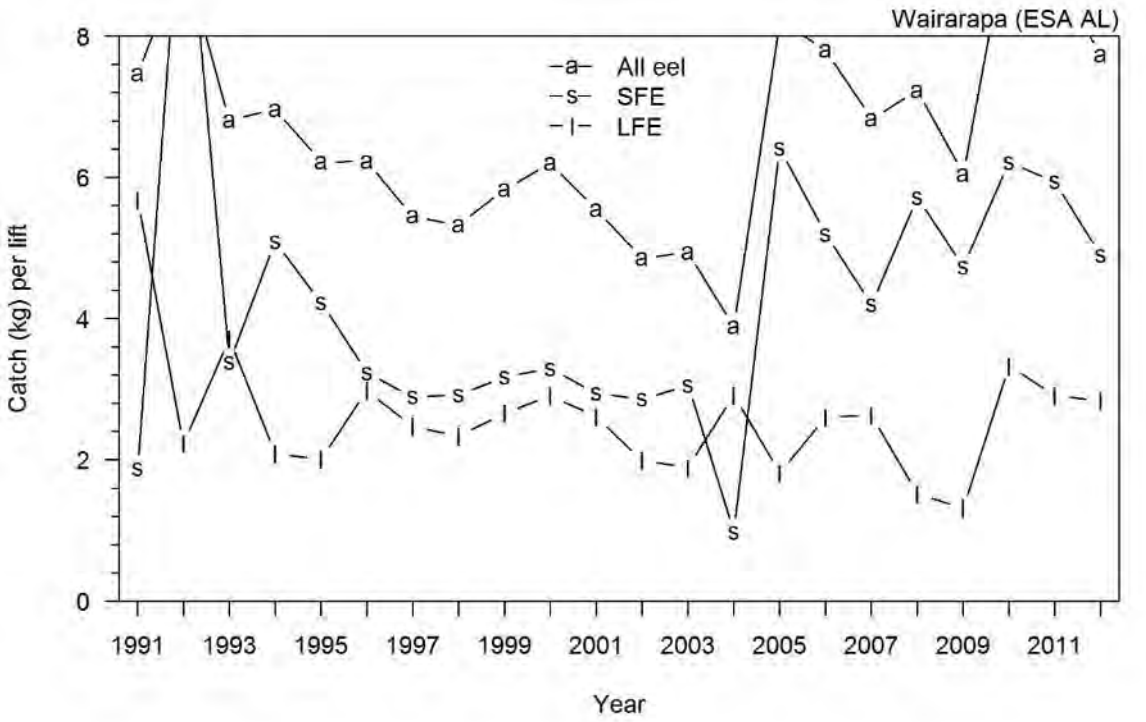


Figure L5: Unstandardised catch per lift (total kg/total lifts) for all eel, shortfin (SFE), and longfin (LFE) for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

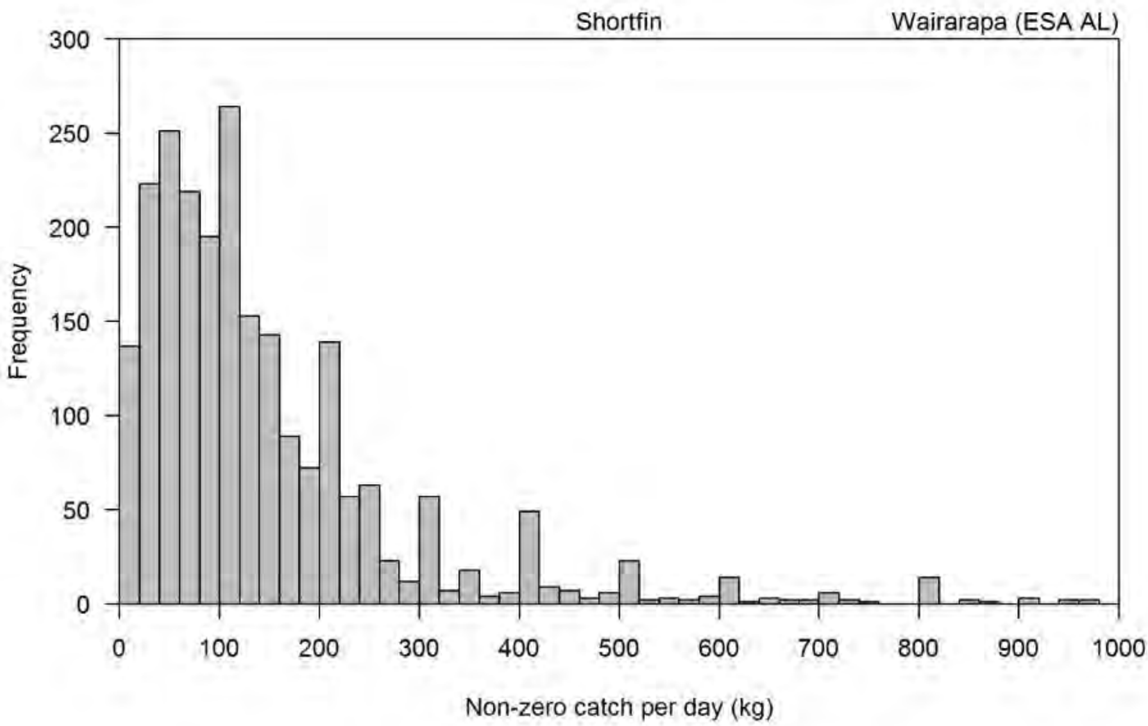


Figure L6: Frequency of shortfin eel catch per day for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

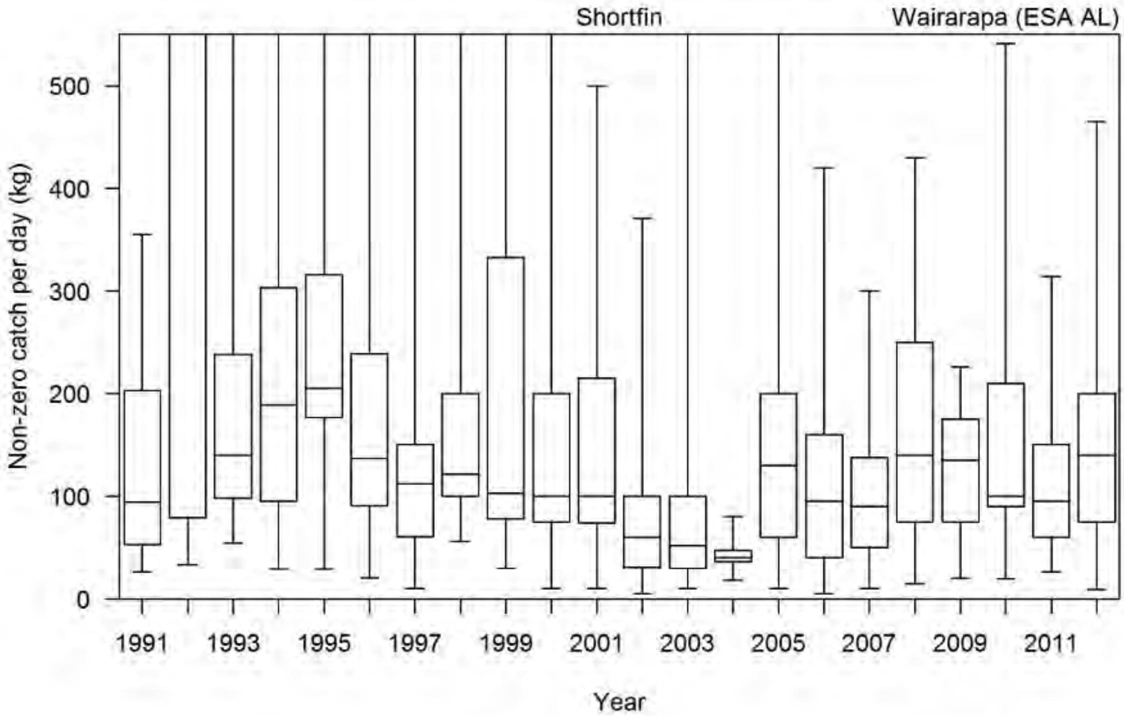


Figure L7: Shortfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Wairarapa (ESA AL)).

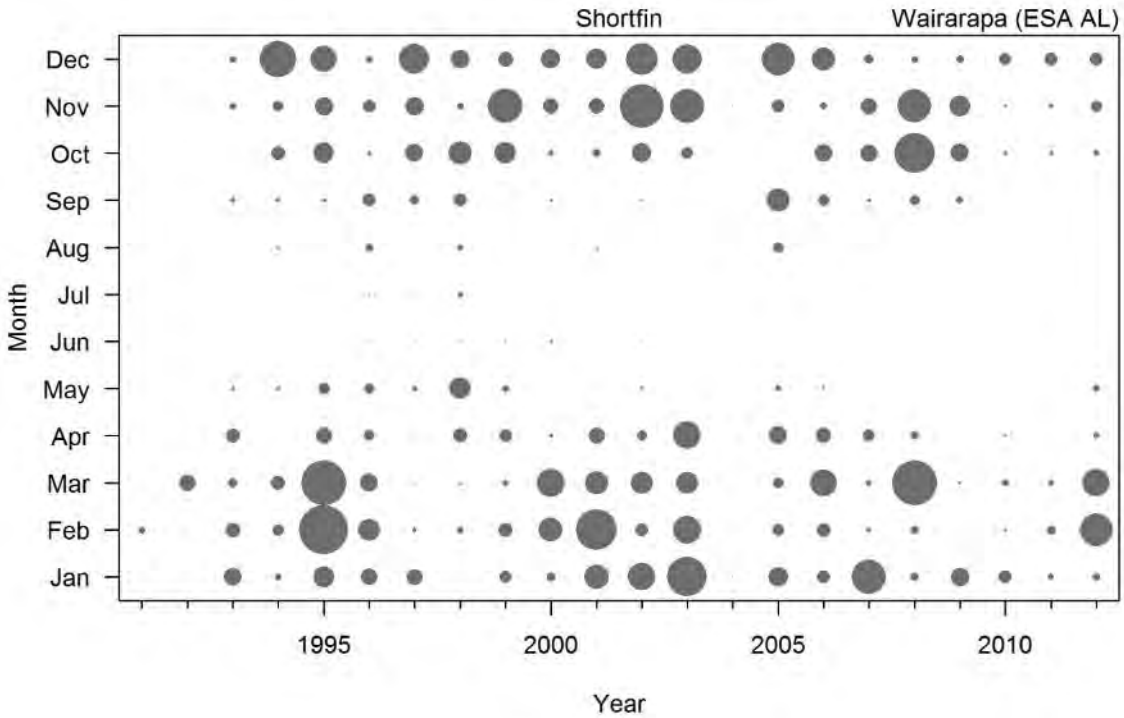


Figure L8: Shortfin eel catch by month for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

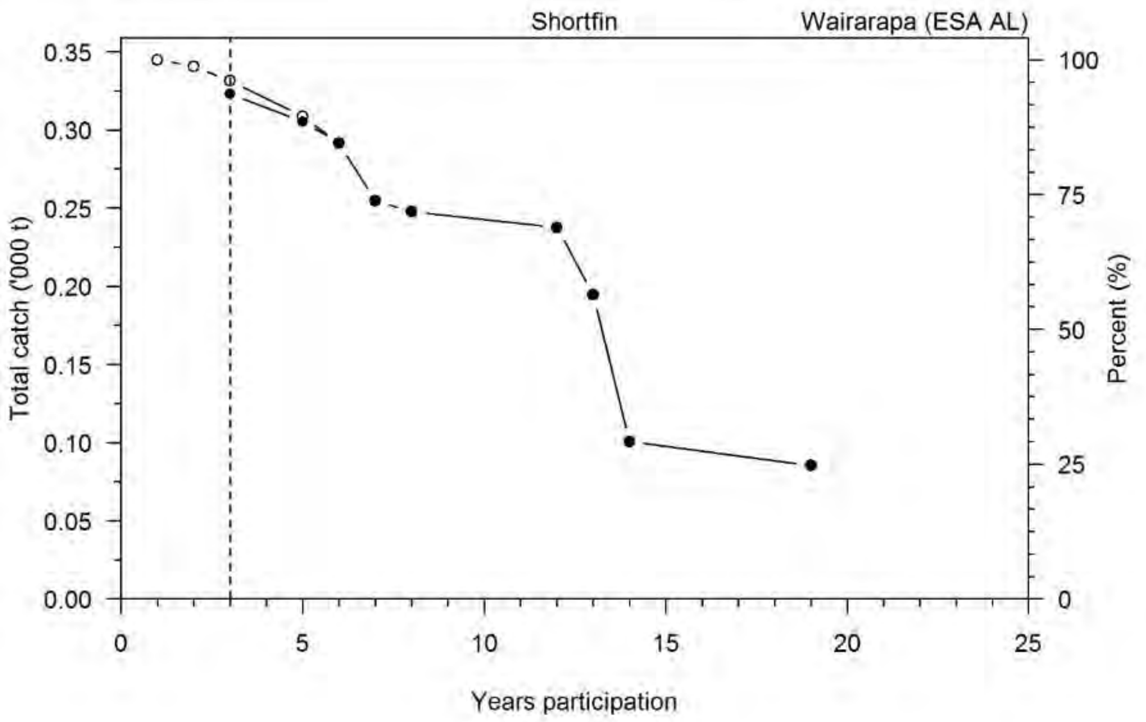


Figure L9: Relationship between years of participation in the fishery and shortfin total catch. The open circles represent all shortfin catch and the closed circles shortfin catch data from fishers who 1) caught shortfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core shortfin fisher analyses for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

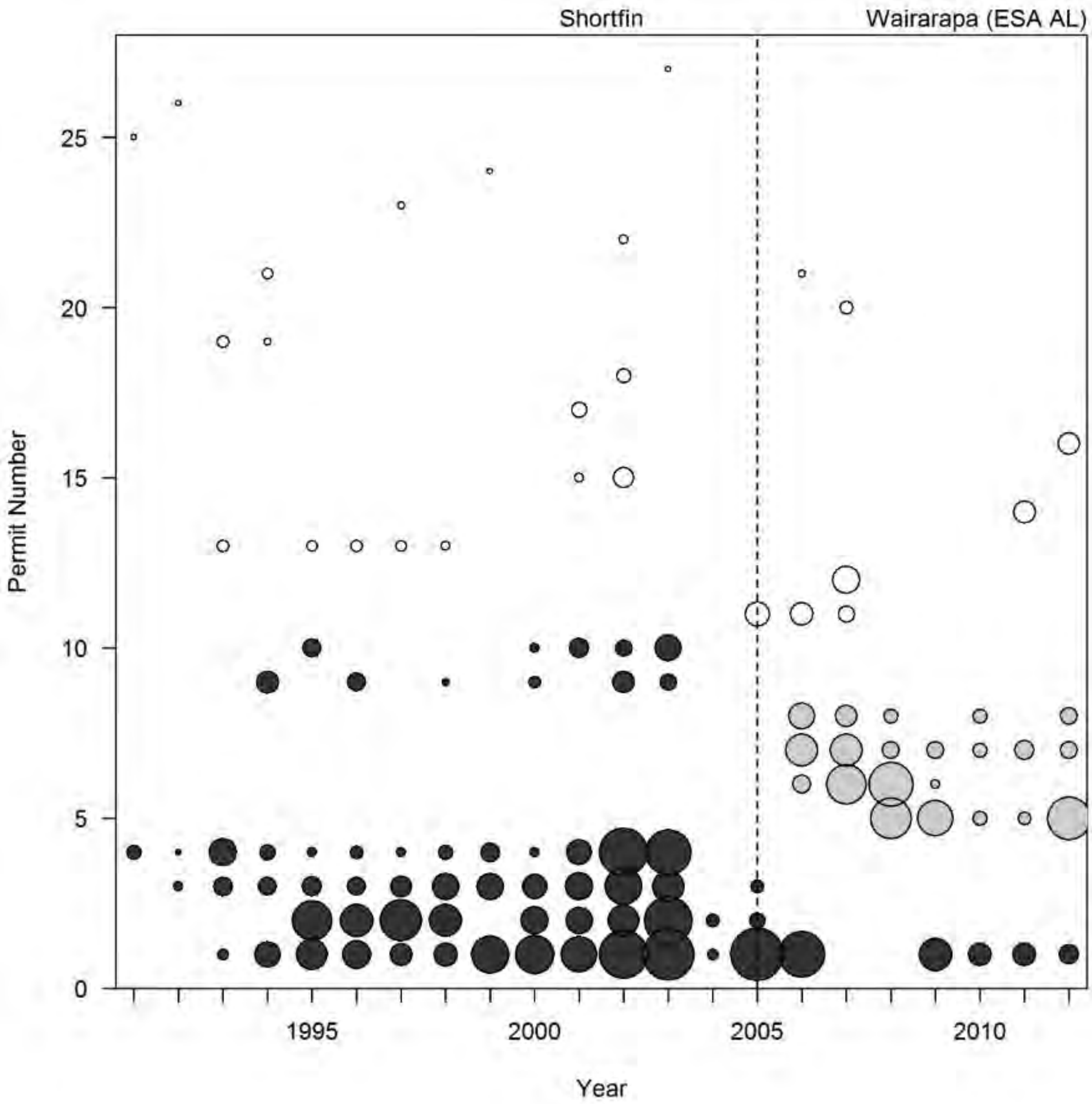


Figure L10: Relative catch of shortfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Wairarapa (ESA AL)).

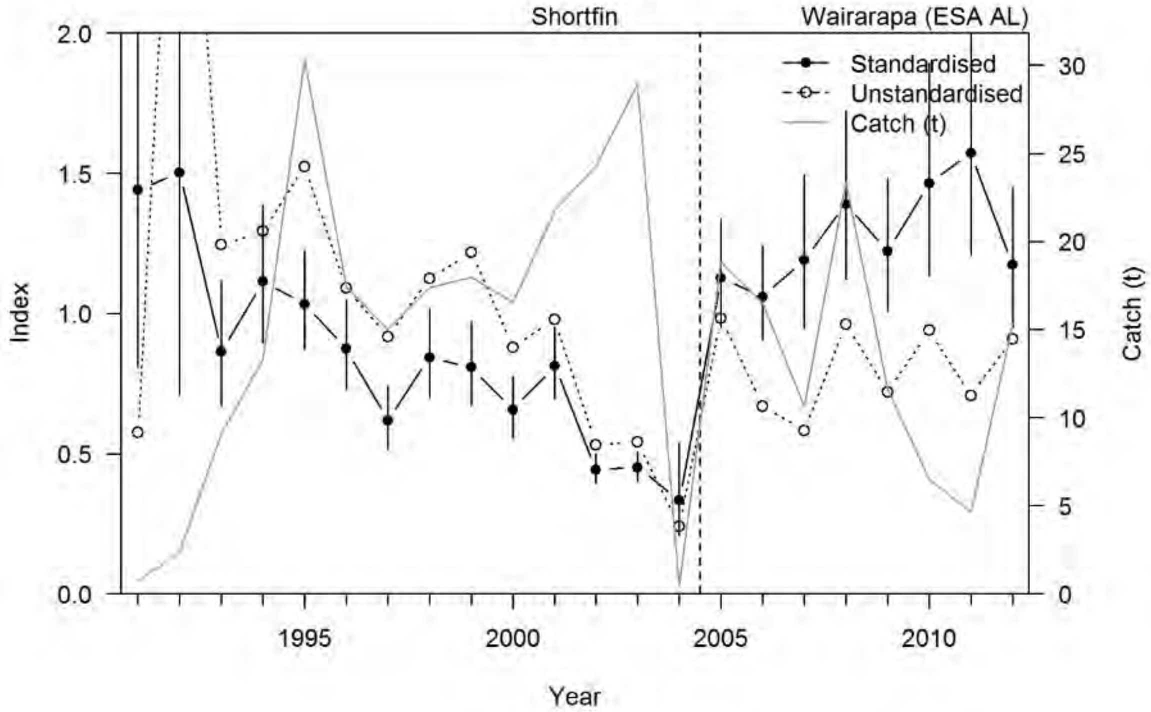


Figure L11: Indices of unstandardised catch per day and standardised CPUE for the core fishers shortfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Wairarapa (ESA AL)).

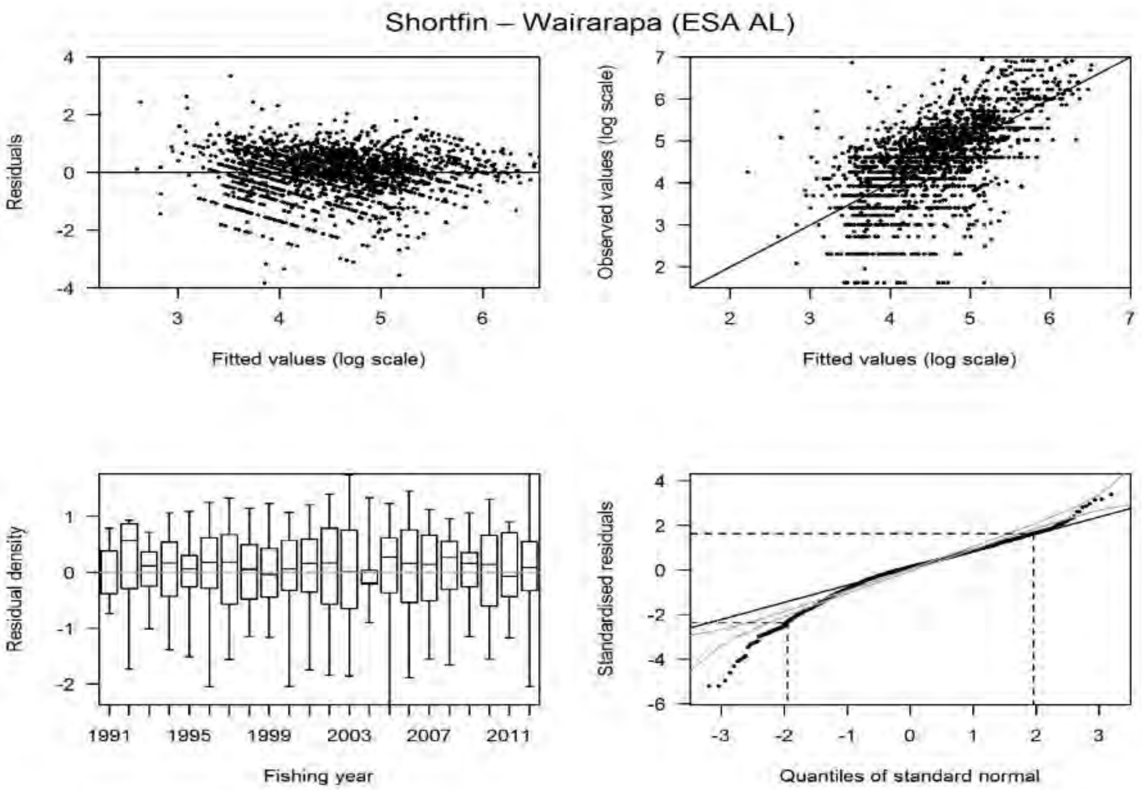


Figure L12: Residual diagnostic plots for the shortfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Wairarapa (ESA AL)).

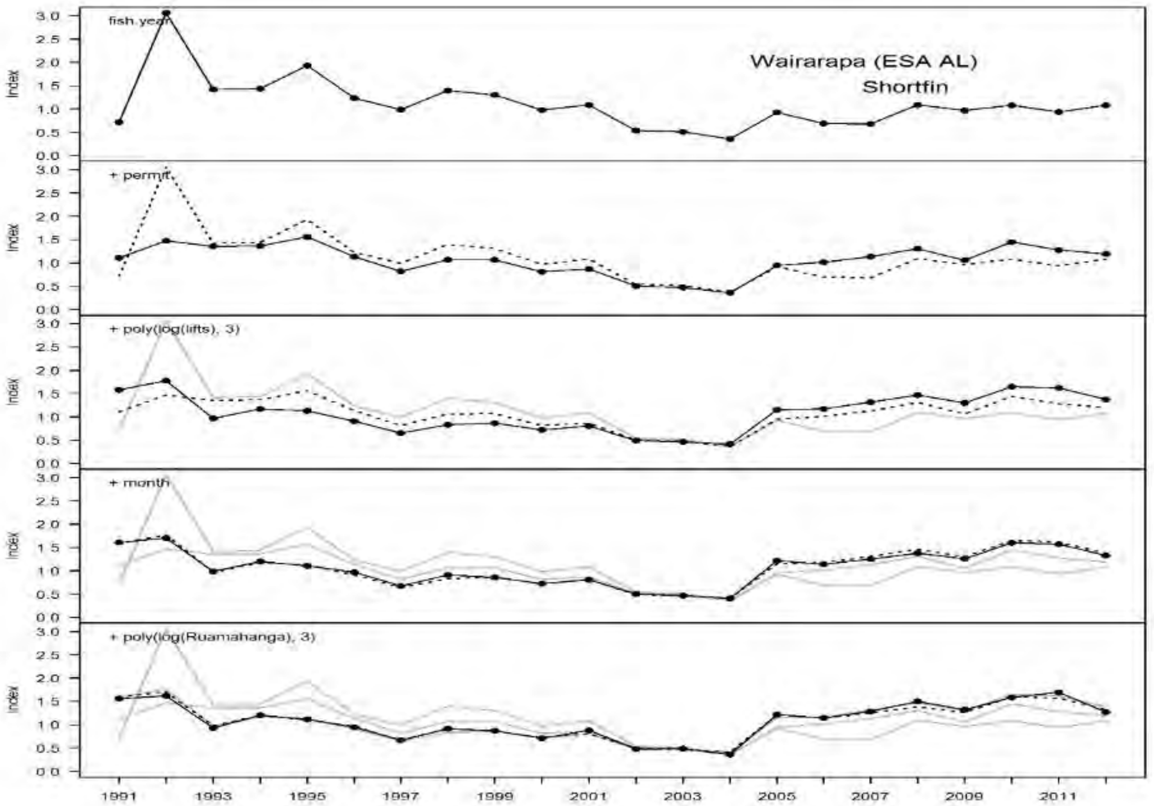


Figure L13: Step plot for the shortfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Wairarapa (ESA AL)).

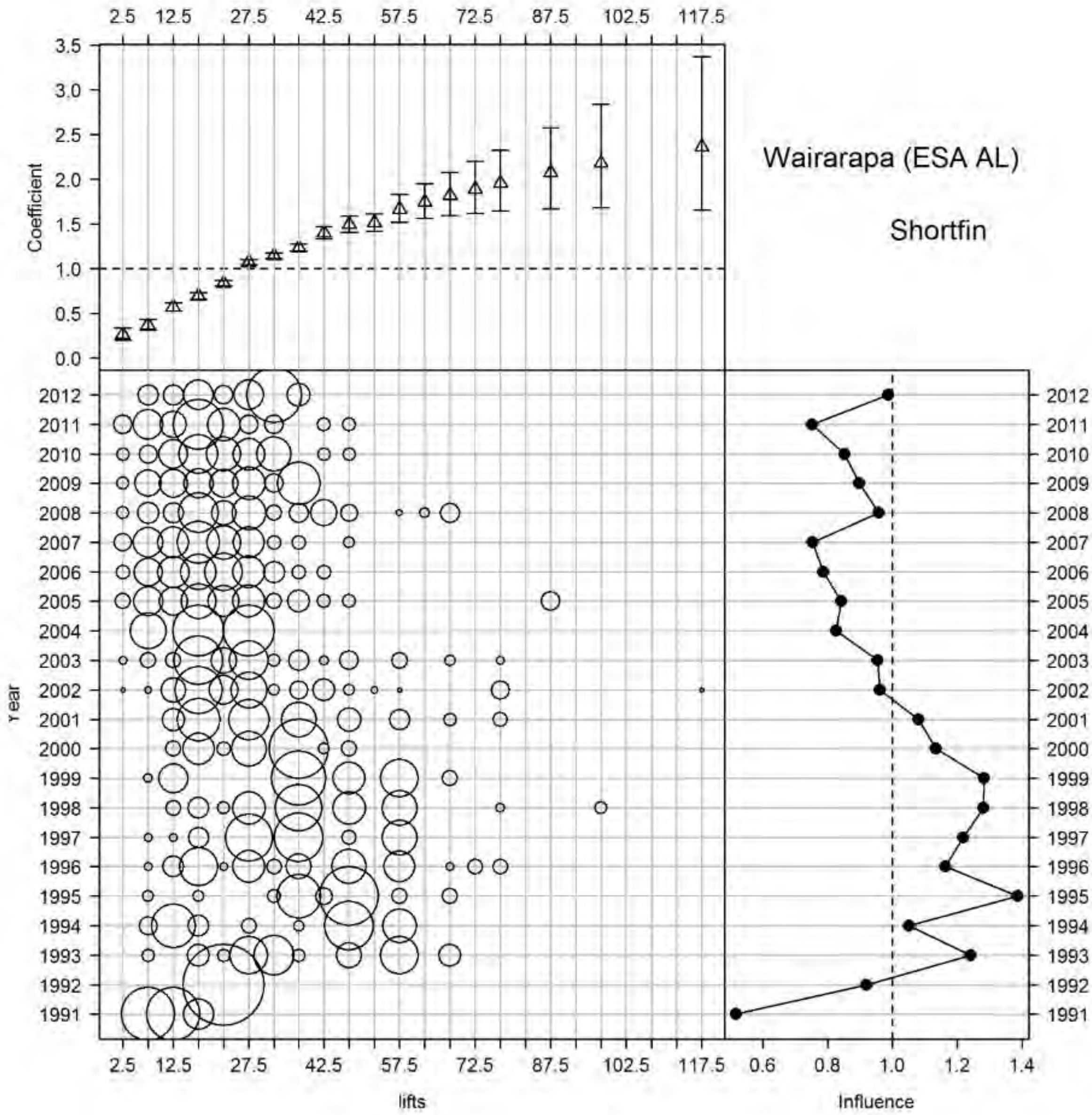


Figure L14: Influence of lifts for the shortfin CPUE model for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

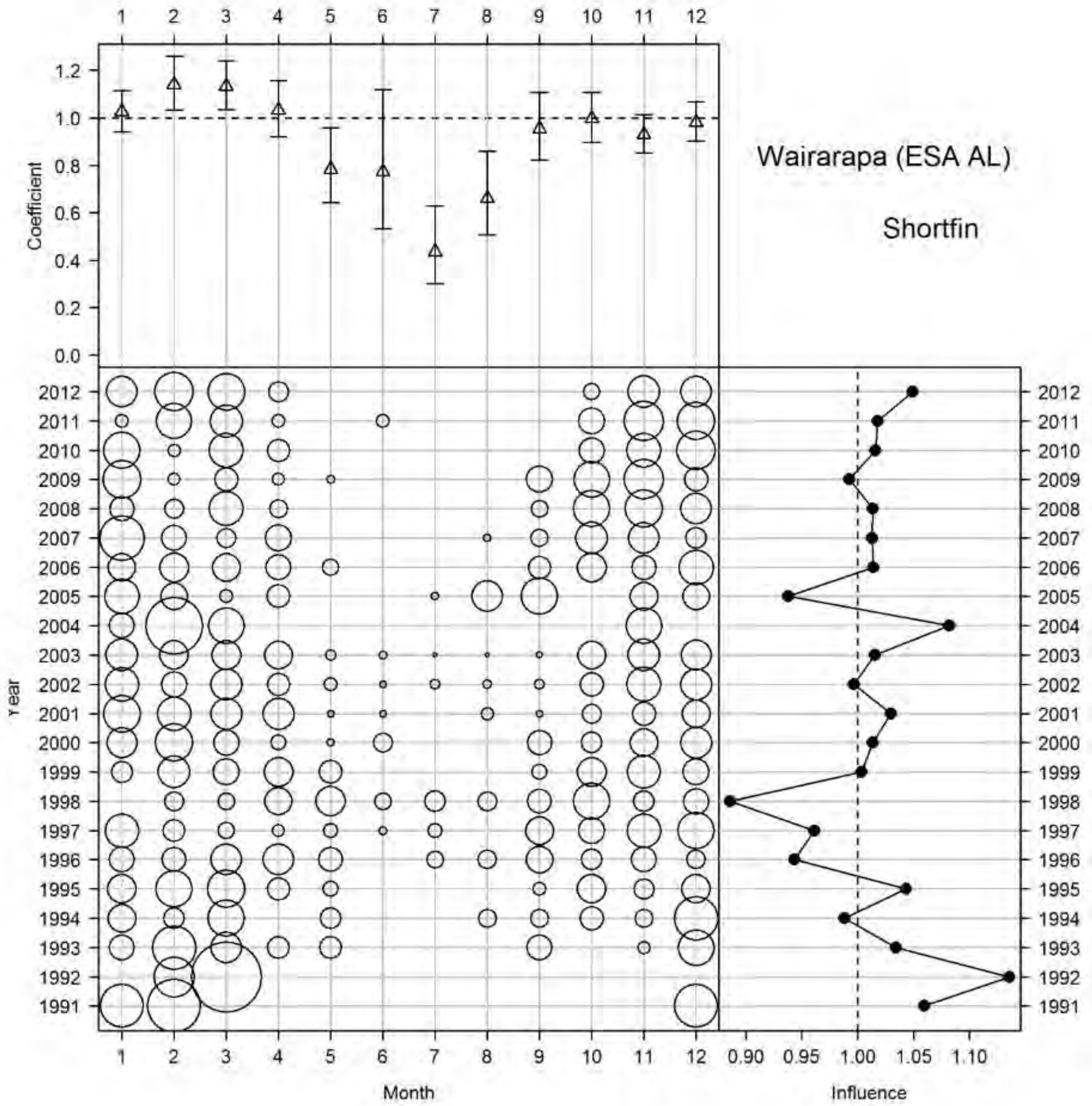


Figure L15: Influence of month for the shortfin CPUE model for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

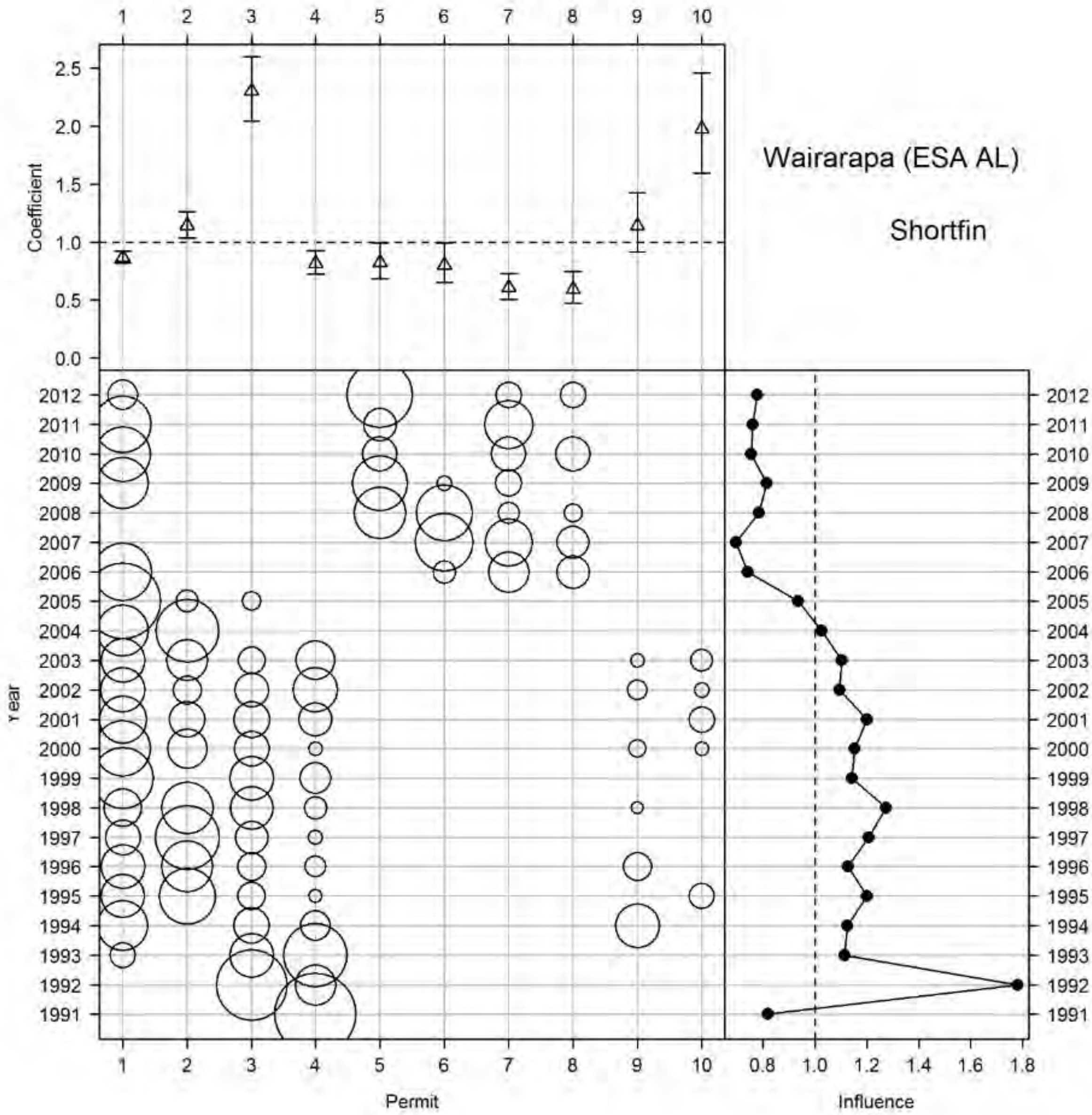


Figure L16: Influence of permit number for the shortfin CPUE model for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

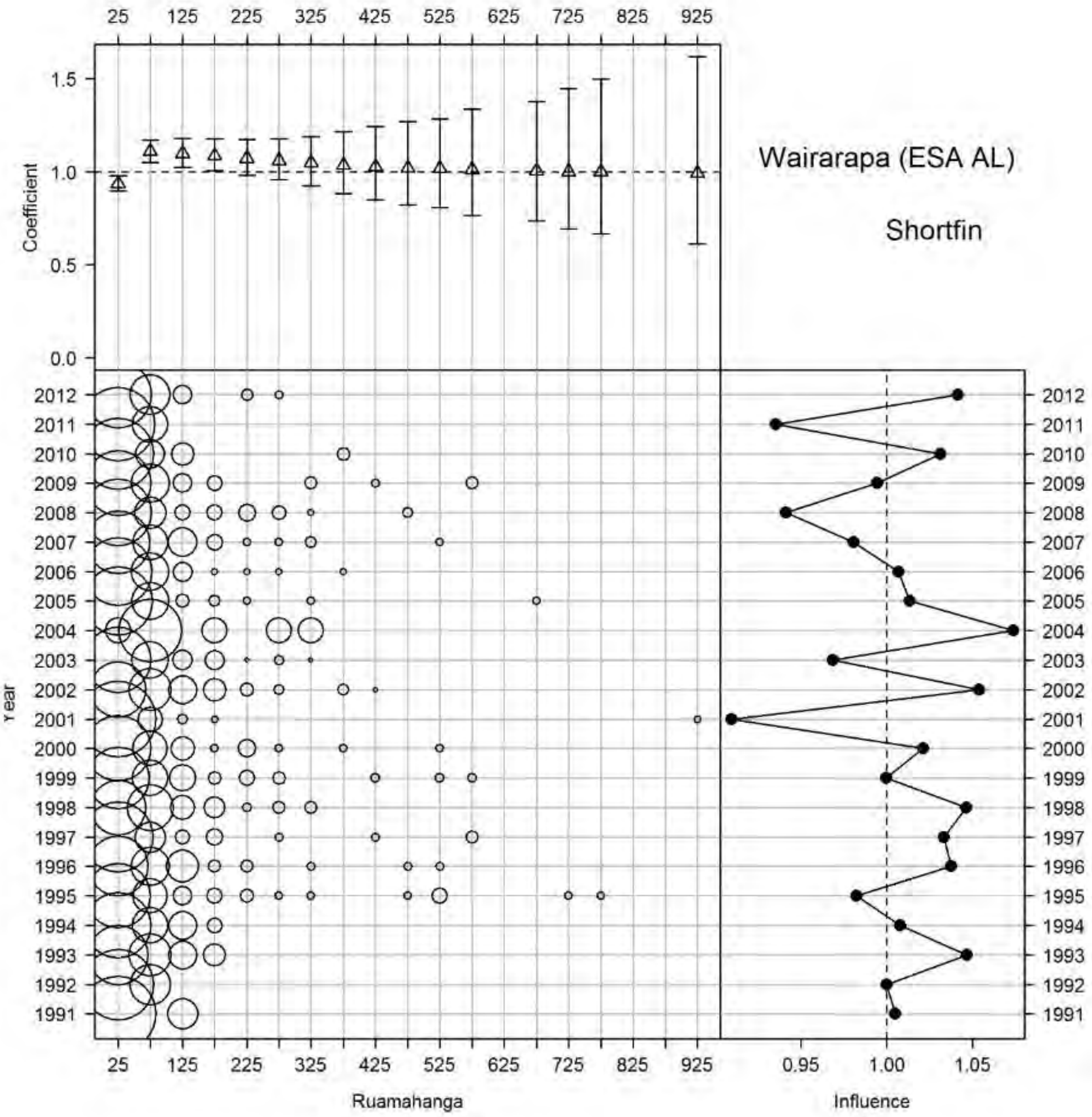


Figure L17: Influence of Ruamahanga River flow for the shortfin CPUE model for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

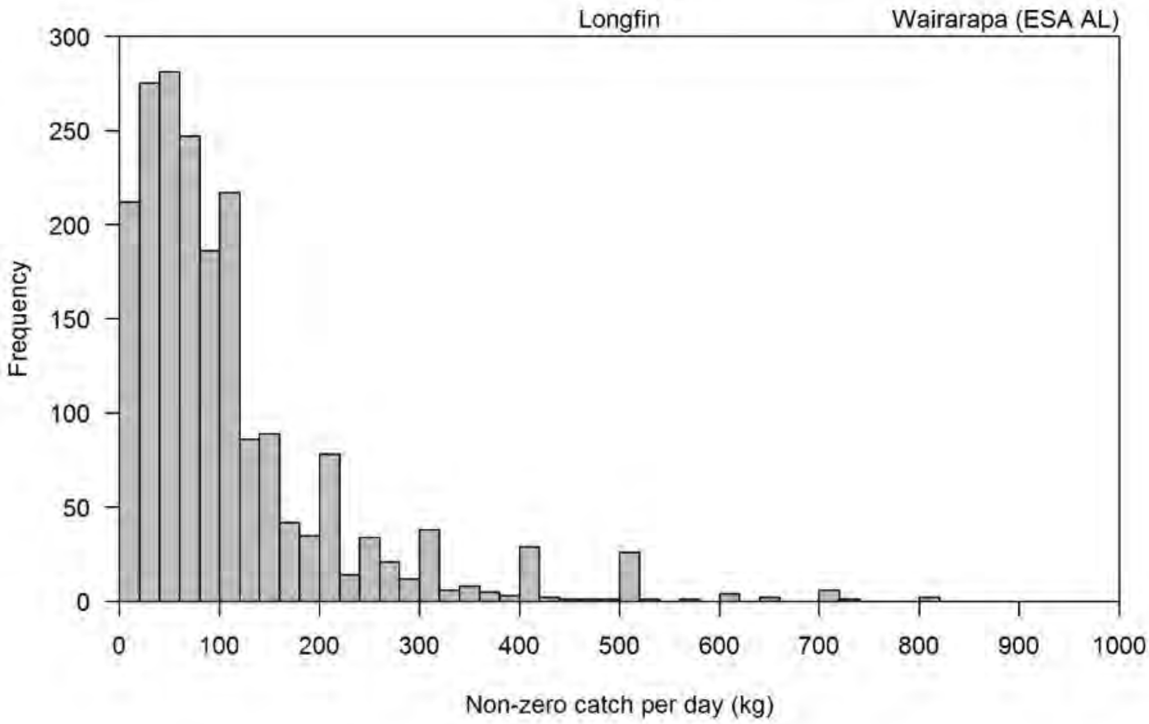


Figure L18: Frequency of longfin eel catch per day for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

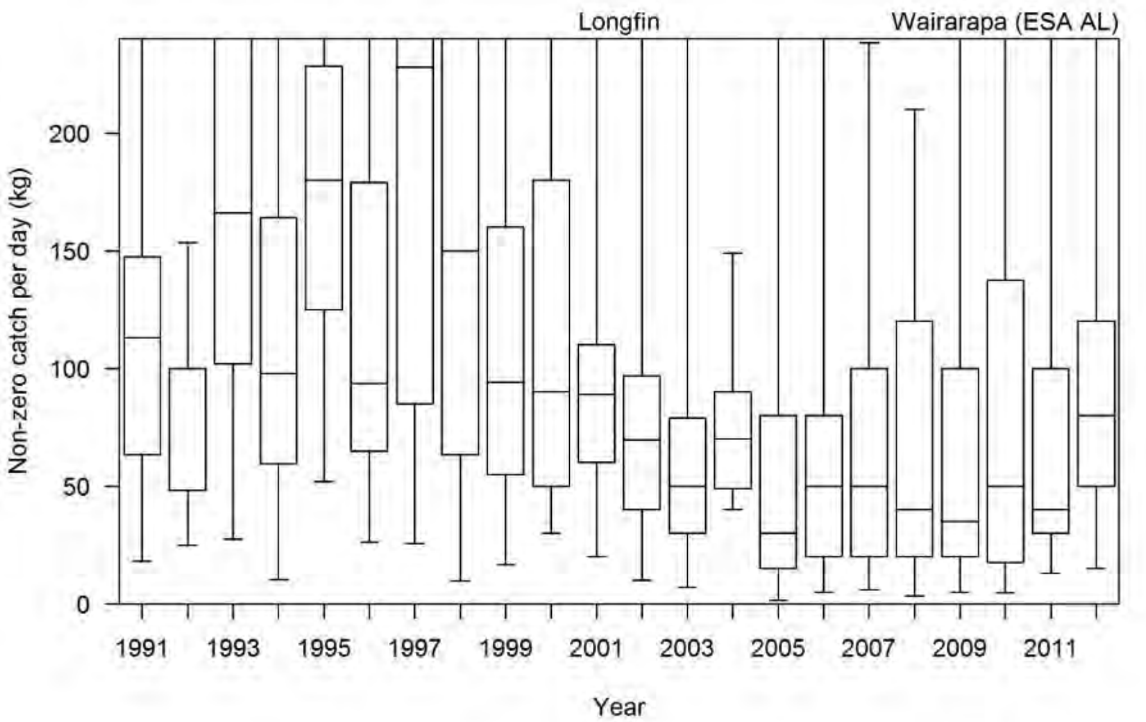


Figure L19: Longfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Wairarapa (ESA AL)).

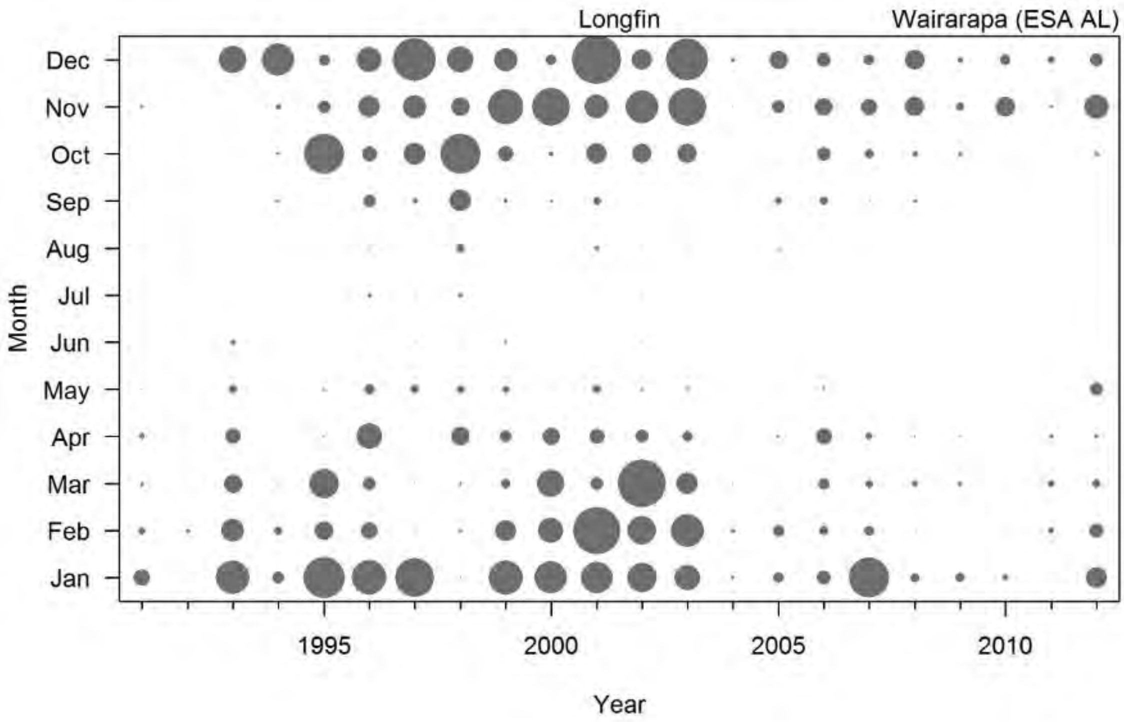


Figure L20: Longfin eel catch by month for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

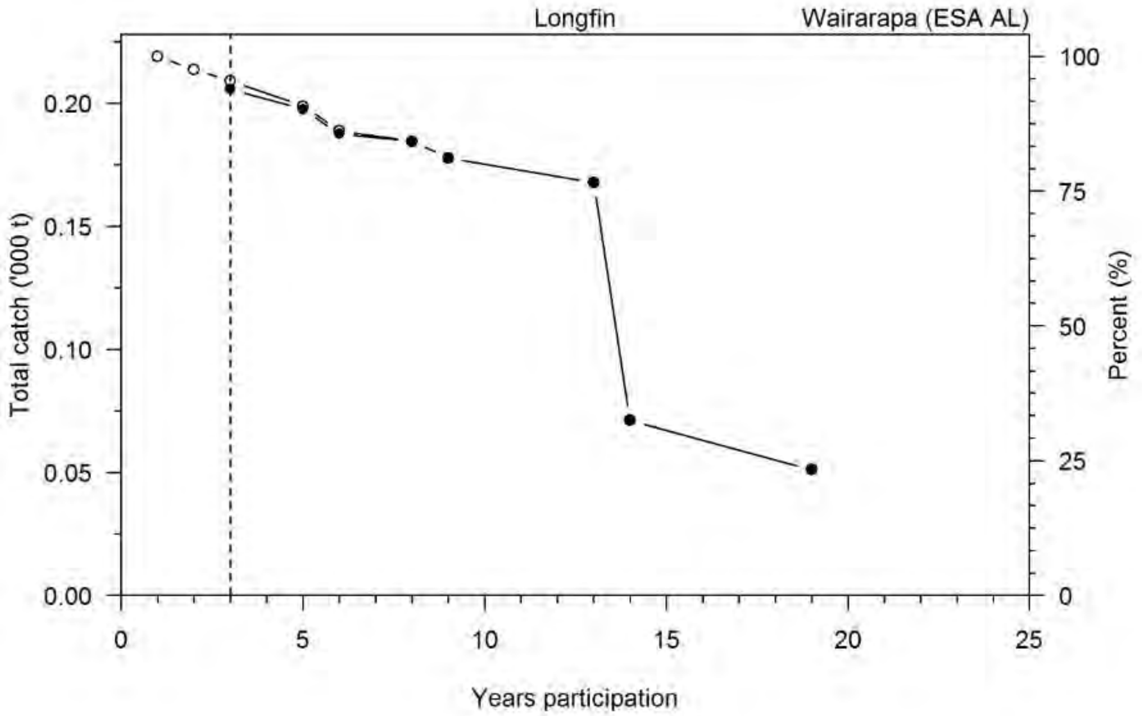


Figure L21: Relationship between years of participation in the fishery and longfin total catch. The open circles represent all longfin catch and the closed circles longfin catch data from fishers who 1) caught longfin in at least three years in each of which fishing took place in 10 days or more, and 2) caught more than 1000 kg over all years. Dotted vertical line represents 3 years participation and indicates the data included in the core longfin fisher analyses for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

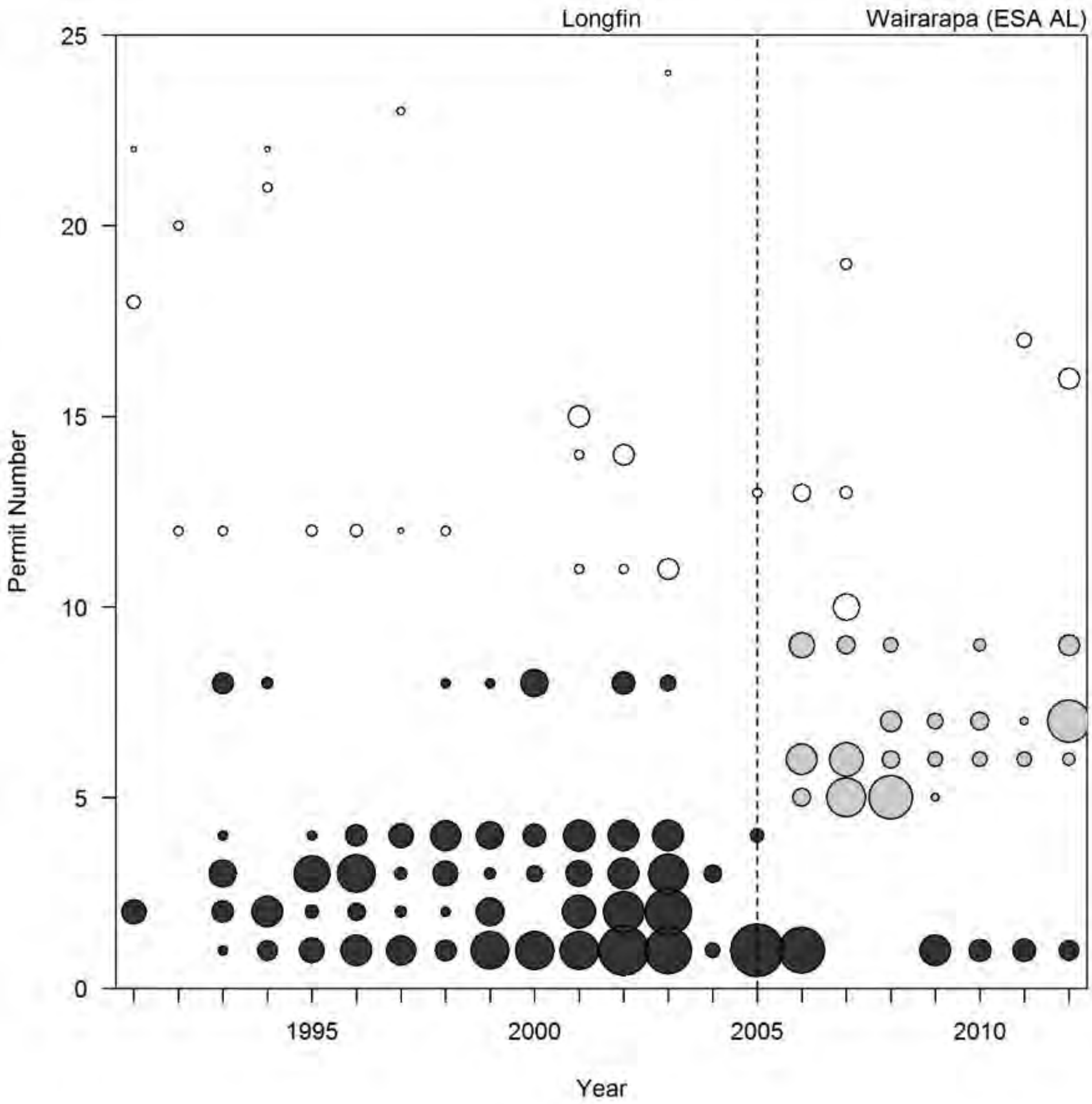


Figure L22: Relative catch of longfin from all fishers (all circles) for the years 1990–91 to 2011–12, and for core fishers (dark and grey shaded circles) included in the catch per unit effort analyses. The vertical dotted line demarks introduction of the QMS in 2004–05. The dark shaded circles post-QMS are existing fishers and the grey, new entrants (Wairarapa (ESA AL)).

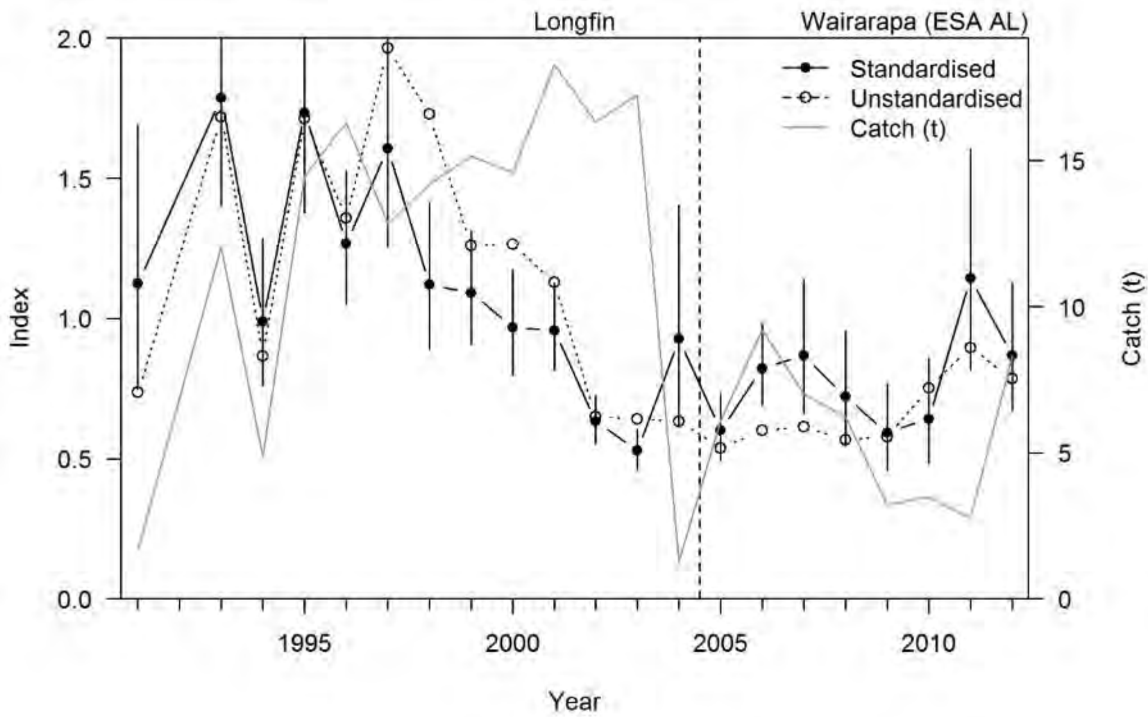


Figure L23: Indices of unstandardised catch per day and standardised CPUE for the core fishers longfin CPUE model for the years 1990–91 to 2011–12. The catch by core fishers is also plotted (Wairarapa (ESA AL)).

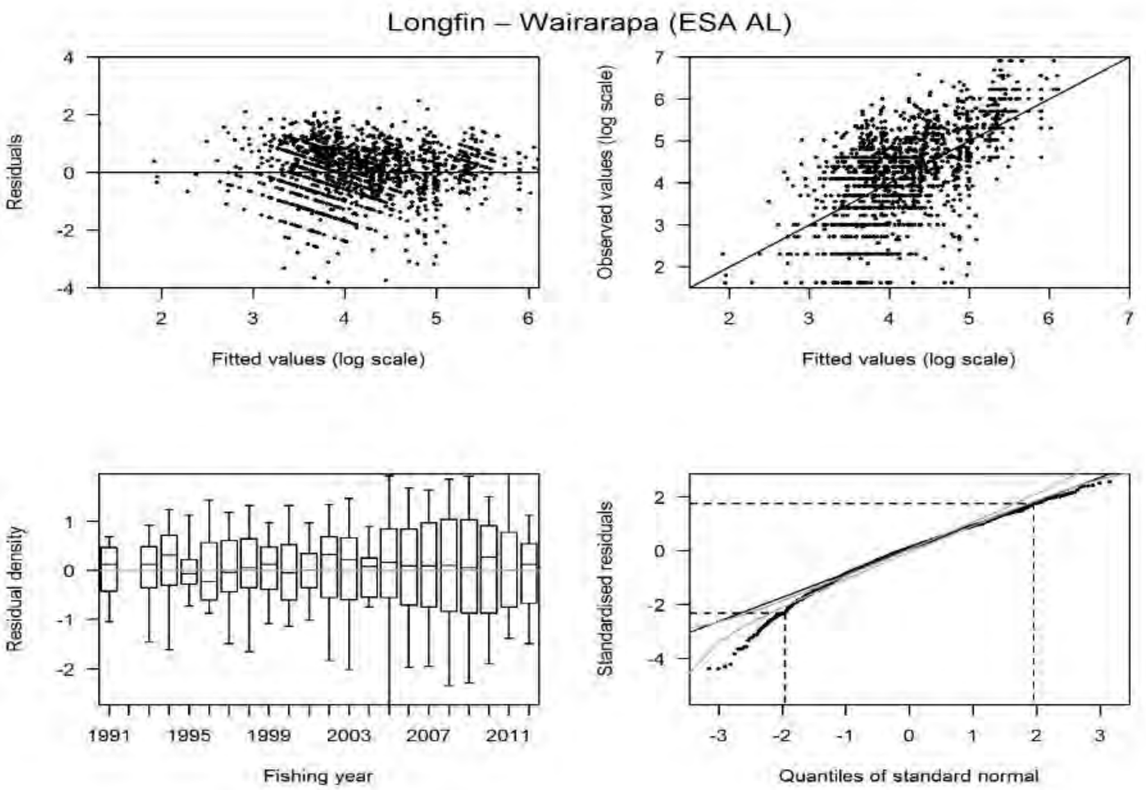


Figure L24: Residual diagnostic plots for the longfin CPUE model for the years 1990–91 to 2011–12. The grey lines on the quantile-quantile plot represent the 95% confidence envelopes of a standard normal distribution (Wairarapa (ESA AL)).

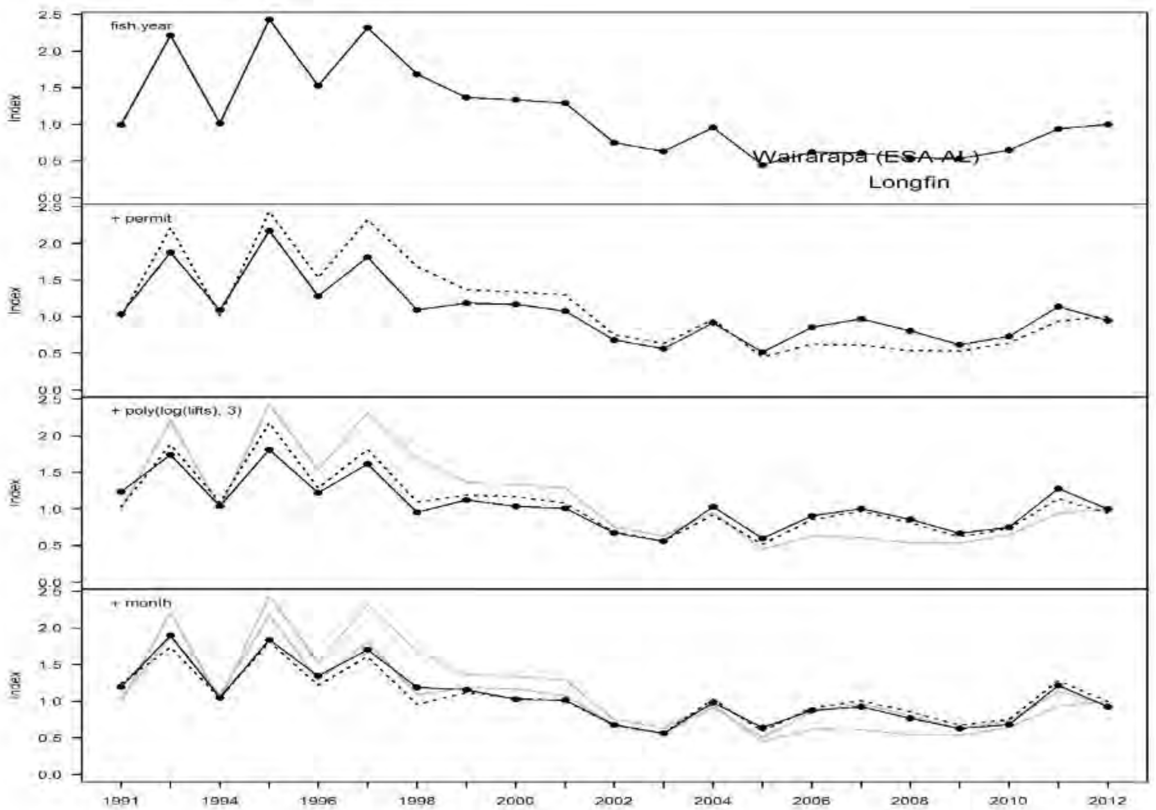


Figure L25: Step plot for the longfin eel CPUE model for the years 1990–91 to 2011–12. Each panel shows the standardised CPUE index as each explanatory variable is added to the model with the previous index shown by the dotted line and the grey lines for steps before that (Wairarapa (ESA AL)).

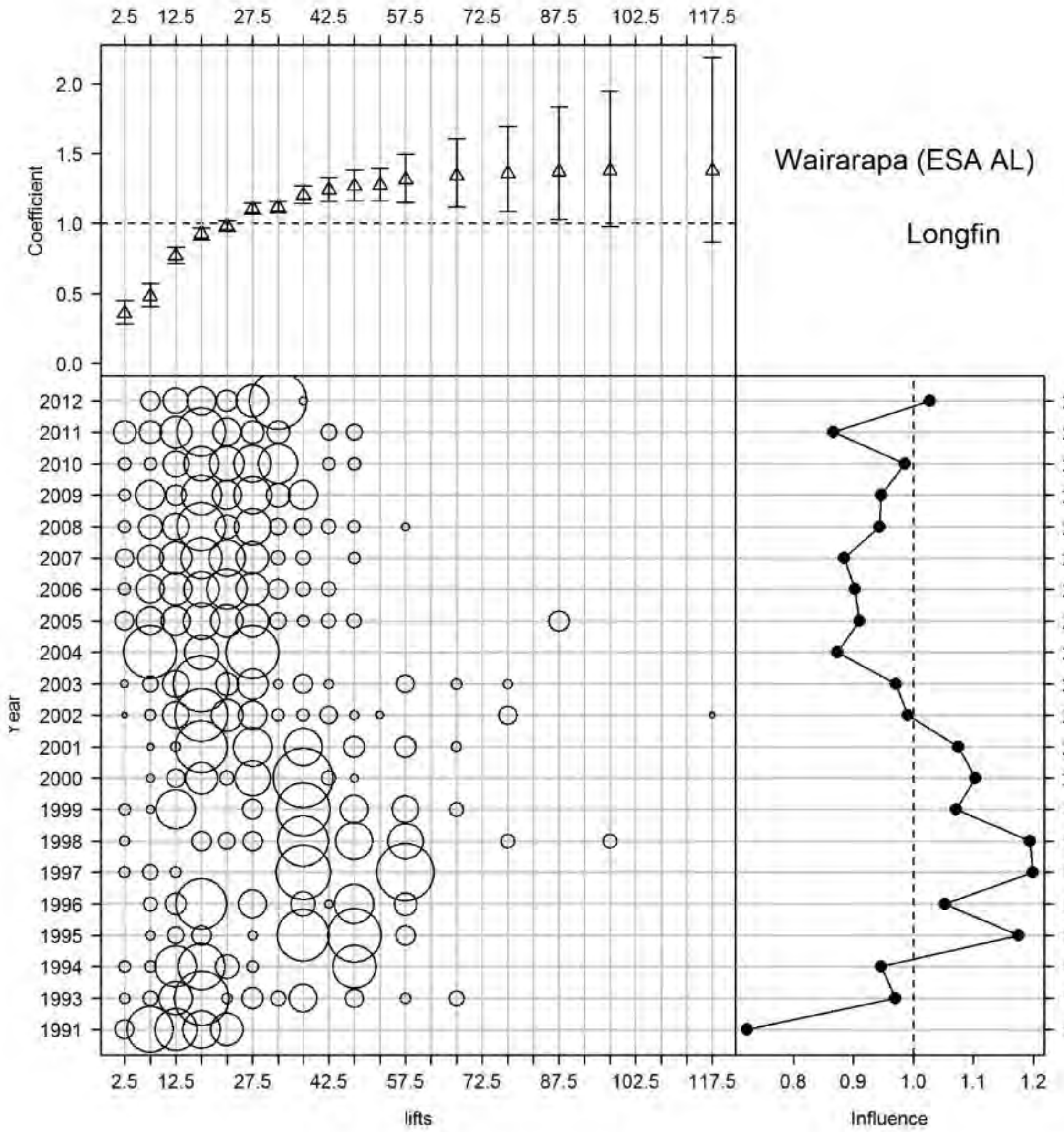


Figure L26: Influence of lifts for the longfin CPUE model for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

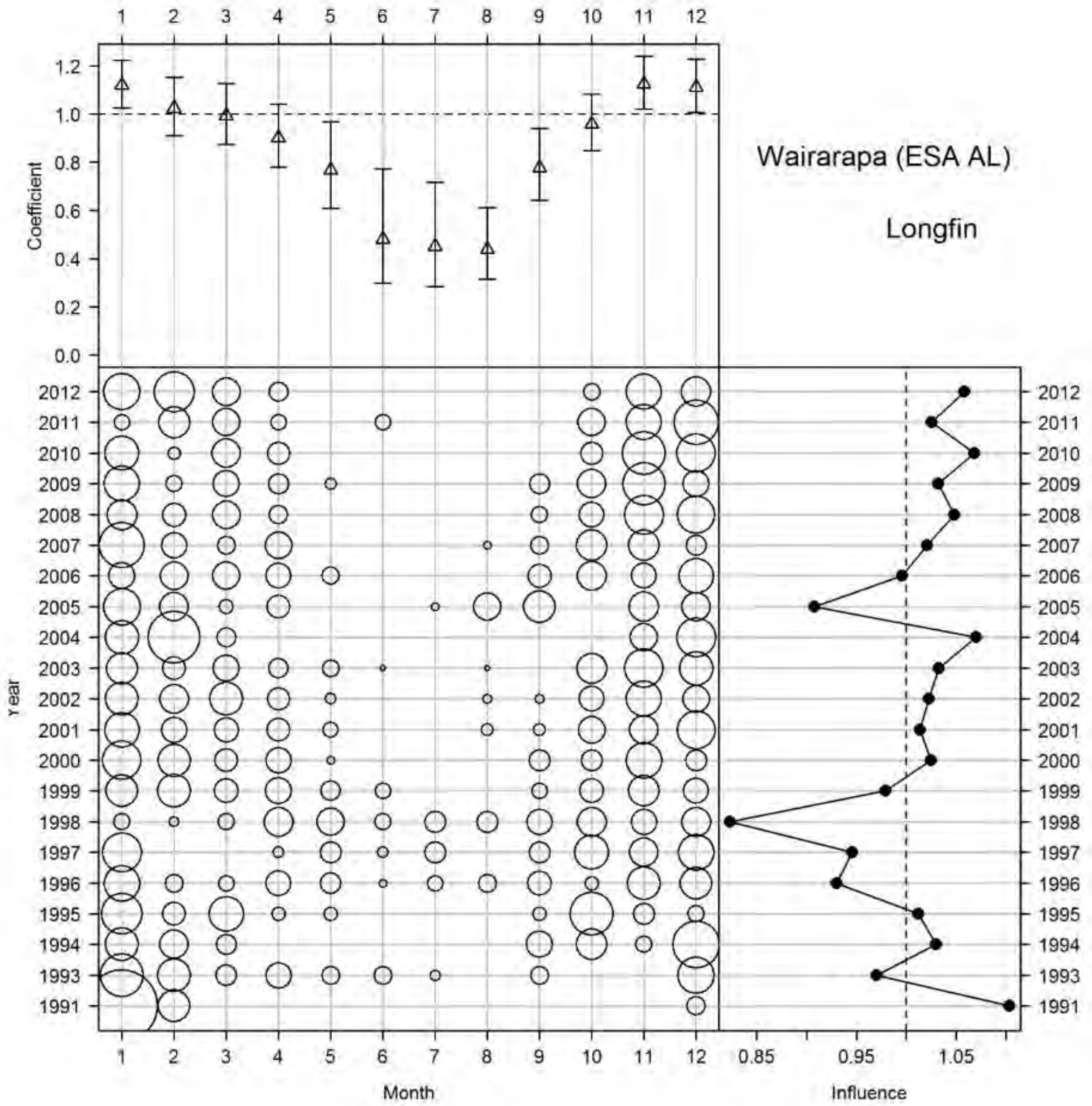


Figure L27: Influence of month for the longfin CPUE model for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

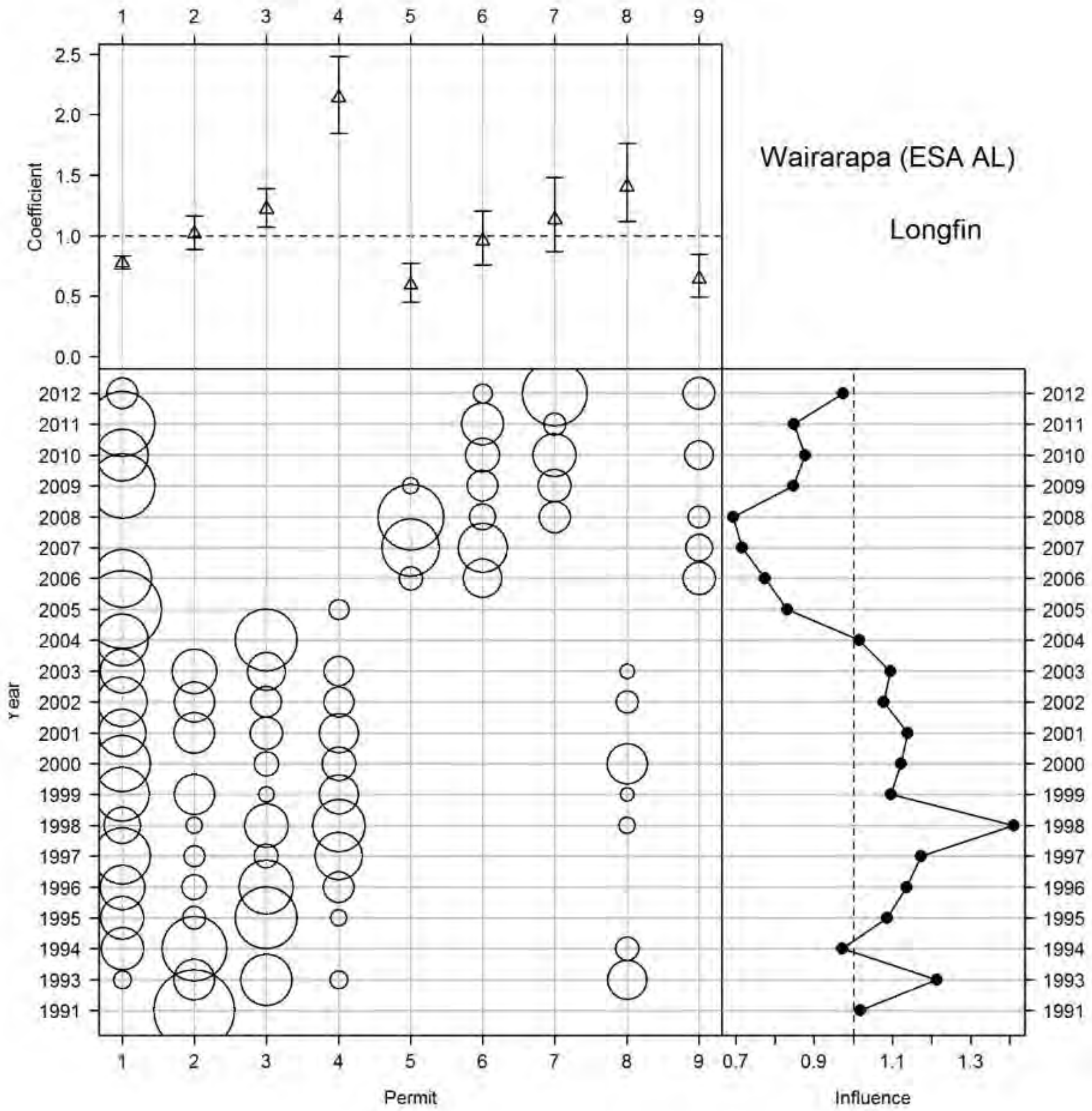


Figure L28: Influence of permit number for the longfin CPUE model for the years 1990–91 to 2011–12 (Wairarapa (ESA AL)).

Appendix M: Wellington (ESA AM)

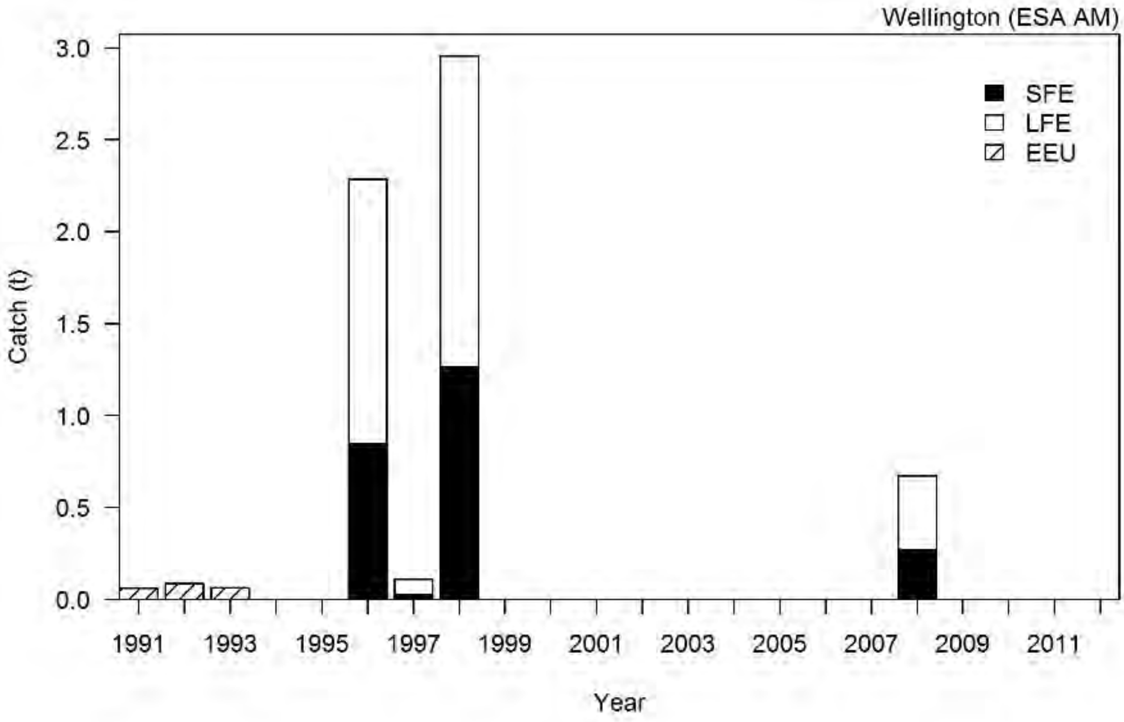


Figure M1: Total estimated commercial catch of shortfin (SFE), longfin (LFE), and unclassified eel catch (EEU) for the years 1990–91 to 2011–12 (Wellington (ESA AM)).

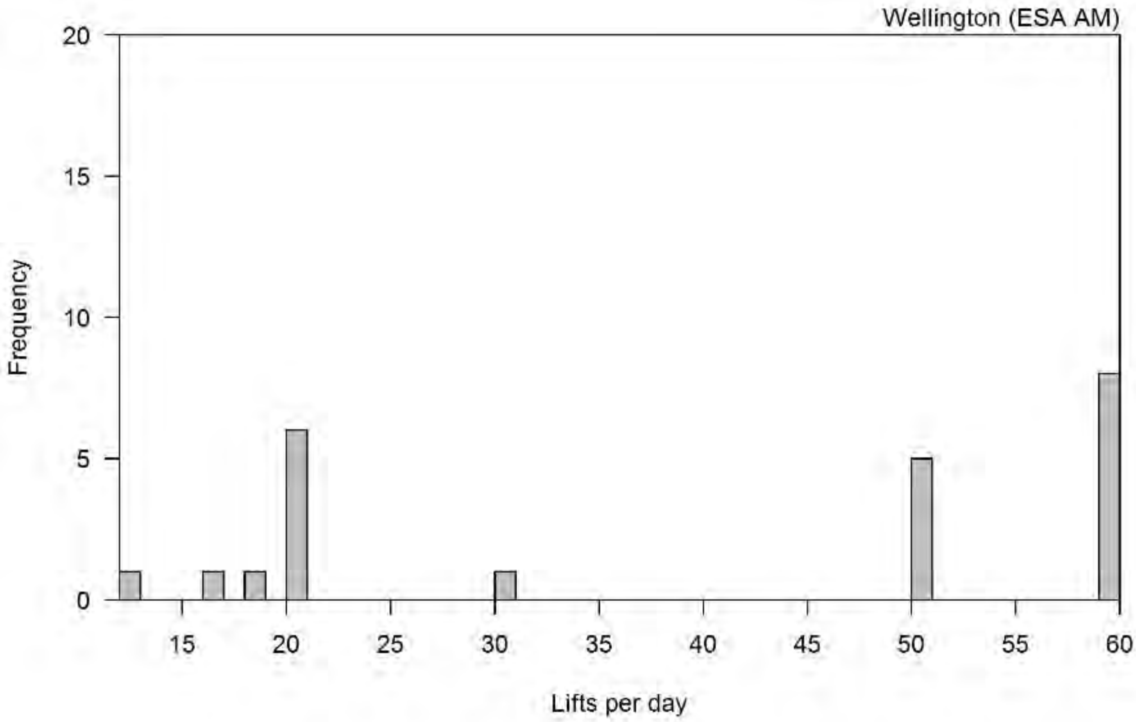


Figure M2: Frequency of total lifts per day for the years 1990–91 to 2011–12 (Wellington (ESA AM)).

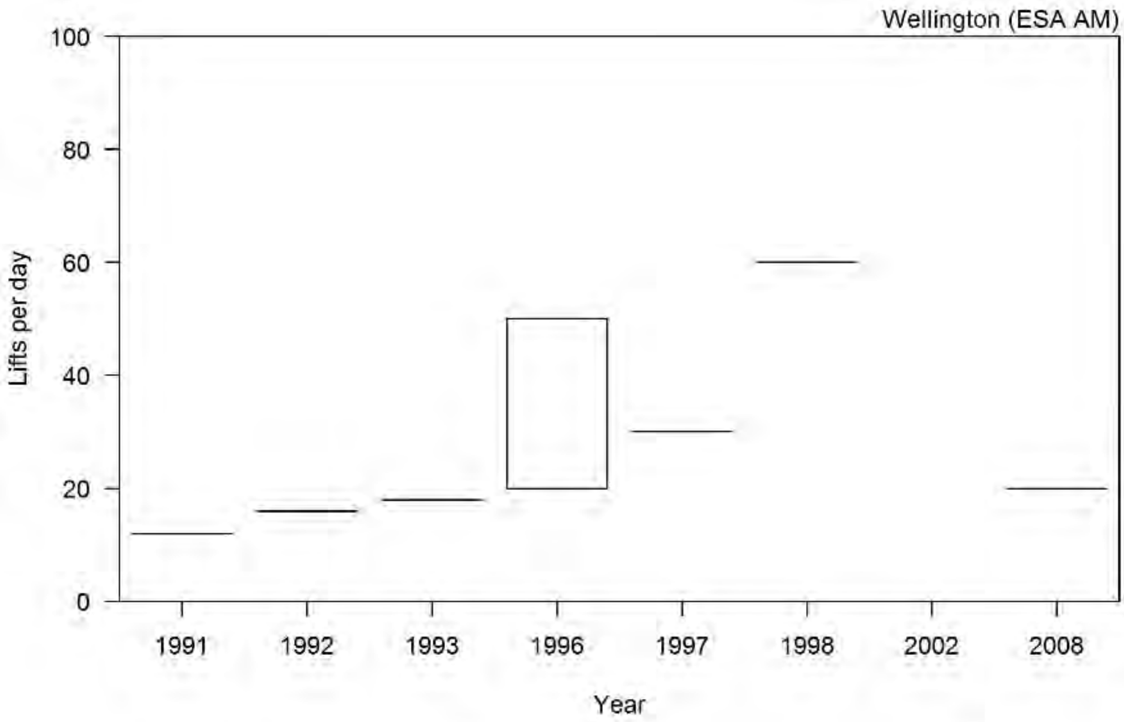


Figure M3: Total lifts per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Wellington (ESA AM)).

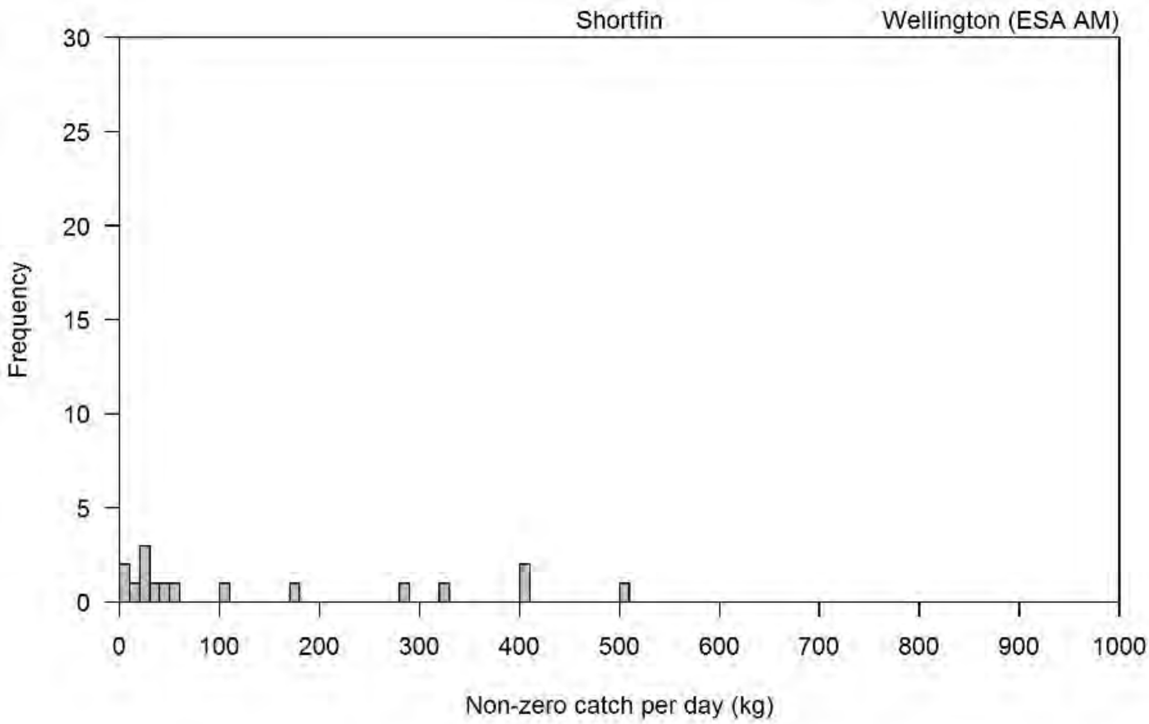


Figure M4: Frequency of shortfin eel catch per day for the years 1990–91 to 2011–12 (Wellington (ESA AM)).

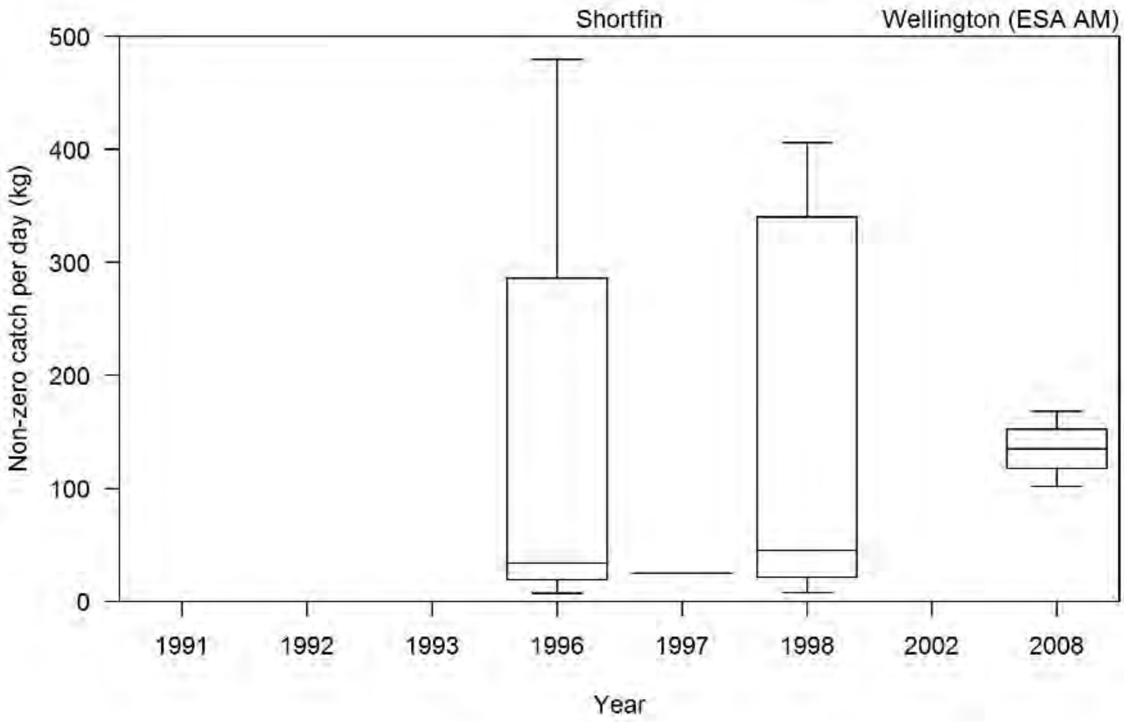


Figure M5: Shortfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Wellington (ESA AM)).

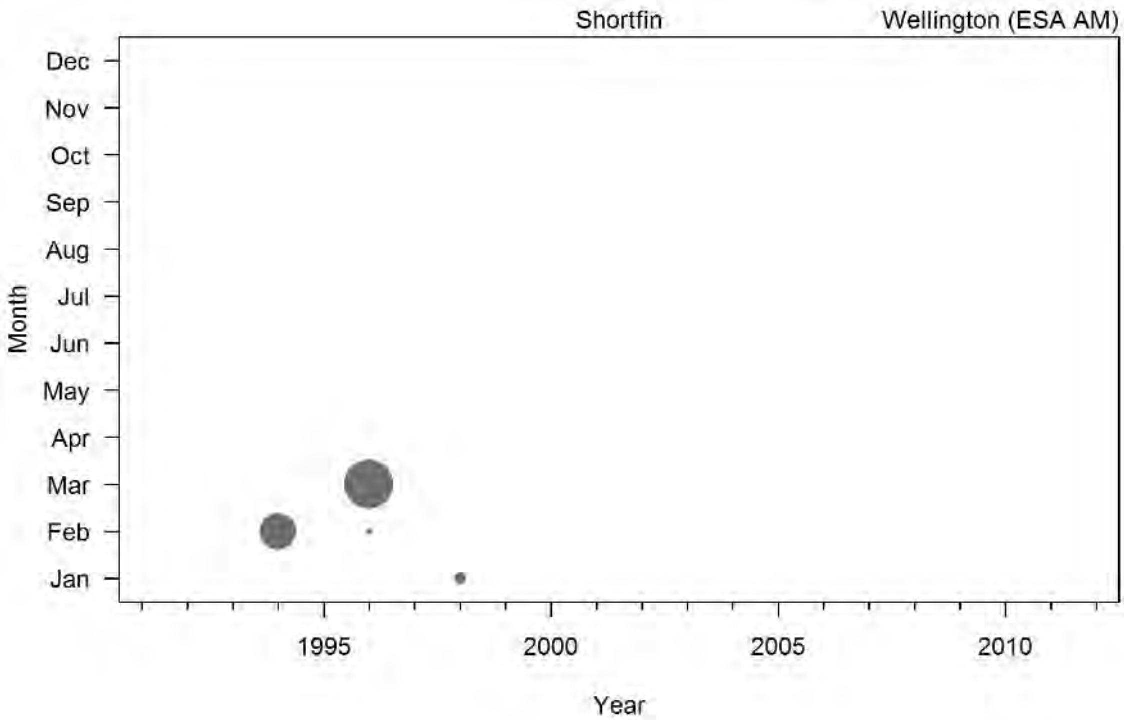


Figure M6: Shortfin eel catch by month for the years 1990–91 to 2011–12 (Wellington (ESA AM)).

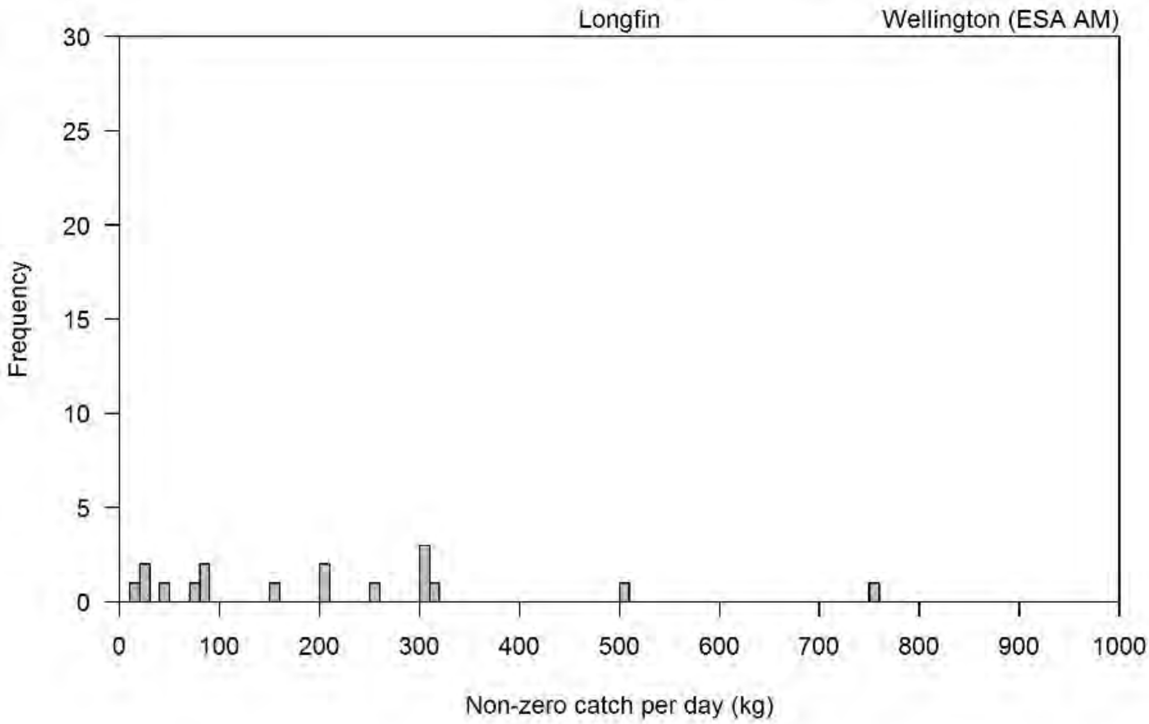


Figure M7: Frequency of longfin eel catch per day for the years 1990–91 to 2011–12 (Wellington (ESA AM)).

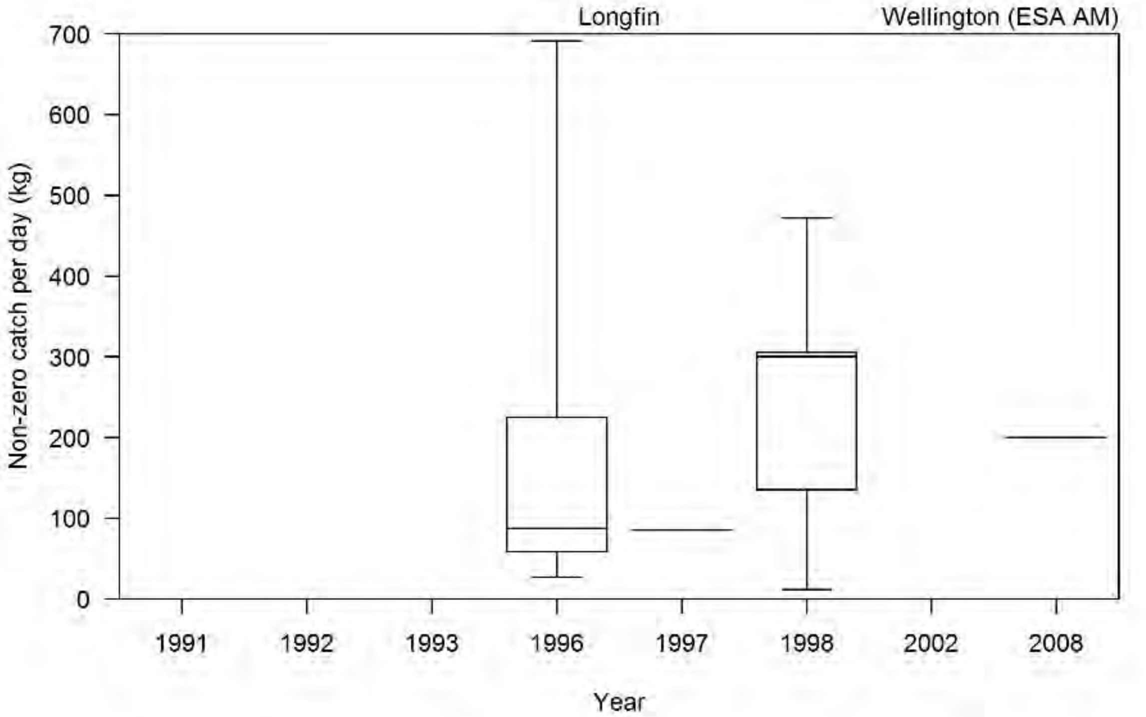


Figure M8: Longfin eel catch per day for the years 1990–91 to 2011–12. The horizontal line is the median, the top and bottom of the box are the interquartiles (25th and 75th), and error bars are the 95th percentile range (Wellington (ESA AM)).

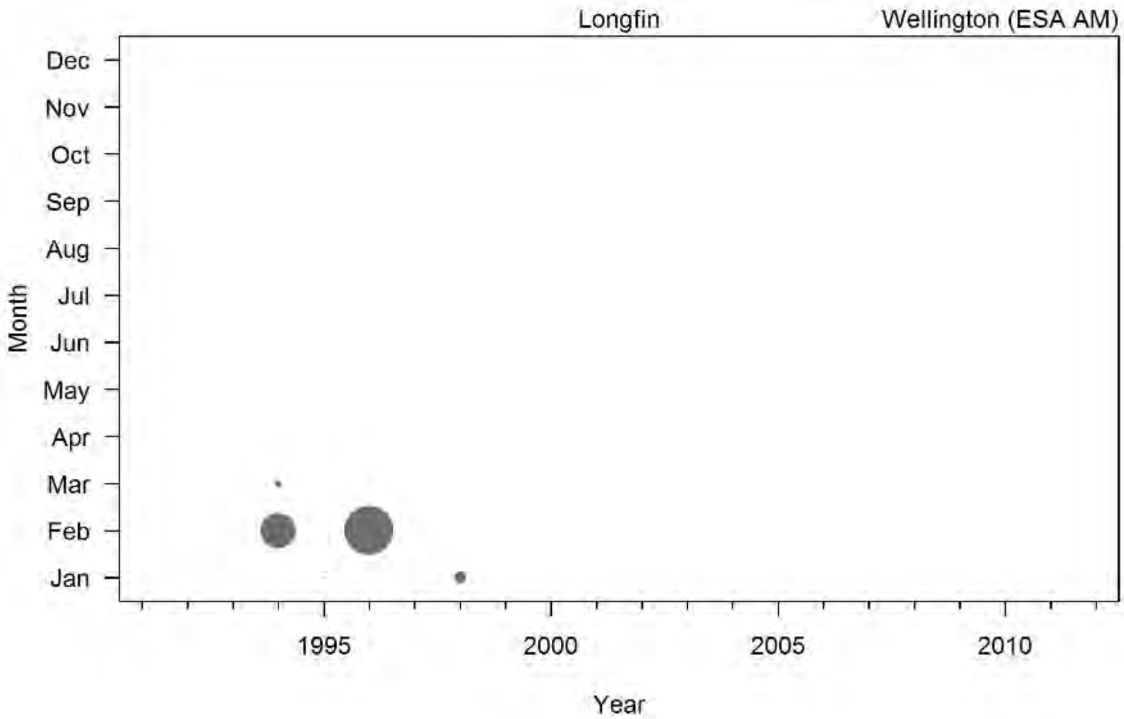


Figure M9: Longfin eel catch by month for the years 1990–91 to 2011–12 (Wellington (ESA AM)).

Appendix 1: Daily river flow data used in the standardised CPUE analyses.

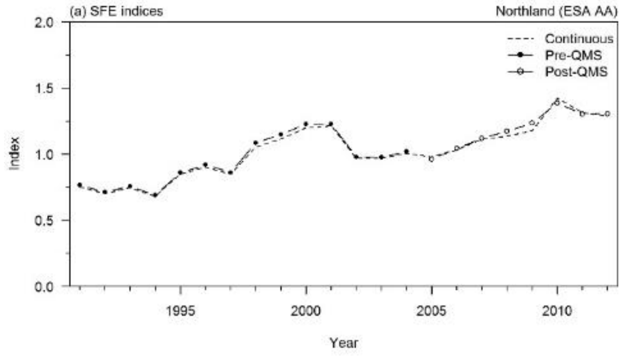
ESA	River	Site/Location	Source
AA (1)	Manganui River	46651, Permanent Station	Northland Regional Council
AB (2)	Hoteo River	45703, Gubbs	Auckland Regional Council
AC (3)	Piako River	9175, Kiwitahi	Environment Waikato
AD (4)	Waikato River	43402, Ngaruawahia C/W	Environment Waikato
AE (5)	Rangitaiki River	15412, Te Teko	NIWA/Trust Power
	Whirinaki River	15410, Galatea	NIWA/Trust Power
AF (6)	Motu River	16501, Houpoto	NIWA
	Waipaoa River	19716, Kanakanaia C/W	NIWA
AG (7)	Mohaka River	21801, Raupunga	NIWA
AH (8)	Whanganui River	33301, Paetawa	NIWA
AJ (9)	Waitara River	39503, Bertrand Rd	Taranaki Regional Council
	Patea River	34308, Skinner Rd	Taranaki Regional Council
AK (10)	Manawatu River	1032560, Teachers College	Horizons Regional Council
AL (11)	Ruamahanga River	29202, Waihenga	Greater Wellington Regional Council
AM (12)	Otaki River	31807, Pukehinau	NIWA

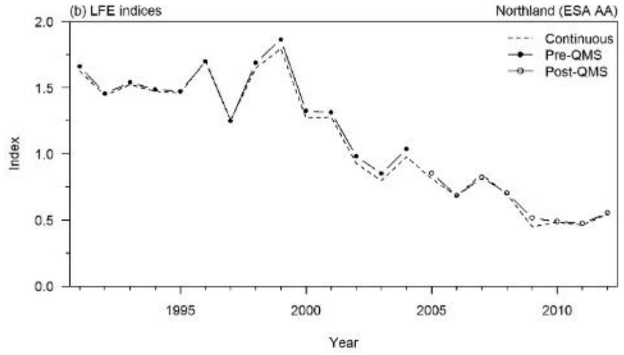
Appendix 2: For each area, the number of records, fishers and catch in all and core datasets. Records do not include those with zero catch. The number of pre-QMS and post-QMS (new entrants and existing) core fishers are shown as well as the percent of the fishers and catch that were included in the core fishers data. SFE, shortfin; LFE, longfin; QMS, quota management system; ESA, eel statistical area.

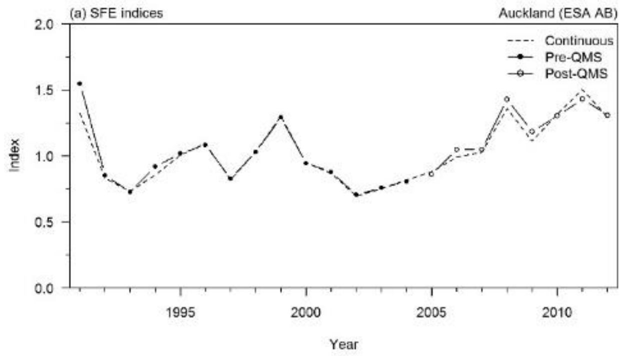
					Number of core fishers			Percent retained	
ESA	Dataset	Records	Fishers	Catch (kg)	PreQMS	PostQMS (existing)	PostQMS (new)	Fishers	Catch
ESA (AA)	All SFE	17 505	74	1 537 455					
	Core SFE	16 081	26	1 444 660	20	11	6	35.1	94.0
	All LFE	9 527	66	467 862					
	Core LFE	8 363	19	421 462	14	7	5	28.8	90.1
ESA(AB)	All SFE	5 888	46	751 225					
	Core SFE	5 298	14	686 943	12	6	2	30.4	91.4
	All LFE	3 280	40	228 664					
	Core LFE	2 771	11	188 093	9	5	2	27.5	82.3
ESA(AC)	All SFE	6 720	32	601 322					
	Core SFE	6 550	12	586 991	8	2	4	37.5	97.6
	All LFE	3 264	29	107 066					
	Core LFE	2 964	9	84 639	7	3	2	31.0	79.1
ESA(AD)	All SFE	20 617	47	1 335 179					
	Core SFE	20 247	25	1 308 122	21	11	4	53.2	98.0
	All LFE	13 924	44	506 954.5					
	Core LFE	13 591	24	490 711.5	20	11	4	54.5	96.8

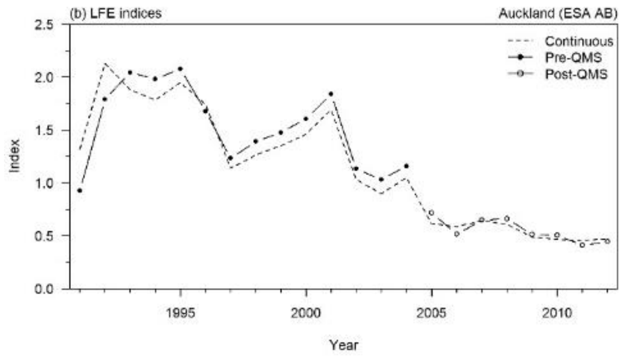
ESA(AE)	All SFE	2 576	18	284 991					
	Core SFE	2 272	8	256 755	5	1	3	44.4	90.1
	All LFE	1 715	17	118 781					
	Core LFE	1 528	8	108 416	5	1	3	47.1	91.3
ESA(AF)	All SFE	712	14	158 674					
	Core SFE	614	5	144 985	4	1	1	35.7	91.4
	All LFE	452	11	50 245					
	Core LFE	339	3	40 390	3	1	0	27.3	80.4
ESA(AG)	All SFE	4 057	33	809 029					
	Core SFE	3 721	11	747 346	9	3	2	33.3	92.4
	All LFE	2 157	24	257 186					
	Core LFE	1 665	6	192 152	4	1	2	25.0	74.7
ESA(AH)	All SFE	3 037	34	452 016					
	Core SFE	2 521	11	336 206	11	6	0	32.4	74.4
	All LFE	3 271	32	462 651					
	Core LFE	2 968	10	419 861	10	5	0	31.3	90.8
ESA(AJ)	All SFE	1 864	23	149 840					
	Core SFE	1 712	6	121 334	6	4	0	26.1	81.0
	All LFE	3 049	20	273 589					
	Core LFE	2 904	8	257 420	8	5	0	40.0	94.1
ESA(AK)	All SFE	2 533	32	455 011					
	Core SFE	2 177	9	392 736	8	6	1	28.1	86.3
	All LFE	1 252	29	94 326					
	Core LFE	833	7	56 188	6	4	1	24.1	59.6
ESA(AL)	All SFE	2 308	27	344 845					
	Core SFE	2 122	10	322 980	6	3	4	37.0	93.7
	All LFE	1 976	24	219 062					
	Core LFE	1 822	9	205 646	5	2	4	37.5	93.9
ESA(AM)	All SFE	16	3	2 405					
	Core SFE	–	–	–	–	–	–	–	–
	All LFE	17	4	3 614					
	Core LFE	–	–	–	–	–	–	–	–

Appendix 3: Standardised CPUE analyses for shortfin and longfin for all North Island eel statistical areas except ESA AM (insufficient data). Indices are plotted for continuous, pre-QMS and post-QMS analyses. All plots and standardised to the same mean. Dates shown represent the end of the fishing year i.e. 1991 = 1990–91 fishing year









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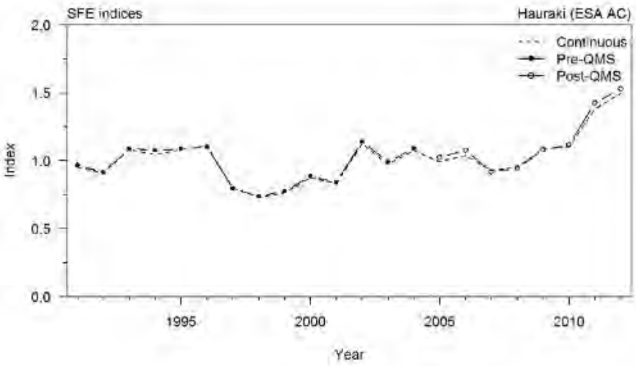

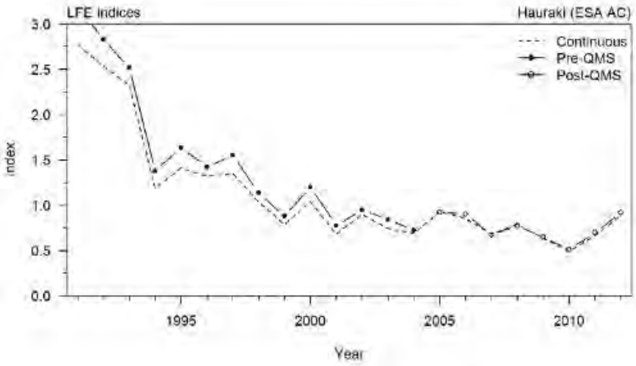

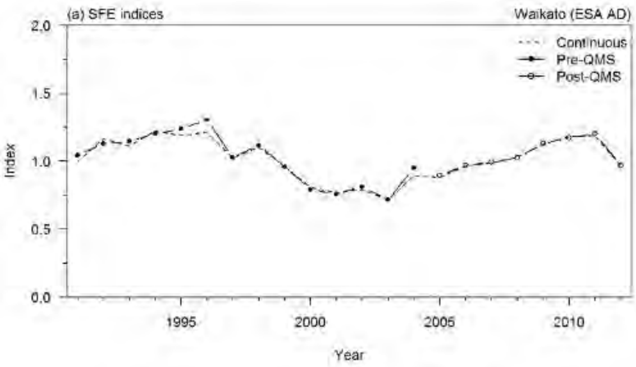

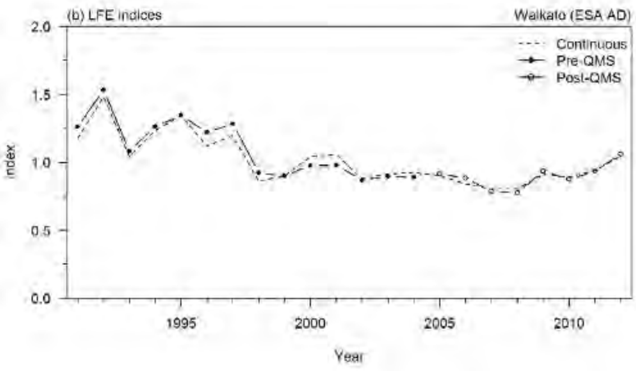

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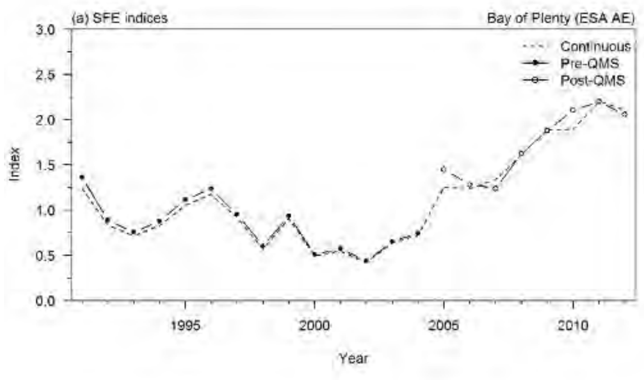

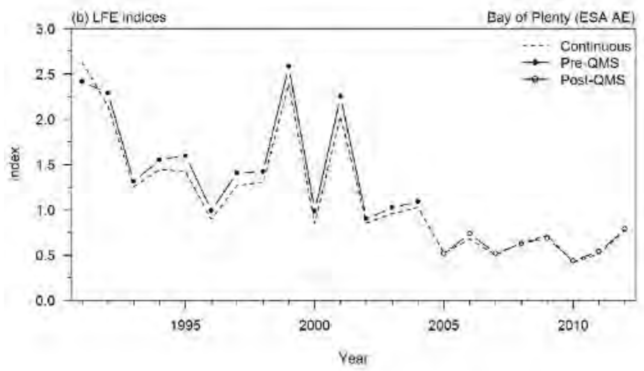

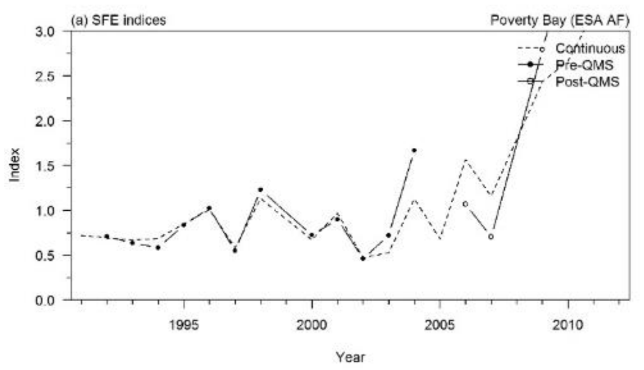

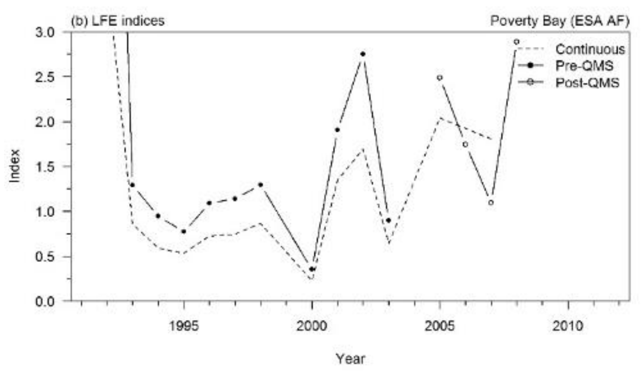

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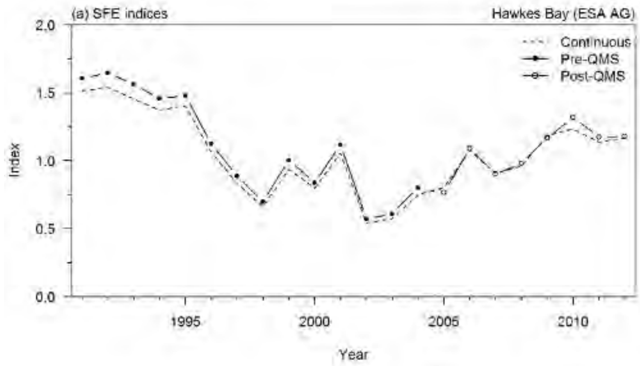

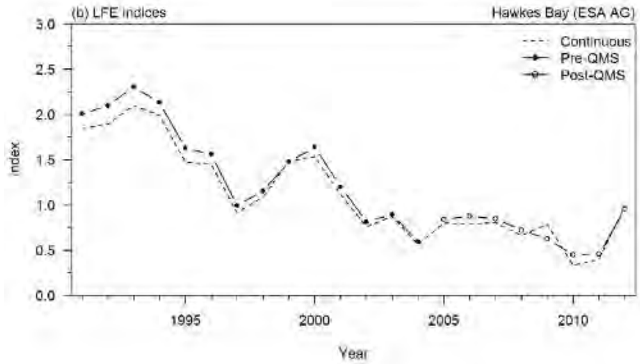

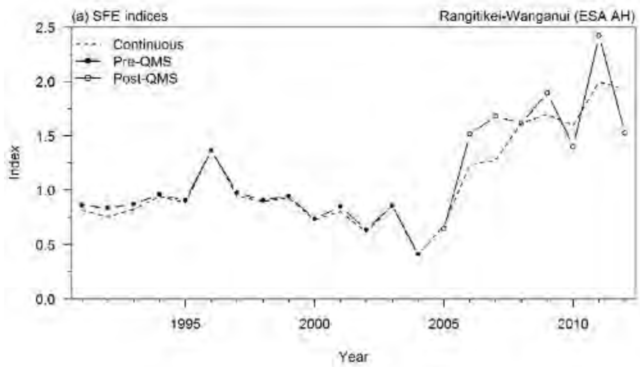

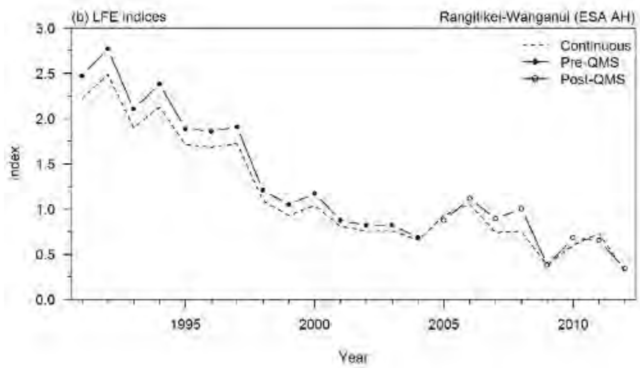

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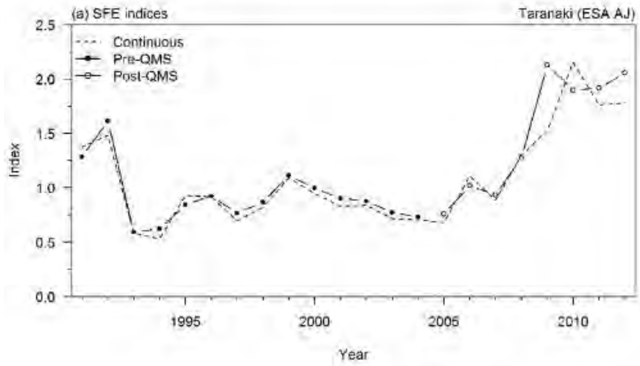

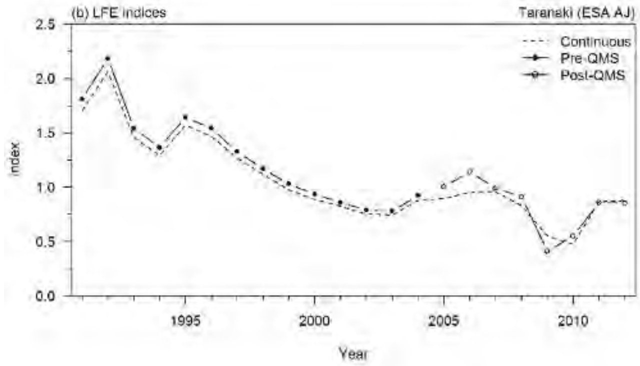

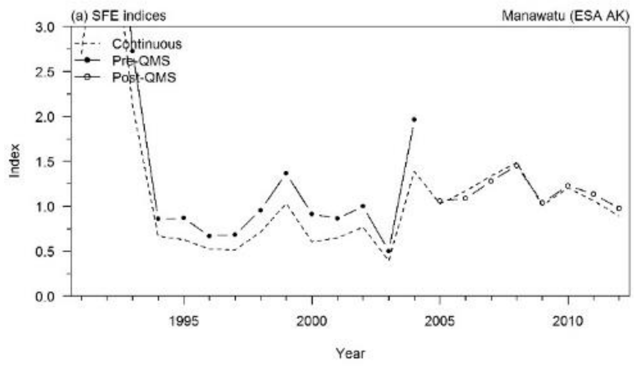

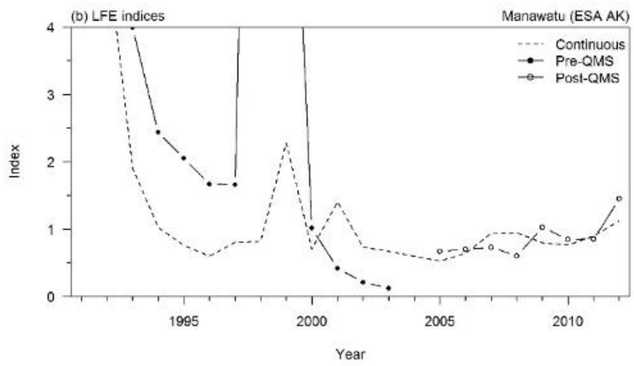

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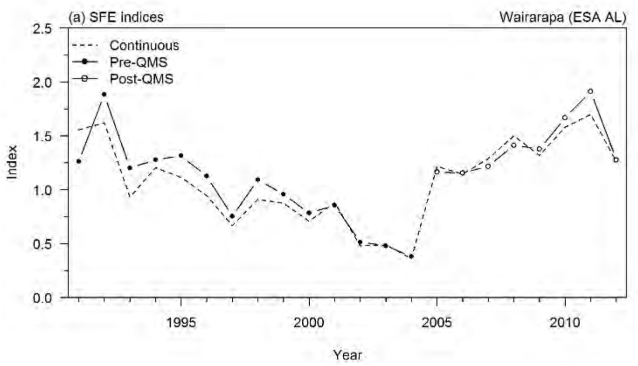

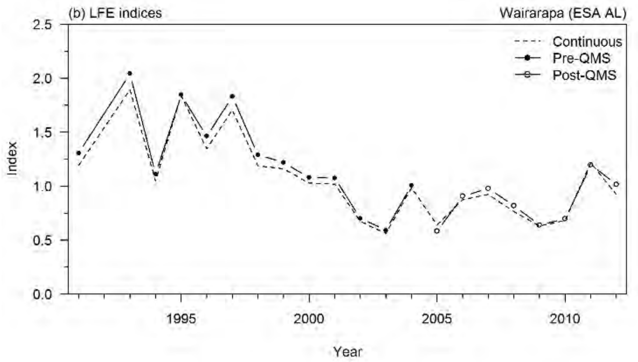

Appendix 4: Predictor variables, degrees of freedom, and R^2 values from GLM stepwise regression analysis for CPUE analyses for shortfin and longfin eels by area. Variables are shown in order of acceptance by the model with associated cumulative R^2 value. Only variables entered into the model are shown. ESA, eel statistical area.

	Shortfin			Longfin		
	Predictors	DF	R^2	Predictors	DF	R^2
ESA (AA)	fish.year	21	0.029	fish.year	21	0.129
	permit	25	0.261	permit	18	0.212
	lifts	3	0.361	month	11	0.228
	month	11	0.368	lifts	3	0.239
	Manganui River	3	0.375	Manganui River	3	0.244
ESA(AB)	fish.year	21	0.091	fish.year	21	0.132
	permit	13	0.451	permit	10	0.305
	lifts	3	0.534	lifts	3	0.329
	month	11	0.539	month	11	0.341
ESA (AC)	fish.year	21	0.051	fish.year	21	0.149
	lifts	3	0.19	permit	8	0.266
	permit	11	0.245	month	11	0.274
	month	11	0.254	lifts	3	0.281
	Piako River	3	0.266			
ESA(AD)	fish.year	21	0.061	fish.year	21	0.061
	permit	24	0.335	permit	23	0.412
	lifts	3	0.369	month	11	0.423
	month	11	0.376	lifts	3	0.43
	Waikato River	3	0.382			
ESA(AE)	fish.year	21	0.275	fish.year	21	0.141
	lifts	3	0.508	permit	7	0.319
	permit	7	0.528	lifts	3	0.405
	month	11	0.538	month	11	0.426
ESA(AF)	fish.year	17	0.354	fish.year	12	0.163
	lifts	3	0.475	month	10	0.256
	month	11	0.518	permit	2	0.324
	permit	4	0.533	lifts	3	0.447
	Waipaoa River	3	0.54	Moon phase	3	0.466
				Waipaoa River	3	0.479
ESA (AG)	fish.year	21	0.335	fish.year	21	0.176
	permit	10	0.541	permit	5	0.306
	lifts	3	0.661	lifts	3	0.368
	month	11	0.671	month	11	0.416
ESA (AH)	fish.year	21	0.137	fish.year	21	0.115
	lifts	3	0.297	permit	9	0.263
	permit	10	0.373	lifts	3	0.353
	month	11	0.392	month	11	0.381
	Whanganui River	3	0.397			
ESA(AJ)	fish.year	21	0.095	fish.year	21	0.228
	permit	5	0.258	permit	7	0.533
	lifts	3	0.316	lifts	3	0.57
	month	11	0.331	month	11	0.583
	Patea River	3	0.343			

ESA(AK)	fish.year	21	0.311	fish.year	19	0.083
	permit	8	0.423	permit	6	0.137
	lifts	3	0.478	month	9	0.173
	month	11	0.5	lifts	3	0.202
				Moon phase	3	0.21
ESA (AL)	fish.year	21	0.152	fish.year	20	0.202
	permit	9	0.349	permit	8	0.309
	lifts	3	0.418	lifts	3	0.342
	month	11	0.427	month	11	0.366
	Ruamahanga River	3	0.437			

Appendix 5: CPUE indices by ESA for shortfin and longfin. CI, 95% confidence intervals; s.e., standard error; CV, coefficient of variation; Dates shown represent the end of the fishing year i.e. 1991 = 1990–91 fishing year.

Northland (ESA AA)

					Shortfin						Longfin
Year	Index	Lower	Upper	se	CV	Year	Index	Lower	Upper	se	CV
1991	0.75	0.72	0.78	0.02	0.02	1991	1.63	1.49	1.77	0.04	0.04
1992	0.70	0.67	0.73	0.02	0.02	1992	1.44	1.31	1.58	0.05	0.05
1993	0.75	0.71	0.78	0.02	0.02	1993	1.52	1.38	1.68	0.05	0.05
1994	0.68	0.65	0.72	0.02	0.02	1994	1.47	1.33	1.63	0.05	0.05
1995	0.85	0.81	0.89	0.02	0.02	1995	1.46	1.33	1.60	0.05	0.05
1996	0.90	0.85	0.95	0.03	0.03	1996	1.70	1.52	1.90	0.06	0.06
1997	0.85	0.80	0.89	0.03	0.03	1997	1.25	1.10	1.42	0.06	0.06
1998	1.05	1.00	1.11	0.03	0.03	1998	1.65	1.48	1.83	0.05	0.05
1999	1.11	1.06	1.17	0.02	0.02	1999	1.79	1.66	1.94	0.04	0.04
2000	1.20	1.15	1.25	0.02	0.02	2000	1.27	1.18	1.37	0.04	0.04
2001	1.22	1.17	1.27	0.02	0.02	2001	1.28	1.19	1.37	0.04	0.04
2002	0.97	0.93	1.00	0.02	0.02	2002	0.93	0.87	0.99	0.03	0.03
2003	0.97	0.93	1.00	0.02	0.02	2003	0.80	0.75	0.85	0.03	0.03
2004	1.01	0.97	1.05	0.02	0.02	2004	0.98	0.91	1.05	0.04	0.04
2005	0.98	0.93	1.03	0.02	0.02	2005	0.81	0.75	0.88	0.04	0.04
2006	1.03	0.98	1.09	0.03	0.03	2006	0.68	0.62	0.74	0.04	0.04
2007	1.11	1.05	1.17	0.03	0.03	2007	0.84	0.77	0.93	0.05	0.05
2008	1.14	1.08	1.19	0.02	0.02	2008	0.69	0.64	0.75	0.04	0.04
2009	1.18	1.11	1.25	0.03	0.03	2009	0.45	0.40	0.50	0.05	0.05
2010	1.42	1.34	1.51	0.03	0.03	2010	0.48	0.43	0.54	0.06	0.06
2011	1.32	1.24	1.39	0.03	0.03	2011	0.46	0.41	0.52	0.05	0.05
2012	1.29	1.21	1.37	0.03	0.03	2012	0.55	0.49	0.61	0.05	0.05

Auckland (ESA AB)

					Shortfin						Longfin
Year	Index	Lower	Upper	se	CV	Year	Index	Lower	Upper	se	CV
1991	1.32	1.07	1.65	0.11	0.11	1991	1.32	0.94	1.85	0.17	0.17
1992	0.83	0.75	0.92	0.05	0.05	1992	2.13	1.61	2.82	0.14	0.14
1993	0.73	0.66	0.81	0.05	0.05	1993	1.88	1.55	2.29	0.10	0.10
1994	0.85	0.75	0.97	0.06	0.06	1994	1.78	1.42	2.25	0.12	0.12
1995	1.00	0.91	1.11	0.05	0.05	1995	1.95	1.56	2.43	0.11	0.11
1996	1.09	0.99	1.20	0.05	0.05	1996	1.74	1.38	2.21	0.12	0.12
1997	0.82	0.76	0.88	0.04	0.04	1997	1.14	0.97	1.33	0.08	0.08
1998	1.03	0.96	1.12	0.04	0.04	1998	1.26	1.10	1.45	0.07	0.07
1999	1.30	1.19	1.41	0.04	0.04	1999	1.35	1.12	1.63	0.10	0.10
2000	0.95	0.88	1.02	0.04	0.04	2000	1.46	1.28	1.66	0.06	0.06
2001	0.87	0.80	0.94	0.04	0.04	2001	1.69	1.49	1.92	0.06	0.06
2002	0.69	0.65	0.75	0.04	0.04	2002	1.03	0.90	1.18	0.07	0.07
2003	0.75	0.70	0.81	0.04	0.04	2003	0.90	0.78	1.03	0.07	0.07
2004	0.82	0.75	0.89	0.04	0.04	2004	1.05	0.92	1.20	0.07	0.07
2005	0.88	0.77	1.00	0.07	0.07	2005	0.61	0.48	0.78	0.12	0.12
2006	0.99	0.89	1.10	0.05	0.05	2006	0.59	0.49	0.69	0.08	0.08
2007	1.03	0.93	1.13	0.05	0.05	2007	0.64	0.55	0.74	0.07	0.07
2008	1.36	1.19	1.55	0.07	0.07	2008	0.61	0.49	0.75	0.11	0.11
2009	1.11	0.98	1.26	0.06	0.06	2009	0.49	0.39	0.60	0.11	0.11
2010	1.31	1.17	1.48	0.06	0.06	2010	0.47	0.38	0.57	0.10	0.10
2011	1.50	1.37	1.65	0.05	0.05	2011	0.45	0.37	0.56	0.10	0.10
2012	1.29	1.17	1.43	0.05	0.05	2012	0.47	0.39	0.57	0.10	0.10

Hauraki (ESA AC)

					Shortfin						Longfin
Year	Index	Lower	Upper	se	CV	Year	Index	Lower	Upper	se	CV
1991	0.95	0.87	1.04	0.04	0.04	1991	2.81	2.36	3.35	0.09	0.09
1992	0.91	0.84	0.98	0.04	0.04	1992	2.57	2.19	3.02	0.08	0.08
1993	1.09	1.02	1.16	0.03	0.03	1993	2.36	2.04	2.73	0.07	0.07
1994	1.04	0.96	1.13	0.04	0.04	1994	1.21	1.01	1.44	0.09	0.09
1995	1.08	1.01	1.14	0.03	0.03	1995	1.43	1.27	1.62	0.06	0.06
1996	1.11	1.04	1.20	0.04	0.04	1996	1.33	1.11	1.60	0.09	0.09
1997	0.79	0.74	0.85	0.04	0.04	1997	1.34	1.15	1.57	0.08	0.08
1998	0.71	0.65	0.76	0.04	0.04	1998	1.04	0.89	1.23	0.08	0.08
1999	0.76	0.70	0.82	0.04	0.04	1999	0.82	0.67	0.99	0.10	0.10
2000	0.88	0.83	0.93	0.03	0.03	2000	1.05	0.94	1.19	0.06	0.06
2001	0.84	0.80	0.89	0.03	0.03	2001	0.70	0.62	0.79	0.06	0.06
2002	1.13	1.06	1.20	0.03	0.03	2002	0.91	0.82	1.03	0.06	0.06
2003	0.98	0.92	1.04	0.03	0.03	2003	0.75	0.67	0.85	0.06	0.06
2004	1.08	1.00	1.16	0.04	0.04	2004	0.69	0.61	0.80	0.07	0.07
2005	1.00	0.93	1.07	0.03	0.03	2005	0.90	0.78	1.05	0.08	0.08
2006	1.04	0.98	1.11	0.03	0.03	2006	0.84	0.74	0.95	0.06	0.06
2007	0.93	0.87	0.99	0.03	0.03	2007	0.67	0.58	0.76	0.07	0.07
2008	0.96	0.89	1.04	0.04	0.04	2008	0.77	0.66	0.90	0.08	0.08
2009	1.09	1.00	1.19	0.04	0.04	2009	0.62	0.50	0.77	0.11	0.11
2010	1.11	1.00	1.23	0.05	0.05	2010	0.48	0.37	0.62	0.13	0.13
2011	1.35	1.21	1.49	0.05	0.05	2011	0.63	0.50	0.79	0.11	0.11
2012	1.51	1.39	1.64	0.04	0.04	2012	0.86	0.74	1.00	0.08	0.08

Waikato (ESA AD)

					Shortfin						Longfin
Year	Index	Lower	Upper	se	CV	Year	Index	Lower	Upper	se	CV
1991	1.00	0.87	1.15	0.07	0.07	1991	1.17	1.04	1.32	0.06	0.06
1992	1.16	1.01	1.34	0.07	0.07	1992	1.48	1.31	1.68	0.06	0.06
1993	1.11	1.00	1.24	0.05	0.05	1993	1.04	0.91	1.20	0.07	0.07
1994	1.22	1.09	1.37	0.06	0.06	1994	1.23	1.07	1.43	0.07	0.07
1995	1.19	1.09	1.30	0.04	0.04	1995	1.34	1.20	1.51	0.06	0.06
1996	1.21	1.13	1.30	0.04	0.04	1996	1.12	1.02	1.23	0.05	0.05
1997	1.03	0.96	1.09	0.03	0.03	1997	1.20	1.10	1.30	0.04	0.04
1998	1.10	1.04	1.17	0.03	0.03	1998	0.86	0.79	0.94	0.04	0.04
1999	0.96	0.92	1.01	0.03	0.03	1999	0.90	0.84	0.97	0.04	0.04
2000	0.81	0.77	0.84	0.02	0.02	2000	1.04	0.99	1.10	0.03	0.03
2001	0.77	0.74	0.80	0.02	0.02	2001	1.06	1.01	1.11	0.03	0.03
2002	0.79	0.76	0.82	0.02	0.02	2002	0.88	0.84	0.92	0.02	0.02
2003	0.72	0.69	0.75	0.02	0.02	2003	0.92	0.87	0.97	0.03	0.03
2004	0.89	0.85	0.93	0.02	0.02	2004	0.93	0.88	0.98	0.03	0.03
2005	0.88	0.84	0.92	0.02	0.02	2005	0.90	0.85	0.96	0.03	0.03
2006	0.96	0.92	1.01	0.02	0.02	2006	0.84	0.79	0.89	0.03	0.03
2007	0.99	0.94	1.03	0.02	0.02	2007	0.80	0.75	0.86	0.03	0.03
2008	1.03	0.98	1.08	0.02	0.02	2008	0.80	0.75	0.86	0.03	0.03
2009	1.12	1.07	1.18	0.02	0.02	2009	0.91	0.85	0.98	0.03	0.03
2010	1.18	1.13	1.24	0.02	0.02	2010	0.89	0.83	0.95	0.03	0.03
2011	1.19	1.13	1.24	0.02	0.02	2011	0.94	0.87	1.01	0.04	0.04
2012	0.97	0.92	1.01	0.02	0.02	2012	1.05	0.98	1.12	0.03	0.03

Bay of Plenty (ESA AE)

					Shortfin
Year	Index	Lower	Upper	se	CV
1991	1.24	1.01	1.52	0.10	0.10
1992	0.83	0.70	0.99	0.09	0.09
1993	0.72	0.61	0.83	0.08	0.08
1994	0.83	0.69	0.99	0.09	0.09
1995	1.05	0.91	1.22	0.07	0.07
1996	1.17	0.99	1.39	0.08	0.08
1997	0.92	0.76	1.10	0.09	0.09
1998	0.57	0.49	0.66	0.07	0.07
1999	0.91	0.73	1.13	0.11	0.11
2000	0.49	0.41	0.59	0.09	0.09
2001	0.54	0.45	0.65	0.09	0.09
2002	0.42	0.36	0.49	0.08	0.08
2003	0.63	0.54	0.74	0.08	0.08
2004	0.72	0.61	0.84	0.08	0.08
2005	1.25	0.97	1.62	0.13	0.13
2006	1.24	0.96	1.60	0.13	0.13
2007	1.33	1.10	1.62	0.10	0.10
2008	1.60	1.24	2.07	0.13	0.13
2009	1.89	1.39	2.55	0.15	0.15
2010	1.89	1.44	2.48	0.13	0.14
2011	2.20	1.69	2.86	0.13	0.13
2012	2.11	1.57	2.85	0.15	0.15

					Longfin
Year	Index	Lower	Upper	se	CV
1991	2.64	1.74	4.00	0.21	0.21
1992	2.15	1.53	3.01	0.17	0.17
1993	1.26	0.93	1.69	0.15	0.15
1994	1.44	1.04	2.01	0.17	0.17
1995	1.43	1.06	1.91	0.15	0.15
1996	0.89	0.63	1.26	0.17	0.17
1997	1.27	0.92	1.76	0.16	0.16
1998	1.30	0.98	1.73	0.14	0.14
1999	2.39	1.69	3.39	0.17	0.18
2000	0.84	0.61	1.16	0.16	0.16
2001	2.03	1.49	2.79	0.16	0.16
2002	0.85	0.63	1.15	0.15	0.15
2003	0.96	0.71	1.30	0.15	0.15
2004	1.03	0.77	1.38	0.15	0.15
2005	0.52	0.32	0.85	0.24	0.25
2006	0.68	0.41	1.11	0.25	0.25
2007	0.50	0.33	0.77	0.22	0.22
2008	0.63	0.39	1.03	0.25	0.25
2009	0.72	0.40	1.28	0.29	0.29
2010	0.42	0.25	0.71	0.26	0.27
2011	0.51	0.30	0.86	0.26	0.26
2012	0.77	0.46	1.31	0.26	0.27

Poverty Bay (ESA AF)

					Shortfin
Year	Index	Lower	Upper	se	CV
1991	0.72	0.47	1.10	0.21	0.22
1993	0.67	0.51	0.87	0.13	0.13
1994	0.69	0.45	1.04	0.21	0.21
1995	0.85	0.67	1.07	0.12	0.12
1996	1.01	0.75	1.34	0.14	0.15
1997	0.58	0.45	0.76	0.13	0.14
1998	1.13	0.76	1.69	0.20	0.20
2000	0.67	0.44	1.03	0.21	0.21
2001	0.97	0.66	1.42	0.19	0.19
2002	0.47	0.38	0.58	0.11	0.11
2003	0.53	0.35	0.79	0.20	0.21
2004	1.13	0.69	1.85	0.25	0.25
2005	0.68	0.44	1.04	0.22	0.22
2006	1.56	0.87	2.79	0.29	0.30
2007	1.16	0.82	1.63	0.17	0.17
2009	2.43	1.33	4.45	0.30	0.31
2010	2.67	1.28	5.56	0.37	0.38
2012	3.74	1.93	7.26	0.33	0.34

					Longfin
Year	Index	Lower	Upper	se	CV
1991	6.51	3.36	12.62	0.33	0.34
1993	0.86	0.61	1.21	0.17	0.17
1994	0.59	0.39	0.91	0.21	0.22
1995	0.53	0.42	0.68	0.12	0.12
1996	0.72	0.46	1.12	0.22	0.22
1997	0.74	0.40	1.36	0.30	0.31
1998	0.86	0.42	1.76	0.36	0.37
2000	0.23	0.13	0.39	0.27	0.28
2001	1.35	0.82	2.22	0.25	0.25
2002	1.70	1.24	2.32	0.16	0.16
2003	0.64	0.29	1.43	0.40	0.41
2005	2.04	0.95	4.38	0.38	0.40
2007	1.81	0.99	3.29	0.30	0.31

Hawkes Bay (ESA AG)

					Shortfin						Longfin
Year	Index	Lower	Upper	se	CV	Year	Index	Lower	Upper	se	CV
1991	1.51	1.31	1.75	0.07	0.07	1991	1.84	1.49	2.28	0.11	0.11
1992	1.54	1.40	1.69	0.05	0.05	1992	1.89	1.59	2.26	0.09	0.09
1993	1.45	1.34	1.58	0.04	0.04	1993	2.10	1.82	2.42	0.07	0.07
1994	1.37	1.24	1.51	0.05	0.05	1994	1.99	1.72	2.31	0.07	0.07
1995	1.40	1.27	1.55	0.05	0.05	1995	1.47	1.21	1.79	0.10	0.10
1996	1.06	0.96	1.17	0.05	0.05	1996	1.45	1.23	1.71	0.08	0.08
1997	0.83	0.76	0.91	0.05	0.05	1997	0.91	0.76	1.10	0.09	0.09
1998	0.66	0.60	0.73	0.05	0.05	1998	1.09	0.94	1.26	0.07	0.07
1999	0.94	0.82	1.07	0.07	0.07	1999	1.48	1.24	1.76	0.09	0.09
2000	0.80	0.72	0.89	0.05	0.05	2000	1.53	1.31	1.79	0.08	0.08
2001	1.05	0.96	1.15	0.05	0.05	2001	1.12	0.97	1.29	0.07	0.07
2002	0.54	0.50	0.59	0.04	0.04	2002	0.76	0.64	0.89	0.08	0.08
2003	0.57	0.53	0.62	0.04	0.04	2003	0.87	0.74	1.02	0.08	0.08
2004	0.75	0.67	0.83	0.06	0.06	2004	0.56	0.46	0.69	0.10	0.10
2005	0.80	0.73	0.87	0.04	0.04	2005	0.80	0.69	0.92	0.07	0.07
2006	1.08	0.99	1.17	0.04	0.04	2006	0.79	0.68	0.92	0.08	0.08
2007	0.91	0.83	0.99	0.04	0.04	2007	0.80	0.70	0.92	0.07	0.07
2008	0.96	0.86	1.07	0.05	0.05	2008	0.66	0.56	0.79	0.09	0.09
2009	1.19	1.01	1.39	0.08	0.08	2009	0.78	0.49	1.26	0.24	0.24
2010	1.23	1.04	1.46	0.08	0.08	2010	0.33	0.20	0.56	0.27	0.27
2011	1.14	0.96	1.35	0.09	0.09	2011	0.40	0.24	0.66	0.25	0.25
2012	1.17	1.02	1.34	0.07	0.07	2012	0.99	0.78	1.26	0.12	0.12

Rangitikei-Whanganui (ESA AH)

					Shortfin						Longfin
Year	Index	Lower	Upper	se	CV	Year	Index	Lower	Upper	se	CV
1991	0.82	0.71	0.93	0.07	0.07	1991	2.22	2.01	2.45	0.05	0.05
1992	0.75	0.64	0.89	0.08	0.08	1992	2.49	2.22	2.80	0.06	0.06
1993	0.83	0.71	0.96	0.08	0.08	1993	1.90	1.72	2.09	0.05	0.05
1994	0.94	0.81	1.09	0.07	0.07	1994	2.12	1.90	2.38	0.06	0.06
1995	0.88	0.76	1.02	0.07	0.07	1995	1.71	1.55	1.89	0.05	0.05
1996	1.37	1.17	1.60	0.08	0.08	1996	1.69	1.49	1.91	0.06	0.06
1997	0.94	0.80	1.11	0.08	0.08	1997	1.72	1.52	1.95	0.06	0.06
1998	0.89	0.73	1.10	0.10	0.10	1998	1.09	0.95	1.26	0.07	0.07
1999	0.93	0.81	1.07	0.07	0.07	1999	0.93	0.83	1.05	0.06	0.06
2000	0.73	0.60	0.88	0.10	0.10	2000	1.04	0.90	1.20	0.07	0.07
2001	0.80	0.70	0.92	0.07	0.07	2001	0.81	0.73	0.90	0.05	0.05
2002	0.61	0.54	0.69	0.06	0.06	2002	0.75	0.69	0.83	0.05	0.05
2003	0.86	0.73	1.00	0.08	0.08	2003	0.76	0.67	0.86	0.06	0.06
2004	0.40	0.32	0.50	0.11	0.11	2004	0.65	0.55	0.77	0.08	0.08
2005	0.68	0.54	0.84	0.11	0.11	2005	0.93	0.79	1.09	0.08	0.08
2006	1.23	0.99	1.54	0.11	0.11	2006	1.05	0.88	1.26	0.09	0.09
2007	1.27	1.01	1.61	0.12	0.12	2007	0.74	0.61	0.90	0.10	0.10
2008	1.62	1.20	2.18	0.15	0.15	2008	0.75	0.57	1.00	0.14	0.14
2009	1.70	1.23	2.33	0.16	0.16	2009	0.38	0.29	0.50	0.13	0.13
2010	1.60	1.23	2.07	0.13	0.13	2010	0.60	0.48	0.75	0.12	0.12
2011	2.00	1.52	2.61	0.13	0.14	2011	0.73	0.54	0.99	0.15	0.15
2012	1.93	1.47	2.54	0.14	0.14	2012	0.31	0.25	0.40	0.12	0.12

Taranaki (ESA AJ)

Shortfin

Year	Index	Lower	Upper	se	CV
1991	1.37	0.80	2.34	0.27	0.27
1992	1.48	1.04	2.11	0.18	0.18
1993	0.58	0.44	0.78	0.15	0.15
1994	0.53	0.39	0.73	0.16	0.16
1995	0.93	0.67	1.28	0.16	0.16
1996	0.92	0.72	1.17	0.12	0.12
1997	0.70	0.56	0.87	0.11	0.11
1998	0.82	0.69	0.98	0.09	0.09
1999	1.09	0.90	1.31	0.09	0.09
2000	0.95	0.82	1.10	0.08	0.08
2001	0.83	0.70	0.98	0.08	0.08
2002	0.84	0.73	0.97	0.07	0.07
2003	0.72	0.61	0.85	0.08	0.08
2004	0.71	0.59	0.86	0.09	0.09
2005	0.68	0.51	0.91	0.15	0.15
2006	1.11	0.86	1.44	0.13	0.13
2007	0.89	0.66	1.20	0.15	0.15
2008	1.30	0.91	1.85	0.18	0.18
2009	1.52	0.66	3.52	0.42	0.44
2010	2.16	1.58	2.95	0.16	0.16
2011	1.76	1.29	2.41	0.16	0.16
2012	1.78	1.33	2.39	0.15	0.15

Longfin

Year	Index	Lower	Upper	se	CV
1991	1.70	1.52	1.90	0.06	0.06
1992	2.06	1.82	2.33	0.06	0.06
1993	1.46	1.31	1.63	0.06	0.06
1994	1.29	1.15	1.45	0.06	0.06
1995	1.57	1.37	1.81	0.07	0.07
1996	1.47	1.30	1.65	0.06	0.06
1997	1.27	1.14	1.40	0.05	0.05
1998	1.12	1.00	1.25	0.05	0.05
1999	0.98	0.88	1.08	0.05	0.05
2000	0.89	0.81	0.97	0.05	0.05
2001	0.82	0.75	0.90	0.04	0.05
2002	0.75	0.69	0.82	0.04	0.04
2003	0.74	0.69	0.80	0.04	0.04
2004	0.88	0.80	0.96	0.05	0.05
2005	0.90	0.78	1.03	0.07	0.07
2006	0.95	0.83	1.10	0.07	0.07
2007	0.96	0.84	1.09	0.07	0.07
2008	0.83	0.66	1.05	0.12	0.12
2009	0.55	0.34	0.89	0.24	0.25
2010	0.47	0.38	0.58	0.10	0.10
2011	0.87	0.69	1.09	0.11	0.11
2012	0.88	0.70	1.10	0.11	0.11

Manawatu (ESA AK)

Shortfin

Year	Index	Lower	Upper	se	CV
1991	2.70	2.30	3.18	0.08	0.08
1992	4.80	4.04	5.71	0.09	0.09
1993	2.12	1.73	2.60	0.10	0.10
1994	0.67	0.58	0.77	0.07	0.07
1995	0.63	0.54	0.72	0.07	0.07
1996	0.52	0.43	0.63	0.09	0.09
1997	0.51	0.41	0.64	0.11	0.11
1998	0.71	0.54	0.93	0.14	0.14
1999	1.03	0.73	1.45	0.17	0.17
2000	0.60	0.54	0.67	0.05	0.05
2001	0.65	0.58	0.71	0.05	0.05
2002	0.77	0.68	0.87	0.06	0.06
2003	0.39	0.34	0.45	0.07	0.07
2004	1.39	0.85	2.27	0.25	0.25
2005	1.03	0.86	1.23	0.09	0.09
2006	1.17	1.01	1.34	0.07	0.07
2007	1.34	1.17	1.53	0.07	0.07
2008	1.49	1.26	1.75	0.08	0.08
2009	1.01	0.86	1.17	0.08	0.08
2010	1.20	1.03	1.40	0.08	0.08
2011	1.06	0.88	1.27	0.09	0.09
2012	0.89	0.75	1.05	0.09	0.09

Longfin

Year	Index	Lower	Upper	se	CV
1991	8.44	1.42	50.12	0.89	1.10
1993	1.91	1.04	3.52	0.31	0.31
1994	1.02	0.75	1.39	0.15	0.15
1995	0.76	0.56	1.02	0.15	0.15
1996	0.60	0.41	0.88	0.19	0.19
1997	0.80	0.46	1.40	0.28	0.28
1998	0.82	0.48	1.40	0.27	0.27
1999	2.28	0.90	5.80	0.47	0.49
2000	0.70	0.46	1.07	0.21	0.21
2001	1.40	1.03	1.91	0.15	0.16
2002	0.73	0.51	1.05	0.18	0.18
2003	0.67	0.49	0.91	0.15	0.15
2005	0.53	0.31	0.88	0.26	0.27
2006	0.64	0.44	0.92	0.18	0.18
2007	0.94	0.65	1.34	0.18	0.18
2008	0.95	0.61	1.46	0.22	0.22
2009	0.80	0.58	1.11	0.16	0.16
2010	0.77	0.52	1.12	0.19	0.19
2011	0.89	0.62	1.30	0.19	0.19
2012	1.12	0.77	1.64	0.19	0.19

Wairarapa (ESA AL)

Shortfin

Year	Index	Lower	Upper	se	CV
1991	1.56	0.87	2.77	0.29	0.29
1992	1.62	0.77	3.44	0.38	0.39
1993	0.93	0.72	1.21	0.13	0.13
1994	1.20	0.97	1.50	0.11	0.11
1995	1.12	0.94	1.32	0.08	0.09
1996	0.94	0.79	1.13	0.09	0.09
1997	0.67	0.56	0.80	0.09	0.09
1998	0.91	0.76	1.10	0.09	0.09
1999	0.87	0.73	1.05	0.09	0.09
2000	0.71	0.60	0.84	0.08	0.08
2001	0.88	0.75	1.03	0.08	0.08
2002	0.48	0.42	0.54	0.06	0.06
2003	0.49	0.43	0.55	0.06	0.06
2004	0.36	0.22	0.58	0.24	0.24
2005	1.22	1.03	1.44	0.09	0.09
2006	1.14	0.98	1.34	0.08	0.08
2007	1.29	1.03	1.61	0.11	0.11
2008	1.50	1.21	1.86	0.11	0.11
2009	1.32	1.09	1.60	0.10	0.10
2010	1.58	1.22	2.04	0.13	0.13
2011	1.70	1.30	2.21	0.13	0.13
2012	1.27	1.02	1.57	0.11	0.11

Longfin

Year	Index	Lower	Upper	se	CV
1991	1.19	0.79	1.80	0.20	0.21
1993	1.90	1.49	2.41	0.12	0.12
1994	1.05	0.81	1.36	0.13	0.13
1995	1.84	1.46	2.32	0.12	0.12
1996	1.34	1.11	1.62	0.09	0.09
1997	1.70	1.33	2.18	0.12	0.12
1998	1.19	0.94	1.50	0.12	0.12
1999	1.16	0.96	1.39	0.09	0.09
2000	1.03	0.85	1.24	0.10	0.10
2001	1.02	0.86	1.20	0.08	0.08
2002	0.67	0.59	0.77	0.07	0.07
2003	0.56	0.49	0.64	0.07	0.07
2004	0.98	0.65	1.49	0.21	0.21
2005	0.64	0.52	0.78	0.10	0.10
2006	0.87	0.73	1.04	0.09	0.09
2007	0.92	0.70	1.21	0.14	0.14
2008	0.77	0.58	1.01	0.14	0.14
2009	0.63	0.49	0.81	0.13	0.13
2010	0.68	0.51	0.91	0.15	0.15
2011	1.21	0.87	1.70	0.17	0.17
2012	0.92	0.71	1.20	0.13	0.13