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N. Bentley
J. D. Booth
P. A. Breen

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N. Bentley[1]
J. D. Booth[2]
P. A. Breen[2]

[1]Trophia Ltd
P O Box 60
Kaikoura

[2]NIWA
Private Bag 14901
Wellington

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EXECUTIVE SUMMARY

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The red rock lobster (*Jasus edwardsii*) fishery is an important inshore fishery in New Zealand. A reliable predictor of recruitment to the fishery would aid in its management. In 1979, a sampling programme was established to measure rates of settlement of postlarval rock lobsters.

The programme uses sampling devices (crevice collectors) that are placed at sites around New Zealand within the main area of the commercial rock lobster fishery. The collectors are sampled about monthly, at least during the main settlement season, for pueruli and first instar juveniles (= recent settlers). There has not been a single standard set of sites from the start, nor have groups of collectors within sites remained constant. This reflects an evolving investigation into, and understanding of, postlarval recruitment processes. Furthermore, due to weather and logistical constraints, the collectors could not always be sampled each month, even during the main settlement season. Thus to obtain a reliable relative index of puerulus settlement it is necessary to standardise for these changes.

We generated standardised indices of recent settler abundance for each quota management area where there were sufficient settlement data: CRA 3, CRA 4, CRA 5, CRA 7, and CRA 8. However, because recent stock assessments for CRA 8 have separated data from Fiordland and Foveaux Strait-Stewart Island, we calculate separate indices for each of these areas (CRA 8F and CRA 8S respectively).

The number of recent settlers in each collector check was usually low. In CRA 7 and CRA 8S, 92% and 87% of samples respectively had no recent settlers. Accordingly, a Poisson error distribution was assumed for the generalised linear models used for the standardisations. Standardisation variables considered were month, site, group, and collector. For each quota management area, a forward selection process was used for selecting the final standardisation model. For most areas, month and site or collector were included as significant explanatory variables in the final model.

For CRA 3 and CRA 4 there were large differences between the unstandardised and standardised indices of settlement. For CRA 5, where trends in settlement numbers between sites were similar, there was little effect of standardisation. In CRA 7 and CRA 8S, the low number of puerulus in each collector produced very high levels of uncertainty in standardisation indices. For CRA 8F the standardised indices differed little from those based on the raw data.

We discuss ways to improve the certainty in the indices of settlement. The standardisations show that there can be large variation in settlement rates between collectors within groups, groups within sites,

1. INTRODUCTION

Recent stock assessments for New Zealand rock lobster fisheries have suggested that recruitment to the stock can vary considerably and can have a significant effect on the magnitude of vulnerable biomass, and hence catch per unit effort (CPUE) (Bentley et al. 2001, Breen et al. 2002). Information on recruitment to the stock would be useful for interpreting trends in the fishery. In Western Australia, settlement rates of puerulus larvae of *Panulirus cygnus* on artificial collectors are used to predict future recruitment to the fishery and hence catches of lobsters (e.g., Caputi et al. 2001). The apparent success of this programme has led to puerulus collection programmes in other spiny lobster fisheries, including New Zealand.

Key sites have been sampled to measure settlement on crevice collectors (Booth & Tarring 1986) along the main rock lobster fishing coasts of New Zealand for up to 20 years. These sites were chosen after extensive trials over many years. Each key site is separated from its neighbour by 150–400 km. Site locations were chosen on the basis of distance from neighbouring sites, accessibility, and level of puerulus catch; other details were given by Booth & Stewart (1993). In addition to the key sites, monthly settlement data exist for many exploratory sites (sites at which settlement was followed for only a few years and where monitoring no longer continues).

Settlement is not uniform in time or space. Settlement occurs mainly at night, at any lunar phase, it is usually seasonal, and levels of settlement can vary by an order of magnitude or more from year to year.

At the key sites, crevice collectors are set in groups of 3–9 collectors, with a minimum spacing of 2 m between individual collectors. There is usually a "core" group at each key site and additional groups of collectors are set in both directions along the coast, as conditions allow, 0.1–25 km from the core collectors. Most of the exploratory sites had fewer collectors, usually three.

The crevice collector types are shore, closing, or suspended (see Booth & Tarring (1986) and Phillips & Booth (1994) for collector design). Collectors on the seafloor (shore and closing crevice collectors) provide a combined index of (a) the number of pueruli in the water column that settled, and (b) the result of post-settlement migration – the net number of older animals (older pueruli, and less often, young juveniles) moving on to the collector from the surrounding seafloor, and animals of similar age moving from the collector to the surrounding seafloor (Booth & Stewart 1993). Collectors are checked approximately monthly, at least over the main settlement season, and all lobsters removed (details of methods were given by Booth & Stewart (1993)).

In the past, an index of annual settlement has been calculated as the mean catch of "recent settlers" per collector, comprising pueruli and juveniles to 14.5 mm carapace length (CL), which is the maximum size for a first instar juvenile observed from laboratory studies, calculated from core collectors over the main settlement season. The main settlement season varies between 6 and 10 months according to site and also time of sampling. It also pools all the data from a quota management area (QMA) in the estimate of settlement so that spatial variation in settlement is accounted for with appropriate estimates of error. We generated indices of puerulus settlement for each QMA where there were sufficient data: CRA 3, CRA 4, CRA 5, CRA 7, and CRA 8. However, because recent stock assessments for CRA 8 have separated data from Foveaux Strait-Stewart Island and Fiordland, we calculated separate indices for each of these areas (CRA 8S and CRA 8F respectively).

Because there have been suggestions that there are similar settlement levels along the entire eastern coasts of the North Island and the upper South Island, we also calculated three indices that were aggregated over two or more quota management areas: CRA 34 (CRA 3 and CRA 4), CRA 45 (CRA 4 and CRA 5) and CRA 345 (CRA 3, CRA 4, and CRA 5). We use the same methods as for the individual QMAs but do not present detailed results or discussion for these indices.

We first describe the structure of the data and the criteria used for choosing subsets of data for analysis in each QMA. Then we describe the method used for standardisation and present results separately for each QMA. Finally, we discuss how the current level of sampling intensity might be better distributed to obtain more reliable settlement indices. This study did not examine whether the collector settlement data provide a reliable index of recruitment to the fishery. Another study examines the correlation between the standardised indices generated here and indicators of recruitment to the fishery from other sampling programmes.

2. DATA

The data associated with the puerulus collector programme are stored in the Ministry of Fisheries's *rocklob* database (Mackay 2000). All the data in that database pertaining to puerulus collectors (tables *t_locations, t_catch, t_puer_lfreq, and t_deploy_method_codes*) were extracted in November 2001. Note that what are referred to in the database as "locations" (e.g., GIS001, KAI003) are called "groups" here, to maintain consistency with previous publications.

Preliminary error checking was performed on this data. Twelve pairs of duplicate observations for location, date, and collector combinations were identified. These duplicates were either removed or corrected (Appendix Table A1).

Below we describe each of the data variables used in the analysis.

2.1 Sites, groups, collectors

Within each site, collectors are arranged in groups, each group being in a different location, which may be up to 25 km apart. Within each group there are several collectors at least 2 m apart. A collector does not refer to a single physical collector, but rather a replicate collector within each group (i.e., physical collectors are replaced when old or damaged). The relationship between sites, groups, and collectors is shown in Figure 1.

2.2 Month

The sampling design requires that each collector be sampled each calendar month. However, because of weather conditions, sampling can sometimes be delayed until early in the following month. In some previous summaries of these data, such a late sample was treated as coming from the calendar month in which it was intended it be taken. In this analysis, month is the month in which the sample was taken.

2.3 Year

We examined patterns in the mean number of recent settlers per sample in each month at each of the key sites. If the peak in catch rate occurred during summer, then it might have been appropriate to use an alternative definition of year to calendar year for generating indices of annual settlement. At most sites, highest mean catch rates were in June and July, and catch rates over summer were usually low. Only in Castlepoint were catch rates high in summer (December; Figure 2). Based on these data, year was left as calendar year for all sites.

2.4 Records included in analysis

The number of collectors at each site in *rocklob* is variable; most sites have 3 (mainly the exploratory sites) but all long-term key sites have at least 6 and usually more than 12 collectors. There were 422 collectors used over all sites over all years. Many of the collectors, such as those at the exploratory sites and those only recently installed, were in operation for only a short time. We excluded all collectors sampled less than 36 times (equivalent to monthly sampling over 3 years). This reduced the number of collectors in the data set to 156.

Further exclusions of entire sites were made because of an inadequate number of sites within a quota management area (e.g., CRA 2), inadequate groups within a site, inconsistent sampling, or no overlap in sampling time with other sites within the area (Table 1). The last could cause confounding between year and site effects in the standardisation model. After these exclusions, the data set used for analysis consisted of 12 573 samples from 133 collectors in 34 groups at 9 sites within 6 QMAs (Table 2).

3. METHODS

3.1 Standardisation framework

The Generalised Linear Model framework (GLM) (McCullagh & Nelder 1989) was used to obtain annual settlement indices that were standardised for changes in the location of collectors and for the month sampled. In a GLM, each value of the response variate (Y_i) has an expectation derived from a link function, $g(\cdot)$, and a linear combination of p independent variables (x_j) each with its own coefficient (β_j),

$$E(Y_i) = g\left(\sum_{j=1}^{p} \beta_j x_{i,j}\right)$$

We developed separate standardisation models for each QMA. The response variate for the standardisation models was the number of recent settlers caught in each collector sample. All independent variables were treated as factors, that is, having a coefficient for each level of the variable. Since the purpose of the standardisation was to estimate annual indices, the year variable was included in all models. The other independent variables – site, group, collector, and month – were added to the model in a stepwise process. At each step, the variable that most improved the fit of the model was included. The Akike Information Criterion was used to select variables and to decide on when the final model had been reached.

Because collectors are nested within groups, and groups are nested within sites, confounding of one of the levels of the nested variable occurs if it is included in a model along with the parent variable (within which it is nested). Therefore, we included only one of these variables in a standardisation model. This does not affect the process of model selection or the estimates of annual indices, only the presentation of the effects of each variable.

We did not investigate any interaction terms between year and site. Only two quota management areas had more than one site, CRA 4 and CRA 8F, and in CRA 8F there was very little temporal overlap of data from the two sites (Table 2). There were differences in annual settlement patterns at each site in CRA 4 (Figure 3), but interaction terms involving year are not useful when producing a set of standardised indices for a quota management area. For example, a *year* x *site* interaction would produce a different set of annual indices for each site, with no natural way for combining these into a set of overall indices for the area. Although sites, group, or collectors may have quite different annual trends in settlement, it is important that these differences be represented in the estimates of standard deviation in the annual indices, and not explained away by relatively arbitrary interaction terms.

Once a final model was selected, we examined plots of residuals for severe outliers. Where there were several severe outliers, these were removed and the model selection process repeated.

An analysis of deviance was performed on the final model for each area. The deviance for a GLM is proportional to twice the difference between its log likelihood and the maximum log likelihood achievable from a saturated model (a model having as many parameters as observations) (McCullagh & Nelder 1989),

$$D = -2\left(\ln(L_m) - \ln(L_s)\right)$$

where L_m is the likelihood for the model under consideration and L_s is the likelihood for the saturated model. An analysis of deviance is similar to an analysis of variance (ANOVA) that is often applied to orthogonal data with normal erors. An analysis of deviance uses deviance, rather than sums of squares, as a measure of discrepency of fit.

Because the independent variables used in the model are not orthogonal, the interpretation of the analysis of deviance table is different to the ANOVA. The analysis of deviance table shows the changes in the deviance that result from sequentially adding each independent variable to the model. It starts with the null model which has only one parameter, the overall mean. The change in deviance associated with adding a variable is the variation accounted for by that variable over and above the variation explained by variables already included in the model.

For each area we present three sets of annual settlement indices.

- Raw: the annual arithmetic mean of the number of settlers per sample
- Unstandardised: the indices derived from a GLM model with year as the only independent variable
- Standardised: indices derived from the final GLM model including standardising independent variables.

Each set of indices is presented as the annual value divided by the geometric mean of the series. This allows the indices to be interpreted similarly to estimates of recruitment from stock assessment models, as deviations from the overall mean in log space.

3.2 Distributional assumptions

Most samples had low counts of recent settlers: about 67% of samples had counts of 1 or less, with high variation among areas (Figure 4). This suggests that a Poisson error distribution may be most appropriate for the standardisation models. Several assumptions about the error distribution were investigated by fitting models with all independent variables included (Table 3).

For both the Poisson and negative binomial distributions, the dispersion parameter (ϕ) was estimated to allow for more variation than expected under the standard Poisson and negative binomial (in which ϕ is assumed to be 1, McCullagh & Nelder (1989)). For each of the distributional assumptions a standardisation model was fitted using the canonical (natural) link function for that distribution (Table 3, McCullagh & Nelder 1989). For the lognormal assumption, the logarithm of the counts per collector was used as the response variable, and because of the large number of zero counts, an arbitrarily small positive number (0.01) was added to all counts.

Three measures were used to assess the appropriateness of each distribution. McCullagh & Nelder (1989) suggested the quasi-deviance (Q) which is calculated as,

$$Q = \sum_i \ln(V(y_i))$$

where y_i is the ith value of the response variate, and $V(\cdot)$ the variance function which describes the relation between the variance and the mean for the distribution used. The most appropriate distribution will have the lowest value for the quasi-deviance. A comparable quasi-deviance could not be calculated for the lognormal distribution because it uses a transformation of the response variate (y). For the Poisson and negative binomial, the estimated variance of an observation with a value of 0 is 0. Because the natural logarithm of zero is undefined, in these cases, the variance was assumed to be an arbirtrarily small value (0.01).

The standard deviation of the standardised residuals (sdsr) was also calculated. It has an expected value of 1. In addition, the median of the absolute standardised residuals (masr) was used because it is less affected by outliers than the sdsr (Francis et al. 2001). The masr has an expected value of 0.675. Plots of the distribution of the standardised residuals were also examined.

The diagnostic statistics were not always consistent. The quasi-deviance suggested that the Poisson distribution was most appropriate for CRA 4, CRA 5, CRA 7, CRA 8S, and CRA 8F, but the negative binomial was most appropriate in CRA 3. The sdsr was close to 1 for most of the distributions in most areas, but was farthest from 1 for the negative binomial distribution. The masr suggested the Poisson was most appropriate for CRA 4, CRA 5, and CRA 8F, but the negative-binomial for CRA 3, CRA 7, and CRA 8S (Table 4). Residual diagnostic plots suggested that the normal distribution was inappropriate in all areas. They did not suggest that the lognormal, Poisson, or the negative binomial was consistently better across all areas.

The residual diagnostic plots for CRA 7 and CRA 8S suggested that all the distributions tested were inappropriate (e.g., CRA 7, Figure 5). This was probably caused by the very low counts in those areas (see Figure 4). An alternative two-part standardisation model was tested for CRA 7 and CRA 8S. This approach was similar to that used for standardising CPUE data that includes a large proportion of zeros (e.g. Vignaux 1994, Coburn et al. 2002). The presence or absence of settlers in samples was modelled using a Generalised Linear Model (GLM) with a binomial error distribution and a logit link function. The number of settlers in samples that had at least one settler was modelled using a GLM with a lognormal error distribution and an identity link (see appendix 1 of Coburn et al. (2002) for more details). All the independent variables were included in each model. The annual coefficients from each of these GLMs can be combined into an annual settlement index.

Residual diagnostic plots for the two-part standardisation model for both CRA 7 and CRA 8 did not suggest a dramatic improvement over the other models. Although residuals for the lognormal part of the model looked good, those for the binomial part did not (e.g., CRA 7, Figure 6).

In the final standardisation models for all QMAs, and for aggregations of QMAs (CRA 34, CRA 345, CRA 45), the Poisson distribution with a log link function was used.

4. RESULTS

Standardised indices of relative annual settlement are presented here as deviations from the mean in log space (Table 5 and 6).

This is the most suitable form for incorporating into a model as part of the stock assessment. In the following sections we describe the development of the standardisation model and provide additional summaries separately for each QMA. For each QMA we provide plots of the estimated annual indices in normal space, as multipliers, where a value of 1 signifies average settlement for the period over which data is available.

4.1 CRA 3

Initial stepwise selection of explanatory variables resulted in a model that included *month* and *collector*. This model had several large outliers (Figure 7). Twenty samples with a standardised residual of greater than 3, or less than –3, were excluded from further analyses (Appendix Table A2). After removal of these outliers, the same standardisation model was selected and the effect on standardised indices was minor (Figure 8). Analysis of deviance for this model suggests that most of the variation is explained by *year* (Table 7).

Both the raw and unstandardised indices show a large peak in 1987–1988 that does not occur in the standardised series (Figure 9). The difference between the unstandardised and standardised indices between 1987 and 1993 is due primarily to changes in the collector groups used. These changes were the consequence of logistical constraints, the evolving understanding of puerulus settlement patterns in the area, and the need for more spatial coverage. In 1987, the GIS005 group of collectors was replaced by the GIS001 group. Most samples came from site GIS001 until 1994, when other sites were introduced (Table 8). Collectors at this site (GIS001) have a high effect compared to collectors that were in operation previously and those that were introduced later (Figure 10).

Eight-five percent of outliers that were removed for the standardisation were from sites GIS001, GIS005, and GIS007 which are located under wharves in Port Gisborne. Because of the peculiar nature of that location, these sites may have settlement patterns that are unrepresentative of the area as a whole. We performed an alternative standardisation excluding these sites, leaving only data from GIS002, GIS003, and GIS004. The same final standardisation model, with year, month, and collector effects, was selected (Table 9). Annual indices of settlement from this model are available only from 1991 onwards, and the model had very little information even for 1991: only the GIS002 collectors, which were installed after the main settlement season was over. The pattern of indices from the two standardisation models for 1991–2000 is similar (Figure 11).

There was very little overlap of sampling at GIS005 and at GIS001 (see Table 8). This may cause confounding between collector effects and year effects. For example, the model has little information on whether settlement was lower in the period 1979 to 1986 than in 1987 to 2000, or whether collectors sites GIS007 and GIS005 have lower catch rates than those at GIS001 to GIS004.

4.2 CRA 4

Initial stepwise selection of standardisation variables resulted in a model that included *month* and *collector*. This model had several large outliers (Figure 12). Fifty-three samples with a standardised residual of greater than 3 or less than –3 were excluded from further analyses (Appendix Table A3). After removal of these outliers, the same standardisation model was selected and the effect on standardised indices was minor (Figure 13).

The difference between the standardised and unstandardised indices between 1979 and 1982 appears to arise because only NAP001, a site with generally low catch rates, was being monitored (Table 10). The peak in indices in 1991 and 1992 appears to have been overemphasised in the unstandardised indices because of the introduction of CPT002 during that time (Figures 14 and 15).

Analysis of deviance for this model suggests that *year* is the most important explanatory variable (Table 11).

4.3 CRA 5

Stepwise selection of standardisation variables resulted in a model that included *month* and *group*. Inspection of residual plots did not reveal any extreme outliers (Figure 16). There was little difference between unstandardised and standardised indices for CRA 5 (Figure 17). This appears to be a result of relatively little change in sites monitored in CRA 5 (Table 12, Figure 18).

Analysis of deviance for this model suggests that *year* was the most important explanatory variable (Table 13). Including *collector* in the model in place of *group* did not improve the fit significantly. This suggests that there is relatively low variation in average catch rate between collectors within groups.

4.4 CRA 7

Data from four collector groups were used in the standardisation (Table 14). Stepwise selection of standardisation variables resulted in a model that included *month* and *group*. Inspection of residual plots suggested that the model's assumption of a Poisson distribution was not met (Figure 19), probably because of the high proportion of zeros in the data. Because this distributional assumption is violated, the model is considered highly unreliable and we do not present an analysis of deviance for it. The raw, unstandardised, and standardised indices all follow a similar pattern, although the relative magnitudes of the peaks differ (Figure 20). The estimated confidence intervals for this model are wide (see Table 5).

4.5 CRA 8 – Stewart Island

Data from five collector groups were used in the standardisation (Table 15). Stepwise selection of standardisation variables resulted in a model that included *month* and *group*. Inspection of residual plots suggested that the model's assumption of a Poisson distribution was not met (Figure 21). As for CRA 7, this was probably caused by the high proportion of zeros in the data. The model is considered unreliable and we do not present an analysis of deviance for it. The raw, unstandardised, and standardised indices follow a similar pattern, although the relative magnitudes of the peaks differ (Figure 22).

4.6 CRA 8 – Fiordland

Data were available from only two collector groups (Table 16). Stepwise selection of standardisation variables resulted in a model that included *month* and *collector*. Inspection of residual plots did not reveal any extreme outliers (Figure 23). Analysis of deviance for the standardisation model suggests that *year* is the most important explanatory variable (Table 17).

There was little difference between patterns of unstandardised and standardised indices (Figure 24). However, the standardisation made some adjustments related to the removal of the CAS002 group and the addition of collectors at CHI001 (Figure 25).

5. DISCUSSION

Generalised Linear Models appear to be an appropriate method for estimating annual indices of rock lobster settlement data from collector samples. They provide several advantages over the current method (using the simple mean catch from the main settlement period): these include generating a longer time series of indices and making better estimates of their variance. This appears to be the first published use of GLM to estimate settlement indices for rock lobsters: for instance, Gardner et al. 2001 and Caputi et al. (2001) used annual means of catch per collector.

The assumption of Poisson distributed data appears to be appropriate for CRA 3, CRA 5 and CRA 8F. However, it does not appear to be appropriate for CRA 7 and CRA 8S where a high proportion of samples had zero recent settlers. For these sites, no alternative distribution that was tested worked any better.

The annual indices of settlement generated here could be used in rock lobster stock assessments. Previously, a choice had to be made about which site to use to represent settlement patterns in a QMA. These estimates of the standard errors of the settlement indices could be used in the same way that the standard errors derived from standardisation of CPUE data are used in the assessment (Breen et al. 2002). The issue of whether, and how, settlement data from multiple sites within a quota management area should be weighted remains unresolved. For example, should data from a collector site found to be subject to unusual hydrological conditions, such that it received settlement in only one month of the year, be given equal weight to results from a site in the same QMA, known to be available to receive settlement in all months?

The analyses carried out in this study do not help establish the most appropriate levels of collector sampling. However, the results do suggest ways that the current level of sampling effort could be reallocated to provide more precise indices of settlement. In particular, the standardisations suggest that there can be large variation in settlement rates between collectors within groups, groups within sites and sites within quota management areas. This suggests that sampling should be spatially more extensive. CRA 3, CRA 5 and CRA 8F currently have a limited number of collector groups and increasing these might improve the representativeness of settlement indices for the whole quota management area.

The standardisation for CRA 3 supports the suspicion that catches on collectors in Port Gisborne are not representative of catches in the whole area. A large proportion of the outliers identified from the standardisation model for this area were from collectors in Port Gisborne. If this location is unrepresentative, then it might be appropriate to discontinue monitoring it.

The current collectors in CRA 7 and CRA 8S have low catches of recent settlers, and consequently such high uncertainty that the indices derived from them are of no use in quantitative stock assessment. They would provide little information to a stock assessment in estimating annual recruitment to the fishery. One way forward would be to increase the number of collectors (and perhaps size of collector) at the most successful collecting locations.

Whenever sampling effort is relocated within an area, as happened in the early, exploratory years of this project, there should be an overlap between sampling in the old and new locations to prevent confounding between the effects of collector location and years.

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Table 1: Sites excluded from analysis, showing the number of collectors, samples taken, and reason for exclusion.

QMA	Site	Group	No. collectors	No. samples	Reason for exclusion
CRA 2	Bay of Plenty	BOP003	3	72	Only one site in area
		BOP008	3	87	
CRA 3	Tokamaru Bay	TKB002	1	24	Only one group at site with only one collector
	Hicks Bay	HKB001	3	75	Two groups not overlapping in time - HKB001(Jun. 1983 to Mar. 1987), HKB005 (May 1987 to Mar. 1989)
		HKB005	3	72	
CRA 8S	Bluff	BLF001	3	78	Only one group at site sampled (Mar. 1981 to Nov. 1983)
	Stewart Island	STW004	3	141	Only one group at site with relatively few samples (Nov. 1979 to Jan. 1986)
CRA 8F	Jackson's Bay	JKB004	5	136	No overlap in sampling with other sites in area

Table 2: Summary of groups of collectors: number of collectors, main settlement season, number of samples, location and type, for sites considered in this report. For definitions of collector type, see Booth & Tarring (1986) and Phillips & Booth (1994).

Area	Site	Group	No. coll.	Period of activity Month/year	No. Samples	Location	Type
CRA 3	Gisborne	GIS001	5	5/1987–12/2000	741	Harbour	Suspended
		GIS002	5	8/1991–12/2000	459	Whangara	Shore
		GIS003	5	3/1994–12/2000	366	Tatapouri	Shore
		GIS004	5	5/1994–12/2000	375	Kaiti	Shore
		GIS005	3	8/1980–6/1987	169	No 7 Wharf	Shore
		GIS007	6	2/1979–1/1983	255	No 7 Wharf	Suspended
CRA 4	Napier	NAP001	6	5/1979–10/2000	1121	Harbour	Suspended
		NAP002	3	5/1991–9/1999	196	Westshore	Closing
		NAP003	5	6/1994–12/2000	325	C. Kidnappers	Shore
		NAP004	3	6/1991–12/2000	274	Breakwater	Shore
	Castlepoint	CPT001	9	1/1983–12/2000	1446	Castlepoint	Shore
		CPT002	5	9/1991–12/2000	420	Orui	Shore
		CPT003	6	12/1981–12/2000	486	Mataikona	Shore
	Wellington	WTN001	3	10/1993–12/2000	255	Island Bay	Shore
		WTN002	3	11/1993–12/1999	216	Lyall Bay	Shore
		WTN003	3	11/1993–12/2000	249	Breaker Bay	Shore
CRA 5	Kaikoura	KAI001	3	6/1981–12/2000	572	South 13–15	Shore
		KAI002	3	12/1988–12/2000	351	South 31–33	Shore
		KAI003	3	10/1980–12/2000	577	North 10–12	Shore
		KAI004	3	5/1992–12/2000	231	North 34–36	Shore
		KAI006	3	12/1982–6/1986	88	Lab 2	Shore
		KAI008	3	7/1981–11/1988	225	Gooch Bay	Shore
		KAI009	3	12/1988–12/1993	168	Middle South Coast	Shore
CRA 7	Moeraki	MOE001	4	8/1982–9/1999	285	Shag Point	Shore
		MOE002	3	8/1990–12/2000	213	Wharf	Closing
		MOE003	3	10/1986–10/1997	195	Katiki	Shore
		MOE004	3	9/1992–11/2000	205	Millers Beach	Shore
CRA 8S	Halfmoon Bay	HMB001	3	10/1980–12/2000	534	Wharf	Suspended
		HMB002	3	6/1986–11/2000	345	Thompsons	Closing
		HMB003	3	6/1990–11/2000	251	Old Mill	Closing
		HMB004	3	3/1992–11/2000	220	The Neck	Closing
		HMB005	3	3/1992–11/2000	213	Mamaku Point	Closing
CRA 8F	Chalky Inlet	CHI001	6	11/1985–11/2000	445	Shallow Passage	Closing
	Caswell Sound	CAS002	3	4/1986–11/1992	102	Paua Bay	Shore

Table 3: Alternative distributions and link functions assumed for standardisation models.

Distribution	Link function	Variance function
Gaussian	identity	ϕ
Lognormal (ln transformed response data)	identity	ϕ
Poisson	log	$\phi\mu$
Negative binomial	log	$\mu + {\mu^2}/{\phi}$

Table 4: Estimates of dispersion, quasi-deviance, sdsr (expected value 1.0) and masr (expected value 0.675) under different distributional assumptions for the full model using all data. The best value of each diagnostic for each QMA is in bold.

QMA	Distribution	Dispersion	Quasi-deviance	sdsr	masr
CRA 3	Gaussian	-	10561.70	**1.00**	0.29
	Lognormal	-	-	**1.00**	0.68
	Poisson	4.81	1477.66	0.99	0.61
	Negative Binomial	1.61	**1134.05**	0.95	**0.77**
CRA 4	Gaussian	-	16408.14	**1.00**	0.36
	Lognormal	-	-	**1.00**	0.74
	Poisson	3.60	**-720.82**	0.99	**0.63**
	Negative Binomial	1.38	-638.43	0.95	0.74
CRA 5	Gaussian	-	1667.68	**1.00**	0.43
	Lognormal	-	-	**1.00**	0.73
	Poisson	1.42	**-5681.52**	0.97	**0.68**
	Negative Binomial	2.87	-5523.80	0.96	0.73
CRA 7	Gaussian	-	-1413.19	**1.00**	0.26
	Lognormal	-	-	**1.00**	0.32
	Poisson	0.81	**-3801.88**	**1.00**	0.33
	Negative Binomial	2.43	-3754.10	0.99	**0.35**
CRA 8S	Gaussian	-	-1386.38	1.01	0.34
	Lognormal	-	-	**1.00**	0.43
	Poisson	1.13	**-6201.95**	0.97	0.53
	Negative Binomial	1.27	-6075.29	0.95	**0.60**
CRA 8F	Gaussian	-	1628.23	**1.00**	0.42
	Lognormal	-	-	**1.00**	0.85
	Poisson	4.61	**-452.46**	0.99	**0.69**
	Negative Binomial	0.86	-463.20	0.94	0.84

Table 5: Estimated annual settlement deviations (Est.: in log space) and associated standard errors (S.E.) for each quota management area.

	CRA 3		CRA 3 (excluding Port Gisborne)		CRA 4		CRA 5		CRA 7		CRA 8S		CRA 8F	
Year	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.
1979	0.092	0.169	-	-	-0.049	0.129	-	-	-	-	-	-	-	-
1980	-0.225	0.160	-	-	0.194	0.101	-4.969	9.532	-	-	2.206	1.172	-	-
1981	-0.563	0.150	-	-	0.716	0.081	0.573	0.214	-	-	3.292	1.014	-	-
1982	0.160	0.146	-	-	-0.121	0.104	-2.528	0.710	1.467	111.5	0.325	1.115	-	-
1983	-0.188	0.173	-	-	0.272	0.062	0.459	0.184	3.879	111.5	2.535	1.009	-	-
1984	-0.124	0.161	-	-	-0.128	0.074	-1.106	0.299	1.525	111.5	0.420	1.148	-	-
1985	0.545	0.144	-	-	-0.509	0.086	-0.979	0.277	-8.224	140.1	-7.705	18.897	-0.177	0.775
1986	-0.287	0.172	-	-	-0.663	0.104	-1.719	0.424	-7.850	123.4	-1.012	1.230	-1.602	0.361
1987	0.770	0.065	-	-	0.390	0.064	0.443	0.171	2.986	111.5	1.681	1.017	0.952	0.294
1988	0.672	0.057	-	-	-0.067	0.075	-0.202	0.207	-8.239	121.6	-0.410	1.115	0.392	0.294
1989	-0.126	0.072	-	-	0.277	0.066	0.287	0.152	3.061	111.5	0.630	1.054	0.679	0.292
1990	-0.854	0.085	-	-	-0.145	0.071	-0.828	0.230	1.936	111.5	0.343	1.054	0.625	0.304
1991	-0.064	0.066	0.343	0.398	0.624	0.054	2.223	0.104	0.622	111.5	1.153	1.025	0.125	0.296
1992	0.409	0.060	0.707	0.262	0.654	0.050	2.305	0.104	0.457	111.5	0.559	1.037	-0.678	0.320
1993	0.253	0.061	0.554	0.257	0.237	0.053	1.547	0.112	0.522	111.5	-7.447	7.847	-1.994	0.454
1994	0.668	0.055	0.935	0.238	-0.119	0.053	0.321	0.164	0.211	111.5	1.336	1.016	1.047	0.301
1995	-0.126	0.061	-0.024	0.250	-0.233	0.054	0.507	0.145	-0.442	111.5	0.280	1.044	-0.792	0.346
1996	0.222	0.058	-0.073	0.258	0.226	0.051	0.237	0.184	1.894	111.5	0.072	1.048	0.823	0.301
1997	-0.096	0.061	-0.063	0.252	0.137	0.051	0.843	0.157	1.033	111.5	0.587	1.028	0.843	0.296
1998	0.214	0.058	0.246	0.242	0.119	0.051	1.142	0.147	1.585	111.5	0.023	1.053	-0.940	0.326
1999	-1.094	0.077	-2.444	0.435	-1.220	0.073	0.811	0.164	-0.022	111.5	-0.287	1.073	0.273	0.314
2000	-0.259	0.065	-0.180	0.253	-0.589	0.062	0.634	0.147	3.599	111.5	1.418	1.017	0.421	0.306

Table 6: Estimated annual settlement deviations (Est.: in log space) and associated standard errors (S.E.) for aggregations of quota management areas. CRA 3 data excludes Port Gisborne collectors (see Section 4.1 for explanation). No other data were excluded.

	CRA 34		CRA 345		CRA 45	
Year	Est.	S.E.	Est.	S.E.	Est.	S.E.
1979	-0.134	0.128	-0.103	0.128	-0.086	0.128
1980	0.366	0.089	0.402	0.089	0.405	0.089
1981	0.656	0.080	0.551	0.076	0.541	0.077
1982	-0.183	0.103	-0.433	0.101	-0.450	0.101
1983	0.252	0.061	0.253	0.059	0.245	0.060
1984	-0.094	0.072	-0.202	0.070	-0.202	0.071
1985	-0.522	0.086	-0.609	0.083	-0.627	0.083
1986	-0.656	0.104	-0.851	0.102	-0.863	0.102
1987	0.396	0.064	0.347	0.062	0.340	0.062
1988	-0.086	0.075	-0.167	0.072	-0.174	0.072
1989	0.244	0.065	0.074	0.062	0.077	0.063
1990	-0.117	0.069	-0.320	0.068	-0.319	0.068
1991	0.633	0.051	0.839	0.048	0.849	0.049
1992	0.686	0.048	0.861	0.046	0.862	0.047
1993	0.295	0.051	0.411	0.049	0.378	0.050
1994	0.161	0.049	0.219	0.048	-0.017	0.050
1995	-0.228	0.051	-0.151	0.049	-0.168	0.051
1996	0.182	0.049	0.243	0.048	0.316	0.049
1997	0.121	0.049	0.208	0.048	0.259	0.049
1998	0.087	0.049	0.179	0.047	0.184	0.049
1999	-1.522	0.071	-1.317	0.067	-1.073	0.069
2000	-0.536	0.056	-0.433	0.054	-0.476	0.059

Table 7: Analysis of deviance for the standardisation model for CRA 3.

			Change	
	d.f.	Deviance	d.f.	Deviance
Null	2345	36363		
Year	2323	15521	22	20842
Year + Month	2312	10872	11	4649
Year + Month + Collector	2284	7058	28	3813

Table 8: Number of samples in each year from each collector group in CRA 3.

Year	GIS001	GIS002	GIS003	GIS004	GIS005	GIS007
1979	-	-	-	-	-	61
1980	-	-	-	-	12	68
1981	-	-	-	-	33	74
1982	-	-	-	-	24	47
1983	-	-	-	-	17	5
1984	-	-	-	-	26	-
1985	-	-	-	-	21	-
1986	-	-	-	-	24	-
1987	24	-	-	-	12	-
1988	48	-	-	-	-	-
1989	49	-	-	-	-	-
1990	55	-	-	-	-	-
1991	60	10	-	-	-	-
1992	58	35	-	-	-	-
1993	54	48	-	-	-	-
1994	55	55	43	38	-	-
1995	60	49	55	59	-	-
1996	60	45	35	60	-	-
1997	55	40	58	55	-	-
1998	60	60	60	55	-	-
1999	52	59	55	53	-	-
2000	51	58	60	55	-	-

Table 9: Analysis of deviance for the standardisation model for CRA 3 excluding Port Gisborne sites.

			Change	
	d.f.	Deviance	d.f.	Deviance
Null	1200	7388.2		
Year	1190	4342.3	10	3045.9
Year + Month	1179	2950.6	11	1391.6
Year + Month + Collector	1165	2436.6	14	514

Table 10: Number of samples in each year from each collector group in CRA 4.

Year	CPT001	CPT002	CPT003	NAP001	NAP002	NAP003	NAP004	WTN001	WTN002	WTN003
1979	-	-	-	40	-	-	-	-	-	-
1980	-	-	-	59	-	-	-	-	-	-
1981	-	-	1	66	-	-	-	-	-	-
1982	-	-	8	66	-	-	-	-	-	-
1983	70	-	9	60	-	-	-	-	-	-
1984	55	-	6	48	-	-	-	-	-	-
1985	44	-	-	48	-	-	-	-	-	-
1986	68	-	-	-	-	-	-	-	-	-
1987	71	-	-	-	-	-	-	-	-	-
1988	66	-	-	18	-	-	-	-	-	-
1989	61	-	-	36	-	-	-	-	-	-
1990	72	-	-	36	-	-	-	-	-	-
1991	72	11	12	48	17	-	17	-	-	-
1992	72	37	27	64	19	-	29	-	-	-
1993	70	63	61	69	14	-	27	9	6	3
1994	92	60	50	65	27	19	30	36	36	36
1995	106	54	46	58	31	37	30	36	36	36
1996	99	54	51	72	34	50	27	30	30	30
1997	108	60	55	71	21	60	33	36	36	36
1998	108	51	44	66	27	58	27	36	36	36
1999	106	8	56	72	6	59	27	36	36	36
2000	106	22	60	59	-	42	27	36	-	36

Table 11: Analysis of deviance for the standardisation model for CRA 4.

			Change	
	d.f.	Deviance	d.f.	Deviance
Null	4 935	44 114		
Year	4 913	25 568	22	18 546
Year + Month	4 868	17 777	45	7 791
Year + Month + Group	4 857	12 425	11	5 352

Table 12: Number of samples in each year from each collector group in CRA 5.

Year	KAI001	KAI002	KAI003	KAI004	KAI006	KAI008	KAI009
1980	-	-	6	-	-	-	-
1981	18	-	24	-	-	12	-
1982	24	-	24	-	3	27	-
1983	24	-	21	-	18	27	-
1984	33	-	33	-	21	30	-
1985	30	-	26	-	31	36	-
1986	27	-	26	-	15	27	-
1987	33	-	33	-	-	33	-
1988	36	6	36	-	-	33	3
1989	36	36	36	-	-	-	36
1990	33	33	33	-	-	-	36
1991	36	33	36	-	-	-	33
1992	30	30	30	21	-	-	30
1993	33	33	33	33	-	-	30
1994	29	30	30	30	-	-	-
1995	36	36	36	36	-	-	-
1996	24	24	24	24	-	-	-
1997	21	21	21	18	-	-	-
1998	18	18	15	15	-	-	-
1999	18	18	21	21	-	-	-
2000	33	33	33	33	-	-	-

Table 13: Analysis of deviance for the standardisation model for CRA 5.

			Change	
	d.f.	Deviance	d.f.	Deviance
Null	2 212	5 408.3		
Year	2 191	3 283.0	212	125.3
Year + Month	2 180	2 731.0	11	552.0
Year + Month + Group	2 174	2 296.4	6	434.7

Table 14: Number of samples in each year from each collector group in CRA 7.

Year	MOE001	MOE002	MOE003	MOE004
1982	8	-	-	-
1983	10	-	-	-
1984	14	-	-	-
1985	9	-	-	-
1986	12	-	11	-
1987	12	-	20	-
1988	20	-	12	-
1989	14	-	15	-
1990	28	5	-	-
1991	17	21	18	-
1992	19	17	9	12
1993	16	18	27	30
1994	23	18	14	19
1995	26	21	27	27
1996	18	21	21	21
1997	21	27	21	24
1998	15	24	-	24
1999	3	15	-	21
2000	-	26	-	27

Table 15: Number of samples for each year from each collector group in CRA 8S.

Year	HMB001	HMB002	HMB003	HMB004	HMB005
1980	9	-	-	-	-
1981	21	-	-	-	-
1982	32	-	-	-	-
1983	27	-	-	-	-
1984	24	-	-	-	-
1985	21	-	-	-	-
1986	21	21	-	-	-
1987	30	24	-	-	-
1988	33	21	-	-	-
1989	18	18	-	-	-
1990	28	15	15	-	-
1991	33	21	21	-	-
1992	27	21	17	21	21
1993	30	24	24	24	20
1994	30	27	27	25	25
1995	33	27	24	24	24
1996	27	24	24	24	24
1997	30	27	27	27	27
1998	24	27	24	24	24
1999	15	24	24	24	24
2000	21	24	24	27	24

Table 16: Number of samples for each year from each collector group in CRA 8F.

Year	CAS002	CHI001
1981	-	-
1982	-	-
1983	-	-
1984	-	-
1985	-	3
1986	9	36
1987	9	24
1988	21	22
1989	18	21
1990	12	22
1991	18	24
1992	15	27
1993	-	18
1994	-	21
1995	-	24
1996	-	36
1997	-	48
1998	-	54
1999	-	30
2000	-	35

Table 17: Analysis of deviance for the standardisation model for CRA 8F.

			Change	
	d.f.	Deviance	d.f.	Deviance
Null	547	3 980.0		
Year	531	2 554.2	161	425.8
Year + Month	520	1 845.4	11	708.8
Year + Month + Collector	512	1 576.8	8	268.7

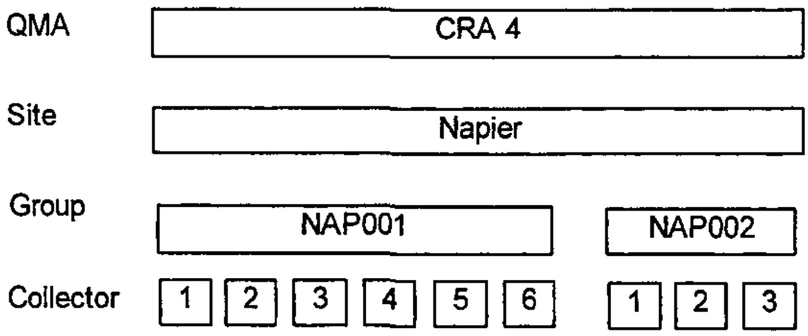


Figure 1: The hierarchical relationship of QMAs, sites, groups, and collectors.

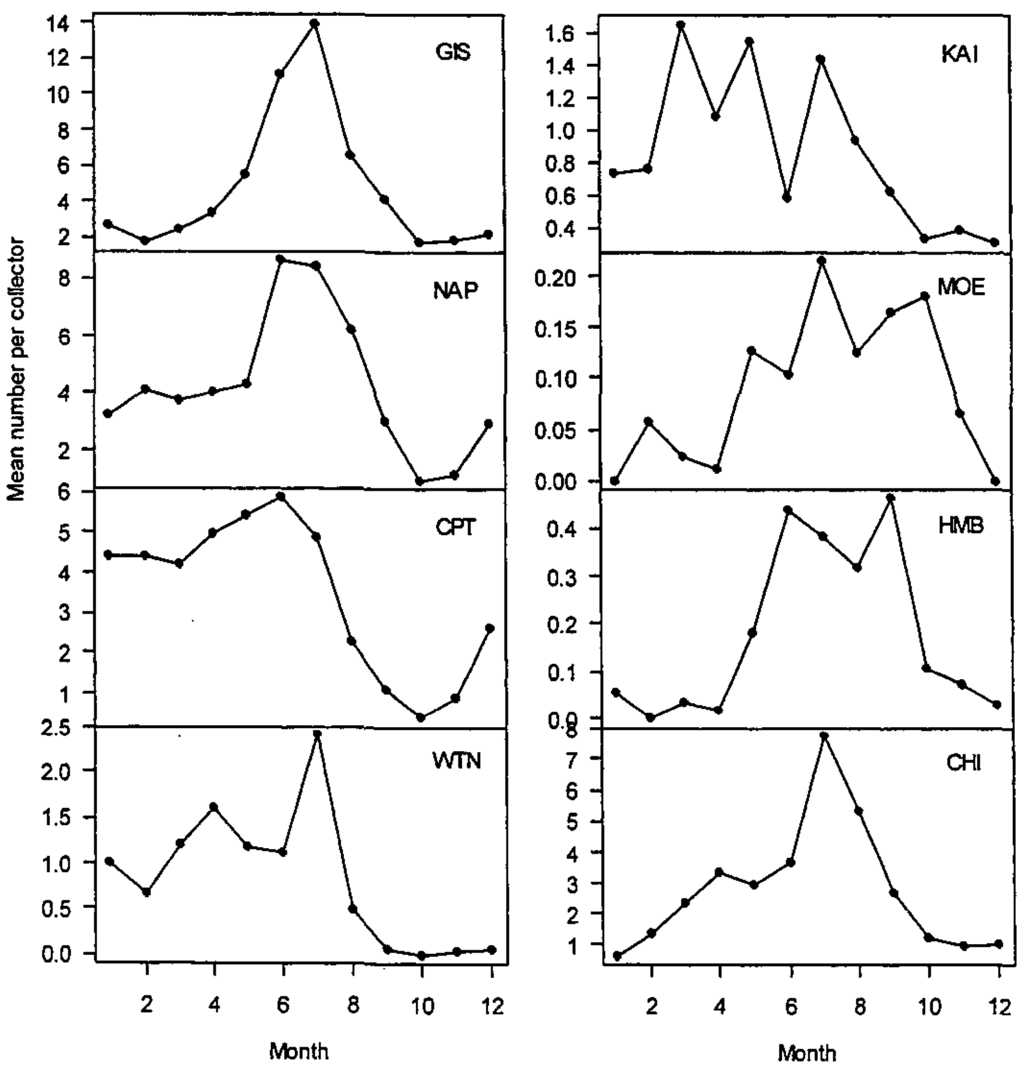


Figure 2: Monthly mean number of recent settlers (pueruli plus first instar juveniles) per collector sample at the main collector sites over all years.

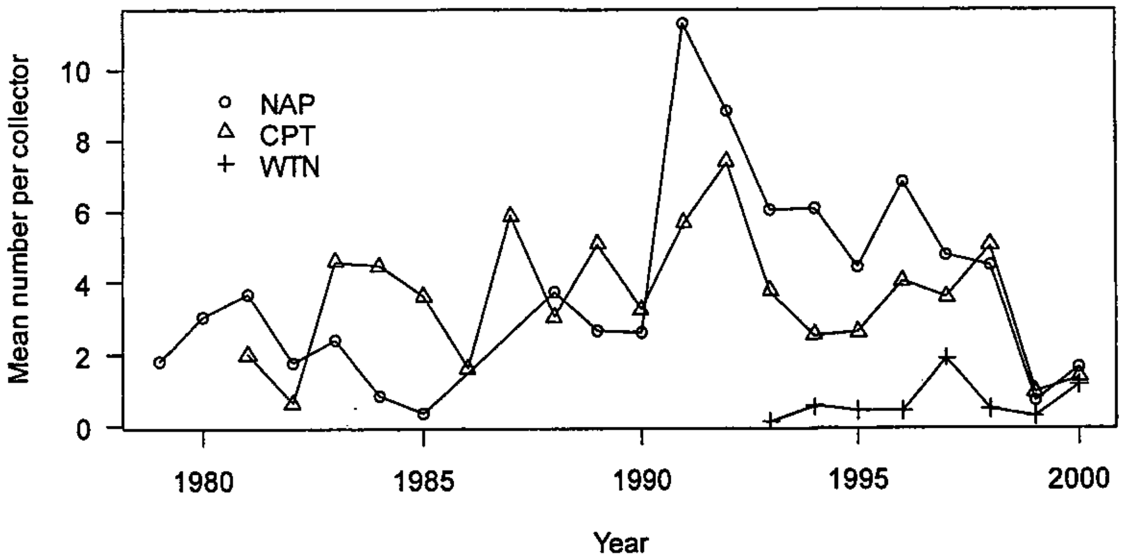


Figure 3: Mean numbers of settlers per collector sample for each year at the three main sites in CRA 4.

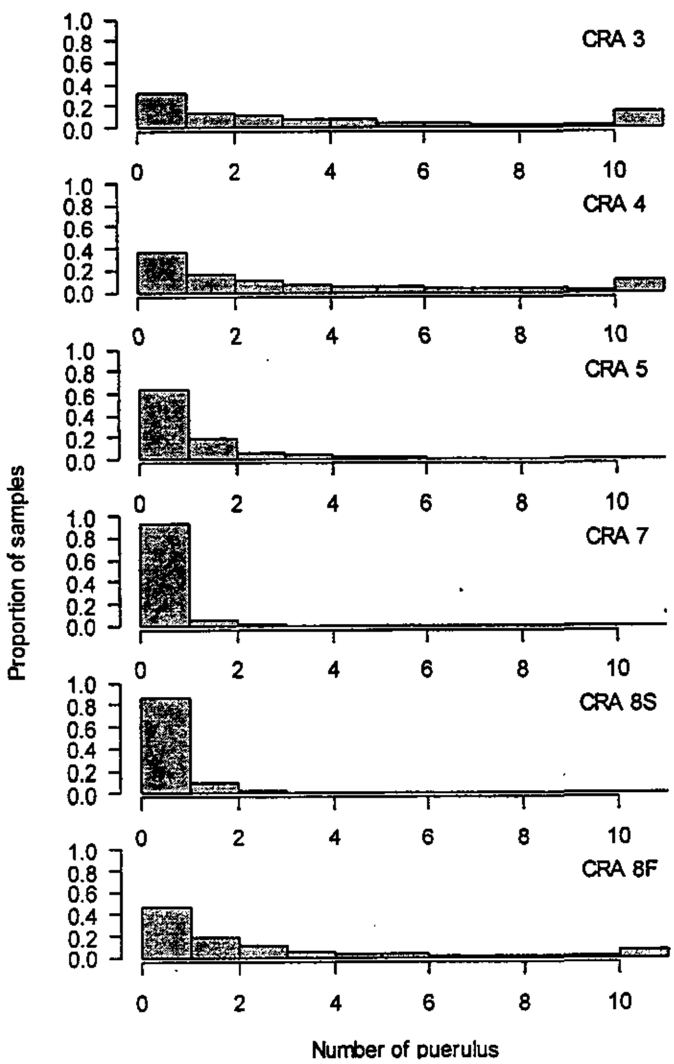


Figure 4: Distributions of the number of recent settlers (pueruli plus first instar juveniles) per sample as a proportion of all samples from all collectors in each quota management area. Counts greater than 10 are included in the 10 bin.

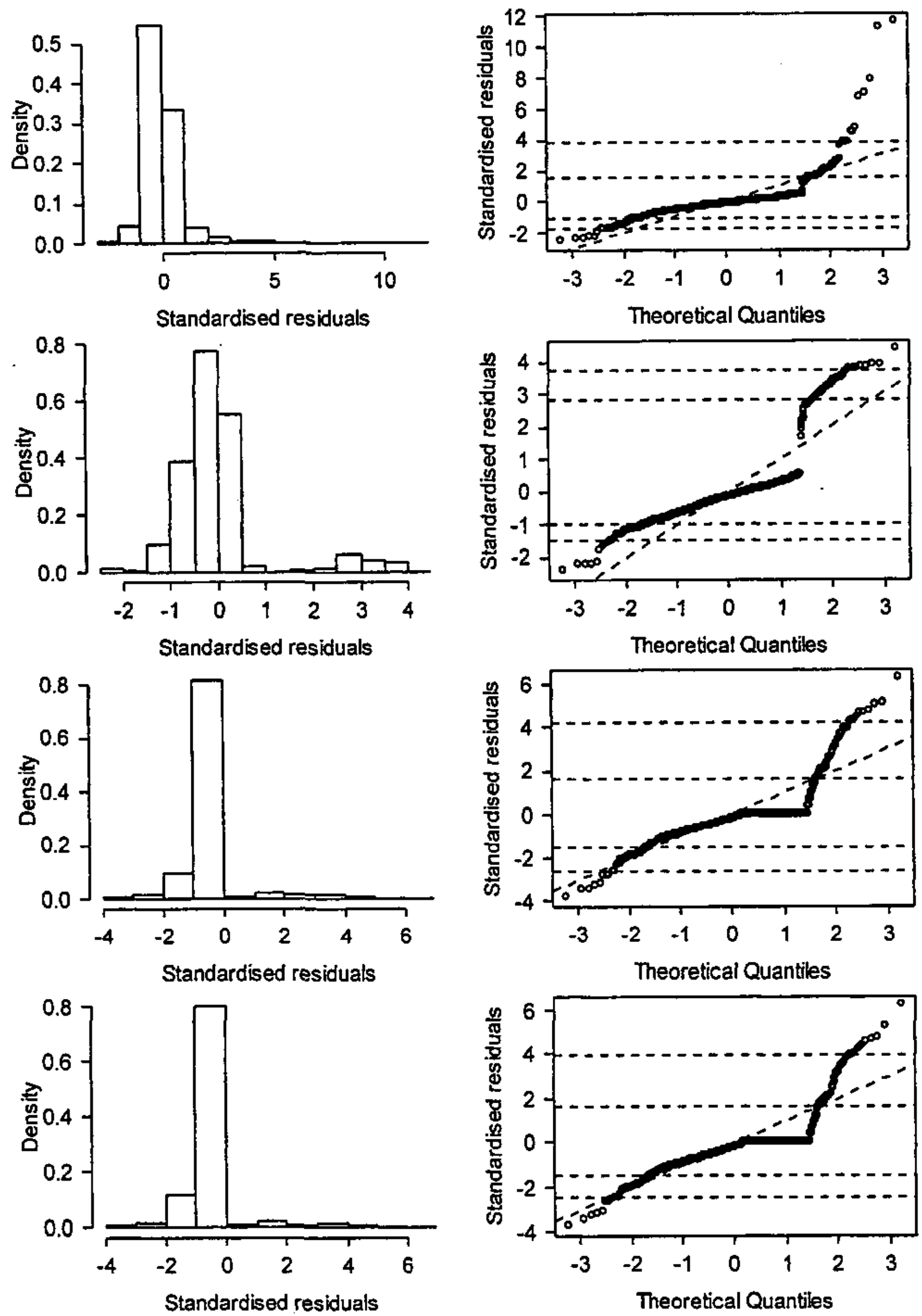


Figure 5: Density and quantile-quantile plots of the residuals from the full standardisation model for CRA 7 assuming (top to bottom) Gaussian (normal), lognormal, Poisson and negative binomial error distributions. Horizontal dashed lines for quantile-quantile plots represent 1st, 5th, 95th, and 99th percentiles.

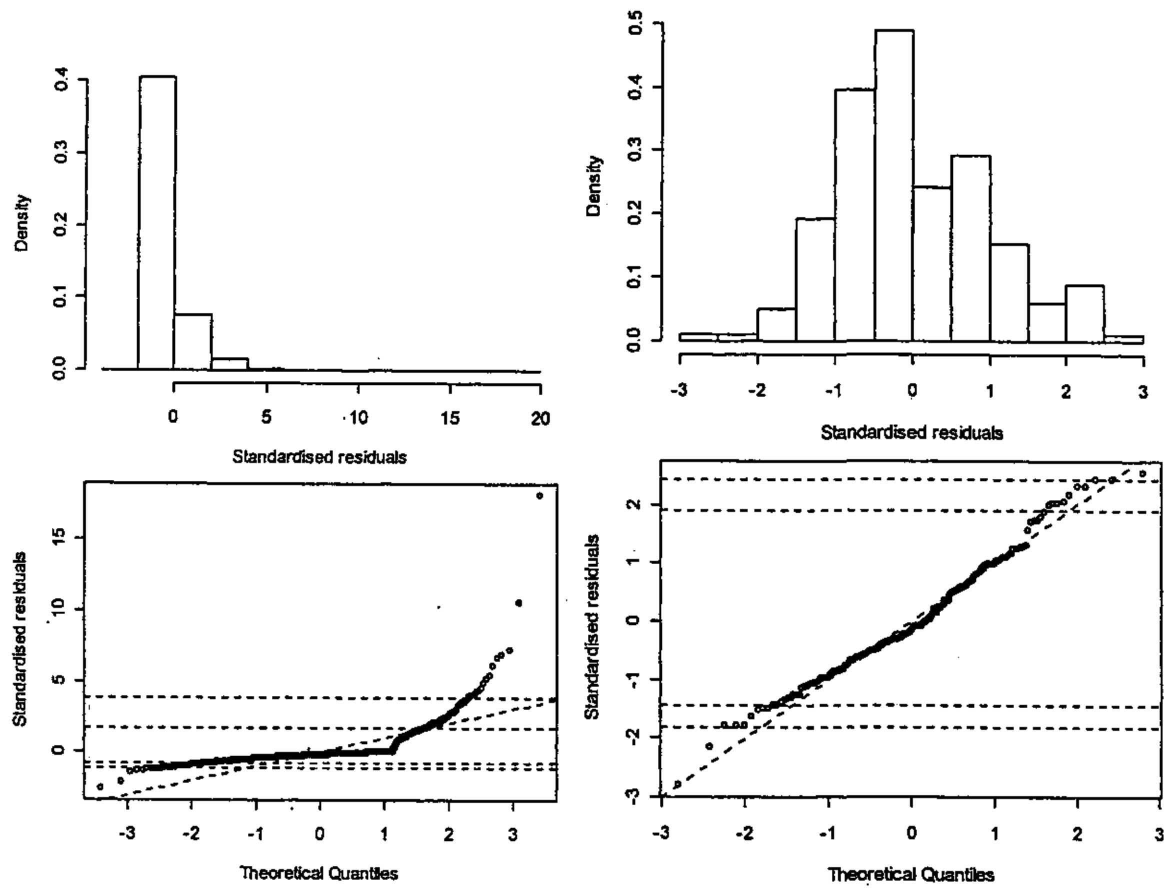


Figure 6: Density and quantile-quantile plots of the residuals from the two-part standardisation model for CRA 7. Left: binomial part. Right: lognormal part. Horizontal dashed lines for quantile-quantile plots represent 1st, 5th, 95th, and 99th percentiles.

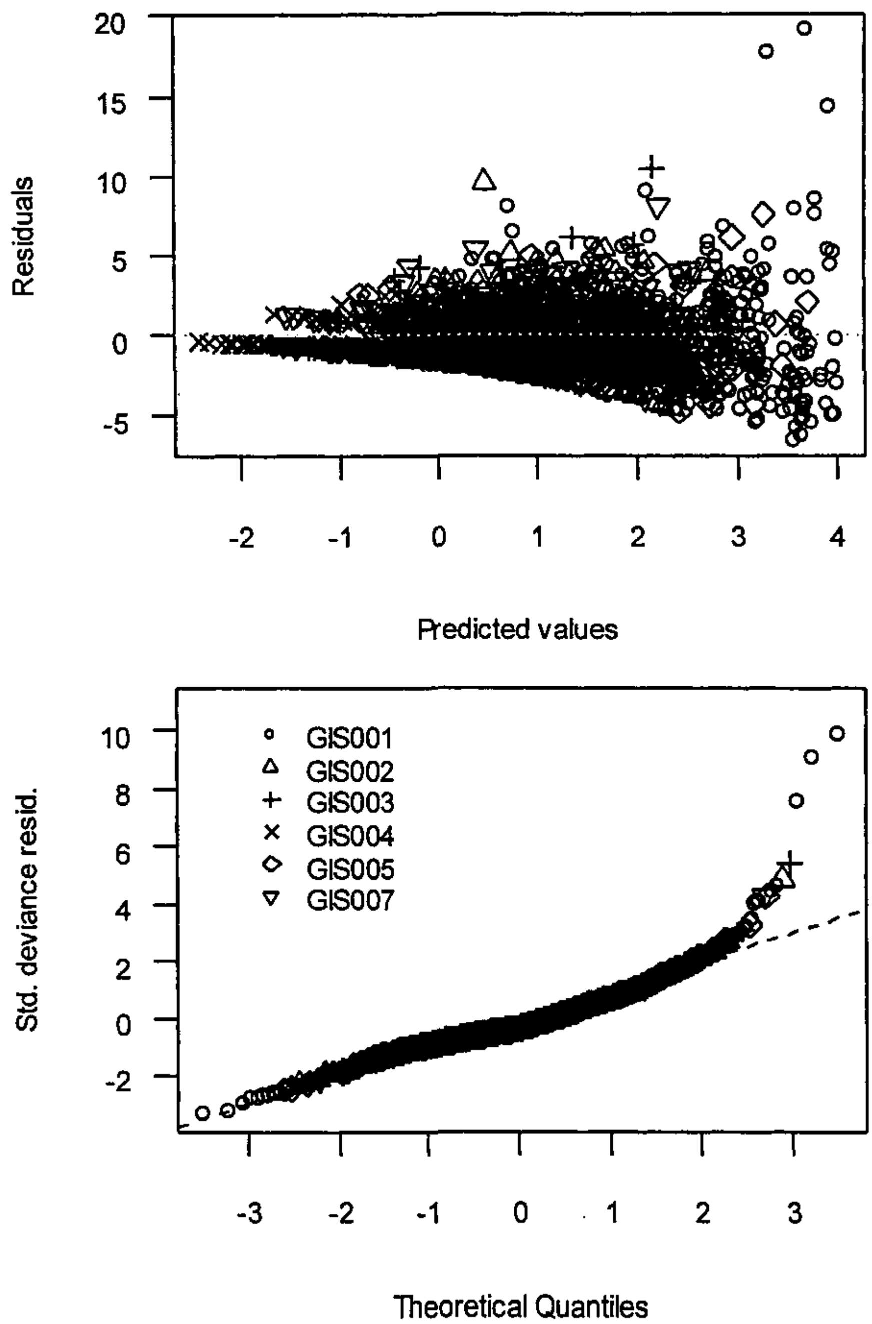


Figure 7: Residual plots from preliminary standardisation model for CRA 3. The predicted values are in log space.

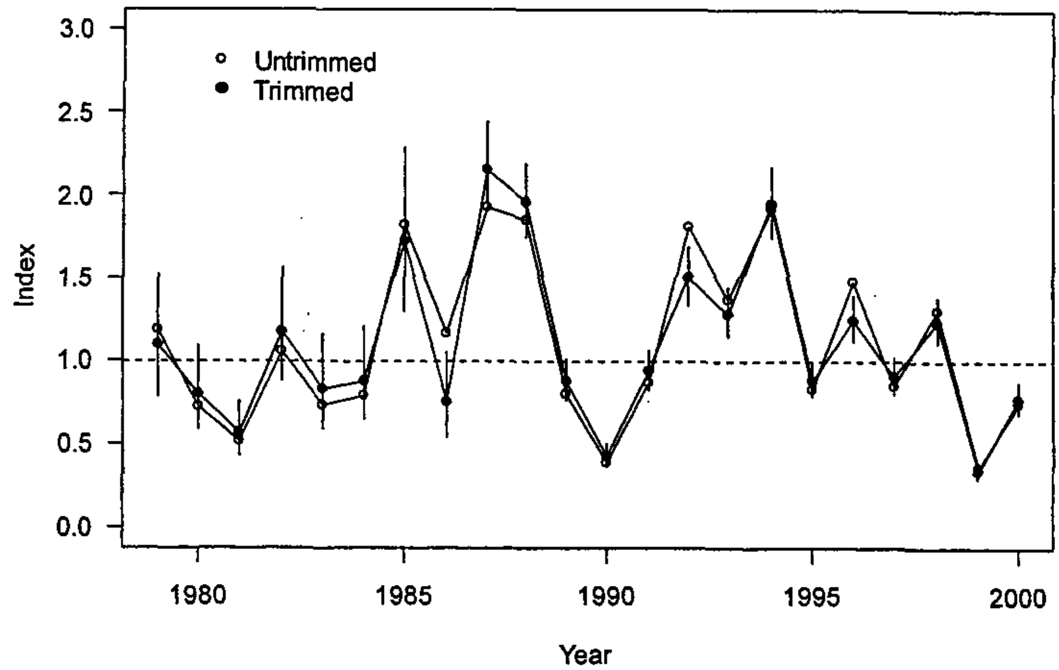


Figure 8: The effect of removing samples with extreme residuals on annual settlement indices for CRA 3. Untrimmed = without outliers removed. Trimmed = outliers removed. Vertical bars for trimmed indices represent 95% confidence intervals.

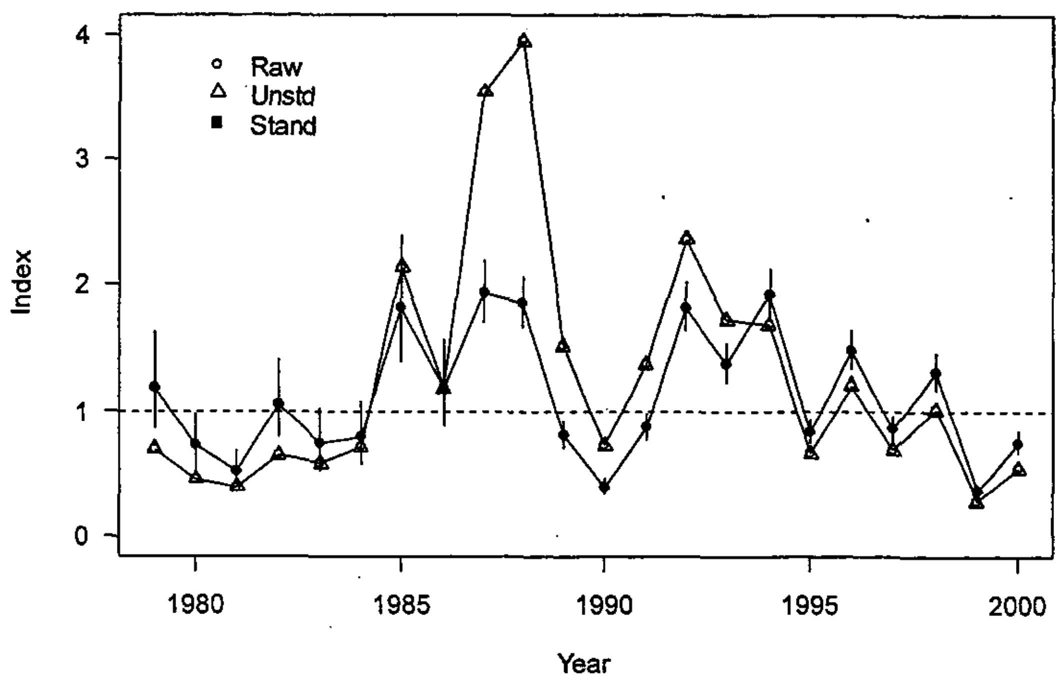


Figure 9: Comparison of settlement indices for CRA 3. Vertical bars on standardised indices represent 95% confidence intervals.

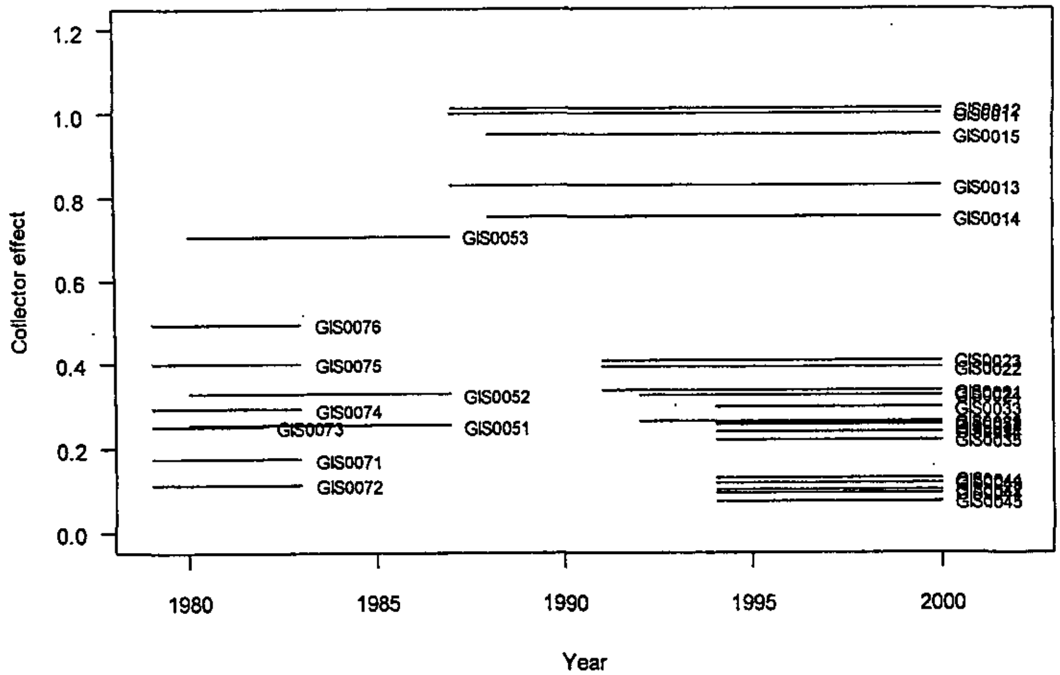


Figure 10: Estimated collector effects for CRA 3 versus the period that the collector was sampled. Collectors are labelled using a concatenation of site and collector number. Effects are relative to collector 1 at GIS001 (labelled GIS0011).

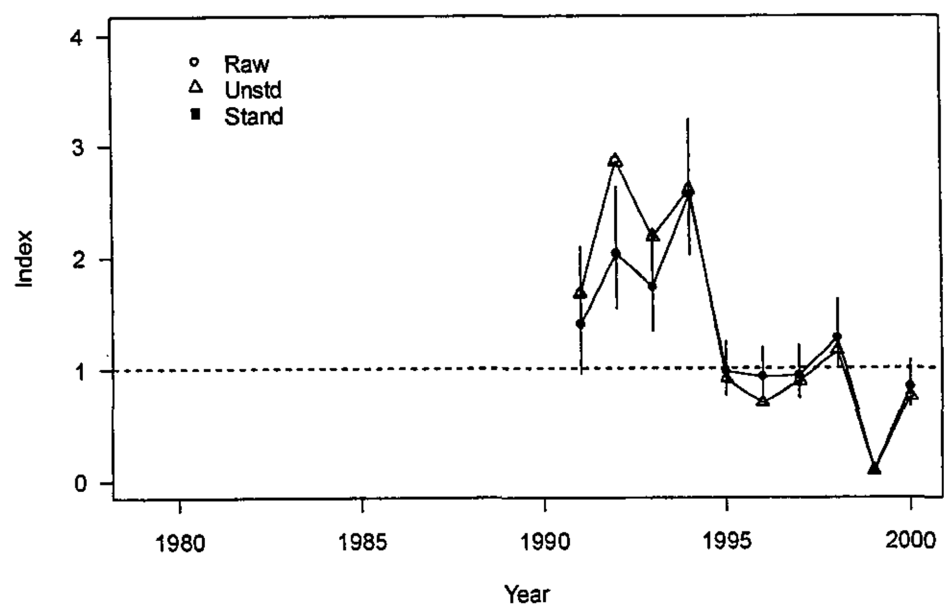


Figure 11: Settlement indices for CRA 3 derived by different methods with data from Port Gisborne excluded. Vertical bars on standardised indices represent 95% confidence intervals.

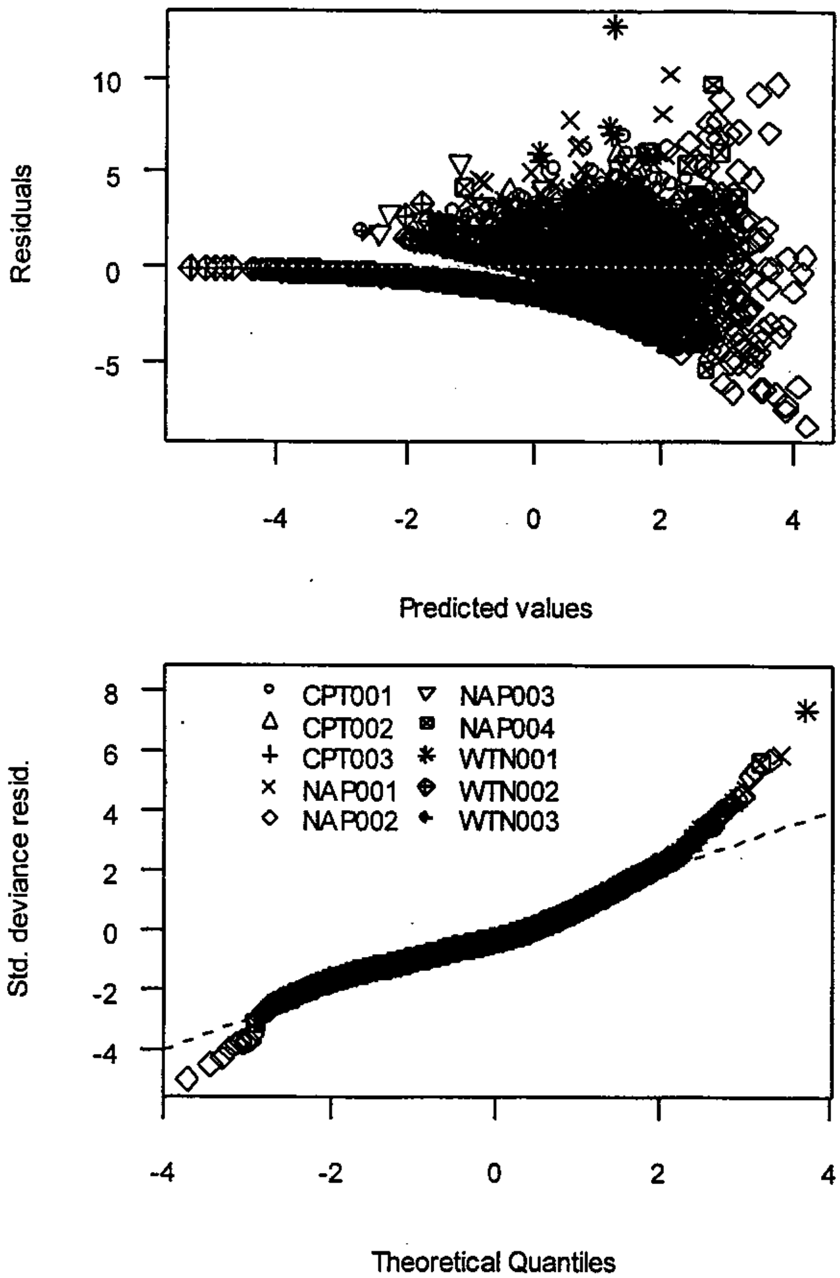


Figure 12: Residuals from preliminary standardisation model for CRA 4. The predicted values are in log space.

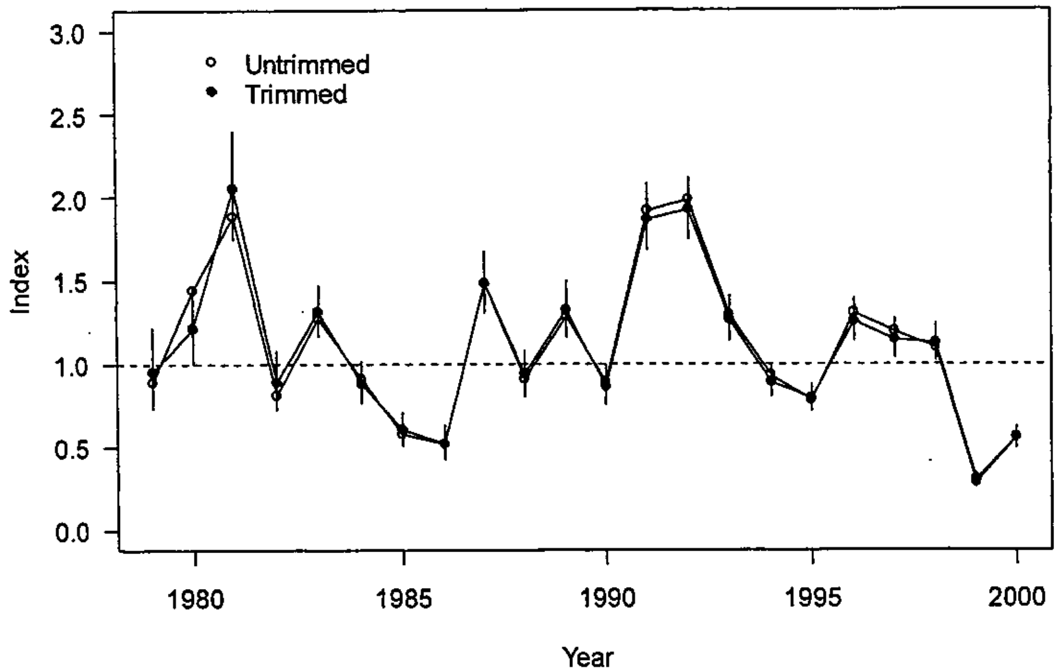


Figure 13: The effect of removing samples with extreme residuals on annual settlement indices for CRA 4. See notes for Figure 8.

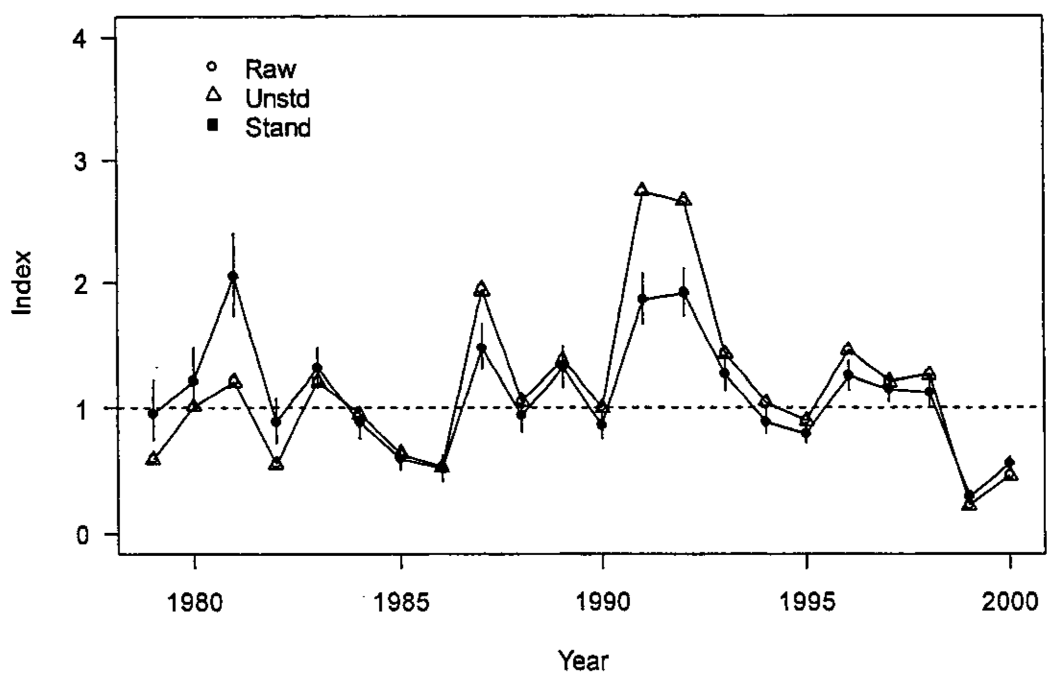


Figure 14: Comparison of settlement indices for CRA 4 derived by different methods. Vertical bars on standardised indices represent 95% confidence intervals.

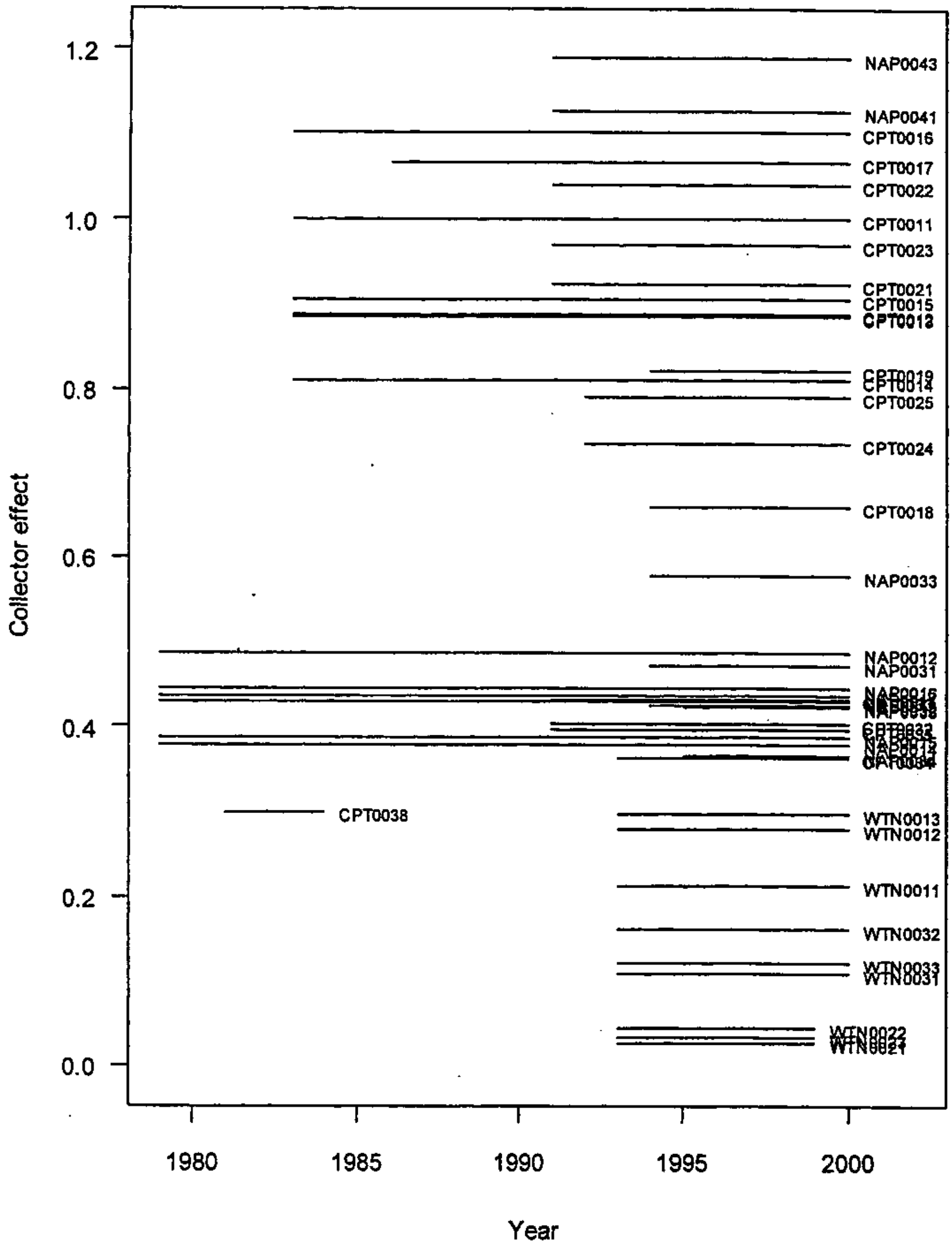
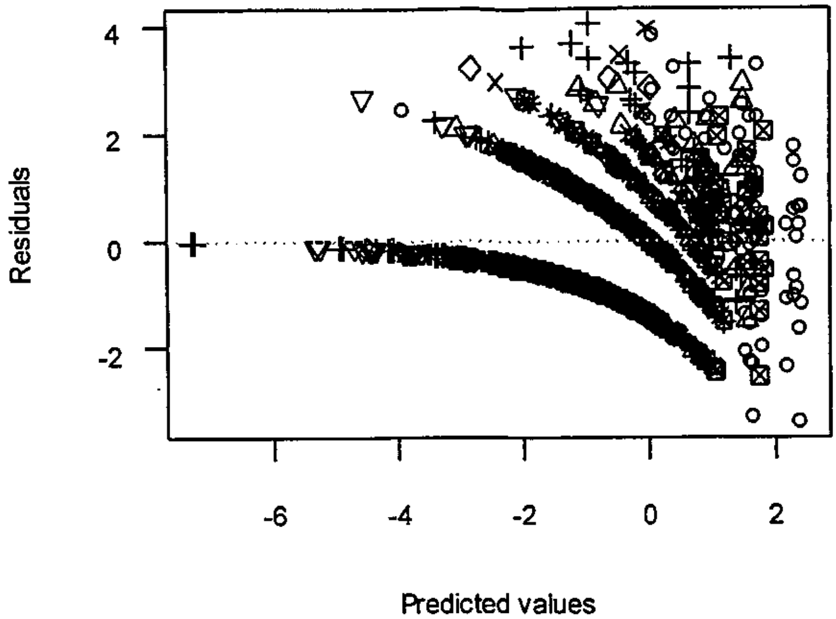


Figure 15: Estimated collector effects for CRA 4 versus the period that the collector was sampled. Collectors are labelled using a concatenation of site and collector number. Effects are relative to collector 1 at CPT001 (labelled CPT0011).



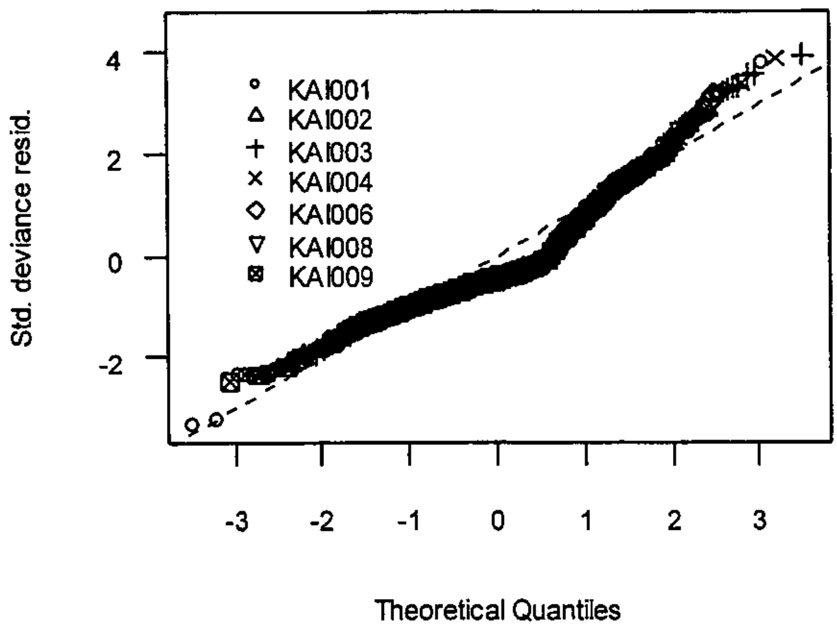


Figure 16: Residual plots from standardisation model for CRA 5. The predicted values are in log space.

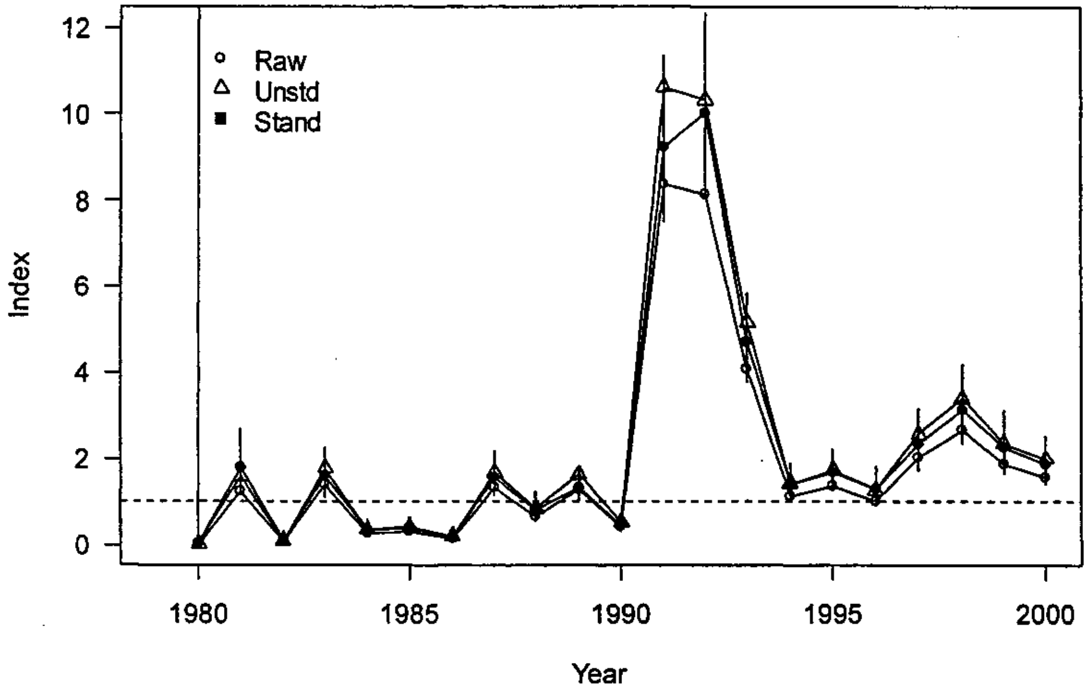


Figure 17: Comparison of settlement indices for CRA 5 derived by different methods.

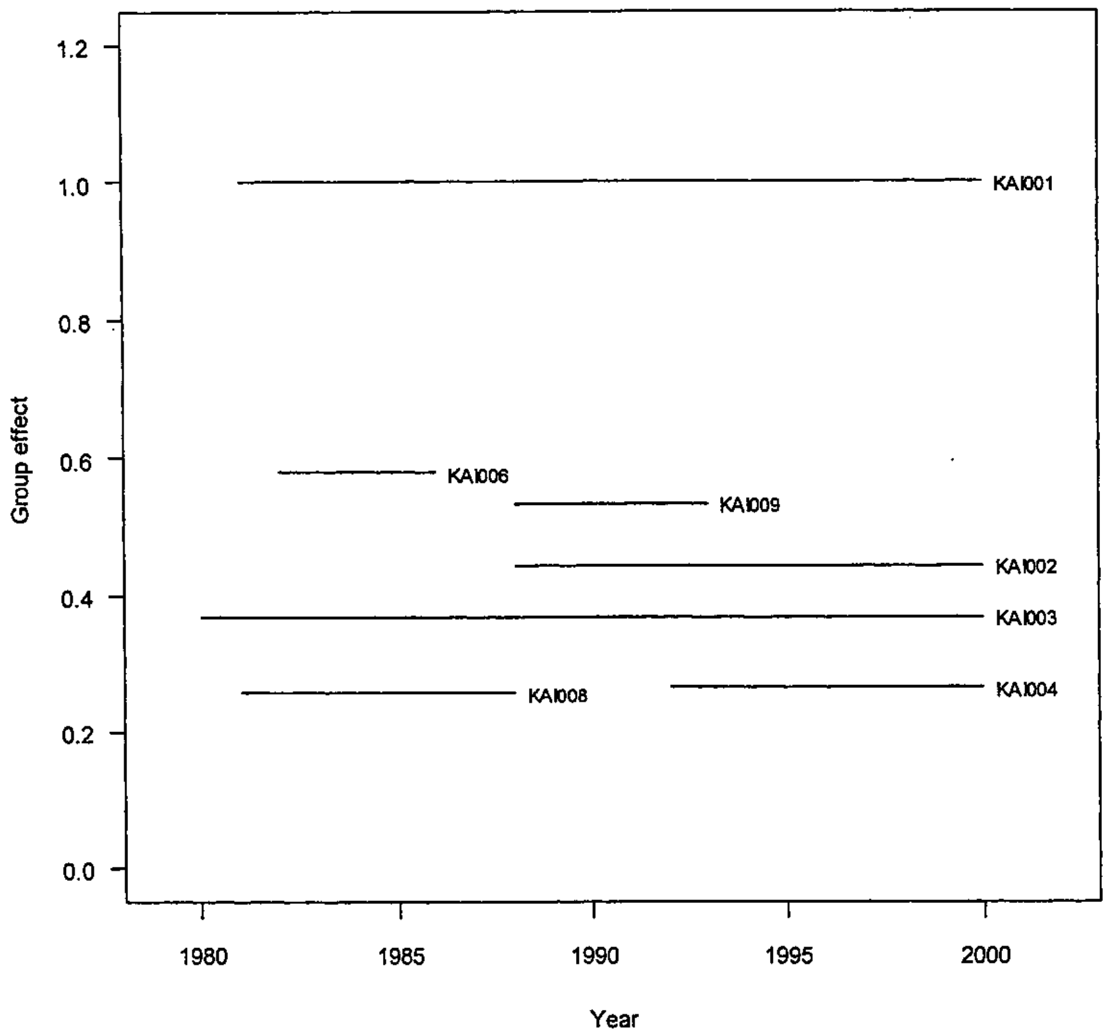
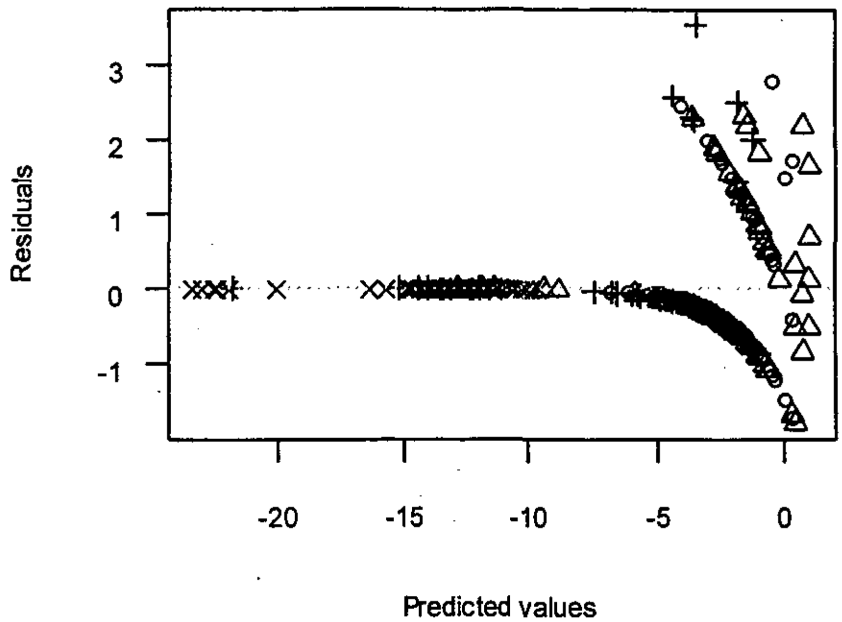


Figure 18: Estimated group effects from standardisation model for CRA 5 versus the period that the group was sampled. Effects are relative to group KAI001.



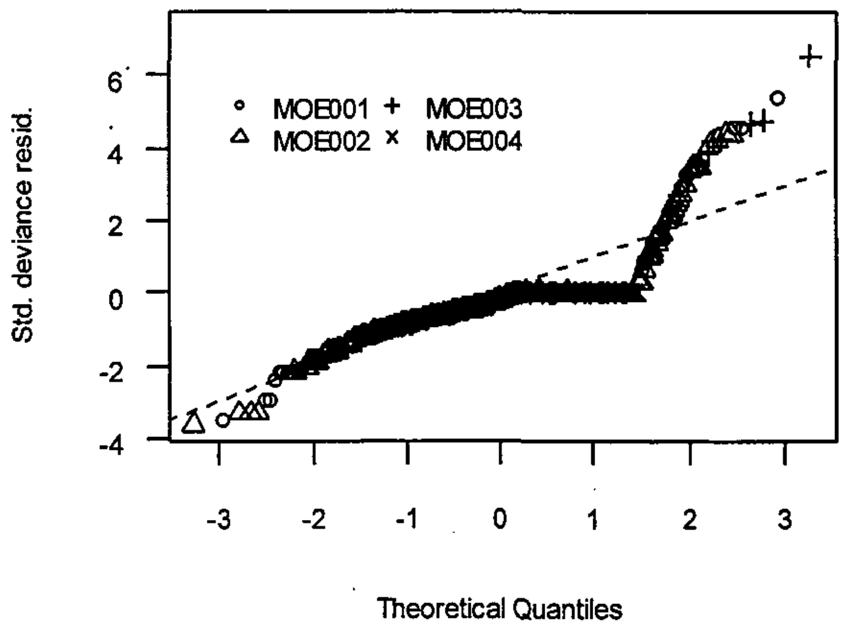


Figure 19: Residual plots from standardisation model for CRA 7. The predicted values are in log space.

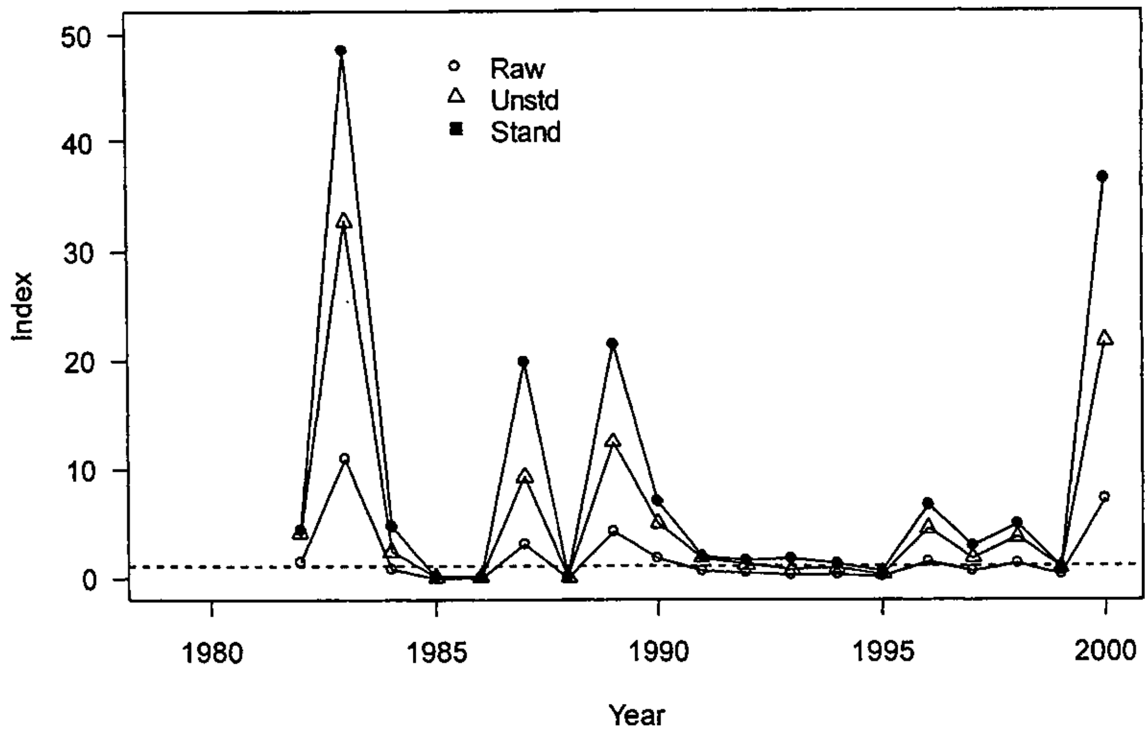


Figure 20: Comparison of settlement indices for CRA 7 derived by different methods. 95% confidence intervals on the standardised indices are not shown because they are so large.

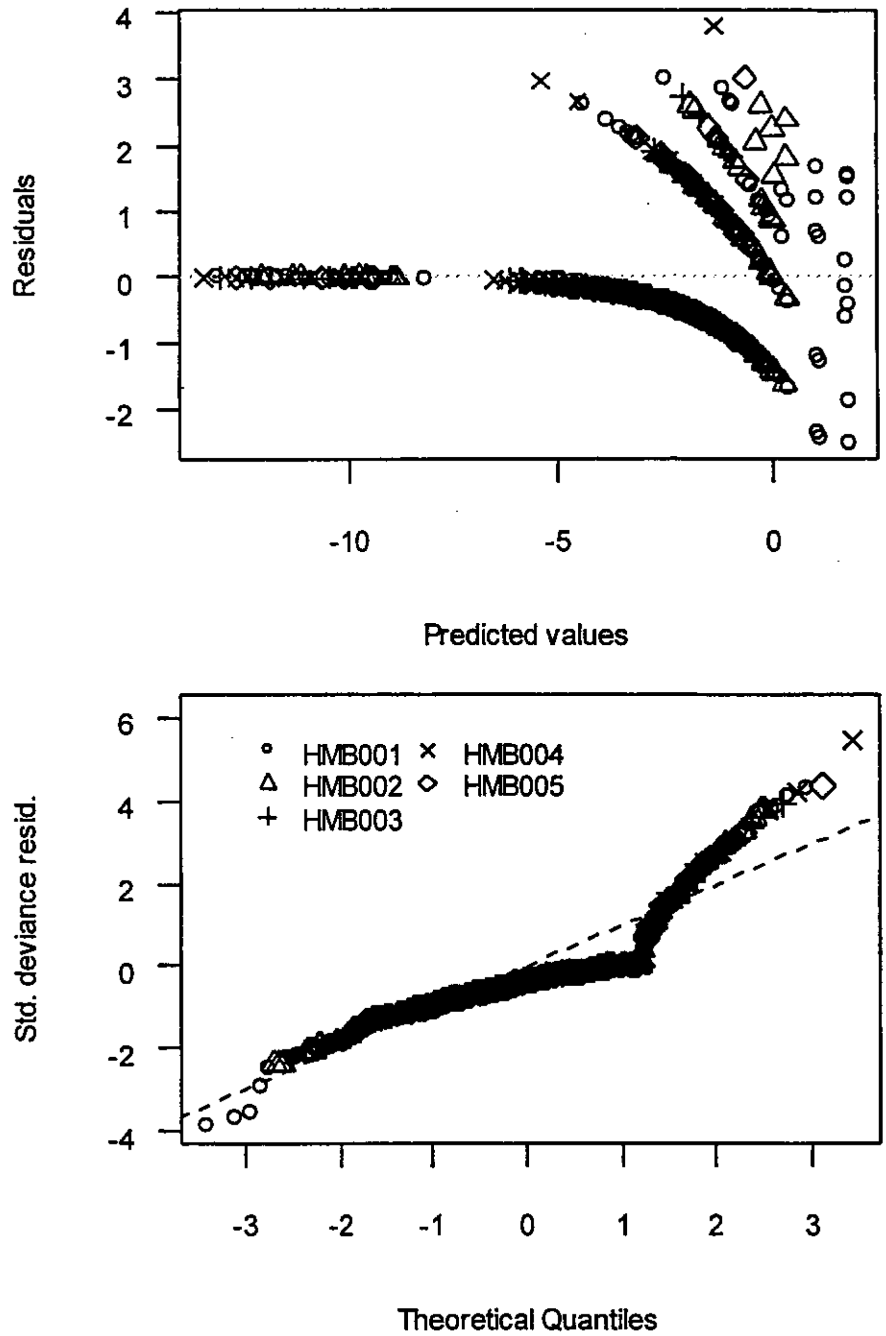


Figure 21: Residuals plots from standardisation model for CRA 8S. The predicted values are in log space.

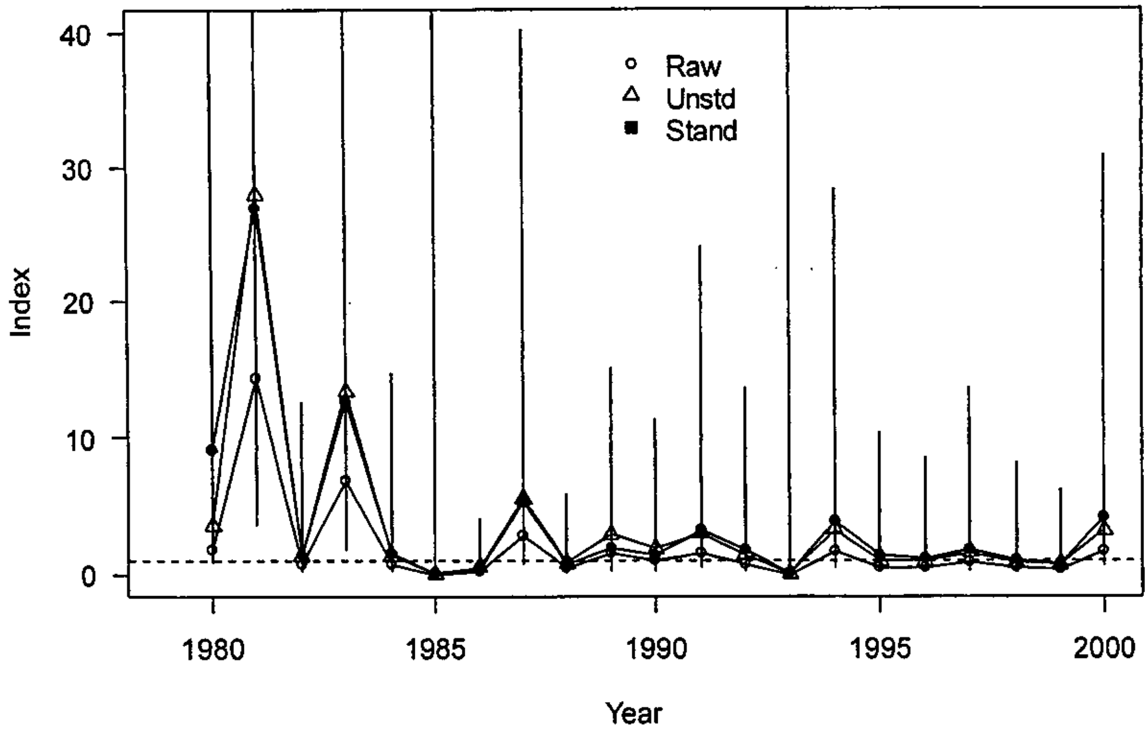


Figure 22: Comparison of settlement indices for CRA 8S derived by different methods. Vertical bars on standardised indices represent 95% confidence intervals.

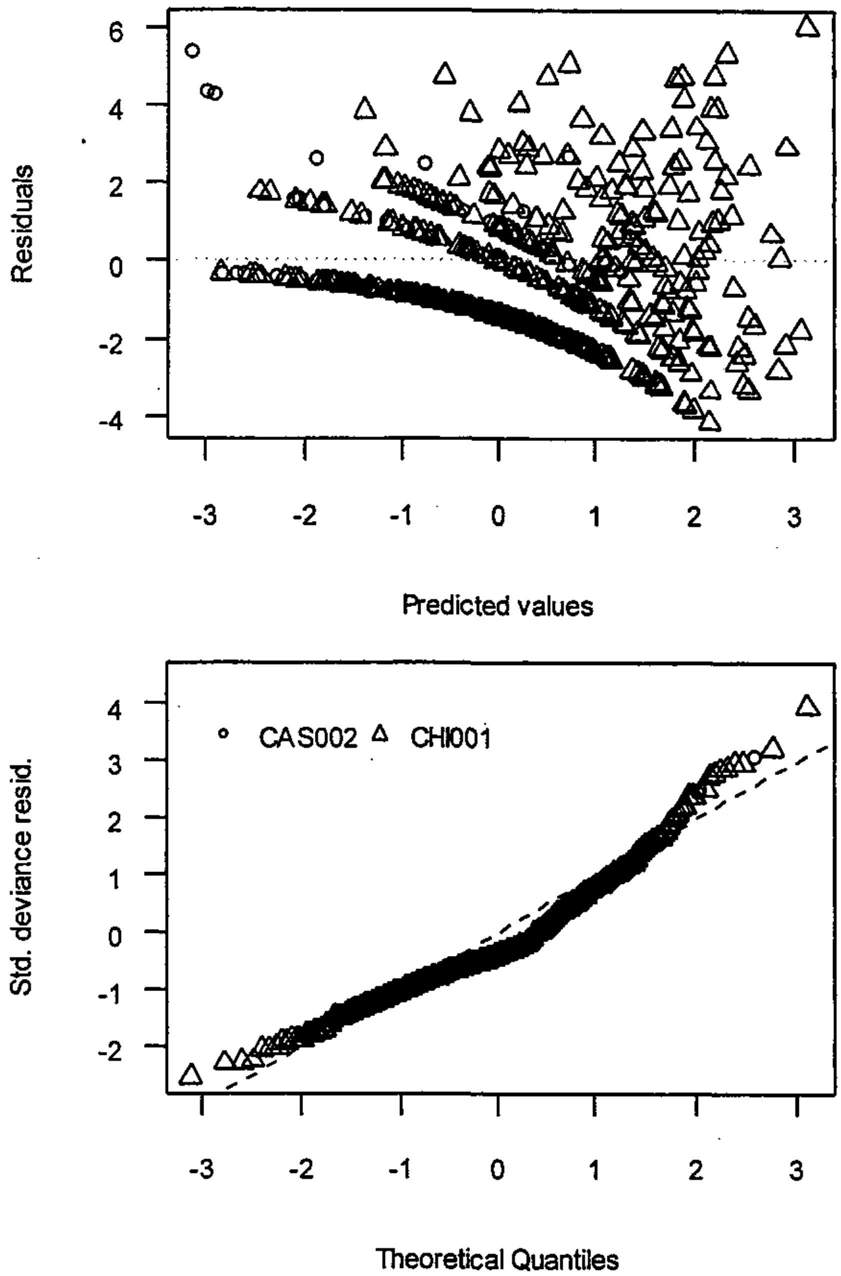


Figure 23: Residuals plots from standardisation model for CRA 8F. The predicted values are in log space.

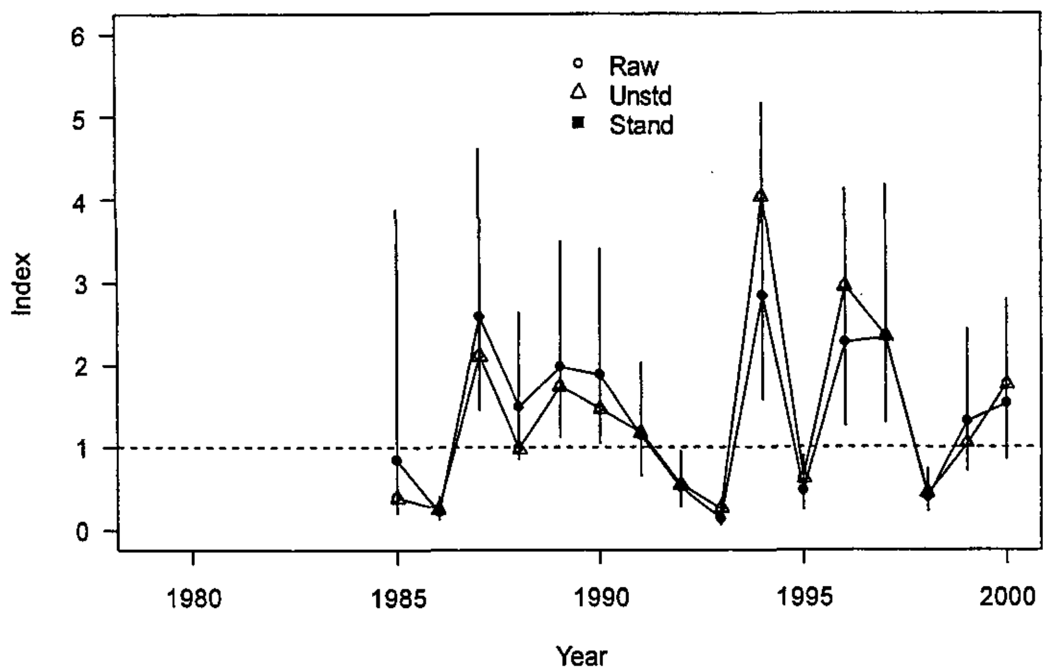


Figure 24: Comparison of settlement indices for CRA 8F derived by different methods. Vertical bars on standardised indices represent 95% confidence intervals.

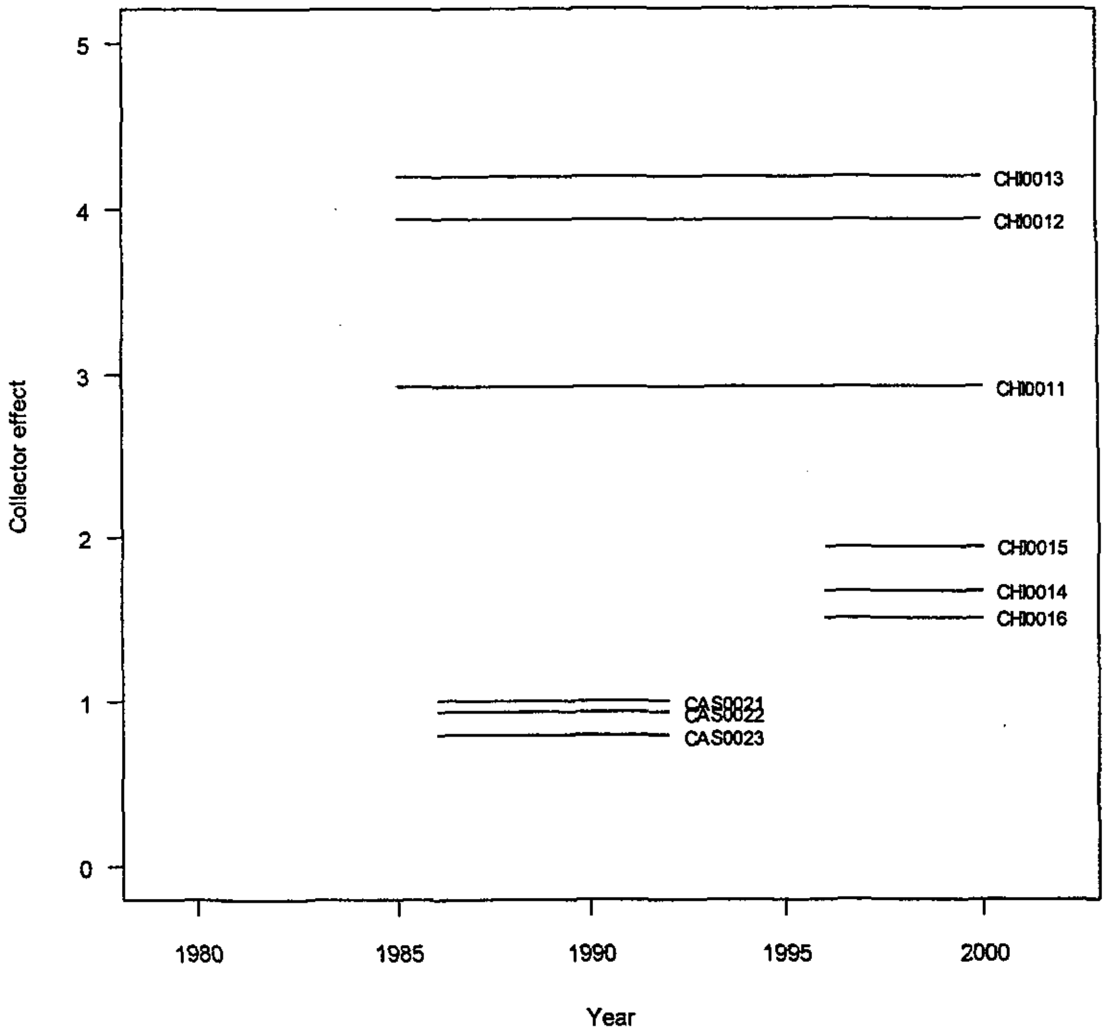


Figure 25: Estimated collector effects for CRA 8F versus the period that the collector was sampled. Collectors are labelled using a concatenation of site and collector number. Effects are relative to collector 1 at CAS002 (labelled CAS0021).

8. APPENDIX

Table A1: Corrections made to puerulus collector data from the *rocklob* database.

Group	Date checked	Collector number	Apparent error	Description of correction
CPT001	04/09/2000	1	Duplicate entries both with catch = 0	One duplicate removed
CPT001	04/09/2000	2	Duplicate entries both with catch = 0	One duplicate removed
CPT001	04/09/2000	3	Duplicate entries both with catch = 0	One duplicate removed
CPT001	04/09/2000	4	Duplicate entries both with catch = 0	One duplicate removed
CPT001	04/09/2000	5	Duplicate entries both with catch = 0	One duplicate removed
CPT001	04/09/2000	6	Duplicate entries both with catch = 0	One duplicate removed
CPT001	04/09/2000	7	Duplicate entries both with catch = 0	One duplicate removed
CPT001	04/09/2000	8	Duplicate entries both with catch = 0	One duplicate removed
JKB003	16/03/2001	1	Collector number entered as 1 instead of 3. Both duplicate had catch = 0	Changed one of the duplicate collector numbers to 3
KAI001	19/02/2001	3	Duplicate entries, one with catch of 0, the other with catch of 2	Duplicate with catch=0 removed
KAI002	19/02/2001	3	Duplicate entries both with catch = 0	One duplicate removed
WTN001	29/09/2000	2	Collector number entered as 2 instead of 1. Both duplicate had catch = 0	Changed one of the duplicate collector numbers to 1

Table A2: List of samples excluded from standardisation model for CRA 3.

Group	Collector No.	Year	Month	Puerulus
GIS001	1	1992	7	184
GIS001	1	1993	7	7
GIS001	1	1993	4	46
GIS001	2	1993	4	32
GIS001	2	1998	6	164
GIS001	2	1999	1	17
GIS001	3	1988	7	105
GIS001	3	1992	7	112
GIS001	3	1996	7	94
GIS001	5	1988	6	8
GIS001	5	1993	8	53
GIS001	5	1996	7	214
GIS001	5	1998	7	5
GIS001	5	1999	1	22
GIS002	4	1993	11	25
GIS003	3	1994	8	55
GIS003	4	1994	9	21
GIS005	3	1985	8	52
GIS005	3	1986	7	74
GIS007	6	1979	8	43

Table A3: List of samples excluded from standardisation model for CRA 4.

Group	Collector No.	Year	Month	Puerulus
CPT001	9	1998	5	25
CPT001	4	1998	2	22
CPT001	7	1995	1	18
CPT002	4	1998	3	20
CPT001	5	1990	12	17
CPT001	5	1984	2	25
NAP002	3	1998	8	0
NAP002	1	1998	8	0
NAP002	2	1997	7	6
NAP002	3	1997	8	60
NAP002	2	1997	8	58
NAP003	3	1995	10	7
NAP002	1	1991	6	12
NAP002	3	1991	9	53
NAP002	2	1991	9	37
NAP002	1	1991	9	52
NAP002	2	1991	6	7
NAP002	3	1991	5	7
NAP002	2	1991	5	5
NAP002	1	1991	5	8
NAP002	3	1991	6	18
NAP002	2	1992	4	97
NAP002	1	1992	3	90
NAP002	1	1996	7	121
NAP002	3	1996	2	67
NAP002	3	1995	2	39
NAP002	2	1993	12	39
NAP002	2	1994	3	37
NAP002	3	1994	4	68
NAP002	1	1993	12	49
NAP002	2	1994	12	31
NAP002	1	1994	6	4
NAP001	3	1980	7	24
NAP001	3	1980	6	25
NAP001	6	1994	8	16
NAP001	1	1994	8	17
NAP001	4	1994	8	20
NAP001	4	1991	6	25
NAP001	5	1991	6	26
NAP001	3	1991	6	29
NAP001	2	1991	6	52
NAP001	1	1991	6	39
WTN001	2	2000	4	12
WTN001	1	2000	4	11
WTN001	3	1997	7	24
WTN001	2	1997	7	23
WTN001	1	1997	7	48
NAP004	1	1991	8	33
NAP004	1	1991	7	49

NAP004	2	1991	9	26
NAP004	2	1992	2	0
NAP003	2	1998	6	20
NAP004	2	1996	6	68