Ministry for Primary Industries
Manatū Ahu Matua

Data for the 2014 stock assessment of red rock lobsters (*Jasus edwardsii*) in CRA 1

New Zealand Fisheries Assessment Report 2015/37

P.J. Starr
P.A. Breen
D.N. Webber

ISSN 1179-5352 (online)
ISBN 978-0-908334-93-3 (online)

July 2015

New Zealand Government

Growing and Protecting New Zealand

Requests for further copies should be directed to:

Publications Logistics Officer
Ministry for Primary Industries
PO Box 2526
WELLINGTON 6140

Email: brand@mpi.govt.nz
Telephone: 0800 00 83 33
Facsimile: 04-894 0300

This publication is also available on the Ministry for Primary Industries websites at:
http://www.mpi.govt.nz/news-resources/publications.aspx or somewhere analogous
http://fs.fish.govt.nz go to Document library/Research reports

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Starr, P.J.; Breen, P.A.; Webber, D.N. (2015). Data for the 2014 stock assessment of red rock lobsters (*Jasus edwardsii*) in CRA 1.

***New Zealand Fisheries Assessment Report 2015/37*. 39 p.**

This document presents data used in the 2014 stock assessment and management procedure evaluation for rock lobsters in CRA 1. Data sets described in this report include catch estimates for all sectors of this fishery, standardised CPUE indices by season, length frequencies, and tag-recapture data. A consideration of the status of CRA 1 as a unit stock, arising from observations of spatial heterogeneity in some of the CRA 1 data sets, is presented in an appendix.

Catch estimates are provided for the commercial, recreational, customary and illegal fisheries, collated by year to 1978 and then by season (spring-summer and autumn-winter), and by size-limited and non-size-limited fisheries. Recreational catch estimates were available from telephone/diary surveys conducted in 1994 and 1996, from a 2011–12 large scale multi-species survey conducted using a population-based survey methodology and a ramp/effort-based survey conducted in 2013–14. A series of recreational catch estimates beginning in 1979 was constructed by assuming that recreational catch was proportional to spring-summer CPUE, a procedure that has been used in all recent rock lobster stock assessments.

CPUE was standardised for the spring-summer and autumn-winter seasons. The F2 algorithm, which uses a truncated distribution of "vessel correction factors" to adjust estimated catches to final catch, was used to prepare the catch and effort data. The destination codes "X" (discarded at sea) and "F" (Section 111 recreational catches) were added to the destination code "L" (landed to an LFR) to obtain the final catch total for scaling the estimated catches.

Length frequency data were available from both observer catch sampling and voluntary logbook programmes. These were collated by data source and by season, and the document describes how the various records were weighted. Tag-recapture data provide information on growth rates for each sex. The document describes this data set.

This work was conducted by a stock assessment team contracted by the New Zealand Rock Lobster Industry Council Ltd.

1. INTRODUCTION

This work addressed parts of Objectives 3 and 4 of the Ministry for Primary Industries (MPI) contract CRA2012-01B. This three-year contract, which began in April 2013, was awarded to New Zealand Rock Lobster Industry Council Ltd. (NZ RLIC Ltd.), who sub-contract Objectives 3 and 4 to the authors of this report.

Objective 3 - CPUE and decision rules: To update the standardised CPUE analysis from all lobster QMAs and report on the operation of current decision rules.

Objective 4 - Stock assessment: To estimate biomass and sustainable yields for rock lobster stocks.

The National Rock Lobster Management Group (NRLMG) determined that both CRA 1 and CRA 3 should be assessed in 2014. Data were compiled for both stocks by a team comprising Paul Starr, D'Arcy Webber and Paul Breen. CRA 1 was then assessed by Paul Starr and D'Arcy Webber, and CRA 3 was assessed by Vivian Haist, Paul Breen and Charles Edwards, with close communication and discussion between the two teams. New graphic routines were developed by D'Arcy Webber and Charles Edwards. This document is limited to the data for CRA 1 and describes catches – including commercial, recreational, customary and illegal – CPUE, length frequencies, and tag-recapture data. Appendix A and Appendix B document formal data requests to Ministry for Primary Industries (MPI) for non-commercial catch information and the associated MPI response. Appendix C considers the status of CRA 1 as a unit stock, given observations of spatial heterogeneity in some of the CRA 1 data sets.

The previous stock assessment of CRA 1 was in 2002 (Starr et al. 2003). This is the first time that operational management procedures have been developed for CRA 1.

Decisions on data and modelling choices were discussed and approved by the Rock Lobster Fishery Assessment Working Group (RLFAWG). For definitions of technical terms used here see the Glossary in the CRA 3 assessment report (Haist et al. 2015).

CRA 1 extends from Kaipara Harbour on the west coast to the Waipu River, south of Bream Bay and Whangarei on the east coast (Figure 1). This QMA includes the Three Kings Islands, designated with a separate statistical area (901). Commercial fishing occurs on both sides of the North Island, as well as at the Three Kings. A TAC has never been set for CRA 1 because the TACC has remained unchanged since the early 1990s, before the passage of the 1996 Fisheries Act (Table 1). Commercial landings have remained at or near the 131 t TACC since the early 1990s (Table 1). In the 2013–14 fishing year, there were 14 vessels operating in CRA 1, a total that has remained relatively unchanged since the early 2000s (Starr 2015). There is significant Iwi involvement in quota share ownership and fishing and rock lobsters have great cultural significance to local Maori. The commercial harvest has an approximate landed value of $9.4 million based on an average port price of $72 000/tonne. CRA 1 landings are shipped to Leigh and to Auckland for processing and export.

2. CATCH DATA

For commercial catches, the fishing year and calendar year were the same before 1979. From 1979 onwards, the fishing year has been April through to March (Breen et al. 2001). Reported annual commercial catches from 1945–1978, summarised by calendar year, were obtained from sources described in Bentley et al. (2005). From 1 January 1979 through to 31 March 1986, catches were taken from monthly data summarised by fishing year from the Fisheries Statistics Unit (FSU), a version of which is now held by MPI. The three months of catch from January through to March 1979 were added to the 1978 annual total to ensure that no catch was lost when switching from calendar year to fishing year.

For 1 April 1986 through to 30 March 1988, monthly reported catch totals from all of New Zealand were obtained from Quota Management Returns (QMRs), maintained by MPI. Because catch estimates for individual QMAs were not available for this period, these total NZ catches were divided into QMA catches based on the proportional landings reported on FSU forms. From 1 April 1988 through to 30 September 2001, catches were summarised from monthly QMRs from each QMA. The QMRs were replaced by Monthly Harvest Returns (MHRs) on 1 October 2001, but the same information is available from these newer forms.

There is uncertainty in the quality of the catch estimates in the years before 1979, but catches in the 1980s were collected when the FSU system was operating and there is confidence in the quality of these estimates. Catch estimates generated from the FSU data available to the stock assessment team are consistent with published historical catch estimates from the FSU system.

Annual commercial catches in CRA 1 averaged 130 t/year between 1945 and 1978, with a 9-year period in the late 1960s and early 1970s when catches ranged from 190 t to 356 t (Figure 2). CRA 1 commercial catches were also high (174–232 t) in the period leading up to the introduction of rock lobster into the QMS (1980–1989), with catches peaking at 232 t in 1983–84 and averaging 200 t/year during that decade. Commercial catches in CRA 1 were less than the TACC until 1993–94, when the TACC was reduced to its current level. Landings have since closely matched the TACC (Table 1, Figure 3).

2.1 CRA 1 Recreational catch

Six annual recreational catch estimates based on survey methodology are available for CRA 1 (

Table 2), although two of these estimates (Kingett Mitchell National Surveys in 2000 and 2001 – Boyd & Reilly 2004; Boyd et al. 2004) have never been accepted by the RLFAWG because they were thought to be biased (unpublished minutes: Recreational Technical Working Group [Auckland NIWA, 10–11 June 2004]).

A recently completed national recreational survey (Wynne-Jones et al. 2014) provided an estimate of the CRA 1 recreational catch for 1 October 2011 through to 30 September 2012. Most of the recreational catch is taken during the spring-summer season (SS, October through to March), so this estimate was assigned to the 2011–12 fishing year. The RLFAWG has the most confidence in this estimate among the available recreational catch estimates. A further CRA 1 recreational survey. based on ramp interviews and estimating associated effort, was executed in 2013–14, extending from Rangiputa to Mangawhai Heads and thereby covering most of Areas 903 and 904 (see Figure 1, Holdsworth, pers. comm.). Holdsworth (pers. comm.) estimated this area to represent 70% of the total CRA 1 recreational catch, with the final estimate extrapolated to all of CRA 1 using this proportion.

MPI were unable to provide estimates of alternative current and historical recreational catches and an appreciation of their uncertainty (see Appendix A and Appendix B).

The recreational catch vectors prepared for this assessment assume that recreational catch is proportional to the SS abundance as reflected by SS CPUE. In most other QMAs (e.g., CRA 2, CRA 3, CRA 4, CRA 7, CRA 8 and CRA 9), the standardised SS CPUE for the entire QMA was used to estimate the relative size of the recreational catch. However, in CRA 1, the arithmetic SS CPUE (Eq.1 in Starr 2015) from Areas 903 and 904 was used because the majority of the recreational fishery takes place in these statistical areas, located on the east coast of the North Island (Holdsworth, pers. comm.). These areas have lower commercial CPUE than the remaining three CRA 1 statistical areas and do not show the large increase in CPUE, starting in the early 2000s that is seen in the other areas (compare the black and blue trajectories in Figure 4). The arithmetic SS CPUE vector was calculated for combined Areas 903 and 904 using data prepared with the F2-LFX algorithm (see Starr 2015), then scaled to the mean catch from the 1994, 1996, 2011 and 2013 recreational surveys (Figure 4) by calculating the ratio of the survey catch estimate in each of these years to the respective SS CPUE. The mean of these ratios was then applied to the SS CPUE for all years from 1979–2013. Catch in

1945 was assumed to be 20% of that estimated for 1979 and was scaled proportionally for 1946–78. This procedure is analogous to that used in recent assessments in other QMAs.

The resulting base case recreational catch vector is shown in Figure 4, after adding to each year the maximum reported recreational landings (2.94 t) from commercial vessels under Section 111 of the Fisheries Act. Recreational catch was split between seasons with 90% assumed taken in the SS and the remainder in AW. The mean annual recreational catch for the period 1979–2013 from this vector was 44 t. The recreational vector based on the standardised SS CPUE for all of CRA 1 was used in one sensitivity trial.

2.2 CRA 1 Customary catch

MPI were asked to provide estimates of current and historical customary catches, and an appreciation of their uncertainty (see Appendix A). The provided information was incomplete (see Appendix B). MPI advised that a constant customary catch of 10 t should be assumed. This was split between seasons with 90% assumed taken in the SS.

2.3 CRA 1 Illegal catch

MPI were asked to provide estimates of current and historical illegal catches, and an appreciation of their uncertainty (see Appendix A). MPI were also asked to provide an estimate of the proportion of illegal catch that was eventually reported as legal catch.

MPI suggested that 72 t/year should be assumed for CRA 1 from 2001, which resulted in a constant illegal catch of 72 t/year from 2002 to 2013. Missing years between 1990 and 2000 (Table 3) were filled in by interpolation. The MPI Compliance estimates for CRA 1 illegal catch did not estimate that any illegal catch was eventually reported to the QMS (category 'R' in

Table 3). This category was assumed to be zero for CRA 1 and consequently there was no transfer of catch from the legal commercial to the illegal category (as is done in other QMAs).

The following procedure was used to estimate illegal catch:

- Starting with the estimates of export discrepancies for all of New Zealand for 1974–80 (McKoy, unpublished data), the CRA 1 illegal catches for each of these seven years were estimated from the ratio of the reported commercial catch in CRA 1 relative to the total New Zealand reported commercial catch for the same years.
- The average ratio of the export discrepancy catch to the reported commercial catch was calculated for the period 1974–80. This ratio was used to generate an illegal catch estimate for all years with no data (1945–73 and 1981–89) by multiplying the reported catch by the average ratio. This approach was agreed by the RLFAWG on 15 Aug 2002.
- Beginning with 1990, the first year for which estimates were provided by QMA, illegal catch was based on MPI Compliance estimates (

- Table 3). For years without Compliance estimates, the level of illegal catch was interpolated between estimates.
- Estimates for "commercial illegal reported" (shown as "reported" in

- Table 3), when present, were used to split the illegal catch into the "SL illegal" and "NSL illegal" categories.
- We assumed that both the reported and unreported annual illegal catches were distributed between seasons in the same proportion as the commercial catch for each year.

The illegal catch estimates for the base case stock assessment and two alternative sensitivity runs (half and double illegal) are shown in Figure 5.

2.4 Size-limited and non-size-limited catch by season

The size-limited (SL) catch is taken under the MLS regulations and the restriction on landing berried females; it is the sum of the commercial and recreational catches minus the reported illegal catches (of which there are none for CRA 1). The non-size-limited (NSL) catch is taken without regard to those restrictions; it is the sum of reported and unreported illegal catches and the customary catches. Annual commercial catches were divided into seasons beginning in 1979 based on the seasonal distribution of the FSU and QMR/MHR data. Illegal catches were divided between seasons in the same proportions as commercial. It was assumed that 90% of the customary and recreational catches were taken in SS. These catches are shown in Figure 6 and Table 4. The proportion of the commercial catch taken in the autumn-winter season increased to near 80% in the late 1990s and early 2000s, and then dropped to around 50–60% (Figure 7).

3. CATCH RATES

3.1 CRA 1 Seasonal Standardised CPUE Indices

Catch and effort data were obtained from MPI in September 2014 (replog 9650), loaded into the CRACE database and processed using standard error checks (Bentley et al. 2005). Data spanned the period 1 April 1979 through to 31 March 2014 and originated from the FSU and CELR data systems.

Data preparation used the "F2" algorithm, which corrects the monthly estimated catch taken by a vessel in a statistical area using a truncated distribution of "vessel correction factors" (*vcf*: ratio of landed catch to estimated catch for one vessel in a year) (Starr 2015). The F2 algorithm used 0.8 and 1.2 as lower and upper bounds for the observed *vcf* distribution, discarding data from vessels outside these bounds in each year. The F2 algorithm scales the estimated catches from each vessel to the combined "L" (LFR) landings, the "X" (discarded to sea) and "F" (Section 111 recreational catch) destination codes using the annual *vcf* for that vessel.

The CPUE standardisation procedure used sequential six-month periods as the time-dependent explanatory variable. Three other explanatory variables were available for this analysis: [month] of capture, [statistical_area] of capture and [vessel]. The first two variables were offered as categorical explanatory factors[1], but [vessel] was not used, even though Starr (2012) showed that [vessel] was potentially an important factor. Vessel codes have not been consistently maintained between the FSU and CELR data systems, so using vessel would require estimating separate CPUE series unless the vessel codes could be reconciled[2]. Using [month] and [statistical_area] as explanatory variables is consistent with analyses done for all previous rock lobster stock assessments.

The number of records available by year for this analysis showed a sharp drop between 1994–95 and 1995–96 in the SS season while the number of AW records stayed relatively strong over the 35 years of observations (Table 5). The final model explained 42% of the deviance, with most of the explanatory power lying in the statistical area variable, followed by the sequential period variable; the month variable had little explanatory power (Table 6).

CRA 1 CPUE indices are shown in Figure 8 and Table 7. The standardised CPUE had generally the same trends as the arithmetic CPUE (annual catch divided by annual effort) and the unstandardised CPUE (geometric mean of the monthly records), except for the high CPUE observations in the late

[1] These analyses estimated separate [month] effects in each half-year period by using as the reference month, the month in each period with the lowest standard error (Starr 2015).

[2] Another potential problem with estimating a constant [vessel] coefficient would be the lack of continuity in skippers on the same vessel between 1979–80 to the present.

2000s, when the standardisation procedure lowered the relative index because the high catch rates came from Area 901 which had an expectation of high CPUE (Figure 9). The diagnostics for this model show some minor departures from the log-normal assumption at the tails of the residual distribution (Figure 10). CPUE reached a low point around 1994 and then gradually increased to a peak in the late 2000s. After that, the AW and SS series diverge, with the AW series peaking in 2012–13 and the SS series dropping from its 2008–09 peak.

3.2 Historical catch rate (CR)

Monthly catch and effort (days fishing by a vessel) data from 1963–73 were summarised by Annala & King (1983) and used to calculate unstandardised catch per day for each calendar year from 1963 to 1973 (Figure 11).

4. LENGTH FREQUENCIES (LFs)

The two sources of length frequency data are voluntary logbooks and observer catch sampling. Data were extracted in September 2014. Data were summarised by year and season over three sex categories: male, immature female and mature female. The logbook data covered 1993–1995 and 2011–2013 (Table 8). The observer catch sampling data covered every year from 1997 to 2013 (Table 8). In CRA 1, the observer catch sampling dataset has greater numbers of lobsters measured.

4.1 LF records and record weighting

Each data record contained all the data from either the AW or SS season in one year. After elimination of logbook records with fewer than three participants and records with fewer than 100 fish measured, there were 39 records, with 31 from the observer programme. One record from the logbook programme (1993 AW) was later dropped because of the extremely large residuals generated by this sample, leaving 38 records for use in the CRA 1 stock assessment.

Record fields were:

- QMA (all CRA 1)
- fishing year
- season (coded 1 for autumn winter AW April–September, 2 for spring summer SS)
- source (in these data: coded 1 for logbooks and 2 for observers; there were no data from market sampling or other old codes)
- a relative weight field for the record (w), described below
- the total number of lobsters measured
- 31 fields, representing the relative proportion (see below) of males measured by sex class, where the first size class is 30–31.9 mm tail width (TW), the next is 32–33.9 mm, etc.
- 31 fields for the relative proportion of immature female numbers measured
- 31 fields for the relative proportion of mature female numbers measured.

Records represented 122 to 6882 lobsters measured and averaged 1929 lobsters. The proportion of males ranged from 22% to 68%, averaging 47%, immature females from 0% to 17%, averaging 4%, and mature females from 18% to 78%, averaging 48%.

Each record comprised measurements taken from various months within the period and from various statistical areas within the QMA. For each month/area cell, the proportion in each length and sex class was calculated as:

$$p^{g}_{m,a,s} = \frac{N^{g}_{m,a,s}}{\sum_{g}\sum_{s} N^{g}_{m,a,s}}$$

where g indexes sex, s indexes size group, m indexes month, a indexes statistical area and $N^{g}_{m,a,s}$ represents the number-at-length for each sex in the month/area cell.

Proportions-at-length/sex from the month/area cells were combined to form a record using their "representativeness" , i.e. using the catch in the month/area cell ($C_{m,a}$) compared with the total catch for the season:

$$P^{g}_{s} = \frac{\sum_{m}\sum_{a}\left(C_{m,a}\, p^{g}_{m,a,s}\right)}{\sum_{m}\sum_{a} C_{m,a}}$$

where P^{g}_{s} is the proportion-at-length and sex in the record. The model re-normalises these to sum to 1 across each sex for some of the fitting procedure options (see Starr et al. 2014).

A relative weight (w) was assigned to each data record within the dataset which combines the representativeness of each month/area cell, the cube root of the number of fish measured ($N_{m,a}$) and the cube root of the number of days sampled ($D_{m,a}$):

$$w = \sum_{m}\sum_{a} \frac{C_{m,a}\sqrt[3]{N_{m,a}}\sqrt[3]{D_{m,a}}}{\sum_{m}\sum_{a} C_{m,a}}$$

The individual weights given to records ranged from 0.013 to 7.50 and averaged 2.91. These weights were further modified during the model fitting process after the length data were integrated with the other data sets used in the model (e.g., see Starr et al. 2014).

4.2 Proportion by sex

Sex proportions were calculated from the normalised data records. Immature females were always in low proportion (Figure 12). Males tended to comprise about 60% of the sampled population in most AW seasons, but the proportion of males dropped to between 20 and 40% in the corresponding SS seasons.

4.3 Mean length

These records were used to calculate mean length by sex and season, with the mean length of AW males and females being relatively consistent over the period of data (Figure 13). AW Males averaged slightly larger than 60 mm TW and AW females averaged between 65–70 mm TW, with both sexes having no overall trend. The mean lengths observed in the SS were more variable, with a suggestion that the female TW had an increasing trend during the mid- to late 2000s, with mean lengths exceeding 70 mm TW.

4.4 Binning

Although the model contains size bins from 30 to 92 mm TW, few fish as small as 30 mm are measured, and very few large fish are measured, especially immature females, leading to many cells with zero observations. For sex/size bins with few observations, the model would be comparing many

zero observations with very small predictions, resulting in a large population of very small residuals that distort the diagnostics, as well as taking up computing time.

Bins at both ends of the range for each sex were therefore combined into "plus" and "minus" bins. The model was therefore given the length range of bins for each sex that contained a reasonable number of observations. These bins were determined arbitrarily by inspecting the proportion of cells in each sex/size bin that contained a minimum proportion of normalised observations. The threshold was set at 0.001, but the procedure was not very sensitive to the chosen value. Figure 14 shows the cumulative distribution of sex/size bins, with 40% of the bins equalling zero.

Figure 15 was used to suggest appropriate binning for each sex category. In the CRA 1 stock assessment, males were fitted for 32–90 mm TW, mature females for 32–90 mm TW and immature females for 32 to 72 mm. For each sex, smaller and larger bins were added to the terminal bin to form minus and plus bins.

4.5 Length frequency (LF) distributions

The distributions of the LF data by sex are shown for each data record included in the stock assessment, where a "data record" represents the summarised frequency in a sequential six-month season by data source (logbook or observer) (Figure 16).

5. TAG-RECAPTURE DATA

Tag-release and recapture data for CRA 1 were extracted in September 2014 and processed with purpose-built software developed by Nokome Bentley (Trophia, unpublished). This software matches recaptures to releases, treating re-recaptures as having been released from the previous recapture. It calculates TW from CL where necessary, using relations developed in the Breen et al. (1988) morphometrics programme. It discards records with the following characteristics: missing tail widths at release or recapture, records with inappropriate sex codes or apparent sex changes, records with apparent shrinkage greater than 10 mm or with an increment greater than 40 mm and records with time at liberty less than 31 days.

The screened MPI tag-recapture data extract for CRA 1 comprised 1675 records: 714 males and 961 females (Table 9). Sizes at release by sex from the combined data set are shown in Figure 17. The records peak near the SS MLS (54 mm TW) for males while there are substantial numbers of female releases above the MLS (60 mm TW).

Releases were made in 1975–79 using western rock lobster tags and from 2000 to 2013 with HallPrint tags (Table 9). The early releases had size recorded in carapace length and the later releases used tail width. Almost all the tags were released in Area 939, located on the west coast, with the balance being released in Area 901 (Three Kings) (Table 10). Nearly all tags remained in the area of release (Table 11).

Times at liberty varied from 32 days to 3730 days (i.e., more than 10 years), with the median at 313 days, 62% were at liberty for less than one year and 87% at liberty less than 2 years. A few lobsters were re-released 4 or more times (Table 12), but 86% of records were from fish that were not re-released. Condition codes were nearly all zero or missing.

Increments (size at recapture minus size at release) ranged from -9.5 to 36.8. For exploration only (not for use by the model), increments were "annualised" based on days at large:

$$\Delta l_i^{ann} = \frac{d_i \left(l_i^{rec} - l_i^{rel} \right)}{365}$$

where Δl_i^{ann} is the annualised increment for the i[th] record, l_i^{rel} and l_i^{rec} are the sizes at release and recapture and d_i is the number of days at liberty. Annualised increments ranged from -31 to 38 mm, and are shown for males and females in Figure 18.

6. SPATIAL HETEROGENEITY IN CRA 1

The RLFAWG noted that there was heterogeneity in the observed catches and catch rates between the two east coast statistical areas (Areas 903 and 904) and the remaining three statistical areas located in the Three Kings (Area 901) and the west coast (Areas 902 and 939) (Appendix C). This difference implied possible differences in growth rates and exploitation history. However, a comparison of the available length frequency distributions, summarised into these two regions, indicated that the population distributions across the full range of sizes were substantially similar. This was interpreted as indicating that the differences in relative abundance were most likely due to productivity differences between the two regions rather than differences in exploitation history or in growth (Appendix C).

7. ACKNOWLEDGEMENTS

This work was conducted under Objectives 3 and 4 of MPI contract CRA2012-01B, awarded to the New Zealand Rock Lobster Industry Council Ltd. We thank Daryl Sykes for encouragement, Helen Regan and Fiona MacKay for logistic support, Rosie Hurst, Victoria McIntyre, Julie Hall, Pauline, Emma and others at NIWA for accommodation and support and Kevin Sullivan for his advice and support.

8. REFERENCES

Annala, J.H.; King, M.R. (1983). The 1963–73 New Zealand rock lobster landings by statistical area. *Fisheries Research Division Occasional Publication, Data Series 11*. 20 p.

Bentley, N.; Starr, P.J.; Walker; N.A.; Breen, P.A. (2005). Catch and effort data for New Zealand rock lobster fisheries. *New Zealand Fisheries Assessment Report 2005/49*. 49 p.

Boyd, R.O.; Gowing, L; Reilly, J.L. (2004). 2000–2001 national marine recreational fishing survey: diary results and harvest estimates. Final Research Report of Ministry of Fisheries project REC9803. (Unpublished report held by the Ministry for Primary Industries, Wellington.)

Boyd, R.O.; Reilly, J.L. (2004). 1999–2000 National Marine Recreational Fishing Survey: harvest estimates. Final Research Report for the Ministry of Fisheries Project REC9803. 28 p. (Unpublished report held by the Ministry for Primary Industries, Wellington.)

Breen, P.A.; Booth, J.D; Tyson, P.J. (1988). Feasibility of a minimum size limit based on tail width for the New Zealand rock lobster *Jasus edwardsii*. *New Zealand Fisheries Research Technical Report 6*. 16 p.

Breen, P.A.; Starr, P.J.; Bentley, N. (2001). Rock lobster stock assessment for the NSN substock and the combined CRA 4 and CRA 5 areas. *New Zealand Fisheries Assessment Report 2001/7*. 42 p.

Haist, V.; Breen, P.A.; Edwards, C.T.T. (2015). The 2014 stock assessment of red rock lobsters (*Jasus edwardsii*) in CRA 3, and development of new management procedures. *New Zealand Fisheries Assessment Report 2015/28*. 73 p.

Starr, P.J. (2012). Standardised CPUE analysis exploration: using the rock lobster voluntary logbook and observer catch sampling programmes. *New Zealand Fisheries Assessment Report 2012/34*. 77 p.

Starr, P.J. (2015). Rock lobster catch and effort data: summaries and CPUE standardisations, 1979–80 to 2013–14. *New Zealand Fisheries Assessment Report 2015/34*. 109 pp.

Starr, P.J.; Bentley, N.; Breen, P.A.; Kim, S.W. (2003). Assessment of red rock lobsters (*Jasus edwardsii*) in CRA 1 and CRA 2 in 2002. *New Zealand Fisheries Assessment Report 2003/41*. 119 p.

Starr, P.J.; Haist, V.; Breen, P.A; Edwards, C.T.T. (2014). The 2013 stock assessment of red rock lobsters (*Jasus edwardsii*) in CRA 2 and development of management procedures. *New Zealand Fisheries Assessment Report 2014/19*. 76 p.

Wynne-Jones, J.; Gray, A.; Hill, L.; Heinemann, A. (2014). National panel survey of marine recreational fishers 2011–12: harvest estimates. *New Zealand Fisheries Assessment Report 2014/67*. 139 p.

Table 1: Historical landings, TACCs and TACs for CRA 1: 1990–91 to 2014–15. '–': incomplete fishing year or TAC not set.

Fishing Year	Landings	TACC	TAC	Fishing Year	Landings	TACC	TAC	Fishing Year	Landings	TACC	TAC
1990–91	131.1	160.1	–	1999–00	125.7	131.1	–	2007–08	129.8	131.1	–
1991–92	128.3	157.0	–	2000–01	130.9	131.1	–	2008–09	131.0	131.1	–
1992–93	110.5	138.0	–	2001–02	130.6	131.1	–	2009–10	130.9	131.1	–
1993–94	127.4	130.5	–	2002–03	130.8	131.1	–	2010–11	130.8	131.1	–
1994–95	130.0	130.5	–	2003–04	128.7	131.1	–	2011–12	130.4	131.1	–
1995–96	126.7	130.5	–	2004–05	130.8	131.1	–	2012–13	130.9	131.1	–
1996–97	129.4	130.5	–	2005–06	130.5	131.1	–	2013–14	130.2	131.1	–
1997–98	129.3	130.5	–	2006–07	130.8	131.1	–	2014–15	–	131.1	–
1998–99	128.7	130.5	–								

Table 2: Information used to estimate recreational catches for CRA 1.

Category	CRA 1
Catch estimates in numbers	
1994	56 000
1996	74 000
2011	29 739
2013	50 430
Derived values	
1994/1996 SS mean weight (kg) [1]	0.717
1994 catch estimate (t)	40.15
1996 catch estimate (t)	53.06
2011 mean weight (kg) [1]	0.810
2011 catch estimate (t)	24.09
2013 mean weight (kg) [1]	0.810
2013 catch estimate (t)	40.75
CPUE series used for scaling	Area 903/904 unstandardised
Reconstructed catch in 1979 (t)	42.70
20% of 1979 catch (t)	12.55
Maximum Section 111 catch (t)	5.02

[1] estimated from commercial SS catch sampling data using 54 and 60 mm MLS and appropriate years

Table 3: Available estimates of illegal catches (t) by QMA from 1990, as provided by MPI (formerly MFish) Compliance over a number of years. R (reported): illegal catch that will eventually be processed though the legal catch/effort system; NR (not reported): illegal catch outside of the catch/effort system. Cells without data or missing rows have been left blank.

	CRA 1		CRA 2		CRA 3		CRA 4		CRA 5		CRA 6		CRA 7		CRA 8		CRA 9	
Year	R	NR	R	NR	R	NR	R	NR	R	NR	R	NR	R	NR	R	NR	R	NR
1990		38		70		288.2		160.1		178		85	34	9.6	25	5		12.8
1992		11		37		250		30		180		70	34	5	60	5		31
1994		15		70	5	37		70		70		70		25		65		18
1995		15		60	0	63		64		70		70		15		45		12
1996	0	72	5	83	20	71	0	75	0	37	70	0	15	5	30	28	0	12
1997					4	60												
1998					4	86.5												
1999					0	136								23.5		54.5		
2000					3	75		64										
2001		72		88	0	75												
2002					0	75	9	51		40		10		1		18		1
2003					0	89.5			5	47								
2004							10	30										
2005																		
2006																		
2007																		
2008																		
2009																		
2010																		
2011														1		3		
2012																		
2013																		

Table 4: Estimated CRA 1 catches (commercial, recreational including s. 111, illegal and customary) by season. Note that the model does not use two seasons until 1979. Annual estimates are provided in the AW column before 1979.

	Commercial		Recreational		Illegal		Customary		Total	
Year	AW	SS	AW	SS	AW	SS	AW	SS	AW	SS
1945	22.1	–	12.6	–	4.2	–	10.0	–	48.8	–
1946	22.8	–	13.4	–	4.3	–	10.0	–	50.5	–
1947	40.0	–	14.3	–	7.5	–	10.0	–	71.8	–
1948	90.7	–	15.2	–	17.1	–	10.0	–	133.0	–
1949	104.2	–	16.1	–	19.6	–	10.0	–	149.9	–
1950	92.4	–	17.0	–	17.4	–	10.0	–	136.8	–
1951	85.0	–	17.9	–	16.0	–	10.0	–	128.8	–
1952	133.7	–	18.8	–	25.1	–	10.0	–	187.5	–
1953	131.2	–	19.6	–	24.7	–	10.0	–	185.5	–
1954	72.0	–	20.5	–	13.5	–	10.0	–	116.0	–
1955	64.0	–	21.4	–	12.0	–	10.0	–	107.4	–
1956	75.2	–	22.3	–	14.1	–	10.0	–	121.7	–
1957	60.7	–	23.2	–	11.4	–	10.0	–	105.3	–
1958	62.0	–	24.1	–	11.7	–	10.0	–	107.8	–
1959	62.2	–	25.0	–	11.7	–	10.0	–	108.9	–
1960	75.1	–	25.9	–	14.1	–	10.0	–	125.1	–
1961	81.0	–	26.7	–	15.2	–	10.0	–	132.9	–
1962	135.5	–	27.6	–	25.5	–	10.0	–	198.6	–
1963	111.2	–	28.5	–	20.9	–	10.0	–	170.6	–
1964	190.8	–	29.4	–	35.9	–	10.0	–	266.0	–
1965	249.0	–	30.3	–	46.8	–	10.0	–	336.1	–
1966	238.4	–	31.2	–	44.8	–	10.0	–	324.4	–
1967	135.2	–	32.1	–	25.4	–	10.0	–	202.7	–
1968	235.2	–	32.9	–	44.2	–	10.0	–	322.3	–
1969	335.6	–	33.8	–	63.1	–	10.0	–	442.5	–
1970	327.8	–	34.7	–	61.6	–	10.0	–	434.2	–
1971	356.4	–	35.6	–	67.0	–	10.0	–	469.0	–
1972	213.4	–	36.5	–	40.1	–	10.0	–	300.0	–
1973	70.9	–	37.4	–	13.3	–	10.0	–	131.6	–
1974	45.0	–	38.3	–	5.8	–	10.0	–	99.0	–
1975	78.0	–	39.2	–	18.9	–	10.0	–	146.0	–
1976	99.0	–	40.0	–	19.2	–	10.0	–	168.3	–
1977	182.0	–	40.9	–	46.7	–	10.0	–	279.7	–
1978	149.2	–	41.8	–	38.3	–	10.0	–	239.3	–
1979	25.3	89.7	4.3	38.4	2.2	7.8	1.0	9.0	32.8	145.0
1980	32.4	147.4	5.0	45.3	3.7	16.8	1.0	9.0	42.1	218.5
1981	32.5	150.8	5.9	53.0	6.1	28.3	1.0	9.0	45.5	241.1
1982	44.1	178.8	4.6	41.8	8.3	33.6	1.0	9.0	58.0	263.3
1983	57.0	174.7	4.8	43.2	10.7	32.8	1.0	9.0	73.5	259.7
1984	49.6	162.0	4.2	38.1	9.3	30.5	1.0	9.0	64.1	239.6
1985	53.6	165.2	4.7	42.0	10.1	31.0	1.0	9.0	69.3	247.2
1986	62.2	149.2	4.4	39.6	11.7	28.0	1.0	9.0	79.3	225.9
1987	40.3	147.4	4.2	37.9	7.6	27.7	1.0	9.0	53.1	221.9
1988	55.0	123.6	4.5	40.2	10.3	23.2	1.0	9.0	70.8	196.0
1989	43.5	130.5	4.2	38.0	8.2	24.5	1.0	9.0	56.9	202.1
1990	38.4	92.6	3.8	34.3	11.1	26.9	1.0	9.0	54.4	162.8
1991	33.6	94.7	3.2	28.6	6.4	18.1	1.0	9.0	44.2	150.4
1992	27.6	82.9	2.7	24.0	2.7	8.3	1.0	9.0	34.0	124.1
1993	32.5	94.9	3.0	26.9	3.3	9.7	1.0	9.0	39.8	140.5
1994	42.1	87.9	4.3	38.8	4.9	10.1	1.0	9.0	52.2	145.9
1995	65.3	61.5	5.6	50.3	7.7	7.3	1.0	9.0	79.6	128.0
1996	79.0	50.4	4.7	42.2	44.0	28.0	1.0	9.0	128.7	129.7
1997	96.7	32.6	4.7	42.0	53.8	18.2	1.0	9.0	156.2	101.8
1998	95.6	33.1	4.2	37.5	53.5	18.5	1.0	9.0	154.3	98.1
1999	100.5	25.2	3.0	26.6	57.5	14.5	1.0	9.0	162.0	75.3
2000	91.1	39.9	4.1	37.1	50.1	21.9	1.0	9.0	146.3	107.9
2001	98.0	32.6	4.6	41.6	54.0	18.0	1.0	9.0	157.6	101.2
2002	81.9	48.9	3.3	29.5	45.1	26.9	1.0	9.0	131.2	114.3
2003	63.2	65.5	2.9	26.0	35.4	36.6	1.0	9.0	102.5	137.1
2004	72.7	58.1	4.3	39.0	40.0	32.0	1.0	9.0	118.1	138.0
2005	69.8	60.7	3.8	34.1	38.5	33.5	1.0	9.0	113.1	137.3
2006	81.3	49.5	5.3	48.0	44.7	27.3	1.0	9.0	132.4	133.8
2007	79.2	50.7	5.9	53.0	43.9	28.1	1.0	9.0	129.9	140.8
2008	87.6	43.4	4.5	40.3	48.2	23.8	1.0	9.0	141.2	116.5
2009	83.0	47.9	5.1	45.9	45.6	26.4	1.0	9.0	134.8	129.1
2010	71.5	59.4	4.6	41.3	39.3	32.7	1.0	9.0	116.4	142.3
2011	66.6	63.9	4.2	37.8	36.7	35.3	1.0	9.0	108.5	146.0
2012	54.9	76.0	5.7	51.7	30.2	41.8	1.0	9.0	91.9	178.4
2013	67.9	62.3	4.5	40.1	37.5	34.5	1.0	9.0	110.9	145.9

Table 5: Number of vessel/statistical area records by fishing year and season in the dataset used to calculate the CRA 1 seasonal CPUE time series. '–': no data.

	Autumn-winter season						Spring-summer season					
Year	901	902	903	904	939	Total	901	902	903	904	939	Total
79/80	8	17	29	33	13	100	16	22	71	62	51	222
80/81	7	6	30	41	13	97	13	31	50	58	41	193
81/82	6	14	30	21	12	83	7	32	52	35	38	164
82/83	3	13	29	30	21	96	9	36	44	41	45	175
83/84	7	16	24	29	16	92	20	52	31	43	41	187
84/85	12	25	17	22	17	93	16	57	30	56	34	193
85/86	14	21	25	37	23	120	25	40	31	53	36	185
86/87	10	22	22	33	20	107	17	38	47	56	46	204
87/88	7	27	27	27	24	112	18	30	50	43	44	185
88/89	9	11	27	16	6	69	20	30	41	29	30	150
89/90	11	15	20	12	13	71	25	26	29	27	19	126
90/91	16	15	14	17	19	81	31	29	20	29	34	143
91/92	9	13	25	22	22	91	8	23	41	44	43	159
92/93	6	8	11	26	25	76	12	22	15	33	38	120
93/94	10	12	16	33	23	94	20	25	19	39	31	134
94/95	12	13	18	31	14	88	24	18	22	38	20	122
95/96	5	12	15	25	23	80	7	10	17	20	14	68
96/97	6	8	15	29	4	62	3	11	22	23	1	60
97/98	8	7	17	23	6	61	1	4	12	22	1	40
98/99	5	7	11	21	23	67	1	4	9	20	5	39
99/00	13	4	6	17	20	60	3	3	8	17	8	39
00/01	17	4	12	19	23	75	8	3	12	22	4	49
01/02	18	8	11	14	27	78	7	1	11	13	12	44
02/03	19	13	10	10	20	72	12	7	8	13	14	54
03/04	6	10	3	15	24	58	6	13	6	16	19	60
04/05	9	13	4	4	15	45	8	12	7	5	11	43
05/06	11	10	8	5	18	52	12	9	6	10	13	50
06/07	14	10	14	10	15	63	13	5	16	8	8	50
07/08	18	13	19	5	11	66	12	15	22	9	3	61
08/09	16	14	12	5	15	62	8	8	9	4	3	32
09/10	16	18	10	8	15	67	14	4	12	9	4	43
10/11	18	9	10	6	14	57	16	12	19	10	5	62
11/12	18	12	19	8	12	69	12	10	23	13	5	63
12/13	15	8	14	15	8	60	21	14	16	17	5	73
13/14	18	5	12	11	14	60	11	12	14	19	7	63

Table 6: Total deviance (R^2) explained by each variable in the CRA 1 standardised seasonal CPUE model. The number of categories in each explanatory variable is given in parentheses.

Variable	1	2	3
Period (70)	0.1724		
Statistical Area (5)	0.4082		
Month (12)	0.0111	0.1843	0.4202
Additional deviance explained	0.0000	0.2358	0.0120

Table 7: Seasonal standardised indices with associated standard error and the corresponding arithmetic CPUE (kg/potlift) for CRA 1 from AW and 1979–80 to 2013–14. This table generated from data prepared using the F2 algorithm scaled to combined "LFX" destination codes.

Fishing	AW season			SS season		
year	Arithmetic	Standardised	s.e.	Arithmetic	Standardised	s.e.
79/80	0.667	0.827	0.0669	0.757	0.839	0.0474
80/81	0.922	0.978	0.0682	1.037	1.007	0.0502
81/82	0.891	0.784	0.0729	1.143	1.026	0.0539
82/83	0.805	0.893	0.0682	1.237	1.078	0.0524
83/84	0.926	0.875	0.0695	1.190	1.011	0.0508
84/85	0.879	0.852	0.0694	0.989	0.917	0.0503
85/86	0.776	0.732	0.0615	0.935	0.888	0.0511
86/87	0.667	0.743	0.0648	0.790	0.854	0.0490
87/88	0.581	0.609	0.0635	0.803	0.860	0.0510
88/89	0.569	0.649	0.0805	0.875	0.683	0.0561
89/90	0.594	0.530	0.0787	0.894	0.809	0.0607
90/91	0.625	0.513	0.0737	0.754	0.661	0.0572
91/92	0.511	0.586	0.0699	0.666	0.751	0.0547
92/93	0.408	0.525	0.0763	0.660	0.654	0.0620
93/94	0.448	0.518	0.0688	0.864	0.783	0.0588
94/95	0.618	0.702	0.0712	0.954	0.963	0.0613
95/96	0.825	1.001	0.0745	1.181	1.312	0.0801
96/97	0.753	0.882	0.0841	0.920	1.076	0.0854
97/98	0.862	0.882	0.0848	0.732	0.999	0.1036
98/99	0.930	0.953	0.0811	0.795	1.109	0.1048
99/00	0.966	0.841	0.0854	0.892	0.873	0.1047
00/01	1.172	0.938	0.0768	1.305	1.400	0.0937
01/02	1.260	1.056	0.0755	1.344	1.271	0.0988
02/03	1.200	1.031	0.0782	1.290	1.140	0.0894
03/04	1.035	0.875	0.0868	1.356	1.213	0.0851
04/05	1.374	1.140	0.0981	1.794	1.493	0.1001
05/06	1.313	1.128	0.0914	1.663	1.570	0.0930
06/07	1.204	1.364	0.0834	1.768	2.085	0.0931
07/08	1.391	1.435	0.0816	2.371	2.108	0.0846
08/09	1.465	1.360	0.0842	1.894	2.295	0.1152
09/10	1.619	1.431	0.0810	2.003	2.029	0.0999
10/11	1.293	1.168	0.0875	1.655	1.869	0.0841
11/12	1.255	1.315	0.0800	1.580	1.639	0.0834
12/13	1.409	1.641	0.0853	1.929	1.701	0.0777
13/14	1.247	1.246	0.0855	1.557	1.668	0.0832

Table 8: Number of days sampled and number of fish measured in CRA 1 by season and sample source.

	Number of days				Number of fish measured			
Fishing	Logbook		Observer		Logbook		Observer	
Year	AW	SS	AW	SS	AW	SS	AW	SS
93/94	34	–	–	–	172	–	–	–
94/95	2	64	–	–	14	461	–	–
95/96	42	1	–	–	482	4	–	–
97/98	–	–	11	6	–	–	1 670	–
98/99	–	–	9	–	–	–	2 635	–
99/00	–	–	24	–	–	–	6 882	–
00/01	–	–	14	1	–	–	4 582	23
01/02	–	–	8	4	–	–	2 092	682
02/03	–	–	8	7	–	–	3 251	1 404
03/04	–	–	7	9	–	–	1 092	3 666
04/05	–	–	11	4	–	–	3 194	852
05/06	–	–	12	8	–	–	3 243	1 710
06/07	–	–	10	5	–	–	2 590	2 199
07/08	–	–	11	5	–	–	2 412	506
08/09	–	–	11	4	–	–	2 604	1 073
09/10	–	–	10	6	–	–	3 938	868
10/11	–	–	8	8	–	–	2 614	1 464
11/12	21	–	8	8	363	–	1 967	1 555
12/13	11	5	8	7	302	162	3 584	3 328
13/14	11	4	10	6	175	122	3 737	834
Total	121	74	180	98	1 508	749	52 087	20 164

Table 9: CRA 1: Recaptures by release year and sex. '–': no data

Year	Male	Female	Total
1976	142	141	283
1977	77	23	100
1978	31	54	85
1979	30	24	54
2000	173	299	472
2001	34	42	76
2002	33	143	176
2003	132	147	279
2004	25	13	38
2005	2	13	15
2006	1	5	6
2007	1	2	3
2009	9	29	38
2010	10	18	28
2011	–	4	4
2012	13	4	17
2013	1	–	1
Total	714	961	1675

Table 10: CRA 1: Releases by area and sex.

Area	Male	Female
901	79	158
902	–	2
903	6	13
939	629	788
Total	714	961

Table 11: CRA 1: Recapture areas versus release areas.

	Recaptures			
Release	901	902	903	939
901	230	5	1	1
902		2		
903			19	
939	4			1405

Table 12: CRA 1: Numbers of re-releases by sex. '–': no data

Re-releases	Male	Female	Total
0	633	811	1444
1	55	110	165
2	19	28	47
3	7	6	13
4	–	3	3
5	–	1	1
6	–	1	1
7	–	1	1

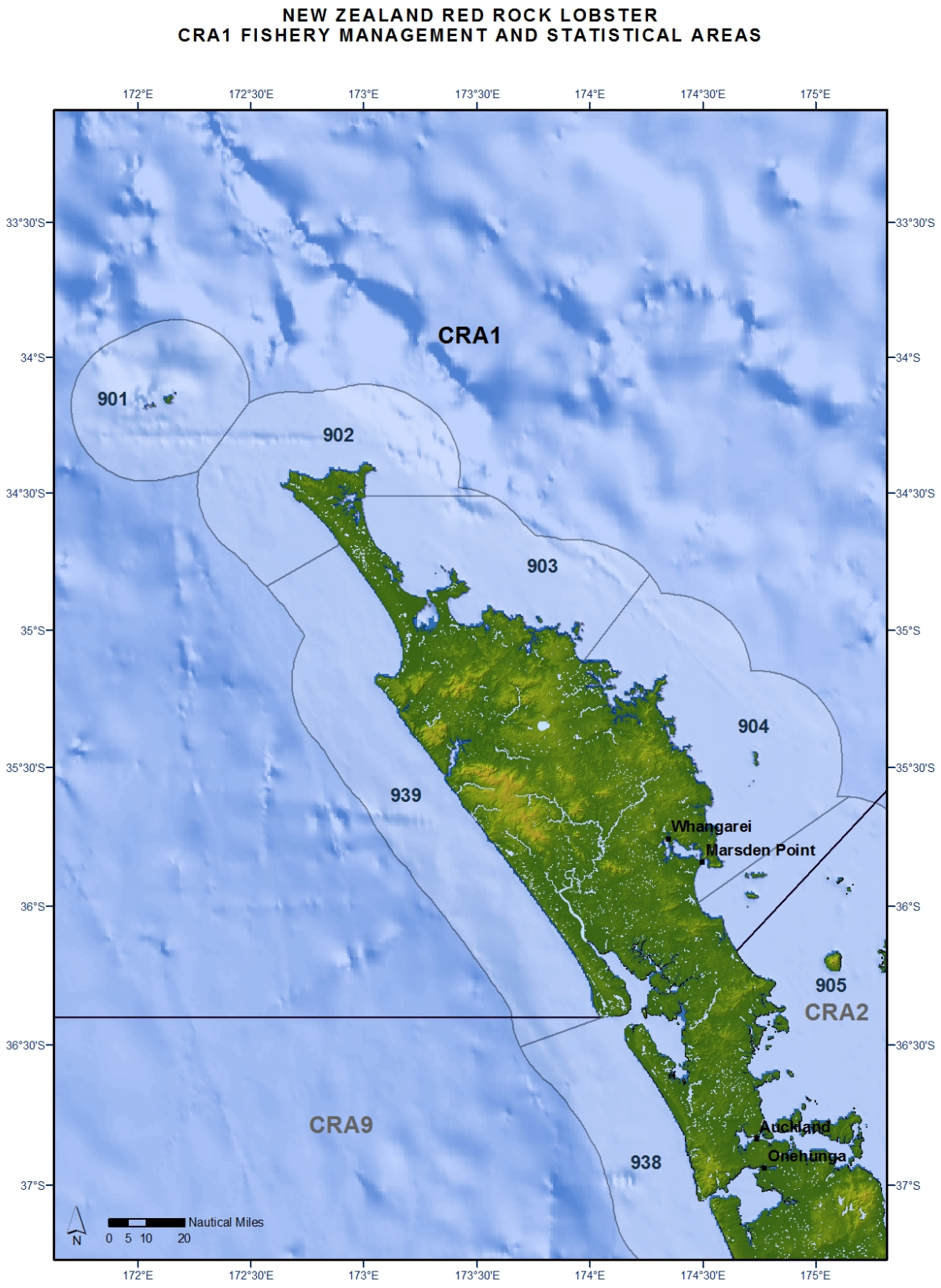

Figure 1: **The CRA 1 stock area on the northern coasts of the North Island, and its statistical areas. The QMA boundaries are shown with heavy black lines while the statistical area boundaries have thinner black lines.**

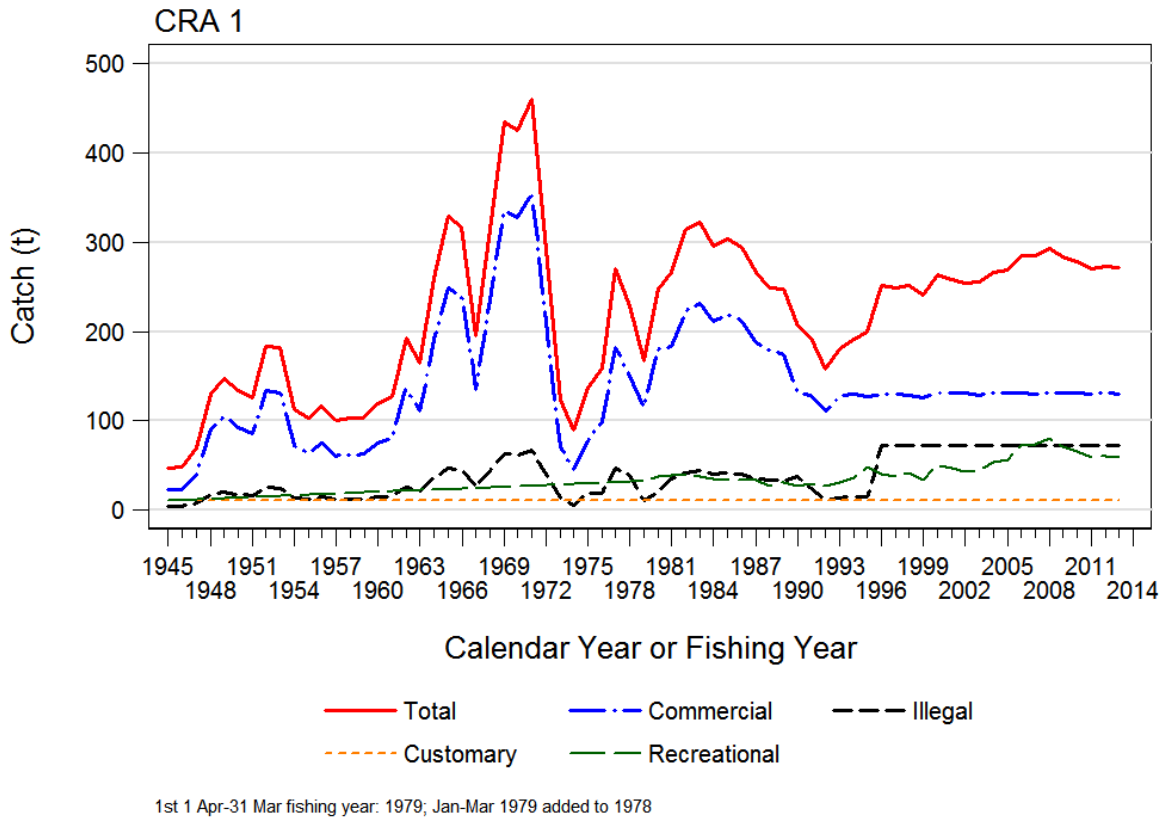

Figure 2: CRA 1 catches by fishery source, 1945–2013.

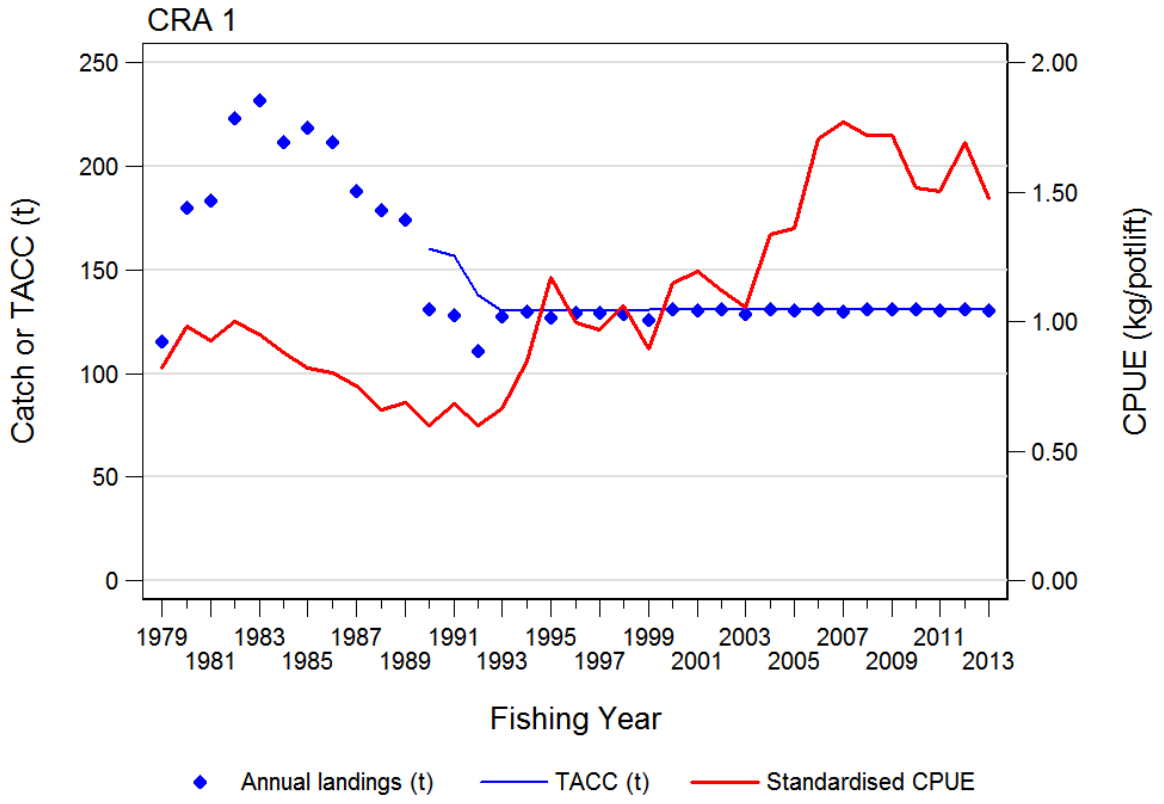

Figure 3: CRA 1 commercial catch, TACC and CPUE, 1979–2013.

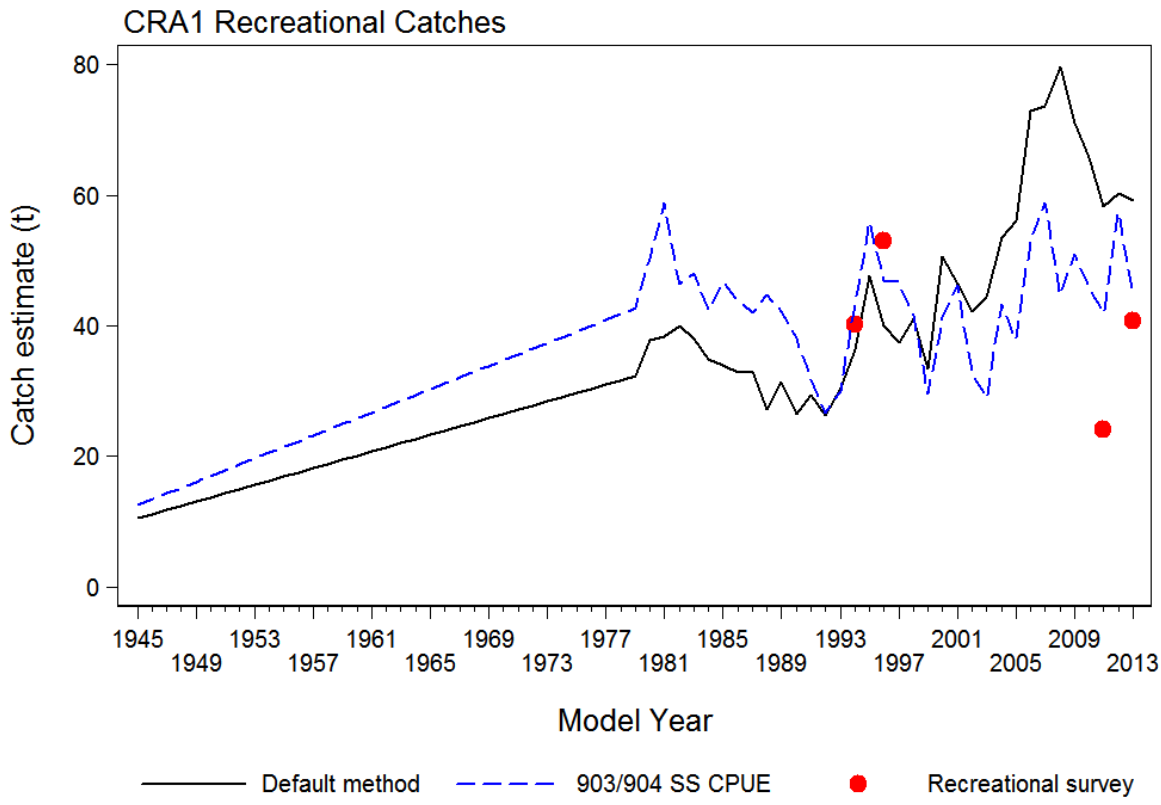

Figure 4: **Estimated CRA 1 recreational catch based on SS CPUE: [black line] using all CRA 1 statistical areas; [dashed blue line] using only Areas 903 and 904; [red dots]: survey estimates. The maximum reported recreational landings (2.94 t) from commercial vessels under Section 111 of the Fisheries Act has been added to each year of the two catch series.**

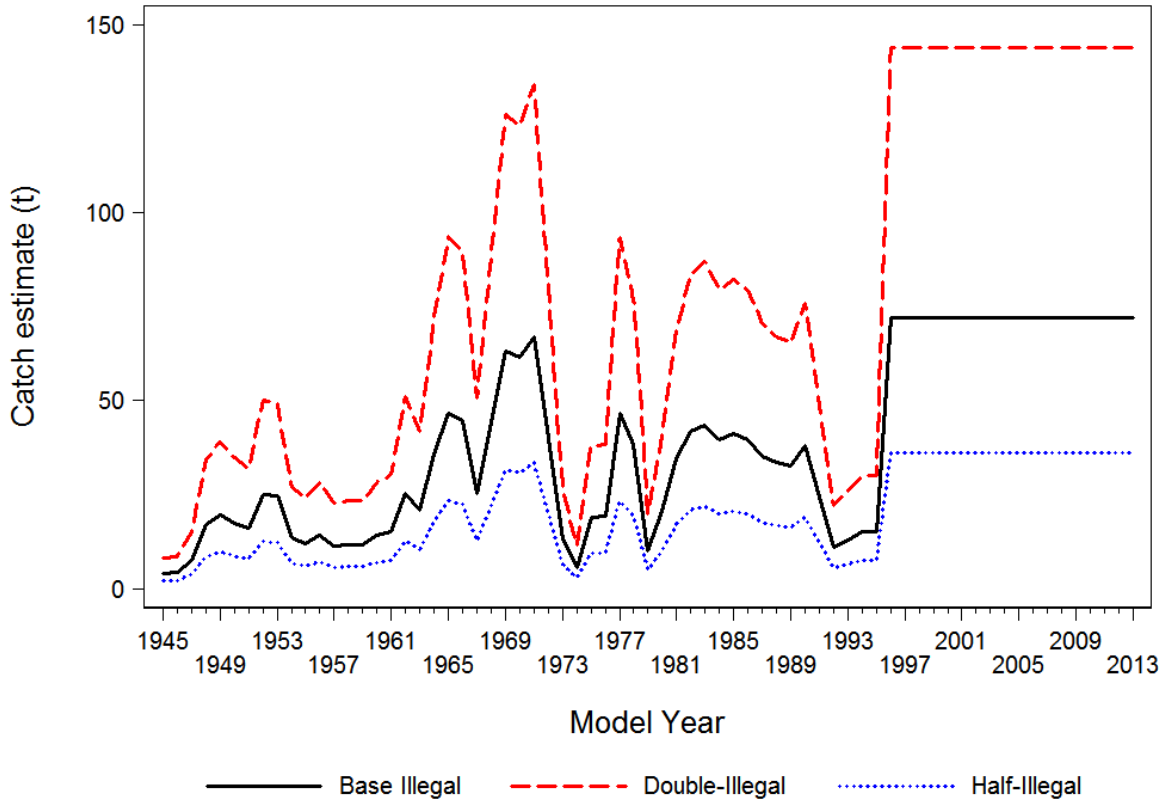

Figure 5: **Illegal catch trajectories for the 2014 stock assessment, showing the base case series and two alternative sensitivity series.**

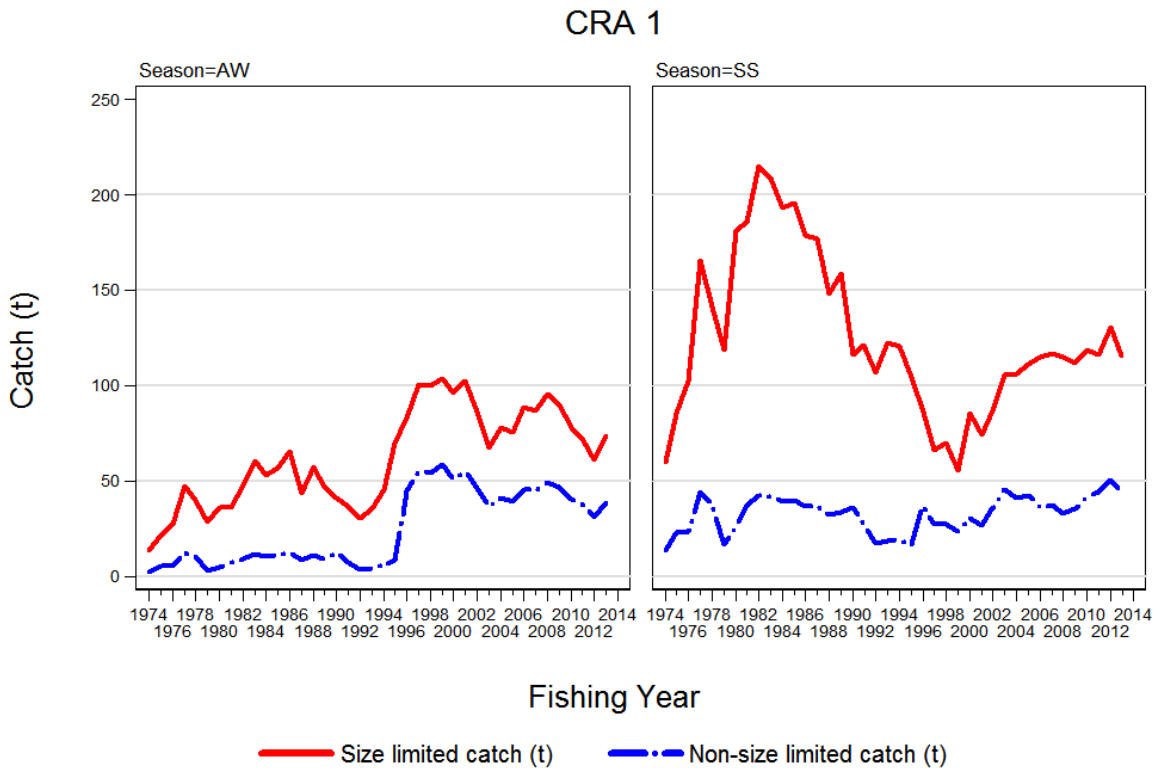

Figure 6: **CRA 1 seasonal Size Limited (SL, solid red line) and Non-Size Limited (NSL, dashed blue line) catches (t).**

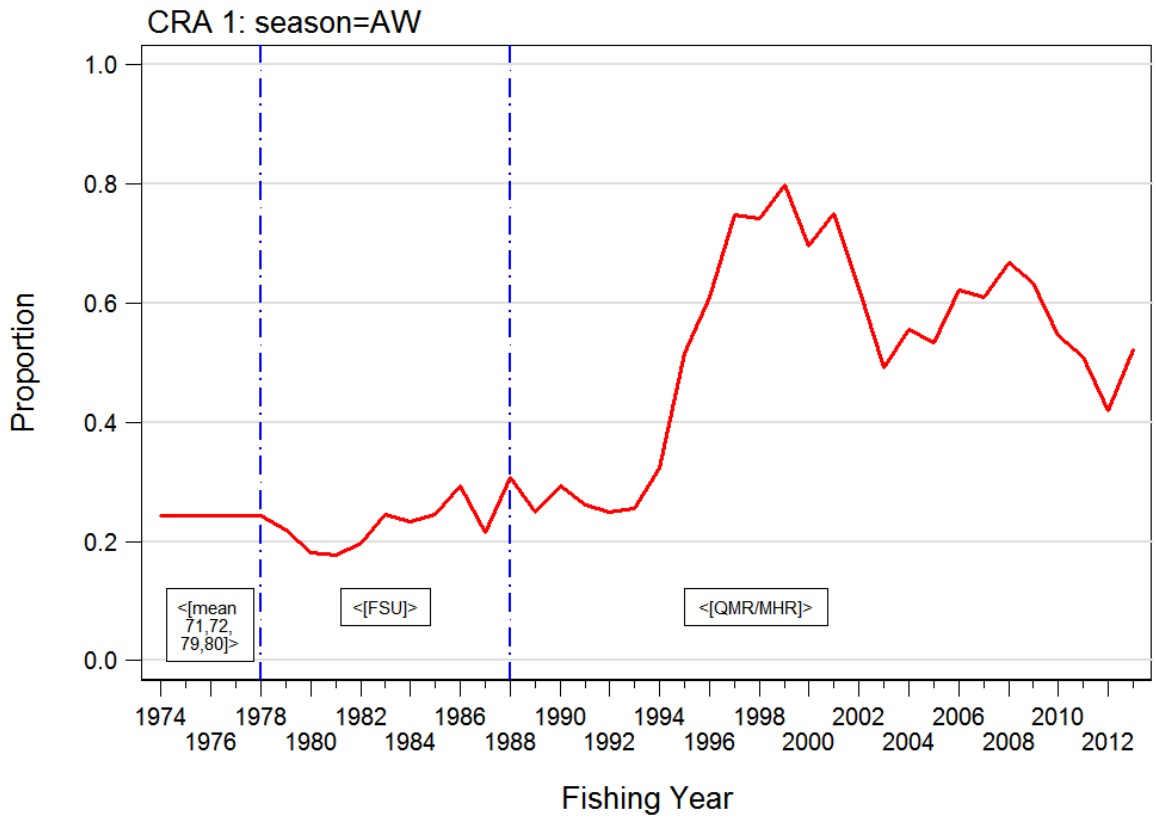

Figure 7: **Proportion by fishing year of the commercial catch taken in the AW season in CRA 1.**

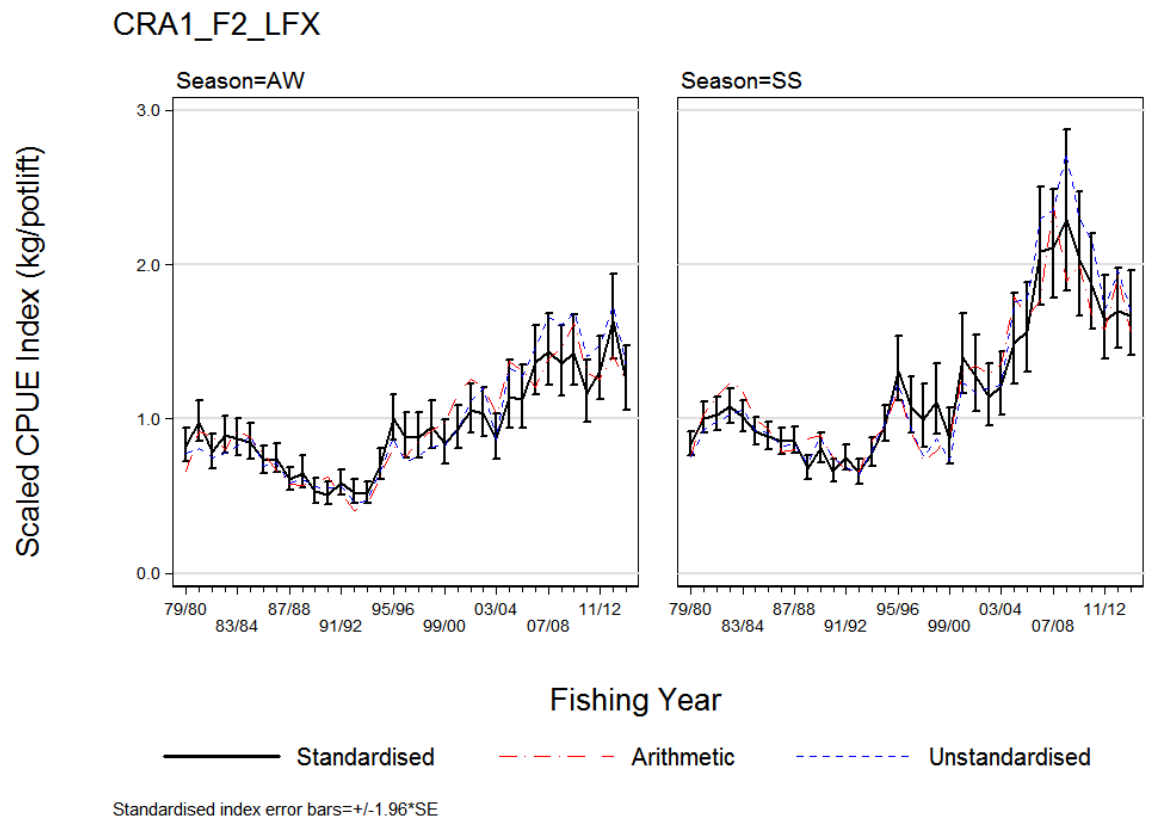

Figure 8: **Standardised, unstandardised, and arithmetic CPUE indices (kg/potlift) by season and fishing year for CRA 1 1979–80 to 2013–14. Vertical bars are 95% confidence intervals. The geometric mean for the AW series (left panel) = 0.90 kg/potlift and for the SS series (right panel) = 1.14 kg/potlift. This figure generated from data prepared using the F2 algorithm scaled to the combined "LFX" destination codes.**

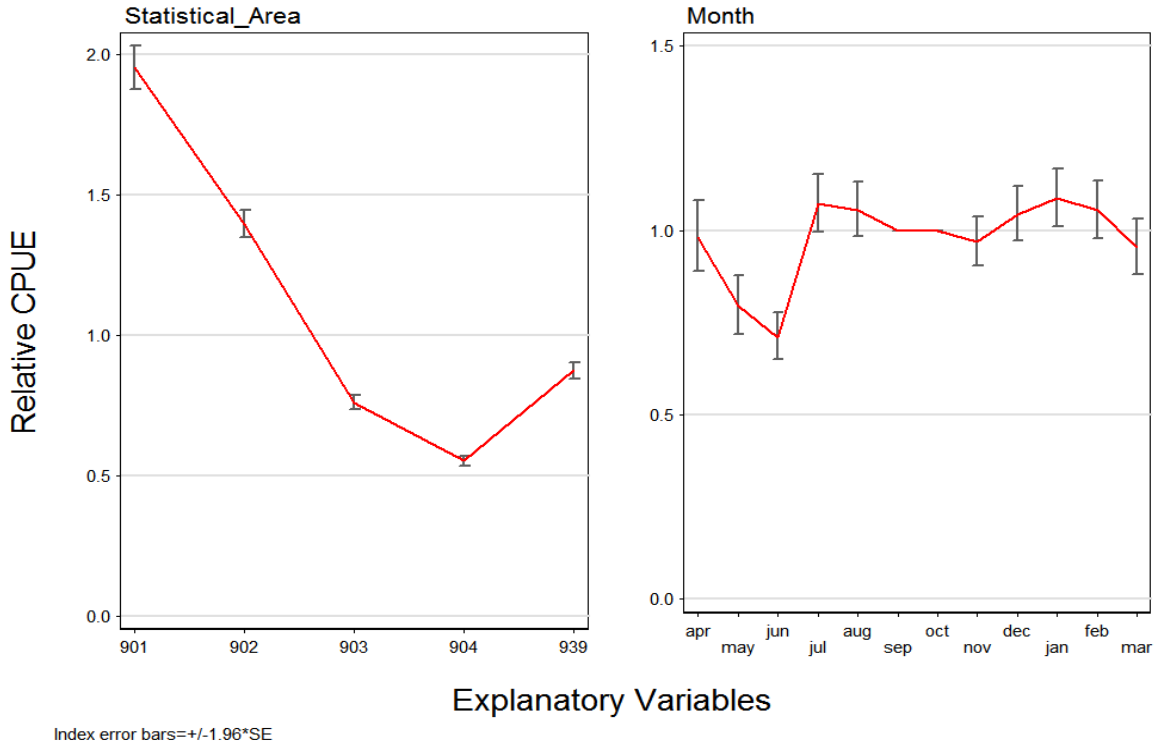

Figure 9: **Coefficients for month and statistical area from the CRA 1 seasonal CPUE standardisation. Month coefficients are not in canonical form, with each of the two reference months (September and October) set to 1.0 and the associated SE set to zero. Error bars show plus and minus 1.96 standard deviations.**

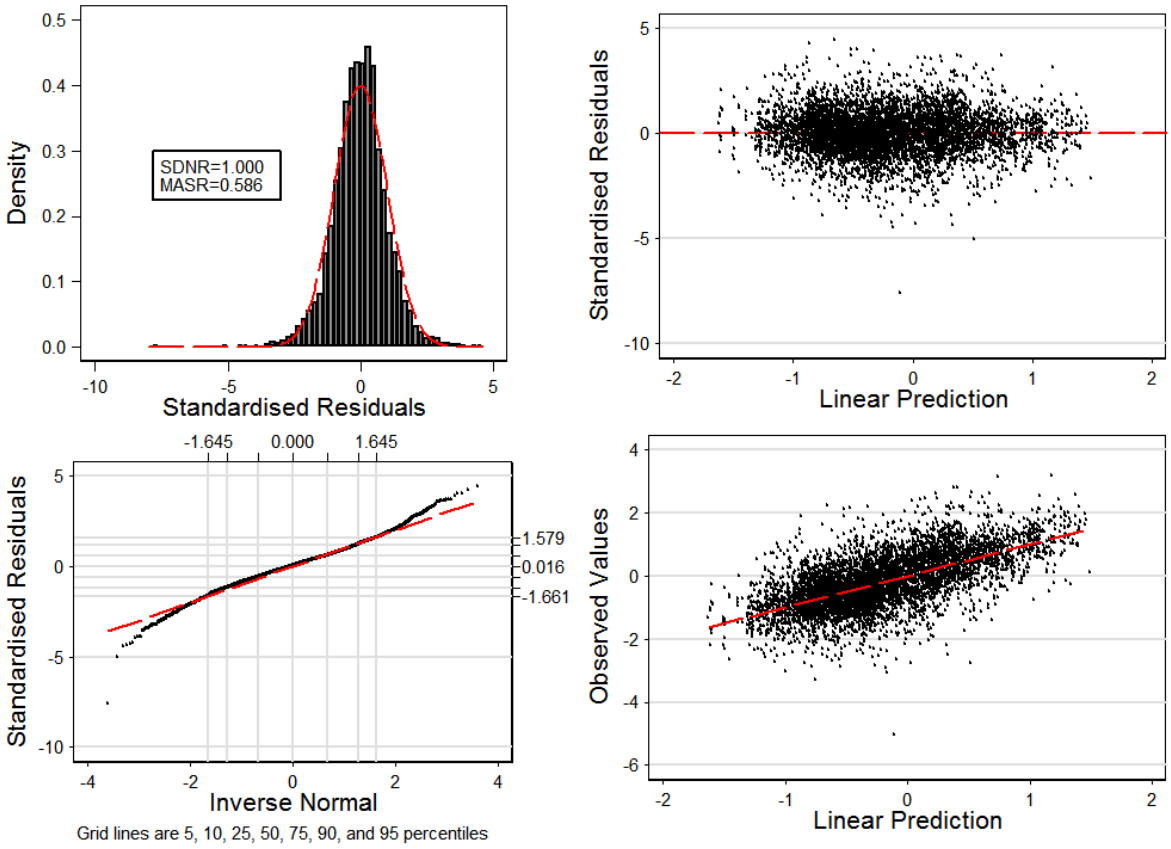

Figure 10: Residual diagnostics for the CRA 1 seasonal CPUE standardisation.

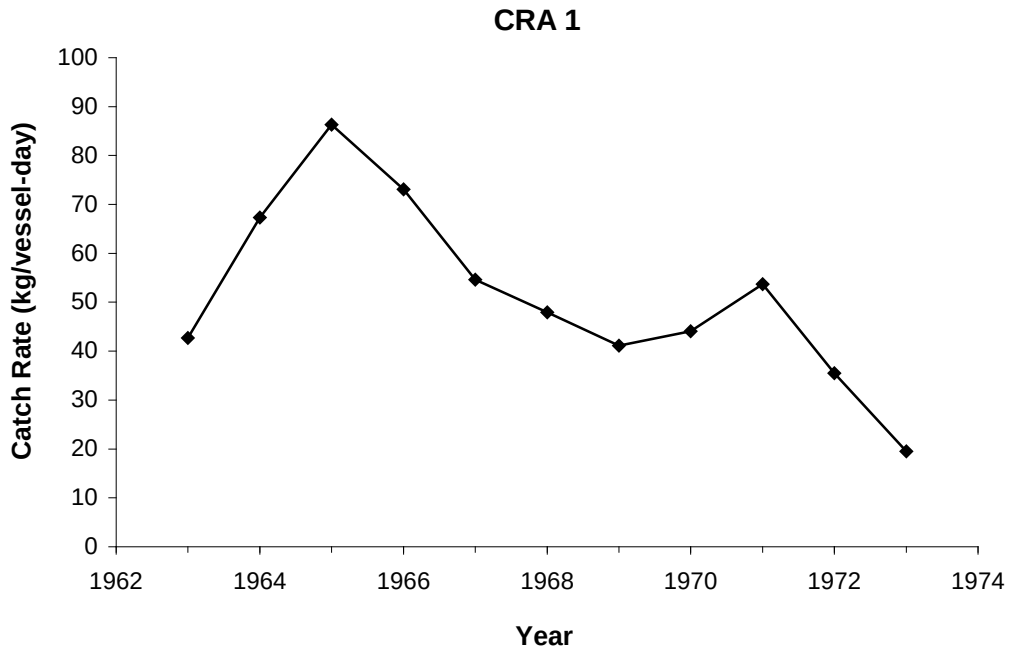

Figure 11: CRA 1 catch rate (kg/vessel-day) (Annala & King 1983) (not used in the assessment).

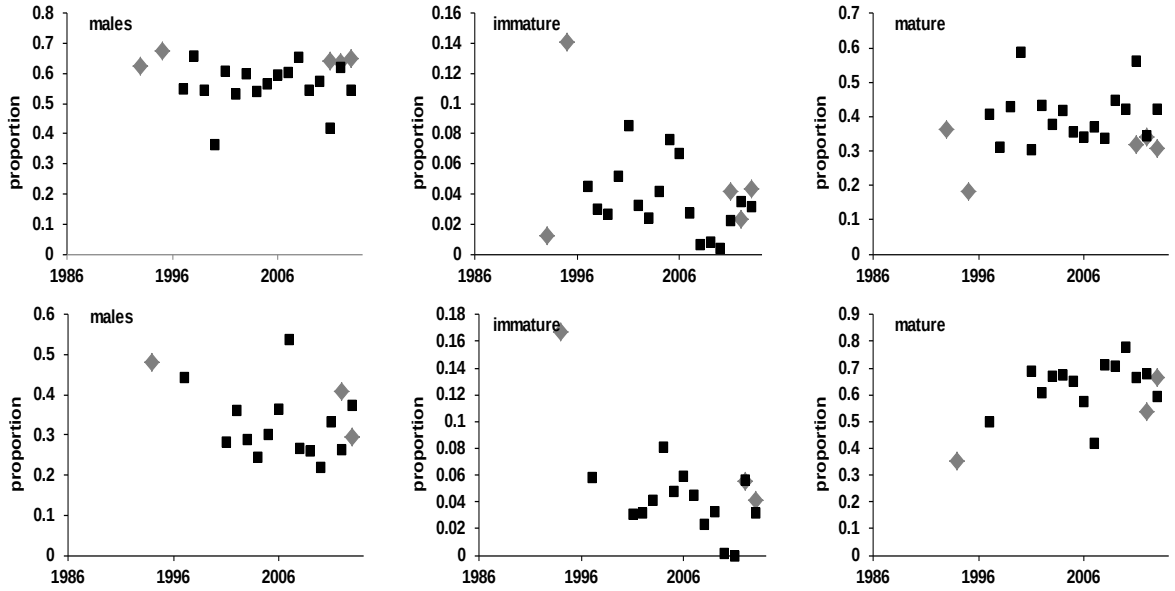

Figure 12: CRA 1: proportions by sex in the LF data for AW (upper) and SS seasons, from logbooks (grey diamonds) and observer catch sampling (black squares).

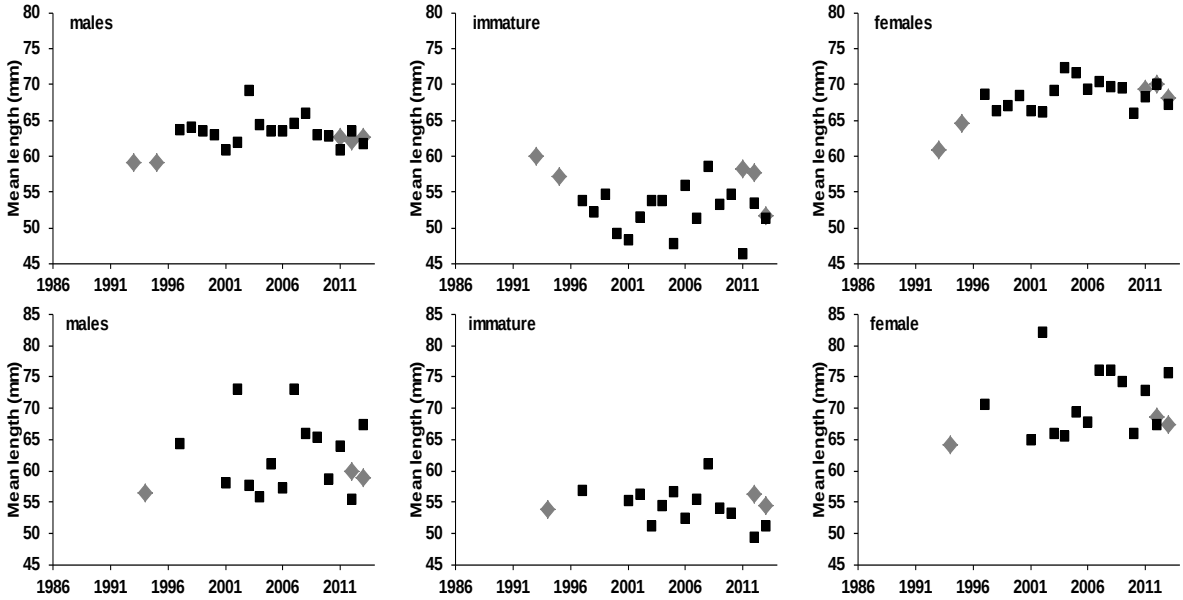

Figure 13: CRA 1: Mean lengths by sex for AW (upper) and SS seasons, from logbooks (grey diamonds) and observer catch sampling (black squares).

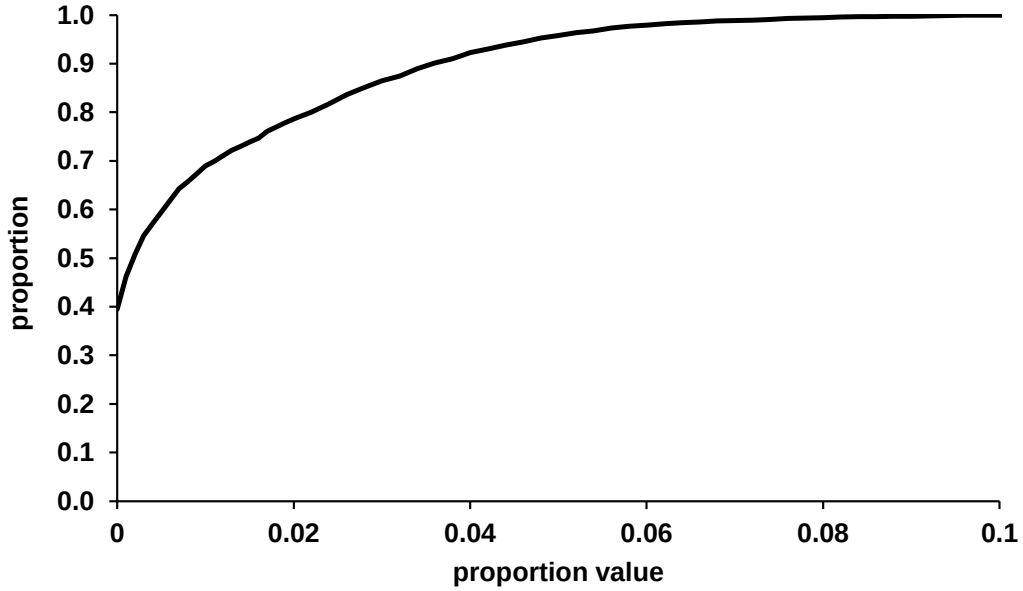

Figure 14: CRA 1: Cumulative frequency distribution of records with increasing proportions of fish measured.

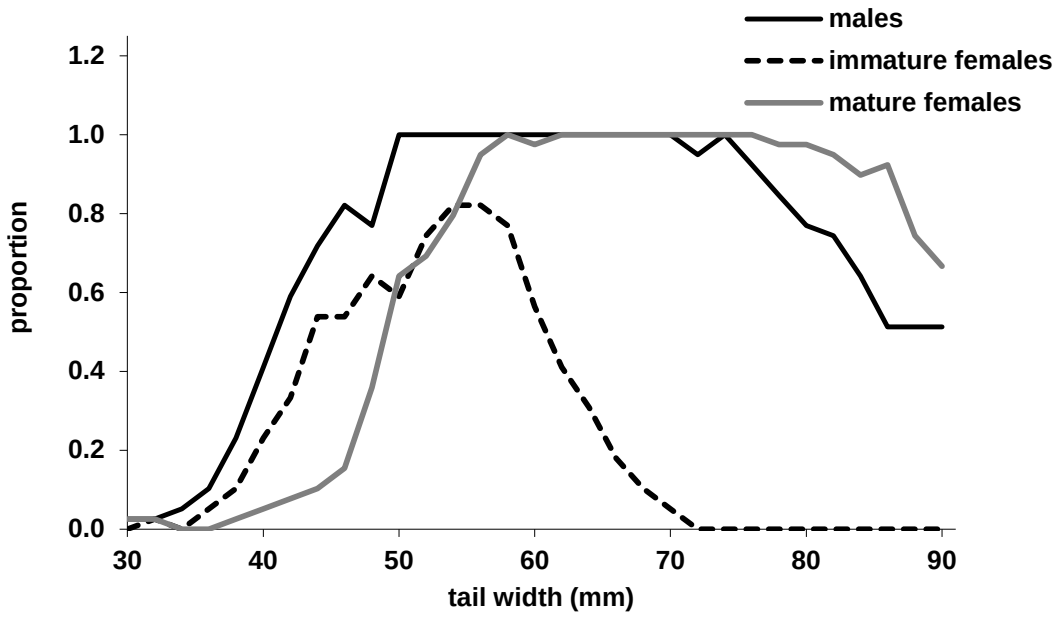

Figure 15: CRA 1: Proportion of cells, across all records, with at least 0.001 of the fish measured.

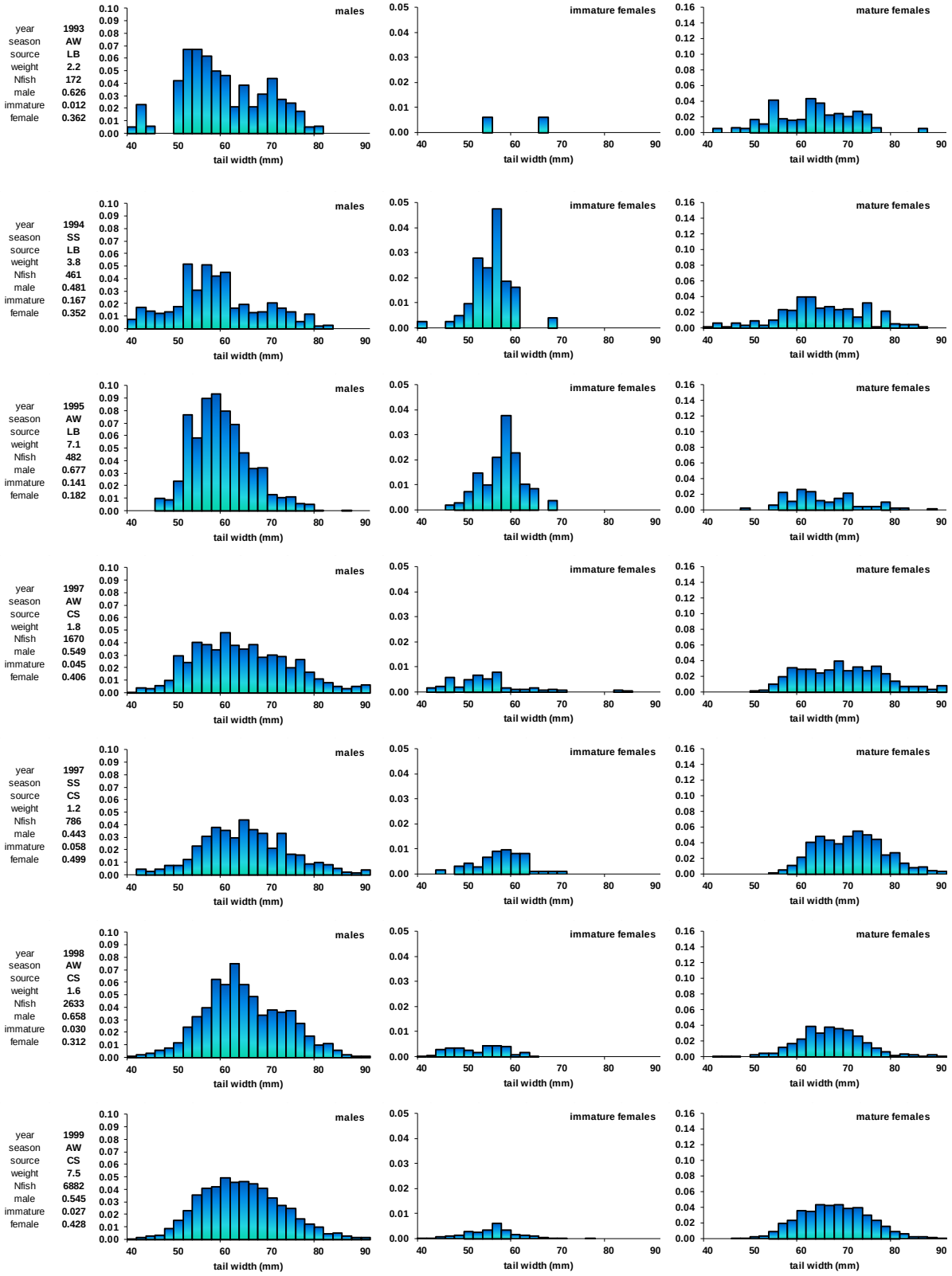

Figure 16: **CRA 1 LF records, showing proportion for each sex; note different scales for each sex but scales are constant throughout the figure. Information on the left is: year, season, source (observer data CS or logbook data LB), the raw sample weight, number of fish measured and the proportions of the three sex groups.**

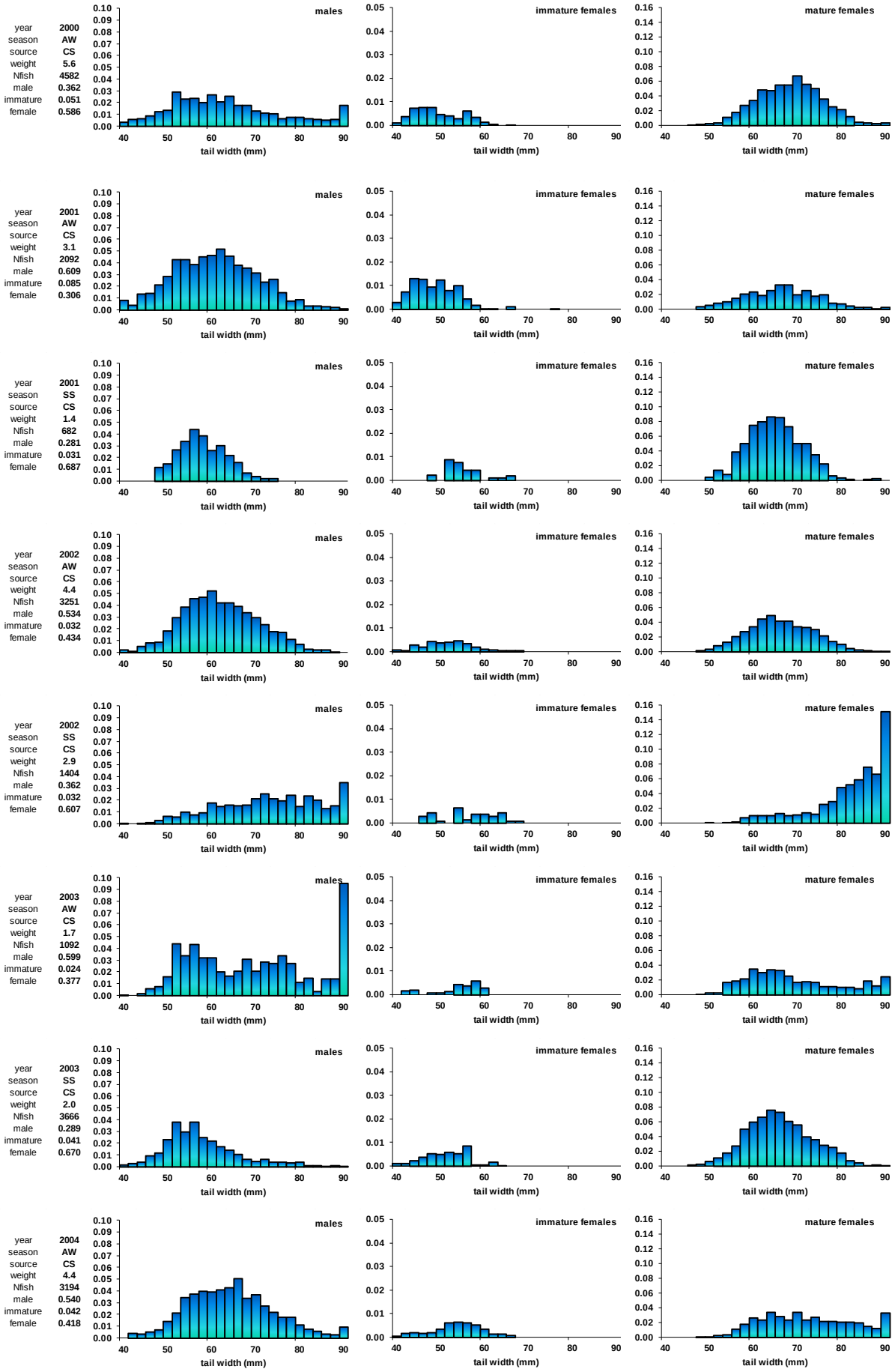

Figure 16: continued.

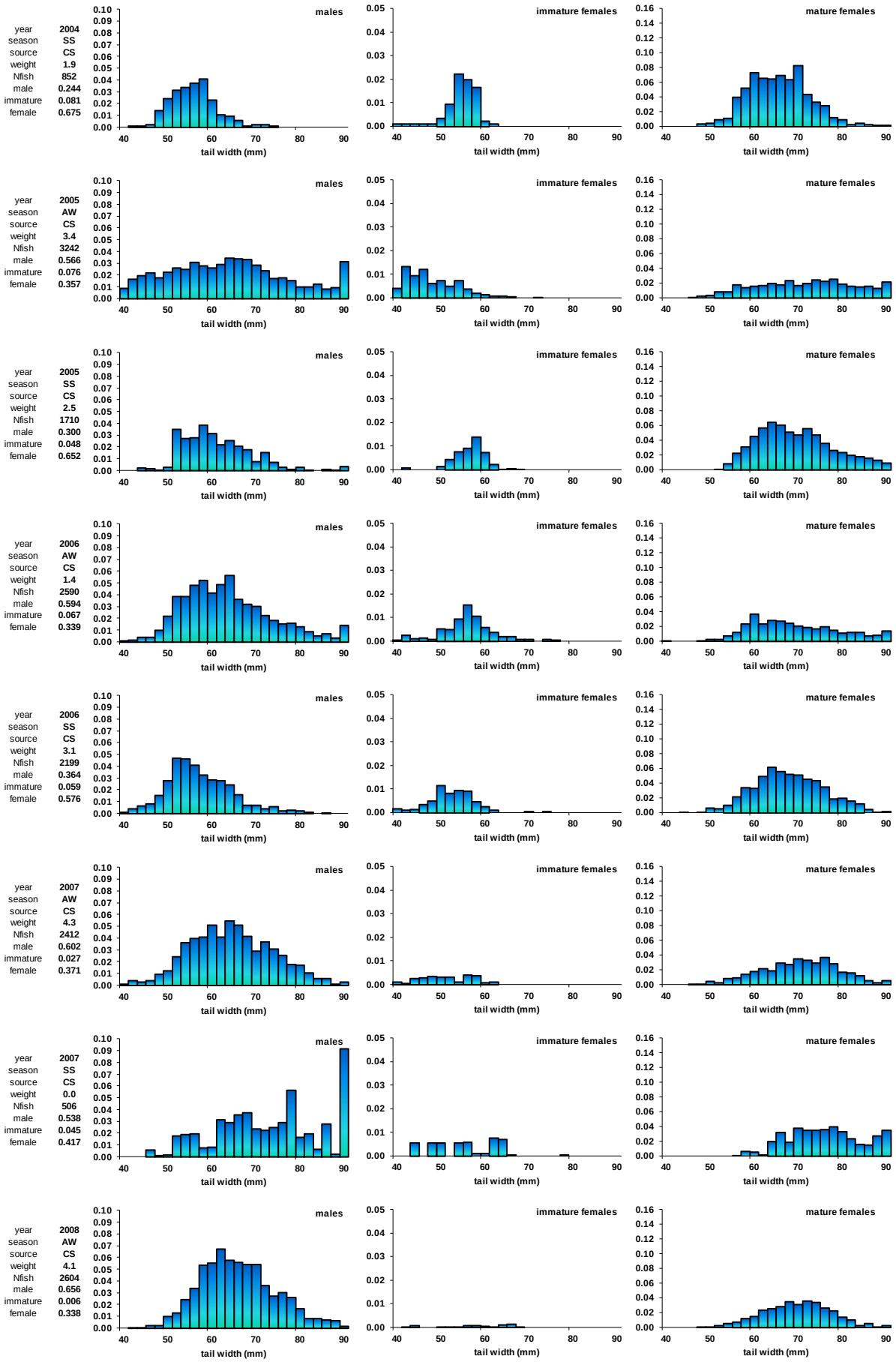

Figure 16: continued.

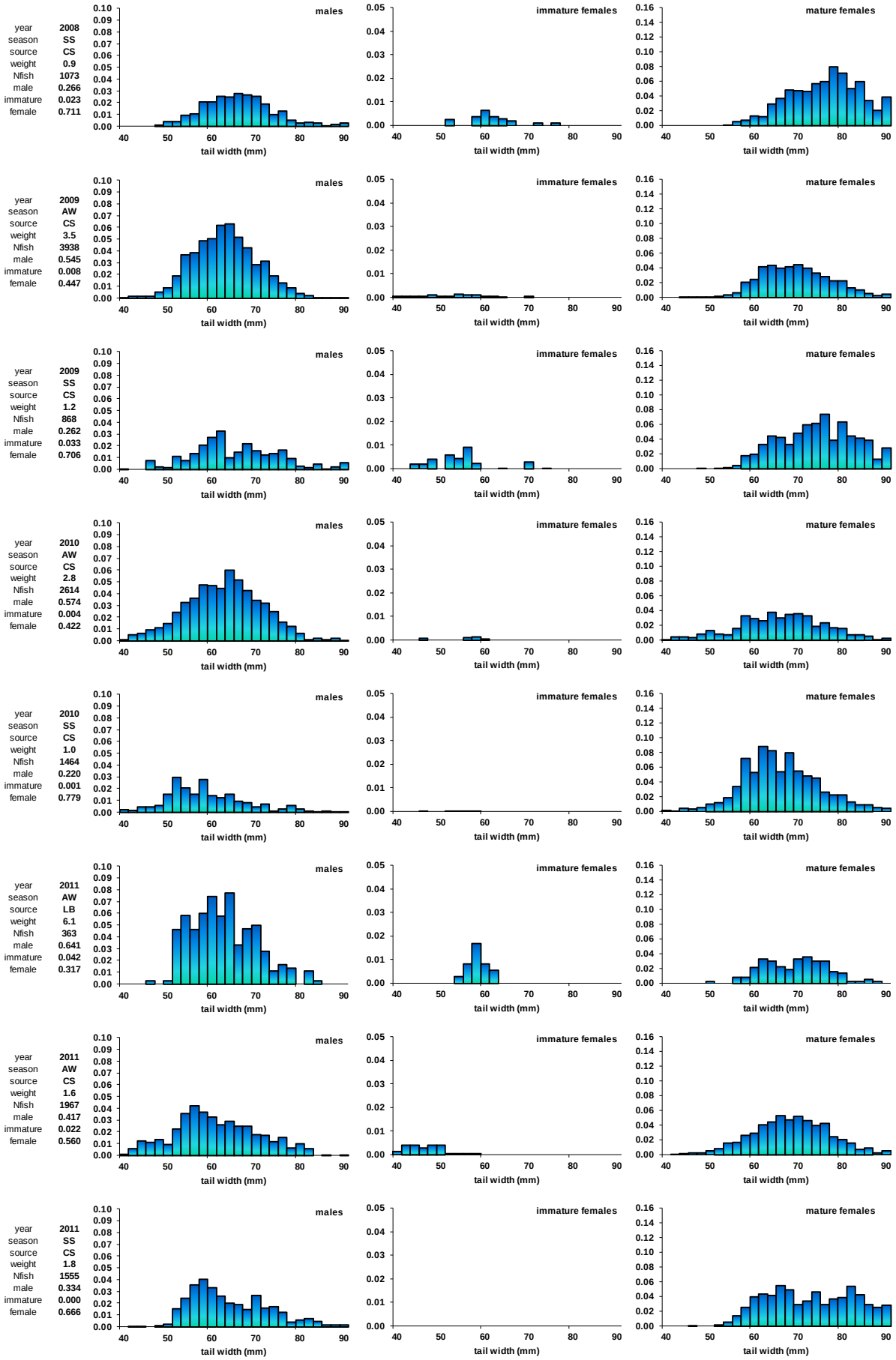

Figure 16: continued.

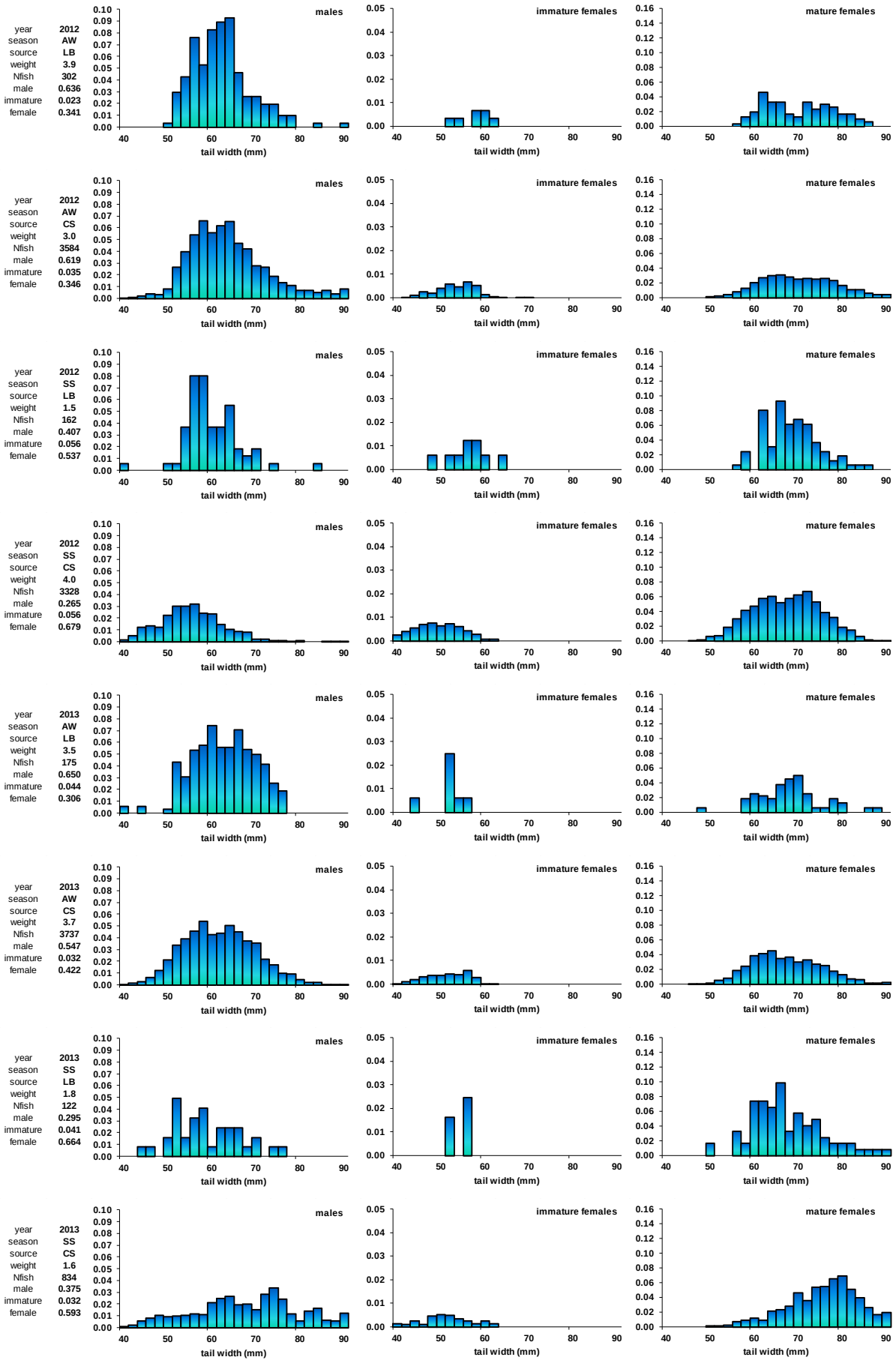

Figure 16: continued.

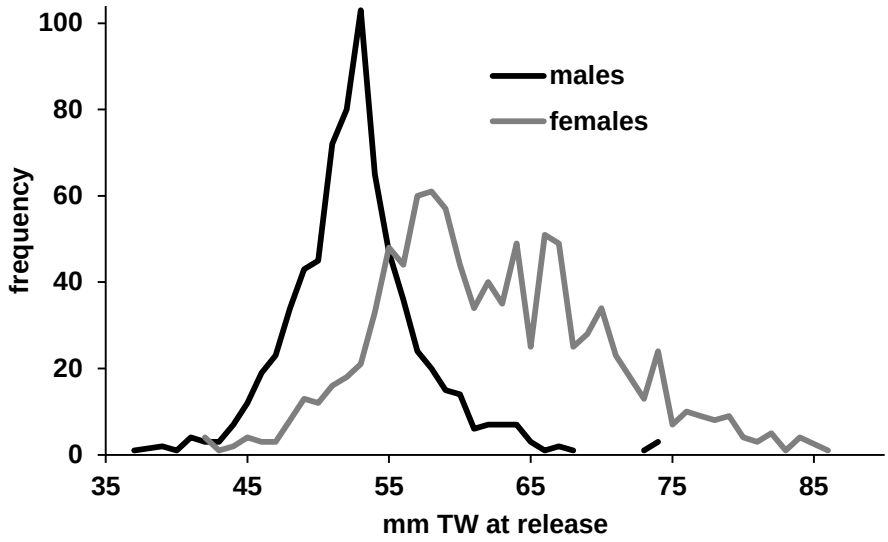

Figure 17: CRA 1: Sizes at release of recaptured tagged lobsters by sex.

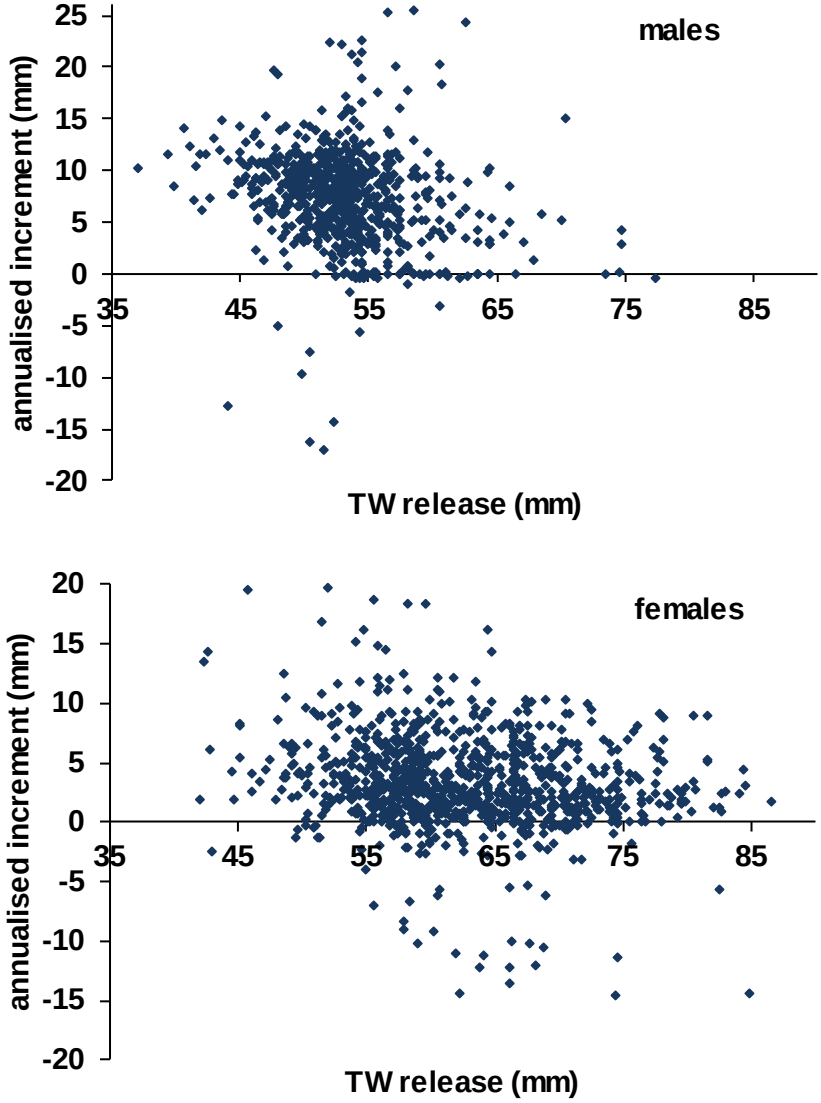

Figure 18: CRA 1: Annualised increments versus size at release by sex. The y-axes have been truncated to exclude the extreme outliers.

Appendix A. REQUEST TO MPI FOR NON-COMMERCIAL CATCH ESTIMATES

NZ ROCK LOBSTER INDUSTRY COUNCIL

Ka whakapai te kai o te moana

PRIVATE BAG 24-901 WELLINGTON 6142
64 4 385 4005 PHONE
64 4 385 2727 FAX
lobster@seafood.co.nz

May 24th 2014

Alicia McKinnon, Ministry of Fisheries
by email: Alicia.McKinnon@mpi.govt.nz

cc Kevin Sullivan, Chair, RLFAWG
by email: Kevin.Sullivan@fish.govt.nz

Dear Alicia:

DATA REQUEST – CRA 1 Stock Assessment and Management Procedure

Under Objectives 4 and 5 of MPI contract CRA 2012/01B, the stock assessment team will be conducting a CRA 1 stock assessment and reviewing CRA 1 management procedure in September and October of this year.

The stock assessment team has access to good data on current and historical commercial catches. However, there are limited data on the non-commercial catch components, which are customary, illegal and recreational catches.

The team has no access to customary catch information.

In the past, MFish provided estimates of illegal catches, but these were highly uncertain and since 2004 there have been no estimates except for advice in response to requests about the stock(s) being assessed each year.

Recreational catch has been estimated by the large-scale multi-species national survey (LSMS), which ended in September 2012. Previous estimates of recreational catch in CRA 1 were available from surveys in 1994-96 and 2000-01. We are content to obtain estimates from the Marine Amateur Fisheries WG when the recent estimates become available.

The stock assessment cannot ignore the current and historical customary and illegal catches: that would cause stock productivity to be greatly underestimated. In the absence of information, only MPI can solve the problem of what to assume for these components; it is up to MPI to specify the customary and illegal catch assumptions that MPI wishes to be used in the stock assessment. It is likely that the RLFAWG will request sensitivity analyses on catch series that are alternatives to the base case non-commercial catch vectors, but the base case non-commercial mortalities must be provided by MPI.

For illegal catches, the assessment team needs to know the MPI estimates of current CRA 1 illegal catch and its historical trend. To assign illegal catch to the appropriate catch components in the stock assessment model, the stock assessment team needs to know the proportions by year of the estimated illegal catches that were reported to the QMS. Otherwise, if commercial fishermen report to an MHR scrubbed females or other illegal fish that are already part of the illegal catch estimate, then that catch will have been double-counted.

The assessment team also requests an appreciation of the uncertainty in the MPI illegal catch estimates.

For customary catch, the requirements are similar: the assessment team requires MPI to provide estimates of the current customary catch in CRA 1 and its historical trend. The assessment team also request an appreciation of the uncertainty in the MPI customary catch estimates.

Without these estimates from MPI, it will not be possible to produce a credible CRA 1 stock assessment.

The input data, including these estimates, are scheduled to be discussed at a RLFAWG meeting on 26 September. These MPI estimates of illegal and customary catches are thus required by 1 September 2014.

Can you please confirm your understanding of this written request and also advise likely delivery dates for these catch estimates? To assist the task, I will be happy to answer any queries you may have.

Sincerely,

Daryl Sykes
Research Programme Manager
NZ Rock Lobster Industry Council

Appendix B. MPI RESPONSE TO NON-COMMERCIAL DATA REQUEST

[MPI letterhead]

29 August 2014

Daryl Sykes
NZ Rock Lobster Industry Council
lobster@seafood.co.nz

Dear Daryl

Data request for CRA 1 and CRA 3 Stock Assessments

This letter provides a response to your request for non-commercial catch data for this year's CRA 1 and CRA 3 stock assessments and management procedure evaluations.

1. CRA 1 and CRA 3 illegal catch estimates

Historical estimates of CRA 1 and CRA 3 illegal catches have been supplied to the Rock Lobster Fisheries Assessment Working Group (RLFAWG) on several occasions from 1990 to 2003. Some of these estimates include a breakdown of the proportion of estimated illegal catches that were reported to the QMS or not. The historical estimates of CRA 1 and CRA 3 illegal catch are available in the November 2013 Rock Lobster Fishery Assessment Plenary Report.

The last illegal catch estimates that MPI supplied for CRA 1 was for 72 tonnes in 2001 and for 89.5 tonnes for CRA 3 in 2003. MPI acknowledges that it has been some time since this estimate was updated. However, as discussed at the recent National Rock Lobster Management Group, there is currently no robust and defensible methodology that MPI can use to accurately estimate illegal catches from these or any other rock lobster fishery.

Anecdotal information from MPI's Compliance team suggests there are moderate levels of illegal activity in parts of the CRA 1 fishery at this time which seems to be highly seasonal and is associated with rock lobsters moving close to shore. In relation to CRA 3, it considered that there are moderate to high levels of illegal activity in the fishery, but it is considered that targeted and varied enforcement efforts in recent years is helping to reduce illegal activities.

Taking into account the uncertainty in the available information on illegal take, MPI suggests that a 72 tonne illegal catch estimate continues to be used in the CRA 1 stock assessment and 89.5 tonnes is used in the CRA 3 stock assessment. It is also suggested that the RLFAWG considers carrying out sensitivity analyses with lower levels of illegal take (i.e. half of the last supplied estimates).

2. CRA 1 and CRA 3 customary catch estimates

Summaries of the information MPI holds on CRA 1 and CRA 3 customary harvest since the 2003/04 April fishing year is provided at the end of this letter (Tables 1 to 4). MPI notes that some harvest information is yet to be entered into the customary database; therefore, the information provided is considered incomplete.

CRA 1 and CRA 3 customary harvest information is collected under two types of regulations: the Fisheries (Kaimoana) Regulations 1998, and Regulation 50 of the Fisheries (Amateur Fishing) Regulations 2013 (previously Regulation 27A of the Fisheries (Amateur Fishing) Regulations 1986).

Under the Kaimoana Regulations, Tangata kaitiaki are responsible for providing quarterly reports of their harvest authorisations to MPI. In areas not covered by the Kaimoana Regulations, customary harvest can be authorised for the purpose of hui or tangi under the Amateur Regulations. There is no mandatory requirement for permit issuers under the Amateur Regulations to provide MPI with details of customary fishing authorisations.

Based on the information supplied on CRA 1 and CRA 3 customary harvest, noting its incompleteness and uncertainty, MPI considers it appropriate to continue to use a 10 tonne customary catch estimate for CRA 1 and a 20 tonne estimate for CRA 3. MPI suggests that the RLFAWG considers carrying out sensitivity analyses for higher levels of CRA 3 customary catch (i.e. of 40 tonnes).

2. CRA 1 and CRA 3 amateur charter catch

Information MPI holds on CRA 1 and CRA 3 rock lobsters reported under the charter boat reporting scheme from the 2010/11 April fishing year is provided in Table 5. Charter vessel operators were required to report CRA 1 catches from October 2011 and CRA 3 catches from 1 October 2012; however, many operators also voluntarily provided catch information ahead of the requirements.

If you would like to clarify any of the details supplied in this letter please do not hesitate to contact me.

Kind regards

Alicia McKinnon
Senior Fisheries Analyst

Table 1: Summary of CRA 1 customary harvest information collected under the Kaimoana Regulations from 2007-08 to 2012-13 (noting no information is available in the customary database for CRA 1 from 2003-04 to 2006-07 and for 2013-14).

April fishing year	*Unit Type*	*Sum of Quantity Approved*	*Sum of Actual Quantity Harvested*
2007/08	NO.	207	207
2008/09	BIN	1	
	NO.	40	20
	(blank)	70	70
2009/10	KG	8	8
	(blank)	25	25
2011/12	NO.	72	58
2012/13	NO.	12	10

Table 2: Summary of CRA 1 customary harvest information collected under the Amateur Regulations from 2003-04 to 2013-14 (noting no information is available in the customary database for CRA 1 from 2003-04 to 2007-08 and for 2013-14).

April fishing year	*Unit Type*	*Sum of Quantity Approved*	*Sum of Actual Quantity Harvested*
2008/09	(blank)		50
2009/10	BIN	4	2
	(blank)	354	215
2010/11	BIN	8	18
	KG	45	9
	(blank)	569	210
2011/12	BIN	7	20
	KG	235	36
	(blank)	1342	212
2012/13	BIN	10	3
	KG	66	0
	(blank)	632	55

Table 3: Summary of CRA 3 customary harvest information collected under the Kaimoana Regulations from 2003-04 to 2013-14.

April fishing year	*Unit Type*	*Sum of Quantity Approved*	*Sum of Actual Quantity Harvested*
2003/04	(blank)	495	138
2004/05	(blank)	290	200
2006/07	KG	225	177
	NO.	1665	456
	(blank)	273	273
2007/08	NO.	17377	10100
	(blank)	1555	1480
2008/09	NO.	8911	6015
	(blank)	1410	1025
2009/10	NO.	1030	663
	(blank)	2985	340
2010/11	NO.	12624	8647
	(blank)	5666	5463
2011/12	NO.	24863	19091
	(blank)	690	484
2012/13	NO.	26927	20901
	(blank)	691	327
2013/14	NO.	13423	10664
	(blank)	18835	15612

Table 4: Summary of CRA 3 customary harvest information collected under the Amateur Regulations from 2003-04 to 2013-14 (noting no information is available in the customary database for CRA 3 for 2013-14).

April fishing year	*Unit Type*	*Sum of Quantity Approved*	*Sum of Actual Quantity Harvested*
2003/04	BIN	15	
	KG	50	
	NO.	275	30
	(blank)	7275	664
2004/05	NO.	1260	
	(blank)	3642	908
2005/06	NO.	2082	477
	(blank)	6072	590
2006/07	KG	390	340
	NO.	8631	4954
	(blank)	4350	2875
2007/08	BIN	4	
	KG	30	30
	NO.	100	
2008/09	(blank)	2626	1730
2009/10	NO.	530	
	(blank)	6371	920
2010/11	NO.	80	
	(blank)	2640	244
2011/12	(blank)	1750	836
2012/13	(blank)	630	119

Table 5: Summary of CRA 1 and CRA 3 amateur charter vessel activity reporting information from 2010-11 to 2013-14.

	Sum of Number Caught	*Sum of Number Retained*
CRA 1		
2010/11	208	123
2011/12	192	127
2012/13	344	172
2013/14	125	67
CRA 3		
2010/11	26	13
2011/12	70	18
2012/13	*Nil*	*Nil*
2013/14	*Nil*	*Nil*

Appendix C. SPATIAL HETEROGENEITY IN CRA 1

Stock assessment models are typically developed for broad scale management, implicitly assuming that fish stocks are spatially homogeneous. This assumption is made for all rock lobster stock assessments. In reality, there usually is considerable heterogeneity within fish stocks, but this is usually ignored. Often there are inadequate data to demonstrate within-stock heterogeneity. While the importance of accounting for spatial population structure in stock assessment is often acknowledged, it is usually ignored due to complexities inherent in modelling fisheries dynamics and biological systems and the lack of adequate data.

There is evidence of heterogeneity in CRA 1 (Figure 1 shows the locations of the CRA 1 statistical areas), with catches in statistical areas 903 and 904 being consistently lower than those in 901, 902 and 939 since the middle 1990s (Figure C.1). Conversely, fishing effort (number of potlifts) in 904 has been higher than that of the remaining statistical areas (Figure C.2). Consequently, the CPUE in 903 and 904 have generally been lower than the remaining areas since the beginning of the series (Figure C.3). However, there is little evidence of differences in the length-frequency (LF) distributions between 903/904 and the remaining statistical areas when summarised by sex and season (Figure C.4 to Figure C.7).

Given the evidence that there are similar length distributions by sex and season between the two regions, the RLFAWG agreed to continue assessing these five statistical areas in a single stock assessment, interpreting the similarity in LF distributions as evidence that exploitation across the entire QMA was similar.

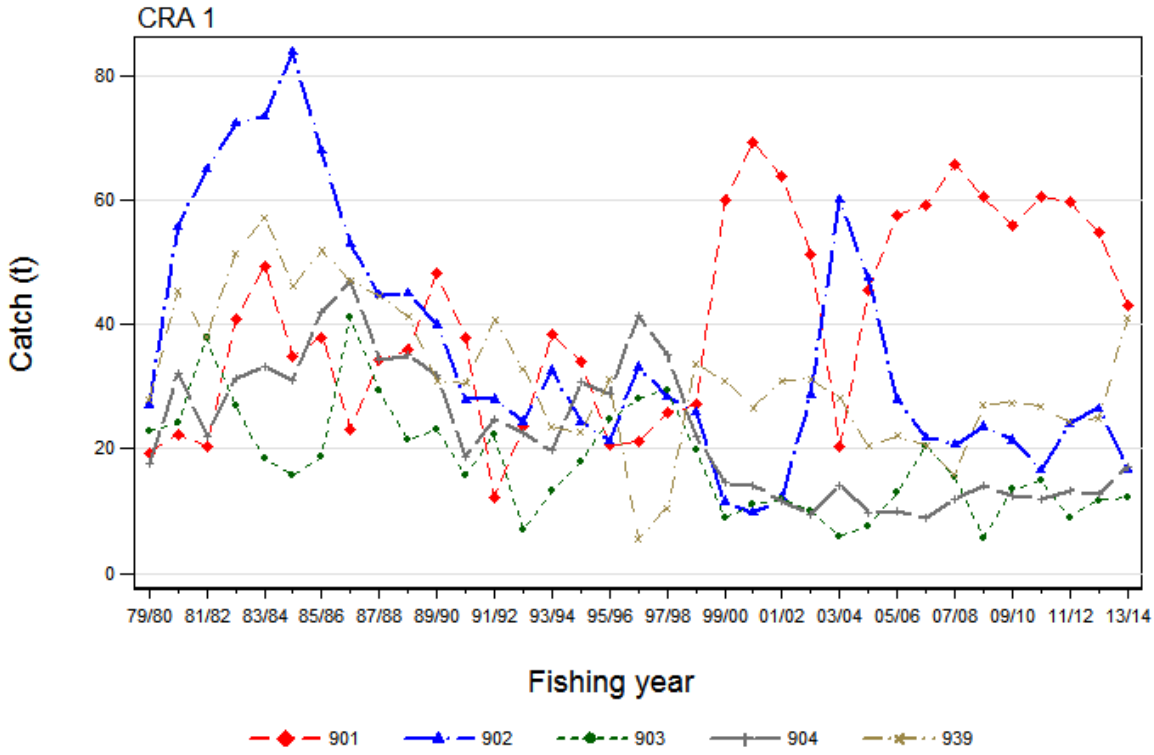

Figure C.1: Catches by statistical area in CRA 1 scaled to sum to the total CRA 1 QMR annual catches from 1979–80 to 2013–14.

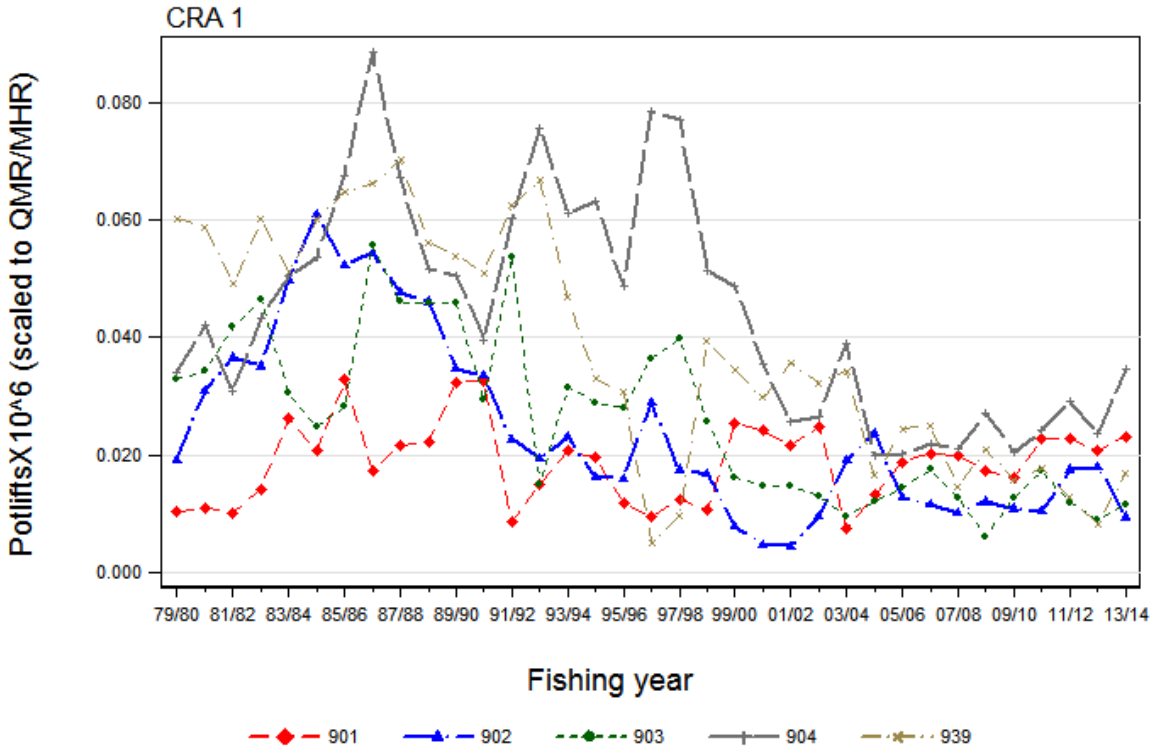

Figure C.2: Potlifts by statistical area in CRA 1 from 1979–80 to 2013–14.

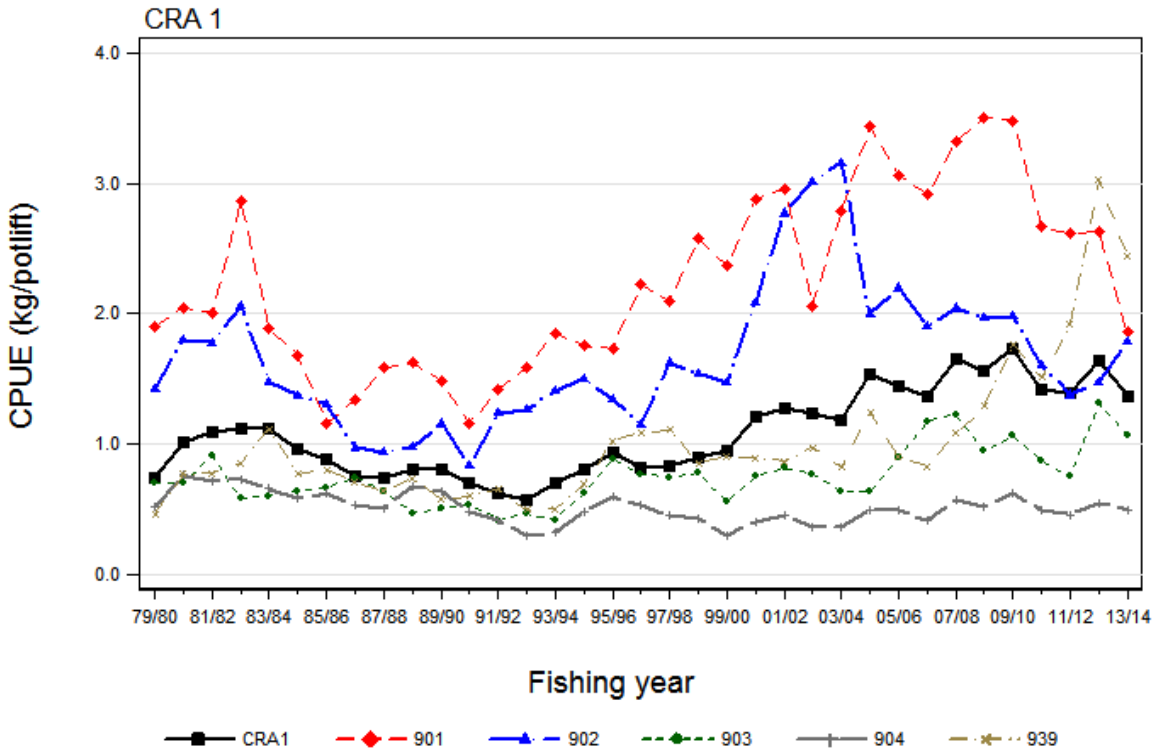

Figure C.3: Unstandardised CPUE (based on the F2_LFX algorithm) by statistical area in CRA 1 scaled to QMR catches from 1979–80 to 2013–14.

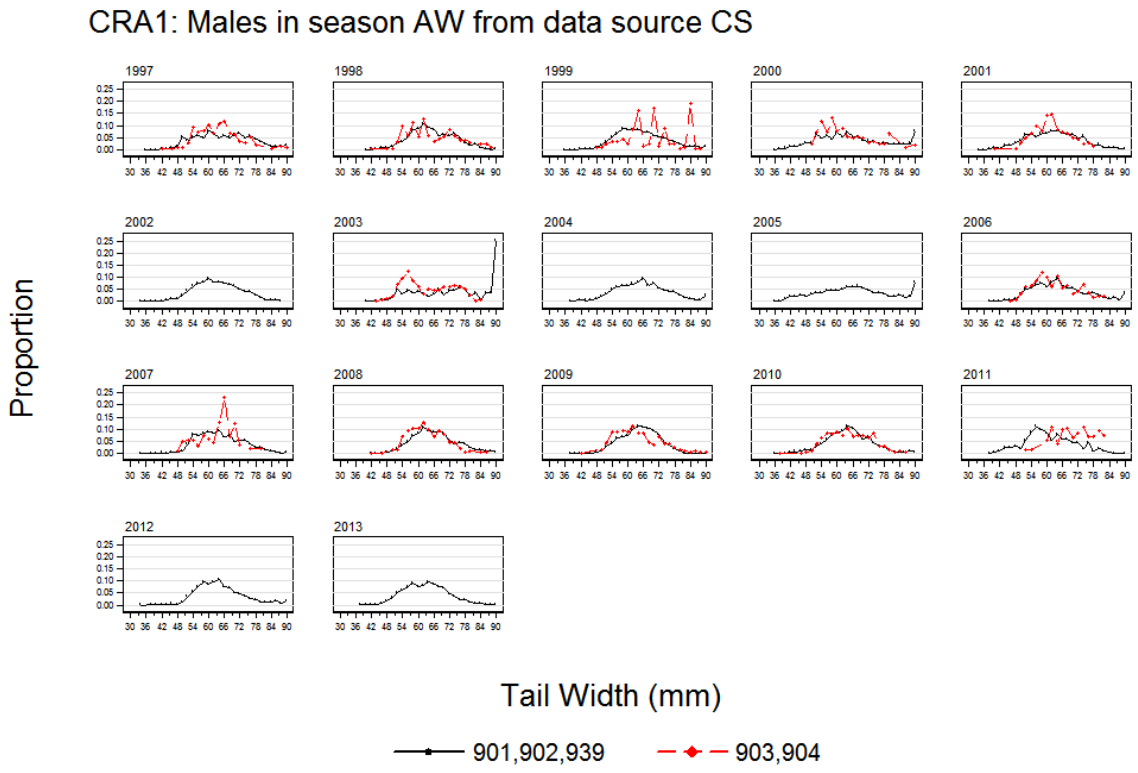

Figure C.4: Comparative distributions of male length frequencies in season AW by fishing year for CRA 1 divided into two regions: combined Areas 903/904 and Areas 901/902/903.

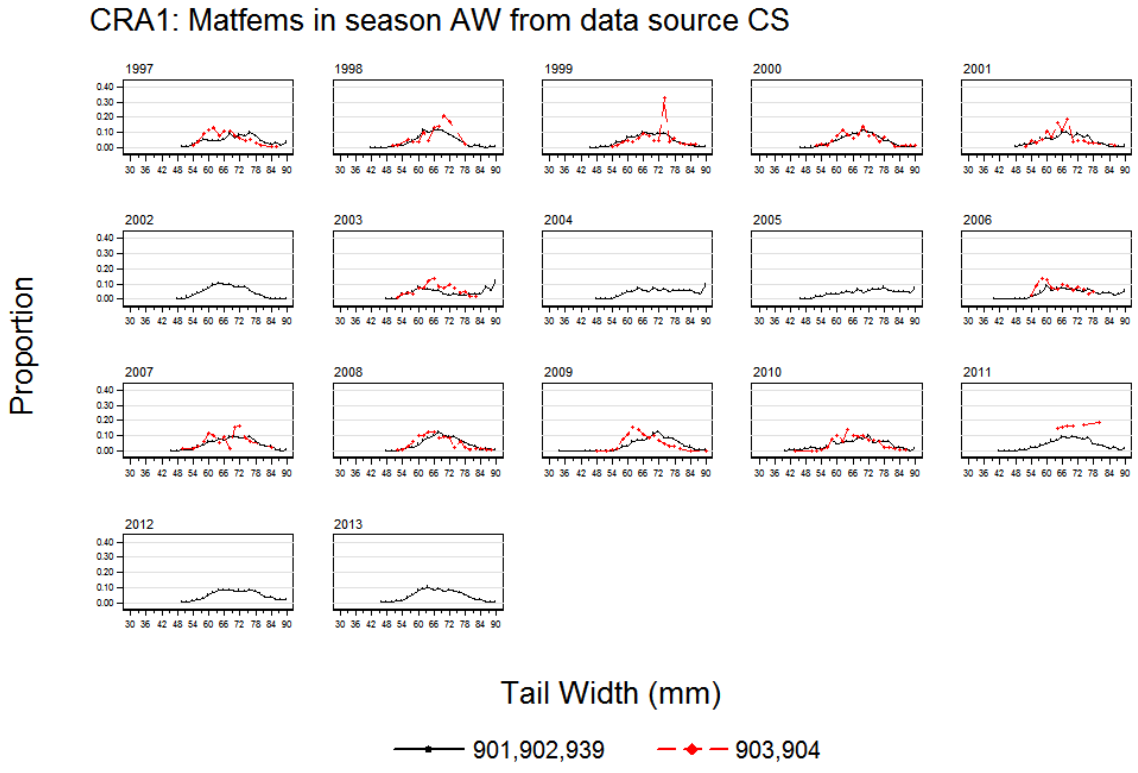

Figure C.5: Comparative distributions of mature female length frequencies in season AW by fishing year for CRA 1 divided into two regions: combined Areas 903/904 and Areas 901/902/903.

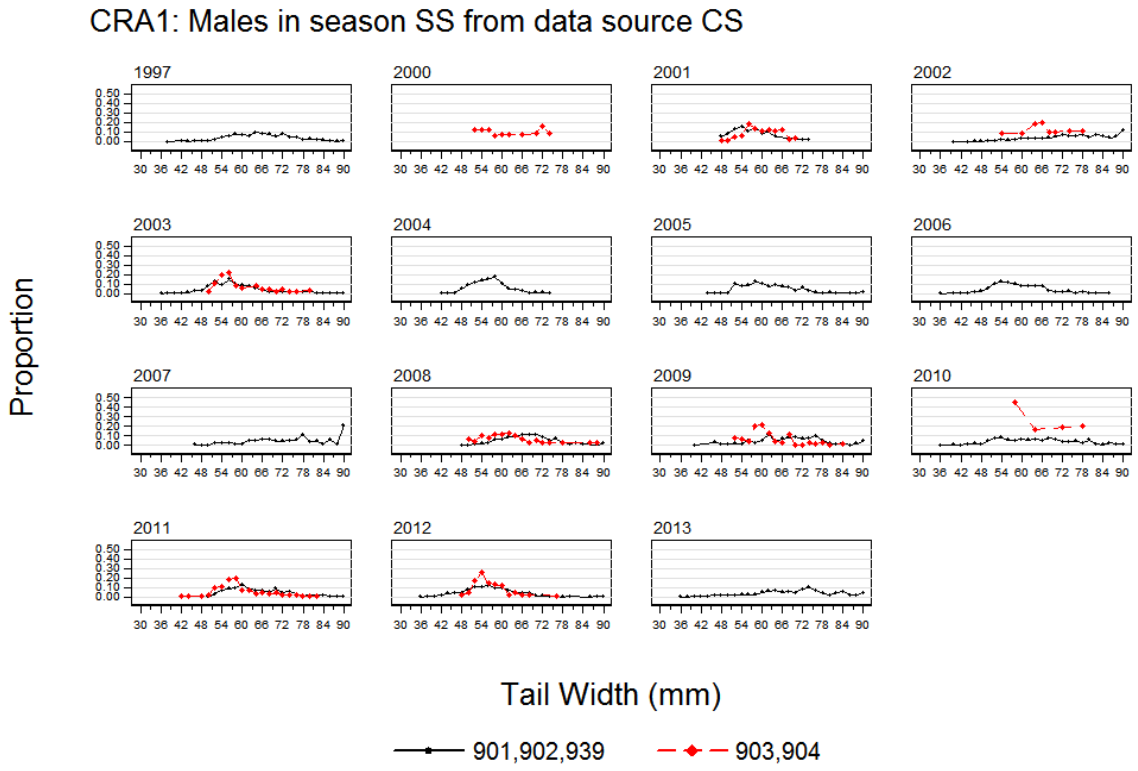

Figure C.6: Comparative distributions of male length frequencies in season SS by fishing year for CRA 1 divided into two regions: combined Areas 903/904 and Areas 901/902/903.

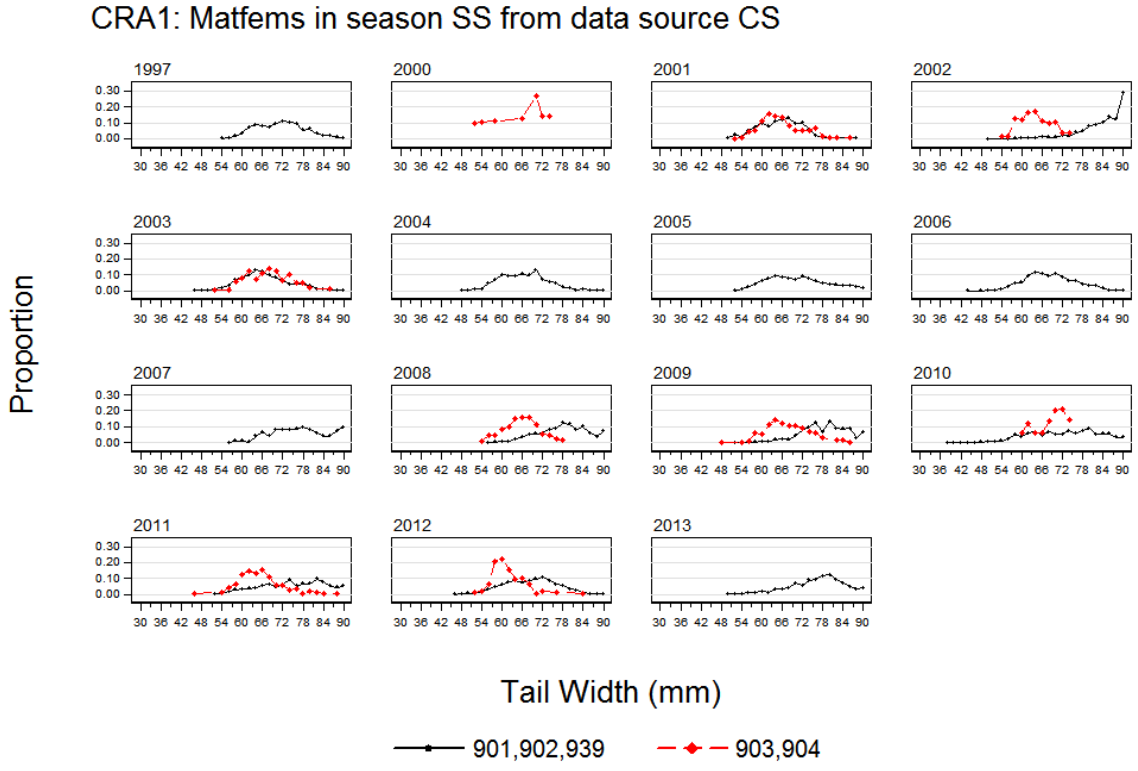

Figure C.7: Comparative distributions of mature female length frequencies in season SS by fishing year for CRA 1 divided into two regions: combined Areas 903/904 and Areas 901/902/903.