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Characterisation of fishery data for red rock lobsters (*Jasus edwardsii*) in CRA 9

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Plain language summary

The red rock lobster supports the most valuable inshore commercial fishery in New Zealand. This fishery has been managed with catch quotas in nine Quota Management Areas (QMAs), which are usually treated as independent populations or stocks.

To estimate those quotas, a stock assessment is done for each QMA approximately every five years. These stock assessments include a review of the previous stock assessments and data inputs, the addition of new data, data processing, and development of a new stock assessment model.

This document describes the characterisation of fisheries and relevant biological data for the CRA 9 stock (the West Coast of the North Island and upper West Coast of the South Island).

EXECUTIVE SUMMARY

Roberts, J.[1]; Webber, D.N.[2]; Starr, P.J.[3]; Rudd, M.B.[4]; Pons, M.[3] (2024). Characterisation of fishery data for red rock lobsters (*Jasus edwardsii*) in CRA 9.

***New Zealand Fisheries Assessment Report 2024/30.* 38 p.**

This document describes a characterisation of fisheries and relevant biological data for the CRA 9 stock of red rock lobster (*Jasus edwarsdii*) in New Zealand.

The CRA 9 fishery extends from north of Bruce Bay (in the south) to the Kaipara Harbour (in the north). However, the CRA 9 fishery is small, with fewer than 10 vessels each landing more than 1 tonne per fishing year since 2003, with most of this caught in two statistical areas off the North Island and South Island.

The unstandardised mean catch-per-unit-effort (CPUE) has increased to above 2 kg/potlift in each of the latest three fishing years (2020 to 2022). However, the catch and effort data in CRA 9 do not support the development of a robust standardised series of annual CPUE that can be used as an index of abundance, due to an apparent non-reporting of discards by some vessels and the sensitivity of standardisation model outputs to which vessels are included in the catch and effort data that are used.

The coverage of potlifts sampled for lobster sex and size composition of the catch has exceeded 1% in nearly all periods (autumn/winter and spring/summer seasons of each fishing year) since 2005. While this level of coverage appears to be adequate in other lobster Quota Management Areas (QMAs), plots of the resulting length frequencies indicate that it is unlikely that this level of sampling is representative of the fishery in CRA 9. The size composition data suggested that the size composition varies by statistical area, although these data were spiky and appear to be of low quality at recent sampling levels. Furthermore, both the sex and size compositions were highly variable among fishing years. Very few lobsters tagged in CRA 9 have been recaptured, precluding the estimation of growth rate using these data. The tag recapture data were particularly deficient for males and South Island lobsters.

All of the key datasets required for a length-based stock assessment were found to be lacking in some way (e.g., insufficient sampling by stock region with respect to catch sex ratio and size composition of the catch, and growth increment data), or of compromised quality for this purpose (e.g., poor quality catch and effort data precluding the development of representative CPUE indices of abundance). Furthermore, the lack of a reliable CPUE index of abundance also precludes the development of a simpler biomass dynamic type assessment for CRA 9.

These issues were caused or exacerbated by the small number of vessels operating across a wide stock area. Even with sampling coverage similar to other QMAs, the resulting data are not capable of informing a size-based stock assessment given the current Total Allowable Commercial Catch, although more of any of the data types would be helpful in this respect. Improvements in catch and effort reporting (particularly of legal discards) will be needed for the development of representative CPUE indices required by all lobster stock assessment approaches. Furthermore, given potential differences in the biology of lobsters in the North Island and South Island components of CRA 9, consideration may be given to targeting specific statistical areas for regional stock assessments in the future. Other research options are given for facilitating the development of a stock assessment for CRA 9.

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1. INTRODUCTION

The research described in this document was in fulfilment of Objective 6 of Fisheries New Zealand contract CRA2022-01, awarded to Quantifish Ltd.

The CRA 9 Quota Management Area (QMA) area is large (Figure 1) but has the smallest Total Allowable Commercial Catch (TACC) of any of the fished red rock lobster (*Jasus edwardsii*) QMAs. The CRA 9 fishery extends from north of Bruce Bay (in the south) to the Kaipara Harbour (in the north) (Figure 1), but commercial lobster fishing occurs mostly on the north-west coast of the South Island and the area between Pātea and Kawhia on the Taranaki coastline (statistical areas 931 and 935, respectively). There are few vessels taking more than 1 tonne (t) annually (e.g., five in 2022[5], Starr 2024).

The CRA 9 commercial fishery is managed by setting annual catch limits, including a TACC (currently set at 60.8 t), a recreational allowance of 30 t, a customary allowance of 20 t, and an 'other mortality' allowance of 5 t. This latter category includes handling mortality and illegal catch. These four catch components are summed to form the Total Allowable Catch (TAC) of 115.8 t, although only the commercial catch is actively managed to stay within its annual catch setting. In addition, there is a suite of input controls which are common with every other CRA QMA, except for the minimum legal size (MLS) regulations (54 mm tail width (TW) for males and 60 mm TW for females) which vary among the QMAs and sometimes the season of capture. The remaining input controls include a prohibition on taking berried females and soft-shell lobsters, the specification of escapement gap sizes which allow small lobsters to escape from pots, and a requirement that lobsters are landed ashore alive. Recreational fishers may take lobsters by pot or by hand (freediving or scuba), although these are subject to the same input controls that are in place for commercial fishers in CRA 9. Additionally, there is a daily bag limit of six rock lobsters combined for both red rock lobster and packhorse rock lobster (*Sagmariasus verreauxi*) in CRA 9.

A management procedure (MP) was developed for CRA 9 in 2013 based on a surplus production model informed by catch-per-unit-effort (CPUE), which resulted in a 60.8 t TACC (Breen 2014) and a TAC of 115.8 t (see above) for the 2014 fishing year. However, the MP was abandoned in 2016, because an unpublished review of the CRA 9 catch and effort data by D. Webber (Quantifish Ltd, January 2016) concluded that the CRA 9 CPUE index series was not a reliable indicator of abundance. This was because the small number of vessels fishing in recent years (six or fewer annually) caused major instability when comparing candidate CPUE models. In addition, there was evidence of inconsistent reporting of catch among fishers; and that the large size of the CRA 9 QMA relative to the size of the catch and the small number of vessels contributed to the uncertainty in the CPUE series, because changes in the fished area could cause inconsistencies among years.

Thus, due to lack of an acceptable abundance series and representative data, there is currently no accepted stock assessment for CRA 9. There has been no change to the TACC and TAC since 2014, when the MP was initially adopted. However, there is a desire among stakeholders and Fisheries New Zealand to develop a formal stock assessment in the future if a robust approach can be developed.

Given the data limitations for this stock, which are described below, it was agreed by Fisheries New Zealand and the Rock Lobster Working Group (RLWG) that a characterisation of the available fishery data was the most appropriate short-term research approach, focusing on the data types required for New Zealand red rock lobster stock assessments. Furthermore, it was agreed that this document should provide recommendations with respect to the information requirements for a stock assessment of CRA 9 in the future.

[5] Throughout this report, fishing years are named from the first nine months, e.g., 1998–99 is called 1998 and represents 1 April 1998 to 31 March 1999.

2. STATUTORY COMMERCIAL CATCH & EFFORT

The statutory commercial catch and effort data for CRA 9 were summarised for the fishing years 1979 to 2022, with respect to: the spatial and seasonal distribution of catches, unstandardised CPUE by fishing year, and the number of vessels operating in the fishery (see Starr 2024 for the methodology).

2.1 Data processing

Catch and effort data from 1 April 1979 to 30 June 1989 were obtained from the FSU (Fisheries Statistics Unit) database. Data from 1 July 1989 to 31 March 2023 were obtained from the Fisheries New Zealand Enterprise Data Warehouse (EDW), which has incorporated the previous WAREHOU database (Fisheries New Zealand replog 15071, received 25 May 2023). These data sources have been documented by Bentley et al. (2005) and the data were stored and maintained in the CRACE database (Bentley et al. 2005). The methods used to process catch and effort data followed those of Starr (2024), including the application of the error flags documented by Bentley et al. (2005). Likewise, the methods used for generating 'vessel correction factor' (*vcf*) values, the ratio of landed to estimated catch for a single vessel in a fishing year and statistical area, followed those of Starr (2024) (see equation D.6 of that publication).

Annual catch totals were based on Quota Management Reports (QMRs) from 1 April 1986 to 31 March 2001 and from Monthly Harvest Returns (MHRs) after 1 April 2001. These data sources are considered the best available information for lobster commercial catches for each QMA in any year. Annual catch totals before 1986 were taken from the Fisheries Statistics Unit (FSU) database (see Bentley et al. 2005).

2.2 Distribution of catch and effort

The CRA 9 TACC has been taken in full in almost every year since spiny rock lobster was introduced into the Quota Management System (QMS) on 1 April 1990 (Table 1). The TACC was raised from 47.0 t to 60.8 t in 2014, where it has since remained. This TACC is the lowest of any fished QMA. The 2022 TAC of 115.8 t included allowances of 20 t for customary catch, 30 t for recreational catch, and 5 t for 'other fishing morality' (Table 1). Note that the non-commercial allowances are not actively managed by Fisheries New Zealand.

Fewer than 10 vessels have operated in this fishery since 2003, with only 7, 6, and 5 vessels reporting annual landings of more than 1 t in CRA 9 in 2020, 2021, and 2022, respectively, compared with approximately 20 vessels operating in each fishing year throughout the 1980s (Table 2). Historically, at least 5 vessels (taking at least 1 t from CRA 9) have reported catches in each of five CRA 9 statistical areas in any one year (statistical areas 930, 931, 935, 936, and 937). However, in recent years, most effort has been concentrated in statistical area 931 (at the top of the West Coast South Island) and in statistical area 935 (Cape Egmont and South Taranaki Bight) (Figure 1). Very few vessels have operated in the southernmost and northernmost statistical areas of CRA 9 (statistical areas 929 and 938) since 1979 (Table 3). Note that the catch and effort summary tables in this report do not show information in strata for which fewer than three vessels have reported catch, which reduces the quantity of information that can be reported in this document.

The distribution of reported catch by statistical area and fishing year (Table 3) resembles the distribution of vessels (Table 2) and the distribution of potlifts (Table 4), with a greater spatial spread in the 1980s than in subsequent years, due to the larger number of vessels participating in this fishery. In the most recent fishing years, more than 70% of the CRA 9 catch was taken from statistical areas 931 and 935.

Before 1993, lobsters in CRA 9 were landed in the period from October to February; however, the peak landing period then shifted to July to October (Table 4, Table 5, and Figure 2). This shift to a winter fishery was also seen in most other CRA QMAs, reflecting the higher prices obtained in the winter before the opening of the western Australian lobster fishery in September. Fishing effort in some QMAs (e.g., CRA 3 and CRA 4) moved back to a summer fishery when catch rates dropped, but returned to

June to August when catch rates increased. The consistency of timing in the CRA 9 fishery likely reflects the generally high catch rates in this fishery (Table 5, Table 6).

2.3 Catch rate

The low numbers of vessels fishing in recent years, poor reporting, and the patchy nature of fishing led to the rejection of CPUE as an index of abundance in this QMA. The mean annual arithmetic CRA 9 CPUE (see Eq. 1 of Starr 2024) was at or slightly below 1 kg/potlift from 1981 to 1994, followed by a strong increase that peaked between 2004 and 2006. It peaked again in the 2010 fishing year, and in 2013 was at the highest level in the series (just below 3.0 kg/potlift) (Table 6, Figure 3). Arithmetic CPUE has exceeded 1.5 kg/potlift in all fishing years since 2004, when it first exceeded 2.0 kg/potlift. The arithmetic CPUE increased to above 2 kg/potlift in each of the most recent three fishing years (2020 to 2022).

2.4 Catch reporting

An unpublished review by D. Webber (Quantifish Ltd, January 2016) highlighted issues with the reporting of catch by most vessels operating in CRA 9 when viewed at the trip level. This review highlighted an apparent lack of reporting of legal discards by a large proportion of vessels operating in CRA 9, which was not considered plausible given the comparatively large size of lobsters captured in this QMA and the market preference at the time for smaller lobsters (see Section 3). The analysis presented in this report updates the catch reporting analysis in aggregate and extends it to the other QMAs to allow comparison between patterns in reporting in CRA 9 and the other CRA QMAs.

This analysis is based on the 25 May 2023 (Fisheries New Zealand replog 15071). The reported weight was summarised by QMA, fishing year, and 'terminal' destination code group (i.e., 'L+LFL+LR+QL'[6]: all codes that are assumed to constitute landed green weight for the purposes of catch rate analysis, destination codes 'L', 'LFL', 'LR', and 'QL'; 'F' = Section 111 recreational take; 'X' = legal fish returned to the water; 'P' = legal lobster put in holding pots; and 'Other' = all other destination codes[7]) (Figure 4). The intention of this plot was to compare the relative size of the catch that was reported as legally discarded within CRA 9 against that of the other QMAs, focusing on the period after 2009, when the reporting of legal discards became mandatory. The proportion of the total catch reported as legally discarded varied considerably by fishing year and QMA, but the patterns of legal discard reporting in CRA 9, when presented in this way, resembled the reporting by CRA 8, the nearest QMA (Figure 4). All the other QMAs presented variable patterns that reflected the fisheries in each area. Note that the 'other' category is much larger after the introduction of the ERS reporting system, reflecting the reporting of non-terminal codes that did not exist when paper forms were used[7].

The RLWG and Plenary meeting were shown an analysis of the same data, which presented the catch weight by fishing year and destination code for individual vessels in CRA 9 that had reported at least 20 t of total catch since 2010. This analysis concluded that some vessels had not reported any legal discards, while others had routinely reported at least 10% of their catch each year as legally discarded (this analysis cannot be displayed here, since it shows catch data from individual vessels). This was considered by the RLWG and Plenary meeting as evidence of issues with catch reporting in CRA 9, which would preclude the use of these data for the purposes of stock assessment. However, based on patterns in catch reporting in other QMAs (considered after the Plenary review), the reporting of legal discards in CRA 9 does not appear to be unusual when considered in aggregate by fishing year and QMA (Figure 4). However, the unpublished review by D. Webber also noted inconsistencies in the catch reporting of individual vessels when viewed at the trip level; at least two of the five main vessels

[6] Note that codes 'LFL', 'QL', and 'LR' are only valid for the Electronic Reporting System (ERS) data; 'L' was the only terminal landing code used during the paper form era.
[7] These codes include 'Y' (sub-legal discards), 'K' (berried females), 'N' (removed from a holding pot); these are codes that were introduced with the establishment of ERS reporting.

operating in CRA 9 at the time apparently misreported legal discards and one vessel recorded estimated catch without assigning this catch to any destination type in most trips.

Consistent issues with catch reporting can adversely affect the *vcf* ratio of individual vessels, i.e., the ratio of landed to estimated catch for a single vessel in a fishing year and statistical area. In the past, CPUE standardisations were based on a subset of the data from vessels in fishing years which were in the range of $0.8 < vcf < 1.2$. For CRA 9, this further reduces the number of vessels from which CPUE data could be used each year, with fewer than five vessels having the required *vcf* in all but one fishing year from 2011 to 2022 (Table 7). Such a small number of vessels operating within such a large and diverse QMA is unlikely to provide coverage of CRA 9 that would reliably track abundance changes over time.

3. OTHER CATCH CATEGORIES

Non-commercial catches are poorly known for CRA 9. As of April 2023, allowances were made of 30 t for recreational catch, 20 t for customary catch, and 5 t for 'other fishing morality'.

Six estimates of recreational catch were available for CRA 9 (Table 8). The first recreational catch estimates in New Zealand were made using offsite telephone-diary surveys, although these were not considered reliable by the Fisheries New Zealand Marine Amateur Fishing Working Group (MAFWG), because of flaws in the methodology for recruiting potential participants and because of likely overstated catches (Wright et al. 2004). The recreational harvest estimates provided by the 2000 and 2001 telephone-diary surveys were thought to be implausibly high for many species by the MAFWG. The problems with the earlier surveys led to the development of a rigorously designed National Panel Survey (NPS) for the 2011 October-September fishing year (Wynne-Jones et al. 2014), which was repeated for the 2017 October-September fishing year (Wynne-Jones et al. 2019). The NPS estimates of annual recreational take in CRA 9 (18.0 t from October 2011 to September 2012, and 17.1 t from October 2017 to September 2018) indicate that the recreational catch is less than the current 30 t allowance, that was also in place when these surveys took place. According to the 2000 survey, the mean individual weights of male and female lobsters taken by the recreational fishery were 0.96 kg and 0.71 kg, respectively, which were comparable with the combined mean weight estimate of 0.85 kg from the 2017 NPS survey (Boyd & Reilly 2004, Wynne-Jones et al. 2019).

CRA 9 illegal catches were estimated by MFish Compliance for the 1990 to 1995 fishing years, ranging from 12.0 to 21.9 t per fishing year. Following the approach of Starr et al. (2013), Breen (2014) applied an algorithm using estimates of export discrepancies for all New Zealand to generate estimates of illegal catches for CRA 9 for the years from 1963 to 2012 that were lacking data. After 2001, illegal catches were assumed to be 1 t annually, set to the value of Fisheries New Zealand Compliance estimate of non-reported illegal catch for that year.

4. SAMPLING COMMERCIAL CATCH COMPOSITION

Catch sampling (CS) (replog 15070) and logbook (LB) data (J. Olver, Fishserve, pers. comm.) for CRA 9 were obtained in May and June 2023, comprising data from 1996 to 2001 and from 2005 to 2022, for a total of 24 fishing years of sampling. The design of the logbook catch sampling programme requires participating fishers to measure and sex every lobster in each of 3–5 marked pots each day up to a maximum of 25 lobsters per pot. If there are more than 25 lobsters in a pot, only the first 25 are measured and sexed while the remaining lobsters are enumerated with respect to size above or below the MLS. This design can result in good spatial and temporal representation of the catch if the participating fishers are representative of the wider fishing fleet and record the data accurately. Since 2005, logbook coverage in CRA 9 has averaged around 2.5% of potlifts in the autumn/winter season (AW) and 1.5% in the spring/summer season (SS), with much lower coverage in earlier fishing years (Table 9, Table 10). The catch sampling programme measures and sexes all lobsters in as many pots as feasible during a day's fishing for the vessel being observed, although there has been nearly zero CS coverage in CRA 9 over all fishing years since the late 1980s.

Due to the negligible amount of CS data for CRA 9, only LB data are summarised here, by year, season, and sex category. The LB data set comprises around 3100 sampling days, with around 12 500 potlifts sampled (Table 9, Table 10, Table 11), and around 45 000 lobsters measured, although sampling was patchy prior to 2005 (Table 11) and very few immature females were sampled (Table 12, Table 13, Table 14, and Table 15).

Length frequency (LF) distributions for all of CRA 9 by season and sex were spiky (indicative of issues with data recording, including rounding) and showed poor agreement between adjacent years of sampling (Figure 5) (note that the distributions in this plot were not weighted by the catch). This was even the case for the 2009 sample, which was the only fishing year with at least 1000 pots sampled, although the continuity of the LFs appear to have improved with an increased rate of catch sampling coverage in the most recent fishing years. The analogous plots for statistical areas 931 and 935 are also quite uneven and appear unlikely to be representative of the catch in each statistical area (Figure 6, Figure 7). This apparent lack of representativeness occurs in spite of the relatively high level of sampling in this fishery (about 2.5% in AW and 1.5% in SS – see Table 9 and Table 10). These levels are comparable with sampling levels observed in other CRA QMAs that are considered well-sampled, but this high level of sampling in CRA 9 has not resulted in samples that could be reliably used in a stock assessment.

Male and mature female lobsters captured in statistical area 931 may be larger on average than in the other CRA 9 statistical areas (Figure 8). This conclusion must be tempered by the apparent poor quality of the LF data and because of potential confounding with year effects.

Males tend to dominate the sample in statistical area 931 during AW, whereas mature females dominate the SS sample in the same statistical area (Figure 9). However, there is a lot of variability in the sex ratios between years, which, together with the generally uneven and often spiky LFs, does not give much confidence that the catch composition is reliably represented by the available sex ratio data.

Some of the changes in size and sex composition in the logbook data could be driven by changes in the spatial distribution of effort through time, particularly given the small number of vessels fishing across CRA 9. Based on the recent electronic reporting system (ERS) data, which is geolocated and has now been collected across three full fishing years (2020 to 2022), it appears that the spatial distribution of fishing effort has not changed much between these years when viewed at the 10 km resolution. Note that these data cannot be presented in this report due to fisher confidentiality requirements. Spatial plots of fishing effort suggest that the lack of agreement in the LFs between fishing years in statistical areas 931 (Figure 6) and 935 (Figure 7) is unlikely to have been driven by changes in fishing distribution at the available level of spatial resolution.

5. GROWTH & MOVEMENT

Tag-recapture data are typically used by red rock lobster stock assessments to inform growth. These data can also be useful to inform decisions about stock structure and movement. Tag-recapture data for all QMAs were obtained in May 2023 from Fisheries New Zealand (replog 15053). The method used to process the tag data followed the approach of Webber et al. (2024).

Recovery rates (tags returned relative to numbers released) varied by QMA, with the highest return rate occurring in CRA 8 (30.3%) and the lowest rate in CRA 9 (2.0%) (Table 16). The QMA with most recovered tags was CRA 8, and the fewest recaptured tags came from CRA 6 and CRA 9, with 250 and 129 recoveries, respectively (Table 16).

In total, the processed tag data for CRA 9 comprised 129 records of recaptured tags, of which:

- a total of 98 were released in statistical area 935 and the remaining 31 recaptures were released in statistical areas 929, 931, or 936 (Table 17);
- all were tagged between 1999 and 2016 (Table 18) and nearly all were released in the period from July to October (Table 19); and
- a total of 95 were female and 34 were male (Table 20).

Tagged red rock lobsters are generally recaptured in the QMA or statistical area of release, with some individuals moving much greater distances. However, no lobsters tagged inside CRA 9 were recaptured in another QMA. Also, apart from two lobsters recaptured in statistical area 929[8] that may have been tagged there but were released in statistical area 928 (in CRA 8) by the tag processing code, none were recaptured inside CRA 9 when released elsewhere. Furthermore, from the very small number of recaptures in CRA 9, there was no evidence of movement between statistical areas (Table 21).

Very few tags were recaptured in CRA 9, which limited inference about growth patterns. The relationship between observed growth increment (mm) and time at liberty (years) appeared to be less variable than for growth increment and TW, with both relationships highly variable (Figure 10, Figure 11). For females the observed growth increment (mm) by TW (mm) at release was generally greater in smaller individuals, although no relationship was discernible from the smaller sample of male data (Figure 10). For both sexes, the observed growth increment increased with increasing period spent at liberty (Figure 11), with the time at liberty ranging from 3 to 2749 days (0.0–7.5 years).

6. DISCUSSION

The main inputs required to inform a length-based stock assessment of red rock lobsters in CRA 9 (representative CPUE indices, sex ratios, LFs, and growth increment data) all appear to be compromised in some way. The main issues identified by this characterisation and by previous research include:

- inconsistencies with catch reporting, specifically the potential non-reporting of legal discards by some vessels in all years, compromising the development of a reliable index of abundance for this stock;
- the small number of vessels by statistical area which results in instability among candidate CPUE models and likely unrepresentative coverage of the underlying lobster population;
- CPUE may be hyperstable, with the small number of vessels capable of maintaining high catch rates despite potential changes in abundance;
- the available length frequency and sex ratio data do not show consistency between years and appear to be compromised by poor quality data recording;

[8] Note that statistical area 929 is shared by CRA 8 and CRA 9 (see Figure 1).

- the LFs and sex ratios appear to indicate that the catch composition between statistical areas 931 (on the South Island) and 935 (on the North Island) differ, thus increasing data requirements to cover both areas; and
- a scarcity of tag-based growth information, especially for males and for South Island statistical areas.

Simpler models are possible using only CPUE indices and catch, e.g., the biomass dynamic models which were used previously for CRA 9 (Breen 2014) and the currently accepted assessment of packhorse rock lobster (Roberts & Webber 2021). However, the development of a robust CPUE-based index of abundance for CRA 9 is precluded by at least two apparently intractable issues. Firstly, the small number of vessels operating in this fishery was identified as a critical issue affecting the stability and reliability of a CPUE series in 2016. The number of vessels operating in CRA 9 has remained low since then and will become even smaller when vessels with out-of-range *vcf* values are removed. Secondly, the unpublished analysis of catch reporting by D. Webber indicated that there was inconsistency in catch reporting of legal discards up to the time of that review (in 2016). The current analysis did not extend the examination of catch reporting of individual vessels at the trip/event level. However, the apparent non-reporting of discards by some vessels in CRA 9 appears to have continued up to the 2022 fishing year. Consequently, even data-poor approaches to stock assessment are not recommended for CRA 9, given the lack of a reliable abundance time series based on the available catch and effort data.

Better LF data would also be required for a size-based stock assessment than are currently available. This is disappointing, given the relatively high level of sampling rate in this QMA (Table 10) which is comparable with levels observed in other CRA QMAs that are considered well sampled. However, it appears that the available sampling is not sufficiently representative, even though some instability in the LFs would be expected in adjacent fishing years, given the small size of this fishery. The spiky LF distributions in many years are indicative of a lack of accuracy in recorded sizes of sampled lobsters (e.g., due to rounding) or inconsistent spatial sampling. This could be partly addressed by using coarser bin widths in the stock assessment model. However, given the apparent different catch composition in the two main statistical areas (statistical area 931 on the South Island and 935 on the North Island), it is likely that a multi-region (or multi-fishery) model would be required to fit these data, thus increasing the sampling requirements in these statistical areas.

The scarcity of tag-based growth information is not as intractable, given that growth information can be 'borrowed' from other stocks, as is the case for the recent stock assessments of CRA 6, which only had a marginally larger sample of available tag recapture data (Rudd et al. 2024; Webber et al. 2024). However, given that CRA 9 covers a large geographical area, it is plausible that growth rates may vary across the QMA. As such, any additional tag-recapture data, particularly for males and South Island statistical areas, will help to guide the selection of proxy QMAs for growth information.

Given the outputs of this characterisation and from previous analyses, the RLWG concluded that there was currently little prospect of assessing the status of the CRA 9 stock, given the limited extent and variability of the data that have been reported to date by a small number of vessels participating in this fishery. However, the RLWG concluded that this situation may change in the future if there were a sustained improvement in catch and effort reporting (including accurate recording of legal discards), combined with a greater participation in the voluntary logbook programme, and if additional catch sampling of this fishery were undertaken.

7. POTENTIAL RESEARCH

The current potential for undertaking a stock assessment within CRA 9 is limited by data availability, both in terms of quantity and quality. The RLWG and Plenary meeting identified some potentially useful research to help address this, including:

- explore ways of enhancing fishery-dependent data collection via reporting from more logbook pots per fisher or reporting from harvest pots;
- work with fishers to improve existing reporting;
- investigate the feasibility of developing a potting survey index, potentially for one or both of the most important statistical areas (i.e., statistical areas 931 and 935);
- explore the feasibility of a biomass dynamic stock assessment model for CRA 9 (or key statistical areas) if the CPUE data provided by this fishery were deemed to be sufficiently reliable to support such an approach; and
- continue tagging work within CRA 9 to increase the available sample for estimating growth, particularly for males.

8. FULFILLMENT OF BROADER OUTCOMES

Whakapapa links all people back to the land, sea, and sky, and our obligations to respect the physical world. This research aims to ensure the long-term sustainability of red rock lobster stocks, for the good of the wider community (including stakeholders and the public) and the marine ecosystems that lobsters inhabit. This project supports both Māori and regional businesses and our research is inextricably linked to the moana from the work it carries out and the tangata whenua it supports.

To support the wider fisheries science community and enable more value to be extracted from the limited resources (time and money) available for fisheries research we make as much code as possible open source (i.e., publicly available). Furthermore, this project has built capacity and capability in fisheries science and stock assessment by employing researchers with a range of experience so that those with a long history of working in fisheries science can pass on their knowledge. This approach has meant that rock lobster stock assessments have consisted of a team with some members that have been involved for many years and some newer team members. This approach further mitigates risk associated with team members not being able to participate any longer.

9. ACKNOWLEDGEMENTS

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11. TABLES

Table 1: Reported commercial catch, TACC, and TAC (tonnes) for CRA 9 from 1979 to 2022. Data from FSU for 1979 to 1985, QMR for 1986 to 2000, and MHR for 2001 to 2022. Note the lack of robust catch data for 1988 and 1989, due to likely incomplete catch reporting in these fishing years by the FSU data system. There were no estimates of commercial catch available for the period prior to 1979.

FSU		QMR/MHR			MHR			
Fishing year	Catch	Fishing year	Catch	TACC	Fishing year	Catch	TACC	TAC
1979	89.0	1990	45.3	54.7	2005	46.6	47.0	–
1980	97.1	1991	47.5	51.5	2006	47.0	47.0	–
1981	72.0	1992	45.7	47.1	2007	47.0	47.0	–
1982	59.1	1993	45.5	47.0	2008	47.0	47.0	–
1983	70.6	1994	45.2	47.0	2009	46.6	47.0	–
1984	80.8	1995	45.4	47.0	2010	47.0	47.0	–
1985	79.2	1996	46.9	47.0	2011	47.0	47.0	–
1986	93.3	1997	46.7	47.0	2012	47.0	47.0	–
1987	92.7	1998	46.9	47.0	2013	47.1	47.0	–
1988	26.0	1999	47.0	47.0	2014	60.8	60.8	115.8
1989	26.8	2000	47.0	47.0	2015	60.6	60.8	115.8
		2001	46.8	47.0	2016	60.8	60.8	115.8
		2002	47.0	47.0	2017	60.7	60.8	115.8
		2003	45.9	47.0	2018	60.8	60.8	115.8
		2004	47.0	47.0	2019	58.4	60.8	115.8
					2020	63.1	60.8	115.8
					2021	60.8	60.8	115.8
					2022	60.8	60.8	115.8

Table 2: Number of vessels by statistical area in CRA 9 from 1979 to 2022 (table reproduced with permission from Starr 2024). Vessels catching less than 1 t in a year for the QMA were excluded. A '–' indicates no fishing in that statistical area/fishing year and '0' indicates that only vessels with < 1 t fished in the cell.

Fishing year	Number of vessels by statistical area							
	929	930	931	935	936	937	938	CRA 9
1979	4	6	6	3	6	3	–	23
1980	2	4	5	4	8	5	1	23
1981	1	3	7	3	4	4	–	20
1982	2	3	7	2	4	4	–	19
1983	1	3	7	3	6	6	–	22
1984	0	3	6	3	6	5	–	21
1985	0	2	7	7	6	6	–	20
1986	0	2	6	5	6	6	–	20
1987	0	2	5	5	6	5	–	19
1988	–	1	1	4	5	2	0	10
1989	1	4	4	7	3	1	–	18
1990	0	1	5	5	2	1	1	12
1991	–	1	5	6	0	1	0	13
1992	–	3	4	6	0	1	0	13
1993	0	3	3	6	0	0	–	12
1994	1	6	3	5	0	1	–	16
1995	1	4	1	6	1	1	–	14
1996	1	6	5	6	1	2	–	18
1997	1	6	5	7	4	1	–	19
1998	1	5	5	5	1	1	1	16
1999	1	7	6	4	0	1	–	17
2000	0	3	2	3	3	2	0	9
2001	0	2	2	4	2	3	0	11
2002	0	1	2	4	2	2	–	10
2003	–	1	3	3	2	1	–	9
2004	–	0	2	4	2	1	–	8
2005	0	1	2	4	1	1	–	8
2006	–	1	2	3	–	1	–	7
2007	–	1	2	3	1	1	–	7
2008	–	1	2	2	0	1	–	6
2009	–	1	2	2	1	1	–	6
2010	0	1	3	2	1	0	–	6
2011	–	1	2	2	0	–	–	5
2012	–	2	1	1	0	–	–	4
2013	–	1	2	1	0	–	–	4
2014	–	1	2	1	0	–	–	4
2015	–	1	3	1	2	–	–	7
2016	–	1	2	2	1	0	–	6
2017	0	1	3	2	0	1	–	5
2018	1	1	2	4	1	1	–	8
2019	2	1	3	3	2	1	–	8
2020	1	1	3	3	2	–	0	7
2021	–	1	3	3	2	0	–	6
2022	–	–	2	3	2	–	–	5

Table 3: Distribution of landings by statistical area and fishing year in CRA 9 from 1979 to 2022 (table reproduced with permission from Starr 2024). An 'x' indicates fewer than three vessels, and a '–' indicates no fishing, in that year/statistical area. Estimates for 2019 (grey shaded) based on mixed source CELR/ERS data.

Fishing	Distribution (%) by statistical area							Annual catch (t) by statistical area						
year	929	930	931	935	936	937	938	929	930	931	935	936	937	938
1979	14.7	14.7	28.8	13.1	13.4	15.3	–	13.1	13.1	25.6	11.7	11.9	13.7	–
1980	3.3	10.9	16.9	14.4	29.2	25.0	x	3.3	10.5	16.5	14.0	28.3	24.3	x
1981	4.3	8.9	32.5	10.2	20.0	24.1	–	3.1	6.4	23.4	7.4	14.4	17.3	–
1982	7.2	9.1	42.3	16.0	8.5	17.1	–	4.2	5.4	25.0	9.5	5.0	10.1	–
1983	x	6.3	50.1	8.2	12.6	20.7	–	x	4.4	35.4	5.8	8.9	14.6	–
1984	x	12.2	42.1	16.5	12.4	16.1	–	x	9.8	34.0	13.3	10.0	13.0	–
1985	x	7.0	38.6	18.8	16.3	19.2	–	x	5.6	30.6	14.9	12.9	15.2	–
1986	x	6.3	34.6	23.2	23.4	11.5	–	x	5.9	32.2	21.6	21.8	10.8	–
1987	x	x	33.5	36.3	16.1	11.2	–	x	x	31.0	33.7	15.0	10.4	–
1988	–	5.5	x	46.9	19.5	8.0	x	–	1.4	x	12.2	5.1	2.1	x
1989	2.0	19.4	24.3	43.3	6.5	4.4	–	0.5	5.2	6.5	11.6	1.7	1.2	–
1990	x	x	40.4	46.5	5.3	1.8	2.1	x	x	18.3	21.1	2.4	0.8	1.0
1991	–	x	49.8	40.2	x	5.1	x	–	x	23.7	19.1	x	2.4	x
1992	–	12.0	41.8	40.5	x	4.0	x	–	5.5	19.1	18.5	x	1.8	x
1993	x	23.3	26.3	47.3	x	1.6	–	x	10.6	12.0	21.5	x	0.7	–
1994	x	32.1	13.0	46.3	x	2.8	–	x	14.5	5.9	20.9	x	1.3	–
1995	5.5	27.4	x	44.1	x	8.9	–	2.5	12.5	x	20.0	x	4.0	–
1996	x	19.0	22.8	45.5	x	4.7	–	x	8.9	10.7	21.3	x	2.2	–
1997	5.7	16.5	19.7	45.4	9.9	2.9	–	2.7	7.7	9.2	21.2	4.6	1.3	–
1998	4.7	31.1	19.2	35.2	x	4.7	x	2.2	14.6	9.0	16.5	x	2.2	x
1999	x	34.8	28.4	28.7	x	5.0	–	x	16.3	13.3	13.5	x	2.3	–
2000	1.2	7.5	x	35.3	10.3	11.9	x	0.6	3.5	x	16.6	4.9	5.6	x
2001	x	10.0	24.0	41.6	12.2	x	x	x	4.7	11.2	19.5	5.7	x	x
2002	x	x	x	44.4	12.4	x	–	x	x	x	20.9	5.8	x	–
2003	–	x	37.2	31.3	16.2	x	–	–	x	17.1	14.4	7.4	x	–
2004	–	x	x	54.7	8.5	x	–	–	x	x	25.7	4.0	x	–
2005	x	x	x	56.2	7.4	x	–	x	x	x	26.2	3.5	x	–
2006	–	x	28.8	59.1	–	x	–	–	x	13.5	27.8	–	x	–
2007	–	x	x	63.9	0.4	x	–	–	x	x	30.1	0.2	x	–
2008	–	x	x	39.7	1.4	x	–	–	x	x	18.7	0.7	x	–
2009	–	x	x	x	2.0	x	–	–	x	x	x	0.9	x	–
2010	x	x	45.3	38.0	7.1	x	–	x	x	21.3	17.8	3.4	x	–
2011	–	x	x	42.0	1.5	–	–	–	x	x	19.7	0.7	–	–
2012	–	x	x	34.0	1.5	–	–	–	x	x	16.0	0.7	–	–
2013	–	x	x	x	2.8	–	–	–	x	x	x	1.3	–	–
2014	–	x	x	x	1.6	–	–	–	x	x	x	1.0	–	–
2015	–	8.3	42.2	29.8	19.7	–	–	–	5.0	25.6	18.1	11.9	–	–
2016	–	x	x	47.0	2.6	x	–	–	x	x	28.6	1.6	x	–
2017	x	x	40.5	x	1.6	x	–	x	x	24.6	x	1.0	x	–
2018	x	x	x	41.7	0.8	x	–	x	x	x	25.4	0.5	x	–
2019	11.8	x	34.7	41.1	x	x	–	6.9	x	20.2	24.0	x	x	–
2020	x	x	32.1	47.0	14.8	–	x	x	x	20.2	29.7	9.4	–	x
2021	–	x	36.0	47.4	x	x	–	–	x	21.9	28.8	x	x	–
2022	–	–	x	50.9	x	–	–	–	–	x	30.9	x	–	–

Table 4: Distribution and annual potlifts by statistical area in CRA 9 from 1979 to 2022 (table reproduced with permission from Starr 2024). An 'x' indicates fewer than 3 vessels and a '–' indicates no fishing in the year/statistical area cell. This table was generated from data prepared using the B4 algorithm scaled to the 'L' or the combined (L+LFL+LR+QL) destination codes. Estimates for 2019 (grey shaded) based on mixed source CELR/ERS data.

Fishing	Distribution (%) by statistical area							Annual potflifts (000s) by statistical area							
year	929	930	931	935	936	937	938	929	930	931	935	936	937	938	CRA 9
1979	13.5	15.8	12.8	23.0	21.8	13.1	–	10.8	12.7	10.2	18.5	17.5	10.5	–	80.2
1980	5.9	11.8	8.5	20.1	37.7	15.8	x	5.0	10.1	7.2	17.1	32.2	13.5	x	85.4
1981	5.8	10.5	13.6	20.3	31.3	18.4	–	4.3	7.7	10.0	14.9	22.9	13.5	–	73.3
1982	7.5	16.2	23.0	19.9	15.8	17.6	–	5.2	11.1	15.8	13.6	10.9	12.1	–	68.7
1983	x	8.4	26.2	12.3	27.4	22.1	–	x	6.3	19.6	9.2	20.5	16.5	–	74.7
1984	x	17.6	20.9	19.5	21.6	18.7	–	x	16.1	19.1	17.8	19.7	17.0	–	91.2
1985	x	9.9	26.8	20.8	22.5	19.8	–	x	10.5	28.6	22.2	24.0	21.1	–	106.8
1986	x	8.6	26.2	22.4	25.8	15.9	–	x	9.2	28.2	24.1	27.7	17.1	–	107.6
1987	x	x	31.8	25.6	22.4	15.5	–	x	x	34.8	28.1	24.5	17.0	–	109.6
1988	–	10.7	x	29.2	30.1	9.8	x	–	3.5	x	9.4	9.7	3.2	x	32.3
1989	3.7	26.5	14.1	34.9	12.9	7.8	–	1.2	8.5	4.5	11.2	4.1	2.5	–	32.1
1990	x	x	28.9	52.7	4.6	x	3.0	x	x	13.4	24.4	2.1	x	1.4	46.2
1991	–	x	34.3	46.3	x	x	x	–	x	17.5	23.6	x	x	x	51.0
1992	–	17.5	25.8	45.7	x	x	x	–	8.9	13.1	23.3	x	x	x	50.9
1993	x	24.9	23.0	48.5	x	x	–	x	8.7	8.0	16.9	x	x	–	34.9
1994	x	45.1	9.2	34.7	x	x	–	x	21.7	4.4	16.7	x	x	–	48.1
1995	11.2	39.1	x	33.4	x	x	–	5.0	17.6	x	15.0	x	x	–	45.0
1996	x	26.9	25.9	35.7	x	x	–	x	12.9	12.4	17.1	x	x	–	47.9
1997	5.4	23.6	25.7	35.1	7.4	x	–	3.2	14.0	15.2	20.8	4.4	x	–	59.4
1998	6.9	38.8	14.5	33.2	x	x	x	3.5	19.7	7.4	16.9	x	x	x	50.9
1999	x	41.2	25.0	24.9	x	x	–	x	22.2	13.5	13.4	x	x	–	53.8
2000	1.6	9.9	x	43.9	20.2	x	x	0.8	5.0	x	22.3	10.2	x	x	50.8
2001	x	15.1	10.9	51.9	x	10.3	x	x	8.6	6.2	29.6	x	5.9	x	57.0
2002	x	x	x	40.8	x	x	–	x	x	x	17.2	x	x	–	42.2
2003	–	x	33.2	22.6	x	x	–	–	x	9.5	6.5	x	x	–	28.7
2004	–	x	x	50.8	x	x	–	–	x	x	11.2	x	x	–	22.0
2005	x	x	x	58.1	x	7.1	–	x	x	x	12.2	x	1.5	–	21.0
2006	–	x	19.0	67.9	–	x	–	–	x	4.6	16.4	–	x	–	24.2
2007	–	x	x	67.3	x	x	–	–	x	x	17.1	x	x	–	25.4
2008	–	x	x	28.6	x	x	–	–	x	x	7.7	x	x	–	26.9
2009	–	x	x	x	x	x	–	–	x	x	x	x	x	–	28.4
2010	x	x	33.0	45.5	x	x	–	x	x	9.7	13.4	x	x	–	29.4
2011	–	x	x	45.5	x	–	–	–	x	x	10.1	x	–	–	22.2
2012	–	x	x	12.3	x	–	–	–	x	x	2.5	x	–	–	20.5
2013	–	x	x	x	x	–	–	–	x	x	x	x	–	–	19.0
2014	–	x	x	x	x	–	–	–	x	x	x	x	–	–	30.7
2015	–	10.8	51.4	19.8	x	–	–	–	3.4	16.3	6.3	x	–	–	31.7
2016	–	x	x	43.1	x	x	–	–	x	x	15.6	x	x	–	36.2
2017	x	x	33.5	x	x	x	–	x	x	11.8	x	x	x	–	35.4
2018	x	x	x	49.9	x	x	–	x	x	x	19.3	x	x	–	38.6
2019	5.7	x	29.8	52.6	x	x	–	1.9	x	10.0	17.7	x	x	–	33.6
2020	x	x	24.2	50.5	17.2	–	x	x	x	7.9	16.5	5.6	–	x	32.7
2021	–	x	35.9	44.6	x	x	–	–	x	9.3	11.6	x	x	–	25.9
2022	–	–	x	45.5	x	–	–	–	–	x	11.7	x	–	–	25.7

Table 5: Percentage of landings in CRA 9 by fishing month for fishing years 1979 to 2022 (table reproduced with permission from Starr 2024). An 'x' indicates fewer than three vessels, and a '–' indicates no fishing, in that year/statistical area. Estimates for 2019 (grey shaded) based on mixed source CELR/ERS data.

Fishing year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1979	3.4	x	0.6	3.6	2.9	2.0	15.0	26.0	11.6	17.5	11.0	6.3
1980	0.8	0.1	0.2	2.7	2.7	2.4	13.4	5.7	21.1	32.0	15.0	3.8
1981	0.6	0.2	1.4	2.4	3.0	1.2	9.0	19.9	20.7	19.7	14.7	7.3
1982	4.0	x	2.4	4.6	8.1	3.1	8.2	8.0	16.0	14.8	20.8	9.3
1983	2.6	x	x	11.2	5.2	0.9	5.5	11.6	11.6	21.1	18.4	8.2
1984	0.8	2.3	x	5.1	5.3	8.3	7.9	16.4	13.4	15.6	14.4	8.2
1985	4.4	1.6	0.3	2.9	6.5	10.4	10.4	14.6	17.3	12.8	11.6	7.3
1986	2.0	0.6	0.6	4.8	4.3	5.1	9.5	16.2	20.8	15.3	10.6	10.2
1987	2.7	x	x	3.0	5.9	4.8	15.9	18.0	13.6	15.2	11.4	7.8
1988	4.4	–	x	4.9	3.0	8.3	3.7	13.6	18.6	21.3	12.9	8.8
1989	1.3	x	x	3.9	7.5	16.0	8.0	10.6	12.5	15.8	18.3	6.0
1990	0.4	–	–	2.2	5.1	11.9	21.4	12.2	6.4	13.1	11.1	16.2
1991	1.1	x	x	17.1	6.1	8.9	9.8	17.4	12.5	10.1	7.4	7.4
1992	0.5	x	11.7	11.9	3.4	13.6	11.6	11.1	10.4	9.1	11.7	4.3
1993	1.0	x	1.0	24.3	9.3	12.7	16.7	6.8	11.0	5.9	8.4	2.6
1994	x	x	4.4	11.9	12.0	13.6	22.4	8.8	13.6	9.6	2.1	1.4
1995	x	x	2.3	8.4	16.5	24.3	23.5	12.8	4.9	3.6	0.5	x
1996	x	0.5	4.6	16.2	17.2	22.3	17.0	8.1	7.3	4.6	0.7	1.1
1997	x	x	12.5	21.0	15.0	17.1	12.0	7.3	7.0	3.6	3.9	x
1998	1.1	1.2	2.6	8.2	12.7	17.9	12.6	18.4	10.8	8.3	3.7	2.6
1999	0.8	1.6	6.4	9.4	15.9	27.3	18.2	12.5	5.7	2.2	x	x
2000	3.2	2.3	6.0	20.4	19.5	12.6	13.9	12.5	6.8	x	x	x
2001	4.2	2.7	8.8	25.3	13.5	23.3	13.9	3.8	2.8	x	x	x
2002	11.3	5.0	1.9	18.0	14.1	14.2	6.3	8.1	8.1	3.2	8.2	x
2003	8.0	0.7	x	16.1	28.8	9.0	8.7	5.8	9.5	10.7	–	x
2004	x	x	3.6	34.6	27.6	16.3	13.3	–	1.1	x	x	x
2005	x	2.5	12.0	20.6	28.8	29.5	2.6	x	0.8	x	x	x
2006	x	7.8	21.4	30.4	17.5	16.3	–	x	1.8	–	–	–
2007	x	x	16.1	39.2	23.5	12.2	x	x	x	x	–	x
2008	x	2.9	7.4	11.4	22.8	34.4	12.9	x	1.7	x	x	x
2009	4.9	3.1	8.2	11.6	5.3	28.9	25.3	3.2	5.3	x	x	x
2010	5.5	3.2	9.0	28.8	11.8	11.5	23.4	–	x	x	x	–
2011	x	x	x	5.2	11.8	30.6	30.0	x	x	x	–	x
2012	x	x	4.8	13.8	6.6	35.9	14.0	x	x	–	x	x
2013	x	x	x	16.6	23.9	29.0	3.2	8.0	x	–	–	x
2014	5.1	4.2	9.2	24.2	26.1	13.4	12.0	x	x	–	–	–
2015	x	x	4.2	28.6	21.8	9.4	11.5	13.9	2.4	–	x	–
2016	8.8	4.3	0.7	11.7	23.4	18.4	19.9	6.0	6.3	–	–	x
2017	2.3	x	9.9	21.0	23.4	25.6	5.8	x	x	–	x	x
2018	6.1	x	x	12.2	10.1	22.6	17.8	7.2	x	x	x	x
2019	x	4.9	11.6	14.2	5.5	15.4	19.4	18.2	x	x	–	x
2020	X	x	x	21.0	17.4	20.9	21.7	4.5	x	x	x	2.9
2021	x	x	x	14.8	24.8	17.7	19.9	9.2	x	–	x	x
2022	–	–	x	10.4	28.3	32.0	20.9	x	–	–	–	x

Table 6: Arithmetic CPUE (kg/potlift) (see Eq. 1 of Starr 2024) for CRA 9 by fishing year and statistical area from 1979 to 2022 (table reproduced with permission from Starr 2024). An 'x' indicates fewer than three vessels, and a '–' indicates no fishing, in that year/statistical area. Estimates for 2019 (grey shaded) based on mixed source CELR/ERS data. Estimates beginning with 2019 may not be comparable to earlier estimates based on CELR or FSU data.

Fishing year	Arithmetic mean CPUE							
	929	930	931	935	936	937	938	CRA 9
1979	1.21	1.03	2.51	0.63	0.68	1.30	–	1.11
1980	0.65	1.05	2.28	0.82	0.88	1.80	x	1.14
1981	0.73	0.83	2.35	0.49	0.63	1.28	–	0.98
1982	0.82	0.48	1.58	0.69	0.46	0.83	–	0.86
1983	x	0.70	1.81	0.63	0.44	0.89	–	0.95
1984	x	0.61	1.78	0.75	0.51	0.77	–	0.89
1985	x	0.53	1.07	0.67	0.54	0.72	–	0.74
1986	x	0.64	1.14	0.90	0.79	0.63	–	0.87
1987	x	x	0.89	1.20	0.61	0.61	–	0.85
1988	–	0.42	x	1.29	0.52	0.66	x	0.81
1989	–	x	–	1.15	0.45	x	–	0.88
1990	–	x	1.32	0.85	x	–	–	0.97
1991	–	x	1.43	0.84	–	x	–	0.94
1992	–	x	1.44	0.75	–	x	–	0.98
1993	–	x	1.49	1.47	–	–	–	1.37
1994	–	–	x	x	–	x	–	1.27
1995	–	–	x	1.33	x	x	–	1.40
1996	–	x	x	1.26	x	x	–	1.13
1997	–	0.38	x	1.03	1.01	x	–	0.91
1998	–	x	x	0.85	x	x	x	1.08
1999	–	x	1.69	0.73	–	x	–	1.01
2000	–	0.84	x	0.74	0.45	x	–	0.95
2001	–	x	x	0.66	x	0.99	–	0.85
2002	–	–	x	1.23	x	x	–	1.25
2003	–	–	x	2.01	x	x	–	1.51
2004	–	x	x	2.16	x	x	–	2.08
2005	–	–	x	2.16	x	x	–	2.30
2006	–	–	x	1.71	–	x	–	1.99
2007	–	–	x	1.77	x	x	–	1.87
2008	–	x	x	2.12	x	x	–	1.75
2009	–	x	x	x	x	x	–	2.07
2010	–	x	2.95	2.53	x	–	–	2.49
2011	–	x	x	x	–	–	–	2.19
2012	–	x	–	x	x	–	–	2.49
2013	–	x	x	x	x	–	–	2.94
2014	–	–	x	x	x	–	–	2.86
2015	–	x	x	x	x	–	–	2.38
2016	–	x	x	x	x	–	–	1.92
2017	–	x	x	x	x	x	–	1.82
2018	–	x	x	1.53	x	x	–	1.79
2019	–	–	x	1.22	x	x	–	1.55
2020	–	x	x	1.85	1.75	–	–	2.03
2021	–	–	x	2.54	x	–	–	2.54
2022	–	–	x	2.72	x	–	–	2.80

Table 7: Number of vessels in each of three vessel correction factor categories in CRA 9 by reporting form type and fishing year from 1990 to 2022 (table reproduced with permission from Starr 2024). Vessels with <1000 kg of annual QMA landings ('A', 'L', 'X', 'LR', 'LFL', 'QL' destination codes) were omitted from this summary. CELR = paper forms; ER = electronic reporting. '–': no data.

Fishing	CELR				ER			
year	<0.8	0.8-1.2	>1.2	Total	<0.8	0.8-1.2	>1.2	Total
1990	–	10	3	13	–	–	–	–
1991	–	12	–	12	–	–	–	–
1992	–	11	1	12	–	–	–	–
1993	–	8	2	10	–	–	–	–
1994	2	5	3	10	–	–	–	–
1995	–	8	1	9	–	–	–	–
1996	1	8	1	10	–	–	–	–
1997	–	12	–	12	–	–	–	–
1998	–	8	2	10	–	–	–	–
1999	–	7	2	9	–	–	–	–
2000	–	9	–	9	–	–	–	–
2001	–	10	1	11	–	–	–	–
2002	–	9	1	10	–	–	–	–
2003	–	8	1	9	–	–	–	–
2004	1	8	1	10	–	–	–	–
2005	–	7	1	8	–	–	–	–
2006	–	7	–	7	–	–	–	–
2007	–	7	–	7	–	–	–	–
2008	1	6	1	8	–	–	–	–
2009	–	6	1	7	–	–	–	–
2010	–	6	1	7	–	–	–	–
2011	–	4	2	6	–	–	–	–
2012	–	3	2	5	–	–	–	–
2013	–	3	2	5	–	–	–	–
2014	–	3	2	5	–	–	–	–
2015	–	5	3	8	–	–	–	–
2016	–	4	2	6	–	–	–	–
2017	–	4	2	6	–	–	–	–
2018	1	4	2	7	–	–	–	–
2019	–	2	2	4	1	3	2	6
2020	–	–	–	–	–	4	2	6
2021	–	–	–	–	1	4	2	7
2022	–	–	–	–	–	4	1	5

Table 8: Available estimates of recreational rock lobster harvest (in numbers and in tonnes [t] for CRA 9, from regional telephone and diary surveys in 1993, 1996, 2000, and 2001 (Bradford 1997, 1998, Teirney et al. 1997, Boyd & Reilly 2004). Other estimates were from 2011 (national panel survey, see Wynne-Jones et al. 2014, Heinemann et al. 2015); and 2017 from a second national panel survey (Wynne-Jones et al. 2019). '–': not available.

Survey	Number	CV (%)	Nominal catch weight point estimate (t)
Northern Region Survey 1993–94	6 000	–	–
1996 Survey	26 000	–	–
2000 Survey	65 000	64	52.8
2001 Roll Over Survey	34 000	68	27.7
National panel survey: Oct 2011–Sep 2012	15 530	30	17.96
National panel survey: Oct 2017–Sep 2018	20 034	34	17.07

Table 9: Total number of potlifts sampled by fishing year and sampling programme in CRA 9 from 1996–2022. '–': no data.

Fishing year	Logbook		Catch sampling		Both methods	
	AW	SS	AW	SS	AW	SS
1996	153	–	–	–	153	–
1997	147	–	–	–	147	–
1998	300	29	–	–	300	29
1999	153	–	–	–	153	–
2000	424	64	–	–	424	64
2001	580	64	151	–	731	64
2002	–	–	–	–	–	–
2003	–	–	–	–	–	–
2004	–	–	–	–	–	–
2005	470	12	–	–	470	12
2006	584	–	–	–	584	–
2007	896	20	–	–	896	20
2008	703	113	–	–	703	113
2009	905	221	–	–	905	221
2010	462	–	–	–	462	–
2011	604	74	–	–	604	74
2012	250	127	–	–	250	127
2013	229	60	–	–	229	60
2014	232	62	–	–	232	62
2015	500	122	–	–	500	122
2016	495	145	–	–	495	145
2017	613	57	–	–	613	57
2018	609	216	–	–	609	216
2019	316	343	–	–	316	343
2020	311	19	–	–	311	19
2021	262	51	–	–	262	51
2022	525	127	–	–	525	127

Table 10: Sampling rate (%) of potlifts by fishing year, season, and sampling programme in CRA 9 from 1996–2022. '–': no data. The total number of potlifts was derived using EDW data extracted from the CRACE database by applying the 'F0_L' algorithm, which means that all effort records with associated landings were included regardless of 'vessel correction ratio' (see appendix D of Starr 2024), and by dropping all records with error flags greater than 1. The count of potlifts sampled by fishing year, season, and sampling programme were matched with the total estimated potlifts for each respective stratum, and the sampling coverage was calculated as the percentage of the total potlifts that was sampled.

Fishing	Logbook		Catch sampling		Both methods	
year	AW	SS	AW	SS	AW	SS
1996	0.5	–	–	–	0.5	–
1997	0.4	–	–	–	0.4	–
1998	0.9	0.5	–	–	0.9	0.5
1999	0.5	–	–	–	0.5	–
2000	1.1	0.7	–	–	1.1	0.7
2001	1.2	1.1	0.3	–	1.5	1.1
2002	–	–	–	–	–	–
2003	–	–	–	–	–	–
2004	–	–	–	–	–	–
2005	2.4	1.0	–	–	2.4	1.0
2006	2.6	–	–	–	2.6	–
2007	3.9	1.4	–	–	3.9	1.4
2008	3.8	2.0	–	–	3.8	2.0
2009	5.2	2.7	–	–	5.2	2.7
2010	2.2	–	–	–	2.2	–
2011	3.8	1.6	–	–	3.8	1.6
2012	2.3	2.3	–	–	2.3	2.3
2013	1.7	2.4	–	–	1.7	2.4
2014	1.2	1.5	–	–	1.2	1.5
2015	2.5	2.2	–	–	2.5	2.2
2016	2.4	2.1	–	–	2.4	2.1
2017	2.7	1.0	–	–	2.7	1.0
2018	3.4	1.6	–	–	3.4	1.6
2019	1.5	2.7	–	–	1.5	2.7
2020	1.5	0.2	–	–	1.5	0.2
2021	1.5	0.8	–	–	1.5	0.8
2022	2.5	2.5	–	–	2.5	2.5

Table 11: Total number of lobsters sampled by fishing year and sampling programme for the CRA 9 region from 1996 to 2022. '–': no data.

Fishing year	Logbook		Catch sampling		Both methods	
	AW	SS	AW	SS	AW	SS
1996	209	–	–	–	209	–
1997	266	–	–	–	266	–
1998	441	165	–	–	441	165
1999	220	–	–	–	220	–
2000	1 084	127	–	–	1 084	127
2001	1 637	142	200	–	1 837	142
2002	–	–	–	–	–	–
2003	–	–	–	–	–	–
2004	–	–	–	–	–	–
2005	1 852	78	–	–	1 852	78
2006	2 628	–	–	–	2 628	–
2007	3 363	110	–	–	3 363	110
2008	2 352	982	–	–	2 352	982
2009	2 727	1 045	–	–	2 727	1 045
2010	1 276	–	–	–	1 276	–
2011	1 529	522	–	–	1 529	522
2012	911	527	–	–	911	527
2013	957	344	–	–	957	344
2014	869	388	–	–	869	388
2015	1 855	884	–	–	1 855	884
2016	2 116	818	–	–	2 116	818
2017	2 305	279	–	–	2 305	279
2018	2 235	584	–	–	2 235	584
2019	1 358	1 342	–	–	1 358	1 342
2020	1 077	64	–	–	1 077	64
2021	1 089	385	–	–	1 089	385
2022	2 566	525	–	–	2 566	525

Table 12: Total number of lobsters measured by fishing year, sex, and season for the CRA 9 region by the observer catch sampling and the logbook programmes from 1996–2022. Note that a small number of lobsters were also sampled in 1974 and 1976, although these records were not attributed to a statistical area and the length measurement was in terms of carapace length rather than tail width. Hence, these earlier data are not shown in any of the plots shown in this document. (Continued next page)

	Catch sampling (CS)				Logbook (LB)			
Fishing year	Male	Immature female	Mature female	Total	Male	Immature female	Mature female	Total
Season=AW								
1996	–	–	–	–	133	–	76	209
1997	–	–	–	–	117	2	147	266
1998	–	–	–	–	291	1	149	441
1999	–	–	–	–	72	15	133	220
2000	–	–	–	–	429	134	521	1 084
2001	92	37	71	200	621	161	855	1 637
2002	–	–	–	–	–	–	–	–
2003	–	–	–	–	–	–	–	–
2004	–	–	–	–	–	–	–	–
2005	–	–	–	–	1 018	56	778	1 852
2006	–	–	–	–	1 314	5	1 309	2 628
2007	–	–	–	–	1 710	12	1 641	3 363
2008	–	–	–	–	1 083	–	1 269	2 352
2009	–	–	–	–	1 265	1	1 461	2 727
2010	–	–	–	–	746	–	530	1 276
2011	–	–	–	–	835	1	693	1 529
2012	–	–	–	–	493	–	418	911
2013	–	–	–	–	387	–	570	957
2014	–	–	–	–	487	–	382	869
2015	–	–	–	–	1 180	1	674	1 855
2016	–	–	–	–	981	5	1 130	2 116
2017	–	–	–	–	1 295	1	1 009	2 305
2018	–	–	–	–	1 087	6	1 142	2 235
2019	–	–	–	–	897	–	461	1 358
2020	–	–	–	–	669	11	397	1 077
2021	–	–	–	–	764	–	325	1 089
2022	–	–	–	–	1 853	13	700	2 566
Total	**92**	**37**	**71**	**200**	**19 727**	**425**	**16 770**	**36 922**

Table 12 continued:

	Catch sampling (CS)				Logbook (LB)			
Fishing year	Male	Immature female	Mature female	Total	Male	Immature female	Mature female	Total
Season=SS								
1996	–	–	–	–	–	–	–	–
1997	–	–	–	–	–	–	–	–
1998	–	–	–	–	32	13	120	165
1999	–	–	–	–	–	–	–	–
2000	–	–	–	–	23	12	92	127
2001	–	–	–	–	47	21	74	142
2002	–	–	–	–	–	–	–	–
2003	–	–	–	–	–	–	–	–
2004	–	–	–	–	–	–	–	–
2005	–	–	–	–	38	4	36	78
2006	–	–	–	–	–	–	–	–
2007	–	–	–	–	37	1	72	110
2008	–	–	–	–	159	1	822	982
2009	–	–	–	–	136	–	909	1 045
2010	–	–	–	–	–	–	–	–
2011	–	–	–	–	45	–	477	522
2012	–	–	–	–	95	–	432	527
2013	–	–	–	–	73	–	271	344
2014	–	–	–	–	40	–	348	388
2015	–	–	–	–	423	1	460	884
2016	–	–	–	–	183	2	633	818
2017	–	–	–	–	88	8	183	279
2018	–	–	–	–	161	2	421	584
2019	–	–	–	–	524	–	797	1 342
2020	–	–	–	–	5	21	59	64
2021	–	–	–	–	160	–	195	385
2022	–	–	–	–	253	30	272	525
Total	**–**	**–**	**–**	**–**	**2 522**	**116**	**6 673**	**9 311**

Table 13: Total number of lobsters measured by fishing year, sex, and season for statistical area 931 by the observer catch sampling and the logbook programmes from 1996–2022. (Continued next page)

	Catch sampling (CS)				Logbook (LB)			
Fishing year	Male	Immature female	Mature female	Total	Male	Immature female	Mature female	Total
Season=AW								
1996	–	–	–	–	–	–	–	–
1997	–	–	–	–	–	–	–	–
1998	–	–	–	–	210	1	54	265
1999	–	–	–	–	72	15	133	220
2000	–	–	–	–	–	–	–	–
2001	–	–	–	–	–	–	–	–
2002	–	–	–	–	–	–	–	–
2003	–	–	–	–	–	–	–	–
2004	–	–	–	–	–	–	–	–
2005	–	–	–	–	483	7	113	603
2006	–	–	–	–	449	5	216	670
2007	–	–	–	–	777	10	638	1 425
2008	–	–	–	–	473	–	573	1 046
2009	–	–	–	–	949	–	702	1 651
2010	–	–	–	–	519	–	161	680
2011	–	–	–	–	486	–	205	691
2012	–	–	–	–	392	–	320	712
2013	–	–	–	–	387	–	570	957
2014	–	–	–	–	487	–	382	869
2015	–	–	–	–	517	–	106	623
2016	–	–	–	–	357	1	657	1 015
2017	–	–	–	–	660	1	310	971
2018	–	–	–	–	548	–	446	994
2019	–	–	–	–	607	–	152	759
2020	–	–	–	–	404	–	180	584
2021	–	–	–	–	589	–	251	840
2022	–	–	–	–	919	4	227	1 150
Total	**–**	**–**	**–**	**–**	**10 285**	**44**	**6 396**	**16 725**

Table 13 continued:

	Catch sampling (CS)				Logbook (LB)			
Fishing year	Male	Immature female	Mature female	Total	Male	Immature female	Mature female	Total
Season=SS								
1996	–	–	–	–	–	–	–	–
1997	–	–	–	–	–	–	–	–
1998	–	–	–	–	32	13	120	165
1999	–	–	–	–	–	–	–	–
2000	–	–	–	–	–	–	–	–
2001	–	–	–	–	–	–	–	–
2002	–	–	–	–	–	–	–	–
2003	–	–	–	–	–	–	–	–
2004	–	–	–	–	–	–	–	–
2005	–	–	–	–	38	4	36	78
2006	–	–	–	–	–	–	–	–
2007	–	–	–	–	37	1	72	110
2008	–	–	–	–	136	1	723	860
2009	–	–	–	–	79	–	771	850
2010	–	–	–	–	–	–	–	–
2011	–	–	–	–	25	–	447	472
2012	–	–	–	–	48	–	266	314
2013	–	–	–	–	73	–	271	344
2014	–	–	–	–	40	–	348	388
2015	–	–	–	–	64	1	342	407
2016	–	–	–	–	68	–	503	571
2017	–	–	–	–	–	–	–	–
2018	–	–	–	–	10	–	224	234
2019	–	–	–	–	146	–	352	498
2020	–	–	–	–	5	–	59	64
2021	–	–	–	–	–	–	–	–
2022	–	–	–	–	121	–	131	252
Total	**–**	**–**	**–**	**–**	**922**	**20**	**4 665**	**5 607**

Table 14: Total number of lobsters measured by fishing year, sex, and season for statistical area 935 by the observer catch sampling and the logbook programmes from 1996–2022. (Continued next page)

	Catch sampling (CS)				Logbook (LB)			
Fishing year	Male	Immature female	Mature female	Total	Male	Immature female	Mature female	Total
Season=AW								
1996	–	–	–	–	125	–	71	196
1997	–	–	–	–	117	2	147	266
1998	–	–	–	–	36	–	57	93
1999	–	–	–	–	–	–	–	–
2000	–	–	–	–	–	–	–	–
2001	–	–	–	–	449	103	587	1 139
2002	–	–	–	–	–	–	–	–
2003	–	–	–	–	–	–	–	–
2004	–	–	–	–	–	–	–	–
2005	–	–	–	–	535	49	665	1 249
2006	–	–	–	–	702	–	1 008	1 710
2007	–	–	–	–	933	2	1 003	1 938
2008	–	–	–	–	610	–	696	1 306
2009	–	–	–	–	316	1	759	1 076
2010	–	–	–	–	225	–	366	591
2011	–	–	–	–	166	–	283	449
2012	–	–	–	–	–	–	–	–
2013	–	–	–	–	–	–	–	–
2014	–	–	–	–	–	–	–	–
2015	–	–	–	–	357	–	353	710
2016	–	–	–	–	222	3	128	353
2017	–	–	–	–	160	–	171	331
2018	–	–	–	–	173	6	399	578
2019	–	–	–	–	4	–	2	6
2020	–	–	–	–	48	–	49	97
2021	–	–	–	–	175	–	74	249
2022	–	–	–	–	294	–	63	357
Total	**–**	**–**	**–**	**–**	**5 647**	**166**	**6 881**	**12 694**

Table 14 continued:

	Catch sampling (CS)				Logbook (LB)			
Fishing year	Male	Immature female	Mature female	Total	Male	Immature female	Mature female	Total
Season=SS								
1996	–	–	–	–	–	–	–	–
1997	–	–	–	–	–	–	–	–
1998	–	–	–	–	–	–	–	–
1999	–	–	–	–	–	–	–	–
2000	–	–	–	–	–	–	–	–
2001	–	–	–	–	27	11	48	86
2002	–	–	–	–	–	–	–	–
2003	–	–	–	–	–	–	–	–
2004	–	–	–	–	–	–	–	–
2005	–	–	–	–	–	–	–	–
2006	–	–	–	–	–	–	–	–
2007	–	–	–	–	–	–	–	–
2008	–	–	–	–	23		99	122
2009	–	–	–	–	57		138	195
2010	–	–	–	–	–	–	–	–
2011	–	–	–	–	–	–	–	–
2012	–	–	–	–	–	–	–	–
2013	–	–	–	–	–	–	–	–
2014	–	–	–	–	–	–	–	–
2015	–	–	–	–	–	–	–	–
2016	–	–	–	–	–	2	–	2
2017	–	–	–	–	8	–	13	21
2018	–	–	–	–	53	2	46	101
2019	–	–	–	–	100	–	97	197
2020	–	–	–	–	–	–	–	0
2021	–	–	–	–	–	–	–	0
2022	–	–	–	–	132	–	141	273
Total	**–**	**–**	**–**	**–**	**400**	**15**	**582**	**997**

Table 15: Total number of lobsters measured by statistical area, sex, and season for the CRA 9 region by the observer catch sampling and the logbook programmes from 1996–2022. Note that a small number of lobsters were also sampled in 1974 and 1976, although these records were not attributed to a statistical area and the length measurement was in terms of carapace length rather than tail width. Hence, these earlier data are not shown in any of the plots shown in this document.

	Catch sampling (CS)				Logbook (LB)			
Fishing year	Male	Immature female	Mature female	Total	Male	Immature female	Mature female	Total
Season=AW								
929	92	37	71	200	–	–	–	–
930	–	–	–	–	475	89	669	1 233
931	–	–	–	–	10 285	44	6 396	16 725
935	–	–	–	–	5 647	166	6 881	12 694
936	–	–	–	–	3 149	126	2 734	6 009
937	–	–	–	–	171	0	90	261
Total	**92**	**37**	**71**	**200**	**19 727**	**425**	**16 770**	**36 922**
Season=SS								
929	–	–	–	–	–	–	–	–
930	–	–	–	–	54	22	144	220
931	–	–	–	–	922	20	4 665	5 607
935	–	–	–	–	400	15	582	997
936	–	–	–	–	1 146	59	1 282	2 487
937								
Total	**–**	**–**	**–**	**–**	**2 522**	**116**	**6 673**	**9 311**

Table 16: Number of tags released compared with the number and proportion recaptured by QMA.

QMA of release	Number released	Number recaptured	Percentage recaptured
CRA 1	19 716	2 210	11.2
CRA 2	29 197	4 909	16.8
CRA 3	43 888	5 807	13.2
CRA 4	42 732	3 148	7.4
CRA 5	43 748	7 554	17.3
CRA 6	9 807	250	2.5
CRA 7	12 409	890	7.2
CRA 8	36 259	10 990	30.3
CRA 9	6 581	129	2.0

Table 17: Number of tags released compared with the number and proportion recaptured by statistical area.

Statistical area of release	Number released	Number recaptured	Percentage recaptured
929	0*	2	–
930	0	0	–
931	1 991	10	0.5
935	1 798	98	5.4
936	2 598	19	0.7
937	189	0	0.0
938	0	0	–

*Note that some of the tag releases were recorded as being inside statistical area 929 by the fishers, although all of these were attributed to CRA 8 by the tag processing code, consistent with the project code ('CRA8_TAG') in the data extract for these tag releases.

Table 18: Number of tag recaptures in CRA 9 by sex and calendar year of release.

Calendar year of release	Females	Males	Total
1999	17	6	23
2000	5	–	5
2001	8	16	24
2002	–	1	1
2003	5	4	9
2005	–	2	2
2014	32	–	32
2015	27	4	31
2016	1	1	2
Total	95	34	129

Table 19: Number of tag recaptures in CRA 9 by statistical area and month of release.

	Statistical area of release							
Release month	929	930	931	935	936	937	938	Total
Apr	–	–	–	–	–	–	–	–
May	–	–	–	–	–	–	–	–
Jun	2*	–	–	–	–	–	–	2
Jul	–	–	–	22	4	–	–	26
Aug	–	–	–	24	10	–	–	34
Sep	–	–	–	28	5	–	–	33
Oct	–	–	–	24	–	–	–	24
Nov	–	–	–	–	–	–	–	–
Dec	–	–	10	–	–	–	–	10
Total	2*	–	10	98	19	–	–	129

*The two recaptures in area 929 may have been released in CRA 8 or area 929 (CRA 9), although were marked here as being released in area 929 to simplify this table.

Table 20: Number of tag recaptures in CRA 9 by sex and statistical area of release.

Statistical area of release	Females	Males	Total
929	0	2*	2*
930	0	0	0
931	6	4	10
935	75	23	98
936	14	5	19
937	0	0	0
938	0	0	0
Total	95	34	129

* The two recaptures in area 929 may have been released in CRA 8 or area 929 (CRA 9), although were marked here as being released in area 929 to simplify this table.

Table 21: Number of tag recaptures in CRA 9 by statistical area of release and recapture.

Statistical area of release	Statistical area of recapture								
	929	930	931	935	936	937	938	Unknown	Total
929	2*	–	–	–	–	–	–	–	2
930	–	–	–	–	–	–	–	–	0
931	–	–	10	–	–	–	–	–	10
935	–	–	–	98	–	–	–	–	98
936	–	–	–	–	17	–	–	2	19
937	–	–	–	–	–	–	–	–	–
938	–	–	–	–	–	–	–	–	–
Total	2*	–	10	98	17	–	–	2	129

* The two recaptures in area 929 may have been released in CRA 8 or area 929 (CRA 9), although were marked here as being released in area 929 to simplify this table.

12. FIGURES

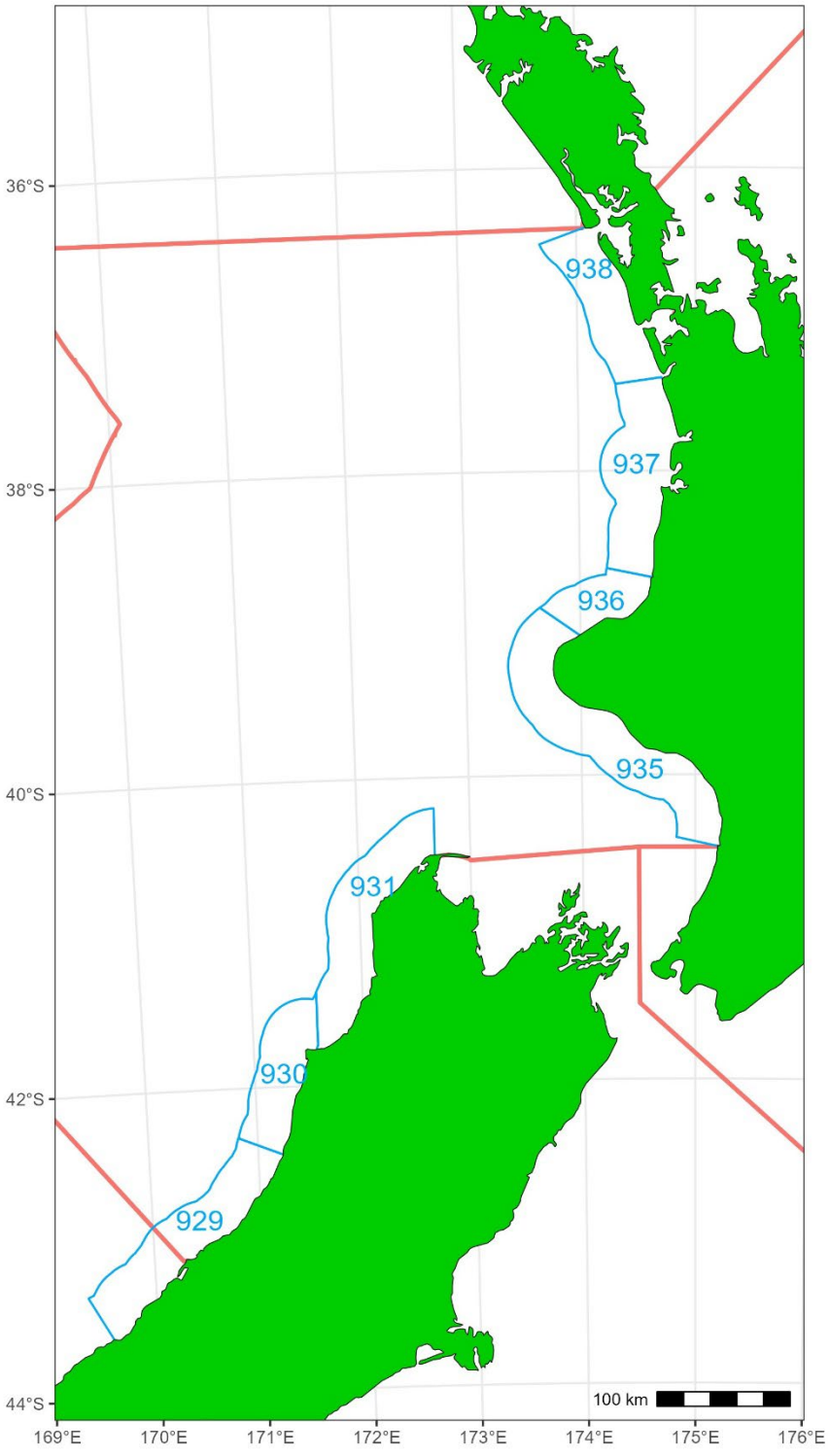

Figure 1: Rock lobster statistical areas (blue polygons) in CRA 9. Red lines represent QMA boundaries.

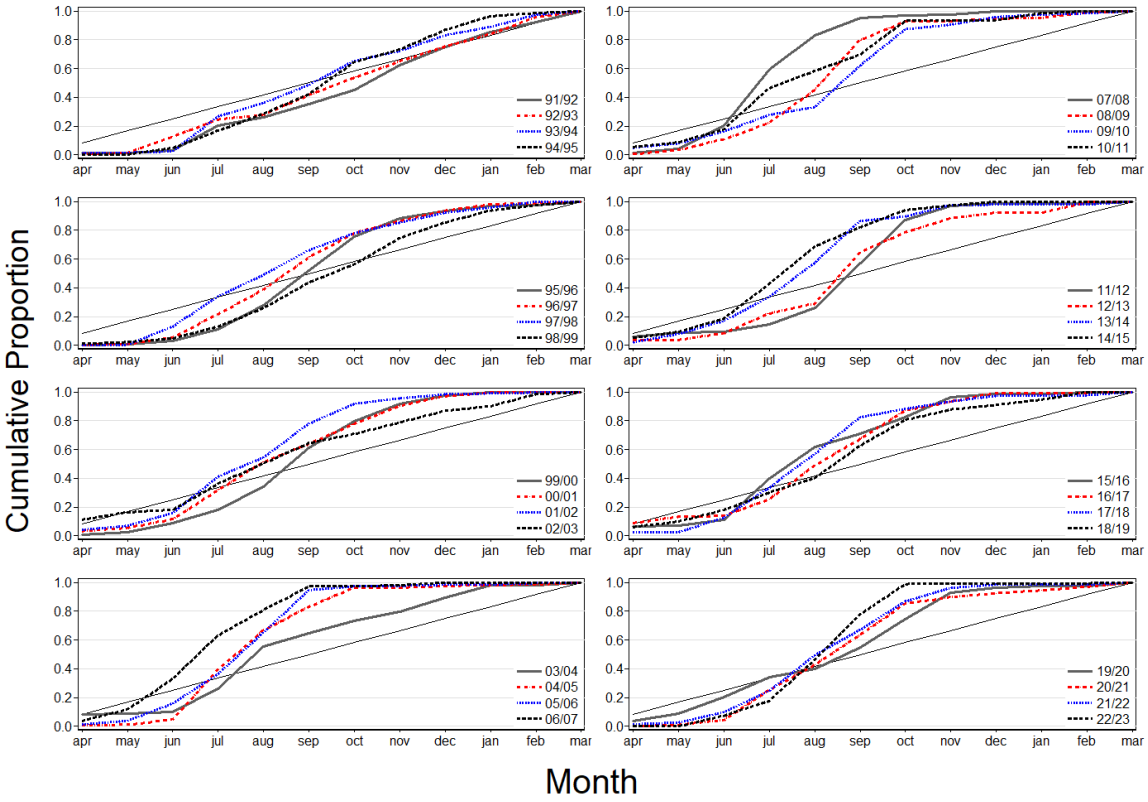

Figure 2: Cumulative landing proportions by fishing month in CRA 9, 1990 to 2022 (figure reproduced with permission from Starr 2024). Thin black line provides a reference equivalent to a uniform distribution of catch across all months. This figure generated from data prepared using the B4 algorithm scaled to the 'L' or the combined (L+LFL+LR+QL) destination codes.

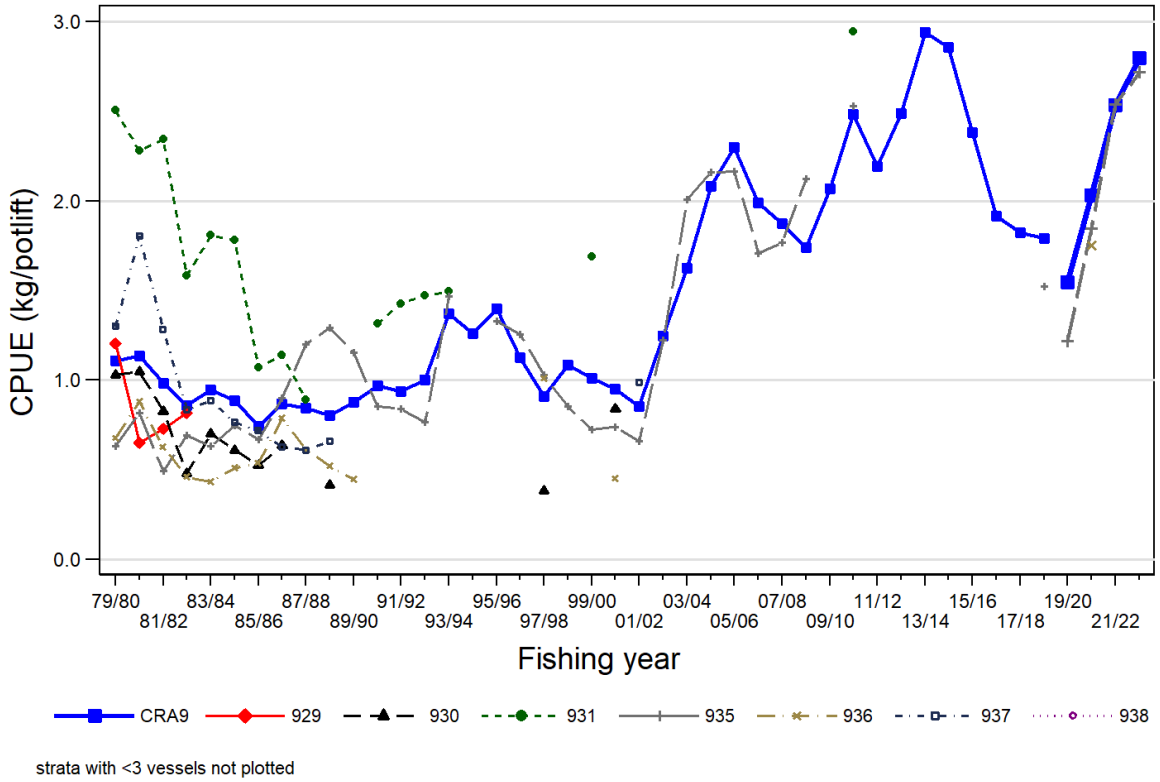

Figure 3: **Arithmetic CPUE (see Eq. 1 of Starr 2024) in CRA 9 by fishing year and statistical area from 1979 to 2022. This figure was reproduced with permission from Starr (2024) and generated from data prepared using the F2 algorithm scaled to the 'LFX' or the combined '(L+LFL+LR+QL)FX' destination codes. Estimates for 2019 to 2022 (plotted separately with larger markers and thicker lines) based on mixed source CELR/ERS or ERS data and may not be comparable with earlier estimates based on CELR or FSU data.**

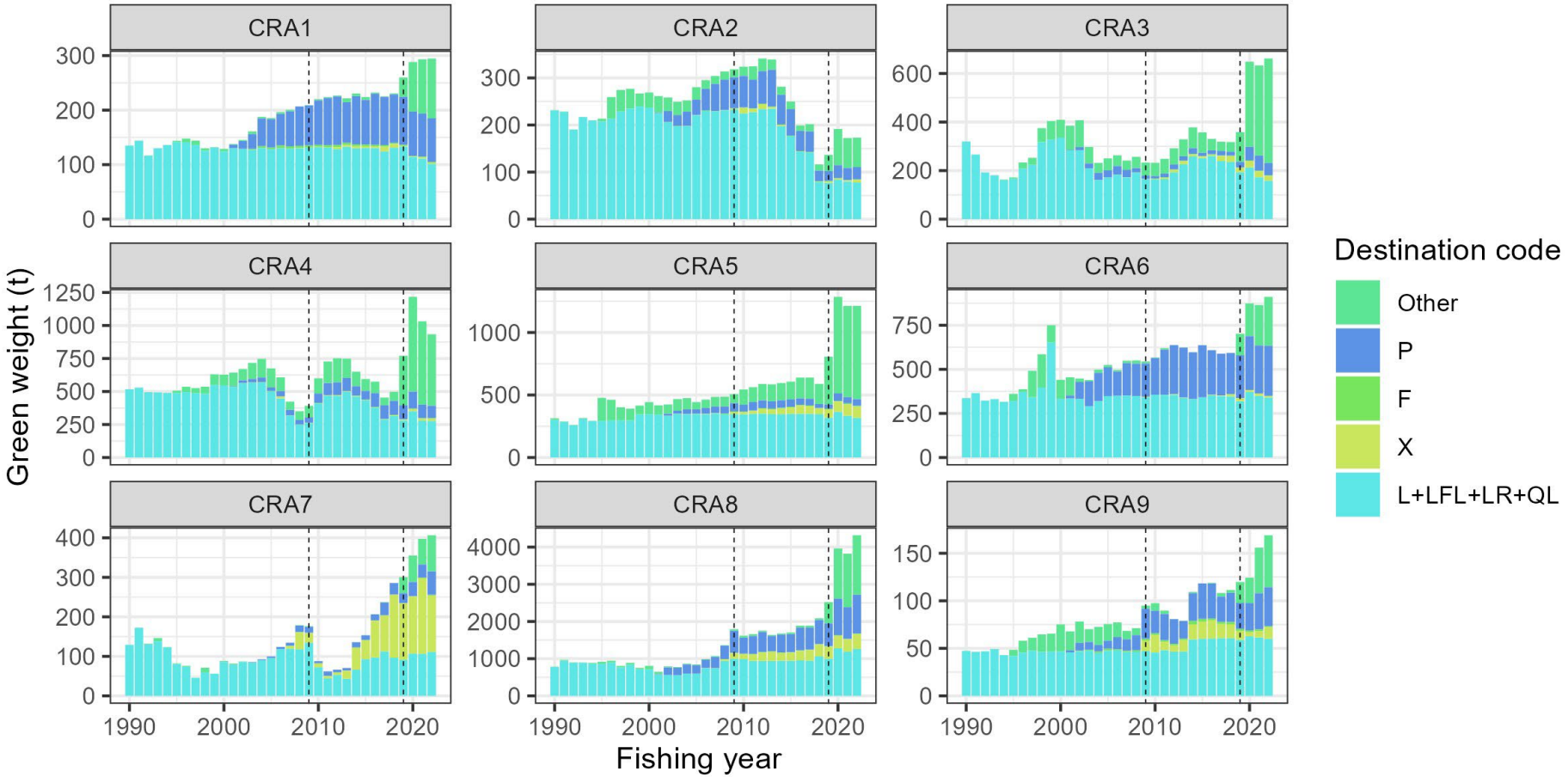

Figure 4: **Total catch weight (t) by reported destination code, fishing year, and quota management area from 1990 to 2022. Destination codes in this plot are: 'L+LFL+LR+QL' = all codes that are assumed to constitute landed green weight for the purposes of catch rate analysis (i.e., destination codes 'L', 'LFL', 'LR', and 'QL'); 'X' = legal fish returned to the water; 'F' = section 111 recreational take; 'P' = legal lobsters put in holding pots; and 'Other' = all other reported destination codes. Note that it was not mandatory to report legal discards prior to 2009, highlighted by the dashed line. The other dashed line highlights the year in which electronic data reporting was implemented across all vessels (spring-summer period of 2019).**

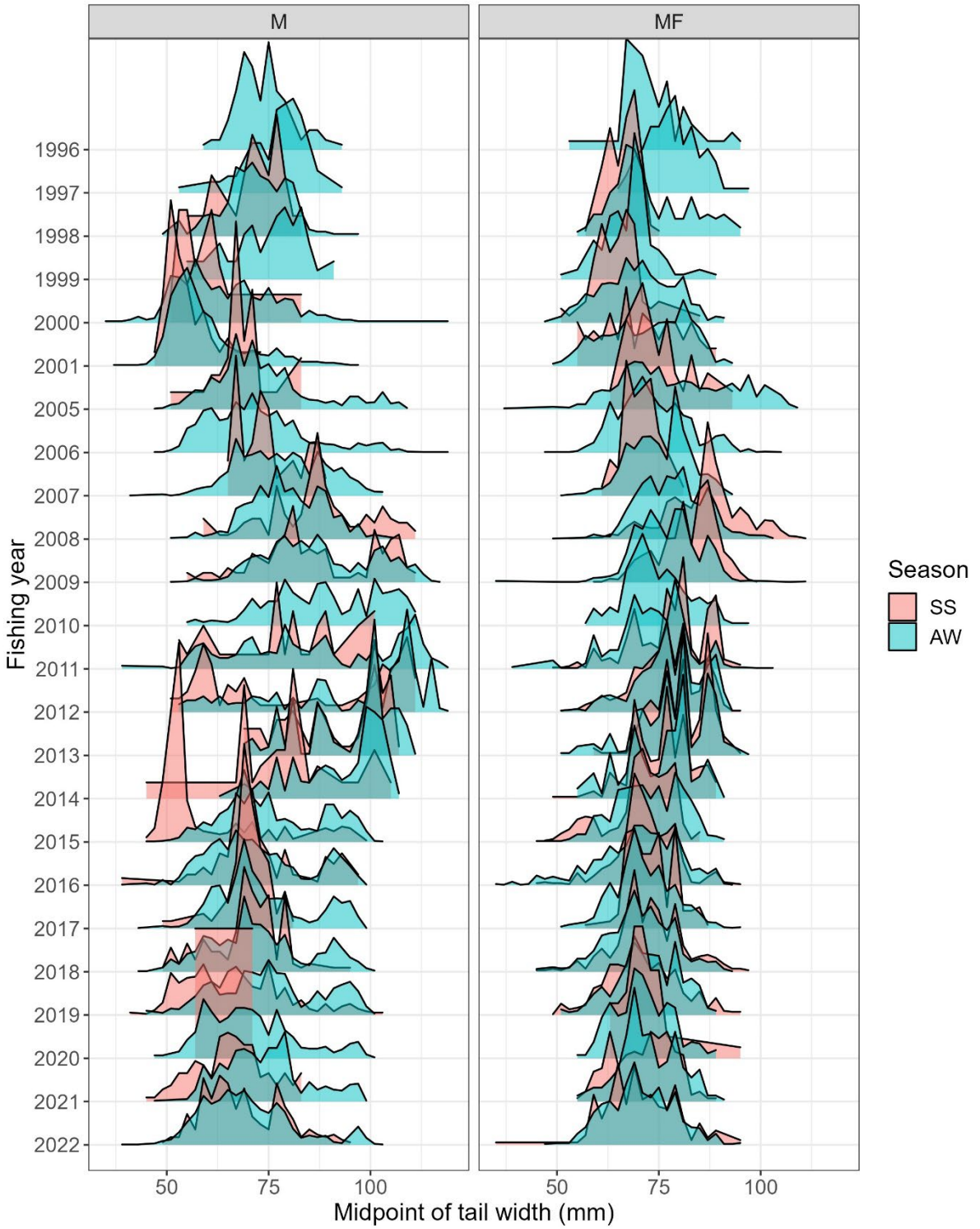

Figure 5: **Proportion at size (mm TW) by fishing year, season ('AW' = autumn/winter; 'SS' = spring/summer), and sex ('MF' = mature females; 'M' = males; immature females not shown) across all statistical areas of CRA 9, from logbook data. The total sample size by source, sex, fishing year, and season is shown in Table 12.**

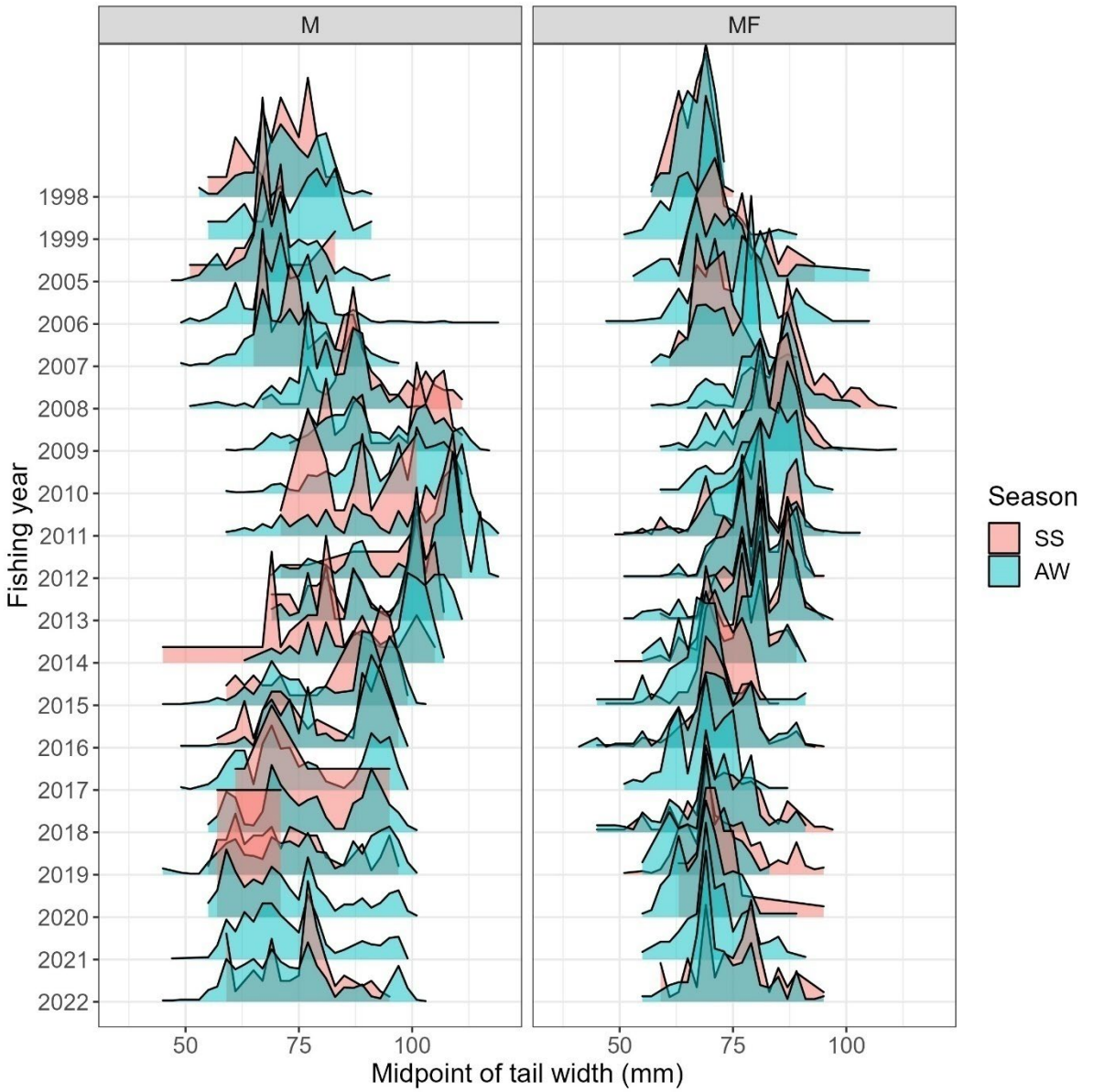

Figure 6: Proportion at size (mm TW) by fishing year, season ('AW' = autumn/winter; 'SS' = spring/summer), and sex ('MF' = mature females; 'M' = males; immature females not shown) for statistical area 931, from logbook data. The total sample size by source, sex, fishing year, and season is shown in Table 13.

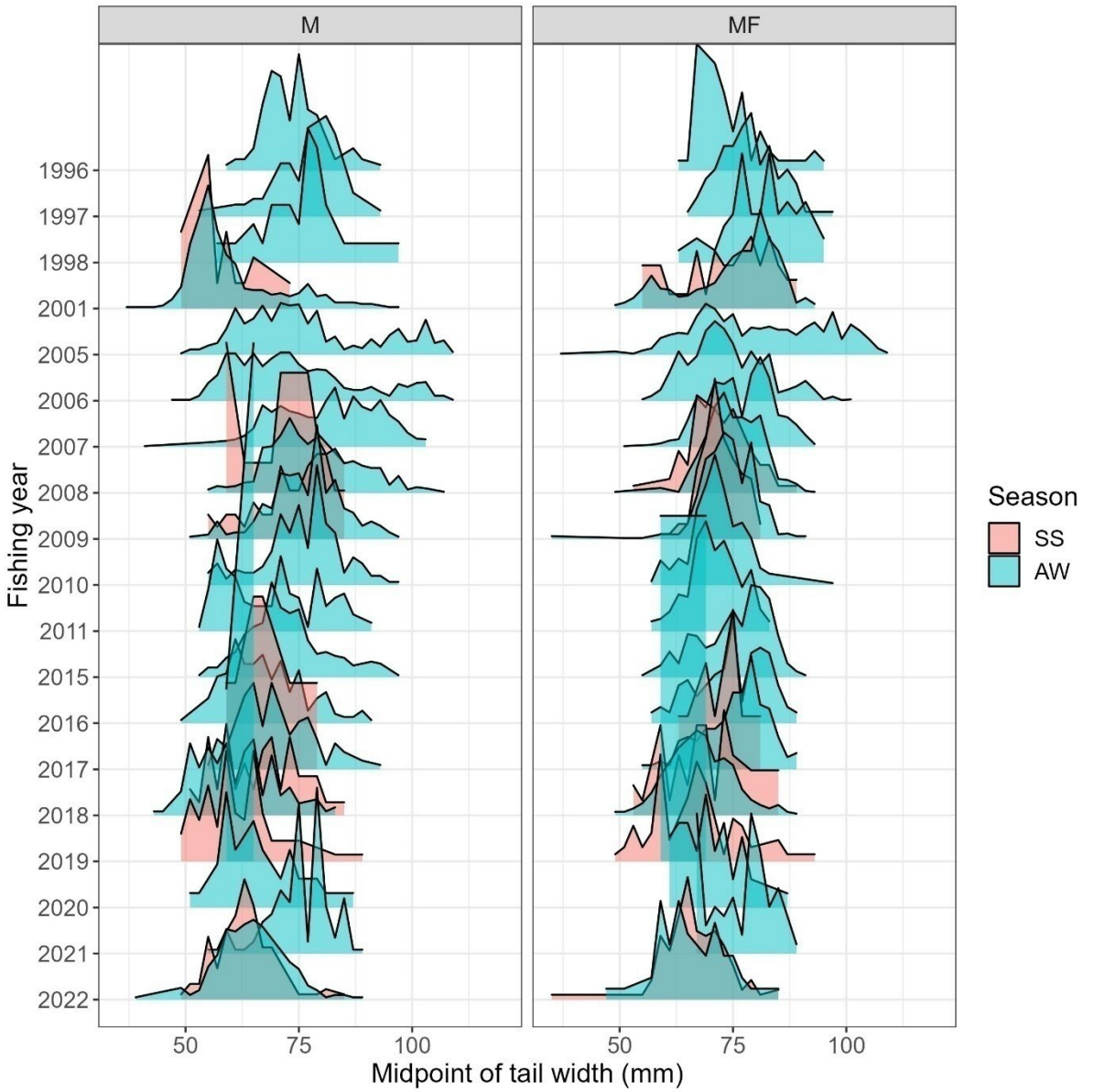

Figure 7: Proportion at size (mm TW) by fishing year, season ('AW' = autumn/winter; 'SS' = spring/summer), and sex ('MF' = mature females; 'M' = males; immature females not shown) for statistical area 935, from logbook data. The total sample size by source, sex, fishing year, and season is shown in Table 14.

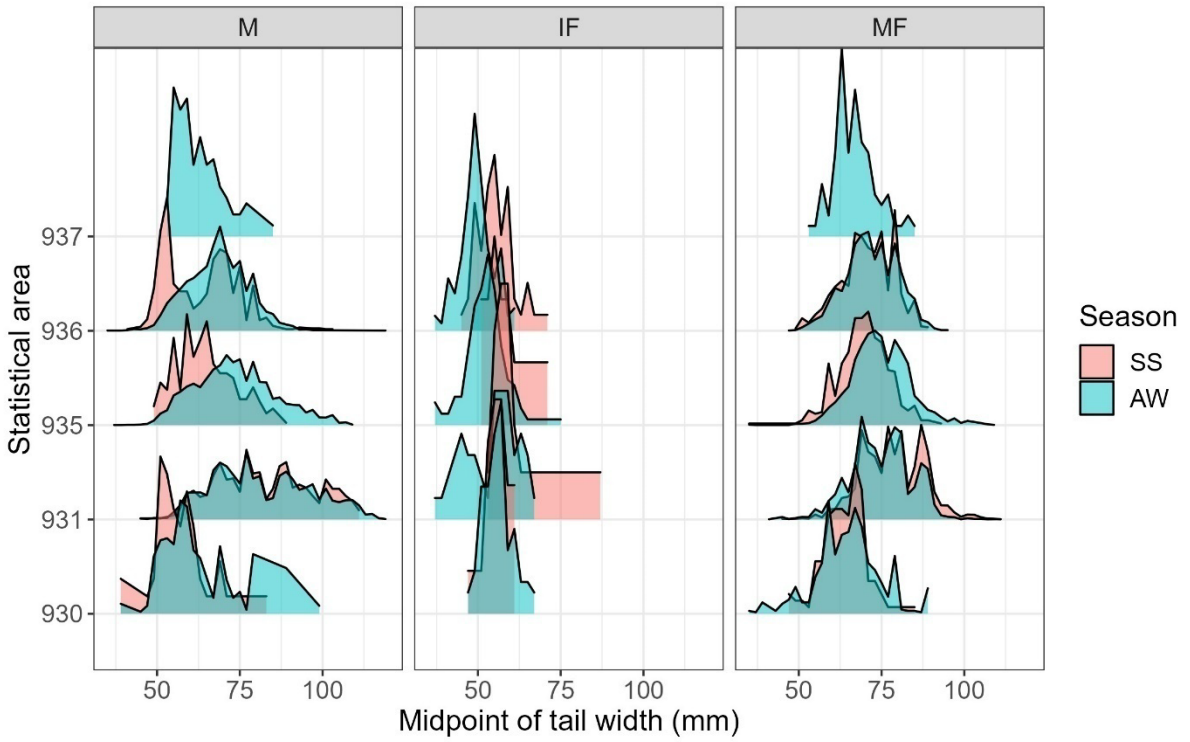

Figure 8: **Proportion at size (mm TW) by CRA 9 statistical area, season ('AW' = autumn/winter; 'SS' =spring/summer), and sex ('M' = males; 'IF' = immature females; and 'MF' = mature females) from logbook data. The total sample size by source, sex, statistical area, and season is shown in Table 15.**

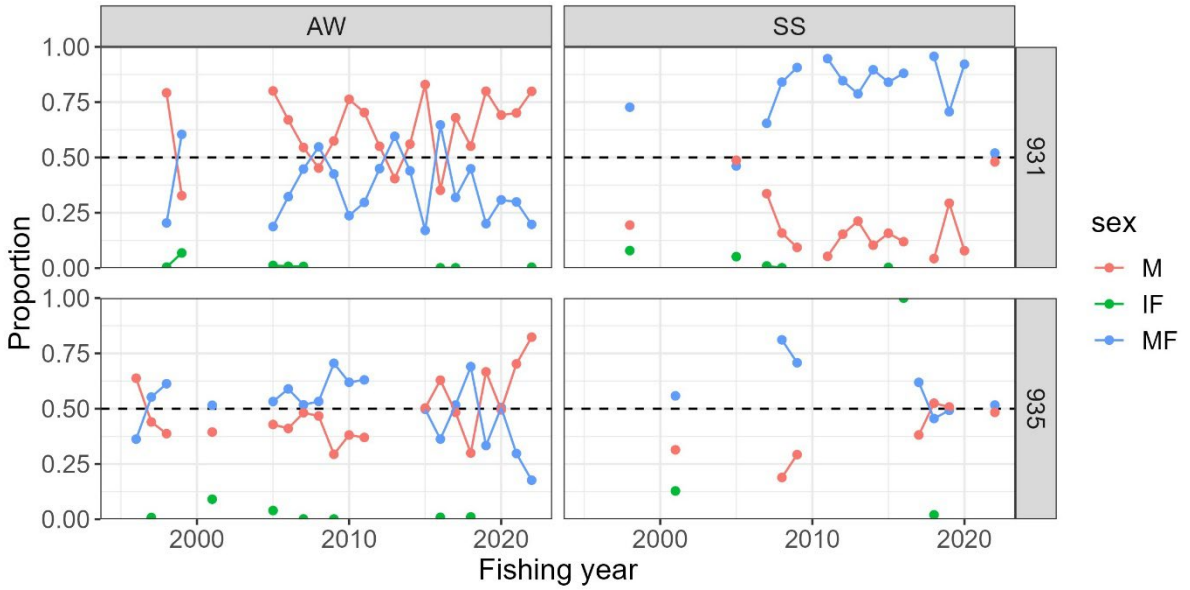

Figure 9: **Sex ratios (M = male, IF = immature female, MF = mature female) of the catch by fishing year, season (AW = autumn/winter, SS = spring/summer), and statistical area, from voluntary logbook data. This plot excludes statistical areas 929, 930, 936, and 937 for which the number of lobsters subject to biological sampling was relatively small (see Table 15).**

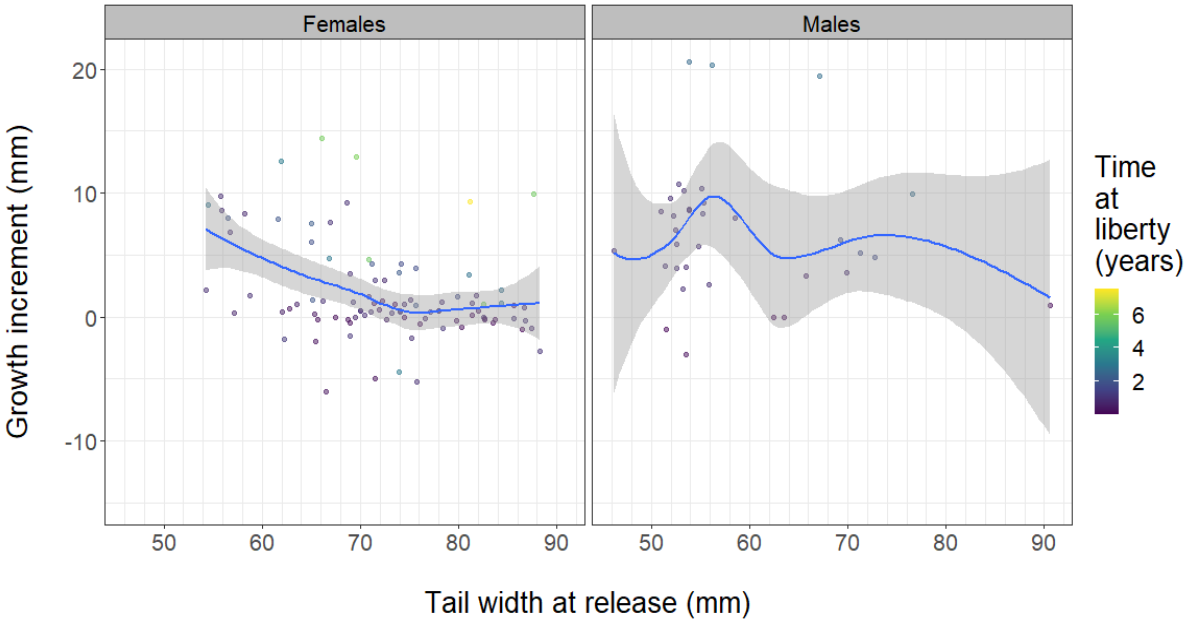

Figure 10: Growth increments (mm) by size at release (mm) and sex for all tags. The colour of each point represents the time at liberty (years). The tag recapture data include 95 females and 34 males. A loess smoother is also displayed on each panel.

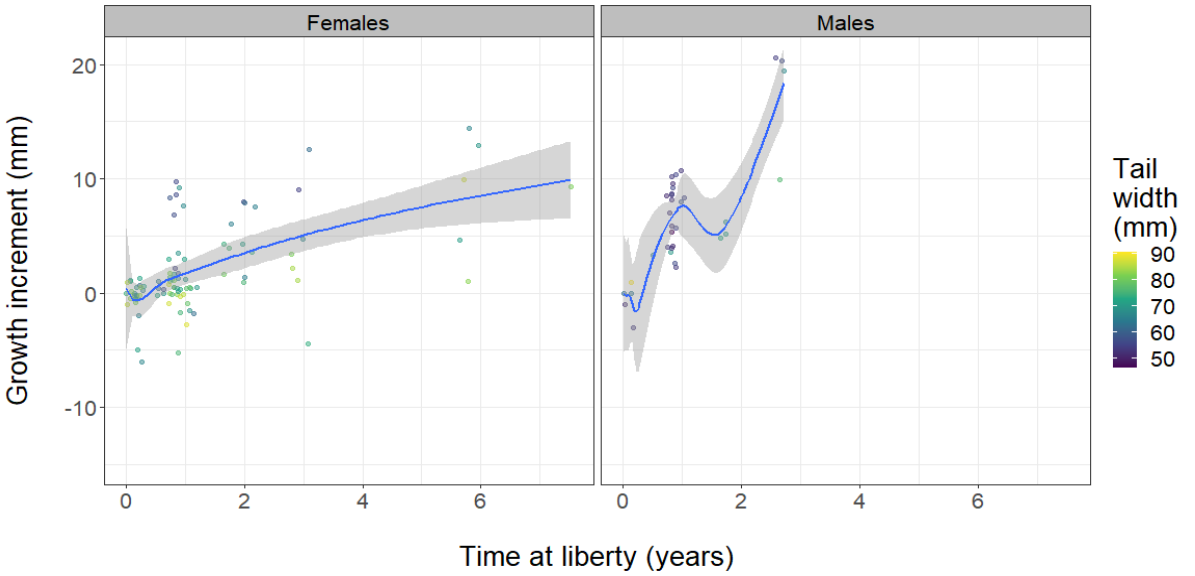

Figure 11: Growth increments (mm) by time at liberty (years) and sex for all tags. The colour of each point represents the size at release (mm tail width). The tag recapture data include 95 females and 34 males. A loess smoother is also displayed on each panel.