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Research Document 2004/071 | **Document de recherche 2004/071**

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Stock indicators for LFA 33 with respect to management changes implemented in 2000.

Indicateur du stock de homard de la ZPH 33 à l'égard des changements en gestion mis en oeuvre en 2000.

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http://www.dfo-mpo.gc.ca/csas/

ISSN 1499-3848 (Printed / Imprimé)

Canada

Abstract

LFA 33 lobster landings since the early 1980's have been higher than the previous 30 years. Voluntary v-notching, increasing the minimum legal size (MLS) from 81mm to 82.5mm, and release of lobsters missing claws (culls) were the management measures applied in LFA 33 in response to the Atlantic-wide management plan implemented to double egg production per recruit. This document reports on the status of indicators for: (1) legal sized lobsters, (2) pre-recruits, (3) berried females, (4) exploitation rate, (5) distribution (prevalence), and (6) ecosystem to evaluate the current stock status, determine the effectiveness of the plan, and to determine the data and indicators important to collect for future assessments. The principal results were: Legal sized lobster indicators were primarily positive or exhibited no change during the years of the management plan. Pre-recruit (sub-legal sized) lobster indicators exhibited no overall change or were negative during the years of the management plan. Berried female (larger than 50% size-at-maturity, >100mm) indicators were positive during the years of the management plan. Exploitation rate indicators declined during the years of the management plan. Positive legal size, berried female, and exploitation rate indicators were consistent with expectations from the management plan. Pre-recruit indicators were not expected to improve as a result of the management plan. The two major data sources that will contribute to improvements in interpreting current indicators are: (1) developing fishermen generated logbooks that include spatial catch and effort data, and (2) increasing the spatial coverage in Fishermen and Scientists Research Society (FSRS) trap programs.

Résumé

Depuis le début des années 1980, les débarquements de homards provenant de la ZPH 33 sont supérieurs à ceux des 30 années précédentes. Suite à l'adoption d'un plan de gestion panatlantique visant à doubler la ponte par recrue, de nouvelles mesures de gestion ont été mises en oeuvre dans cette zone; il s'agit notamment du marquage volontaire par encoche en V, d'une augmentation de la taille minimale réglementaire (TMR) de 81 mm à 82,5 mm et d'interdiction de garder les individus n'ayant qu'une pince (amputés). Sont présentés dans ce rapport les indicateurs sur : 1) les homards de taille réglementaire, 2) les prérecrues, 3) les femelles oeuvées, 4) le taux d'exploitation, 5) la distribution spatiale (incidence) et 6) l'écosystème en vue d'évaluer l'état actuel du stock, de déterminer l'efficacité des mesures de gestion et d'identifier les données et les indicateurs à recueillir aux fins d'évaluations futures. Voici les principaux résultats observés durant la période d'application du plan de gestion : les indicateurs concernant les homards de taille réglementaire ont été pour l'essentiel positifs ou n'ont présenté aucun changement; les indicateurs concernant les prérecrues (homards de taille inférieure à la TMR) n'ont présenté aucun changement ou ont été négatifs; les indicateurs concernant les femelles oeuvées (taille à laquelle 50 % sont matures > 100 mm) ont été positifs; et les indicateurs du taux d'exploitation ont diminué. Les indicateurs positifs au sujet de la taille réglementaire, des femelles oeuvées et du taux d'exploitation étaient conformes à ce qui était escompté dans le plan de gestion, mais on ne s'attendait pas à ce que ce dernier se traduise par une amélioration des indicateurs concernant les prérecrues. Les données qui contribueront à des améliorations de l'interprétation des indicateurs disponibles viendront principalement : 1) des journaux de bord remplis par les pêcheurs et contenant des données spatiales sur les prises et sur l'effort, et 2) de l'extension de la portée spatiale des relevés au casier de la Fishermen and Scientists Research Society (FSRS).

Introduction

LFA 33 extends from Halifax to Port La Tour (Fig. 1). The fishing season extends from the last Monday in November to May 31 (Table 1). The total number of licenses in LFA 33 is around 720 depending on the number of partnerships in effect. About 173,000 traps are fished each fishing season (Table 2). Landings and production in the eastern portion of LFA 33 are usually found to be lower than in the western portion (Campbell and Mohn 1983; Hudon 1994; Claytor et al. 2001). Representation from the fishing industry on management and scientific advice is provided by port cluster representatives at Advisory Committee meetings and science workshops. There are 13 port clusters defined for LFA 33 (Fig. 2).

In 1995, following a decline in landings from the 1991 peak, the Minister of Fisheries and Oceans, the Honourable Brian Tobin, tasked the Fisheries Resource Conservation Council (FRCC) to review the state of the lobster fishery. In their report, A Conservation Framework for Atlantic Lobster (FRCC 1995), the FRCC concluded that the level of exploitation in the lobster fishery was too high and that not enough females were having an opportunity to spawn. Based on the recommendations of the FRCC, a long-term management strategy, in consultation with area fishers, was developed with specific measures for each LFA. A four-year plan for LFA 33 was implemented in the 1998 - 1999 season and ended in 2001 - 2002. Subsequently, a three-year Conservation Harvesting Plan (CHP) was introduced in the fall of 2002. The stated goal of these plans was to double egg production per recruit.

The following management measures were applied in LFA 33. Voluntary v-notching began in 1998. These lobsters were prohibited from being landed. Minimum legal carapace length increased from 81mm to 82.5 mm in the spring of 2000 but was not fully applied until the opening of the fall of 2000. A requirement to release female one-clawed catch (culls) was introduced in the fall of 2002 as part of the new three-year CHP.

The Report of the Lobster Conservation Working Group (DFO 2001) recommended the development of indicators to evaluate the status of the stock and fishery. These included indices of the following categories in the population or fishery: (1) spawners, (2) recruits, (3) exploitation rate, (4) distribution (prevalence), and (5) ecosystem. This document develops indicators, where possible in each of these categories and adds indicators of legal sized lobsters to the list. These indicators are compared to short and long-term trends in an effort to:

1. Evaluate current stock status of lobster stocks in LFA 33 ;
2. Evaluate whether there are measurable changes in stock status that are attributable to recent management changes, and provide advice accordingly;
3. Recommend stock indices that will be valuable for monitoring the health of lobster stocks in the future.

Data descriptions:

Landings:

Landings data are derived from historical records summarized by Williamson (1992) from 1892 to 1988. These data have been summarized only by calendar year. Data from 1892 to 1946 are summarized only by county and from 1947 to 1988 by statistical district. The DFO statistic branch records from purchase slips are used from 1989 to 1996 and from 1997 to the present, data from monthly mandatory logbooks are used. Monthly logbooks require each fisherman to report daily catch but not effort or location information.

Landings data for the 2002 - 2003 fishery are preliminary. Landings for the fall portion of the fishery have only been partly entered and virtually no landings from the spring (Mar. 1 - May 31) portion of the fishery had been entered as of the preparation date (Nov. 2003) for the assessment meeting in Jan. 2004.

Voluntary logbooks:

Voluntary logbooks have been maintained by 49 fishermen in LFA 33 since 1984. These individuals recorded daily landings in pounds or numbers of lobster and effort (trap-hauls). These data provide the main source of catch-rate information on the fishery (Table 3). Thirty-five of these individuals, representing about 5% of the licenses in LFA 33, have participated for three or more years and recorded 10 or more fishing days per year.

Fishermen Scientists Research Society (FSRS) Lobster Recruitment Traps:

A juvenile lobster monitoring program initiated by fishermen members of the FSRS was used to derive many of the indices in this document for legal, sub-legal, and berried females. The monitoring program used standardized 101.6 cm by 53.3 cm by 35.6 cm traps with a 2.5 cm mesh and a 12.7 cm entrance. To prevent small lobsters from leaving, the traps did not have escape vents. In comparison, commercial traps were a similar size but had mesh sizes ranging from 3.81 to 5.08 cm and an escape vent (Miller 1990). Participants placed the monitoring traps within their fishing ground where they expected to catch juvenile lobster. The traps remained at the same location during a given fishing period for spring fisheries but may have been moved between the fall and spring period for fall-spring fisheries. During a fishing period, monitoring occurred on a daily basis unless weather or other factors prevented it.

Fishers recorded the number of lobster of each sex, the FSRS defined length-class (Table 4), and whether or not the length was above the MLS (minimum legal size), in each monitoring trap on each fishing day.

During the study, 23 to 42 fishers participated in LFA 33 and each one fished 3 monitoring traps per season. Monitoring trap hauls ranged from about 3,800 to 5,400 for full seasons. The 1998-1999 season data was collected only during the spring of 1999 (Table 5).

Life history and length-classes are reported by FSRS defined length-class, whether the lobster was sub-legal or legal, and male, female, or berried (Table 6). Number

of trap-hauls during the monitoring represents effort and is used to derive catch per unit effort (CPUE) for these traps (Table 6).

An automated temperature recorder placed on one monitoring trap from each participant recorded temperature at 30 min intervals. Average daily temperatures were based on recordings from midnight to midnight. Seasonal temperature trends in these data have been described by Petrie and Pettipas (2004).

Industry reviews:

Industry reviews are provided through minutes taken at science workshops held in local communities from 2002 to 2004 (Appendix 1). Previous workshops have been reported in Claytor et al. 2001.

Legal sized indicators: Methods

Indicators of the status of legal sized lobster in LFA 33 are developed from landings, voluntary logbooks, and FSRS recruitment trap data.

Landings:

Long-term (1892 - 2002) landings data are presented by county for calendar year. Short-term (1989-1990 to 2001-2002) landings data are presented by port cluster. Port Clusters are grouped into eastern (1 to 6) and western components (7 to 13). These are based on correlations analyses completed earlier (Claytor et al. 2001).

Voluntary logbooks:

Voluntary logbooks were analyzed using the multiplicative catch rate model described by Quinn and Deriso (1999). The main effects examined were Season, Week, and Fisherman. Only fishermen participating in the program for 3 or more years and 10 or more days in a year were included in the analysis (Table 3). Port Clusters 1 to 6 were included in the eastern area and port clusters 7 to 13 were in the western area. No interactive effects were examined.

Fall season weeks were defined from the beginning of the season. This had the effect of keeping the seasons of the week consistent, even though the dates were not consistent. Spring seasons started Mar 1, of each year. The time period between the end of week 7 and the beginning of the spring were excluded each year. Not all fishermen fish during this time and catch rates are low because of low temperatures. As a result, it was felt that data during this portion of the season was not indicative of abundance.

Correlations between areas for total season (Fall + Spring), Fall, and Spring portions of the seasons were examined using regression analysis.

FSRS recruitment trap:

FSRS recruitment trap data for legal size lobster were analyzed using the same multiplicative model as the voluntary logbook catch rates. Season, Week, and Fisherman were the main effects examined. Interactive effects were not examined. Fall and spring portions of the season were combined for these analyses. The period between week 7 (about Jan. 15) and Mar. 1 were removed for similar reasons given for voluntary logbook catch rates.

Legal sized indicators: Results

Landings:

Lunenburg and Queen's Counties reside entirely within LFA 33. Shelburne County is in LFA 33 and LFA 34. Halifax County is in LFA 32 and LFA 33. With respect to LFA 33, it is possible to compare long-term landings only for Lunenburg, and Queen's counties (Fig. 3). In each case, landings declined, with some annual variation, until the early 1920's when landings in each of these counties were < 150 tonnes (about 350,000 lbs). Landings in Halifax County declined the most dramatically from over 2,000 tonnes to < 150 tonnes (Fig. 3). Average landings doubled during the latter 1920's and 1930's but only reached pre-1920 values in Queen's and Lunenburg counties recently (Fig. 3).

Landings in every county since 1982 exceeded those between 1947 and 1982 (Fig. 3). Landings from Lunenburg and Queen's Counties since 1982 also exceeded those since 1900. Landings from Halifax County remain relatively low compared to previous historical highs (Fig. 3).

Landings in each port cluster have generally increased since the early to mid-1990's (Fig. 4, Table 7). Landings are generally well above those at the end of the 1980's for Port Clusters 1 to 6. In contrast, landings for Port Clusters 7 to 13 only just exceed or are slightly under the landings at the end of the 1980's (Fig. 4).

About 65% to 95% of the mandatory logbook records for the fall portion of the 2002 - 2003 fishery had been entered at the time of data preparation (Nov. 2003) for the assessment meeting. The exception to this trend was in Port Cluster 1, which were 33% complete (Fig. 4). These percentages were estimated by comparing the average number of boats in the database during the last 5 years, compared to the number of boats entered in the database at the time of the meeting. These percentages indicate that, even when fall landings are complete for 2002, that they will be lower than recent averages (Fig. 4).

Spring landings for 2002-2003 are not interpretable at the present time because of severe incompleteness in the statistical branch data file, < 5% of boats entered relative to the previous 5 year mean. However, reports from fishermen indicate that the spring season was relatively better than the fall and in some areas (Sambro) it was the best spring in years. (See meeting minutes, Appendix 1).

Eastern port clusters have generally shown an increase in landings since the 1989 – 1990 season, due mainly to increasing fall landings. Western port clusters have increased in recent years, but landings have not greatly exceeded those in the early 1990's (Fig. 5).

Spring landings are significantly correlated with fall landings for the eastern portion of LFA 33 ($p<0.05$) but not the western portion (Fig. 6).

Voluntary logbooks:

Each of the main effects in the multiplicative analyses were significant (Appendix 2), with Week accounting for most of the variation and having the highest Mean Square values of the three main effects.

Catch rates for the total season declined in eastern and western areas from 1985 to 1996 (Fig. 7). They increased from 1997 to 1999 in both areas. From 2000 to 2002 the catch rates have declined in the east but remained stable in the west (Fig. 7).

For the fall portion of the season, catch rates declined from highs in the mid-1980's to lows in the mid-1990s (Fig. 8). Catch rates increased to 1999 and from 1999 – 2000 to 2001 – 2002 were higher than the mid- 1990s (Fig. 8). The fall catch rates for the 2002-2003 season were considerably lower than any of the previous three years (Fig. 8).

Spring catch rate trends also declined from highs in the mid- 1980's to lows in the mid-1990s (Fig. 9). Catch rates increased to 1999 and from 1999 – 2000 to 2001 – 2002 were higher than the mid- 1990s (Fig. 9). Spring catch rates in 2002-2003 were much higher that 2001 – 2002 (Fig. 9).

The eastern and western areas catch rates are similar within seasons. Good and bad years are synchronous between areas. Regression analyses comparing total seasons and fall and spring portions of seasons between areas were significant (Fig. 10).

Correlations between spring and fall catch rates were significant for the eastern portion of LFA 33 but not the western (Fig. 11).

Trends in FSRS recruitment trap indices of legal sizes differ between east and west. Size 6 lobsters were highest in the first year of data collection in the east but have been lower and stable since. Size 6 lobster increased each year in the west (Fig. 12). Size 7 and 8 lobsters were highest in the most recent year in the east. Size 7 and 8 in the west, increased the first three years but declined in the most recent year (Fig. 12).

FSRS recruitment trap:

All main effects for legal sized lobster in the multiplicative model were significant for LFA 33 West. Season effects were not significant for legal sizes in LFA 33 East (Appendix 3). Highest mean squares were for Week and Fisherman effects indicating that most of the variation in these data was explained by these factors.

Legal sized indicators: Discussion

Voluntary logbook data provide an indication of trends during the most recent season when landings data are not available. The decline in catch rates during the fall portion of the most recent season indicate that catches and catch rates during the fall of 2002 were much lower than the most recent years. The increase in spring catch rates observed in the catch rate analysis for 2002-2003 support the reports of fishermen that the spring season was successful in spite of a below average fall.

Differences in trends between the east and west with respect to FSRS size 6 – 8 lobster need to be interpreted with caution as Season effects were not significant for the east. However, significant Season effects in the western portion indicate greater certainty in identified trends among legal size lobster within that area.

Initial reports (first two weeks of the season) for the fall of 2003 were that landings seemed to improve in terms of expectations moving west to east, until Sambro and Eastern Passage where landings this fall were very poor. These areas were coincident with the eye of hurricane Juan, which passed through these areas on Sept. 29, 2003.

The inability to obtain timely landings data increased the uncertainty in assessing stock status. Data from voluntary logbooks and FSRS project participants were the only sources of information for stock status indicators for the 2002-2003 season. These voluntary programs need to be maintained to compensate for the uncertain delivery timeframe of official statistics.

The correlation analyses between the eastern and western portions of LFA 33 indicate that good years in one area of LFA 33 generally correspond to good years in the other area. Residuals are higher for the spring. Fall temperature trends among these two areas of LFA 33 are strongly correlated, while spring temperatures sometimes show one area with a greater temperature anomaly than the other (Petrie and Pettipas 2004). These differences in spring temperature regimes may explain the higher spring residuals when comparing between the areas and the reason that fall to spring catch rates are not correlated for the western portion of LFA 33.

It is important to separate environmental effects on landings and catch rates from abundance effects. Catch rates have been shown to be affected by temperature experimentally (McLeese and Wilder 1958). In addition, catch of juvenile lobster is correlated with temperature in the FSRS traps (unpublished data). To a certain extent, the multiplicative model will separate these effects because Week and Temperature are likely correlated (unpublished data). That Week explains much of the variation in these data supports this conclusion. However, additional research is required before we will be able to distinguish legal sized lobster catch rate changes due to abundance versus those due to the environment. One reason for this is that temperature and abundance are changing simultaneously during the season. The interaction of temperature and abundance on catch rates is an important topic for future research. An understanding of this interaction is necessary for the proper interpretation of changes in catch rate with respect to abundance.

Pre-recruit indicators: Methods

Indicators of the status of pre-recruit (sub-legal juvenile lobster) in LFA 33 are developed from FSRS recruitment trap data. A multiplicative model with Season, Week, and Fisherman was applied to these data in a similar manner as for legal sizes from the FSRS recruitment trap data.

Pre-recruit indicators: Results

All main Season effects were significant for sub-legal lobster (FSRS size 1 – 5) in the eastern and western portions of LFA 33 (Appendix 3). Indicators of pre-recruits were generally negative or exhibited no overall change from the pre-management plan year (Fig. 13).

Pre-recruit indicators: Discussion

These analyses indicate that recruitment in the eastern portion of LFA 33 is variable and without an increasing or decreasing trend. The comments related to temperature, abundance, and catch rate effects provided in the discussion of legal size indicators also applies to pre-recruit indicators, with the exception that pre-recruit abundance is not changing due to fisheries while temperature is changing. Research investigating pre-recruit trap catches and temperature effects are in progress.

Spawner indicators: Methods

Indicators of the status of berried females by length-class in LFA 33 are developed from FSRS recruitment trap data. A multiplicative model with Season, Week, and Fisherman was applied to these data in a similar manner as for legal sizes from the FSRS recruitment trap data.

An index of berried females is also available from voluntary logbook participants recording daily numbers of berried females in addition to commercial catch and effort. A multiplicative model was applied to these data in the same manner as for the commercial legal sized catch rates described above. Only fishermen recording berried females for three or more years and for 10 or more days in each year were included in the analysis. The main effects examined were Season, Week, (weeks 1 to 7 and 15 to 26 (Mar. 1 to May 31) and Fisherman.

Spawner indicators: Results

Season effects were significant only for size 8 berried females in the western and eastern portions of LFA 33 using the FSRS data (Appendix 4). Catch rates of FSRS size 8 berried lobster in the LFA 33 east and west areas of the FSRS recruitment traps have generally increased over the last four years (Fig. 14).

All main effects were significant (Appendix 5) for the berried female index using the voluntary logbook data (Fig. 15). Berried females from 1997 to 2002 are at a higher level than previous years for the eastern portion of LFA 33 (Fig. 15). The index for berried females in the west dropped slightly since 1991. However, it has been at roughly the same level since 1990 after a series of declining years in the late 1980's (Fig. 15).

Spawner indicators: Discussion

Increases in berried females are consistent with expectations from the reductions in exploitation rate expected from the management plan. This interpretation is strongest for FSRS size 8 berried females, which is the size that corresponds to that of 50% maturity for LFA 33. Most berried females will be in this size-class and will carry more eggs than smaller lobster (Fogarty 1995).

Prior to 2002-2003 season berried females had been increasing in both the eastern and western areas in the voluntary logbook data, but each of these areas declined in the 2002-2003 season. Increases in berried females from management plan actions were expected because of v-notching which began in the fall of 1998 and reductions in exploitation rates in 81-90mm (FSRS size 6 size

group). As females escape exploitation in subsequent years, it is expected that berried female catch rates in index traps will increase.

The voluntary logbook data shows increases in berried females that are comparable to those observed during the plan. These prior increases and decreases make it difficult to assign recent increases solely to the management plan. Temperature effects are likely to be an important influence on berried female catch rates, as stated above for legal and pre-recruit lobster.

Exploitation rate indicators: Methods

We define exploitation rate as (catch / population numbers) x 100. Management measures initiated during the 4 year plan were designed to reduce exploitation rate and increase egg/ recruit. We use a change-in-ratio method (Claytor and Allard 2003) to estimate exploitation rate by length-class for a variety of LFA's and sub-areas within LFA's.

Two exploitation rates were examined. The first, called the strict exploitation rate is defined as the percentage or proportion of the exploitable population caught during a fishing season.

However, regulations that increase the minimum legal size can result in a smaller exploitable population and therefore increase the exploitation rate, even if catch is constant. As a consequence, a second exploitation rate was examined, called the extended exploitation rate. The extended exploitation rate is defined as the proportion or percentage of the number in the exploited population plus the number in some non-exploited portion of the population. The extended exploitation rate allows a consistent base population to be compared between years that are independent of regulation changes.

Exploitation rate estimates were obtained from the FSRS recruitment trap data using the method described by Claytor and Allard (2003). This method uses the change -in-ratio between a reference or unexploited class and an exploited class over the fishing season to estimate exploitation rate.

The assumptions of the analysis are that (1) the population is closed, (2) that the ratio of catchability between the classes is constant throughout the season for all traps, (3) that the ratio of catchability by the monitoring traps and by the commercial traps is constant over the season for all classes and (4) that the ratio of the fleet effort to the monitoring trap effort is either constant over the season or can be estimated up to a constant factor.

In an effort to determine a relative scale of the reliability of the estimates in addition to examining whether the parameter estimates were significant and the size of the confidence intervals, we also looked at the effect of sample size. The number of cases with significant parameter estimates was compared to sample size and contour lines associated with the combination of reference and exploited sample sizes were plotted.

Exploitation rate indicators: Results

Sample size has an important effect on the reliability of the result. The best estimates are obtained when reference and legal classes both exceed about 200 animals. This roughly corresponds to the 0.9 contour line (Fig. 16). However, we consider that estimates of about 100 animals in each class, if the parameters are significant also produce reliable and meaningful results for evaluating management decisions. These correspond to the 0.7 contour line (Fig. 16). Estimates derived from sample sizes smaller than this, should be interpreted with caution, even if the parameters are significant. Parameters were considered significant if the confidence limits of the A and B parameters given in equation 2 of Claytor and Allard (2003) did not include 0.

Where reliable estimates are obtained a decline in exploitation rate has occurred from the season after the management plan was fully implemented (2000-2001) compared to the season prior to its implementation for size 6 length-class (Fig. 17). Exploitation rate estimates of length-classes 7 and 8, where comparisons are possible, indicate a reduction in exploitation rate on these sizes as well (Fig. 17).

Exploitation rate indicators: Discussion

These results indicate that increases in MLS were useful in reducing exploitation rate of affected length-classes. These estimates are most reliable when reference and exploited length-classes are adjacent and narrow (Claytor and Allard 2003).

The reduction in larger, size 7 and 8, length-classes as well as the affected size 6 is important because the effectiveness of MLS would be reduced if it had the effect of reducing exploitation rate on one component but raising it on another.

Partial season exploitation rates: Methods

The Claytor and Allard (2003) change-in-ratio method for estimating exploitation rate also allows partial season exploitation rates to be estimated. Partial season estimates are obtained using the final parameter estimates and back-calculating the exploitation rate at each day of the season.

Partial season exploitation rates are provided for the reliable estimates as indicated above.

Partial season exploitation rates: Results

Most of the exploitation occurs during the first two weeks of the season for both sexes and size groups in the eastern portion of LFA 33 (Fig. 18). Exploitation accumulates more slowly in the western portion and does not level off for the winter months until the end of December (Fig. 19).

There may be a slightly sharper increase in exploitation at the end of the season in the eastern compared to western portion (compare Figs. 18 and 19). However, this requires additional analyses in order to evaluate this hypothesis.

Partial season exploitation rates: Discussion

These results indicate that the effective season for LFA 33 is in general about two months, in spite of a 6 month calendar season (Table 1). Very little exploitation occurs in LFA 33 during the cold winter months. This is likely related to low temperatures causing low catchabilities during this time (McLeese and Wilder 1958) and poor weather restricting fishing activity.

Estimating partial season exploitation rates provides a method for assessing the effectiveness of seasonal changes in reducing exploitation rate. For example, shortening the season may lead to changes in fishing patterns, such as increased fishing on marginal weather days that would reduce the effectiveness of season changes on exploitation rate.

These partial season estimates also provide a method for investigating the environmental effects on exploitation.

Distribution (Prevalence) Indices: Methods

Catch rates (numbers / trap-haul) by FSRS size group were used to derive distribution (prevalence) based indices by 10 minute square and season. Individual square and season catch rates were assigned to percentile categories based on all seasons combined. Values for 10 minute squares were ordered from lowest to highest. Abundance indices were divided into 4 categories. Those with zero catches of the indicated class were assigned to the first class. The remaining groups were: (Group 2) 0 to 33% of the cases, (Group 3) >33% to 67%, and (Group 4) > 67% to 100%.

Indicators were judged to be positive if the number of squares with catch rates in the 67% to 100% percentile category was higher in each of the seasons from 2000 - 2001 to 2002 - 2003 than the 1999 - 2000 season.

Berried female numbers / trap-haul were converted to eggs / trap-haul using the Campbell and Robinson formula for Bay of Fundy given by Fogarty (1995). The mid-point of each FSRS size group was used as the carapace length for each lobster in the above formula. Total eggs for each size group were determined by multiplying by the numbers in each size group.

Distribution (Prevalence) Indices: Results

The largest indices of berried females or eggs are in the eastern portion of LFA 33 (Fig. 20). However, the greatest numbers of other size groups are in the western portion for sizes 1 to 6 (Figs. 21 to 26). Larger length-classes are relatively more prevalent in the eastern portion (Fig. 27, 28).

Distribution (Prevalence) Indices: Discussion

Differences in berried females and juvenile lobster have been previously observed between the eastern and western portion of LFA 33 (Miller 1997). Understanding

why these differences occur will be important in interpreting productivity differences among the areas of LFA 33.

Production: Methods

Making the assumption that landings are an approximate indicator of abundance of berried females from the same group of animals permits an analysis of production potential or stock recruitment relationships by examining the relationship between catch in year i and 7 years later. Lobsters are about 7 to 9 years old upon entering the fishery in LFA 33 (Fogarty 1995).

Lobster size composition was estimated from a composite of all port samples taken in LFA 33 in recent years. These were then converted to proportions by weight using conversions from Fogarty (1995) to estimate weight from length by size and sex in the samples. The proportions at size determined from these samples were then used to estimate the weight of female lobster >100 mm and recruit lobster <90mm in the catch. The derived index for females >100 mm was used as spawners and the derived index of lobster <90mm in the catch was used as recruits in Ricker and Beverton-Holt recruitment models to determine the expected relationships between spawners and recruits by County in LFA 33. The number of spawners associated with the maximum difference between predicted recruits and the replacement line using the Ricker function with the outliers removed was defined as optimal production.

The Ricker function used was of the form:

$$\text{Recruits} = S \times \exp(a(1-S/b))$$

The Beverton – Holt function used was of the form:

$$\text{Recruits}=(a \times S) / (b+S)$$

Where S is the number of spawners, and a and b are parameters to be estimated.

Production: Results

Each area shows a period of higher than expected productivity during the early 1980's (Fig. 29). Beverton-Holt stock recruitment curves do not fit these years well and they must be removed to get a good fit. Ricker models fit all data. However, only Ricker fits without outliers are shown for consistency. There is little difference between the ascending limbs of these two models of the Ricker and Beverton-Holt models fitted without the outliers. Ricker models without the outliers are used to compare all counties (Fig. 29).

The comparison among counties illustrates the higher productivity of western (Shelburne and Queen’s Counties) compared to eastern counties (Halifax and Lunenburg) in LFA 33 (Fig. 30).

Spawner levels are generally near or exceed optimum production levels in all areas in the most recent years (Fig. 29).

Production: Discussion

At the present time these analyses should be considered preliminary and an approximation of the stock-recruitment relationships and productive capacity among the areas in LFA 33. This is an area of continuing investigation.

Avoiding the ascending portion of the stock recruitment curve would be a safe management regime for lobster in LFA 33. The comparison graph indicates that this may be more difficult in the east than west. It also indicates that the east may be more sensitive to environmental influences on productivity.

Greater abundance of berried females relative to juveniles in the east compared to the western portion of LFA 33 was also found by Miller (1997). Understanding this variation will be an important aspect of lobster management and biology in the future.

One aspect of lobster productivity which has not been incorporated into this analysis is blending of year-classes in the creation of new recruits and any effects this may have on spawners required for optimal production. Sheehy (2001) has shown by simulation that this may affect interpretations of productivity and the shape of stock-recruitment curves for lobster.

General Discussion:

Effects of Management Measures

Initial expected positive effects of the management measures implemented in the 4 year management plan were an increase in catch rates of lobster between 90 to 100mm (FSRS size 7), an increase in berried females, and a decline in extended exploitation rate. Changes consistent with these expectations are positive changes in overall catch rates compared to previous 5 year means; FSRS size 7 lobster indicators, berried female indicators in east and west, and declines in exploitation rates of the groups affected by the MLS change.

The detection of long-term effects on the fishery, from increased egg production, will have to wait until the progeny of lobster initially affected by the management plan enter the fishery at 7-9 years old. Industry reports that participation in v-notching berried females has ranged from 10% to 50%. The effect of releasing culls may be limited because lobsters with claws exhibiting any growth are considered to be clawed and may be retained. Growth may occur between fall and spring and culls released in the fall may be caught in the spring. V-notching culls would increase the effectiveness of this measure.

The relative effect of increasing MLS from 81mm to the indicated size, releasing lobster within a specified size range (Window), releasing lobster above a specified size, and v-notching at the specified rate indicate that the management measures applied to LFA 33 likely produced a 25% to 30% increase in egg production per recruit compared to the 100% goal (Table 8). Various combinations of v-notching, minimum, maximum, and window size regulations would have achieved similar results (Table 8, DFO 1998).

Resource status

Summary tables are used to describe the trends in each of the indicators discussed above. The trends in the indicators are divided into Negative, meaning that all indicators since the management plan started are lower than the years before the plan. No change, means that the annual signal was mixed and that some years of a particular indicator exceed those prior to the plan, and some years are lower than those prior to the plan. Positive, means that all annual values of an indicator since the plan exceed those prior to the plan.

The principal results of the indicators were: Legal sized lobster indicators were primarily positive or exhibited no change during the years of the management plan. Pre-recruit (sub-legal sized) lobster indicators exhibited no overall change or were negative during the years of the management plan. Berried female (larger than 50% size-at-maturity, >100mm) indicators were positive during the years of the management plan. Exploitation rate indicators declined during the years of the management plan. Positive legal size, berried female, and exploitation rate indicators were consistent with expectations from the management plan (Table 9). Pre-recruit indicators were not expected to improve as a result of the management plan.

Recommended stock indicators

Several recommendations can be made concerning which indicators will be most useful for future assessments. Most accurate conclusions regarding stock status and the effects of management will come from indicators that combine information on relative abundance and distribution.

The two major data sources that will contribute to improvements in interpreting indicators of relative abundance and distribution are:

1) Fishermen generated logbooks of catch and effort including improvements by:
    a) Increasing participation
    b) Reporting on the spatial distribution of catch and effort
2) The FSRS trap programs including improvements by:
    a) Increasing the area of the population covered by fixed location recruitment traps by adding participants in areas not currently sampled
    b) Collecting recruitment trap type-data from commercial traps.

The specific indicators that should be continued and further developed are:

1) Pre-recruit indicators - catch rates of various sizes based on the FSRS traps.
2) Legal indicators – catch rates from index logs, mandatory logs, and FSRS traps.
3) Berried female indicators – catch rates from FSRS traps, at-sea samples, and logbooks.
4) Exploitation indicators – change-in-ratio estimates and length-class composition.
5) Prevalence or spatial distribution indicators – spatial catch rates from index logs, mandatory logs, and FSRS traps. Participation and spatial coverage in these programs should be expanded where necessary.

6) Ecosystem indicators – continue with temperature data in FSRS traps. Investigate collecting data at fixed depths along the coast.

Outlook

The outlook for the future depends on short-term and long term recruitment trends. In the short-term, negative recruitment indicators indicate that catch rates and legal size indicators may not be as positive for the next few years as they were for the most recent years. However, fishermen comments during fall 2003 fishing indicate that berried females and recruits are increasing in the west. In the long-term, positive indicators for berried females indicate that prospects 7 to 9 years from now, assuming current conditions remain the same, are positive. The total number of legal trips will be reduced during this period as a number of B licenses are expected to retire over the next ten years.

The MLS is one or two molts below the 50% size-at-maturity. The consequences of this are that more than 60% of lobsters are harvested before they reproduce. Ensuring that sufficient numbers of large lobsters are able to reproduce will be the biggest challenge to ensuring that long-term management goals are met.

Relevant research required

The increased occurrence of soft lobster has been an issue in recent years. There are many hypotheses concerning the cause of increases in soft lobster, including too many lobster, double molt, delayed molt, and poor food supply. In order to distinguish between these hypotheses, data on the occurrence and spatial distribution of lobster condition needs to be collected. This data collection needs to occur routinely and not just in years of concern.

Lobster abundance is believed to be the main cause of changes in fishery landings from year to year, but annual changes in catchability likely contribute to variability. Annual temperature variability has likely influenced relative catch rate indicators. A method for including temperature effects in index models needs to be developed in order to provide indicators that more closely reflect changes in abundance.

Studies that investigate the link between lobster abundance and FSRS trap catch rates are needed.

Stock structure and linkages within and outside of LFA 33 during the planktonic larval stage are not well understood.

Size-at-maturity estimates are based on studies from the 1980's. There is uncertainty as to whether maturity has changed and up to date estimates are warranted (Comeau 2003).

Long-term changes in lobster distribution could affect interpretation of abundance trends. Expanding the spatial aspects of all data sets is needed in order to detect changes in lobster distribution.

Ecosystem considerations are not taken explicitly into account when assessing and advising on lobster fisheries. Methods for identifying and incorporating ecosystem effects need to be pursued, and would include the effects of predation, food sources, other fisheries, other species, invasive species, and environmental effects.

Acknowledgements:

We thank the executive of the Fishermen and Scientists Research Society (FSRS) for making the trap monitoring data accessible. We especially thank the many FSRS members who participated in the data collection. Thanks to Patty King, Carl MacDonald, Jeff Graves, Shannon Scott-Tibbetts, and numerous FSRS interns that kept this program so well organized. We owe a special thanks to Shannon Scott-Tibbetts for expert editing of the data and her patience for dealing with many urgent interruptions and questions from the data users.

Thanks are in order for Steve Nolan, Ron Duggan, and Bob Miller for the operation and maintenance of the voluntary logbook and port sampling programs in LFA 33.

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Table 1. Starting dates for each season in LFA 33 since the management plan was implemented.

Season	StartDate	End Date
19981999	Nov-23-1998	May-31-1999
19992000	Nov-29-1999	May-31-2000
20002001	Nov-27-2000	May-31-2001
20012002	Nov-26-2001	May-31-2002
20022003	Nov-25-2002	May-31-2003

Table 2. Distribution of Lobster License Types in LFA 33 During the 2002-2003 Fishery.

License Category	Number of licenses	Number of traps per license	Total Traps
A	625	250	156,250
B	61	75	4,575
Partnerships	32	375	12,000
Total	718		172,825

Table 3. Number of days recorded in logbook by season for voluntary logbook participants in LFA 33. Last two digits in Id identify individual fishermen, the first 1 or 2 digits identify port cluster. The Used row indicates whether or not an individual fisherman met the 3 days, with 10 days or more of recording criteria for inclusion in the multiplicative analysis. Thirty-five fishermen in total were used representing about 5% of the total license holders in LFA 33.

A) Port clusters 1 – 4

Id	101	102	103	104	201	202	203	204	205	206	207	301	302	303	304	401
1984-1985	0	78	0	32	0	0	0	0	0	0	0	0	0	0	0	0
1985-1986	0	30	0	0	23	0	0	0	0	0	0	0	0	0	0	0
1986-1987	0	0	27	0	72	30	0	0	0	0	0	0	0	0	0	0
1987-1988	22	0	0	0	67	79	13	0	0	0	0	0	0	0	0	0
1988-1989	27	21	0	0	65	69	12	0	0	0	0	0	0	0	0	0
1989-1990	0	0	0	0	67	82	14	0	0	0	0	0	0	0	0	0
1990-1991	0	0	0	0	63	66	0	0	0	0	0	0	0	0	0	0
1991-1992	0	0	0	0	60	16	12	0	0	0	0	23	0	0	0	0
1992-1993	0	0	0	0	46	33	0	0	0	0	0	0	0	34	52	0
1993-1994	0	0	0	0	51	33	0	0	0	0	0	0	0	0	0	0
1994-1995	0	0	0	0	58	42	0	0	0	0	0	26	0	40	38	0
1995-1996	0	0	0	0	48	41	0	0	0	0	0	42	12	0	0	0
1996-1997	0	0	0	0	0	28	0	0	0	0	0	31	12	0	0	0
1997-1998	0	0	0	0	0	47	0	0	0	0	0	50	32	0	0	0
1998-1999	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0
1999-2000	0	0	0	0	0	62	0	0	0	0	0	0	0	0	0	0
2000-2001	0	0	0	0	0	43	0	0	76	45	0	0	0	47	46	46
2001-2002	0	0	0	0	0	41	0	23	0	20	53	0	0	50	50	41
2002-2003	0	0	0	0	0	42	0	0	0	0	0	0	0	45	0	42
Used	No	Yes	No	No	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes

B) Port clusters 5 - 8

Id	501	502	503	504	505	506	601	701	801	802	803
1984-1985	35	91	89	0	0	0	0	0	0	0	0
1985-1986	54	89	90	0	0	0	0	0	0	0	0
1986-1987	24	80	101	0	0	0	0	0	0	0	0
1987-1988	72	83	93	0	0	0	0	0	0	0	0
1988-1989	76	91	96	0	0	0	0	0	0	0	0
1989-1990	83	94	101	0	0	0	0	0	0	0	0
1990-1991	82	89	101	0	0	0	0	0	0	0	0
1991-1992	72	0	96	0	0	0	0	0	0	0	0
1992-1993	59	0	80	60	0	0	24	0	0	0	0
1993-1994	66	0	0	74	0	0	19	0	0	0	0
1994-1995	70	0	110	90	0	0	79	0	0	0	0
1995-1996	72	0	92	94	0	0	79	0	61	76	0
1996-1997	65	0	81	81	0	0	72	0	73	49	0
1997-1998	143	48	95	97	84	15	81	65	73	49	57
1998-1999	23	0	0	0	80	25	78	70	76	74	60
1999-2000	74	0	0	107	72	14	83	0	60	101	105
2000-2001	71	0	0	100	0	10	76	63	78	157	141
2001-2002	71	0	0	100	90	12	76	61	79	118	58
2002-2003	62	0	0	89	66	6	54	63	65	69	66
Used	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3 (cont.)

C) Port cluster 9

Id	901	902	903	904	905	906	907	908	909	910	911
1984-1985	64	0	0	0	0	0	66	0	0	0	0
1985-1986	86	0	0	0	0	0	57	0	0	0	0
1986-1987	82	0	0	0	28	32	0	0	0	0	0
1987-1988	69	82	17	65	0	0	0	0	0	0	0
1988-1989	83	66	34	0	0	0	0	0	0	0	0
1989-1990	79	87	70	80	0	0	0	0	0	0	0
1990-1991	75	98	79	63	0	0	0	0	0	0	0
1991-1992	58	57	61	66	0	0	0	0	0	0	0
1992-1993	0	55	60	61	0	0	0	0	0	0	0
1993-1994	60	71	54	0	0	0	0	73	88	0	0
1994-1995	0	72	75	0	0	0	0	86	0	0	0
1995-1996	0	72	24	0	0	0	0	0	0	0	0
1996-1997	0	70	0	0	0	0	0	0	39	15	0
1997-1998	0	80	0	0	0	0	0	0	21	41	0
1998-1999	0	90	0	0	0	0	0	0	24	55	0
1999-2000	0	86	0	0	0	0	0	0	0	53	0
2000-2001	0	78	0	0	0	0	0	0	0	51	0
2001-2002	0	80	0	0	0	0	0	0	0	52	70
2002-2003	0	69	0	0	0	0	0	0	0	52	63
Used	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	No

D) Port cluster 10 - 13

Id	1001	1002	1004	1101	1102	1201	1202	1301	1302	1303
1984-1985	0	0	0	0	0	0	0	0	0	0
1985-1986	0	0	0	0	0	0	0	0	0	0
1986-1987	0	0	0	0	0	0	0	0	0	0
1987-1988	0	0	0	0	0	0	0	0	0	0
1988-1989	0	0	0	0	0	0	0	0	0	0
1989-1990	0	0	0	0	0	0	0	0	0	0
1990-1991	0	0	0	0	0	0	0	0	0	0
1991-1992	0	0	0	0	0	0	0	0	0	0
1992-1993	0	0	0	0	0	0	0	0	0	0
1993-1994	151	91	0	0	0	0	0	0	0	0
1994-1995	190	111	0	0	0	0	0	18	28	44
1995-1996	267	128	0	0	0	0	0	27	39	61
1996-1997	116	87	0	0	0	0	0	26	27	48
1997-1998	116	87	0	0	0	0	0	31	40	53
1998-1999	91	94	0	86	0	0	0	39	43	59
1999-2000	94	60	0	82	0	0	0	0	0	0
2000-2001	93	67	91	118	66	66	57	0	0	0
2001-2002	74	59	91	103	0	68	58	0	0	0
2002-2003	65	51	86	80	0	62	65	0	0	0
Used	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes

Table 4. Fishermen and Scientists Research Society (FSRS) defined length-classes. For length-class 6, sub-legal and legal sized lobster were differentiated during the data collection.

Length-class	Size definition (mm)
1	< 51
2	51 - 60
3	61 - 70
4	71 - 75
5	76 - 80
6	81 - 90
7	91 -100
8	> 100

Table 5. Counts of lobster in LFA 33 portion of the FSRS recruitment trap project. Tables includes numbers at FSRS length-class trap-hauls, participants and sampling days. The 1998-1999 season was for the spring only.

	Season				
Size	19981999	19992000	20002001	20012002	20022003
1	167	277	220	301	365
2	582	1073	924	1145	1231
3	1040	2174	2069	2593	2375
4	817	1970	2070	2892	2603
5	641	1734	1914	2655	2198
6	212	1299	1634	2294	2307
7	78	511	829	1040	941
8	50	158	223	316	277
Total	3587	9196	9883	13236	12297
TrapHauls	1450	3825	4696	4935	5408
Participants	23	31	30	32	42
SamplingDays	41	147	167	156	146

Table 6. Counts of lobster by FSRS length-class, legal status, and sex from the FSRS recruitment trap program, includes trap-hauls. Codes are: first digit is FSRS length-class, second digit is 1 for sub-legal, and 0 for legal, third digit is 1 for males, 2 for females, and 3 for berried. Thus, 111 is a length-class 1, sub-legal, male

	Numbers					CPUE per 100 trap-hauls				
Life History	1998	1999	2000	2001	2002	1998	1999	2000	2001	2002
Code	1999	2000	2001	2002	2003	1999	2000	2001	2002	2003
111	93	164	107	159	176	6.41	4.29	2.28	3.22	3.25
112	74	113	113	141	188	5.10	2.95	2.41	2.86	3.48
113				1	1	0.00	0.00	0.00	0.02	0.02
211	272	602	476	540	583	18.76	15.74	10.14	10.94	10.78
212	310	471	448	600	647	21.38	12.31	9.54	12.16	11.96
213				5	1	0.00	0.00	0.00	0.10	0.02
311	545	1177	1078	1280	1191	37.59	30.77	22.96	25.94	22.02
312	495	994	985	1308	1177	34.14	25.99	20.98	26.50	21.76
313		3	6	5	7	0.00	0.08	0.13	0.10	0.13
411	426	1073	1103	1517	1338	29.38	28.05	23.49	30.74	24.74
412	391	884	959	1364	1248	26.97	23.11	20.42	27.64	23.08
413		13	8	11	17	0.00	0.34	0.17	0.22	0.31
511	330	956	1017	1373	1169	22.76	24.99	21.66	27.82	21.62
512	304	765	883	1261	1010	20.97	20.00	18.80	25.55	18.68
513	7	13	14	21	19	0.48	0.34	0.30	0.43	0.35
611		19	189	292	321	0.00	0.50	4.02	5.92	5.94
612		9	157	284	298	0.00	0.24	3.34	5.75	5.51
613		2	4	4	5	0.00	0.05	0.09	0.08	0.09
601	128	788	771	969	992	8.83	20.60	16.42	19.64	18.34
602	78	467	496	714	648	5.38	12.21	10.56	14.47	11.98
603	6	14	17	31	43	0.41	0.37	0.36	0.63	0.80
701	42	310	537	611	565	2.90	8.10	11.44	12.38	10.45
702	33	172	231	359	296	2.28	4.50	4.92	7.27	5.47
703	3	29	61	70	80	0.21	0.76	1.30	1.42	1.48
801	28	102	146	178	156	1.93	2.67	3.11	3.61	2.88
802	14	39	57	88	60	0.97	1.02	1.21	1.78	1.11
803	8	17	20	50	61	0.55	0.44	0.43	1.01	1.13
Total	3587	9196	9883	13236	12297	247.38	240.42	210.46	268.21	227.39

Table 7. Catch and numbers of boats in LFA 33 by port cluster.

Table 7. PortCluster	Season	Fall	Spring	Total	Fall Boats	Spring Boats	FallLbs	SpringLbs	TotalLbs
1	1989-1990	13.3	2.0	15.3			29,260	4,400	33,660
1	1990-1991	17.7	4.0	21.7			38,940	8,800	47,740
1	1991-1992	20.5	3.0	23.5			45,100	6,600	51,700
1	1992-1993	10.7	4.1	14.8			23,540	9,020	32,560
1	1993-1994	6.1	15.1	21.2			13,420	33,220	46,640
1	1994-1995	18.3	17.7	36.0			40,260	38,940	79,200
1	1995-1996	7.4	3.1	10.5			16,280	6,820	23,100
1	1996-1997	12.9	4.1	17.0	11	9	28,380	9,020	37,400
1	1997-1998	13.4	7.3	20.7	11	9	29,480	16,060	45,540
1	1998-1999	19.6	8.2	27.8	12	4	43,120	18,040	61,160
1	1999-2000	24.8	6.4	31.2	11	5	54,567	14,049	68,616
1	2000-2001	18.6	10.8	29.4	11	9	41,015	23,718	64,733
1	2001-2002	32.0	5.1	37.1	12	7	70,391	11,233	81,624
1	2002-2003	5.1		5.1	4		11,273	-	11,273
2	1989-1990	29.8	9.2	39.0			65,560	20,240	85,800
2	1990-1991	45.2	14.9	60.1			99,440	32,780	132,220
2	1991-1992	40.8	10.5	51.3			89,760	23,100	112,860
2	1992-1993	21.2	9.5	30.7			46,640	20,900	67,540
2	1993-1994	28.7	36.9	65.6			63,140	81,180	144,320
2	1994-1995	26.6	21.5	48.1			58,520	47,300	105,820
2	1995-1996	40.0	10.2	50.2			88,000	22,440	110,440
2	1996-1997	43.3	8.4	51.7	45	32	95,260	18,480	113,740
2	1997-1998	44.2	18.6	62.8	39	32	97,240	40,920	138,160
2	1998-1999	53.0	24.0	77.0	40	14	116,600	52,800	169,400
2	1999-2000	55.1	23.7	78.9	36	27	121,286	52,208	173,494
2	2000-2001	57.0	32.4	89.4	31	29	125,330	71,265	196,594
2	2001-2002	67.5	24.9	92.4	38	29	148,438	54,740	203,179
2	2002-2003	33.8		33.8	28		74,369	-	74,369
3	1989-1990	69.6	30.8	100.4			153,120	67,760	220,880
3	1990-1991	83.1	53.5	136.6			182,820	117,700	300,520
3	1991-1992	70.4	34.5	104.9			154,880	75,900	230,780
3	1992-1993	59.0	41.9	100.9			129,800	92,180	221,980
3	1993-1994	84.6	48.4	133.0			186,120	106,480	292,600
3	1994-1995	88.8	30.2	119.0			195,360	66,440	261,800
3	1995-1996	92.9	23.7	116.6			204,380	52,140	256,520
3	1996-1997	93.3	15.0	108.3	77	57	205,260	33,000	238,260
3	1997-1998	107.0	43.5	150.5	73	66	235,400	95,700	331,100
3	1998-1999	112.7	62.8	175.5	71	25	247,940	138,160	386,100
3	1999-2000	145.4	56.4	201.8	74	69	319,814	124,102	443,916
3	2000-2001	107.5	61.8	169.2	68	66	236,423	135,883	372,306
3	2001-2002	148.8	36.6	185.3	70	53	327,270	80,454	407,724
3	2002-2003	60.0	0.4	60.4	57	2	132,079	906	132,986
4	1989-1990	75.6	41.5	117.1			166,320	91,300	257,620
4	1990-1991	68.4	51.2	119.6			150,480	112,640	263,120
4	1991-1992	74.8	31.8	106.6			164,560	69,960	234,520
4	1992-1993	57.3	31.3	88.6			126,060	68,860	194,920
4	1993-1994	66.7	36.8	103.5			146,740	80,960	227,700
4	1994-1995	76.8	7.8	84.6			168,960	17,160	186,120
4	1995-1996	104.1	38.0	142.1			229,020	83,600	312,620
4	1996-1997	148.7	34.0	182.7	92	63	327,140	74,800	401,940
4	1997-1998	151.5	74.2	225.7	81	66	333,300	163,240	496,540
4	1998-1999	161.1	73.9	235.0	86	25	354,420	162,580	517,000
4	1999-2000	173.1	56.6	229.6	80	70	380,734	124,476	505,210
4	2000-2001	135.9	59.6	195.5	75	61	298,885	131,217	430,102
4	2001-2002	166.5	50.3	216.8	82	62	366,373	110,618	476,991
4	2002-2003	69.1		69.1	61		151,919	-	151,919
5	1989-1990	24.2	27.9	52.1			53,240	61,380	114,620
5	1990-1991	36.8	22.4	59.2			80,960	49,280	130,240
5	1991-1992	23.1	10.1	33.2			50,820	22,220	73,040
5	1992-1993	21.0	13.0	34.0			46,200	28,600	74,800
5	1993-1994	34.3	11.2	45.5			75,460	24,640	100,100
5	1994-1995	22.3	16.5	38.8			49,060	36,300	85,360
5	1995-1996	25.9	15.7	41.6			56,980	34,540	91,520
5	1996-1997	34.6	16.7	51.3	30	26	76,120	36,740	112,860
5	1997-1998	37.1	30.3	67.4	33	29	81,620	66,660	148,280

Table 7. PortCluster	Season	Fall	Spring	Total	Fall Boats	Spring Boats	FallLbs	SpringLbs	TotalLbs
5	1998-1999	42.1	28.7	70.8	34	5	92,620	63,140	155,760
5	1999-2000	45.6	16.6	62.3	32	25	100,426	36,593	137,018
5	2000-2001	29.7	22.9	52.5	25	26	65,267	50,279	115,546
5	2001-2002	35.9	18.0	53.9	24	25	79,039	39,640	118,679
5	2002-2003	17.7	0.0	17.7	23	1	39,039	11	39,050
6	1989-1990	41.6	15.7	57.3			91,520	34,540	126,060
6	1990-1991	54.5	20.8	75.3			119,900	45,760	165,660
6	1991-1992	31.9	7.0	38.9			70,180	15,400	85,580
6	1992-1993	23.9	10.5	34.4			52,580	23,100	75,680
6	1993-1994	27.6	12.2	39.8			60,720	26,840	87,560
6	1994-1995	30.0	13.0	43.0			66,000	28,600	94,600
6	1995-1996	45.0	13.0	58.0			99,000	28,600	127,600
6	1996-1997	59.5	11.3	70.8	44	35	130,900	24,860	155,760
6	1997-1998	71.2	30.6	101.8	48	39	156,640	67,320	223,960
6	1998-1999	76.3	29.6	105.9	49	12	167,860	65,120	232,980
6	1999-2000	75.5	24.7	100.2	44	40	166,188	54,320	220,508
6	2000-2001	74.3	31.4	105.7	46	43	163,442	69,139	232,582
6	2001-2002	102.5	20.6	123.1	50	33	225,458	45,366	270,824
6	2002-2003	50.5		50.5	47		111,085	-	111,085
7	1989-1990	169.2	100.8	270.0			372,240	221,760	594,000
7	1990-1991	192.7	89.0	281.7			423,940	195,800	619,740
7	1991-1992	159.7	39.7	199.4			351,340	87,340	438,680
7	1992-1993	170.3	47.5	217.8			374,660	104,500	479,160
7	1993-1994	130.1	46.0	176.1			286,220	101,200	387,420
7	1994-1995	105.2	44.0	149.2			231,440	96,800	328,240
7	1995-1996	143.0	21.6	164.6			314,600	47,520	362,120
7	1996-1997	125.5	16.6	142.1	64	50	276,100	36,520	312,620
7	1997-1998	145.8	57.3	203.1	62	56	320,760	126,060	446,820
7	1998-1999	147.2	56.3	203.5	65	35	323,840	123,860	447,700
7	1999-2000	177.2	59.0	236.2	57	56	389,880	129,756	519,636
7	2000-2001	171.3	75.0	246.3	57	54	376,867	165,000	541,867
7	2001-2002	226.0	53.6	279.6	58	61	497,237	117,850	615,087
7	2002-2003	97.6	0.1	97.7	54	1	214,810	229	215,039
8	1989-1990	84.7	30.6	115.3			186,340	67,320	253,660
8	1990-1991	111.9	40.1	152.0			246,180	88,220	334,400
8	1991-1992	118.7	24.5	143.2			261,140	53,900	315,040
8	1992-1993	96.3	41.8	138.1			211,860	91,960	303,820
8	1993-1994	115.0	37.3	152.3			253,000	82,060	335,060
8	1994-1995	54.2	20.1	74.3			119,240	44,220	163,460
8	1995-1996	110.5	14.9	125.4			243,100	32,780	275,880
8	1996-1997	108.8	13.1	121.9	47	38	239,360	28,820	268,180
8	1997-1998	108.7	28.2	136.9	43	38	239,140	62,040	301,180
8	1998-1999	79.9	42.0	121.9	48	18	175,780	92,400	268,180
8	1999-2000	122.8	37.1	159.9	43	34	270,160	81,521	351,681
8	2000-2001	137.9	54.8	192.7	43	40	303,345	120,628	423,973
8	2001-2002	175.5	37.0	212.6	49	36	386,197	81,470	467,667
8	2002-2003	63.4		63.4	32		139,487	-	139,487
9	1989-1990	131.7	125.5	257.2			289,740	276,100	565,840
9	1990-1991	239.0	104.6	343.6			525,800	230,120	755,920
9	1991-1992	217.7	62.6	280.3			478,940	137,720	616,660
9	1992-1993	207.7	103.5	311.2			456,940	227,700	684,640
9	1993-1994	209.5	131.3	340.8			460,900	288,860	749,760
9	1994-1995	146.2	69.3	215.5			321,640	152,460	474,100
9	1995-1996	236.6	49.8	286.4			520,520	109,560	630,080
9	1996-1997	208.3	34.3	242.6	67	62	458,260	75,460	533,720
9	1997-1998	189.9	73.1	263.0	62	56	417,780	160,820	578,600
9	1998-1999	168.3	87.6	255.9	58	66	370,260	192,720	562,980
9	1999-2000	193.0	88.3	281.3	57	56	424,710	194,218	618,928
9	2000-2001	226.5	111.9	338.4	54	56	498,194	246,209	744,403
9	2001-2002	294.5	71.6	366.2	58	56	647,964	157,590	805,554
9	2002-2003	147.4	0.2	147.6	52	1	324,265	526	324,790
10	1989-1990	240.8	150.0	390.8			529,760	330,000	859,760
10	1990-1991	345.9	143.9	489.8			760,980	316,580	1,077,560
10	1991-1992	301.6	84.6	386.2			663,520	186,120	849,640
10	1992-1993	219.0	84.6	303.6			481,800	186,120	667,920
10	1993-1994	279.2	112.9	392.1			614,240	248,380	862,620
10	1994-1995	159.3	63.0	222.3			350,460	138,600	489,060
10	1995-1996	255.5	75.8	331.3			562,100	166,760	728,860

Table 7. PortCluster	Season	Fall	Spring	Total	Fall Boats	Spring Boats	FallLbs	SpringLbs	TotalLbs
10	1996-1997	267.0	52.6	319.6	104	98	587,400	115,720	703,120
10	1997-1998	219.2	101.7	320.9	98	97	482,240	223,740	705,980
10	1998-1999	211.4	118.0	329.4	105	86	465,080	259,600	724,680
10	1999-2000	219.6	85.8	305.3	90	81	483,043	188,670	671,713
10	2000-2001	224.6	137.9	362.5	85	79	494,116	303,371	797,487
10	2001-2002	328.0	97.4	425.4	85	69	721,600	214,335	935,935
10	2002-2003	137.0		137.0	56		301,334	-	301,334
11	1989-1990	144.5	76.8	221.3			317,900	168,960	486,860
11	1990-1991	204.3	86.0	290.3			449,460	189,200	638,660
11	1991-1992	127.5	43.6	171.1			280,500	95,920	376,420
11	1992-1993	129.6	37.8	167.4			285,120	83,160	368,280
11	1993-1994	162.5	45.7	208.2			357,500	100,540	458,040
11	1994-1995	95.0	48.1	143.1			209,000	105,820	314,820
11	1995-1996	157.7	40.1	197.8			346,940	88,220	435,160
11	1996-1997	230.0	34.2	264.2	74	56	506,000	75,240	581,240
11	1997-1998	165.7	62.9	228.6	74	56	364,540	138,380	502,920
11	1998-1999	153.6	88.8	242.4	79	47	337,920	195,360	533,280
11	1999-2000	204.6	73.5	278.1	72	61	450,160	161,636	611,796
11	2000-2001	224.6	112.5	337.0	72	67	494,019	247,432	741,451
11	2001-2002	214.3	115.4	329.7	65	58	471,440	253,838	725,278
11	2002-2003	94.6	1.6	96.2	42	4	208,014	3,628	211,642
12	1989-1990	121.1	95.6	216.7			266,420	210,320	476,740
12	1990-1991	124.3	66.9	191.2			273,460	147,180	420,640
12	1991-1992	121.9	39.0	160.9			268,180	85,800	353,980
12	1992-1993	117.7	44.9	162.6			258,940	98,780	357,720
12	1993-1994	110.6	52.2	162.8			243,320	114,840	358,160
12	1994-1995	71.1	47.1	118.2			156,420	103,620	260,040
12	1995-1996	118.3	30.8	149.1			260,260	67,760	328,020
12	1996-1997	122.0	24.6	146.6	37	31	268,400	54,120	322,520
12	1997-1998	105.7	39.8	145.5	37	34	232,540	87,560	320,100
12	1998-1999	89.0	57.6	146.6	35	46	195,800	126,720	322,520
12	1999-2000	111.4	43.7	155.1	39	35	245,047	96,164	341,211
12	2000-2001	129.1	68.0	197.1	36	35	284,046	149,635	433,682
12	2001-2002	150.4	48.6	199.0	36	34	330,922	106,817	437,738
12	2002-2003	64.3	0.3	64.6	26	1	141,440	667	142,107
13	1989-1990	89.9	94.5	184.4			197,780	207,900	405,680
13	1990-1991	118.1	80.7	198.8			259,820	177,540	437,360
13	1991-1992	104.9	43.7	148.6			230,780	96,140	326,920
13	1992-1993	85.7	41.5	127.2			188,540	91,300	279,840
13	1993-1994	73.2	53.8	127.0			161,040	118,360	279,400
13	1994-1995	54.8	48.0	102.8			120,560	105,600	226,160
13	1995-1996	108.7	41.9	150.6			239,140	92,180	331,320
13	1996-1997	111.1	37.1	148.2	55	50	244,420	81,620	326,040
13	1997-1998	112.2	64.1	176.3	54	53	246,840	141,020	387,860
13	1998-1999	104.9	65.1	170.0	55	26	230,780	143,220	374,000
13	1999-2000	123.4	54.5	178.0	47	49	271,550	120,003	391,554
13	2000-2001	120.5	84.5	205.0	46	46	265,120	185,898	451,018
13	2001-2002	177.6	54.3	231.9	47	44	390,773	119,482	510,255
13	2002-2003	96.1	0.2	96.3	40	1	211,486	429	211,915

Table 8. Relative Effect (0% to 100%) of Various Management Measures in Increasing Egg Production per Recruit (DFO 1998).

Min. Size	Window	Max. Size	% v-notch	Relative Effect
83			0	18
83			15	24
84			0	30
81	110 –120		0	45
84	110 –120		0	95
81	117 -127		0	25
85	117 -127		0	100
81		120	0	40
84		120	0	90
81		127	0	20
86		127	0	90

Table 9. Summary of indicators used to assess resource status in LFA 33. All indicator comparisons are between the status of the indicator during the 2000-2001 to 2002-2003 seasons compared to the 1999-2000 season for FSRS derived indicators. Other comparisons with respect to the 2000-2001 to 2002-2003 seasons are indicated as required.

Legal Size Indicators		
Indicator	**East**	**West**
Landings : Calendar year 2000 to 2001		
Compared to 16 yr mean	**Positive**	**Positive**
Compared to 50 yr mean	**Positive**	**Positive**
Compared to 10 yr mean	**Positive**	**Positive**
Landings: Season 2000-2001 to 2001-2002		
Compared to 10 yr mean	**Positive**	**Positive**
Catch rates: Voluntary Log cpue (kg/th)		
Compared to 5 yr mean	**Positive**	**Positive**
Compared to 16 yr mean	No change	No change
Catch rates: Voluntary Log combined with FSRS Log		
Compared to 5 yr mean	**Positive**	**Positive**
Compared to 16 yr mean	No change	No change
Catch rates: FSRS numbers / trap-haul		
FSRS Size 6	**Negative**	**Positive**
FSRS Size 7	No change	**Positive**
FSRS Size 8	No change	No change
Pre-recruit Indicators		
FSRS Size 1	No change	**Negative**
FSRS Size 2	No change	**Negative**
FSRS Size 3	No change	**Negative**
FSRS Size 4	No change	No change
FSRS Size 5	**Negative**	No change

Table 9. cont.

Berried Female Indicators		
FSRS Size 4	**Negative**	**Negative**
FSRS Size 5	**Positive**	No change
FSRS Size 6	No change	**Positive**
FSRS Size 7	**Positive**	No change
FSRS Size 8	**Positive**	**Positive**
Berried females from voluntary logbook, compared to previous 5 yr mean	**Positive**	**Positive**

Exploitation Indicators		
Indicator	**East**	**West**
Effort (reported boats)		
Fall	No change	No change
Spring	No change	No change
Fall and Spring	No change	No change
Extended exploitation rate: Change-in-ratio		
Males FSRS Size 6	**Positive**	**Positive**
Females FSRS Size 6	**Positive**	**Positive**
Strict exploitation rate: Change-in-ratio		
Males FSRS Size 6	**Positive**	**Positive**
Females FSRS Size 6	**Positive**	**Positive**
Females FSRS Size 7	**Positive**	**Positive**

Distribution (Prevalence) Indicators		
Legal Sizes		
FSRS Size 6	No change	No change
FSRS Size 7	**Positive**	**Positive**
FSRS Size 8	No change	No change
Pre-recruits		
FSRS Size 1	***Negative***	***Negative***
FSRS Size 2	***Negative***	No change
FSRS Size 3	***Negative***	No change
FSRS Size 4	No change	No change
FSRS Size 5	***Negative***	No change
Berried females		
Eggs	**Positive**	**Positive**

Ecosystem Indicators		
Fall	No change	No change
Winter	No change	No change
Spring	***Cooler***	No change

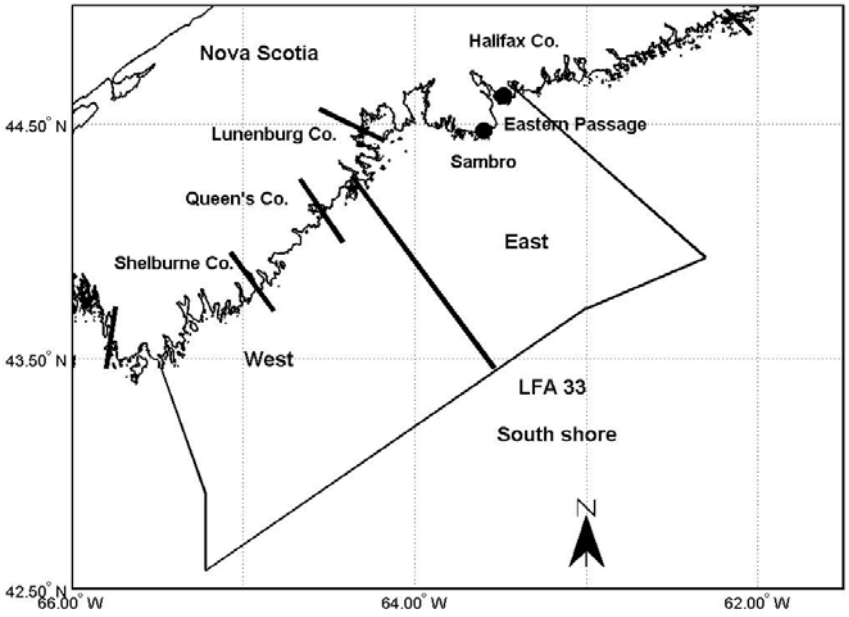


Fig. 1. Locations of LFA 33 and sub-areas that are examined in the assessment. East refers to port clusters 1-6 and is labeled 331 in subsequent figures. West refers to port clusters 7-13 and is labeled 332 in subsequent figures.

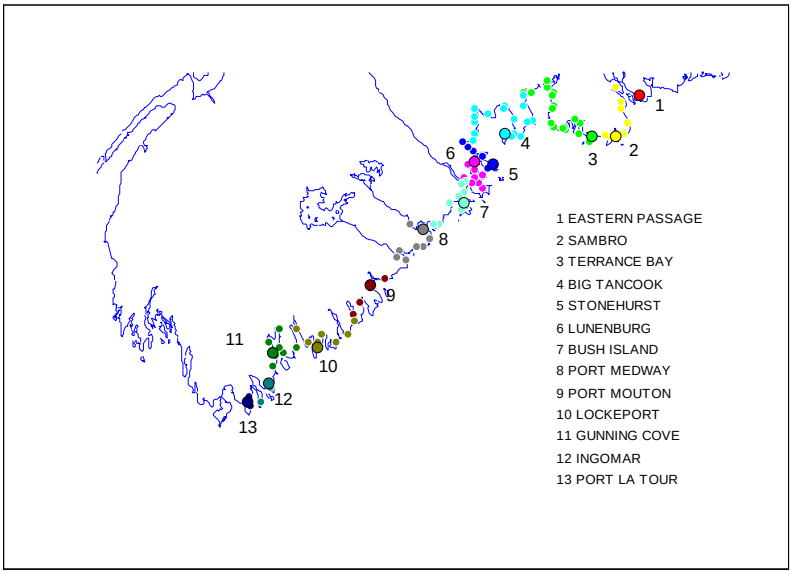


Fig. 2. Locations of ports within LFA 33 port clusters. Port Cluster boundaries for LFA 33 are indicated by different shadings. Main port in each cluster is identified.

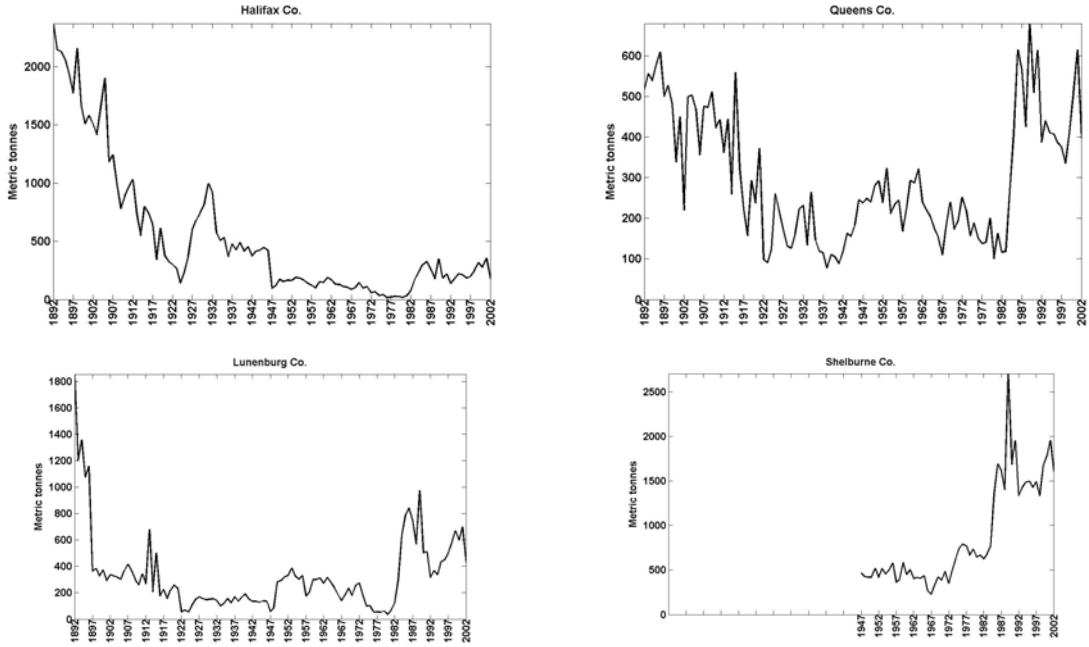


Fig. 3. Long-term landings summarized by calendar year for Halifax, Lunenburg, Queen's, and portion of Shelburne counties within LFA 33. Note, scales differ among figures.

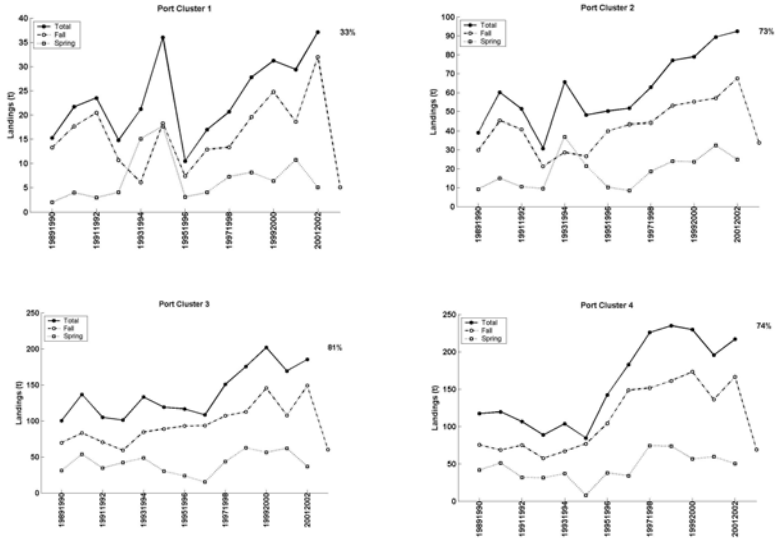


Fig. 4. Landings by port cluster in LFA 33 since fall 1989 for total season, fall, and spring portions separately. Landings for 2002-2003 are preliminary. The percentage in the upper right hand corner indicates the percentage of boats in the DFO statistical branch data file in the fall of 2002 compared to the average of the fall portions for the previous 5-years. It is an indication of the completeness of the reported landings data at the time of data preparation (Nov. 2003). Landings for spring were <5% complete.

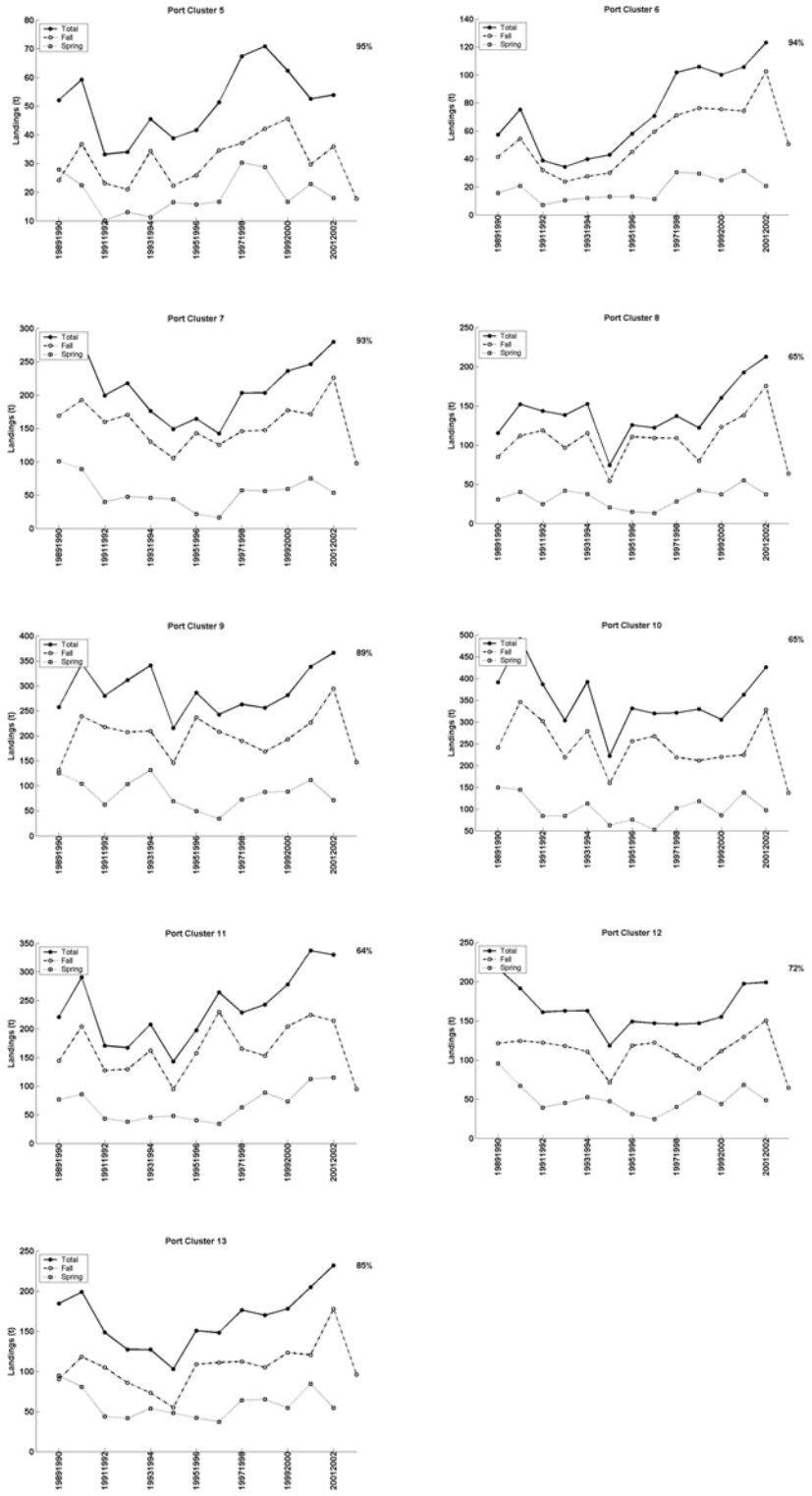

Port Cluster 5
Total
Fall
Spring
95%
Landings (t)
Port Cluster 6
94%
Port Cluster 7
93%
Port Cluster 8
65%
Port Cluster 9
89%
Port Cluster 10
65%
Port Cluster 11
64%
Port Cluster 12
72%
Port Cluster 13
85%
19891990
19911992
19931994
19951996
19971998
19992000
20012002

Fig. 4 (cont.)

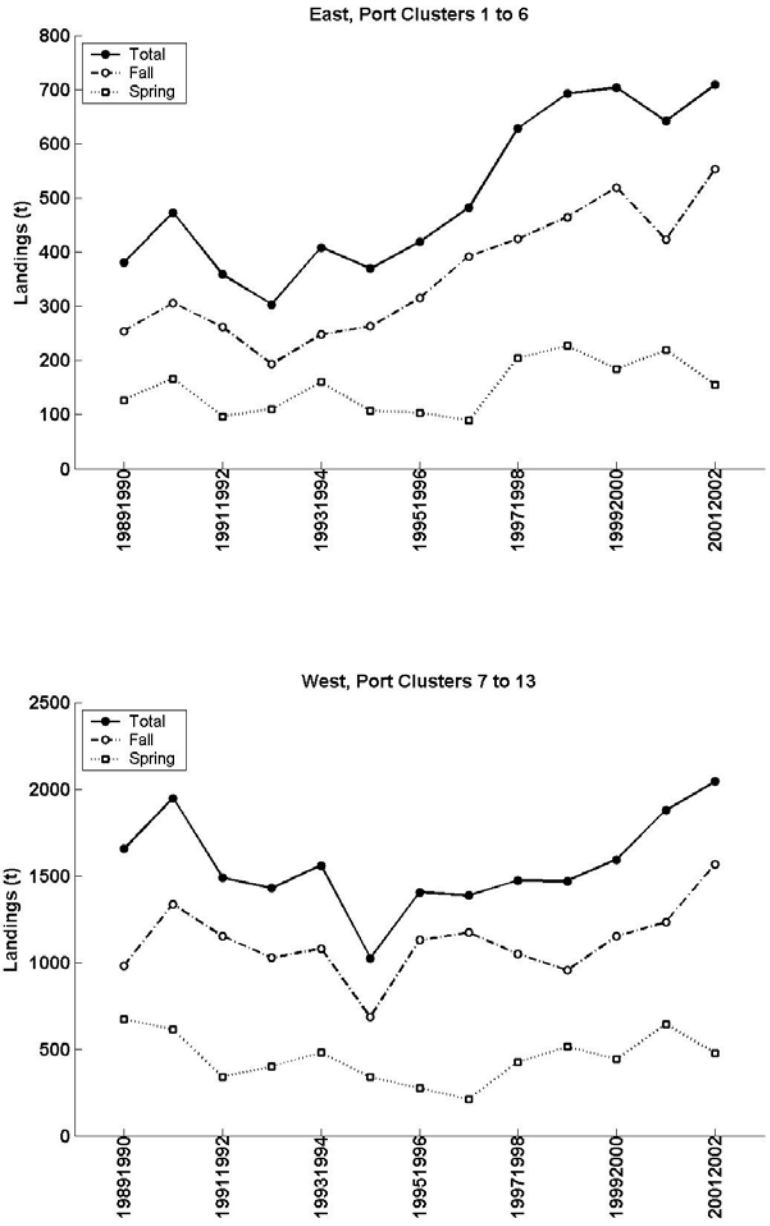


Fig. 5. Landings by east and west port clusters in LFA 33.

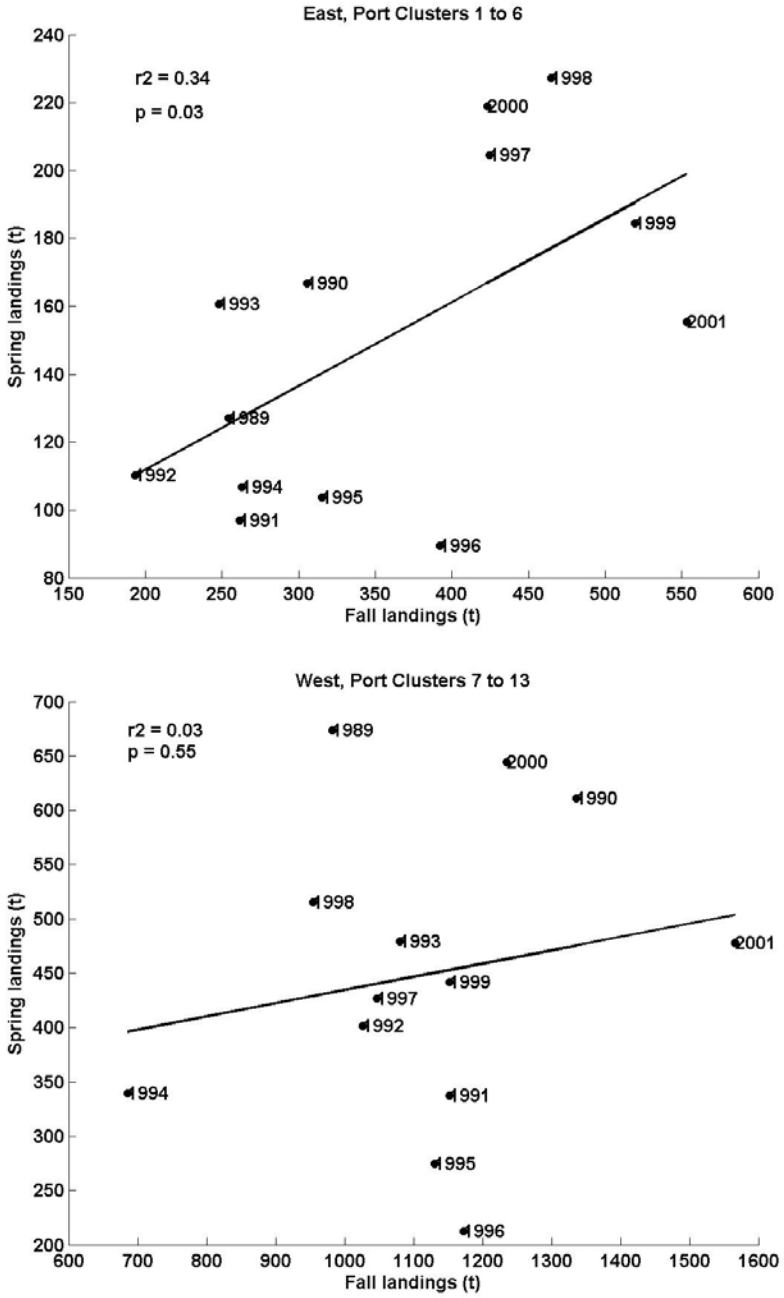
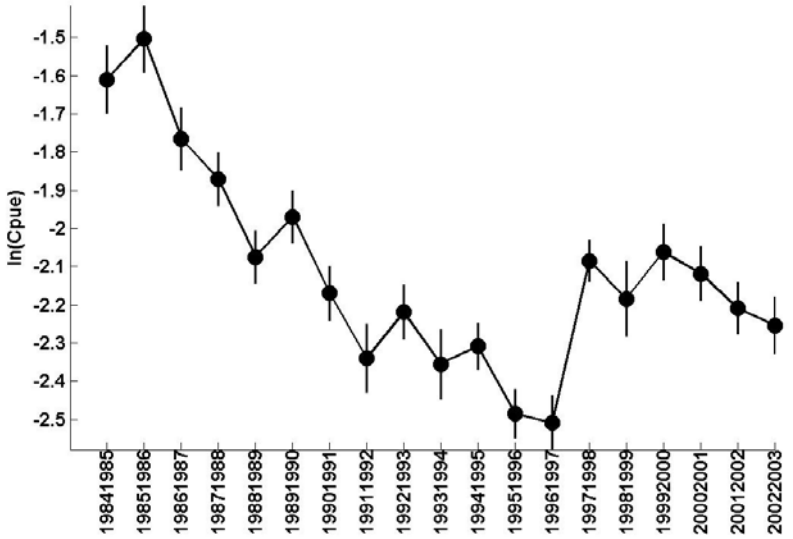


Fig. 6. Results of correlations analysis between fall and spring landings for eastern and western groups of port clusters in LFA 33.

East



West

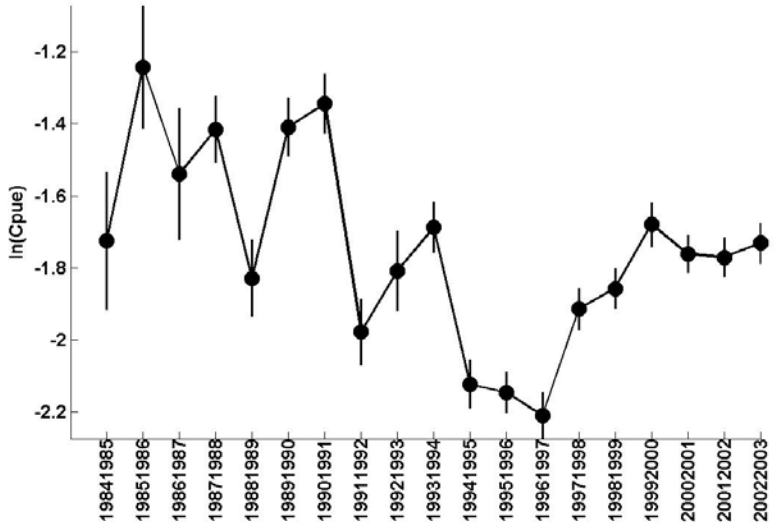
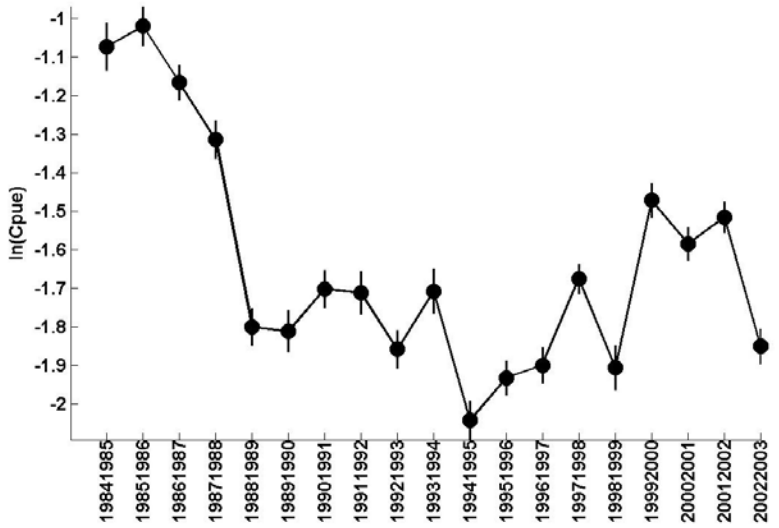


Fig. 7. Catch rates, ln(Cpue, kg / trap-haul) for fall and spring seasons combined from voluntary logbook data. Vertical bars are 95% confidence intervals.

East



West

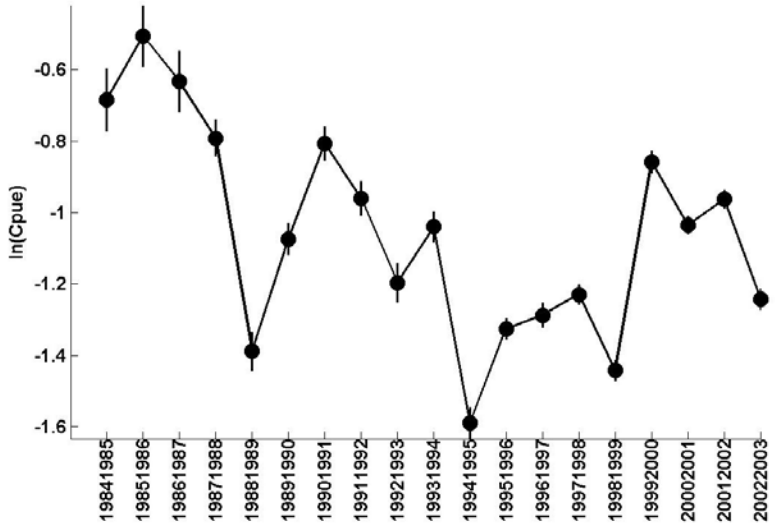
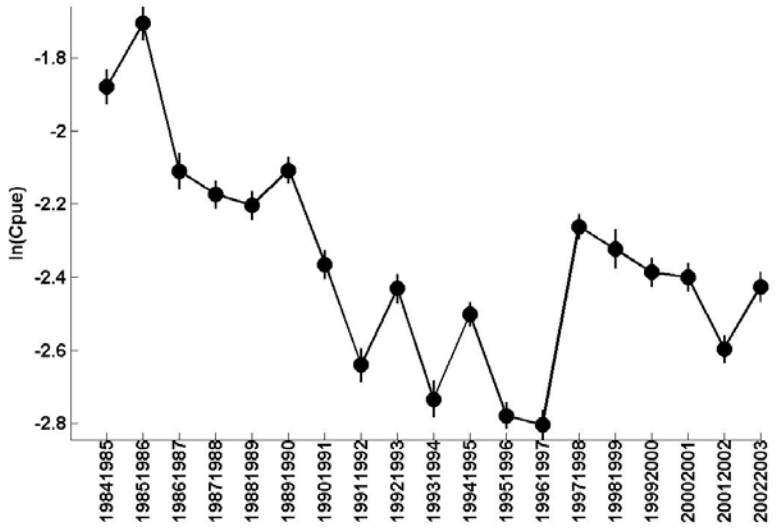


Fig. 8. Catch rates, ln(Cpue, kg / trap-haul) for fall season from voluntary logbook data. Vertical bars are 95% confidence intervals.

East



West

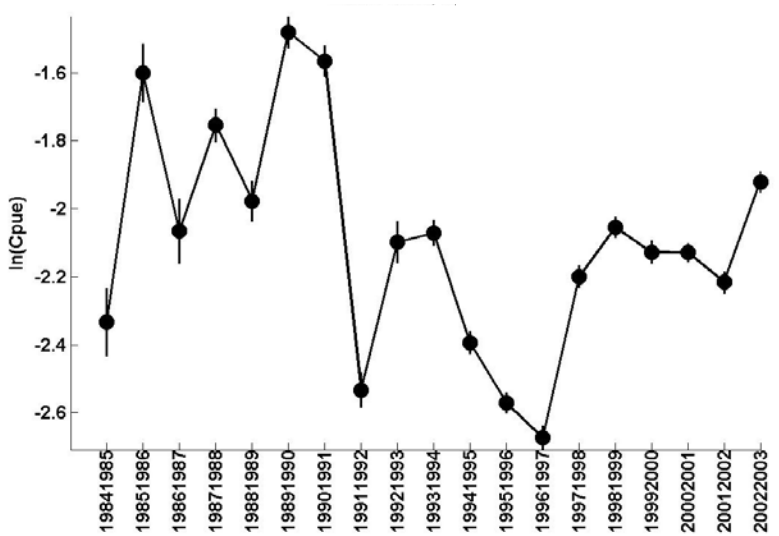
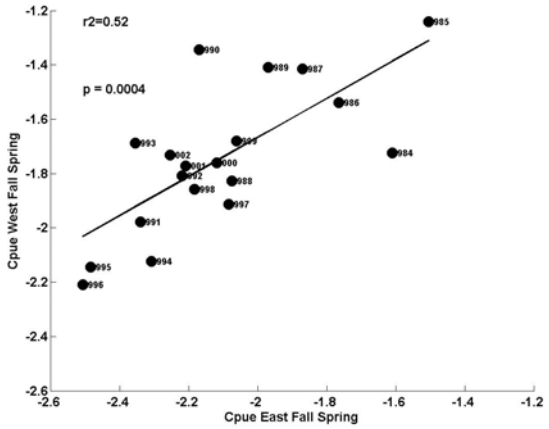
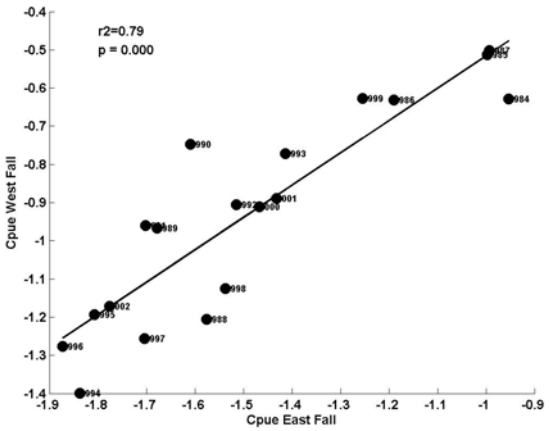


Fig. 9. Catch rates, ln(Cpue, kg / trap-haul) for spring season from voluntary logbook data. Vertical bars are 95% confidence intervals.

Fall - Spring



Fall



Spring

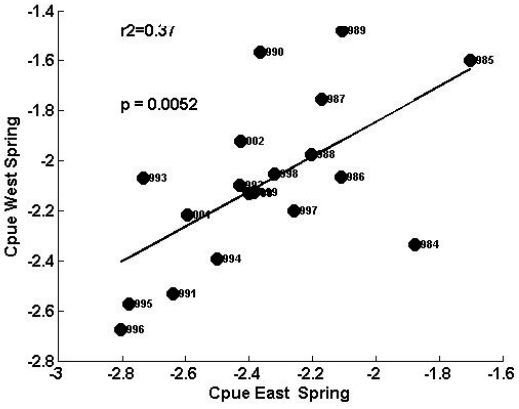
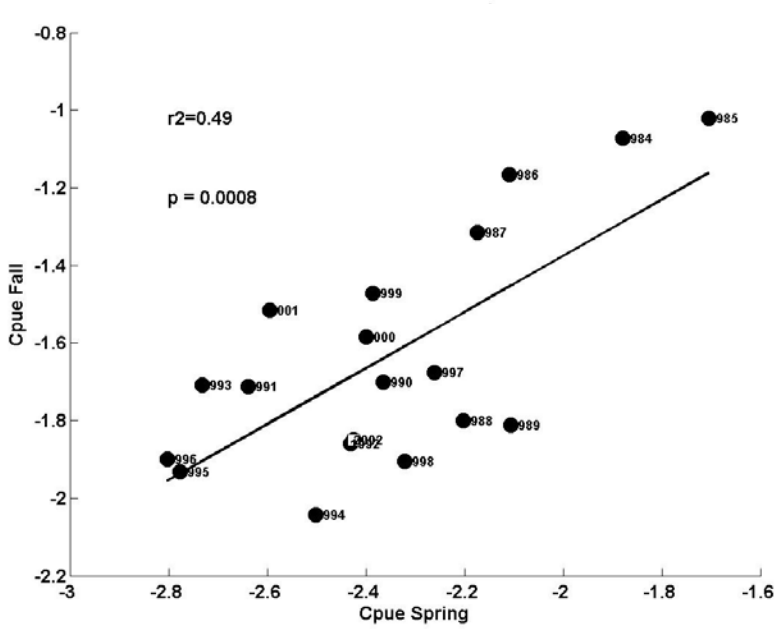


Fig. 10. Correlations between east and west areas for catch rate analysis in Fig. 7 to 9.

East



West

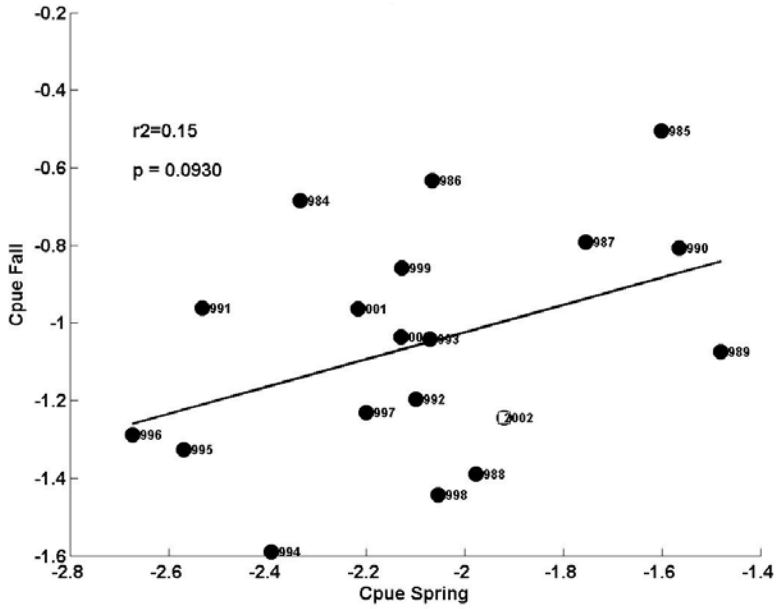


Fig. 11. Results of catch rate correlation tests between fall and spring for the eastern and western portions of LFA 33.

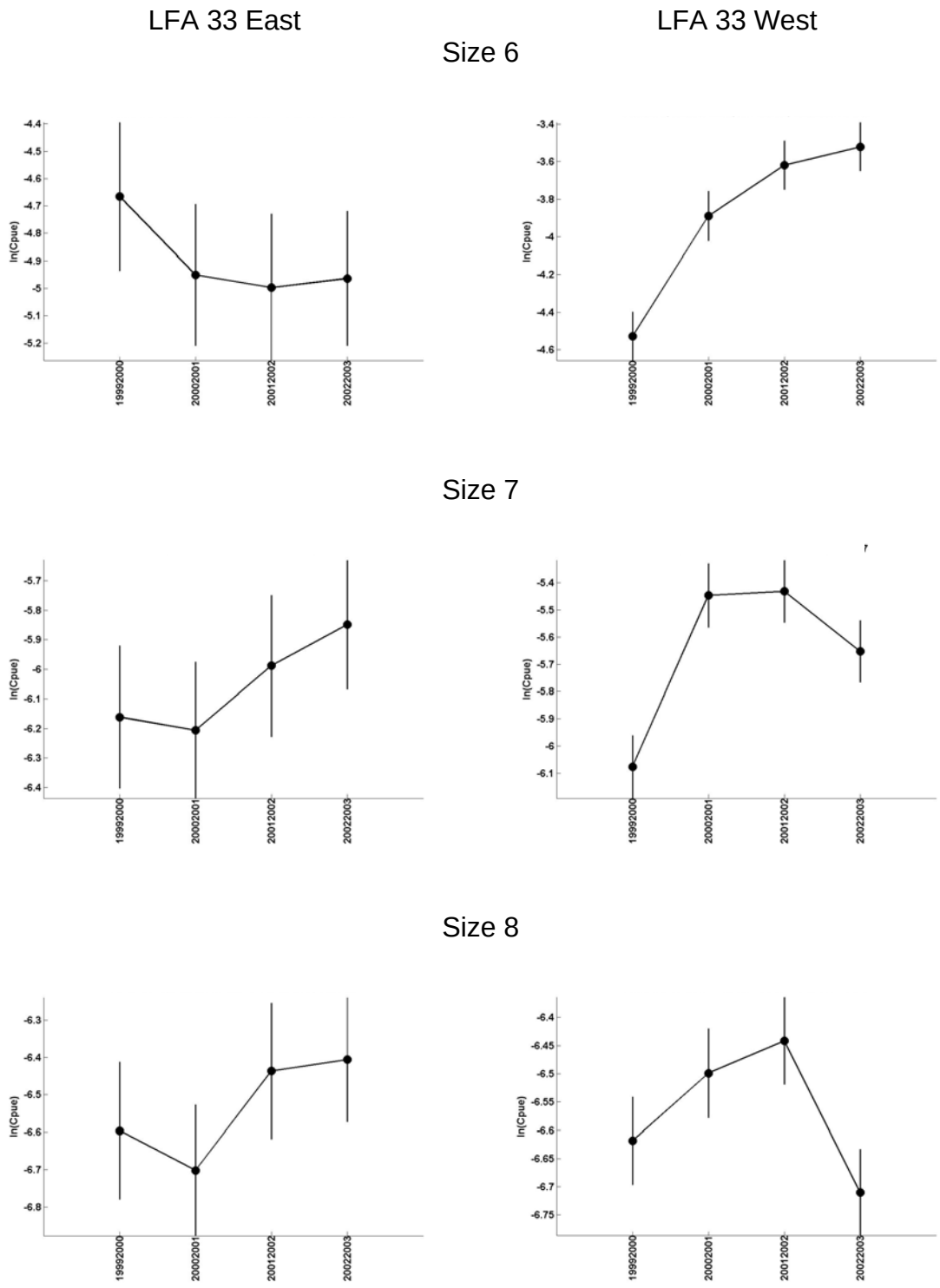


Fig. 12. Results of multiplicative analysis of ln(catch rates (numbers / trap-haul)) of legal sized lobster in FSRS recruitment traps. Solid circles are predicted values and vertical lines are 95% confidence intervals.

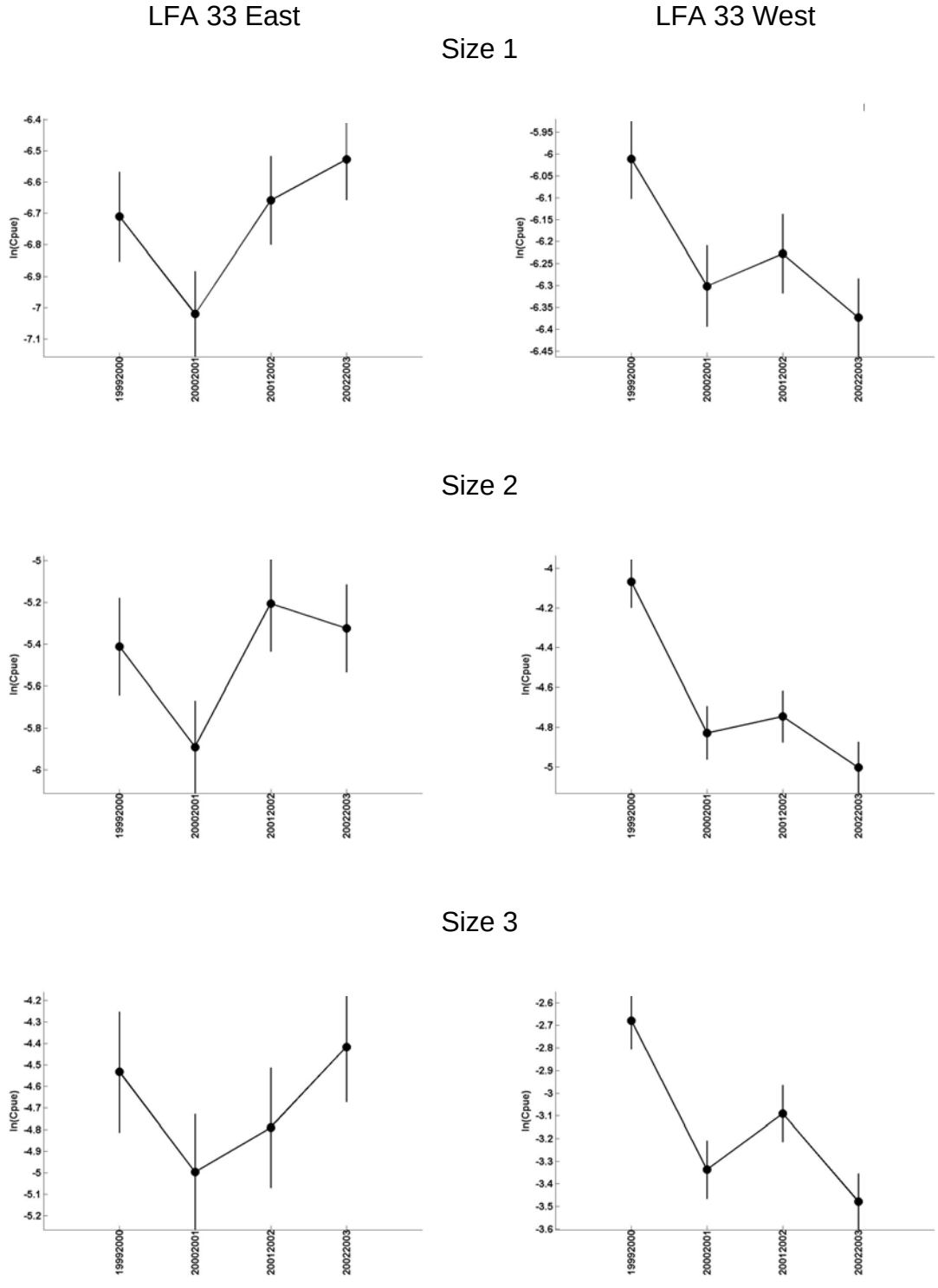
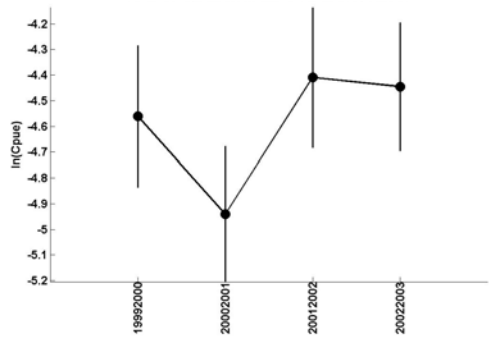


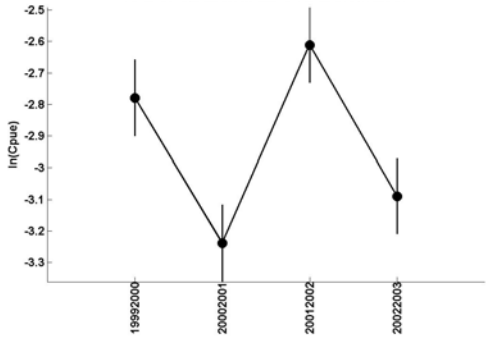
Fig. 13. Catch rate indices for pre-recruits from FSRS recruitment trap data. Vertical bars are 95% confidence intervals.

LFA 33 East

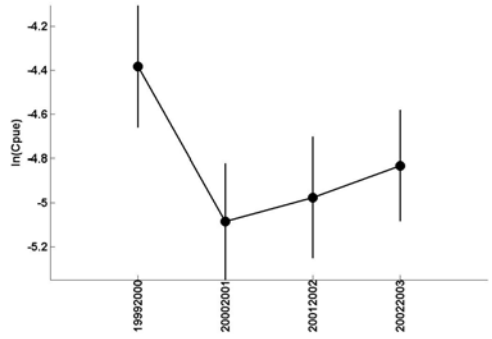
LFA 33 West

Size 4





Size 5



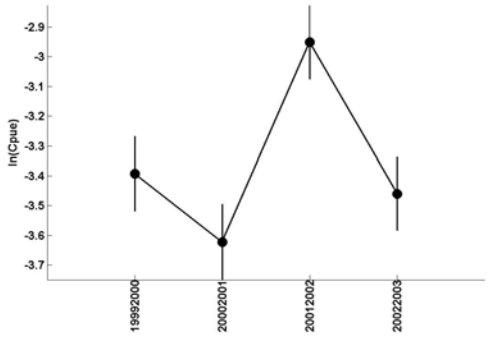


Fig. 13. (cont.).

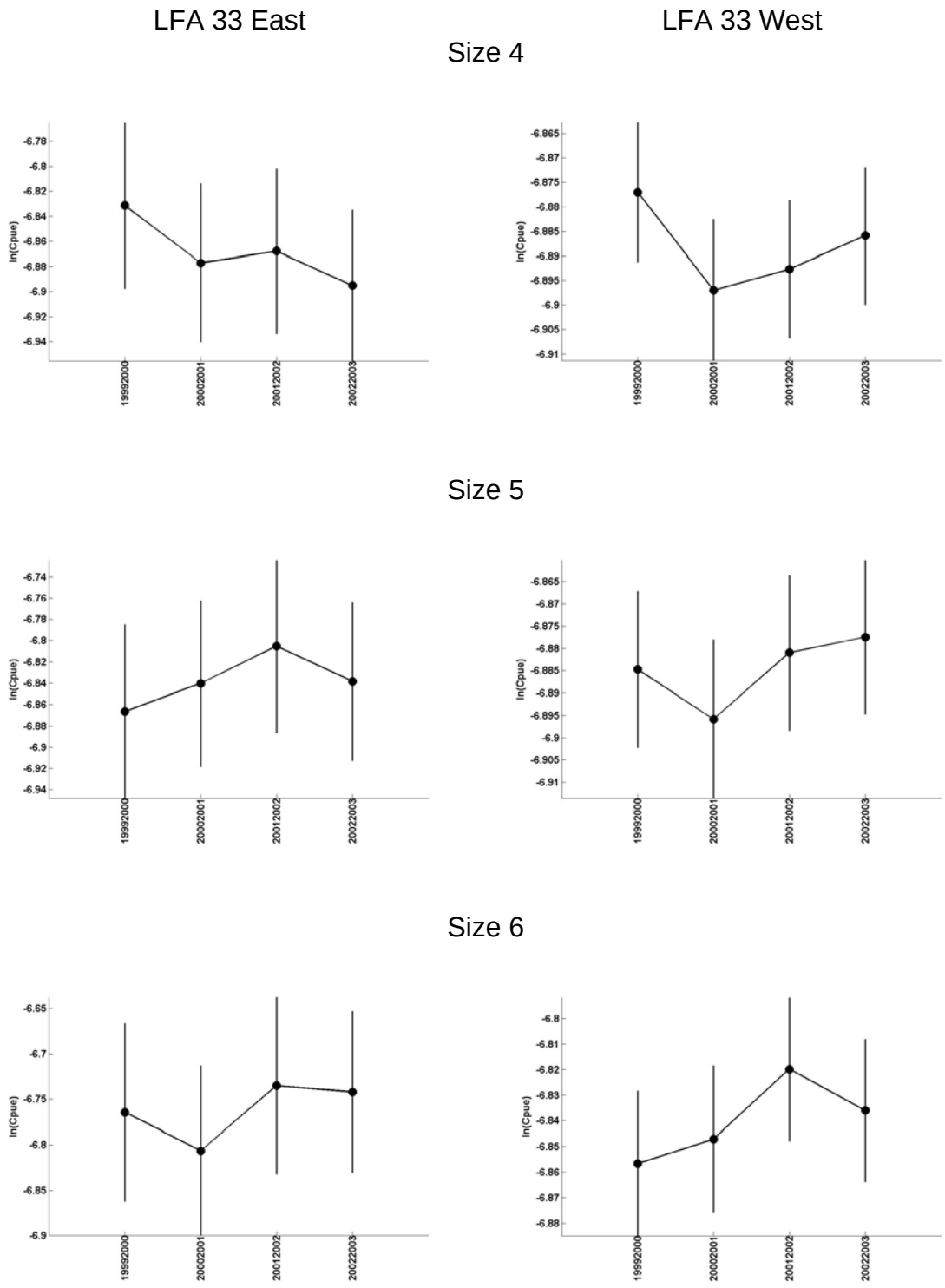
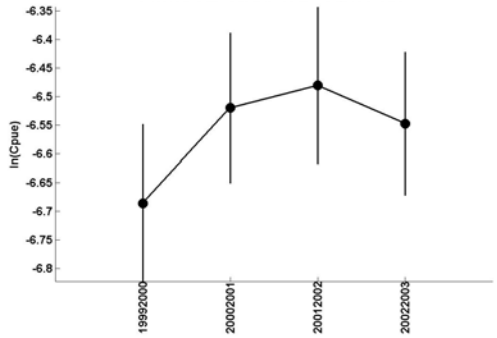


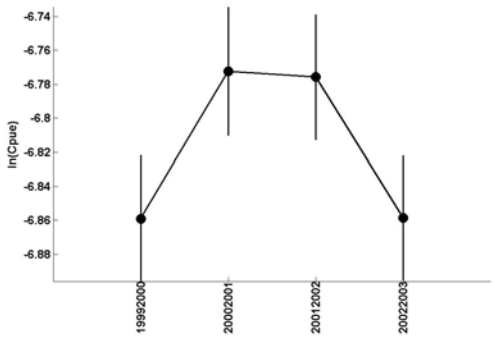
Fig. 14. Catch rates of berried females from the FSRS recruitment trap program. Vertical bars are 95% confidence intervals.

LFA 33 East

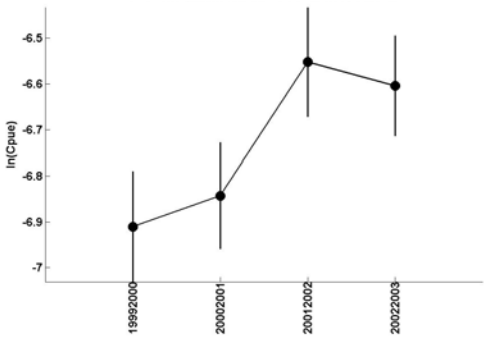
LFA 33 West

Size 7





Size 8



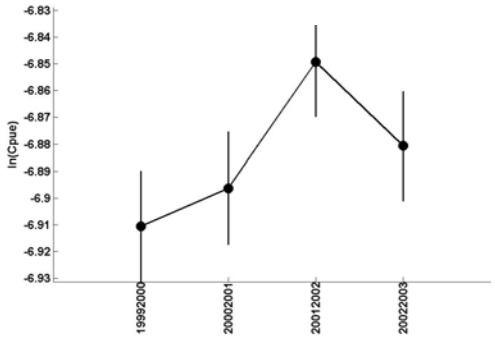


Fig. 14 (cont.)

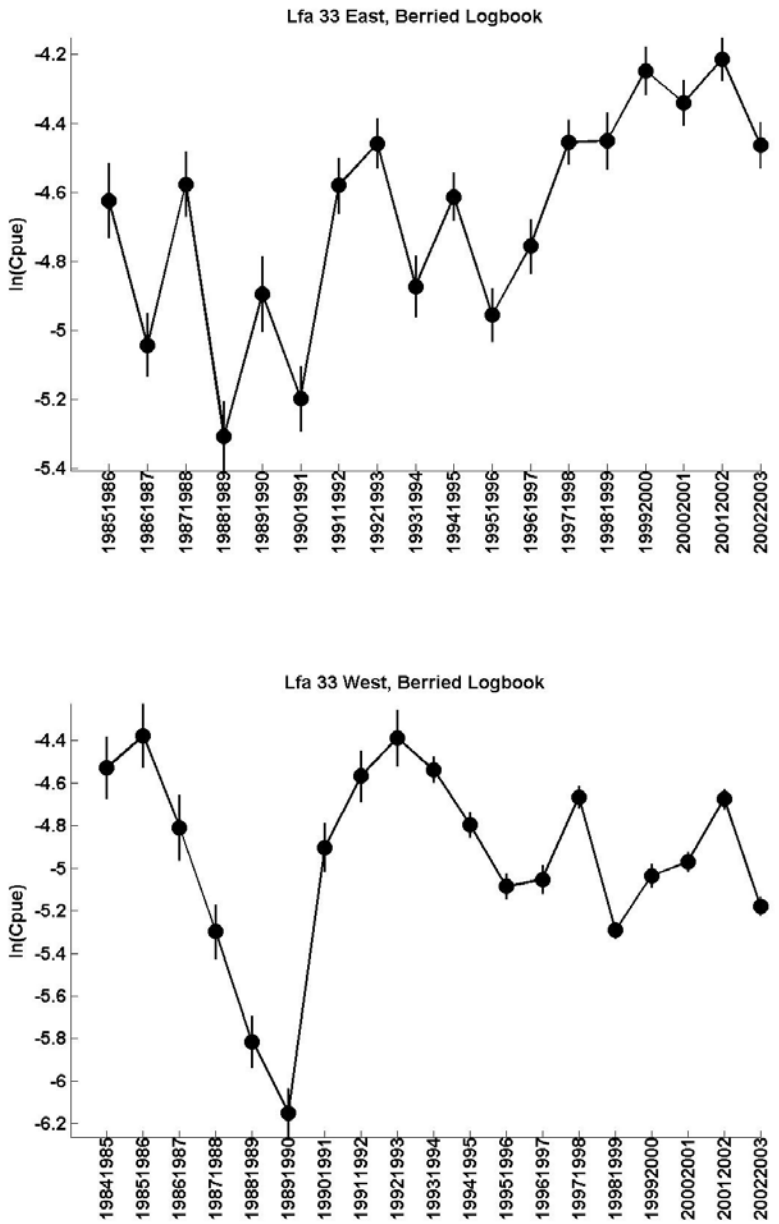


Fig. 15. Index of berried females ln(numbers / trap-haul) from voluntary logbooks in eastern and western portions of LFA 33. Vertical bars are 95% confidence intervals.

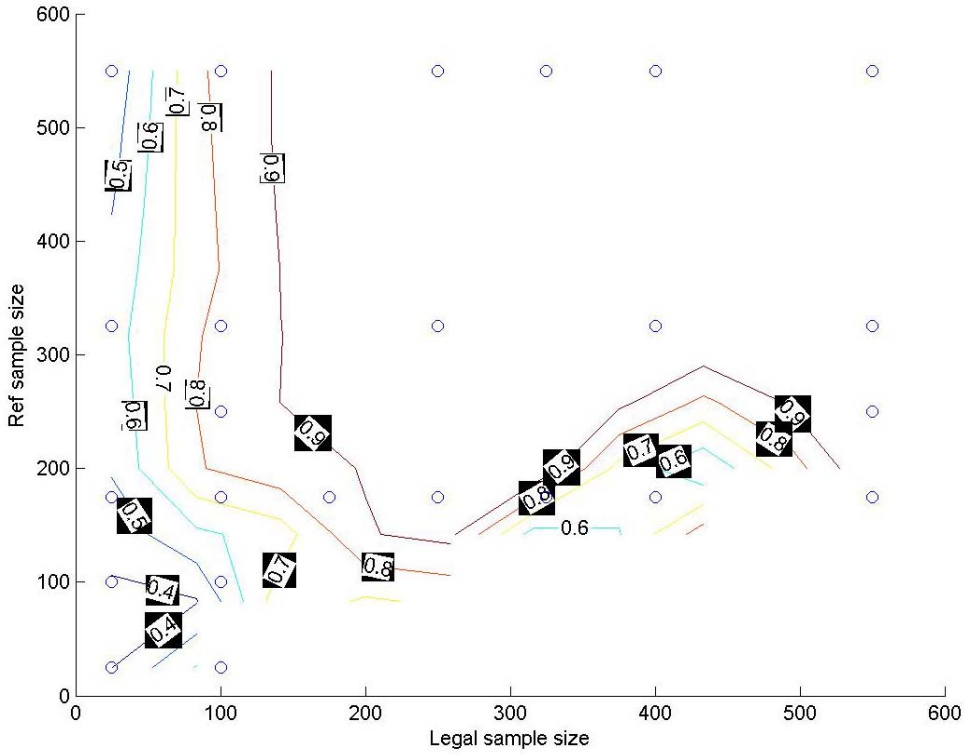


Fig. 16. Effect of sample size on significance test. Contour lines 0.7 and 0.9 corresponds to combination of sample sizes that produced significant parameter estimates 70% and 90% of the time.

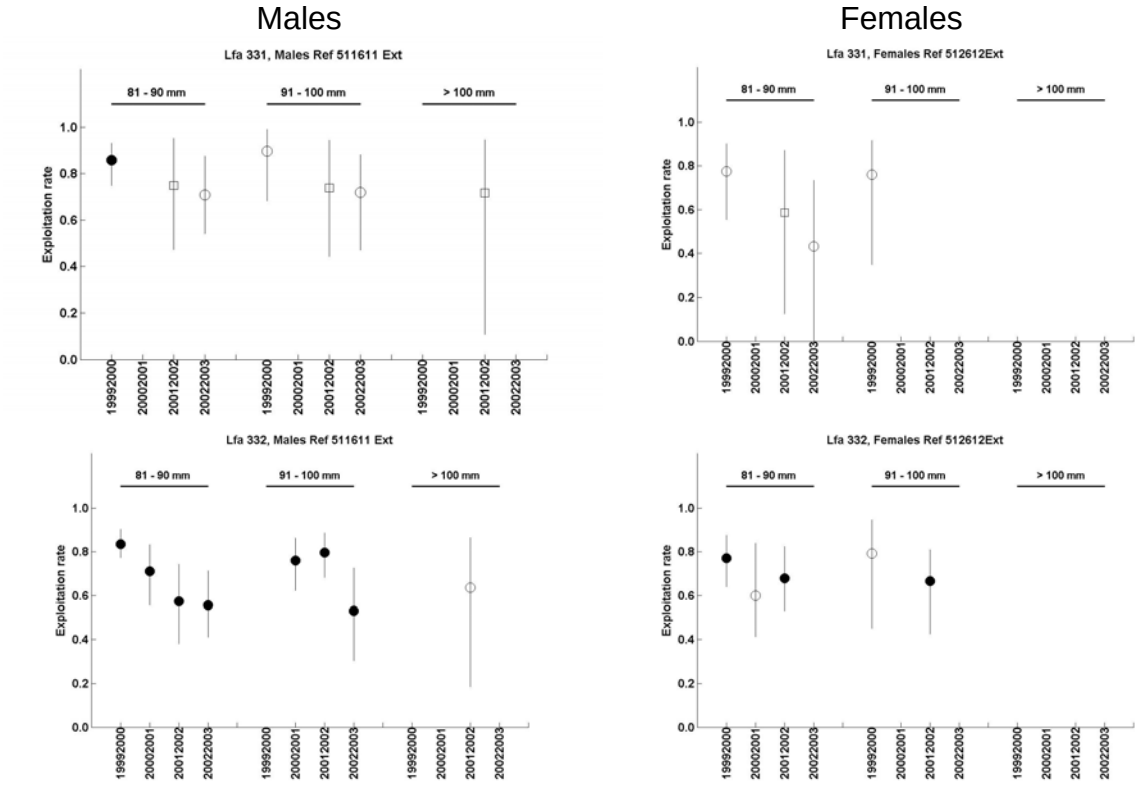


Fig. 17. Point exploitation rate estimates (circles) and 95% confidence intervals (vertical lines). Solid circle refers to estimates with sample sizes within the 0.9 contour line and are considered to be the most reliable. Open circle refers to estimates with sample sizes between the 0.7 and 0.9 contour lines. These estimates are considered reliable. Open squares refers to estimates associated with sample sizes less than the 0.7 contour line and are not considered reliable. Estimates not shown were not significant because of small sample sizes.

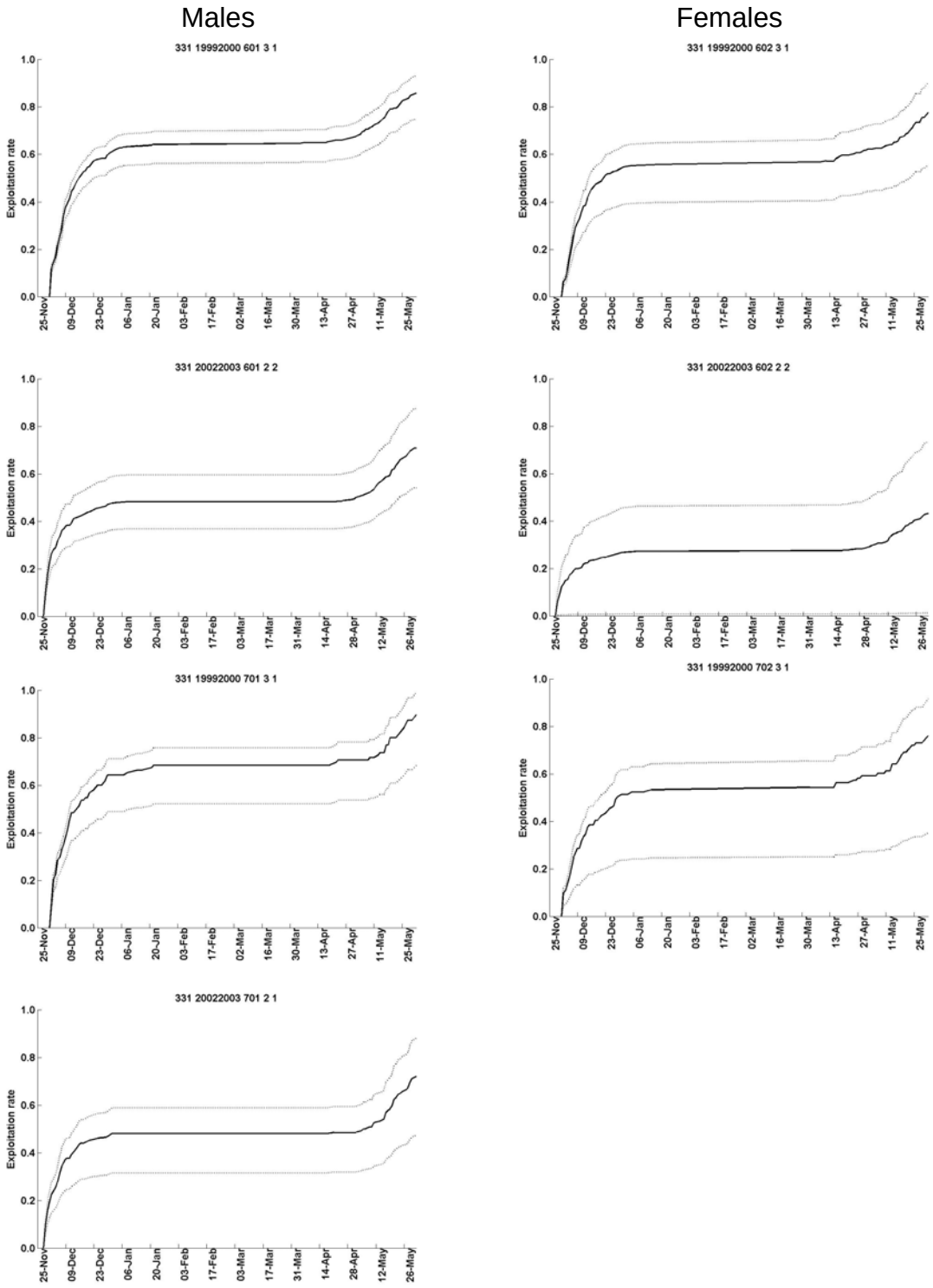


Fig. 18. Partial season exploitation rates (ER) with 95 % confidence intervals for eastern portion of LFA 33. Title codes, 331 indicates LFA 33 east, followed by the season, life history code (see table 6), and exploitation rate method codes. First digit, 3 indicates reference class is 81 – 90 mm, a 2 indicates it is 82.5 – 90. Second digit, 1 indicates strict ER, a 2 extended ER.

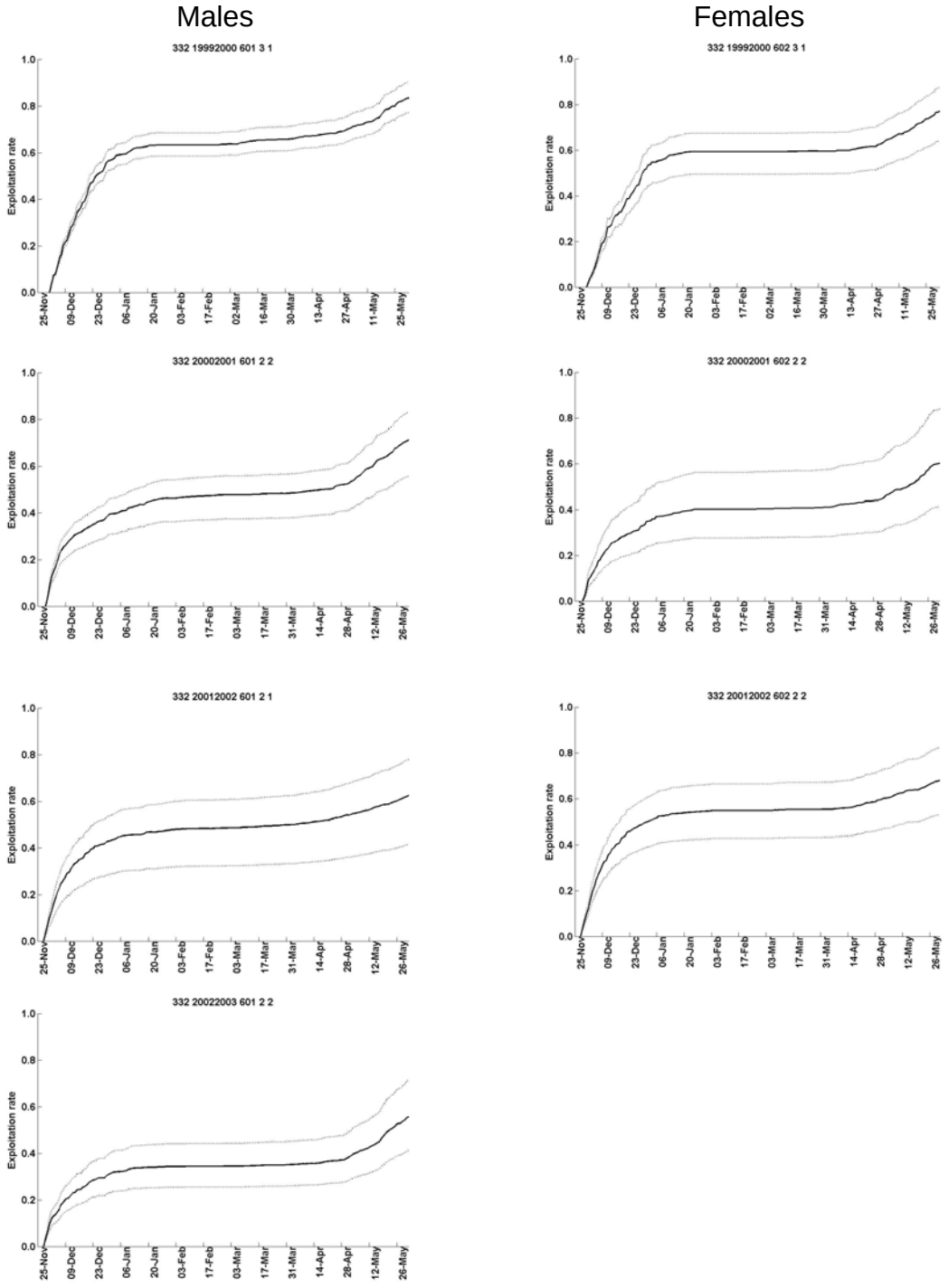


Fig. 19. Partial season exploitation rates (ER) with 95 % confidence intervals for western portion of LFA 33. Title codes, 331 indicates LFA 33 east, followed by the season, life history code (see table 6), and exploitation rate method codes. First digit, 3 indicates reference class is 81 – 90 mm, a 2 indicates it is 82.5 – 90. Second digit, 1 indicates strict ER, a 2 extended ER.

Males

Females

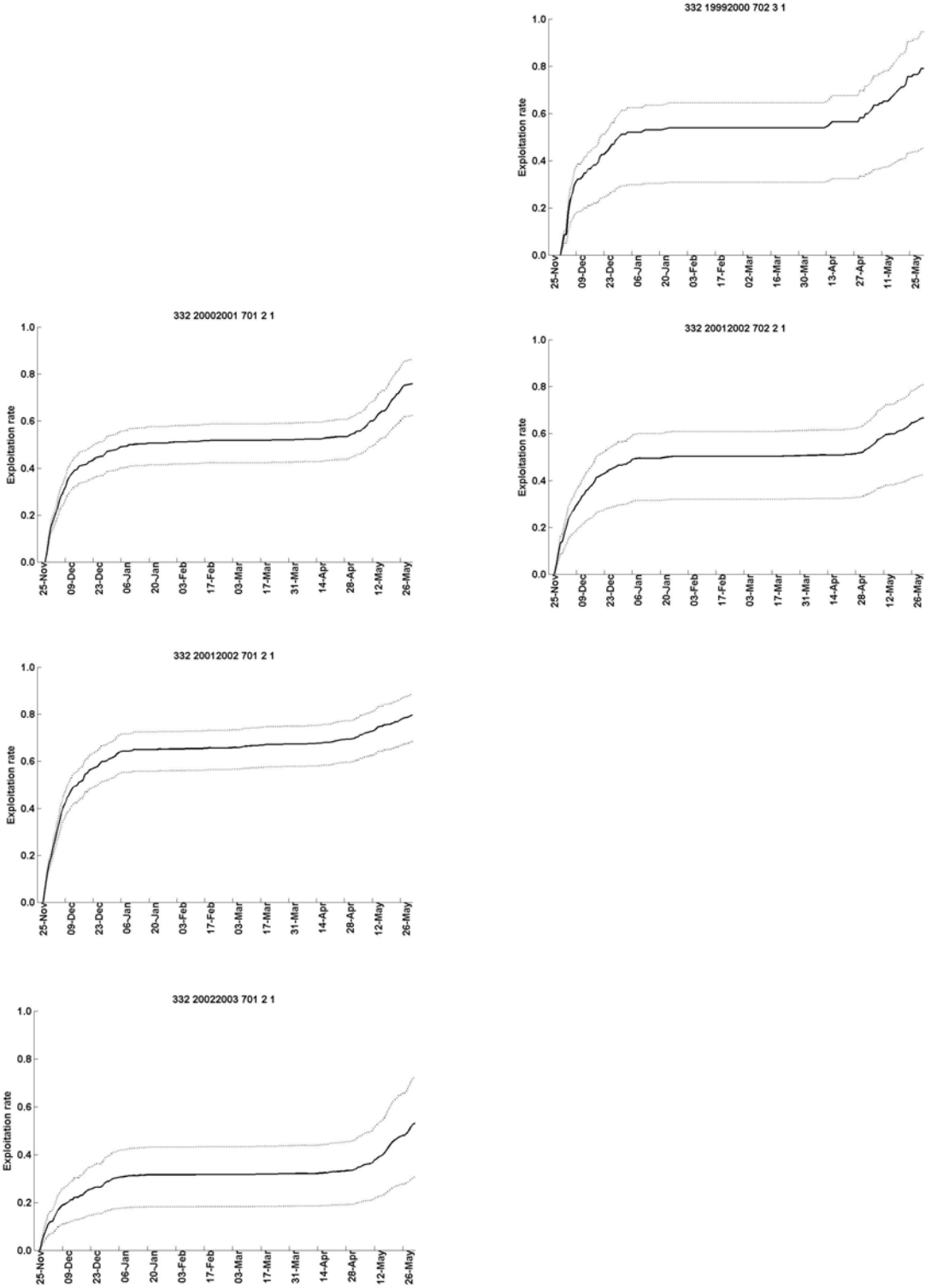


Fig. 19 (cont.)

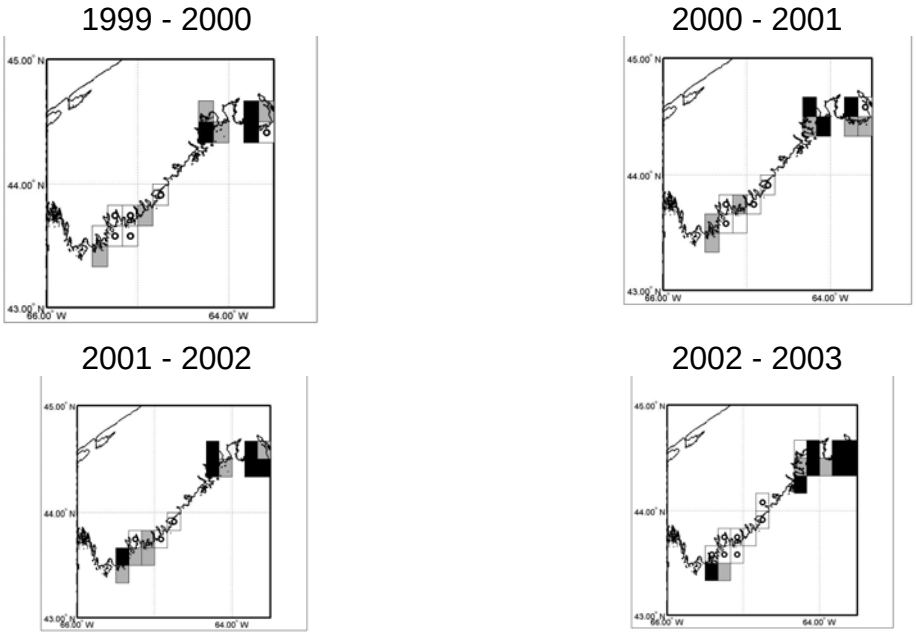


Fig. 20. Distribution of egg/ trap-haul in LFA 33 from FSRS recruitment trap data. Abundance indices were divided into 4 categories. Those with zero catches of the indicated class were assigned to the first class (open square). The remaining groups were: (Group 2) 0 to 33% of the cases (open square with open circle), (Group 3) >33% to 67% (gray square), and (Group 4) > 67% to 100% (black square).

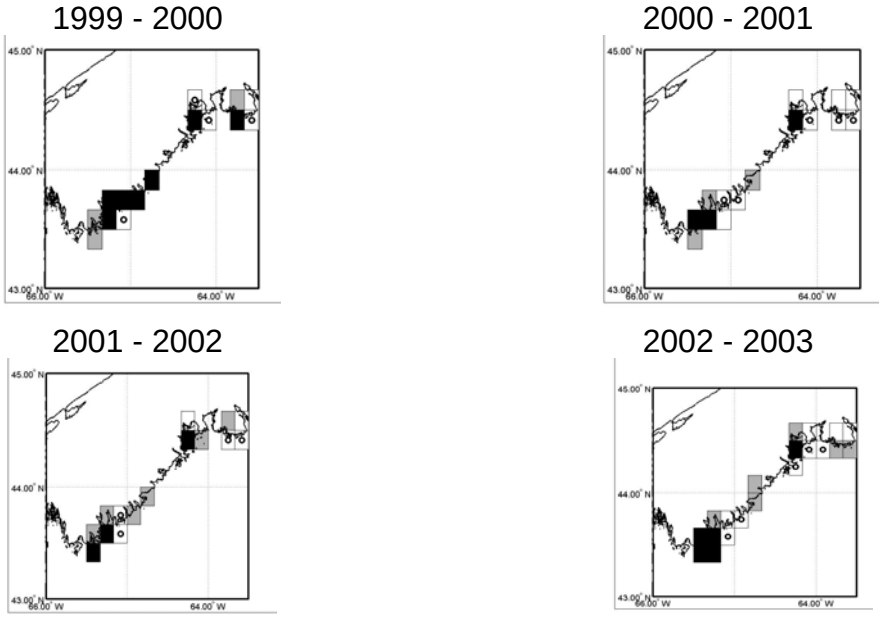


Fig. 21. Distribution of size 1 / trap-haul in LFA 33 from FSRS recruitment trap data. Legend as in Fig. 20.

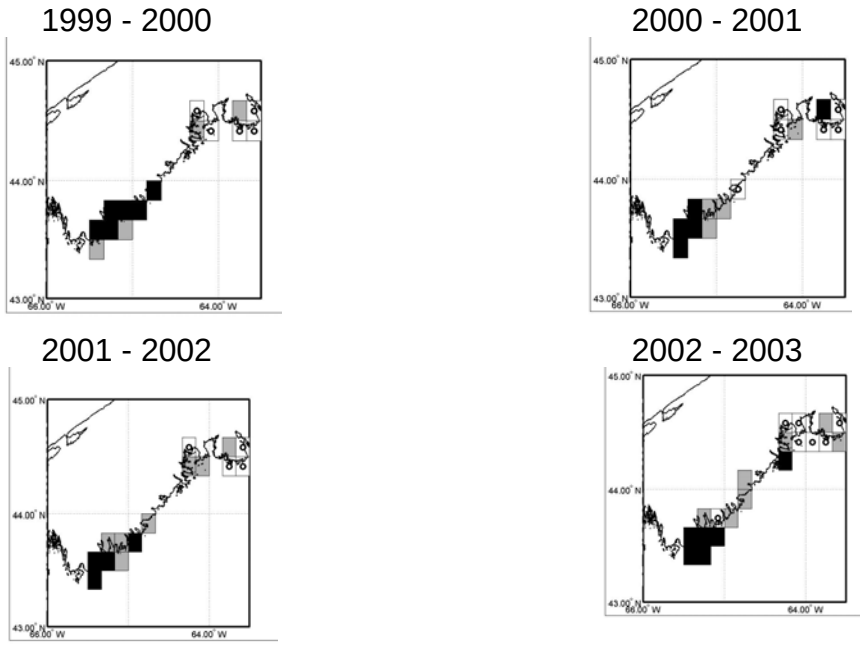


Fig. 22. Distribution of size 2 / trap-haul in LFA 33 from FSRS recruitment trap data. Legend as in Fig. 20.

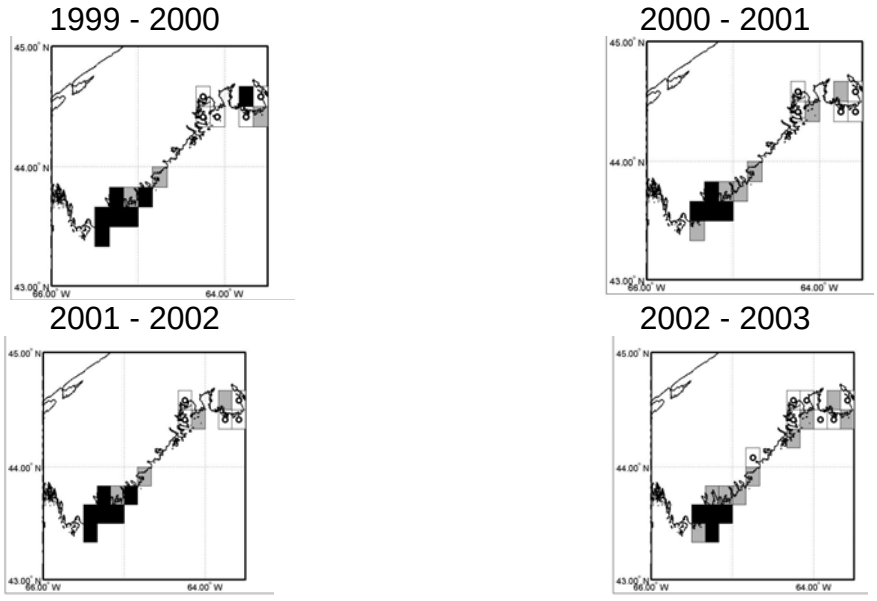


Fig. 23. Distribution of size 3 / trap-haul in LFA 33 from FSRS recruitment trap data. Legend as in Fig. 20.

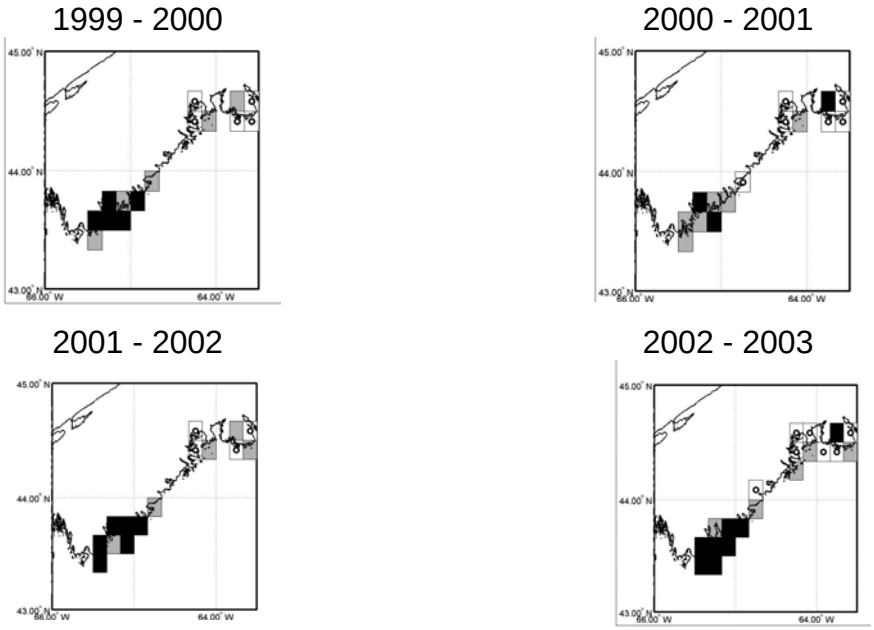


Fig. 24. Distribution of size 4 / trap-haul in LFA 33 from FSRS recruitment trap data. Legend as in Fig. 20.

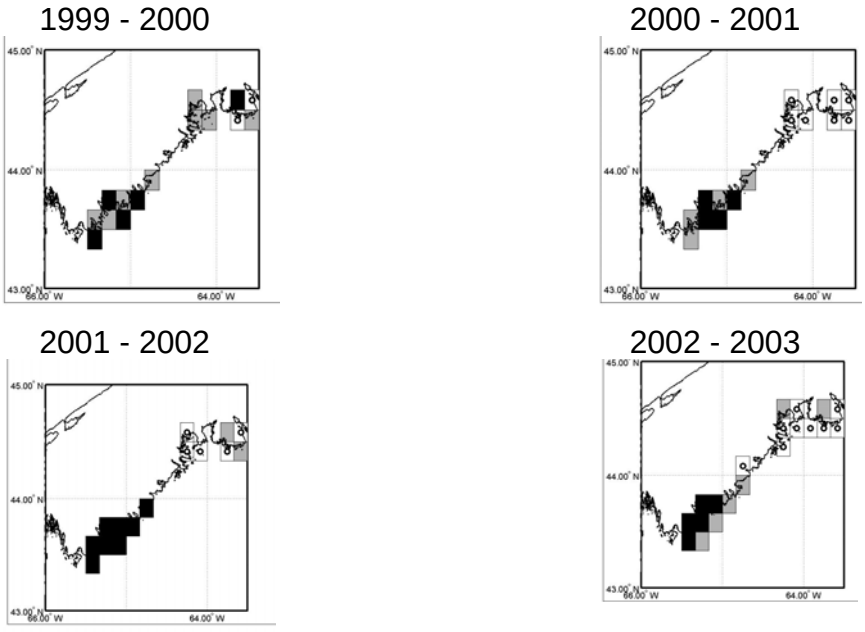


Fig. 25. Distribution of size 5 / trap-haul in LFA 33 from FSRS recruitment trap data. Legend as in Fig. 20.

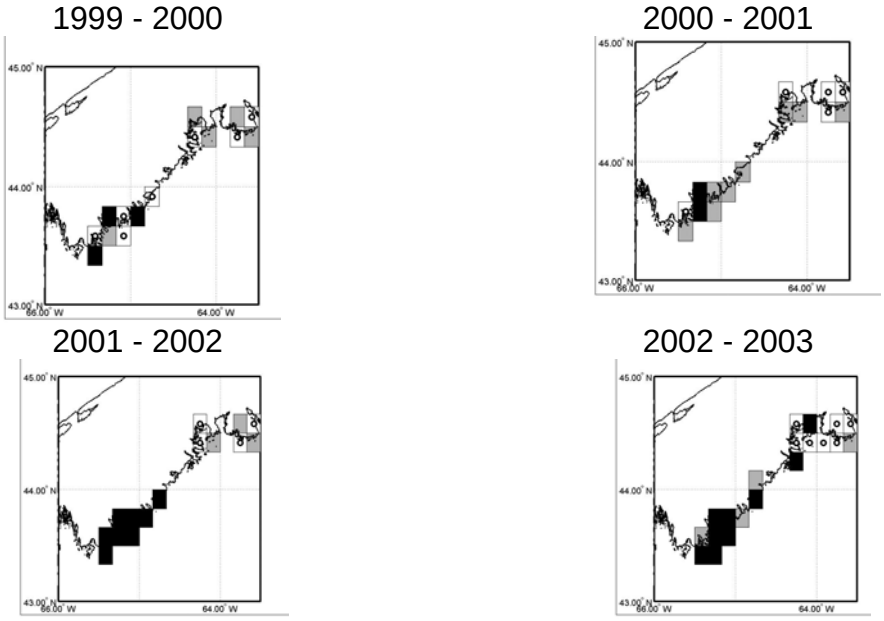


Fig. 26. Distribution of size 6 / trap-haul in LFA 33 from FSRS recruitment trap data. Legend as in Fig. 20.

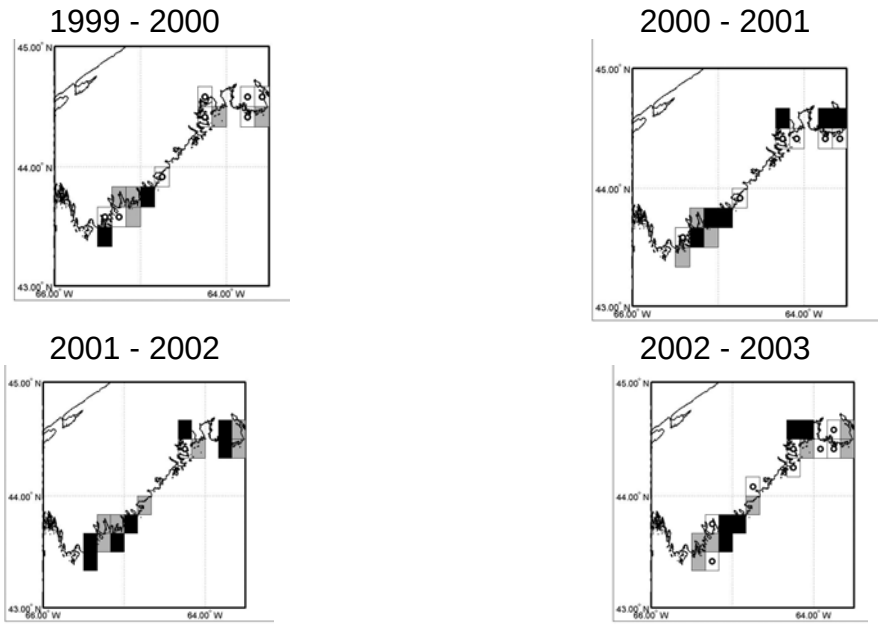


Fig. 27. Distribution of size 7 / trap-haul in LFA 33 from FSRS recruitment trap data. Legend as in Fig. 20.

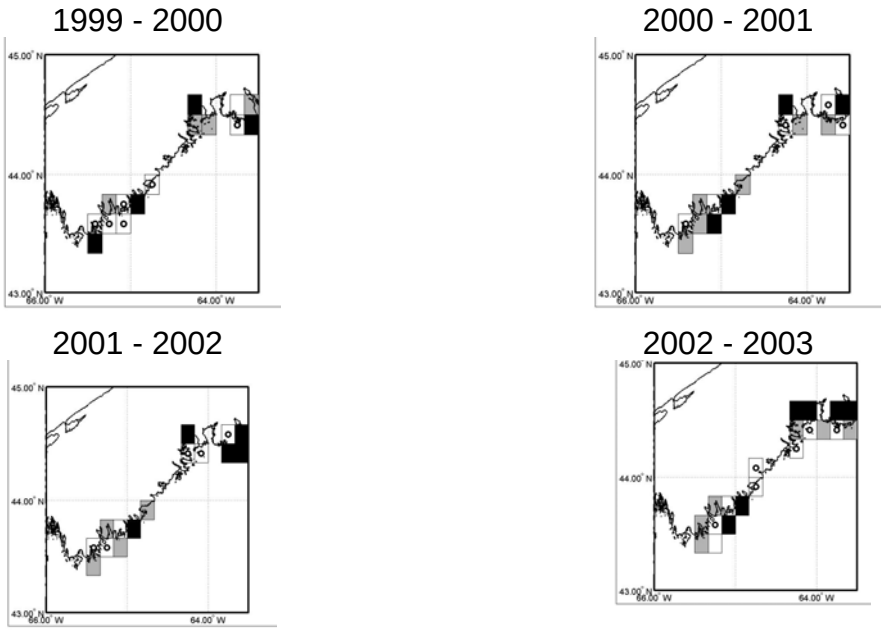


Fig. 28. Distribution of size 8 / trap-haul in LFA 33 from FSRS recruitment trap data. Legend as in Fig. 20.

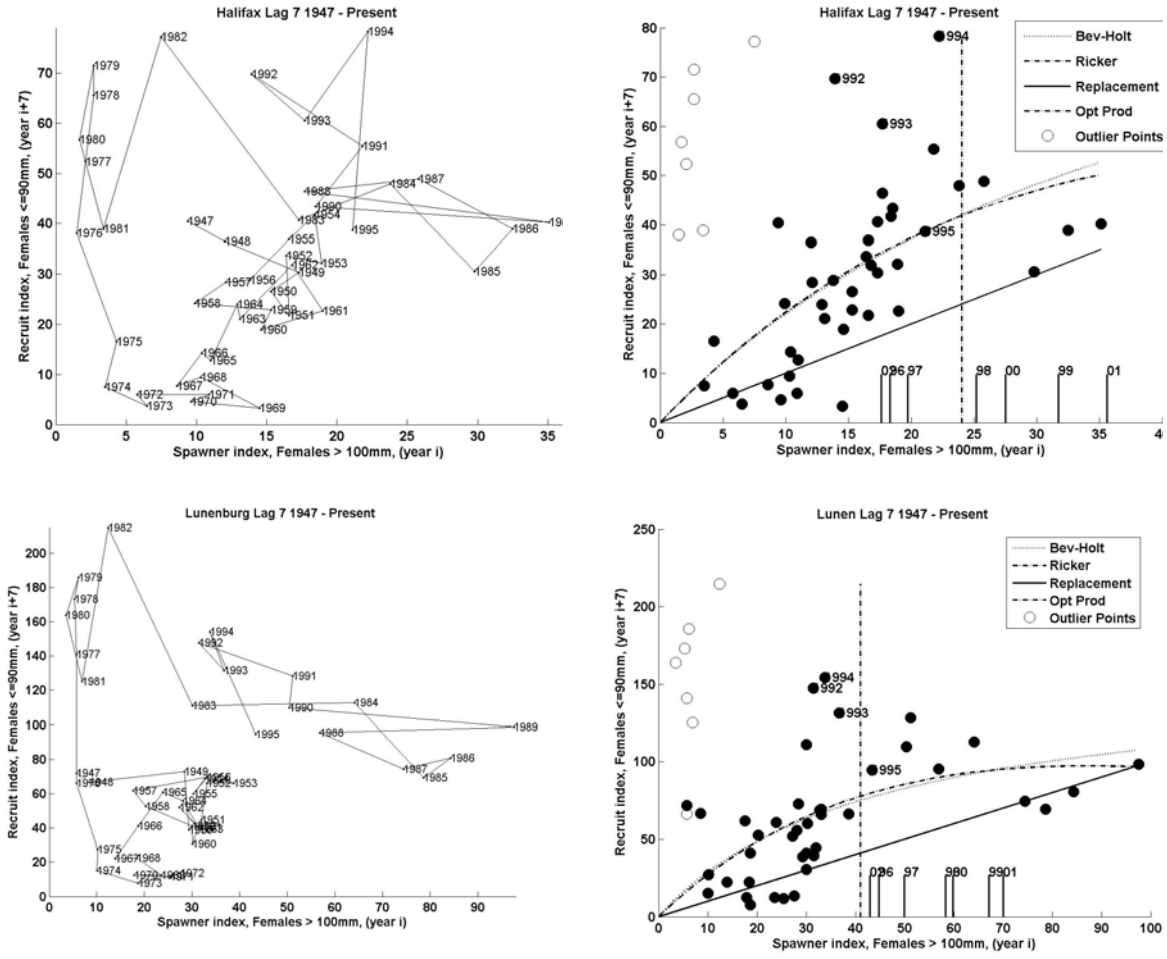


Fig. 29. Relationship between landings in year i and year i+7 by county from 1947 to 2001 for LFA 33. Year shown is year i, which is the year of spawning. The replacement line and spawner level that corresponds to optimal production are also shown. Only the most recent years are indicated in the right hand figures to save space. Open circles indicate years that had to be removed for a Beverton-Holt fit to be successful.

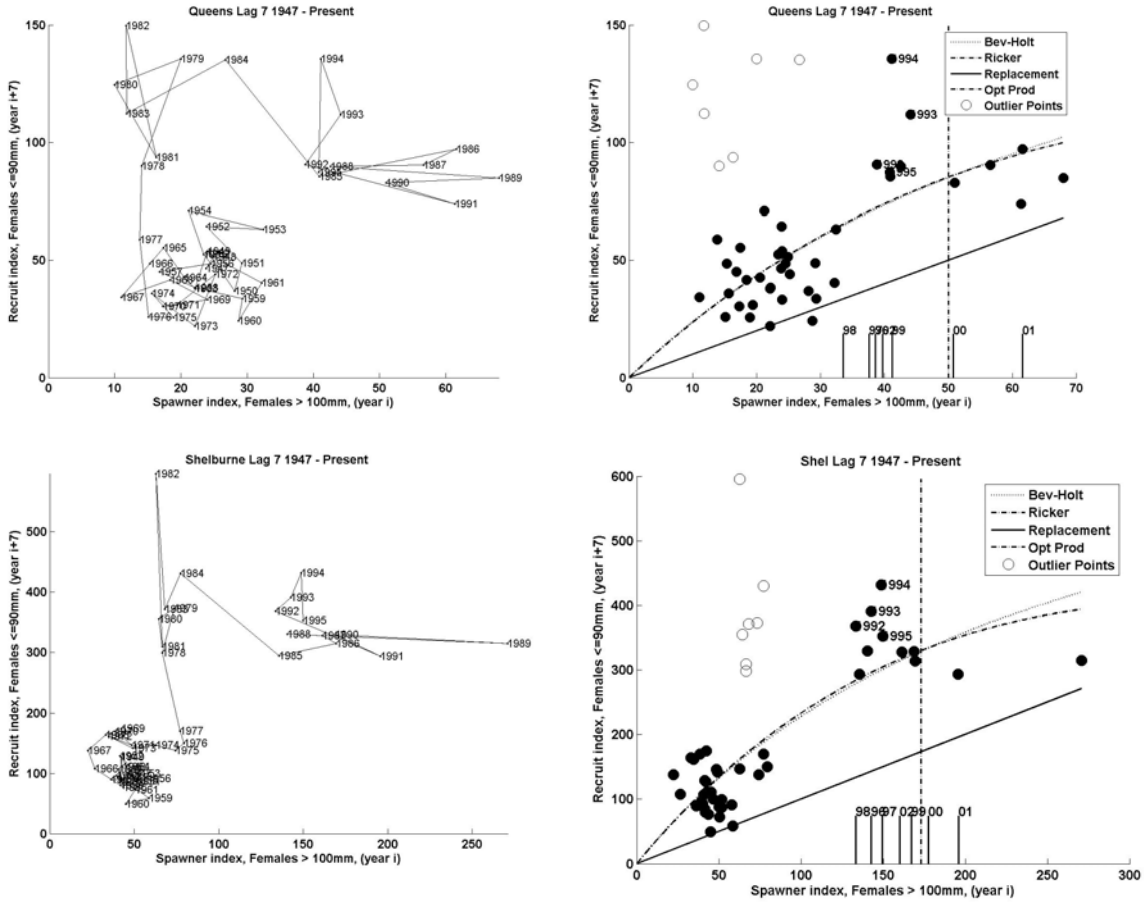

Queens Lag 7 1947 - Present
Recruit index, Females <=90mm, (year i+7)
Spawner index, Females > 100mm, (year i)
Bev-Holt
Ricker
Replacement
Opt Prod
Outlier Points
Shelburne Lag 7 1947 - Present
Shel Lag 7 1947 - Present

Fig. 29. cont.

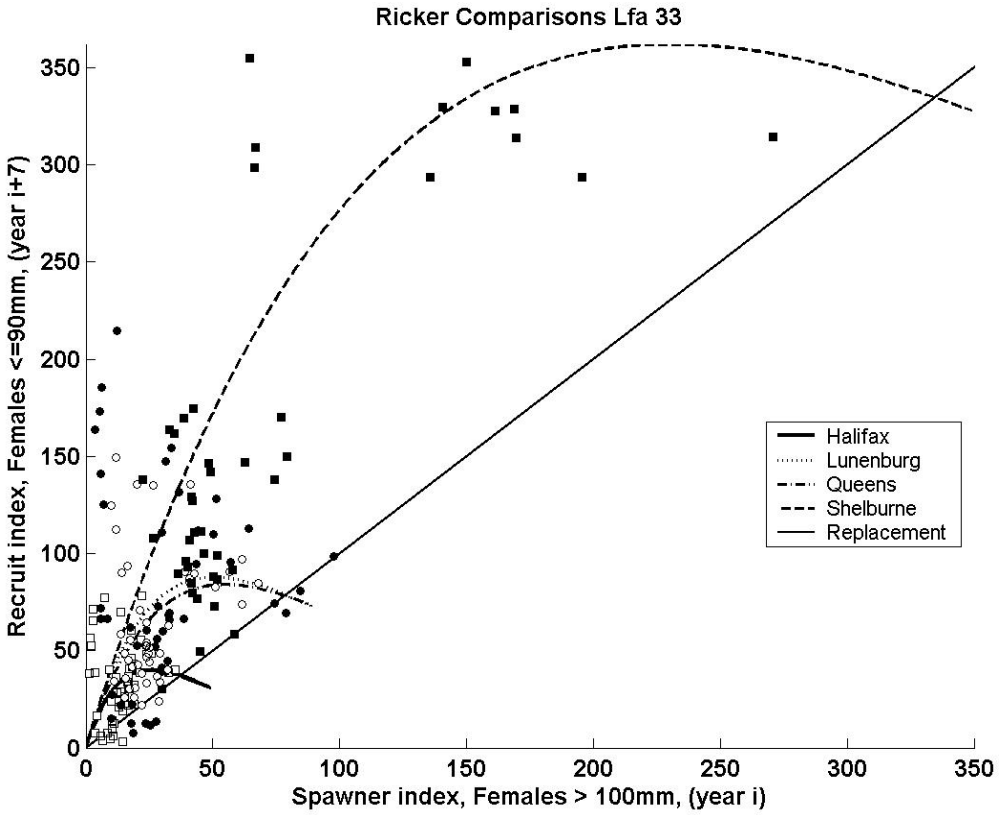


Fig. 30. A comparison of Ricker curves for each county in LFA 33.

Appendix 1. Minutes from LFA 33 Science Workshops, held at indicated place date, and time.

Lobster workshop: Lunenburg, Aug. 13, 2002

Attendees:		Gary Tanner	Bayport
Stephen Scobey	Moose Hbr.	Dale Cook	First South
Brad Crouse	West Berlin	Bernie Selig	Bayport
Tim Wentzell	Feltzen South	Jeff Graves	FSRS
Larry Risser	Rose Bay	Jim Jamieson	DFO
Russell Selig	Bayport	Ross Claytor	DFO
David Croft	Bayport	Ron Duggan	DFO

Ross opened the meeting by reviewing the agenda and circulating a sign up sheet for participants. Participants were then asked to provide comments on their personal observations on the previous year's fishery. These are as follows.

Industry comments by individual:

- Had a very poor spring but last fall about average. Didn't note any difference in size of lobsters caught, thought maybe a few larger ones.
- Said that had an average fall but poor spring, fishes inner part of Lunenburg Hbr.
- Had a better fall than last year with most lobsters on inner grounds and about average spring. Poor weather and cold water in spring, large fantails didn't appear until near end of season. He noted a good sign of shorts and berried females. He thought a large number of culls were being returned and that there was confusion as to definition of cull.
- Missed comment on fall fishery. Reported good spring catch and lots of small ones. Culls released were v-notched. Concerned about summer food fishery and had to expand area fished to make up loss from food fishery.
- Didn't do well in fall in deep water but thought that was because he didn't get on right area. Also had poor spring due to weather and cold water. Objects to timing of summer food fishery.
- Last fall catches were down because of absence of larger lobsters seen in previous years. Spring catches down as well, large fan tails didn't show up but maybe a few more large males than usual. Saw good sign of berried females but didn't see many v-notches. Approved of DFO and summer tour tagging.
- Had good fall and poor spring but saw lots of shorts. Didn't see many of the tie wrap tags. Fishes both inner and outer areas of Lunenburg Bay and doesn't think got any of his own v-notches back.
- Catches for both spring and fall were about average but prices were much lower than last spring. Catch of females up over last spring but fishes shallows where no other gear set.
- As others had a good fall and a poor spring due to bad weather and cold water. Noticing more urchins on grounds.

Comments general to all areas: More urchins showing up, and problems with interpretation of culls and v-notching regulations.

Ross then reviewed his work on fishery indicators and presented results of last years projects which are attached.

Jeff Graves presented the FSRS Recruit trapping program, proposed a commercial trap monitoring program and asked for volunteers.

Ross concluded the meeting with a presentation on a proposal to allow harvesting of female rock crabs for bait. A scientific analysis found that the proposal would not meet the current definition of conservation.

Lobster workshop: Armdale, Aug. 14, 2002

Attendees:	
Kevin Slaunwhite	Terence Bay
Wayne Eddy	Eastern Passage
Ross Claytor	DFO
Ron Duggan	DFO
Jim Jamieson	DFO
Patti King	FSRS

Ross opened the meeting by reviewing the agenda and circulating a sign up sheet for participants. Participants were then asked to provide comments on their personal observations on the previous year's fishery. These are as follows.

Industry comments by individual:

- Good fall fishery, catches were up but price was down resulting in fewer dollars for that part of season. He observed more soft lobsters than normal for fall season and more v-notches than previous year. Most lobsters were on inner ground. Poor catches in spring, FSRS temperature recorder record showed low temperatures that did not warm up until late May and the bait was ravaged by sea fleas in early season. There were no jellyfish this spring where lots in previous years. Kelp is healthy but seeing more urchins. In previous years large males showed up in spring before females but large fan tail females not seen this spring. Large lobsters in deeper water were not seen this year but increase in urchins was noted. Catches of v-notches down by ½ this spring. Fishes from 3-35 fathoms and no movement offshore in his area.
- Decent fall fishery but poor spring. More boats moving further off each year. Outside boats in 20-30 fathoms had 1200-1400 lbs 1st day last fall vs 1000-1200lbs for boats in 5-20 fathoms. Water was cold in spring until late season and large females absent until late may where they were present through the whole of the month last year. He noted that one of the boats from his area fishing on outside grounds caught large females during last 2 weeks of season. Urchins are spotty on grounds but increasing and there appears to be lots of small ones.

General comments common to all areas: more urchins, green crabs throughout shallows but don't appear to affect lobster fishery.

Ross then reviewed his work on fishery indicators and presented results of last year's projects which are attached.

Patti King from the FSRS outlined their recruitment trap project and solicited more volunteers to apply. She also outlined a proposal to introduce a commercial trap monitoring project and asked attendees to think about how it might be implemented.

Ross concluded the meeting with a presentation on a proposal to allow harvesting of female rock crabs for bait. A scientific analysis found that the proposal would not meet the current definition of conservation.

Lobster workshop: North East Harbour, Aug. 12, 2002

Attendees:	
Fred Perry	Ingomar
Marlon Cunningham	Churchover
Jim Perry	Ingomar
Wilford Smith	Port LaTour
Ross Claytor	DFO
Ron Duggan	DFO

Ross opened the meeting by reviewing the agenda and circulating a sign up sheet for participants. Participants were then asked to provide comments on their personal observations on the previous year's fishery. These are as follows.

Industry comments by individual:

- The fall fishery was about average with most of the catch coming from the inside grounds. He noted that there were more soft shell lobsters on the outer ground than usual. His spring catch was down considerably from the previous year which he attributed to bad weather and cold water. He said there were no large lobsters until the last few days of the season but got both large males and females. As for shorts there were as many or more than previous years and they showed up in numbers about the 12th of May.. In the fall some fishers were as far off as Browns and grounds were being expanded outwards more each year. The spring fishery was mostly inside 30 fathoms. He estimated about 20% of licences fished the entire season. He repeated last years comment that if an area was baited up that the lobsters would come to it. Reported that up to 50% of berried females caught were v-notched.
- Echoed comments about having an average fall with good catches on the inside grounds and a bad spring due to weather and cold water. He also saw more short lobsters. Most licenses in his area don't fish in February.
- Fishes inner Shelburne Hbr. with an outboard motor and had a good fall. He felt that the catches remained steady for a longer time into the season than usual. He also had a poor spring and thought that the usual run of large lobster in late spring never got into the harbour. Some of the larger boats are moving gear from outside into the harbour in late spring. He generally fishes in 10 fathoms or less.
- Had average fall with good catches on inside grounds. Says largest run of large lobsters he's ever seen and more soft shells than ever. He sets gear from 20-40 fathoms.

General comments from all areas:

Larger amount than usual of soft lobsters. Cold water in late spring stayed until late summer and may have delayed moult, resulting in soft lobsters in fall catch.

Better catches on inside grounds in fall.

Poor spring, bad weather, cold water.

Green crabs invading shallow water.

Different views on v-notching.

Ross then reviewed his work on fishery indicators and presented results of last years projects which are attached.

Patti King from the FSRS outlined their recruitment trap project and solicited more volunteers to apply. She also outlined a proposal to introduce a commercial trap monitoring project and asked attendees to think about how it might be implemented.

Ross concluded the meeting with a presentation on a proposal to allow harvesting of female rock crabs for bait. A scientific analysis found that the proposal would not meet the current definition of conservation.

Minutes: LFA 33 lobster fishery workshop, Port Clusters 10-11 Mar.1, 2004, Jordan Bay Community Centre, Jordan Bay, N.S.

Attendees.	
Katie Rapp	FSRS
Ricky Hallett	West Green Harbour
David Hallett	West Green Harbour
Ernie Pierce	Jordan Bay
Jim Bower	Jordan Bay
Steve Nolan	DFO
Ross Claytor	DFO
Ron Duggan	DFO

The session was chaired by Ross Claytor, DFO Research Scientist, who reviewed the agenda and then asked those attending to introduce themselves. Each fisherman was asked to provide personal comments on his observations of the fishery for the past season.

Industry comments by individual:
These observations were similar for each individual and noted that landings were about the same as the previous season. Lobsters from the outside grounds and those on soft bottom had a high incidence of soft-shells although those from inside were OK. A higher number of berried females than previous seasons was also reported. These seemed to disappear after the first two weeks. There are more shorts than previous years. The shore price for the first time ever was affected by quality and some entire catches were refused by buyers. Those holding catches for long periods eventually sold, but price received was unknown. Green crabs were more prevalent but not yet a problem. Rock crabs were virtually absent in this area. There were more seals again this year. Urchin density was low and not creating any problems. Fishing effort is moving further offshore, 17-18 miles and 50+ fathoms. Last fall was bad for lost fishing days due to weather even though the season allowed a full week in Nov. Concern was expressed that start day 2004 would only allow for only 1 days fishing in Nov. and it was suggested that a change in start day designation would allow for more time in Nov. and avoid fluctuations as in past.

Presentation
Ross presented an overview of the assessment for the lobster fishery in LFA 33, discussing topics such as landings, breeding populations, and comparing the eastern and western portions of the district. Also presented was a review of tagging and recovery data for release sites in the LFA. See attached summary of slides presented.

A request for more detailed reporting of catch locations, i.e. inside vs outside 15 fathom contour divided between headlands along shore was met with mixed response, some feeling that it could be used in future to define historic catch areas and limit movement throughout the LFA.

Also, reaction to proposed pilot study for pipeline considerations was mixed. Mistrust of any activities associated with a pipeline by any party was apparently a concern of some attendees. Others were concerned that agreement to undertake the project would indicate that they were in favour of accepting compensation for pipeline activities. It was indicated that the purpose of the project was to acquire scientific information on movement of large female lobster that would enable a more detailed baseline study on the entire population to be developed. Agreement or disagreement with the project carried no implication on compensation for anyone.

The final topic, left for further consideration, was a request from DFO for suggestions for future research projects. Lobster quality was suggested as a possible research topic. Ross Claytor indicated he would find out what the Lobster Centre in PEI was doing on this topic. It was suggested that, out of season temperature monitoring would be a good first step.

Minutes: LFA 33 lobster fishery workshop, Port Clusters 12-13 Mar.9, 2004, Port La Tour Fire Hall, Port La Tour, N.S.

Attendees:			
Name	Address	Name	Address
Austin Nickerson	Baccaro	Everett Garon	Baccaro
David Nickerson	Ingomar	Ross Claytor	DFO
Murray Atkinson	Barrington Passage	Ron Duggan	DFO
Wilford Smith	Pt. LaTour	Katie Rapp	FSRS

The session was chaired by Ross Claytor , DFO Research Scientist, who reviewed the agenda and then asked those attending to introduce themselves. Each fisherman was asked to provide personal comments on his observations of the fishery for the past season.

Industry comments by individual:

- Information from a buying station in LFA 34 reported that they bought more lobsters than last year but had to send 23% of those to the cannery because of poor quality. Lobsters on outside grounds were soft, better on the inside areas, and there were lots of rock crabs around.
- One fisherman on inside grounds, reported catches better than last year, saying that he got one full crate of four pound lobsters on the first day. Catches were better on inside grounds but animals were soft and "short-meated" He noted more berried, more shorts, and more and bigger urchins.
- One fishermen on outside grounds reported catches were the same or a bit better than last year and didn't see a lot of soft-shell lobsters. There were few rock crabs and urchins but a lot of toad crabs.
- Another reported rough weather and strong tides at the start of the season which resulted in lower catch than last year even though the pressure on his grounds was somewhat relieved by a number of boats moving further west than usual. The best strategy was to allow longer sets, and he got a nice run of "shiny" 1½ pound lobsters. He figured that these had finally hardened up and started to crawl. He didn't think there was any difference in percentage of soft-shell between inside and outside grounds. He noted a large number of small urchins and increasing amounts of Stone crabs and also is seeing more V-notched lobster.
- General comments included that two prices were offered for the first time and that a large catch by an offshore boat (30,000 pounds) had to cull 20,000 pounds of soft-shells and bring only 10,000 pounds ashore.

Presentation

Ross then presented summaries of the LFA 33 assessment and results of tagging studies. See attached copies of slides used in presentation. A request for more detailed reporting of catch locations, i.e. inside vs outside 20 fathom contour divided between headlands along the shore was met with little opposition. Additional discussion was suggested for the advisory committee meeting. It was noted that a concern raised in a previous meeting was that this information could be used in future to define historic catch areas and limit movement throughout the LFA
A request for suggestions for new projects brought forth the following:

1. Gathering out of season temperature data.

2. Follow progress of 100 soft lobsters from early season by placing in warmer water and providing lots of food to see if natural food shortage is a problem.
3. Test lobsters by gradually reducing temperature, in food rich situation and try to determine at what temperature they stop feeding if at all.
4. Contact the PEI veterinary college to expand quality testing.

The meeting was adjourned following the discussion of new projects.

Minutes: LFA 33 lobster fishery workshop, Port Clusters 5-9 Mar.10, 2004, Lunenburg Fisheries Museum, Lunenburg, N.S.

Attendees			
Stephen Nolan	DFO	Keith Bush	West Dublin
Ross Claytor	DFO	Moyle Tumblin	West Dublin
Ron Duggan	DFO	Tim W entzell	Feltzon South
Stephen Scobey	Moose Harbour	Ralph Church	Lunenburg
Brad Crouse	West Berlin	William Flower	Lunenburg
Gary Tanner	Stonehurst	Katie Rapp	Shelburne
Gary Nowe	Lunenburg	Barry Levy	Lunenburg
Gary Tanner	First South		

The session was chaired by Ross Claytor, DFO Research Scientist, who reviewed the agenda and then asked those attending to introduce themselves. Each fisherman was asked to provide personal comments on his observations of the fishery for the past season.

Industry comments by individual:
These observations were similar for each individual and noted that landings were down from the previous fall season. Last fall was bad for lost fishing days due to weather even though the season allowed a full week in November. Most participants reported a very large number of soft-shelled lobsters (as high as 50%) and that it was necessary to throw some of these back. Protein counts were also reported as down from previous years. Catches in deeper areas were poor and some usually productive locations had few lobsters. The number of berried females tended to be up from previous seasons (as high as 150/day in the Port Mouton area) and as well, the number of pre-recruits had increased. It was reported the Rock and Jonah crabs tended to be more numerous than usual, but Green crabs were not yet a problem. Urchin density however, appears to be greatly increasing in a few locations, as well as their size, and they are moving into shallower areas, especially Black Rock, Cape Lahave. Seals continue to be a problem and are reported to have increased by as much as 4 times in the last 10 years in most areas. They also appear to be expanding their territory and are now being found in deep water. A Queens County fisherman estimated that the population near East Berlin has gone from 300 to 2000 seals during this period and that flounders and skate are non-existent in shallow water.

Presentation
Ross presented an overview of the assessment for the lobster fishery in LFA 33, discussing topics such as landings, breeding populations, and comparing the eastern and western portions of the district. Also presented was a review of tagging and recovery data for release sites in the LFA. See attached summary of slides presented.

For the past three years, lobsters have been tagged as part of a summer Lobster Tour. Results from this tagging project have been routinely circulated to the fishermen of the Lunenburg area. Concerns were raised about two issues. The first, concerned the amount of stress tagging puts on lobsters. It was explained that the tagging technique is not new and has been used in many places for a number of tagging projects. The people doing the tagging have been trained to follow recognized tagging procedures that minimize stress to the lobster. Returns from the first year were still being returned two years after the initial tagging. The percentage of tags returned is as expected from previous work. Growth of lobsters was similar to that observed from other tagging projects. Soft-shelled lobsters and very large lobsters are not tagged during the Tour. The combination of these factors indicates that the tagging procedures used in the Tour are appropriate and minimize stress. The second issue raised was the influence that reporting on location of tag recoveries may have on changes in fishing effort locations. The concern is that effort has begun to concentrate on locations where tagged lobsters are shown to be caught. Ross Claytor will work

with local port representatives to determine the best way to report tagging results without compromising the fishery.

Currently all lobster tagged as part of the Lobster Tour are released well inside Lunenburg Harbour. A suggestion was made to change the tagging and release location to one that was either east or west of the Harbour and more towards the headlands. This would provide additional information on another part of the Lunenburg lobster population. Ross Claytor indicated he would discuss this with the Tour operator.

It was indicated that in the coming year, only sub-legal lobster will be tagged. This change will enable fishermen to better understand the percentage of lobster that are molting each year and whether or not the legal size lobster being caught are a mixture of one or more years of sub-legal lobster that have grown to legal size. It was suggested that the year of tagging be printed on the tag as well as having a different colour for each year. This would enable fishermen to readily identify the history of the lobster when it was caught.

A request for more detailed reporting of catch locations, i.e. inside vs outside 20 fathom contour divided between headlands along the shore was met with little opposition. However, the fishermen suggested that the depth line should be moved into 15 fathoms rather than 20 and as well that the amount of additional information requested should be kept to a minimum. They also expressed concerns regarding the accuracy of the information that would be provided, if it is made mandatory to include this additional information in their logbooks. They felt that voluntary participation would yield far higher quality data. It was noted that a concern raised in a previous meeting was that this information could be used in future to define historic catch areas and limit movement throughout the LFA

The final topic, left for further consideration was a request from DFO for suggestions for future research projects. The group felt that more research should be done on the protein counts and the effect of water temperature on distribution and catchability. It may be possible to use the Lobster Tour to acquire some important out of season information on the causes and prevalence of soft-shelled lobster. Mostly though, they all felt that a solution to the seal problem has to be found.

Minutes: LFA 33 lobster fishery workshop, Port Clusters 1-4 Mar.11, 2004, Seven Seas Club, Sambro, N.S.

Attendees			
Name	Location	Name	Location
Jeff Graves	FSRS	Dale Slaunwhite	Terrence Bay
Stephen Nolan	DFO	Pat Gray	Sambro
Ross Claytor	DFO	Steven Gray	Sambro
David Gray	Sambro	Robbie Hennebery	Sambro
Victor Gray	Sambro	Vincent Boutilier	Hubbards to East River Point
James Gray	Sambro		

The session was chaired by Ross Claytor, DFO Research Scientist, who reviewed the agenda and then asked those attending to introduce themselves. Each fisherman was asked to provide personal comments on his observations of the fishery for the past season.

Industry comments:
These observations were similar for each individual and noted that landings were about the same as the previous fall season. However, the landings at the beginning of the season were low, but were maintained at a level amount throughout the season and extended later than normal into mid-January. Catches in deeper areas were poor. Around the Aspotogan area, the catches were above fall 2002 but were still lower than the average of the previous few seasons. Many soft-shelled and damaged lobsters of all sizes were seen throughout the area, but fewer were seen in Terrence Bay than other areas. The number of berried females was on par with previous seasons and the number of pre-recruits was the same or slightly more. It was reported that Rock and Jonah crabs tended to be more numerous than usual, but Green crabs were not yet a problem. Urchin density however, appears to be greatly increasing, as well as their size, and they are moving into shallower areas. Last fall was bad for lost fishing days due to weather even though the season allowed a full week in November.

Presentation
Ross presented an overview of the assessment for the lobster fishery in LFA 33, discussing topics such as landings, breeding populations, and comparing the eastern and western portions of the district. Also presented was a review of tagging and recovery data for release sites in the LFA. See attached summary of slides presented.

A request for more detailed reporting of catch locations, i.e. inside vs outside 20 fathom contour divided between headlands along the shore was met with little opposition. However, the fishermen suggested that the depth line should be moved into 10 fathoms rather than 20 since little fishing occurs at depth greater than 20 fathoms and as well that the amount of additional information requested should be kept to a minimum. They also expressed concerns regarding the accuracy of the information that would be provided, if it is made mandatory to include this additional information in their logbooks. They felt that voluntary participation would yield far higher quality data. It was suggested that local meetings be held by port cluster to gain fishermen's input into the location of reporting lines and to explain what is expected.

The final topic, left for further consideration was a request from DFO for suggestions for future research projects. Inshore/offshore movements of lobsters are an unanswered question in many fishermen's minds. It was suggested that lobsters caught offshore during DFO groundfish and scallop surveys, and the commercial crab fisheries, could be tagged. A monthly diving survey at various locations along the shore throughout June to November to determine locations and relative amounts of lobsters before the season was also requested.

Appendix 2. Anova from multiplicative analysis of voluntary logbooks on legal sized unberried lobster for LFA 33.

Fall – Spring LFA 33 East					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	337.05	18.00	18.72	70.45	0.00
Week	2521.19	19.00	132.69	499.25	0.00
Fisherman	52.81	23.00	2.30	8.64	0.00
Error	1883.11	7085.00	0.27		
Total	5047.70	7145.00			
Fall – Spring LFA 33 West					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	359.13	18.00	19.95	75.22	0.00
Week	4268.34	19.00	224.65	846.97	0.00
Fisherman	357.80	19.00	18.83	71.00	0.00
Error	2299.37	8669.00	0.27		
Total	7428.30	8725.00			
Fall LFA 33 East					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	166.20	18.00	9.23	39.48	0.00
Week	928.67	6.00	154.78	661.78	0.00
Fisherman	19.16	23.00	0.83	3.56	0.00
Error	584.47	2499.00	0.23		
Total	1714.09	2546.00			
Fall LFA 33 West					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	142.01	18.00	7.89	37.63	0.00
Week	1422.13	6.00	237.02	1130.57	0.00
Fisherman	87.52	30.00	2.92	13.92	0.00
Error	692.05	3301.00	0.21		
Total	2427.63	3355.00			
Spring LFA 33 East					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	241.91	18.00	13.44	51.11	0.00
Week	355.64	13.00	27.36	104.03	0.00
Fisherman	60.33	23.00	2.62	9.97	0.00
Error	1195.47	4546.00	0.26		
Total	1932.61	4600.00			
Spring LFA 33 West					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	361.20	18.00	20.07	66.75	0.00
Week	777.05	13.00	59.77	198.82	0.00
Fisherman	150.50	30.00	5.02	16.69	0.00
Error	1455.41	4841.00	0.30		
Total	2860.55	4902.00			

Appendix 3: Anova results from multiplicative model for unberried lobster of FSRS sizes 1 to 8. Non-significant results, p>0.05 are in bold.

Appendix 3:
Unberried LFA 33 East Size 1

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	59.69	3.00	19.90	9.28	0.00
Week	60.86	19.00	3.20	1.49	**0.08**
Fisherman	2263.71	22.00	102.90	47.99	0.00
Error	4536.59	2116.00	2.14		
Total	6931.41	2160.00			

Unberried LFA 33 East Size 2

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	130.16	3.00	43.39	7.67	0.00
Week	138.10	19.00	7.27	1.28	**0.18**
Fisherman	2397.53	22.00	108.98	19.26	0.00
Error	11974.35	2116.00	5.66		
Total	14703.28	2160.00			

Unberried LFA 33 East Size 3

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	90.55	3.00	30.18	3.64	0.01
Week	525.45	19.00	27.66	3.34	0.00
Fisherman	2545.72	22.00	115.71	13.97	0.00
Error	17529.76	2116.00	8.28		
Total	20873.62	2160.00			

Unberried LFA 33 East Size 4

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	84.56	3.00	28.19	3.52	0.01
Week	552.67	19.00	29.09	3.64	0.00
Fisherman	3155.10	22.00	143.41	17.93	0.00
Error	16924.83	2116.00	8.00		
Total	21120.04	2160.00			

Unberried LFA 33 East Size 5

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	127.20	3.00	42.40	5.26	0.00
Week	1295.89	19.00	68.20	8.46	0.00
Fisherman	1988.37	22.00	90.38	11.20	0.00
Error	17069.0	2116.0	8.07		

Appendix 3:

	5	0			
Total	20874.89	2160.00			

Unberried LFA 33 East Size 6

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	31.10	3.00	10.37	1.35	**0.26**
Week	2945.44	19.00	155.02	20.20	0.00
Fisherman	1979.90	22.00	90.00	11.73	0.00
Error	16240.10	2116.00	7.67		
Total	21426.87	2160.00			

Unberried LFA 33 East Size 7

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	35.37	3.00	11.79	1.92	**0.12**
Week	2131.98	19.00	112.21	18.24	0.00
Fisherman	1369.42	22.00	62.25	10.12	0.00
Error	13018.87	2116.00	6.15		
Total	16650.22	2160.00			

Unberried LFA 33 East Size 8

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	26.53	3.00	8.84	2.50	**0.06**
Week	408.75	19.00	21.51	6.08	0.00
Fisherman	567.05	22.00	25.78	7.28	0.00
Error	7488.95	2116.00	3.54		
Total	8527.39	2160.00			

Unberried LFA 33 West Size 1

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	58.60	3.00	19.53	4.79	0.00
Week	210.98	19.00	11.10	2.72	0.00
Fisherman	1405.37	24.00	58.56	14.36	0.00
Error	16010.75	3925.00	4.08		
Total	17683.32	3971.00			

Unberried LFA 33 West Size 2

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	395.05	3.00	131.68	15.41	0.00

Appendix 3:

Week	1276.67	19.00	67.19	7.86	0.00
Fisherman	4462.34	24.00	185.93	21.75	0.00
Error	33550.86	3925.00	8.55		
Total	39984.40	3971.00			

Unberried LFA 33 West Size 3

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	298.87	3.00	99.62	12.64	0.00
Week	2210.29	19.00	116.33	14.77	0.00
Fisherman	3364.51	24.00	140.19	17.79	0.00
Error	30924.08	3925.00	7.88		
Total	37508.55	3971.00			

Unberried LFA 33 West Size 4

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	238.44	3.00	79.48	11.05	0.00
Week	1715.37	19.00	90.28	12.55	0.00
Fisherman	3474.88	24.00	144.79	20.13	0.00
Error	28232.16	3925.00	7.19		
Total	33858.61	3971.00			

Unberried LFA 33 West Size 5

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	246.73	3.00	82.24	10.58	0.00
Week	1912.17	19.00	100.64	12.94	0.00
Fisherman	3769.93	24.00	157.08	20.20	0.00
Error	30525.03	3925.00	7.78		
Total	36511.23	3971.00			

Unberried LFA 33 West Size 6

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	484.76	3.00	161.59	19.12	0.00
Week	5318.08	19.00	279.90	33.12	0.00
Fisherman	1693.74	24.00	70.57	8.35	0.00
Error	33169.26	3925.00	8.45		
Total	40476.08	3971.00			

Unberried LFA 33 West Size 7

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	225.81	3.00	75.27	11.32	0.00

Appendix 3:					
Week	3747.91	19.00	197.26	29.66	0.00
Fisherman	3356.59	24.00	139.86	21.03	0.00
Error	26106.80	3925.00	6.65		
Total	33682.02	3971.00			
Unberried LFA 33 West Size 8					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	41.67	3.00	13.89	4.65	0.00
Week	371.61	19.00	19.56	6.56	0.00
Fisherman	601.35	24.00	25.06	8.40	0.00
Error	11710.53	3925.00	2.98		
Total	12764.08	3971.00			

Appendix 4: Anova results from multiplicative model for berried lobster of FSRS sizes 1 to 8. Non-significant results, p>0.05 are in bold.

Appendix 4:
Berried LFA 33 East Size 4

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	0.91	3.00	0.30	0.65	**0.58**
Week	4.15	19.00	0.22	0.47	**0.97**
Fisherman	52.80	22.00	2.40	5.19	0.00
Error	979.48	2116.00	0.46		
Total	1038.35	2160.00			

Berried LFA 33 East Size 5

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	0.88	3.00	0.29	0.42	**0.74**
Week	11.61	19.00	0.61	0.87	**0.62**
Fisherman	60.14	22.00	2.73	3.89	0.00
Error	1486.14	2116.00	0.70		
Total	1561.52	2160.00			

Berried LFA 33 East Size 6

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	1.48	3.00	0.49	0.49	**0.69**
Week	20.39	19.00	1.07	1.06	**0.39**
Fisherman	39.34	22.00	1.79	1.77	0.02
Error	2140.31	2116.00	1.01		
Total	2208.09	2160.00			

Berried LFA 33 East Size 7

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	10.66	3.00	3.55	1.78	**0.15**
Week	34.29	19.00	1.80	0.91	**0.58**
Fisherman	411.35	22.00	18.70	9.38	0.00
Error	4215.77	2116.00	1.99		
Total	4688.34	2160.00			

Berried LFA 33 East Size 8

Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	42.40	3.00	14.13	9.25	0.00

Appendix 4:					
Week	41.85	19.00	2.20	1.44	**0.10**
Fisherman	275.02	22.00	12.50	8.18	0.00
Error	3232.26	2116.00	1.53		
Total	3594.12	2160.00			
Berried LFA 33 West Size 4					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	0.19	3.00	0.06	0.65	**0.58**
Week	0.77	19.00	0.04	0.40	**0.99**
Fisherman	11.32	24.00	0.47	4.72	0.00
Error	392.22	3925.00	0.10		
Total	405.12	3971.00			
Berried LFA 33 West Size 5					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Week	2.11	19.00	0.11	0.73	**0.79**
Fisherman	8.09	24.00	0.34	2.22	0.00
Error	595.66	3925.00	0.15		
Total	606.27	3971.00			
Berried LFA 33 West Size 6					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	0.67	3.00	0.22	0.56	**0.64**
Week	8.35	19.00	0.44	1.11	**0.33**
Fisherman	32.51	24.00	1.35	3.43	0.00
Error	1550.09	3925.00	0.39		
Total	1594.44	3971.00			
Berried LFA 33 West Size 7					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	6.60	3.00	2.20	3.22	0.02
Week	32.16	19.00	1.69	2.48	0.00
Fisherman	42.65	24.00	1.78	2.60	0.00
Error	2679.72	3925.00	0.68		
Total	2761.93	3971.00			
Berried LFA 33 West Size 8					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	1.88	3.00	0.63	2.97	0.03

Appendix 4:					
Week	6.03	19.00	0.32	1.50	**0.07**
Fisherman	5.77	24.00	0.24	1.14	**0.29**
Error	828.83	3925.00	0.21		
Total	842.62	3971.00			

Appendix 5. Anova results from multiplicative model for berried females from voluntary logbook data for LFA 33. East is port clusters 1 – 6, West is port clusters 7 – 13.

Berried Fall – Spring LFA33 East					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	188.29	17.00	11.08	16.85	0.00
Week	856.10	22.00	38.91	59.20	0.00
Fisherman	238.85	9.00	26.54	40.37	0.00
Error	2492.05	3791.00	0.66	0.00	0.00
Total	4242.55	3839.00	0.00	0.00	0.00
Berried Fall – Spring LFA33 West					
Source	SumSq.	d.f.	MeanSq.	F	Prob>F
Season	527.33	18.00	29.30	43.46	0.00
Week	743.94	25.00	29.76	44.14	0.00
Fisherman	211.37	17.00	12.43	18.44	0.00
Error	3440.72	5104.00	0.67	0.00	0.00
Total	5508.90	5164.00	0.00	0.00	0.00