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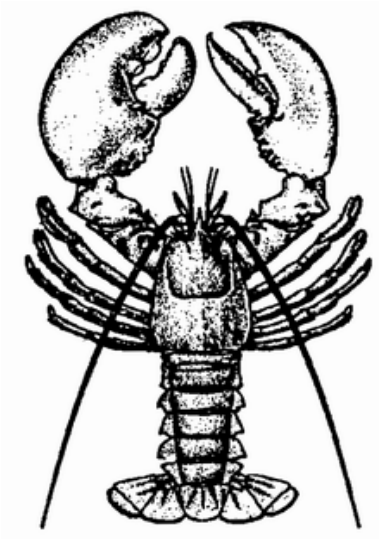
Newfoundland and Labrador Region

Canadian Science Advisory Secretariat
Science Advisory Report 2013/068

ASSESSMENT OF AMERICAN LOBSTER IN NEWFOUNDLAND



American Lobster (Homarus americanus)
Image: Fisheries and Oceans Canada

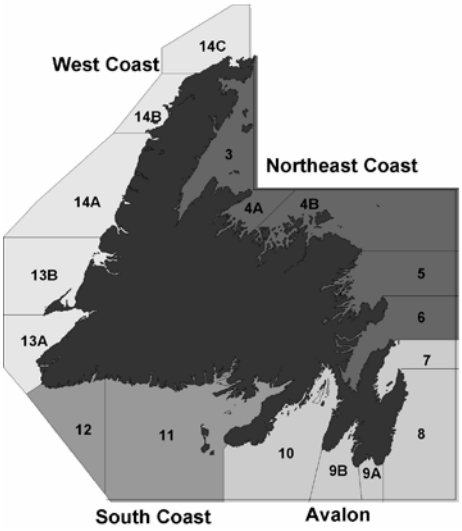


Figure 1. Newfoundland Lobster Fishing Areas (LFAs 3-14) divided into assessment regions.

Context:

The American Lobster (Homarus americanus) is distributed near shore around the island of Newfoundland and along the Strait of Belle Isle portion of the Labrador coast. Major life history events (i.e., molting, mating, egg extrusion and hatching) generally take place during mid-July to mid-September, following the fishing season.

The fishery is localized and prosecuted from small open boats during an 8-10 week spring fishing season. Traps are set close to shore, at depths generally less than 20 m. Fishing effort is controlled through restrictive licensing and daily trap limits. Regulations prohibit the harvest of undersized and ovigerous animals. In addition, there is a voluntary practice called v-notching, which involves cutting a shallow mark in the tail fan of an ovigerous female. The mark is retained for 2-3 molts and notched females cannot be retained in the fishery. The practice thus serves to protect proven spawners even when they are not brooding eggs externally. The number of licenses is currently around 2700 and trap limits range from 100 to 300 depending on the Lobster Fishing Area (LFA) (Fig. 1).

These stocks were last assessed in 2009 and are currently assessed every 3 years. The present assessment of these stocks is requested by Fisheries Management to provide current information on the status of the resource and provide the data that will be used in the updated Integrated Fisheries Management Plan. In 2013 the LFAs were assessed based on 4 regions (Northeast (LFAs 3-6), Avalon (LFAs 7-10), South Coast (LFAs 11-12) and West Coast (LFAs 13-14)) (Fig. 1). The key indicators for the assessment are reported landings, nominal effort, mean catch per unit effort (CPUE) and survival rate indicators based on molt class ratios.

This Science Advisory Report (SAR) is from the May 15-16 and May 21-22, 2013 Meeting of the Newfoundland and Labrador Regional Advisory Process (RAP) on Lobster. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Canada

SUMMARY

Overall (LFAs 3-14)

- The Newfoundland lobster assessment was completed for four assessment regions which are a geographical grouping of LFAs into Northeast (LFAs 3-6), Avalon (LFAs 7-10), South Coast (LFAs 11-12) and West Coast (LFAs 13-14).
- The fishery has always been a recruit-based fishery, therefore reported landings reflect abundance. Reported landings are going down in the Northeast and Avalon and going up on the South and West Coasts.
- Total reported landings for Newfoundland have remained relatively stable since the 1960s. Reported landings increased by 70% from 1760 t in 2000 to 3000 t in 2008 before declining by 28% to 2150 t in 2012 resulting from a decrease in the Northeast and Avalon regions and an increase in the South and West Coasts.
- The reported landings have become spatially concentrated. The contribution of the most productive LFA (11) to the reported landings has increased from less than 15% in the early 1990s to around 45% in the last three years.
- Nominal effort (based on active fishers, trap limits and fishing days) has decreased by 31% since 2008, due to license retirements, fewer active fishers, shorter seasons, and trap limit reductions.
- Catch per Unit Effort has changed little over the time period for which data are available (2004-12).
- It appears that the survival fraction has increased, since 2008, in all regions except for the Northeast. It appears that the survival fraction in the South and West Coast regions is lower than the Northeast and Avalon regions.

Northeast Region (LFAs 3-6)

- Reported landings have declined from about 750 t in the early 1990s to 140 t in 2012. The greatest declines have occurred in LFA 4.
- Nominal effort has decreased by 33% since 2008 due to fewer active fishers.
- Mean CPUE has changed little since 2004 in all LFAs.
- Lobster survival has gradually decreased from a peak in 2008, based on molt class ratios for males and females.
- Since 2006 the percent v-notching has remained between 8% and 13%.

Avalon Region (LFAs 7–10)

- Reported landings have declined from about 460 t in the early 1990s to about 50 t in 2012. The greatest declines have occurred in LFA 10, the most productive LFA in this region.
- Nominal effort has decreased by 46% since 2008 due to fewer active fishers and shorter seasons.
- Mean CPUE has changed little since 2005 in LFAs 8-10 whereas it gradually increased in LFA 7.

- Lobster survival gradually increased from 2008 to 2011 before declining slightly in 2012, based on molt class ratios for males and females.
- Since 2006 the percent v-notching in this region has remained between 13% and 23%.

South Coast Region (LFAs 11–12)

- Reported landings increased from about 400 t in the early 1990s to peak at 1300 t in 2010. They decreased to 990 t in 2011 and then increased to 1100 t in 2012. The greatest increase occurred in LFA 11, the LFA with the highest reported landings in all years.
- Nominal effort has decreased by 23% since 2008 due to license retirements, fewer active fishers, shorter seasons and trap limit reductions.
- Mean CPUE has increased slightly since 2004 in both LFAs.
- Lobster survival was lowest in 2005-08 based on molt class ratios for males and females. It increased in 2009 and declined gradually to 2011 before increasing sharply in 2012 to the highest levels in the time series.
- Since 2006 the percent v-notching has remained between 4% and 7%.

West Coast Region (LFAs 13–14)

- Reported landings increased from about 750 t in 2000 to 1400 t in 2008 before declining to about 770 t in 2011 and increasing to about 880 t in 2012.
- Nominal effort has decreased by 29% since 2008 due to license retirements, fewer active fishers, and trap limit reductions.
- Mean CPUE has varied without trend since 2004 in all LFAs with the highest mean CPUE in LFA 13.
- Lobster survival gradually increased since 2007, based on molt class ratios for males and females, with a sharper increase for females than males in 2012.
- Since 2006 the percent v-notching has remained between 8% and 12%.

BACKGROUND

Species Biology

The American Lobster (*Homarus americanus*) is a decapod crustacean characterized by a life cycle which is predominately benthic. Lobsters may live for more than 30 years. In Newfoundland waters, at the northern range of the species distribution, it takes about 8-10 years for a newly hatched lobster to reach the minimum legal size (MLS) of 82.5 mm in carapace length (CL). Growth is achieved through molting, and frequency of molting decreases with increasing age. Growth is also affected by temperature, as molting probability tends to decrease with water temperature.

Molting and mating occur in the months of July to September, and females extrude (spawn) eggs roughly one year subsequent to mating. Ovigerous (egg bearing) female lobsters carry the eggs in clutches on the underside of their tail, protecting and maintaining the eggs for 9-12 months. Thus, female lobsters are characterized by a biennial molt-reproductive cycle, though smaller mature females sometimes molt and spawn within the same year. At 1-2 mm below the MLS, about 50% of females will extrude eggs during the spawning season. Fecundity of females

increases exponentially with size. Eggs from larger lobsters tend to contain more energy per unit weight, and larger females tend to release larvae earlier in the season, potentially enhancing growth and survival (Attard and Hudon 1987).

Hatching occurs during a four month period extending from late May through most of September. Once released, the larvae swim upward and undergo a series of three molts during their 4-6 week planktonic phase, during which most mortality is thought to occur. With the third molt, a metamorphosis occurs and the newly developed post larvae, which resemble miniature adults, are prepared to transition to the benthic environment. Newly-settled lobster progress through several stages before reaching sexual maturity (Factor 1995).

The adult lobster is thought to have few natural predators and commercial harvesting accounts for most adult mortality. Diet typically consists of rock crab, lobster, polychaetes, molluscs, echinoderms, and various finfish.

The Fishery

The history of the American Lobster fishery in Newfoundland dates back to the early 1870s. The fishery is prosecuted from small open boats. Traps are set close to shore, at depths generally less than 20 m. Effort was uncontrolled up to 1976, at which point a limited-entry licensing policy was implemented, and trap numbers were regulated. The minimum legal size was increased from 81 mm CL to 82.5 mm CL in 1998.

Following the implementation of the 1998-2002 management plan, there was a 25% reduction in licenses in the Newfoundland lobster fishery. Reductions in trap limits, season lengths and licenses issued were put in place as deemed necessary by fishery managers. In recent years, a lobster enterprise retirement program and the Atlantic lobster sustainability measures program were implemented. Together these programs have led to license and trap limit reductions in the Newfoundland lobster fishery, particularly in the South and West Coast regions.

There are currently about 2700 licenses with trap limits varying from 100 to 300 per licensed fisher, depending on LFA. Traps must possess vents which allow undersize lobster to escape. Regulations prohibit the retention of undersize animals, as well as ovigerous and v-notched females.

Reported landings do not account for local sales, poaching, and handling mortalities that can occur prior to the sale of the catch. The extent of local sales, in particular, can be considerable and varies by location and year.

Reported landings peaked at almost 8000 t in 1889 (Fig. 2). Early documentation indicates that all lobsters captured were landed and processed by small canning operations that existed around the coast. A stock collapse occurred in the mid-1920s, after which the fishery was closed for three years, from 1925 to 1927. The fishery reopened in 1928, and reported landings reached over 2000 t, but dropped sharply the following year. In the early 1930s, regulations were introduced to protect undersized and ovigerous animals.

The fishery has always been a recruit-based fishery, therefore reported landings reflect abundance. Reported landings are going down in the Northeast and Avalon and going up on the South and West Coasts. Total reported landings for Newfoundland have remained relatively stable since the 1960s (Fig. 2). The reported landings have become spatially concentrated. The contribution of the most productive LFA (11) to the reported landings has increased from less than 15% in the early 1990s to around 45% in the last three years.

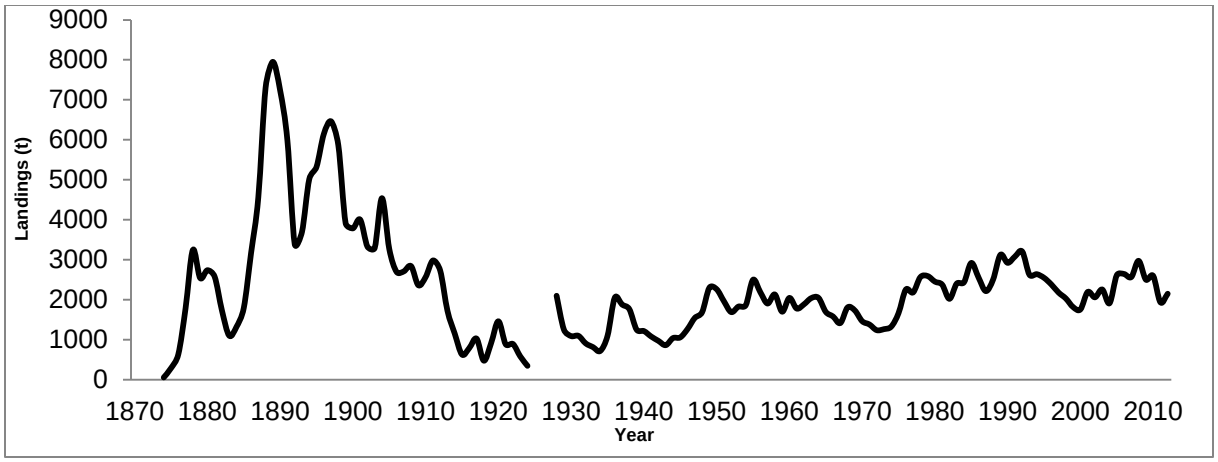


Figure 2. Trends in reported landings for the Newfoundland lobster fishery.

ASSESSMENT

The Newfoundland lobster assessment was completed for four assessment regions which are a geographical grouping of LFAs into Northeast (LFAs 3-6), Avalon (LFAs 7-10), South Coast (LFAs 11-12) and West Coast (LFAs 13-14). The data available for assessing lobster in Newfoundland is all fishery-dependent and each LFA/region has varying data sources and availability by year. Stock indicators included reported landings, nominal effort, mean CPUE, percent v-notching and size frequency data collected from at-sea sampling.

The fishery has always been a recruit-based fishery, therefore reported landings reflect abundance. Reported landings data are available for each LFA and hence each region. Local sales are not always reported, and hence not documented; therefore reported landings underestimate the actual landings by an unknown amount.

At-sea sampling data were used to generate size frequency plots for males and females within each region. Detailed at-sea sampling data were collected from the Northeast (LFAs 4B and 5), Avalon (LFA 10), South Coast (LFA 11) and West Coast (LFAs 14A and 14B) regions since 2004 with data from additional LFAs available in 2004-05 and since 2009.

At-sea sampling data were also used to calculate molt class ratios, which were used as an indicator of lobster survival. If the set of legal-sized lobsters contains an increasing fraction that have (that are large enough that they must have) molted again since reaching legal size, this could be evidence that the annual survival fraction is increasing. The fraction could also increase if the mean time between molts is decreasing or the change in size between successive molts is increasing. Of these possible changes, it may be that change in annual survival fraction is the most plausible.

Logbook data from index fishers were available from 2004 to 2012 for each region, with representation from most LFAs for most years. The data available from these logbooks were utilized to generate CPUE plots (number of lobster caught/number of traps hauled) and percentage of v-notching of ovigerous females within regions.

Mandatory logbooks were implemented in the Newfoundland lobster fishery starting in 2010. Catch per Unit Efforts were calculated from these and comparisons with index logbook data showed similar trends. The mandatory logbook data for 2012 were preliminary.

Nominal effort is a measure of the maximum potential number of trap hauls within a region during a fishing season. It is a product of the number of active fishers, the daily trap limit and the length of the fishing season in days.

A potential pre-recruit index was derived from modified traps in the index logbook program. The traps were modified to prevent the escape of pre-recruits. The modifications were not standardized until 2010, leading to uncertainty in the pre-2010 data. Another potential pre-recruit index was derived from at-sea sampling data from the unmodified traps of the index fishers.

Overall (LFAs 3-14) Resource Status

The Newfoundland lobster assessment was completed for four assessment regions which are a geographical grouping of LFAs into Northeast (LFAs 3-6), Avalon (LFAs 7-10), South Coast (LFAs 11-12) and West Coast (LFAs 13-14). The fishery has always been a recruit-based fishery, therefore reported landings reflect abundance. Most size frequency plots clearly show a sharp drop at legal size and few lobsters achieving the second molt class, indicating that most of the exploitable biomass is caught in the year of recruitment to the fishery (Fig 3). Reported landings are going down in the Northeast and Avalon and going up on the South and West Coasts. Total reported landings for Newfoundland have remained relatively stable since the 1960s. Reported landings increased by 70% from 1760 t in 2000 to 3000 t in 2008 before declining by 28% to 2150 t in 2012 resulting from a decrease in the Northeast and Avalon regions and an increase in the South and West Coasts. The reported landings have become spatially concentrated. The contribution of the most productive LFA (11) to the reported landings has increased from less than 15% in the early 1990s to around 45% in the last three years. Nominal effort (based on active fishers, trap limits and fishing days) has decreased by 31% since 2008, due to license retirements, fewer active fishers, shorter seasons, and trap limit reductions (Fig. 4). Mean catch rates of pre-recruit lobsters show little annual variation and there is no apparent relationship between these catch rates and future commercial reported landings or CPUE. Catch per unit effort has changed little over the time period for which data are available (2004-12). It appears that the survival fraction has increased, since 2008, in all regions except for the Northeast. It appears that the survival fraction in the South and West Coast regions is lower than the Northeast and Avalon regions.

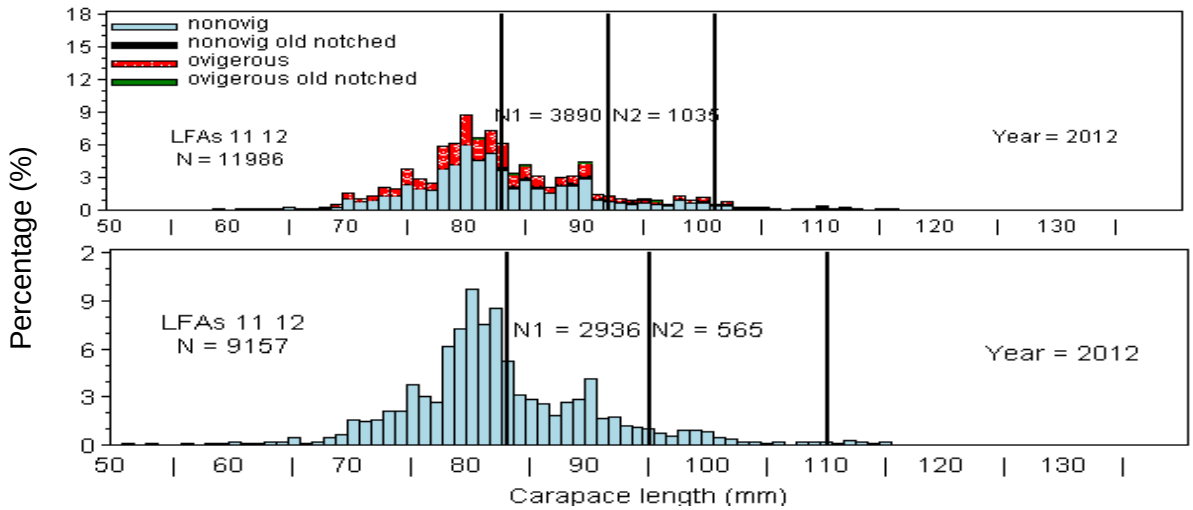


Figure 3. Typical size frequency plots for females (top panel) and males, from South Coast region for illustrative purposes.

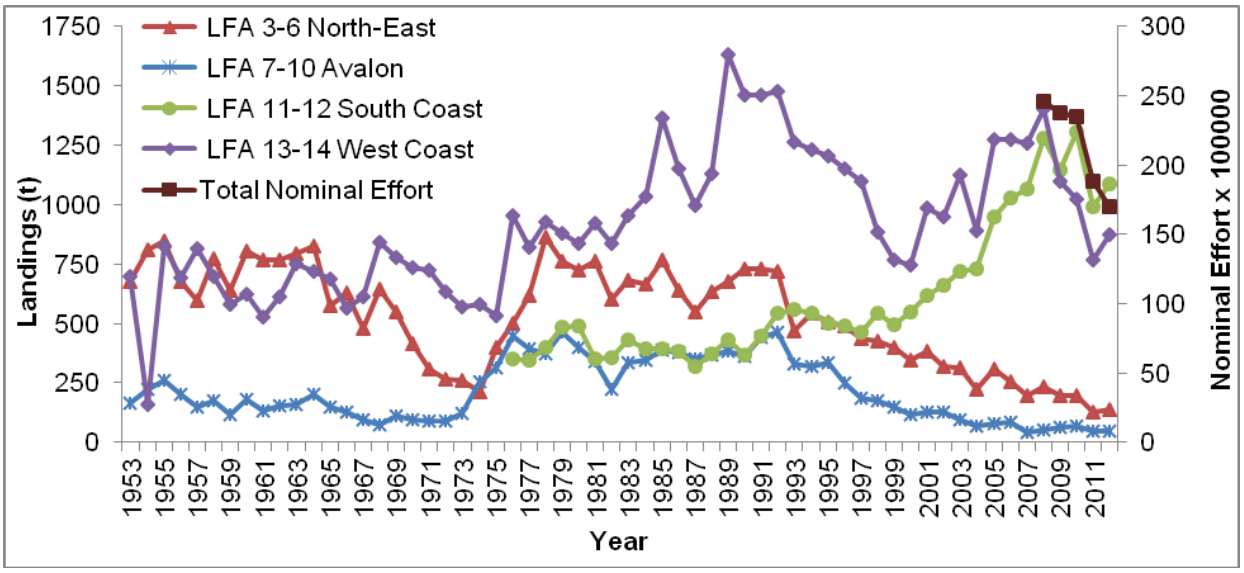


Figure 4. Trends in reported landings and nominal effort, by assessment region, in the Newfoundland lobster fishery.

Northeast Region (LFAs 3-6) Resource Status

Reported landings have declined from about 750 t in the early 1990s to 140 t in 2012 (Fig. 5). The greatest declines have occurred in LFA 4. Meanwhile, nominal effort has decreased by 33% since 2008 due to fewer active fishers (Fig. 5). Mean CPUE has changed little since 2004 in all LFAs (Fig. 6).

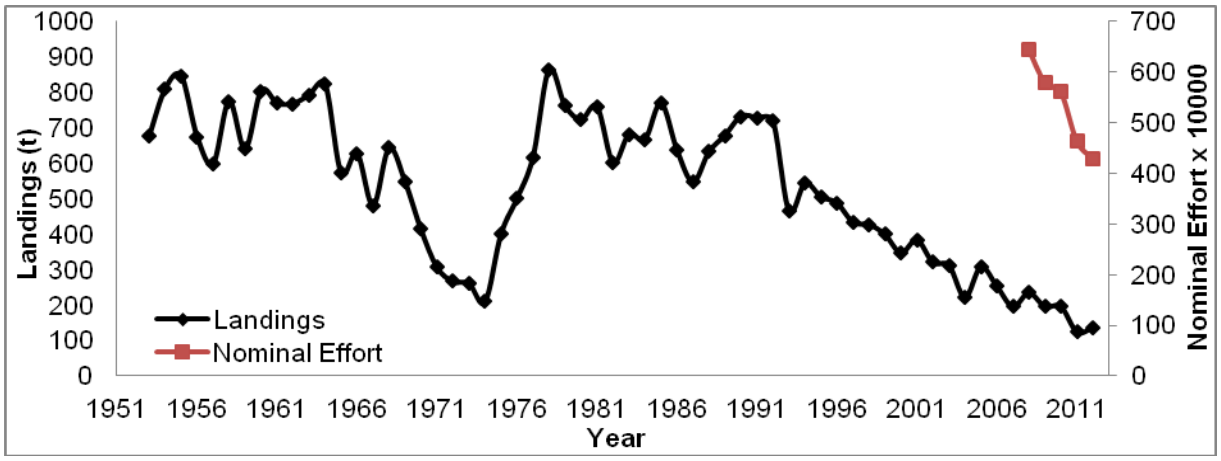


Figure 5. Trends in reported landings and nominal effort in the Northeast region.

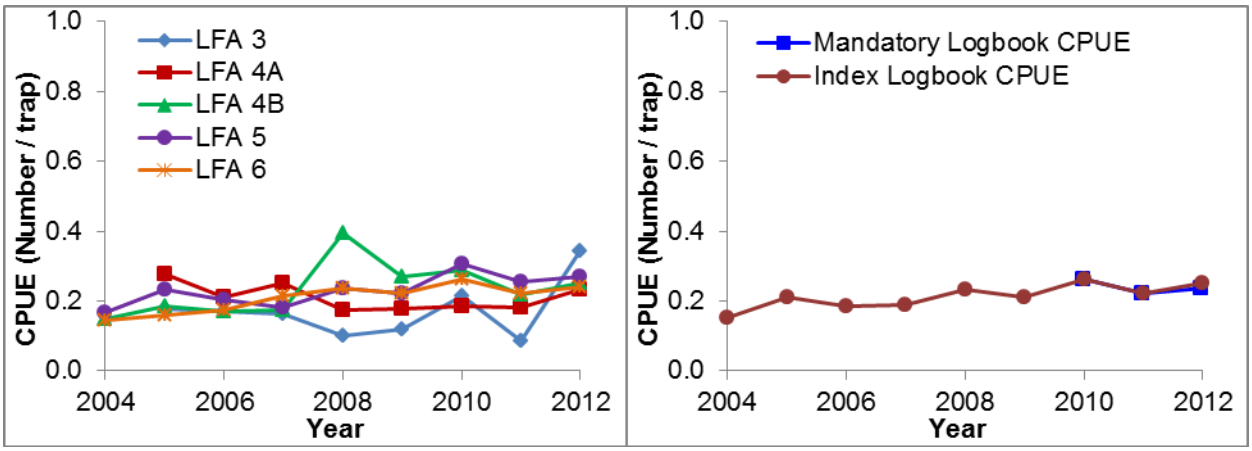


Figure 6. Mean CPUE from Index Fishers Logbooks for LFAs 3-6 and the entire Northeast region, as well as mean CPUE from Mandatory Logbooks for the entire Northeast region.

Lobster survival has gradually decreased from a peak in 2008, based on molt class ratios for males and females (Fig. 7). Since 2006 the percent v-notching has remained between 8% and 13% (Fig. 8).

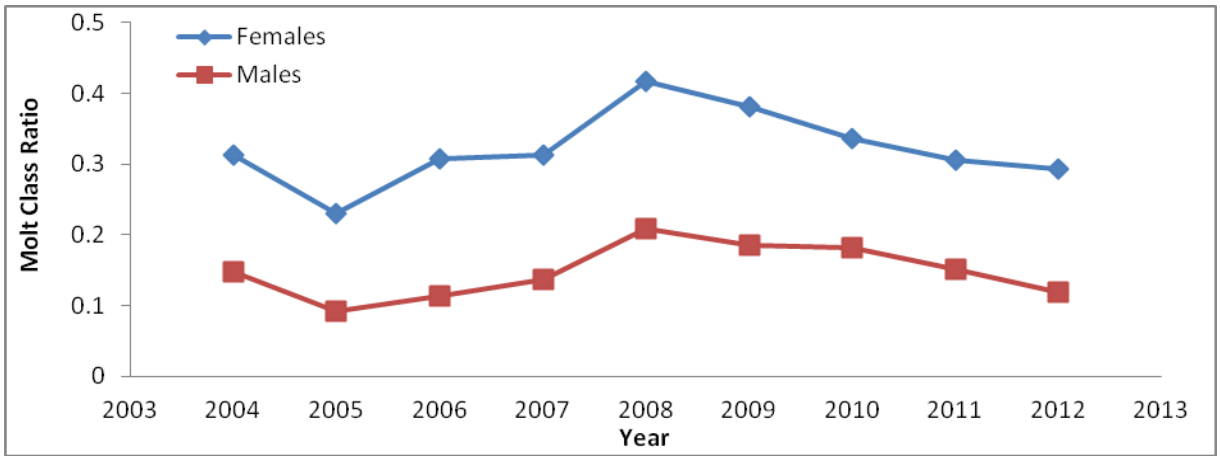


Figure 7. Molt class ratios for male and female lobsters in the Northeast region.

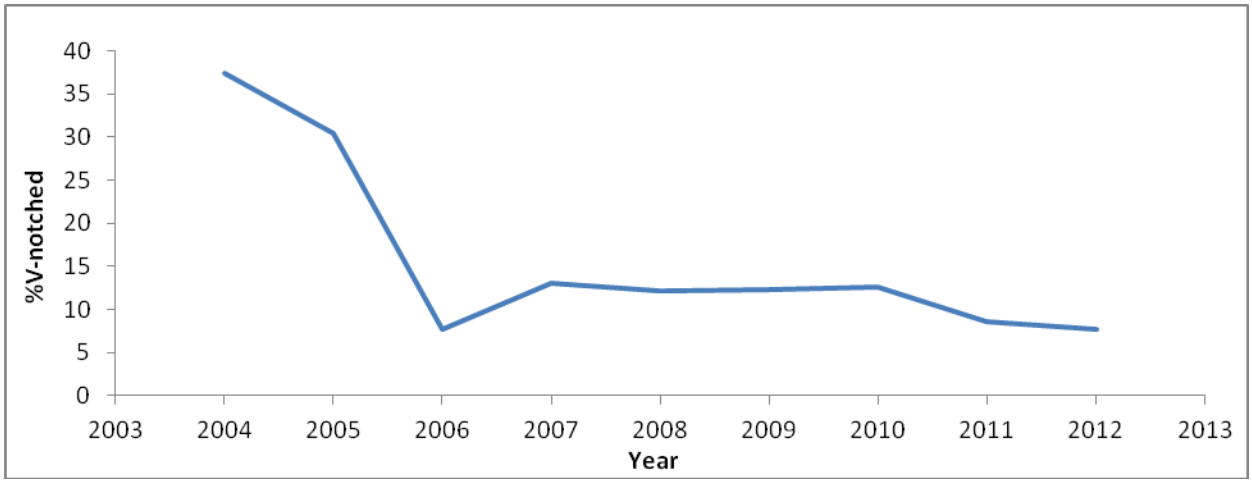


Figure 8. Percentage of V-notching in the Northeast region.

Avalon Region (LFAs 7-10) Resource Status

Reported landings have declined from about 460 t in the early 1990s to about 50 t in 2012 (Fig. 9). The greatest declines have occurred in LFA 10, the most productive LFA in this region. Nominal effort has decreased by 46% since 2008 due to fewer active fishers and shorter seasons (Fig. 9). Mean CPUE has changed little since 2005 in LFAs 8-10 whereas it gradually increased in LFA 7 (Fig. 10).

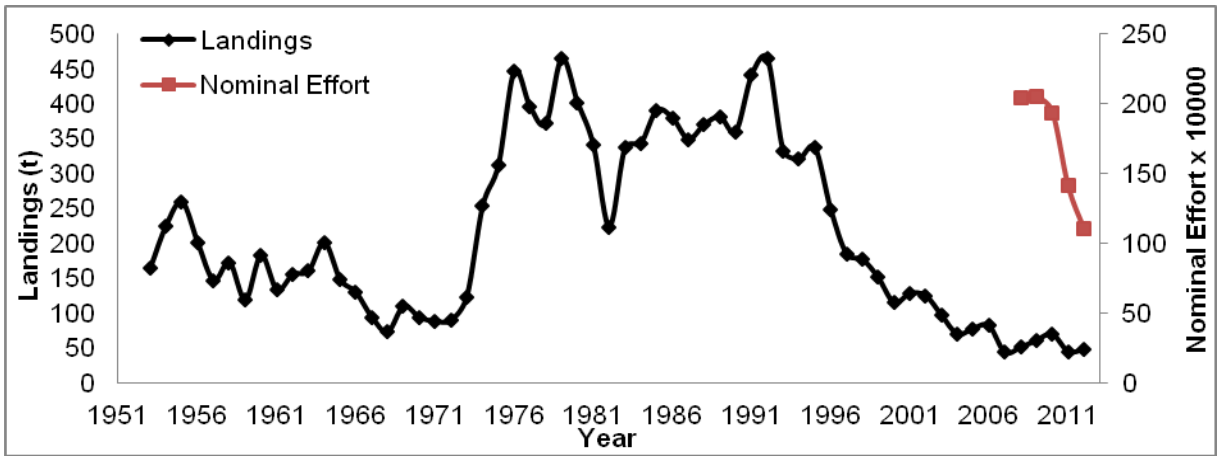


Figure 9. Trends in reported landings and nominal effort in the Avalon region.

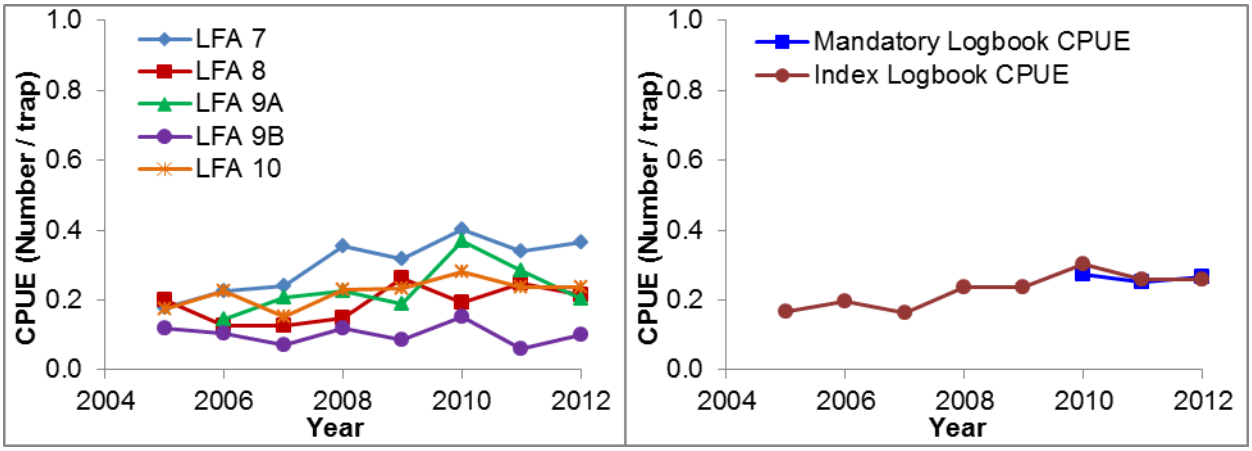


Figure 10. Mean CPUE from Index Fishers Logbooks for LFAs 7-10 and the entire Avalon region, as well as mean CPUE from Mandatory Logbooks for the entire Avalon region.

Lobster survival gradually increased from 2008 to 2011 before declining slightly in 2012, based on molt class ratios for males and females (Fig. 11). Since 2006 the percent v-notching in this region has remained between 13% and 23% (Fig. 12).

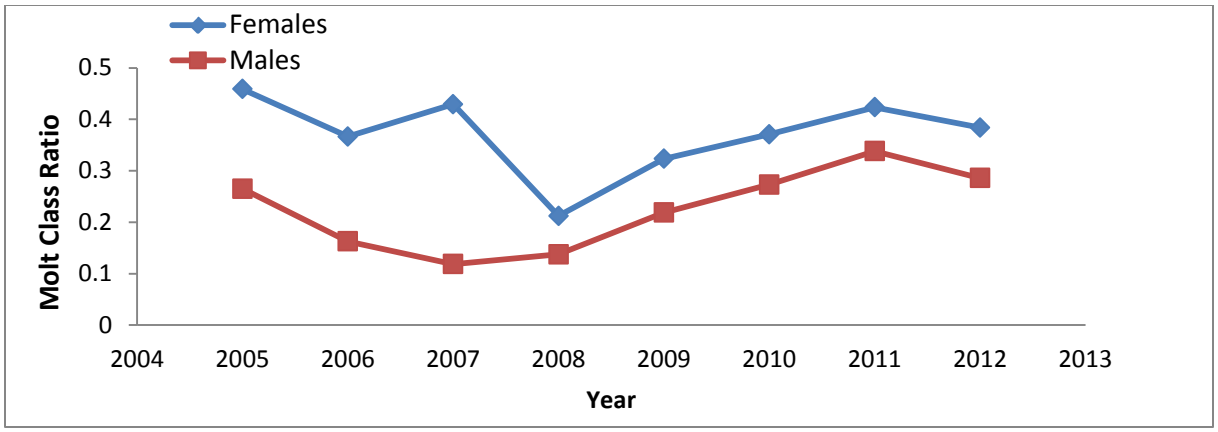


Figure 11. Molt class ratios for male and female lobsters in the Avalon region.

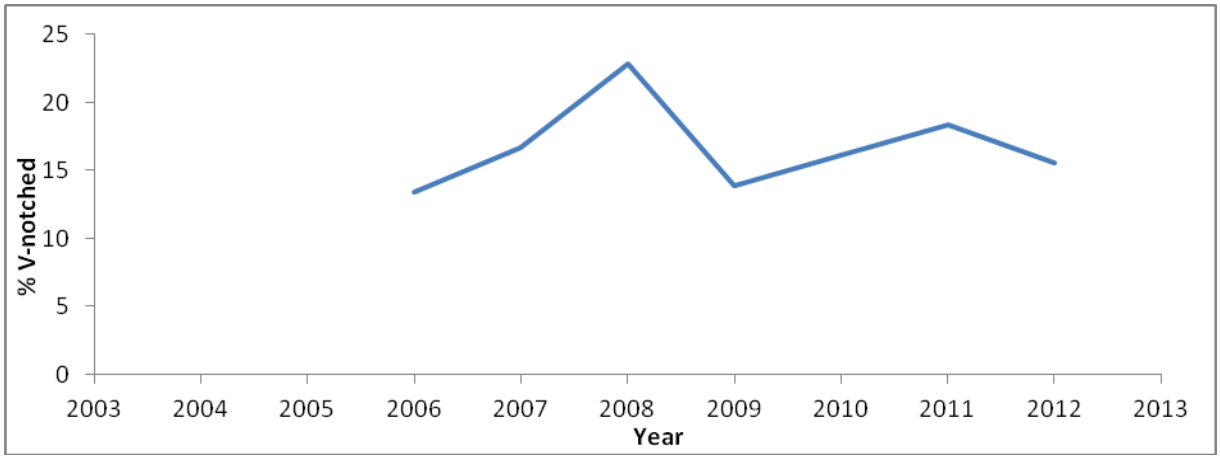


Figure 12. Percentage of V-notching in the Avalon region.

South Coast Region (LFAs 11-12) Resource Status

Reported landings increased from about 400 t in the early 1990s to peak at 1300 t in 2010. They decreased to 990 t in 2011 and then increased to 1100 t in 2012 (Fig. 13). The greatest increase occurred in LFA 11, the LFA with the highest reported landings in all years. Nominal effort has decreased by 23% since 2008 due to license retirements, fewer active fishers, shorter seasons and trap limit reductions (Fig. 13). Mean CPUE has increased slightly since 2004 in both LFAs (Fig. 14).

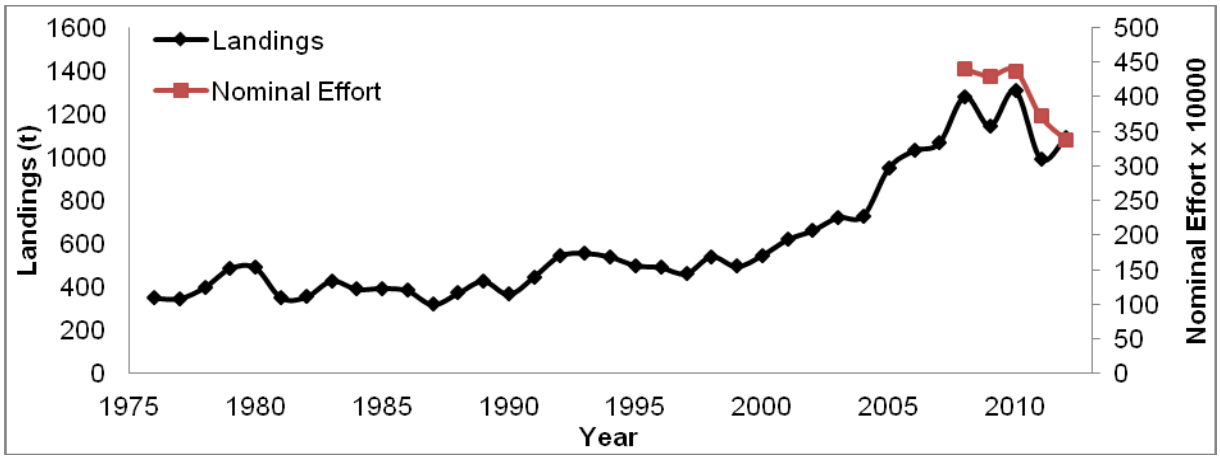


Figure 13. Trends in reported landings and nominal effort in the South Coast region.

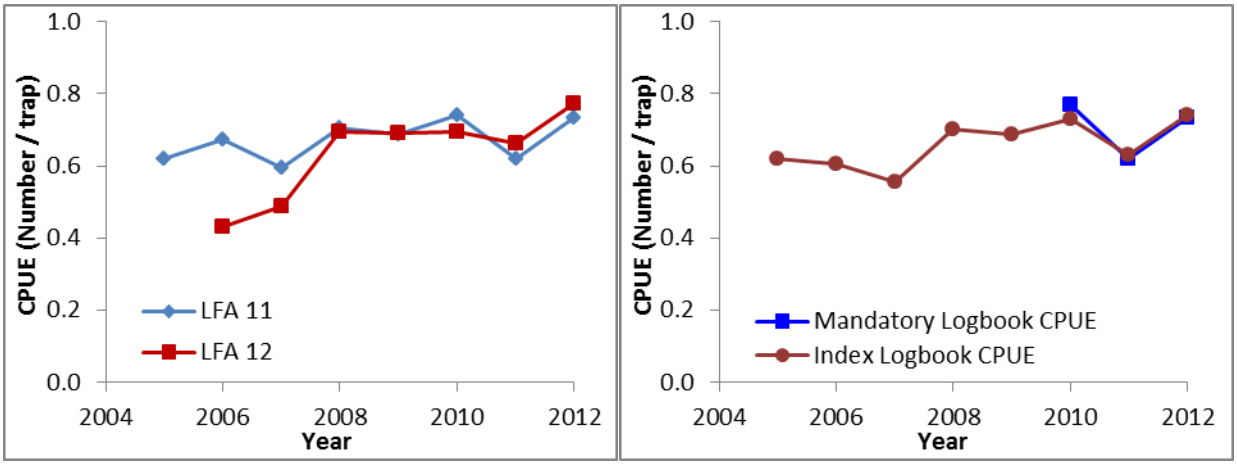


Figure 14. Mean CPUE from Index Fishers Logbooks for LFAs 11-12 and the entire South Coast region, as well as mean CPUE from Mandatory Logbooks for the entire South Coast region.

Lobster survival was lowest in 2005-08 based on molt class ratios for males and females. It increased in 2009 and declined gradually to 2011 before increasing sharply in 2012 to the highest levels in the time series (Fig. 15). Since 2006 the percent v-notching has remained between 4% and 7% (Fig. 16).

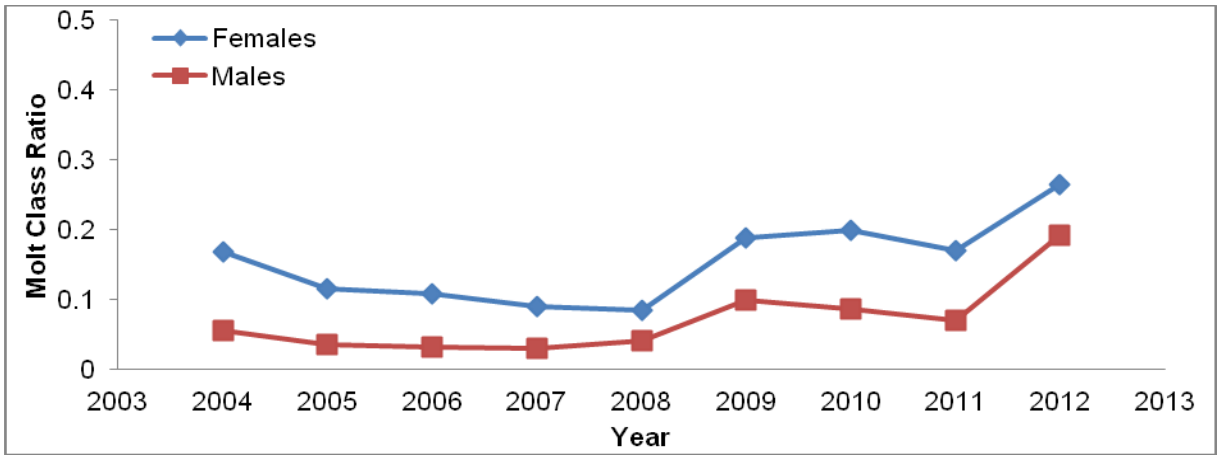


Figure 15. Molt class ratios for male and female lobsters in the South Coast region.

Figure 16. Percentage of V-notching in the South Coast region.

West Coast Region (LFAs 13-14) Resource Status

Reported landings increased from about 750 t in 2000 to 1400 t in 2008 before declining to about 770 t in 2011 and increasing to about 880 t in 2012 (Fig. 17). Nominal effort has decreased by 29% since 2008 due to license retirements, fewer active fishers, and trap limit reductions (Fig. 17). Mean CPUE has varied without trend since 2004 in all LFAs with the highest mean CPUE in LFA 13 (Fig. 18).

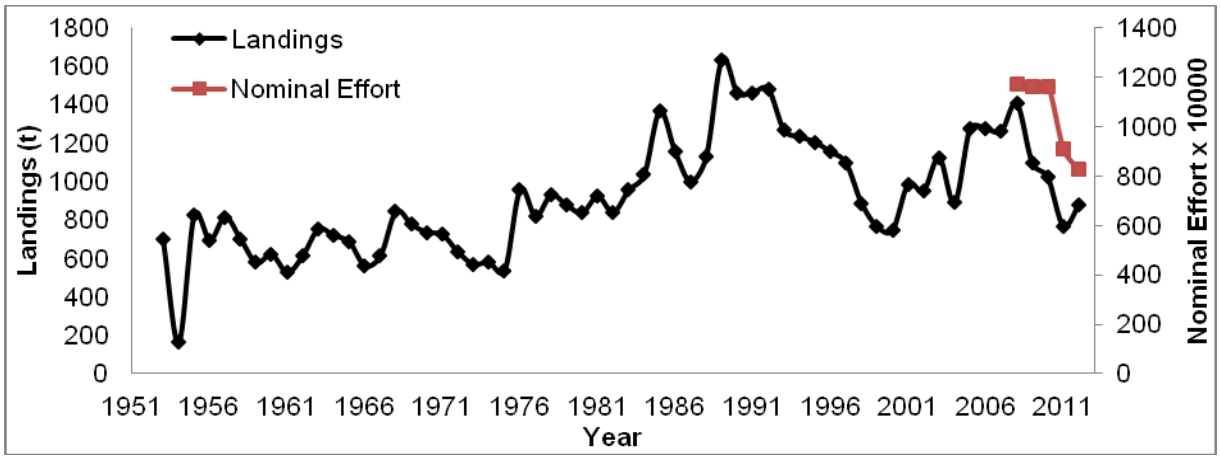


Figure 17. Trends in reported landings and nominal effort in the West Coast region.

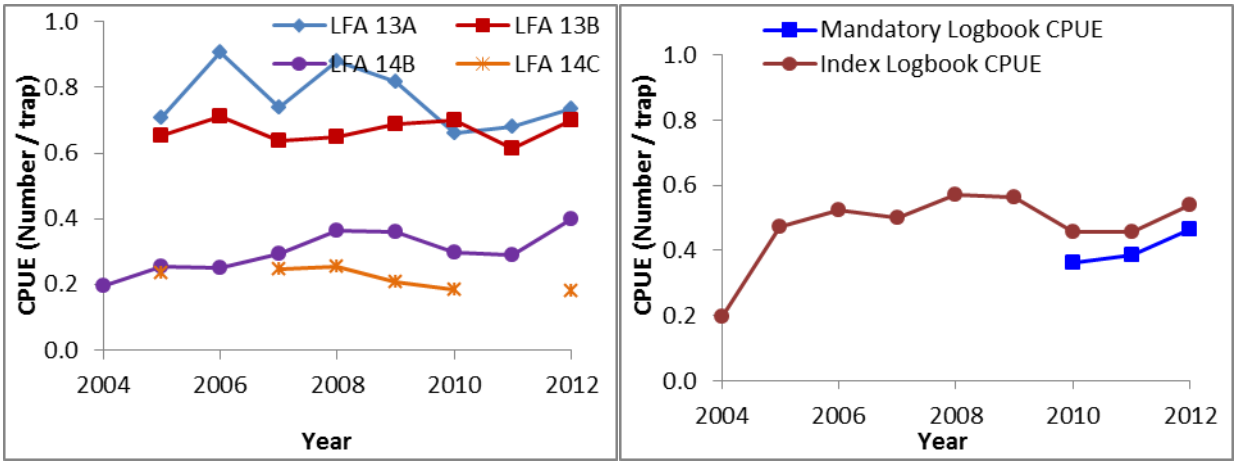


Figure 18. Mean CPUE from Index Fishers Logbooks for LFAs 13-14 and the entire West Coast region, as well as mean CPUE from Mandatory Logbooks for the entire West Coast region.

Lobster survival gradually increased since 2007, based on molt class ratios for males and females, with a sharper increase for females than males in 2012 (Fig. 19). Since 2006 the percent v-notching has remained between 8% and 12% (Fig. 20).

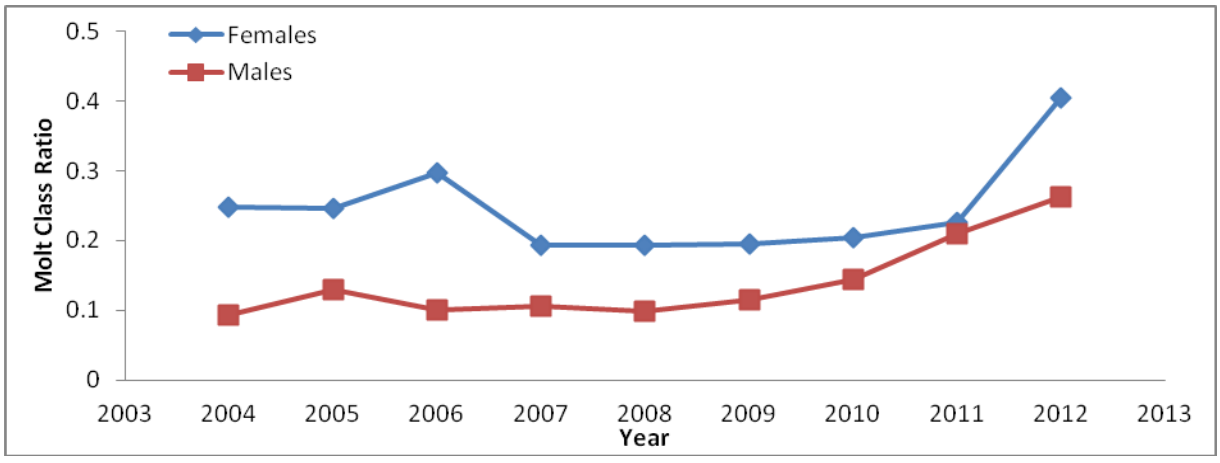


Figure 19. Molt class ratios for male and female lobsters in the West Coast region.

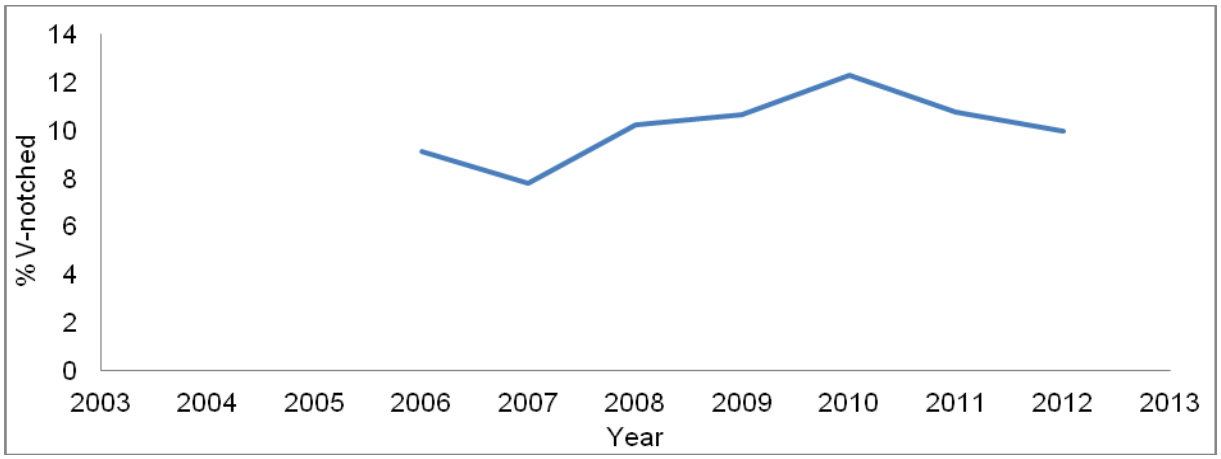


Figure 20. Percentage of V-notching in the West Coast region.

Sources of Uncertainty

The assessment is based solely on fishery-dependent data and the time series from logbooks and at-sea sampling are short (maximum 8-9 years). There is uncertainty with nominal effort data prior to 2008.

Reported landings do not account for local sales, poaching, and handling mortalities that can occur prior to the sale of the catch. The extent of local sales, in particular, can be considerable and varies by location and year.

For the at-sea sampling, effects of year to year differences in spatial and temporal coverage are unknown.

Size compositions and catch rates are influenced by catchability. Environmental conditions, soak time and changes in fishing gear can affect catchability. Sublegal lobsters could be captured multiple times during a fishing season, potentially biasing interpretation of size compositions.

There are uncertainties around using CPUE as an index of abundance. There are problems of estimating local density and it is unclear how to integrate local concentrations over space and time. Trap density and competition can affect how well catch rates measure local densities. A decrease in the number of active fishers will reduce gear competition and result in an increase in CPUE.

Methods for inferring annual survival fractions from the size structure of legal lobsters have not been tested or calibrated. They depend on several “all other things being equal” assumptions, and the potential errors when all other things are not equal have not been investigated. Some of these assumptions include constant recruitment, constant fishing pressure and accurate molt increment estimates.

V-notching of ovigerous female lobsters has been taking place annually since its initiation in the mid-1990s. There are no reliable accounts of the amount of v-notching taking place but it is believed to be less than 15% and variable in different areas. Data from mandatory logbooks may provide a reasonable representation with a longer time series. If there is a positive effect of v-notching on recruitment, it has not yet become clear.

There are studies demonstrating that larger female lobster produce more, and more viable, eggs. Protecting these females in the population is a reasonable step towards increasing egg production but it is unknown if egg supply is a limiting factor for future fishery recruitment.

Furthermore, it is unknown where enhanced recruitment, if any, will occur relative to the v-notching sites.

CONCLUSIONS

Each year the catch consists largely of new recruits. Mean catch rates of pre-recruit lobsters show little annual variation and there is no apparent relationship between these catch rates and future commercial reported landings or CPUE. The reported landings have become spatially concentrated. The contribution of the most productive LFA (11) to the reported landings has increased from less than 15% in the early 1990s to around 45% in the last three years. Nominal effort has decreased by 31% since 2008. It appears that the survival fraction has increased, since 2008, in all regions except for the Northeast. It appears that the survival fraction in the South and West Coast regions is lower than in the Northeast and Avalon regions.

OTHER CONSIDERATIONS

Logbooks

Several issues were identified with logbooks including their timely return, availability to fishers at the start of the season, and representativeness of the index fisher logbooks. Neither mandatory nor index fisher logbooks consistently record catches of undersized lobsters.

Green Crab (*Carcinus maenas*)

There are concerns about effects of predation of Green Crab on lobster. It was speculated that they target small recently-settled lobster. Green crabs first appeared in localized areas of Placentia Bay (LFA 10) in 2007 where harvesters have reported traps full of Green Crab. Their distribution has since expanded into other LFAs.

Management Considerations

There are concerns about the effects of aquaculture (fin fish and mussel farms) on lobster stocks. The concerns come from the drastic drop in reported landings in LFA 4 where mussel farms exist, and the effects of salmon farms on the lobster habitat and catch in LFA 11.The impacts, in Newfoundland, are not documented but studies are underway to investigate the potential impacts of salmon aquaculture on lobster stocks.

Concerns exist about the presence of jumbo (>127 mm CL) lobsters in the population. There are claims that the large lobsters eat the smaller ones, though there was no data provided at the meeting.

Presently there are no reference points for the Newfoundland lobster stocks. Further work on the precautionary approach is needed.

SOURCES OF INFORMATION

This Science Advisory Report is from the May 15-16 and May 21-22, 2013. Meeting of the Newfoundland & Labrador Regional Advisory Process (RAP) on Lobster. Additional publications from this meeting will be posted on the *Fisheries and Oceans Canada (DFO) Science Advisory Schedule* as they become available.

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