Fisheries and Oceans Canada | Pêches et Océans Canada
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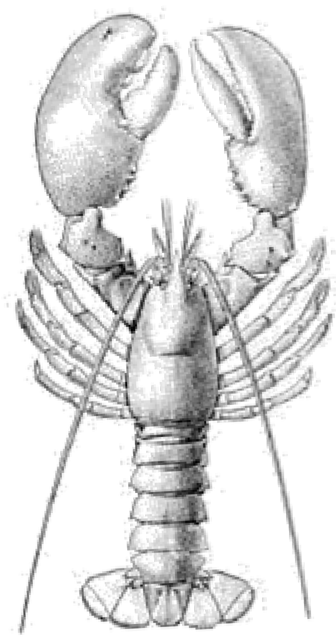
Maritimes Region

Canadian Science Advisory Secretariat
Science Advisory Report 2021/020

ASSESSMENT OF AMERICAN LOBSTER (*HOMARUS AMERICANUS*) IN LOBSTER FISHING AREAS 35–38



*American Lobster (*Homarus americanus*)*

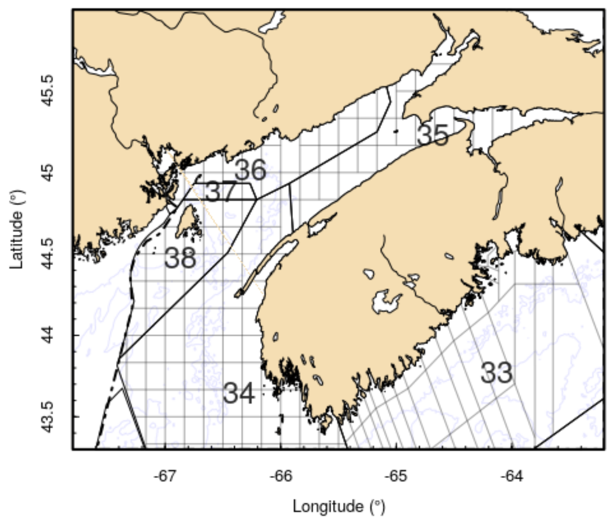


Figure 1. Map of Lobster Fishing Areas (LFAs) 35–38.

Context:

*American Lobster (*Homarus americanus*) are found in coastal waters from southern Labrador to Maryland, with some major fisheries in the Canadian Maritimes. Lobster Fishing Areas (LFAs) 35–38 cumulatively cover 14,000 km^2 from southwestern Nova Scotia, north to the Bay of Fundy and along the New Brunswick coast to the Canadian-United States border.*

The status of the Lobster resources in LFAs 35–38 was last updated in 2018. Fisheries Management has requested updated information on the status of the LFAs 35–38 Lobster stocks. A framework meeting was held from September 10–11, 2019, to establish the scientific basis for the provision of management advice for these stocks.

This Report is from the Science Advisory Process held on October 1, 2019, Stock Assessment of American Lobster Fishing Area(s) (LFA) 34 and 35–38. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada (DFO) Science Advisory Schedule] as they become available.

SUMMARY

- Lobster Fishing Areas (LFAs) 35–38 are effort controlled, with restrictions on season length, number of licences, number of traps per licence, minimum legal size, and retention of berried females.
- The primary indicator for describing stock status relative to reference points is the modelled commercial Catch Per Unit Effort (CPUE). The primary indicators show commercial biomass is at or near the highest in the time series in all areas.
- Secondary indicators represent time-series trends that are tracked individually, without defined reference points. The secondary indicators are landings, total effort, recruit-abundance time series from the DFO Scallop and Summer Research Vessel (RV) surveys, commercial biomass estimates from the DFO Summer RV Survey, and relative fishing mortality.
- The DFO Summer RV Survey commercial-biomass time series showed a pulsed increase from 2000–2004, which subsequently declined until 2010, followed by an increase to 2013 where biomass has remained high and variable since.
- The DFO Summer RV Survey recruit abundance (70–82 mm carapace length) has followed a similar pattern to total biomass, with increases from 2010 to 2013, followed by variable catch at a substantially higher level than has been observed in the time series.
- The current status of the Lobster stocks within each LFA is within the Healthy Zone.

LFA 35

- The CPUE trend indicates an increase in stock biomass occurred between 2005 and 2011. The CPUE time series has remained high (more than twice the Upper Stock Reference [USR]) since 2011. The 3-year running median for CPUE for the 2017–2018 fishing season is 3.90 kg/Trap Haul (TH), which is above the USR (1.62 kg/TH).
- Landings in LFA 35 reached a record high of 3,941 t in the 2013–2014 fishing season. The reported landings for the 2018–2019 fishing season are 2,577 t. This does not represent a full accounting due to outstanding logs.
- The abundance of Lobster recruits from DFO Scallop Survey tows within LFA 35 have increased in recent years from 14 to 35.4 Lobster/km^2.

LFA 36

- The CPUE trend indicates an increase in stock biomass occurred between 2010 and 2013. The CPUE time series has remained high (more than twice the USR) since 2013. The 3-year running median for CPUE for the 2017–2018 season is 3.91 kg/TH, which is above the USR (1.36 kg/TH).
- Landings in LFA 36 have more than doubled to a record high of 4,022 t in the 2017–2018 fishing season. The reported landings for the 2018–2019 fishing season are 2,913 t. This does not represent a full accounting due to outstanding logs.
- The abundance of Lobster recruits from DFO Scallop Survey tows within LFA 36 was low between 1999 and 2005 at a median of 4.6 Lobster/km^2, increased to 2010, and has remained high and stable since with a median of 49.3 Lobster/km^2.

LFA 38

- The CPUE trend indicates an increase in stock biomass occurred between 2013 and 2014. The CPUE time series has remained high (more than twice the USR) since 2014. The 3-year running median for CPUE for the 2017–2018 season is 4.78 kg/TH, which is above the USR (1.91 kg/TH).
- Landings in LFA 38 more than doubled to a record high of 5,711 t in the 2015–2016 fishing season. The reported landings for the 2018–2019 season are 3,830 t. This does not represent a full accounting due to outstanding logs.

BACKGROUND

Species Biology

The American Lobster (*Homarus americanus*) is a crustacean species that has been commercially fished since the early 1800s. This decapod has a complex life cycle characterized by several phases from eggs, larvae, juvenile, and adults, and relies on moulting its exoskeleton for an increase in size. Typically, the mature females mate after moulting in late summer, and extrude eggs the following summer. The eggs are attached to the underside of the tail to form a clutch and are carried for another 10–12 months, hatching in June–August. The eggs hatch into a pre-larvae (also known as prezoea), and through a series of moults become motile larvae. These larvae spend 30–60 days feeding and moulting in the upper water column before the post-larvae settle to the bottom, seeking shelter. For the first few years of life, juvenile Lobster remain in or near their shelter to avoid predation, spending more time outside of the shelter as they grow (Lavalli and Lawton 1996). Nova Scotia Lobster can take up to 8–10 years to reach a minimum commercial size of 82.5 mm Carapace Length (CL). Moulting frequency begins to decrease from one moult per year, at about 0.45 kg, to moulting every 2 or 3 years for Lobster above 1.4 kg (Aiken and Waddy 1980).

Lobster mature at varying sizes depending upon local conditions (Aiken and Waddy 1980, Campbell and Robinson 1983, Comeau and Savoie 2002) with climatological factors, such as temperature, influencing the size at maturity. Generally, regions characterized by warmer summer temperatures have smaller sizes at maturity than regions with cooler summer temperatures, such as the Bay of Fundy (Le Bris et al. 2017). Estimates of the size (CL) at 50% maturity (SoM) in the offshore areas vary regionally from 82 mm CL on the slope off New England and 92 mm CL for Georges Bank and Gulf of Maine (Little and Watson 2005), to approximately 93 mm CL for Northeast Georges and Browns Bank (Cook et al. 2017). In LFAs 35–38, the SoM has been estimated through several studies (e.g., Gaudette et al. 2014), with the general consensus that SoM is larger in the Bay of Fundy than other regions.

In LFA 35–38, the Minimum Legal Size (MLS) is below the SoM indicating only a small proportion of females have had the opportunity to breed prior to entering the fishery (Gaudette et al. 2014). Between initial maturity and approximately 120 mm, female Lobster produce eggs every second year with a moult in intervening years. Based on laboratory studies using ambient inshore Bay of Fundy water temperatures, female Lobster are able to spawn twice without an intervening moult (consecutive spawning) at a size greater than 120 mm CL (Waddy and Aiken 1986, Waddy and Aiken 1990), though this size may vary in nature (Comeau and Savoie 2002). Consecutive spawning may occur in two forms: successive-year (spawning in two successive summers, a moult in the first and fourth years) and alternate-year (spawning in alternate summers). In both types, females often are able to fertilize the two successive broods with the sperm from a single insemination. Intermoult mating has also been observed in laboratory conditions (Waddy and Aiken 1990). This consecutive spawning strategy enables large Lobster to spawn more frequently over the long term than their smaller conspecifics. This combined with the exponential relationship between body size and numbers of eggs produced (Campbell and Robinson 1983, Estrella and Cadrin 1995) means that very large Lobster have a much greater relative fecundity and are thus an important component to conservation. In the Gulf of Maine, the management plan and past stock assessments (Pezzack and Duggan 1987, Pezzack and Duggan 1995) have looked at maintaining the high reproductive potential in this area by preserving its size structure dominated by mature individuals.

Fishery

The inshore commercial fishery for American Lobster has been active for over 150 years in Lobster Fishing Areas (LFAs) 35–38. These areas cumulatively cover 14,000 km^2 from southwestern Nova Scotia, north to the Bay of Fundy and along the New Brunswick coast to the Canadian–United States border (Figure 1). The fishery is prosecuted throughout the LFAs with both inshore and offshore components.

These Lobster fisheries are effort controlled, with restrictions on season length, number of licences, number of trap per licence, MLS, and retention of berried females (Table 1). The landings in LFAs 35–38 have averaged 12,160 t for the 2014–2015 to 2017–2018 fishing seasons. A breakdown of landings by LFA is presented in Table 2.

Table 1. Lobster Fishing Area (LFA) specific conservation measures and season dates.

LFA	Season	Total No. of Licences	Trap Limit[1]	MLS (mm)	Other Measures
35	October 14th to December 31st and last day of February to July 31st	94	300	82.5	No retention of berried females; no retention of V-notched Lobster; escape vents and biodegradable panels.
36	2nd Tuesday in November to January 14th and March 31st to June 29th[2]	177	300	82.5	
38	2nd Tuesday in November to June 29th	136	375	82.5	

[1] Trap limit is for category "A" licence holder. Part-time or category "B" licences are allowed 30% and Partnerships 150% of the limit of a single full-time licence.
[2] For the period of 2017–2018 to 2019–2020, an additional 10 days has been approved for LFA 36 on a pilot basis, with the season closing on July 9th.

Table 2. Landings (tonnes) for recent fishing seasons in Lobster Fishing Areas (LFAs) 35–38. Landings presented for LFA 38 do not include summer fishery landings authorized within territorial waters claimed by both Canada and the United States.

Season	LFA 35	LFA 36	LFA 38
2014–2015	3723	3524	5045
2015–2016	3482	3681	5711
2016–2017	3072	3382	4915
2017–2018	3605	4063	4438
2018–2019[1]	2577	2913	3830

[1]Not all logs were submitted when this report was produced. The estimated percent of outstanding logs for 2018–2019 season as of Sep 23, 2019, are: LFA 35 (13.9%), LFA 36 (24.8%), LFA 38 (10.4%).

ASSESSMENT

Stock Status Indicators

This stock assessment applies the methods and primary, secondary, and contextual indicators presented at the 2019 Framework Assessment (Cook et al. 2020). Some indicators are directly linked to stock health and status (e.g., abundance), whereas others describe the population characteristics (e.g., size structure) or ecosystem considerations (e.g., temperature). These indicators provide a snapshot of the LFAs 35–38 Lobster stocks and the ecosystem.

Primary indicators are used to define stock status in relation to reference points presented in Cook et al. (In prep.)[1]. Secondary indicators are those in which time-series trends are displayed but do not have reference points. Some secondary indicators are representative of the combined LFAs 35–38 area, while others are specific to each LFA. The contextual indicators may describe additional population and ecosystem characteristics that were examined as part of this assessment but are not presented in annual updates.

The data available for establishing indicators for LFAs 35–38 come from both fishery-dependent and fishery-independent sources. Fishery-dependent data consist of commercial logbooks that report information on date, location (grid), effort, and estimated catch. The fishery-independent data sources include the DFO Maritimes Region Summer Research Vessel (RV) Survey (herein DFO Summer RV Survey) and the DFO Scallop Surveys in the Bay of Fundy. Although designed to monitor the abundance of different species (groundfish and scallop), these surveys have recorded and measured Lobster caught and serve as fishery-independent indicators of Lobster abundance in these areas.

Primary Indicators

In LFAs 35–38, the primary indicator of stock status, which describes the time-series trends relative to reference points, is the modelled commercial Catch Per Unit Effort (CPUE).

[1]Cook, A.M., Hubley, P.B., Howse, V., and Denton, C. In prep. 2019 Framework Assessment of American Lobster (*Homarus americanus*) in LFA 34–38. DFO Can. Sci. Advis. Sec. Res. Doc.

Catch Per Unit Effort

Catch rates are a preferred indicator over landings data as they are standardized to account for the level of fishing effort, which is especially important in effort-controlled fisheries. However, catch rates vary during the fishing season due to changes in biomass and catchability, which can be accounted for in catch-rate models. Biomass, the underlying process behind this indicator, changes over time as Lobster recruit to the fishery (usually between seasons when moulting occurs) and during the season as Lobster are removed from the population through fishing. Catchability can vary as a result of behaviour due to changing temperature during the season. Temperature also varies annually and it is important to account for annual variations in temperature to ensure the annual catch rate index reflects changes in biomass and not catchability. Commercial catch rates were modelled separately for each LFA with generalized linear models. The weight reported in each log record was log-transformed and offset by the log of the Trap Hauls (THs) with factors of day of season, predicted bottom temperature, and year. The annual index was the predicted CPUE on the first day of the season at the average temperature typically experienced on that day.

Data for assessing catch rates primarily come from mandatory logs that were not put in place until the mid 2000s. This time series covers the current high-productivity period and a lower-productivity period from 2006–2010. The median of the high-productivity period (2011–2018) was used as the proxy for the biomass at carrying capacity (*K*). Following the recommendations of DFO (2009), the Upper Stock Reference (USR) and Limit Reference Point (LRP) were set to 40% and 20% of the *K* proxy. The 3-year running median is used to compare the commercial catch rates to the USR and LRP. This value will dampen the impact of any anomalous years, which may occur due to factors outside of changes in abundance.

Secondary Indicators

Secondary indicators represent time-series trends that are tracked individually, without defined reference points. The secondary indicators for LFAs 35–38 are landings, total effort, recruit-abundance time series from the DFO Scallop and DFO Summer RV surveys, commercial biomass estimates from the DFO Summer RV Survey, and relative fishing mortality.

Landings and Effort

Levels of commercial landings are related to population abundance as fishery controls are input- (effort controls) rather than output-based (total allowable catch). There are many factors that can affect this relationship, including changes in levels of fishing effort, catchability (including the effects of environment, gear efficiency), Lobster size distribution, and the spatial overlap between distribution of Lobster and effort.

Fishing effort is an indicator of fisheries performance as changes in landings can be due to changes in commercial-sized biomass, or fishing effort, or both. Fishing effort, recorded as the number of THs, in the Lobster fishery, is controlled by fishing season length, trap limits, and the limited number of fishing licences. Consequently, there is a maximum fishing effort that can be deployed; however, this maximum is never met as factors such as weather conditions, seasonally variable catch rates, and fishing partnerships limit the total number of THs. Presently, total fishing effort is calculated from mandatory logbooks, but, prior to their widespread adoption, effort was calculated from CPUE and total catch.

Scallop Survey Recruit Abundance

Annual surveys for Sea Scallops have been conducted since the early 1980s to assess abundance (Sameoto et al. 2012, Smith et al. 2012). These surveys started in the Bay of Fundy in 1981 and were extended into the area off southwest Nova Scotia in 1991. Lobster are caught as a bycatch in a subset of the stations and are measured prior to being returned to the ocean. Scallops are typically found on gravel sea bottoms, a habitat not favored by Lobster (Tremblay et al. 2009), but the two species do overlap in some areas. The surveys are primarily conducted in July for the Bay of Fundy (LFAs 35 and 36) and August around Grand Manan Island (LFA 38), which, in some years, overlaps the Lobster moulting period. Scallop dredges tend to capture Lobster that are under the legal size and are useful as indicators of recruitment.

Research Vessel Survey Commercial Biomass and Recruit Abundance

Despite strata boundaries from the DFO Summer RV Survey significantly overlapping with LFAs 35–38, there were few (< 20 per year) sets within each LFA, suggesting that the information derived from the indicators was limited. The Commercial Biomass and Recruit Abundance of the combined LFAs 35–38 areas are presented as secondary indicators.

Prior to 1999, information on Lobster size was not collected on the DFO Summer RV Survey. The ratio of commercial to total biomass estimated between 1999 and 2018 (0.746) was used to extend the commercial survey biomass index prior to 1999. The commercial biomass time series showed a pulsed increase from 2000–2004, which subsequently declined until 2010, followed by an increase to 2013, where biomass has remained high and variable (Figure 2). The SoM for the Bay of Fundy is substantially greater than the MLS, and, as such, the commercial biomass available post-fishery will constitute those individuals entering the spawning population in the upcoming year.

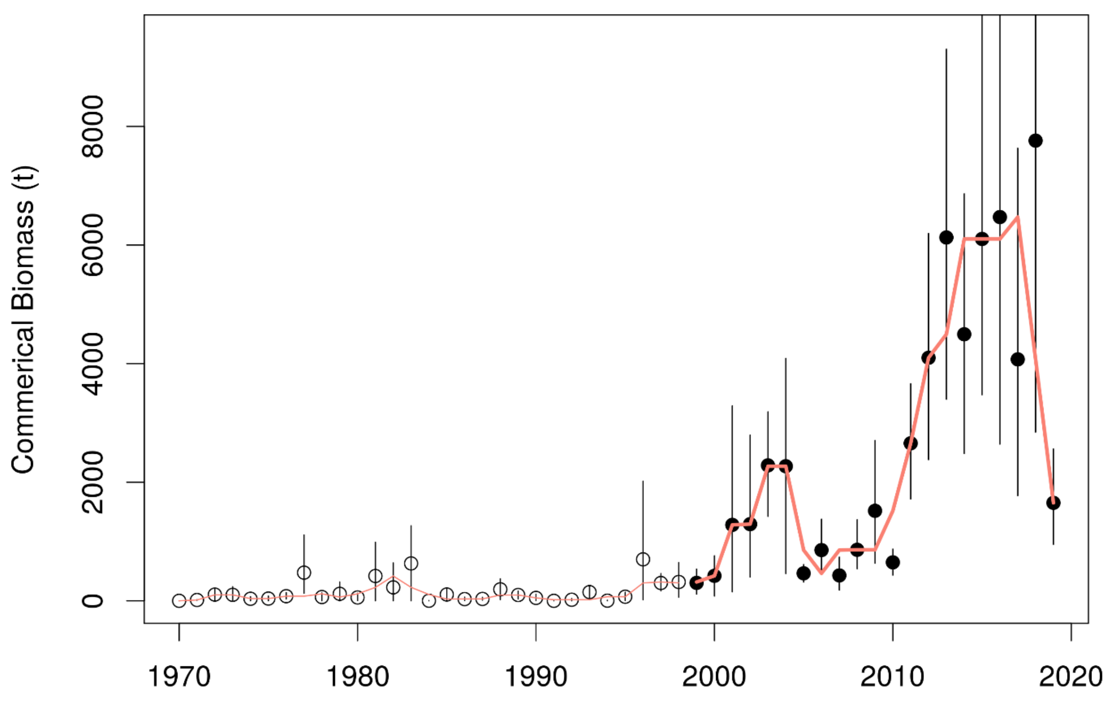


Figure 2. Time series of DFO Summer RV Survey trends for LFAs 35–38 commercial biomass. The red line represents the 3-year running median. Values prior to 1999 were derived using the mean proportion of commercial to total biomass between 1999 and 2018 (0.746).

The DFO Summer RV Survey recruit abundance (70–82 mm CL) has followed a similar pattern to total biomass, with increases from 2010 to 2013, followed by variable catch at a substantially higher level than has been observed in the time series (Figure 3).

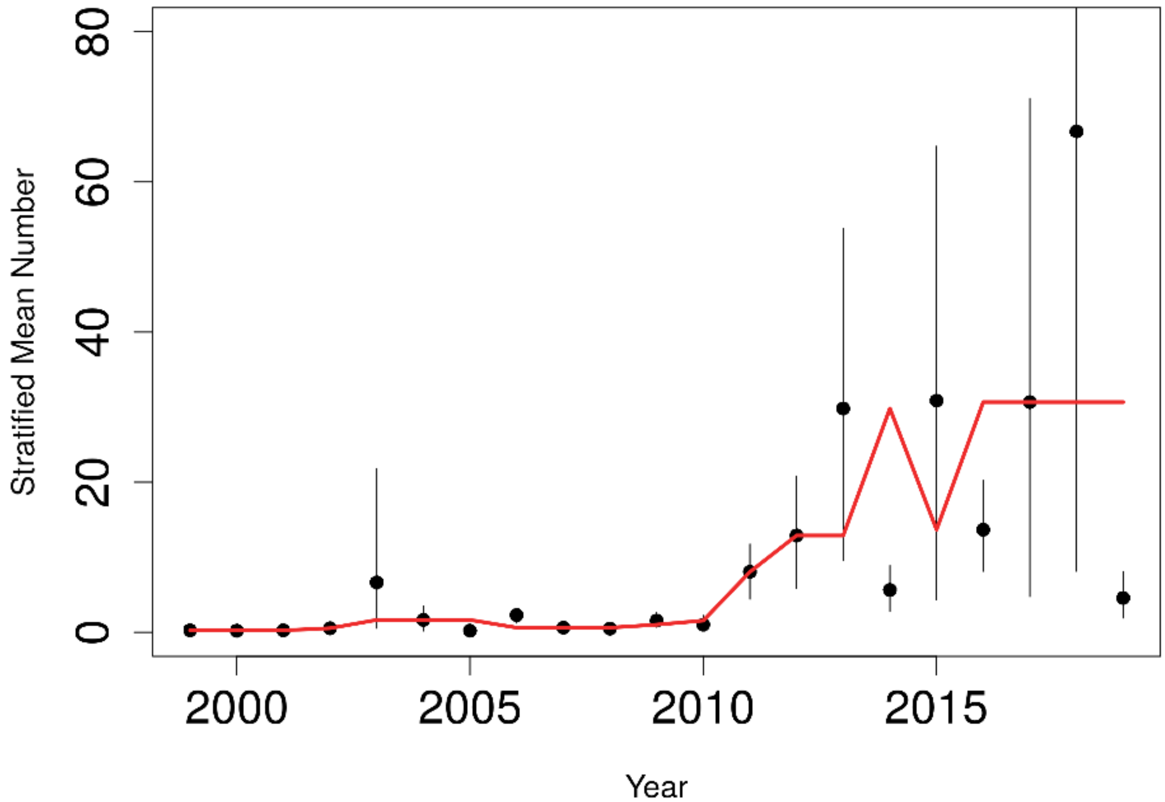


Figure 3. Time series of DFO Summer RV Survey trends for LFAs 35–38 recruit abundance. The red line represents the 3-year running median.

Relative Fishing Mortality

Relative fishing mortality (*relF*) uses the DFO Summer RV Survey commercial biomass estimates and landings to show the changes in removals (C_t) relative to the *j* survey indices (I_{jt}). As the RV survey occurs after the fishery is complete, the estimation of *relF* was adjusted by the landings as:

$$relF_{jt} = \frac{C_t}{(I_{jt} + C_t)}$$

Assuming that survey catchabilities were constant and the index of commercial biomass was proportional to true commercial biomass, *relF* represented an index *F*.

The estimates of *relF* reflect the variation in the commercial biomass index with decreases between the late 1990s and early 2000s, increases to 2010, then decreases to 2013, with variable but low estimates of *relF* since then (Figure 4). Tracking the relative fishing mortality for the Bay of Fundy provides a depiction of the observed patterns across the larger area.

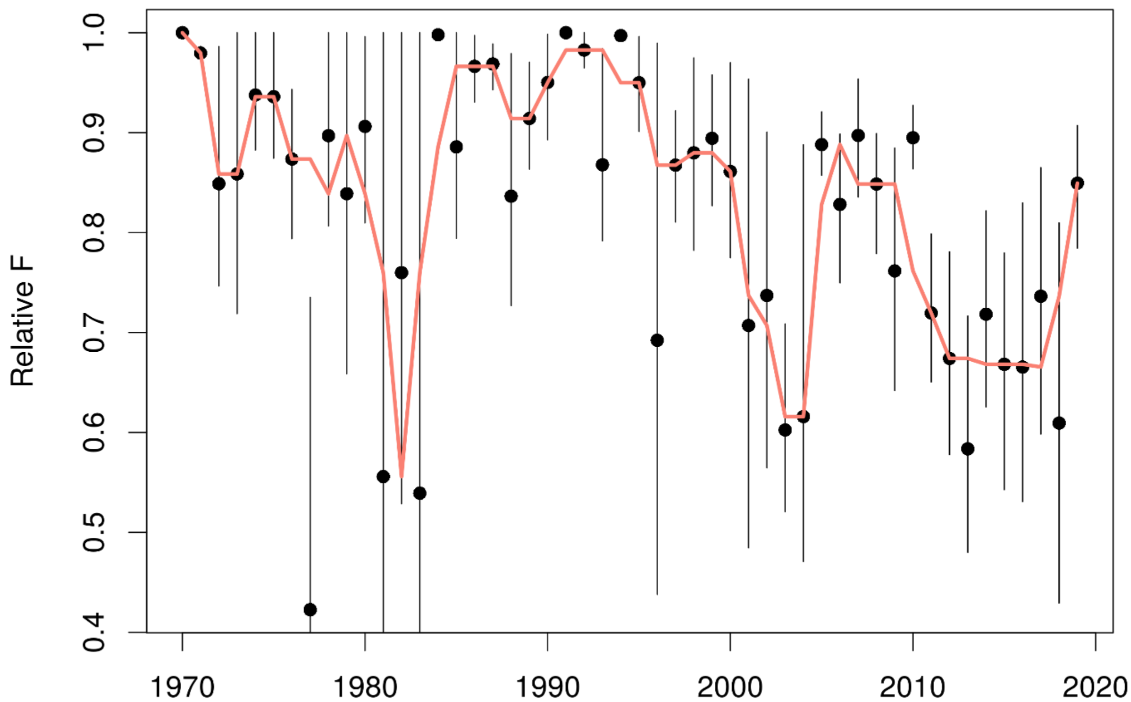


Figure 4. Relative fishing mortality from the DFO Summer RV Survey commercial biomass estimates and the landings in LFAs 35–38.

Contextual Indicators

The contextual indicators (figures 5a and 5b) are total Lobster abundance, predator abundance and biomass, bottom temperature, design-weighted area occupied, and the Gini index from the DFO Summer RV Survey for the combined LFA 35–38 areas, as well as the Gini index for the specific fisheries.

Total Lobster abundance from the DFO Summer RV Survey in LFAs 35–38 showed an increasing trend since 2010 (Figure 5a). There were slight increases in Lobster abundance in the early 2000s; however, the rapid increase from 2010 to 2013 and the variability around a higher production level is evident. Predator biomass has decreased since the late 1980s, while the abundance has shown less of an overall trend. The pulses of incoming recruitment to various predator species at small sizes, as well as the overall decreases in body size of groundfish in the area, contributed to the differences observed in the trends. The upward increase in 2015 and 2016 was largely due to several strong year-classes of Haddock. This indicator would be strengthened by weighting the predator species and size groups using relative consumption estimates if these become available.

The summer bottom temperature in the Bay of Fundy increased dramatically between 2010 and 2011. The median temperature prior to 2010 was 7.75 ºC but increased to 9.05 ºC thereafter. The increase in landings and survey abundance within the Bay of Fundy coincided with increases in summer temperatures. Further research on the relationship between temperature, Lobster productivity, and bioenergetics should be considered to better predict the changes in landings related to these factors.

The area occupied by Lobster as derived from survey catches provides an index of stock distribution. The area occupied by Lobster has been increasing since the mid-1990s and is currently high and stable. Further, the Gini index of patchiness decreased in the late 1990s and early 2000s and has been variable but low since. These indicators suggest that Lobster are increasing their overall habitat usage. The difference between time periods in the area occupied was more pronounced than the change in the Gini index, which suggests there is higher variability in Lobster catch rates despite being found in a broader range of habitats. Fishery patchiness represent the evenness of landings throughout the LFA. There was no trend in LFA 35 or 36 (Figure 5b). There was a decrease in the patchiness of landings between 2010 and 2012 in LFA 38, and again from 2016 to present.

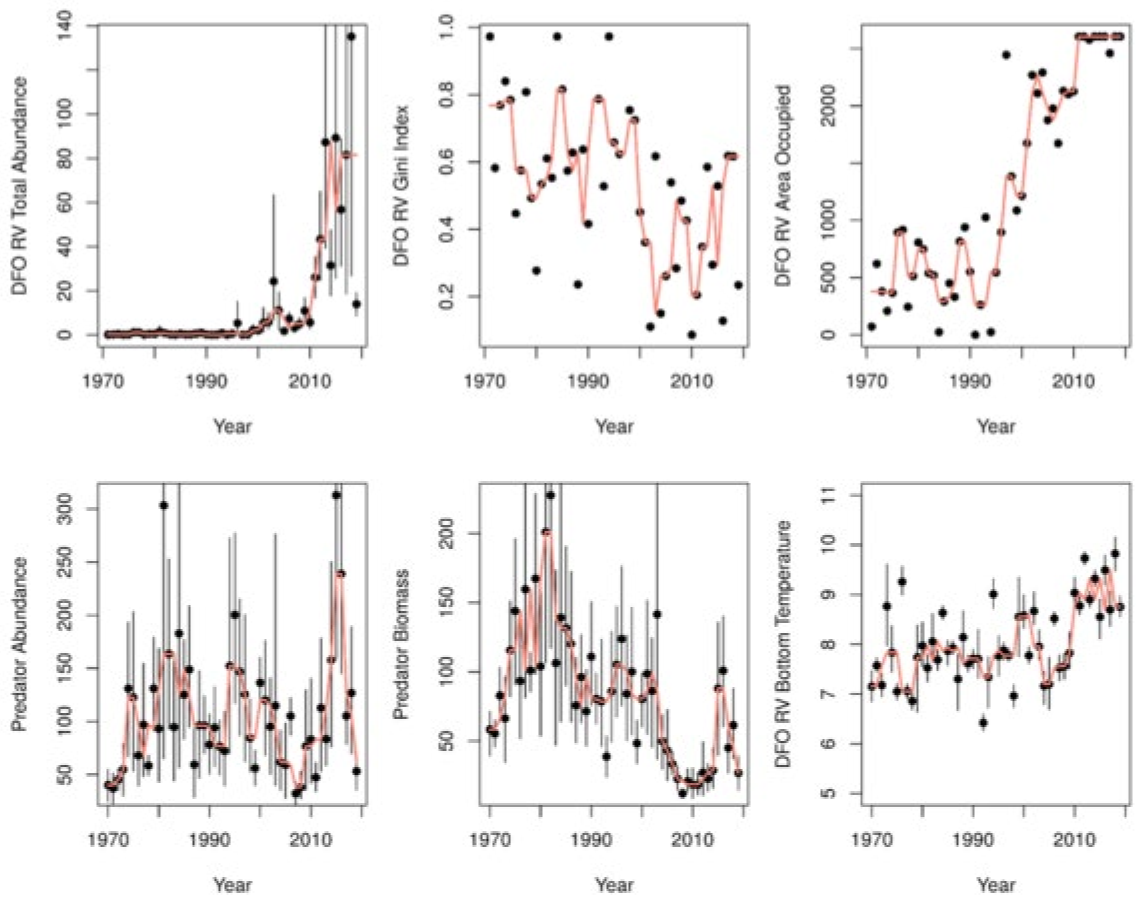


Figure 5a. Contextual indicators (clockwise from top-left): DFO Summer RV Survey total Lobster abundance, Gini Index, Area Occupied, bottom temperature, predator biomass, and abundance.

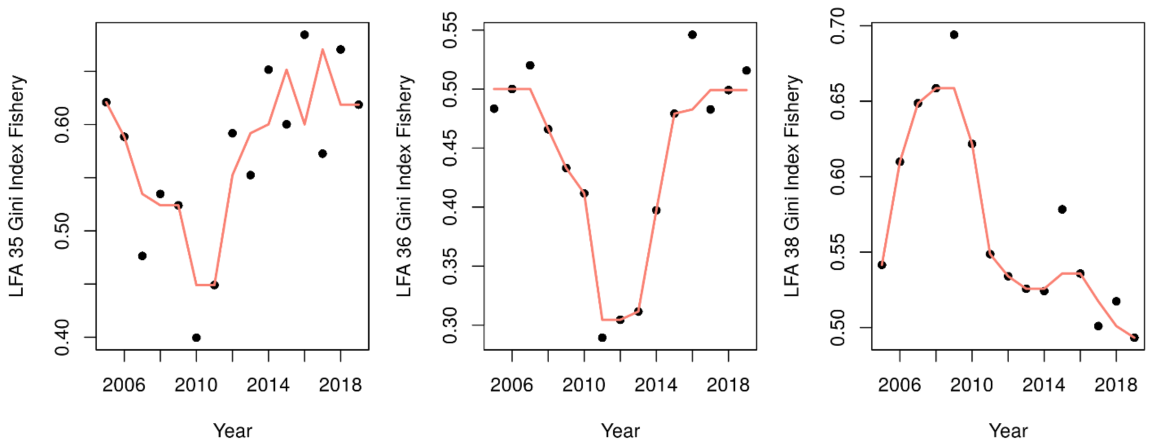


Figure 5b. Contextual indicators: Gini Index of Landings for LFA 35 (left), 36 (middle) and 38 (right).

Lobster Fishing Area 35

Catch Per Unit Effort

The CPUE trend indicates an increase in stock biomass occurred between 2005 and 2011 (Figure 6). The CPUE time series has remained high (more than twice the USR) since 2011. The 3-year running median for CPUE for the 2018 fishing season is 3.90 kg/TH, which is above the USR (1.62 kg/TH).

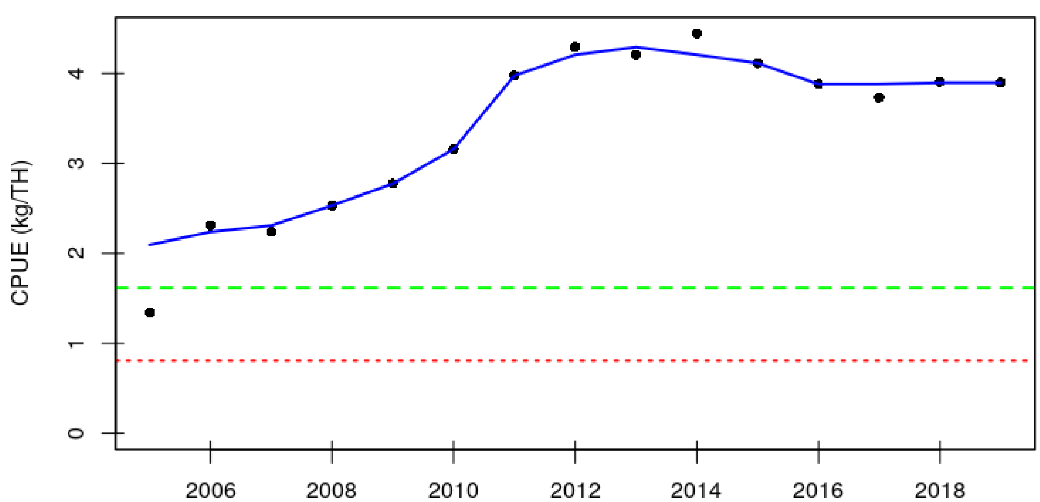


Figure 6. Time series of commercial catch rates (black line) for LFA 35, along with the 3-year running median (dashed blue line). The horizontal lines represent the upper stock (dashed green line) and limit reference point (dotted red line).

Landings and Effort

Between 1947 and 1984, landings in LFA 35 had a median of 134 t with a range of 75 to 184 t. Landings increased between 1984 and 1994 to a median of 250.5 t (range 226–330 t) and in 2014 landings increased to a record high of 3,941 t (Figure 7). Landings provides the longest data time-series for Lobster in the region. The potential effort (number of licences x trap limit x season length) has largely been consistent throughout much of the past 40 years; however, realized effort is increasing. The reported landings for the 2018–2019 season are 2,577 t. This does not represent a full accounting due to outstanding logs.

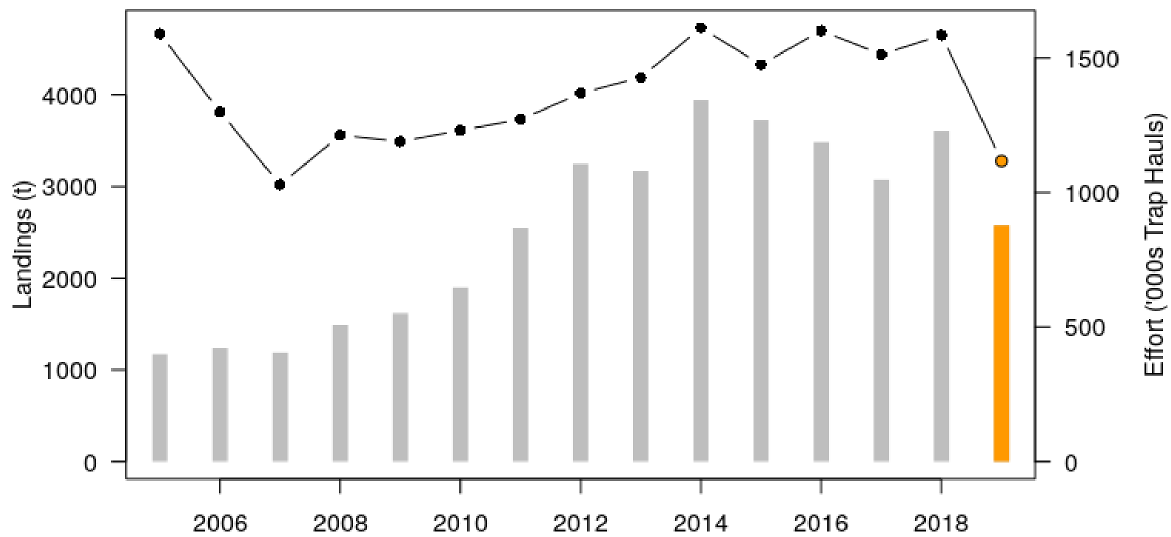


Figure 7. Time series of landings (bars) and effort (sold line with points) for LFA 35. The data for the 2018–2019 fishing season are incomplete (orange).

Scallop Survey Recruit Abundance

The abundance of Lobster recruits from DFO Scallop Survey tows within LFA 35 has been increasing in recent years (Figure 8). Prior to and post 2008, there are marked differences in the median abundance of Lobster, increasing from 14 to 35.4 Lobster/km^2.

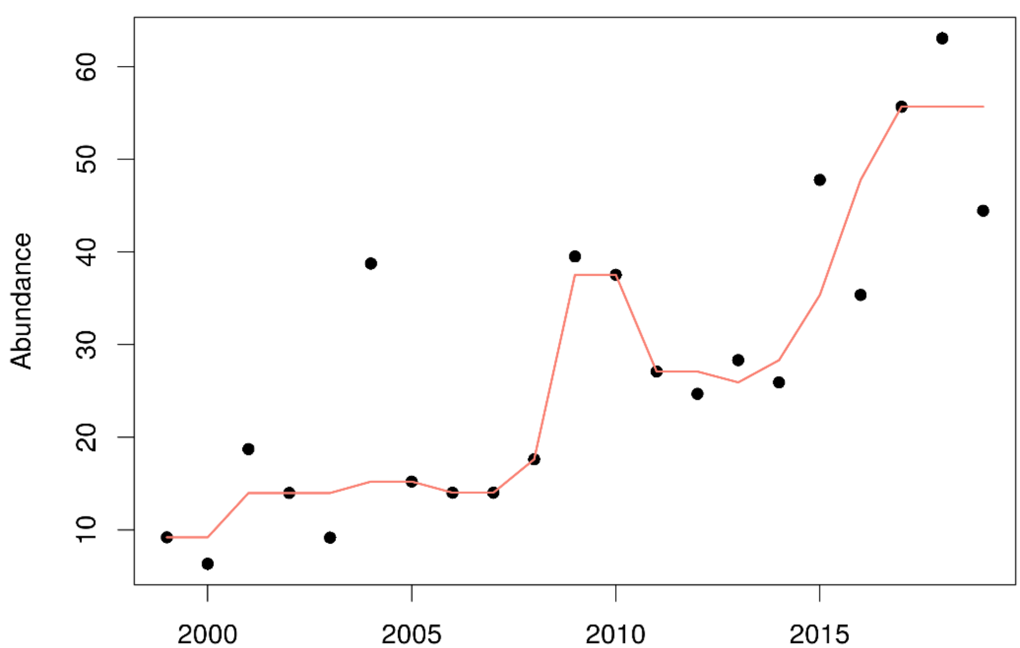


Figure 8. Time series of recruit abundance from the DFO Scallop Survey in LFA 35.

Lobster Fishing Area 36

Catch Per Unit Effort

The CPUE trend indicates an increase in stock biomass occurred between 2010 and 2013 (Figure 9). The CPUE time series has remained high (more than twice the USR) since 2013. The 3-year running median for CPUE for the 2018 season is 3.91 kg/TH, which is above the USR (1.36 kg/TH).

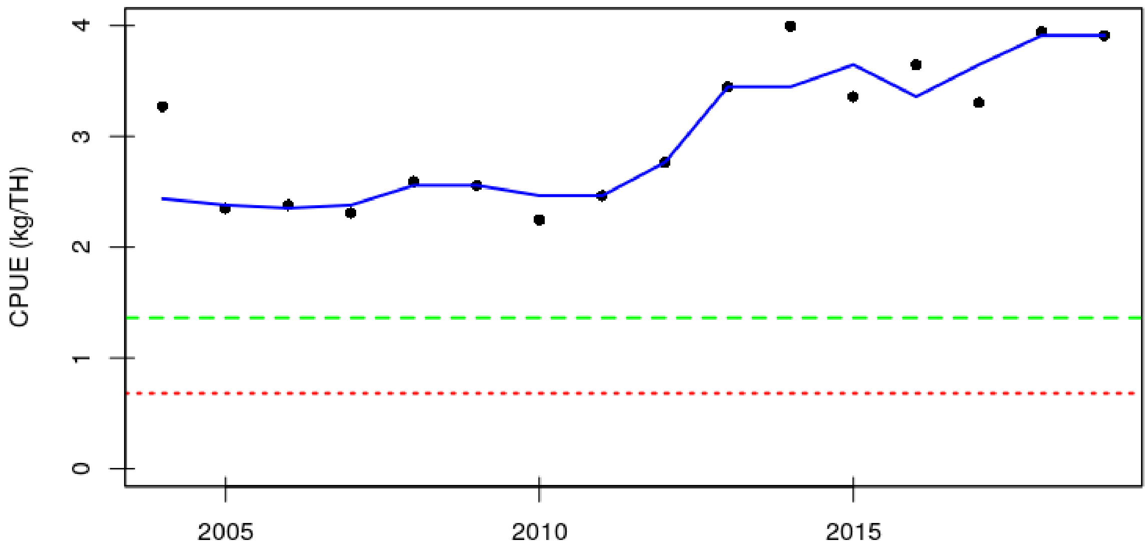


Figure 9. Time series of commercial catch rates (black line) for LFA 36, along with the 3-year running median (dashed blue line). The horizontal lines represent the upper stock (dashed green line) and limit reference point (dotted red line).

Landings and Effort

Between 1947 and 1980, landings in LFA 36 had a median of 227 t with a range of 47 to 338 t. Landings increased between 1981 and 1996 to a median of 268.5 t (range 156–427 t), and from 1997 to 2010 there was a steady increase in landings to a median of 1,594 t (Cook et al. In prep.)[1]. In recent years, landings in LFA 36 have more than doubled to a record high of 4,022 t in 2018 (Figure 10). Landings provide the longest data time-series for Lobster in the region. The potential effort (number of licences x trap limit x season length) has largely been consistent throughout much of the past 40 years; however, realized effort is increasing. The reported landings for the 2018–2019 season are 2,913 t. This does not represent a full accounting due to outstanding logs.

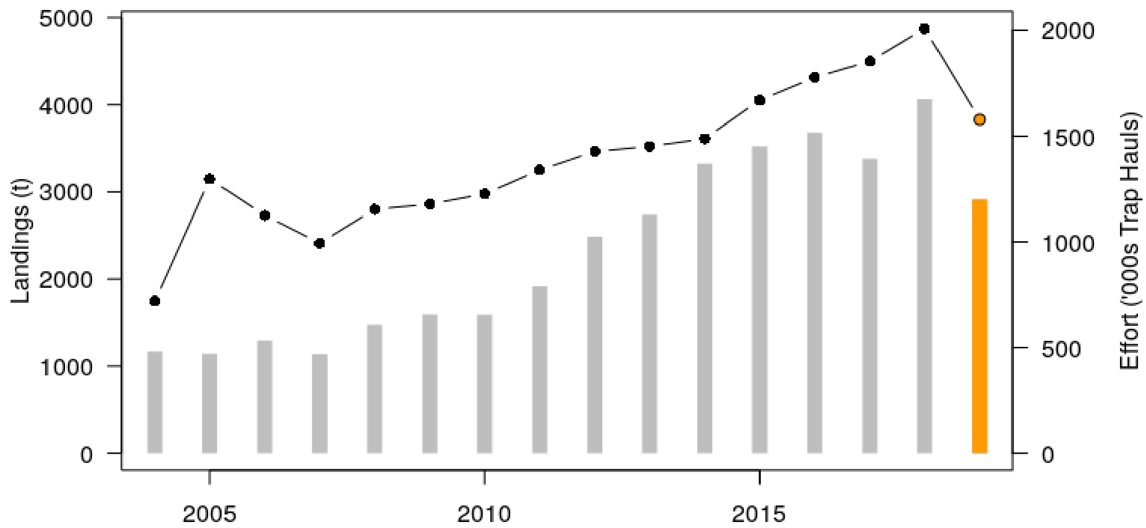


Figure 10. Time series of landings (bars) and effort (sold line with points) for LFA 36.

Scallop Survey Recruit Abundance

Between 1999 and 2005, the median abundance of Lobster recruits from DFO Scallop Survey tows within LFA 36 was 4.6 Lobster/km^2. Lobster recruit abundance increased from 2005 to 2010 and has been high and stable since 2011 with a median of 49.3 Lobster/km^2 (Figure 11).

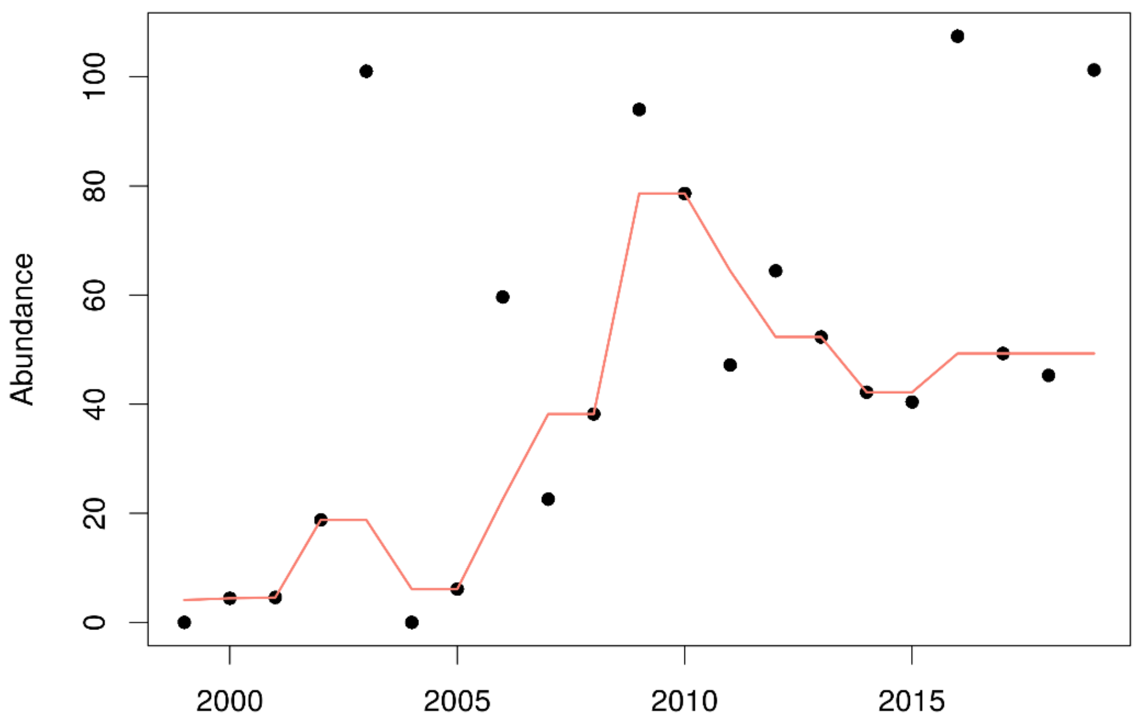


Figure 11. Time series of recruit abundance from the DFO Scallop Survey in LFA 36.

Lobster Fishing Area 38

Catch Per Unit Effort

The CPUE trend indicates an increase in stock biomass occurred between 2013 and 2014 (Figure 12). The CPUE time series has remained high (more than twice the USR) since 2014. The 3-year running median for CPUE for the 2018 season is 4.78 kg/TH, which is above the USR (1.91 kg/TH) and the LRP (0.95 kg/TH).

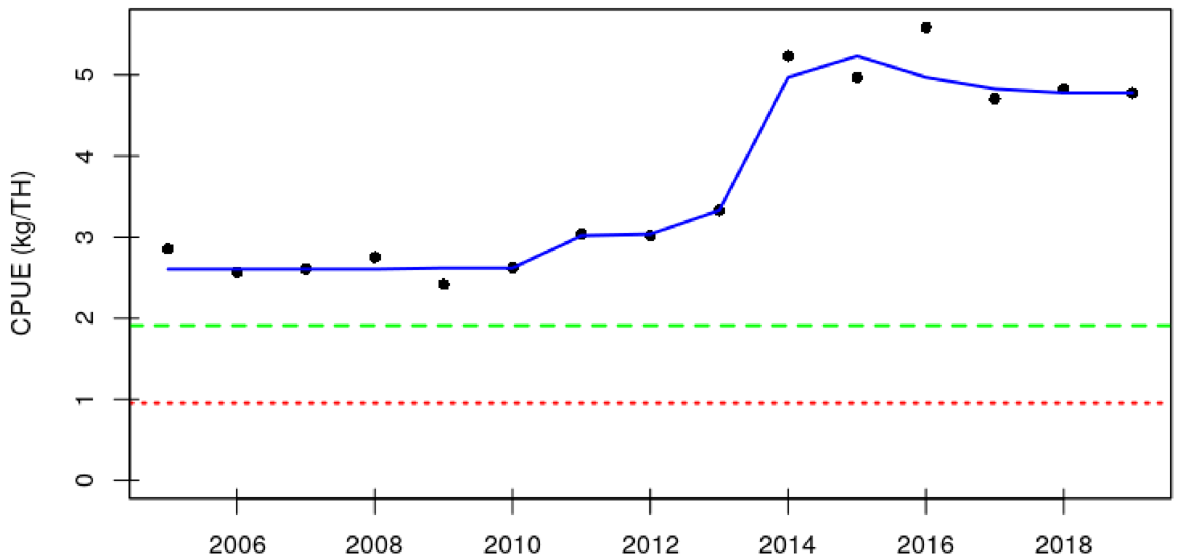


Figure 12. Time series of commercial catch rates (black line) for LFA 38, along with the 3-year running median (dashed blue line). The horizontal lines represent the upper stock (dashed green line) and limit reference point (dotted red line).

Landings and Effort

Between 1947 and 1988, landings in LFA 38 had a median of 325 t with a range of 170 to 450 t. Landings increased between 1989 and 1997 to a median of 512 t (range 467–661 t), and from 1997–2013 to a median of 2,682 t (Cook et al. In prep.)[1]. Landings in LFA 38 have more than doubled in recent years to a record high of 5,711 t in 2016 (Figure 13). Landings provides the longest data time-series for Lobster in the region. The potential effort (number of licences x trap limit x season length) has largely been consistent throughout much of the past 40 years; however, realized effort is increasing. The reported landings for the 2018–2019 season are 3,830 t. This does not represent a full accounting due to outstanding logs.

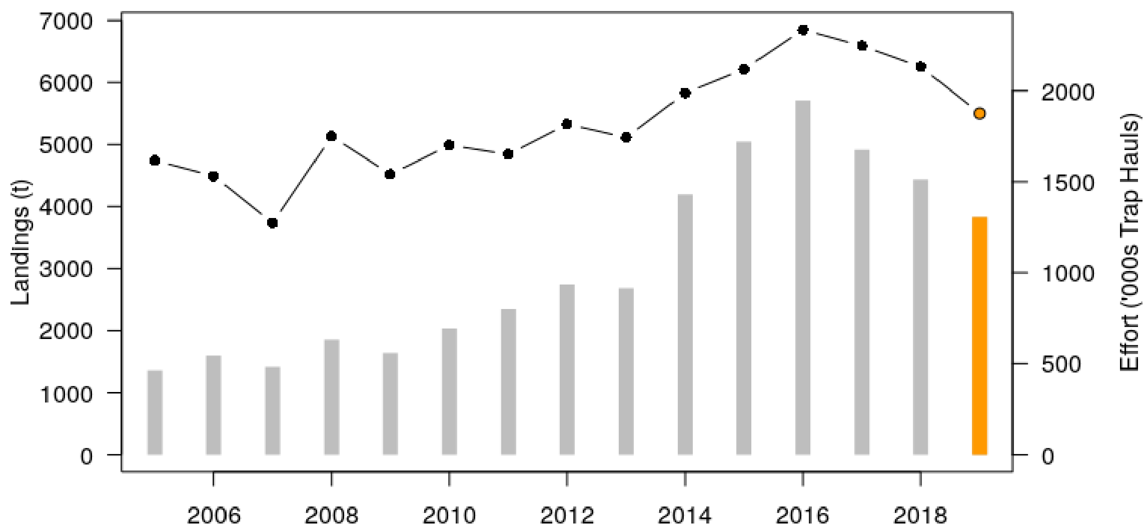


Figure 13. Time series of landings (bars) and effort (sold line with points) for LFA 38. The data for the 2018–2019 fishing season are incomplete (orange).

Scallop Survey Recruit Abundance

Between 1999 and 2008, the median abundance of Lobster recruits from DFO Scallop Survey tows within LFA 38 was 160 Lobster/km^2 between 1999 and 2008. This was followed by four years of high density (median 480 Lobster/km^2) and four years of a low density (median 239 Lobster/km^2) with the last two years having high abundance (median 444 Lobster/km^2, Figure 14). The DFO Scallop Survey provides information on Lobster recruitment through large portions of the LFA; however, changes in recruitment do not fully align with changes in commercial catch rates or landings.

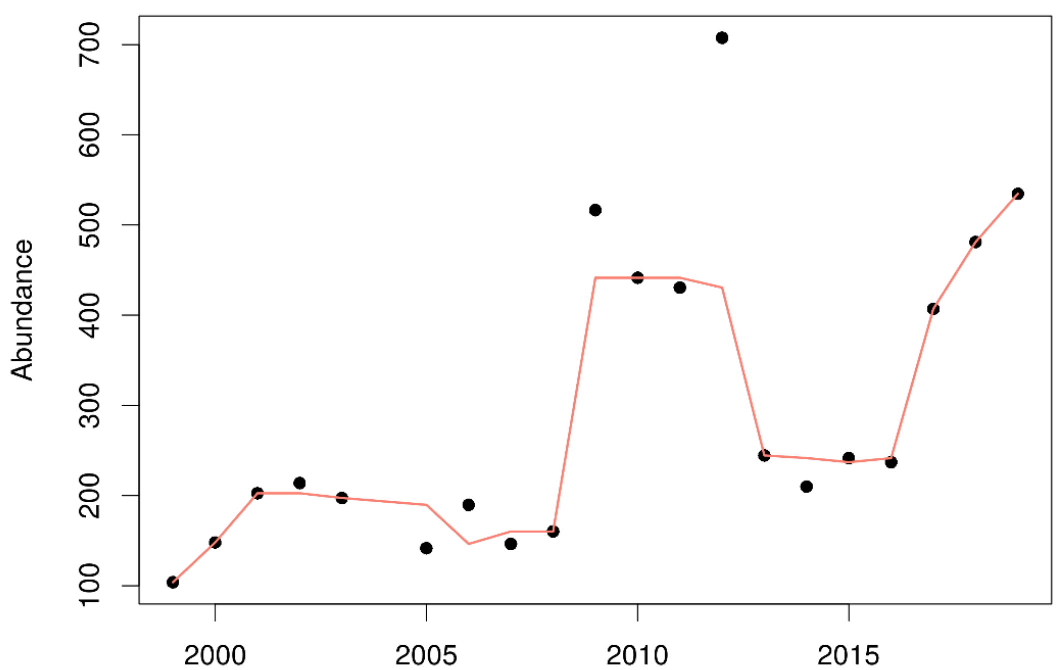


Figure 14. Time series of recruit abundance from the DFO Scallop Survey in LFA 38.

Sources of Uncertainty

The primary data sources for assessing Lobster stocks in LFAs 35–38 are collected from Lobster traps. Due to the passive nature of traps, the inferences on population processes are limited to the component of the stock retained by the traps. Catchability describes the relationship between total landings and the fishable biomass, and it is comprised of the availability of the species to the fishing gear and the selectivity of the gear. For Lobster traps, availability is dependent on the proximity of the animal to the gear, the behaviour of individuals, and their desire to enter traps. Numerous studies have suggested that Lobster are not available to traps at all times with factors such as water temperature, mating, and moult status being influential. Relying solely on trap data to assess stock status leads to uncertainties in trends over time. Obtaining a region-wide fisheries-independent data source would improve our confidence in describing stock status.

The assumption that the Lobster populations have been at or near carrying capacity during the monitoring period underlies the definition of reference points and stock status. Most time series suggest that the Lobster in LFAs 35–38 have been more productive over the last 15 years than previously recorded. It is uncertain if this level of productivity is sustainable into the future or if production will decrease. Applying productivity-based reference points make the definition of stock status more precautionary than if the full time series was used.

The impacts of predation pressure on Lobster is unknown; however, it was suspected to be a large component of mortality when groundfish were abundant. The influence of recovering groundfish, or the range expansion of other predator species into Lobster habitat, on future Lobster productivity is not known.

The impact of changing climate on Lobster biology, physiology, and phenology have been studied, but the long-terms effects are not known. Climate may be an important driver of population process in Lobster (Le Bris et al. 2017).

CONCLUSIONS AND ADVICE

The primary indicators show commercial biomass is at or near the highest in the time series in all areas. These LFAs have been determined to be in a high productivity period since 2011, and the median modelled CPUE between 2011–2018 was used as a proxy for carrying capacity. The current status of the Lobster stocks within each LFA is within the Healthy Zone.

Across these LFAs, there has been an increase in total, commercial, and recruit abundance since the early 2000s, particularly since 2010. These increases in relative abundance coincide with increasing bottom water temperatures in the area.

LIST OF MEETING PARTICIPANTS

Name	Affiliation
Brittany Beauchamp	DFO Science, Maritimes Region
Adam Cook	DFO Science, Maritimes Region
Verna Docherty	DFO Science, Maritimes Region
Lei Harris	DFO Science, Maritimes Region
Brad Hubley	DFO Science, Maritimes Region
Tara McIntyre	DFO Science, Maritimes Region
Sarah Quigley	DFO Science, Maritimes Region
Brian Guptill	Grand Manan Fishermen's Association
Denise McDonald	Sipekne’katik First Nation

Name	Affiliation
Vanessa Mitchell	Maritime Aboriginal Aquatic Resources Secretariate
Bonnie Morse	Grand Manan Fishermen's Association
Shannon Scott-Tibbetts	Fishermen and Scientists Research Society (FSRS)
Roger Sark	Maliseet Nation Conservation Council
Burton Shank	NOAA - National Marine Fisheries Service
Joseph Beland	Confederacy of Mainland Mi'kmaq, Mi'kmaw Conservation Group
Lillian Mitchell	Fundy North Fishermen's Association

SOURCES OF INFORMATION

This Report is from the Science Advisory Process held on October 1, 2019, Stock Assessment of American Lobster Fishing Area(s) (LFA) 34 and 35–38. 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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Center for Science Advice (CSA)
Maritimes Region
Fisheries and Oceans Canada
Bedford Institute of Oceanography
1 Challenger Drive, PO Box 1006
Dartmouth, Nova Scotia B2Y 4A2

Telephone: 902-426-7070
E-Mail: MaritimesRAP.XMAR@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

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