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Maritimes Region

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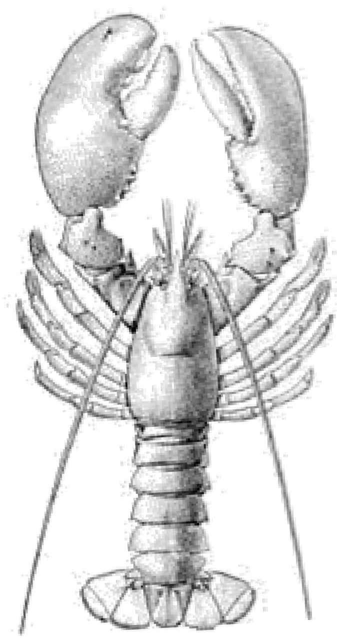
Science Advisory Report 2021/015

ASSESSMENT OF AMERICAN LOBSTER (*HOMARUS AMERICANUS*) IN LOBSTER FISHING AREA 34



American Lobster (Homarus americanus)

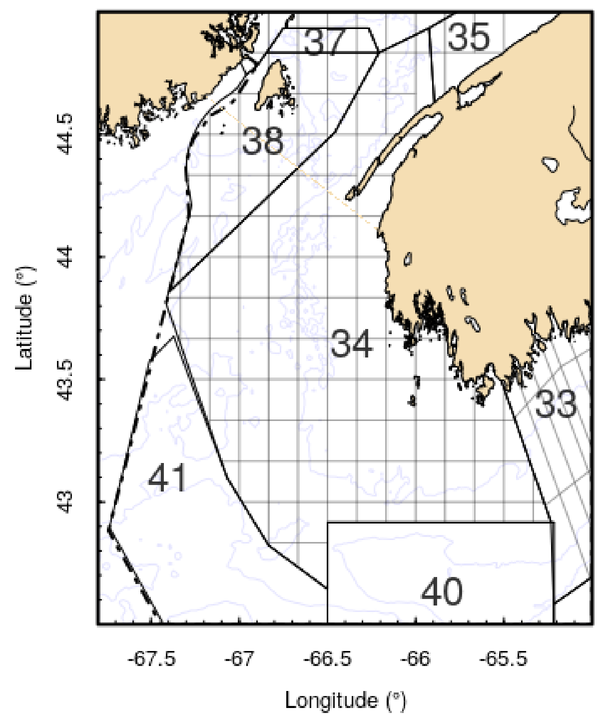


Figure 1. Map of Lobster Fishing Area (LFA) 34.

Context:

*Lobsters (*Homarus americanus*) are found in coastal waters from southern Labrador to Maryland, with some major fisheries in the Canadian Maritimes. Lobster Fishing Area (LFA) 34 covers 20,000 km^2 from southwestern Nova Scotia, north to the Bay of Fundy.*

The status of the Lobster resources in LFA 34 was last updated in 2018. Fisheries Management has requested updated information on the status of the LFA 34 Lobster stock. A meeting was held from September 10–11, 2019, to update the framework for the scientific basis for the provision of management advice for this stock.

This Science Advisory Report is from the October 2, 2019 regional peer review meeting on the Stock Status Assessment for American Lobster Fishing Area 34. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada (DFO) Science Advisory Schedule](#) as they become available.

SUMMARY

- The Lobster Fishing Area (LFA) 34 fishery is effort controlled, with restrictions on the season length, number of licences, number of traps per licence, minimum legal size, and retention of berried females.
- There has been nearly a 600% increase in landings since 1980. Landings peaked in the 2015–2016 season at 29,133 t. Reported landings for the 2018–2019 season are 19,232 t (incomplete due to outstanding logs).
- Primary indicators are used to define stock status in relation to reference points. The primary indicator for stock status, which describes the time-series trends relative to reference points, is commercial biomass from four fishery independent surveys. The exploitation indicator (relative fishing mortality) is derived from the survey commercial biomass and the landings.
- The primary indicators show exceptionally high commercial biomass since 2010. The indicators that have a longer time series (North East Fisheries Science Center [NEFSC] Spring and Fall surveys) show higher commercial biomass beginning in 2000. The Inshore Lobster Trawl Survey (ILTS) shows a modest decline in both commercial biomass and recruit abundance, in the last three years.
- Secondary indicators represent time-series trends that are tracked individually, without defined reference points. The secondary indicators for LFA 34 are the modelled Catch Per Unit Effort (CPUE) estimates, landings and total effort, and the recruit abundance time series from various sources (DFO Scallop Survey; DFO Maritimes Region Summer Research Vessel Trawl Survey; NEFSC Spring and Fall surveys; and recruitment trap project).
- The trend in CPUE indicates a steady increase in stock biomass since 2000. The 3-year running median for modelled CPUE for the first day of the 2018–2019 season was 3.11 kg/Trap Haul.
- Most recruit indices indicate increasing abundance since 2010, with one index, the ILTS, showing a decline in recruit abundance in the last three years.
- The current estimates for commercial survey biomass are above their respective upper stock indicators for all 4 of the surveys (2 of 4 required) and, therefore, the stock is considered in the Healthy Zone.
- Relative fishing mortality is below the removal indicator in all four survey indices; therefore, overfishing is not occurring.

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 or 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 lobsters 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 lobsters 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 1 moult per year at about 0.45 kg to moulting every 2 or 3 years for lobsters above 1.4 kg (Aiken and Waddy 1980).

Lobsters 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 varies 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 34–38, 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 Lobster Fishing Area (LFA) 34–38, 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 lobsters produce eggs every second year with a moult in intervening years. Based on laboratory studies using ambient inshore Bay of Fundy water temperatures, female lobsters 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). 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 lobsters 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 lobsters 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 animals.

Fishery

The inshore commercial fishery for American Lobster has been active for over 150 years in LFA 34. This area covers 20,000 km^2 from southwestern Nova Scotia, north to the Bay of Fundy (Figure 1). The fishery is prosecuted throughout the LFA with both inshore and offshore components.

Lobster Fishing Area 34 accounts for 20% of Canadian landings and 10% of North American Lobster in each of the last several years, producing approximately 20,000–25,000 t of landed lobster. This fishery is effort controlled, with restrictions on the season length, number of licences, number of traps per licence, MLS, and retention of berried females. The landings in LFA 34 for the last five fishing seasons are presented in Table 1.

Table 1. Landings and number of licences (as of Dec 31) for recent fishing seasons in LFA 34.

Season	Landings (t)	Number of Licences
2014–2015	24,148	979
2015–2016	29,133	979
2016–2017	22,684	979
2017–2018	23,955	979
2018–2019[1]	19,232	979

[1]Not all logs were submitted for the 2018–2019 fishing season when this report was produced. Approximately 7.7% of logs were outstanding as of September 23, 2019.

ASSESSMENT

Stock Status Indicators

This stock assessment applies the methods and the primary, secondary, and contextual indicators presented at the 2019 Framework Assessment (Cook et al. 2020). These indicators provide a snapshot of the status of the LFA 34 Lobster stock and ecosystem.

Primary indicators are used to define stock status in relation to reference points, defined in Cook et al. 2020). Secondary indicators are those in which time-series trends are displayed but do not have reference points. The contextual indicators may describe additional population and ecosystem characteristics that were examined as part of this assessment, but they are not presented in annual updates.

The data available for establishing indicators for LFA 34 come from both fishery-dependent and independent sources. Fishery-dependent data include commercial logbooks that report information on date, location (grid), effort, and estimated catch. The Fishermen and Scientists Research Society (FSRS) are contracted to conduct a recruitment trap project involving volunteer fishermen who record lobsters captured in standardized traps. The traps are designed to retain both legal-size and sub-legal-size lobsters. The fishery-independent data sources include the DFO Maritimes Region Summer Research Vessel Trawl Survey (DFO RV Survey), the Northeast Fisheries Science Center (NEFSC) bottom trawl surveys conducted in spring (March–May) and fall (September–November), the Inshore Lobster Trawl Survey (ILTS), and the DFO Scallop Survey in Scallop Fishing Area (SFA) 29 that covers part of LFA 34. Although initially designed to monitor the abundance of different species (groundfish and scallop), these surveys have recorded and measured lobsters caught and serve as fishery-independent indicators of Lobster abundance in the areas they cover.

Primary Indicators

In LFA 34, the primary indicator for stock status, which describes the time-series trends relative to reference points, is commercial biomass from four fishery-independent surveys. There is also an exploitation indicator (Relative *F*) derived from the survey-commercial biomass and the landings.

As multiple surveys are available, the methods employed in Cook et al. (2017) were used to define reference indicators and reference points (Table 2). Stock status will be a combined result across survey indices, relative to the respective Limit Reference Indicator (LRI) and Upper Stock Indicators (USIs). For each index, the USI was defined by using the median commercial biomass during the high-productivity period as a proxy for carrying capacity *K* and setting it equal to 40% of *K*. The LRI was defined as the median of the 5 lowest non-zero biomasses from which the stock has rebuilt. The Removal Indicator (RI) is defined as the median exploitation rate during the low-productivity period. The transition from a healthy stock status to a cautious stock status (i.e., below the Upper Stock Reference [USR]) would require 3 of 4 survey biomasses to fall below the respective USIs. Similarly, to enter the Critical Zone (i.e., below the Limit Reference Point [LRP]) would require 2 of 4 survey biomasses to fall below respective LRIs. Overfishing will be considered to have occurred when 3 or more of the RIs have been exceeded for their respective stock status zone.

Table 2. Description of the Upper Stock Reference (USR) and Limit Reference Point (LRP) for LFA 34.

Zone	Reference Points	
Healthy	USR	2 or more survey biomasses are above their respective USIs
Cautious	-	3 or more survey biomasses are below their respective USI and above their respective LRI; or
		2 survey biomasses are above their respective USIs and 2 survey biomass are below their respective LRIs; or
		1 survey biomass above its respective USI, 1 survey biomass below its respective LRI, and 2 survey biomasses between their respective USIs and LRIs
Critical	LRP	2 or more survey biomasses are below their respective LRIs

Survey Commercial Biomass

Commercial biomass was defined as individuals available to the fishable component, i.e., ≥ 82.5 mm CL, and excluded berried females. The commercial biomass from spring and summer surveys represents the individuals remaining, following the commercial fishery. The commercial biomass from the fall survey was considered post moult (i.e., just moulted into this size class) and would be part of the fishery during the upcoming season. In LFA 34, the size-at-50% maturity (SoM) is greater than the MLS for the fishery (Gaudette et al. 2014), indicating significant proportions of the overall stock have not matured or spawned prior to becoming available to the fishery. The survey indices of commercial-size lobsters in spring and summer represent the individuals that would moult to the mature size class and become part of the spawning stock. Ensuring sufficient biomass of spawners is key to population persistence. Commercial biomass relates to both the fishable biomass and those commercial-size individuals remaining in the spring and summer surveys that will likely enter the spawning component during their summer moult.

Indices from trawl survey data have the advantage that they do not rely on individual behaviour or other external factors in order to attract and capture lobster; however, bottom-contacting mobile gears do not sample all habitats where lobster reside. This is evident in the years where the surveys did not report the capture of any lobster (1970s), despite significant landings in the commercial fishery.

In LFA 34, multiple trawl surveys are conducted by several agencies using different trawl gear types. This provides the opportunity to examine the temporal patterns across the different time series. Dynamic factor analyses showed that several of the surveys displayed similar patterns of abundance, biomass, and distributional changes; this provides confidence in selecting this type of data as the basis of the stock assessment (Cook et al. 2020).

The time-series trends in abundance or biomass of several size classes of Lobster were examined across the multiple surveys. From each of these surveys, two time trends were often identified, each showing a dramatic increase in recent years. This increase was also seen in the commercial catch-rate data, as well as the total landings. Given the relatively constant effort in the fishery, it has long been presumed that landings are proportional to total abundance. There was supporting evidence from the indicators of distribution and patchiness suggesting that Lobster in LFA 34 were more evenly distributed across a much broader range of habitats than previously reported.

The ILTS Survey shows that commercial biomass in LFA 34 was exceptionally high between 2010–2017. The last two years have shown a decline in commercial biomass, but it still remains high relative to the full time series (Figure 2). The DFO RV Survey indicates a similar pattern, but it has been more variable in recent years (Figure 3).

The NEFSC Spring Survey commercial biomass index was relatively stable up until 2000, when it underwent a rapid increase, and has remained fairly high (Figure 4). The NEFSC Fall Survey commercial biomass index was similar to the NEFSC Spring Survey index but with more variability in the recent period (Figure 5).

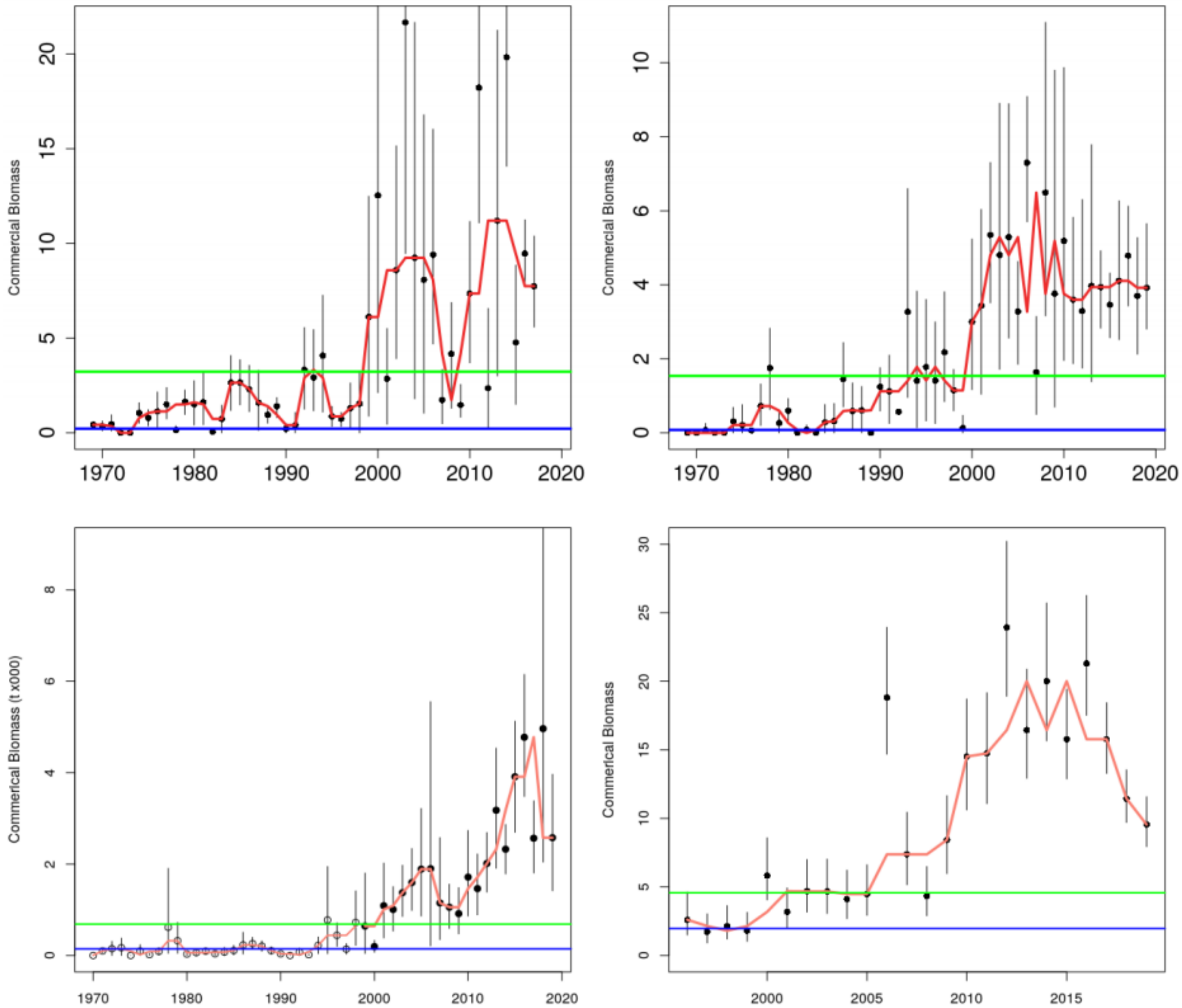


Figure 2. Commercial biomass estimates from the NEFSC Spring Survey (upper left), NEFSC Fall Survey (upper right), DFO RV Survey (lower left), and ILTS (lower right) in LFA 34. The red line is the 3-year running median. The green line represents the Upper Stock Indicator and the blue line represents the Limit Reference Indicator within each figure.

Relative Fishing Mortality

Relative fishing mortality (*relF*) uses the survey commercial biomass estimates and landings to show the changes in removals (C_t) relative to the *j* survey indices (I_{jt}).

$$relF_{jt} = \frac{C_t}{I_{jt}}$$

As the DFO RV Survey, the ILTS, and the NEFSC Spring Survey occur 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*. By using the time series of *relF,* the level of fishing pressure the stock has experienced can be examined (Figure 3).

There were substantial increases in the biomass of commercial Lobster throughout the time series. The survey indices of commercial biomass increased at a rate faster than the landings, indicating a decrease in exploitation in recent years.

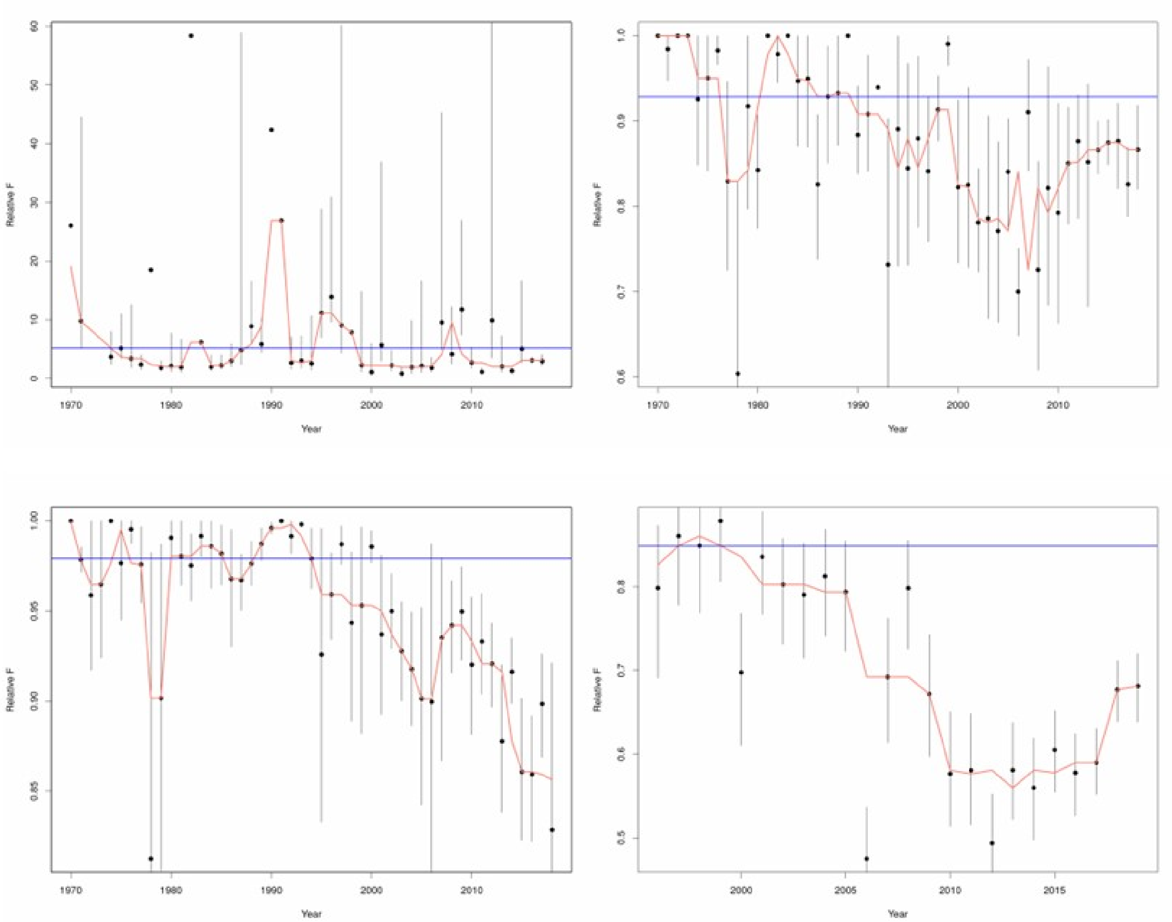


Figure 3. Relative fishing mortality (Relative F) from the trawl survey commercial biomass estimates and the landings. Clockwise from top left, figures represent NEFSC Fall, NEFSC Spring, ILTS, and DFO RV surveys, respectively. The blue line represents the Removal Reference Indicator for each respective survey.

Secondary Indicators

Secondary indicators represent time-series trends that are tracked individually, without defined reference points. The secondary indicators for LFA 34 are the modelled Catch Per Unit Effort (CPUE) estimates, landings and total effort, recruit abundance time series from various sources including the Scallop and RV surveys (DFO, NEFSC Spring and Fall), as well as standardized recruitment traps.

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. This is especially important in effort-controlled fisheries. However, catch rates vary during the fishing season due to changes in biomass and catchability; this can be accounted for in catch-rate models. Biomass, the underlying process behind this indicator, changes over time as lobsters recruit to the fishery (usually between seasons when moulting occurs) and during the season as lobsters 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 that the annual catch-rate index reflects changes in biomass and not catchability. Commercial catch rates were modelled with generalized linear models. The weight reported in each log record was log-transformed and offset by the log of the Trap Hauls (TH) 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.

The CPUE index indicates increasing abundance in recent years; however, it is somewhat less pronounced than uncorrected values because temperature has been higher in recent years. The trend in CPUE indicates a steady increase in stock biomass since 2000 (Figure 4). The 3-year running median for modelled CPUE for the first day of the 2018–2019 season was 3.11 kg/TH.

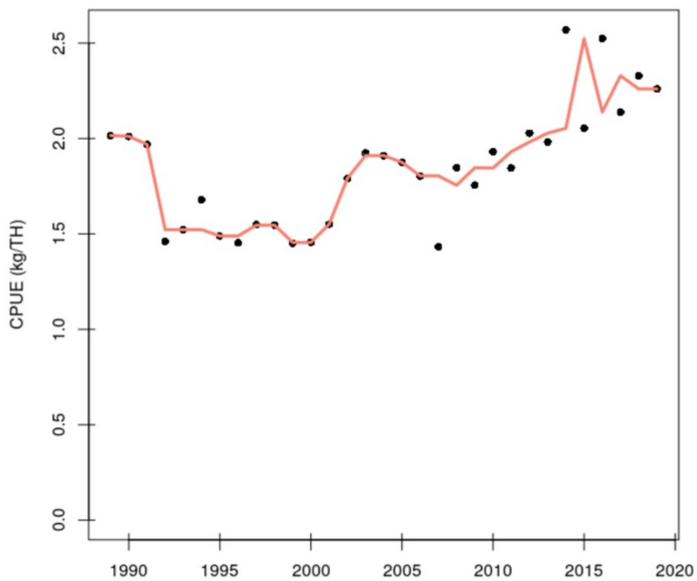


Figure 4. Time series of commercial catch rates for LFA 34, along with the 3-year running median (red line).

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 and 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. The effort trends in LFA 34 show an increasing trend over the past 25 years, albeit at a slower rate than the landings increase (Figure 5). Fishing effort, recorded as the number of THs in the lobster fishery, is controlled by fishing season length, trap limits, and limited number of fishing licences. Consequently, there is a maximum fishing effort that can be deployed; however, this maximum is never met because 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. Prior to the widespread adoption effort of mandatory logbooks, total fishing effort was calculated from CPUE and total catch.

Landings provide the longest time series of data available for Lobsters in the region. The nominal effort (number of licences x trap limit x days fished) has largely been consistent throughout much of the past 40 years. Historical landings in LFA 34 between 1897 and 1980 had a median of 3,266 t with a range of 857 to 7,563 t (Cook et al. 2020). There has been nearly a 600% increase in landings since 1980, which in the last 10 years has a median landings of 23,043 t with a range of 17,262 to 29,133 t (peak in 2015–2016). The reported landings for the 2018–2019 season are 19,232 t. This does not represent a full accounting due to outstanding logs (Table 1).

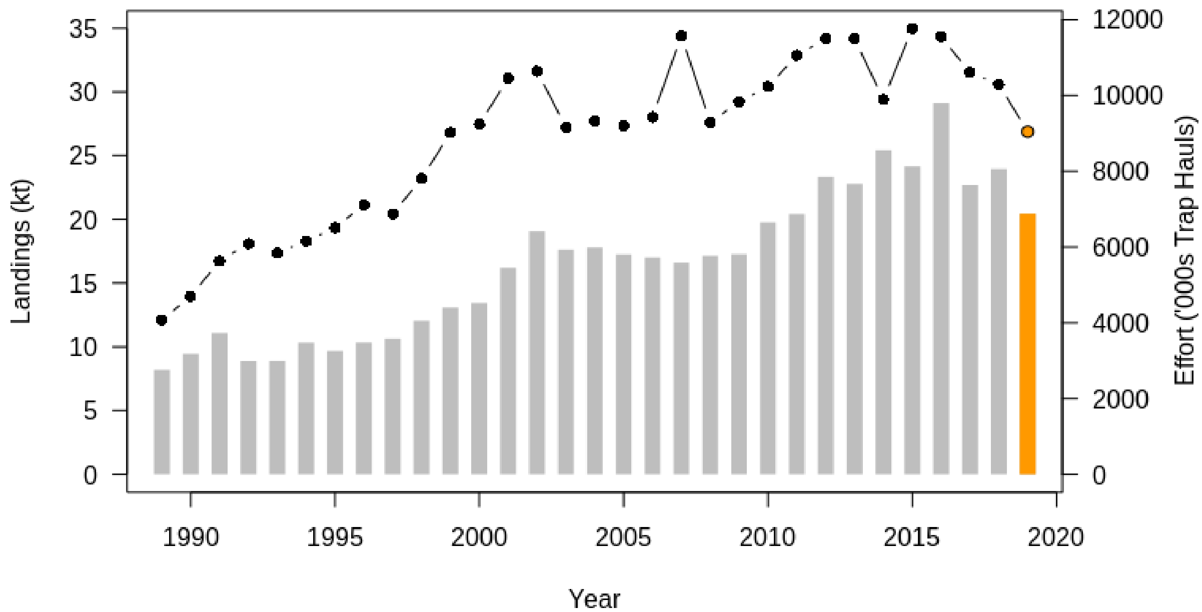


Figure 5. Time series of landings (bars) and effort (solid line with points) in LFA 34.The data for the 2018–2019 fishing season is incomplete (orange).

Survey Recruit Abundance

Recruits were defined as individuals between 70 and 82 mm, assuming these individuals would moult into the fishable component of the stock. The abundance of recruits from spring and summer surveys were considered in a premoult stage and, therefore, would be entering the fishery in the fall of the same year. The recruits from the fall surveys were considered post moult (i.e., just moulted into this size class) and would be entering the fishery in the following year. The fall surveys were lagged one year in order to make trends comparable. As > 80% of landings in the inshore lobster fishery consists of newly-recruited lobsters and exploitation rates are very high (Cook et al. 2020), this indicator constitutes an important component of the lobster stock and fishery.

The survey recruit-abundance indicator is presented as six different time series from the available data sources: ILTS, DFO RV Survey, NEFSC Spring Survey, NEFSC Fall Survey, and DFO Scallop Survey, as well as the standardized recruitment trap project (Figure 6). Presently, only the ILTS adequately covers the total area, but collectively the six indices provide valuable information on recruit abundance. Most recruit indices indicate increasing abundance since 2010. The ILTS indicates a decline in recruit abundance in the last three years.

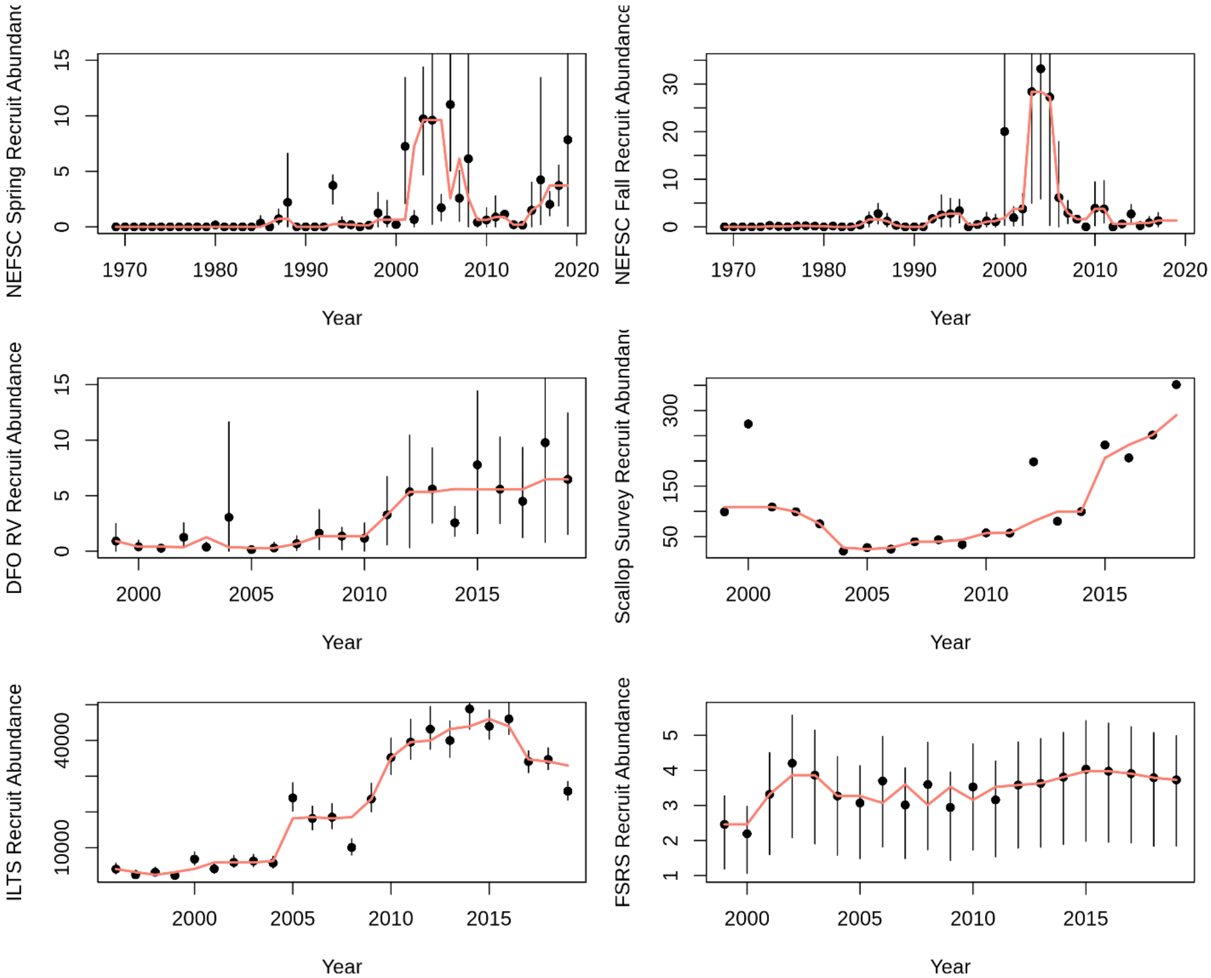


Figure 6. Time series of recruit abundance in LFA 34 from various surveys. Clockwise from top left NEFSC Spring Survey, NEFSC Fall Survey, Scallop Survey, Recruitment Trap Survey, ILTS, and DFO RV Survey. The red line is the 3-year running median. Where appropriate, bars within each plot represent confidence intervals.

Contextual Indicators

The contextual indicators, presented in Figure 7, for LFA 34 are:

- Total Lobster abundance from the DFO RV Survey, NEFSC Spring Survey, and NEFSC Fall Survey.
- Average bottom temperature from the DFO RV Survey, NEFSC Spring Survey, and NEFSC Fall Survey.
- Design weighted area occupied from the DFO RV Survey, NEFSC Spring Survey, and NEFSC Fall Survey.
- The Gini index from the DFO RV Survey, NEFSC Spring Survey, NEFSC Fall Survey, and fishery.
- Predator abundance and biomass from the DFO RV Survey.

Total Lobster-abundance indices show trends similar to the primary and secondary indicators of commercial biomass and recruit abundance They represent the longest time series of data from multiple surveys

Bottom temperature trends of observed data in LFA 34 show strong levels of inter-annual variability. The three time series used here represent spring, summer, and autumn surveys and, therefore, provide a broader picture of the within-year trends than any survey alone. Survey data indicate a pulse of warm temperatures during the early 1980s, a decline during the early 1990s, and a consistent increasing trend in temperature since the mid-1990s.

The area occupied by Lobsters captured within the surveys provides an index of the distribution of the stock. Typically, as abundance increases, optimal habitat becomes fully utilized and the stock becomes more widely distributed. For species with strong affinity to specific habitats, regions of high localized biomass may remain as the stock is increasing or decreasing, resulting in patchy distributions. It is important to consider both area occupied (total distribution) and the patchiness of the distribution to better understand the stock dynamics. Across the three surveys beginning in 1969–70, an increasing trend is apparent in the area occupied. This suggests that Lobsters occupy more habitat than in earlier periods. Fishery patchiness represents the evenness of landings throughout the LFA. In LFA 34, since 2010, the distribution of Lobster landings has become more uniform across the LFA. This information, coupled with the increased overall landings, suggests that they are not only increasing in abundance in localized areas, but are broadening their habitat usage.

Predator abundance and biomass was estimated using the DFO RV Survey series. In LFA 34, predator biomass has decreased since the early 1990s, whereas the abundance has shown less of an overall trend. The pulses of incoming recruitments of 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 metrics. This indicator would be strengthened by weighting the predator species and size groups using relative consumption estimates when available.

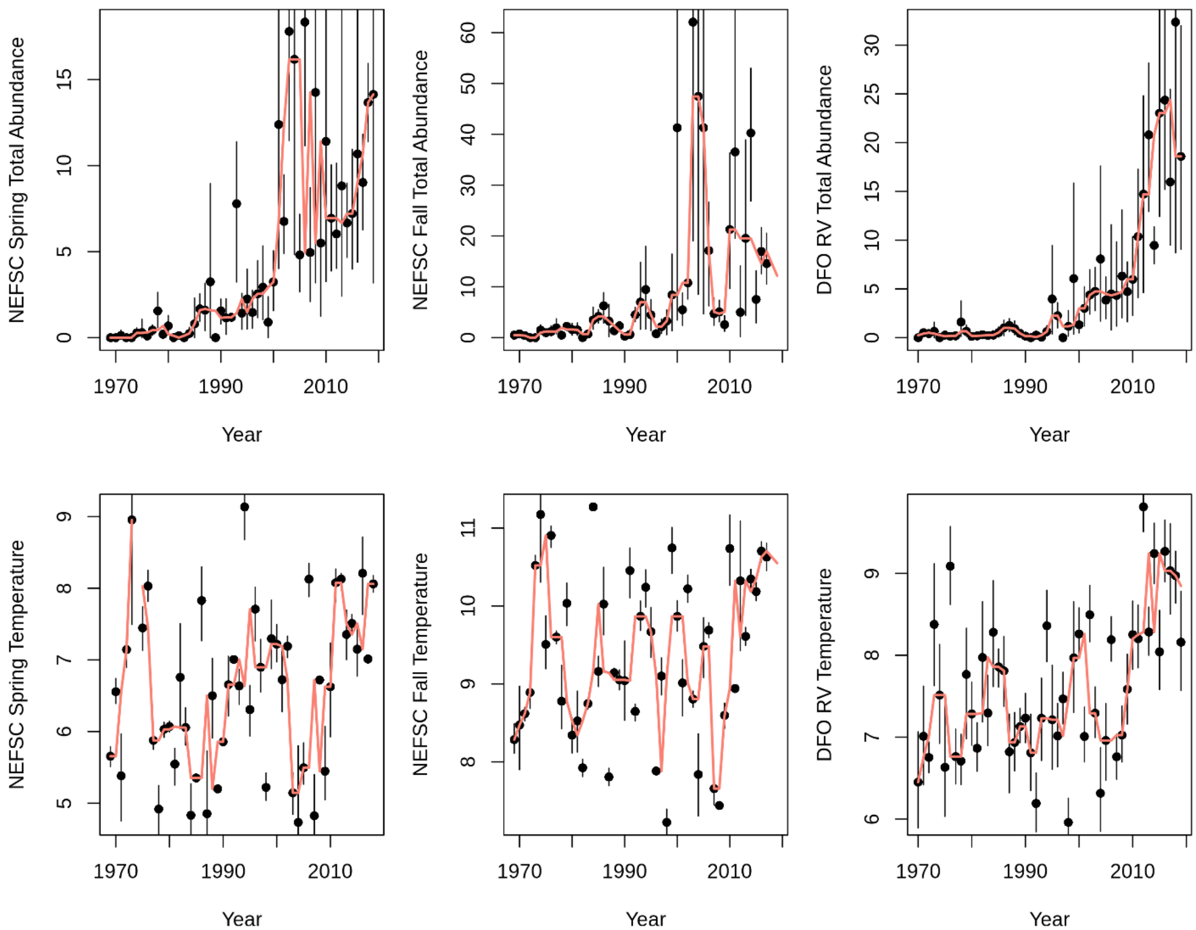


Figure 7a. Contextual indicators: Total lobster abundance from NEFSC Spring Survey, NEFSC Fall Survey, and DFO RV Survey. Bottom temperature from NEFSC Spring Survey, NEFSC Fall Survey, and DFO RV Survey. The red line represents the 3-year running median.

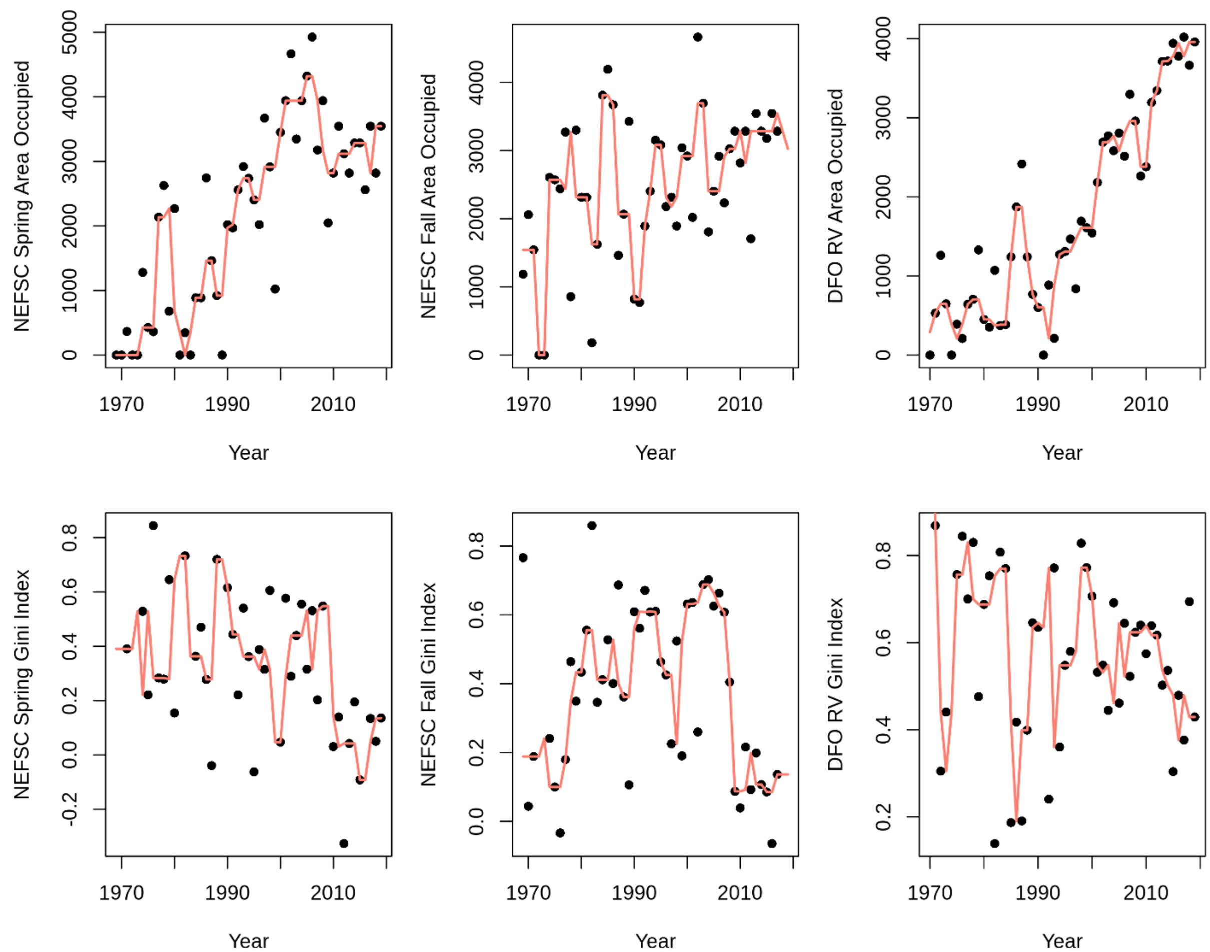


Figure 7b. Contextual indicators: Design weighted area occupied from NEFSC Spring Survey, NEFSC Fall Survey, and DFO RV Survey. Gini index from NEFSC Spring Survey, NEFSC Fall Survey, and DFO RV Survey. The red line represents the 3-year running median.

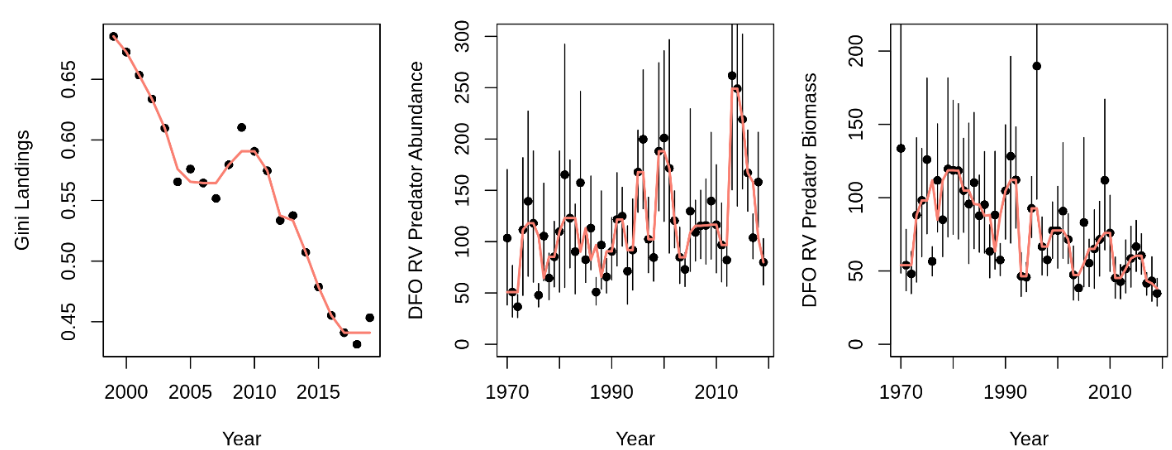


Figure 7c. Contextual indicators: Gini index from fishery landings, predator abundance, and predator biomass from DFO RV Survey. The red line represents the 3-year running median.

Sources of Uncertainty

The assumption that the LFA 34 Lobster stock has been at, or near, carrying capacity during the monitoring period underlies the definition of reference points and stock status. Most time series suggest that Lobster in LFA 34 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 the productivity-based reference points makes 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-term effects are not known. Climate may be an important driver of population processes in Lobster (Le Bris et al. 2018).

Availability of lobster to survey trawl gear varies with abundance, as the gear is not always able to sample preferred lobster habitat. As abundance increases, lobsters spread out to less preferred habitat where they are more susceptible to the survey trawl gear. This is evident in the years when the surveys did not report the capture of any Lobster (1970s) despite significant landings in the commercial fishery.

CONCLUSIONS AND ADVICE

The primary indicators show exceptionally high commercial biomass since 2010. The indicators that have a longer time series (NEFSC Spring and Fall) show higher commercial biomass, beginning in 2000. The ILTS shows a modest decline in both commercial biomass and recruit abundance, in the last three years. Applying the proposed reference indicators to the running medians of the survey and *relF* trends can be seen in the phase plots found in Figure 8. Combining these reference indicators to define the stock status can be done through the examination of these plots. The current estimates for commercial survey biomass are above their respective USIs for all 4 surveys (2 of 4 required) and, therefore, the stock is considered to be in the Healthy Zone. Furthermore, as the *relF* is below the removal indicator in all four survey indices, overfishing is not occurring. Through these phase plots it can be inferred that the stock was in the Cautious Zone between 1970 and 1999, relative to current productivity, as all 4 surveys fell below their respective USIs. Since 1970, LFA 34 has never been in the Critical Zone, and overfishing has only occurred during several short periods in the 1970s and 1980s.

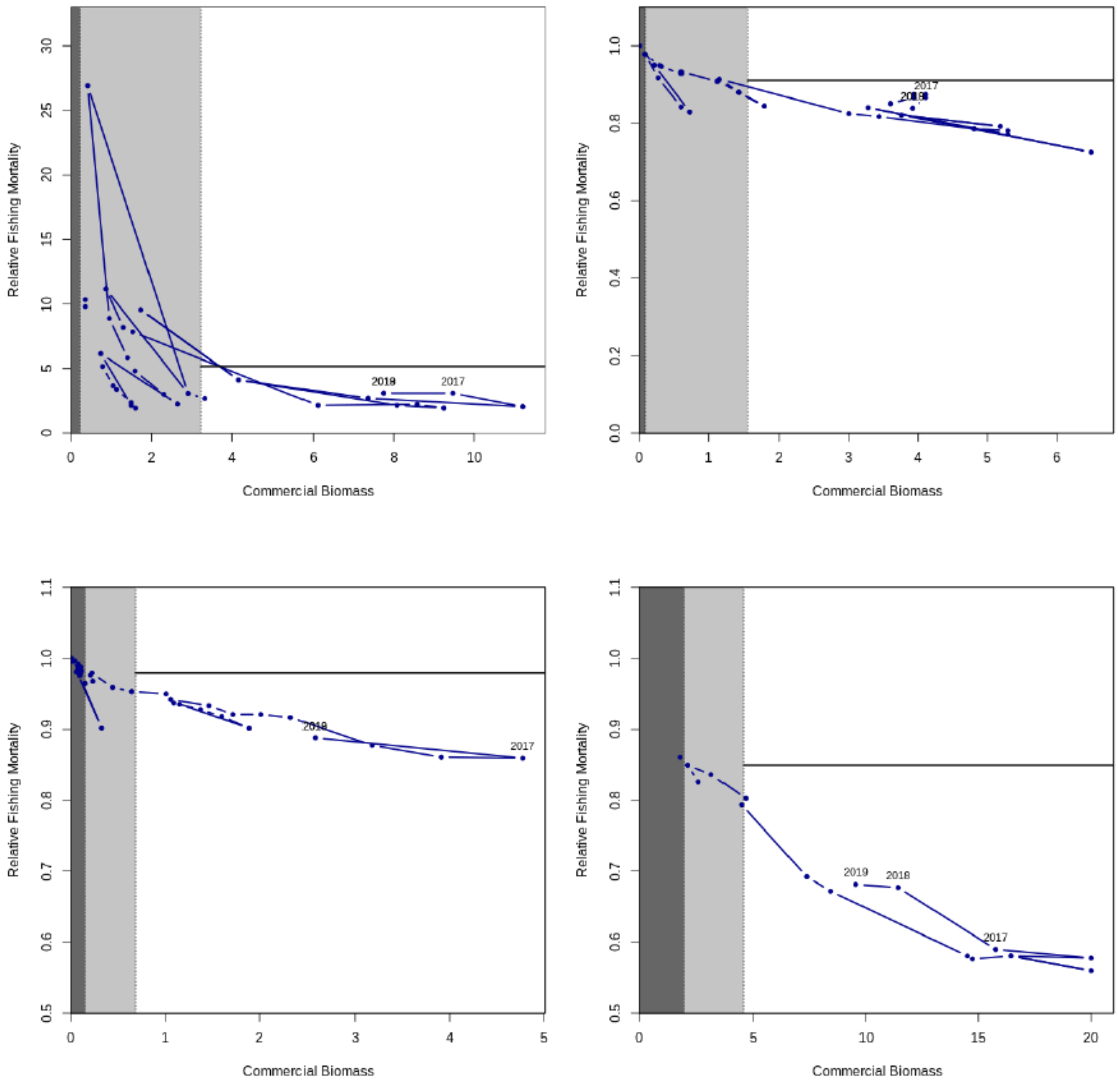


Figure 8. Phase plots of the running median of commercial biomass and relative fishing mortality. Clockwise from top left – NEFSC Fall Survey, NEFSC Spring Survey, ILTS, and DFO RV Survey. Within each plot, the last three year's data points are labelled with the year. The Removal Indicator is the horizontal line in the non-shaded area, the Limit Reference Indicator is represented by the line between dark and light shading, and the Upper Stock Indicator is represented by the line between light shading and no-shading.

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Joseph Beland	Confederacy of Mainland Mi'kmaq Conservation Group
Lillian Mitchell	Fundy North Fishermen's Association

SOURCES OF INFORMATION

This Science Advisory Report is from the October 2, 2019 regional peer review meeting on the Stock Status Assessment for American Lobster Fishing Area 34. 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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