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Canadian Science Advisory Secretariat
Maritimes Region **Science Response 2021/018**

STOCK STATUS UPDATE FOR AMERICAN LOBSTER (*HOMARUS AMERICANUS*) IN LOBSTER FISHING AREA 34 FOR 2020

Context

Advice on the stock status of American Lobster (*Homarus americanus*) in Lobster Fishing Area (LFA) 34 is requested annually by Fisheries Management. The last assessment of this stock occurred in October 2019 (DFO 2020). This document is the first update since that assessment. LFA 34 assessment methodology was reviewed and accepted during a stock assessment framework in September 2019 (Cook et al. In prep[1]). This Science Response updates the primary stock status indicator, the primary fishing pressure indicator, as well as secondary indicators to the end of the 2019–2020 fishing season.

This Science Response Report results from the Science Response Process of September 28, 2020, on the Stock Status Update of American Lobster in Lobster Fishing Area (LFA) 34.

Background

Description of the fishery

In LFA 34, the inshore commercial fishery for American Lobster has been active for over 150 years. 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 (inside of 50 nautical miles).

LFA 34 Lobster landings account for 20% of Canadian and 10% of North American totals, removing an average of 24,000 t annually over the past 5 years. This fishery is effort controlled by season length, number of licences, number of traps per licence, minimum legal size, and non-retention of berried females. Other management measures include the requirement for escape vents to allow sublegal-sized Lobster to leave the trap and biodegradable trap mechanisms to mitigate ghost fishing of lost traps.

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

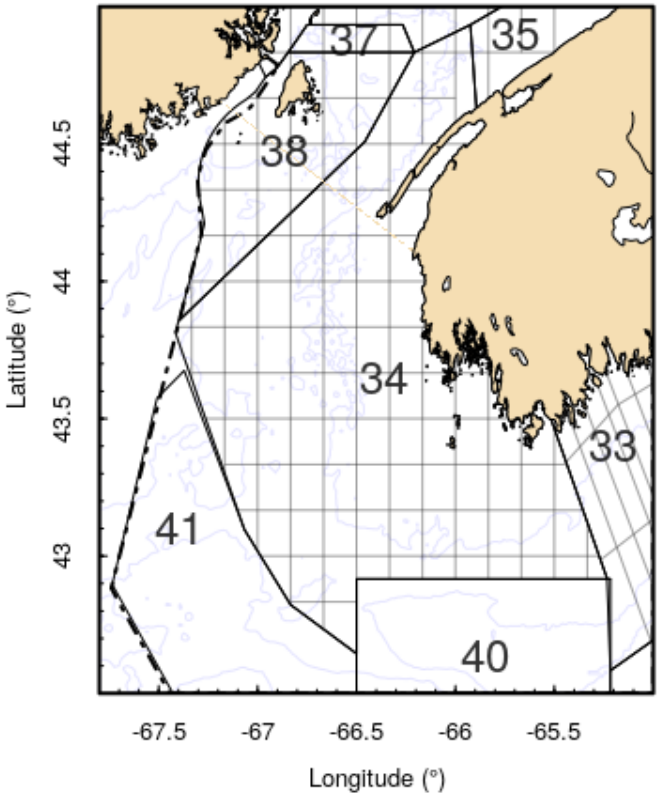

Figure 1. Map of Lobster Fishing Area (LFA) 34 with logbook reporting grids outlined in grey.

Analysis and Response

Indicators of Stock Status

The stock status of Lobster in LFA 34 is assessed using primary, secondary, and contextual indicators. This update includes the primary indicators, which are used to define stock status in relation to reference points, and secondary indicators, which display time-series trends without defined reference points (Cook et al. In prep). The data for the indicators for LFA 34 come from both fishery-dependent and -independent data sources. Fishery-dependent data consist of commercial logbooks that report information on date, location (grid), effort, and estimated catch. The fishery-independent data sources are from the Inshore Lobster Trawl Survey (ILTS), DFO Maritimes Region Summer Trawl Survey (herein RV survey), and spring and fall autumn surveys conducted by the Northeast Fisheries Science Center (NEFSC). The NEFSC surveys were not conducted in 2020 due to concerns with the COVID-19 global pandemic and will, therefore, not be updated, but information is provided using the 2019 data.

Primary Indicators

The primary indicator of LFA 34 stock status, comparing the time-series trends relative to reference points, is the commercial biomass indices from the four fishery-independent surveys. From each survey, an exploitation indicator (relative F; fishing mortality) was derived from the resulting commercial biomass index and landings.

As multiple surveys are available, the methods employed in Cook et al. (2017) are used to define reference indicators and reference points (Table 1). Stock status is a combined result across survey indices, relative to the respective Limit Reference Indicators (LRIs) and Upper Stock Indicators (USIs). For each index, the USI is 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*. LRI is 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 agreed transition from the healthy zone to the cautious zone (i.e., below the Upper Stock Reference [USR]) requires 3 of 4 survey biomasses to fall below the respective USIs. Entering the critical zone (i.e., below the Limit Reference Point [LRP]) requires 2 of 4 survey biomasses to fall below the respective LRIs. Overfishing will be considered to have occurred when 3 or more of the Removal Indicators (RI) have been exceeded for their respective stock status zone.

Table 1. Description of the Upper Stock Reference (USR) and Limit Reference Point (LRP) for LFA 34. USI = Upper Stock Indicator, LRI = Lower Stock Indicator.

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 biomasses 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 those individuals available to the fishable component, that is, ≥ 82.5 mm carapace length with berried females excluded. The commercial biomass from spring and summer surveys represents the individuals remaining after the commercial fishery. The commercial biomass from the fall survey was considered post-moult (i.e., just moulted into their current size class) and would be part of the commercial biomass during the upcoming season.

The ILTS survey shows that commercial biomass in LFA 34 increased to a high level between 2010 and 2016. The last three years have shown a decline in commercial biomass, though it still remains high relative to the full time series (Figure 2). The DFO RV survey indicates a similar pattern but has been more variable in recent years (Figure 2).

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 2). The NEFSC fall survey commercial biomass index was similar to the NEFSC spring index but with more variability in the recent period (Figure 2).

All the commercial biomass indices are above their respective USIs.

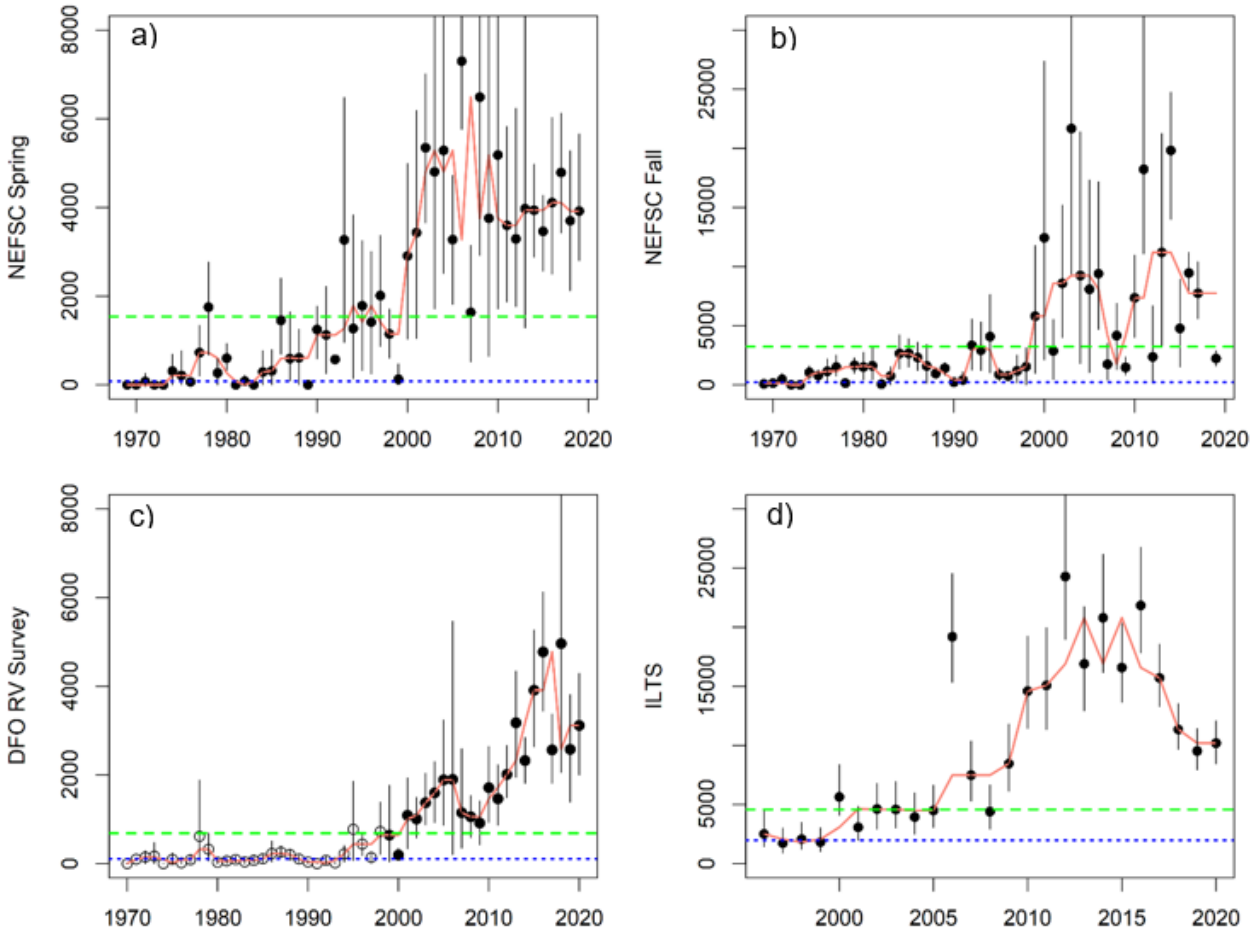

Figure 2. Commercial biomass estimates (t) from the a) NEFSC Spring, b) NEFSC Fall), c) DFO RV Survey, and d) ILTS survey in LFA 34. Red line is the 3-year running median. Green line represents the USI, and blue line represents the LRI within each figure.

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}).

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

Since 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,

resulting in a decrease in relative fishing mortality in recent years. Relative fishing mortality remains well below the respective RI (blue lines) for each index (Figure 4).

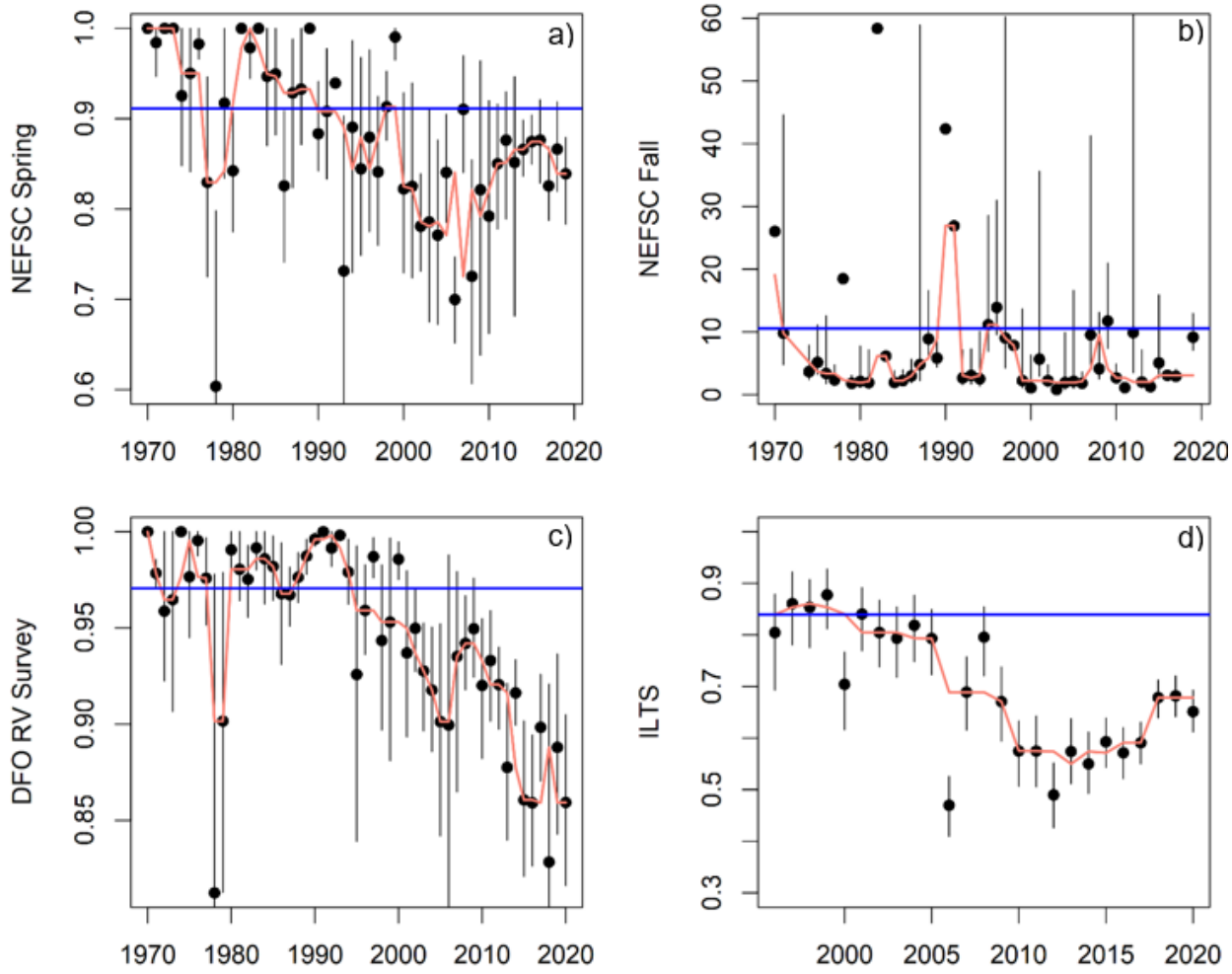

Figure 3. Relative fishing mortality from the trawl survey commercial biomass estimates and the landings. a) NEFSC Spring, b) NEFSC Fall, c) DFO RV Survey, and d) ILTS survey in LFA 34. Red line is the 3-year running median. The blue line represents the Removal Reference Indicator for each respective survey.

Secondary Indicators

Secondary indicators represent time-series trends that are tracked individually without defined reference points. The secondary indicators for LFA 34 are total landings, total effort, and commercial catch rates from logbook data.

Landings and Effort

Levels of commercial landings are related to population biomass, as fishery controls are input- (effort controls) rather than output-based (e.g., 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, etc.), Lobster size distribution, and the spatial overlap between distribution of Lobster and effort.

Fishing effort, represented by the number of Trap Hauls (THs), in the Lobster fishery is controlled by fishing season length, trap limits, and number of fishing licences. Total fishing effort is calculated from mandatory logbooks.

Over the past 4 seasons, both total landings and total effort have decreased from the record high landings in 2016 (Figure 4). In 2020, the COVID-19 global pandemic limited the fishing effort in many LFAs, including LFA 34. LFA 34 landings decreased less than total THs, as the impacts of COVID-19 were not prevalent until the second half of the fishery (March 2020), traditionally a period of lower landings. This pattern is evident in the 2020 estimates of commercial catch rates, with Catch Per Unit Effort (CPUE) in 2020 being among the highest on record (Figure 5). CPUE increased from 2009–2014 and remains high.

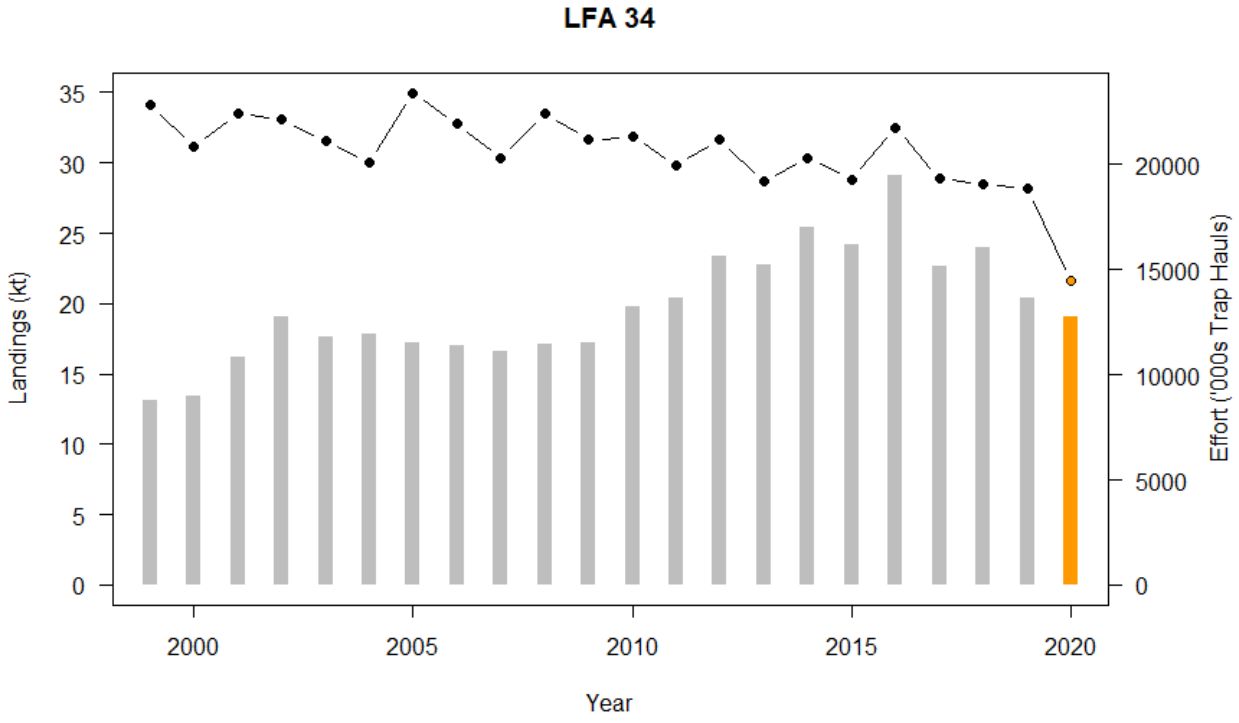

Figure 4. Time series of landings (bars) and effort (sold line with points) by fishing season. Year refers to end year of season. Data (in orange) for the 2019–20 fishing season are incomplete due to outstanding fishing logs[2].

[2] Outstanding fishing logs refer to logs not yet accessible in the Maritimes Fishery Information System (MARFIS) database. This can include logs not yet submitted by fishermen, or not yet entered into the database through dockside monitoring companies.

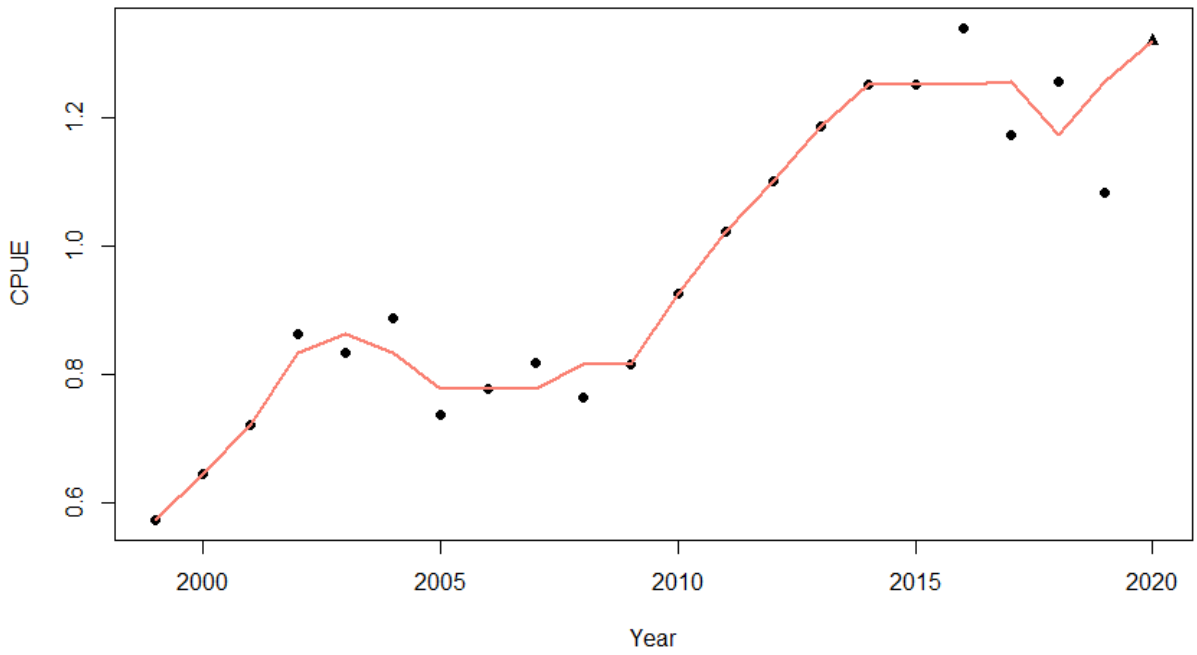

Figure 5. Time series of commercial catch rates (CPUE - symbols) and their three-year running median for LFA 34. The data for 2019–2020 fishing season are incomplete due to outstanding logs (triangle).

Conclusions

The primary indicators increased from 2010 through 2016 to the highest levels on record. Since then, biomass indicators have stabilized or decreased. Similarly, the fishing-pressure indicators have stabilized or increased over the past several years. Phase plots (Figure 6) compare the running medians of the survey and associated relative F trends to proposed reference indicators. Determination of the stock status can be made through the examination of these plots. Current estimates for commercial survey biomass are well above their respective USIs for all 4 of the surveys (2 of 4 required) and, therefore, the stock is considered to be in the healthy zone. Relative F is below the removal indicator for all four survey indices, so overfishing is not occurring. Secondary indicators (landings, effort, and commercial catch rates) all support the primary indicators that the stock remains high relative to historic levels.

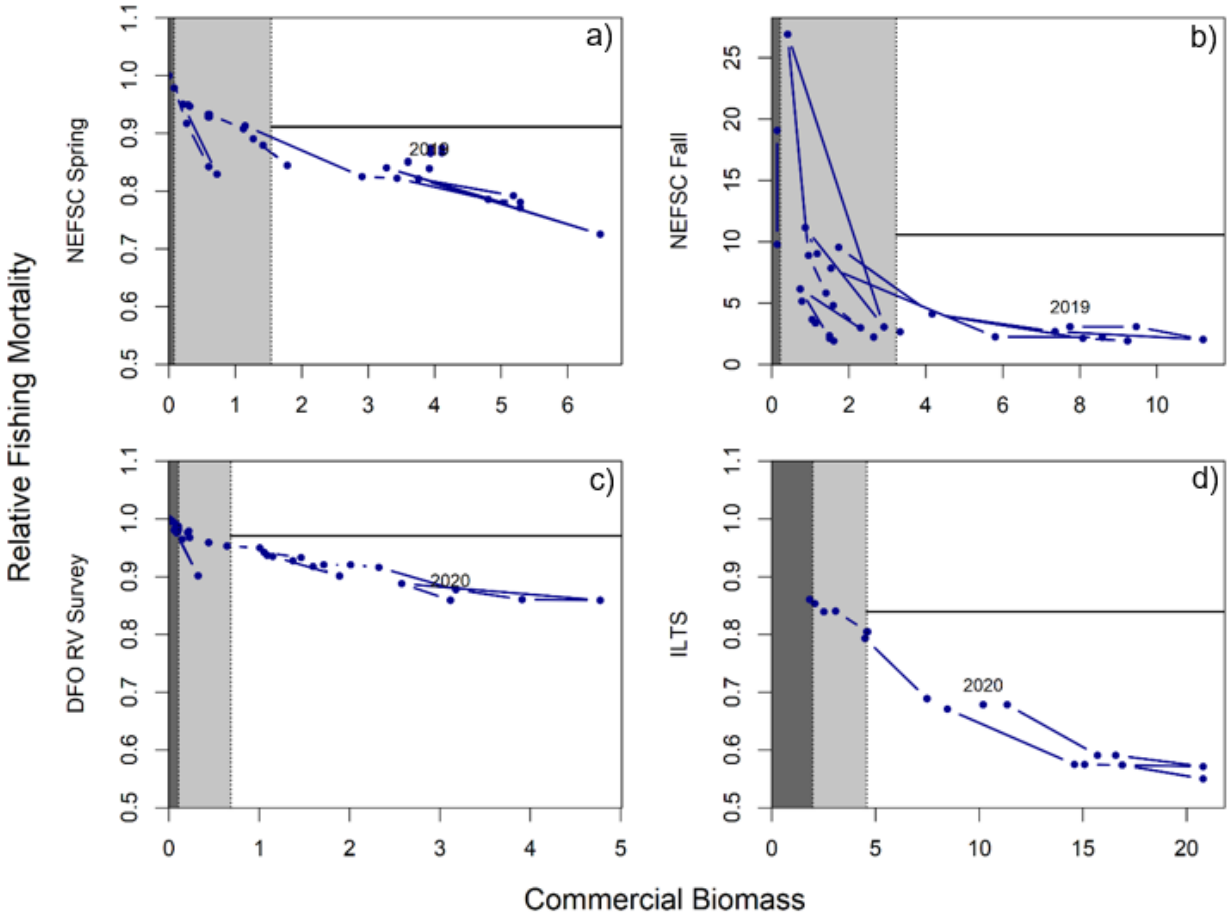

Figure 6. Phase plots of the running median of commercial biomass and relative fishing mortalities: a) NEFSC Spring, b) NEFSC Fall, c) DFO RV, and d) ILTS. Within each plot, the last year's data point is labelled and the RI (horizontal black line), LRI (vertical line between dark and light grey zones), and USI (vertical line between light grey and white zones) are shown.

Contributors

Name	Affiliation
Adam Cook (lead)	DFO Science, Maritimes Region
Cheryl Denton	DFO Science, Maritimes Region
David Hardie	DFO Science, Maritimes Region
Rabindra Singh	DFO Science, Maritimes Region
Ben Zisserson	DFO Science, Maritimes Region
Jeremy Broome	DFO Science, Maritimes Region
Verna Docherty	DFO Resource Management, Maritimes Region
Brady Stevenson	DFO Resource Management, Maritimes Region

Approved by

Alain Vézina
Regional Director of Science
DFO Maritimes Region
Dartmouth, Nova Scotia
Ph. 902-426-3490

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Sources of Information

DFO. 2021. Assessment of Lobster (*Homarus americanus*) in Lobster Fishing Area 34. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2021/015.

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Center for Science Advice (CSA)
Maritimes Region
Fisheries and Oceans Canada
PO Box 1006, 1 Challenger Drive
Dartmouth, Nova Scotia
Canada B2Y 4A2

Telephone: 902-426-7070
Fax: 902-426-5435
E-Mail: MaritimesRAP.XMAR@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

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