



# STOCK STATUS UPDATE FOR AMERICAN LOBSTER (*HOMARUS AMERICANUS*) IN LOBSTER FISHING AREA 34 FOR 2022

## Context

Advice on the stock status of American Lobster (*Homarus americanus*) in Lobster Fishing Area (LFA) 34 is requested annually by Fisheries and Oceans (DFO) Maritimes Fisheries Management. The last assessment of this stock occurred in October 2019 (DFO 2021). This document is the third update since that assessment. The LFA 34 assessment methodology was reviewed and accepted during a stock assessment framework in September 2019 (Cook et al. In press). This Science Response updates the primary stock status indicator, the primary fishing pressure indicator, as well as secondary indicators to the end of the 2021–2022 fishing season.

This Science Response Report results from the Regional Peer Review of October 7, 2022, 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<sup>2</sup> 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 21,844 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.

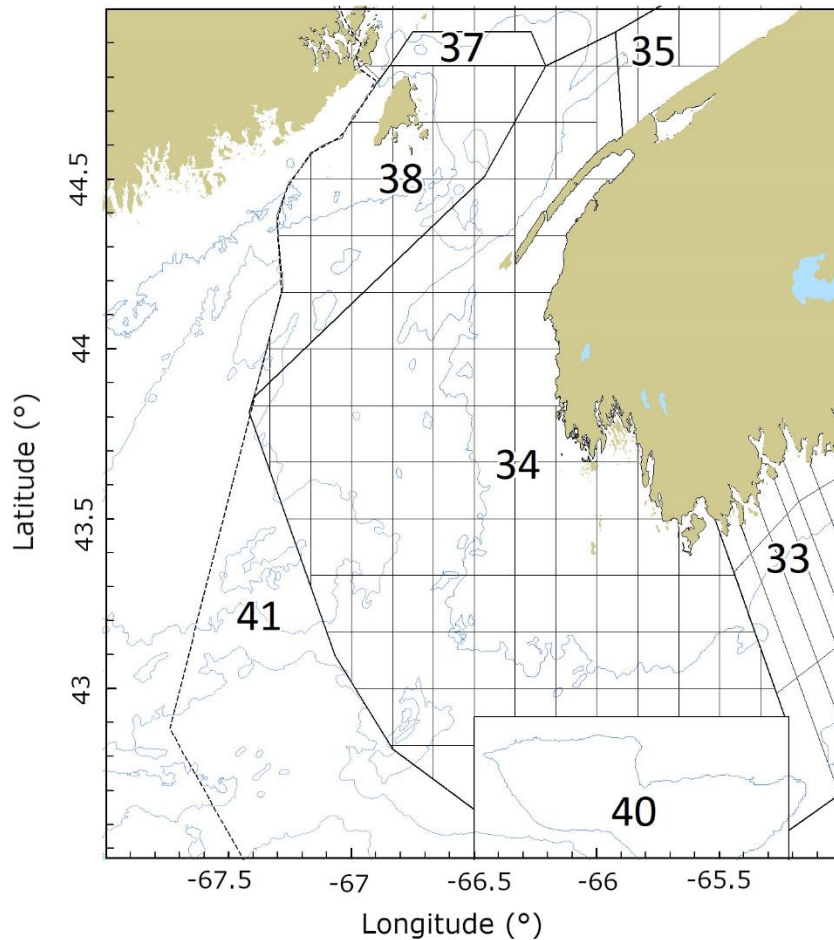


Figure 1. Map of Lobster Fishing Area (LFA) 34 and adjacent LFAs with logbook reporting grids outlined in grey.

## 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 press). 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 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. In 2021, the spring NEFSC survey was completed and this indicator was updated; however, the RV survey was not completed due to issues with the survey vessel. Spring NEFSC and RV surveys were completed in 2022 and are updated in this document.

**Primary Indicators**

The primary indicator of LFA 34 stock status, 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. Rather than relying on the inherently variable annual estimates of survey indices, the three-year running median estimated up to the last available survey year was used to compare to the LRI's, USI's and RI's. 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 Reference Indicator.*

<b>Zone</b>	<b>Reference Points</b>	
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  $\geq 82.5$  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 peaked between 2010 and 2016. The commercial biomass during the last five years declined from this peak but the 3-year median biomass in 2022 remains 100% higher than the USI (Figure 2). The DFO RV survey indicates a similar pattern but has been more variable in recent years. The 3-year median in 2022 was 638% higher than the USI (Figure 2).

Maritimes Region

The NEFSC spring survey commercial biomass index was relatively stable until 2000, when it underwent a rapid increase. The 3-year median is currently 157% above the time series USI (Figure 2). The NEFSC fall survey commercial biomass index has been highly variable over the last decade, but the 3-year median is still 80% above the USI (Figure 2).

All the commercial biomass indices as determined by their 3-year running median, are above their respective USIs.

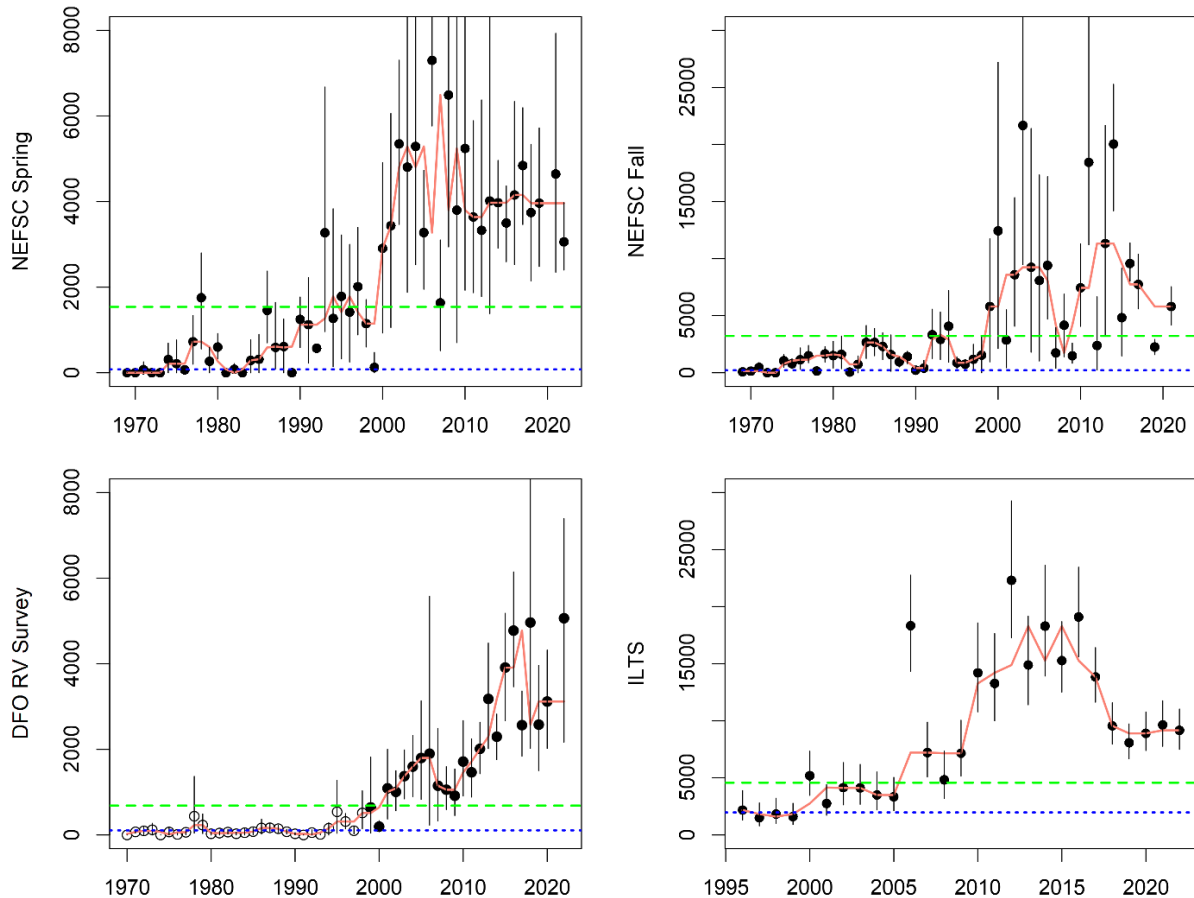


Figure 2. Commercial biomass estimates ( $t$ ) from the NEFSC Spring, NEFSC Fall, DFO RV survey, and Inshore Lobster Trawl Survey (ILTS) in LFA 34. Red line is the 3-year running median. Green line represents the Upper Stock Indicator (USI), and blue line represents the Limit Reference Indicator (LRI) 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. The 3-year running medians of relative fishing mortality remains well below the respective RI (blue lines) for each index (Figure 3). The 3-year running medians of *relF* for NEFSC Spring, NEFSC Fall, RV survey and ILTS were 8%, 65%, 19% and 21% lower than their respective RI's.

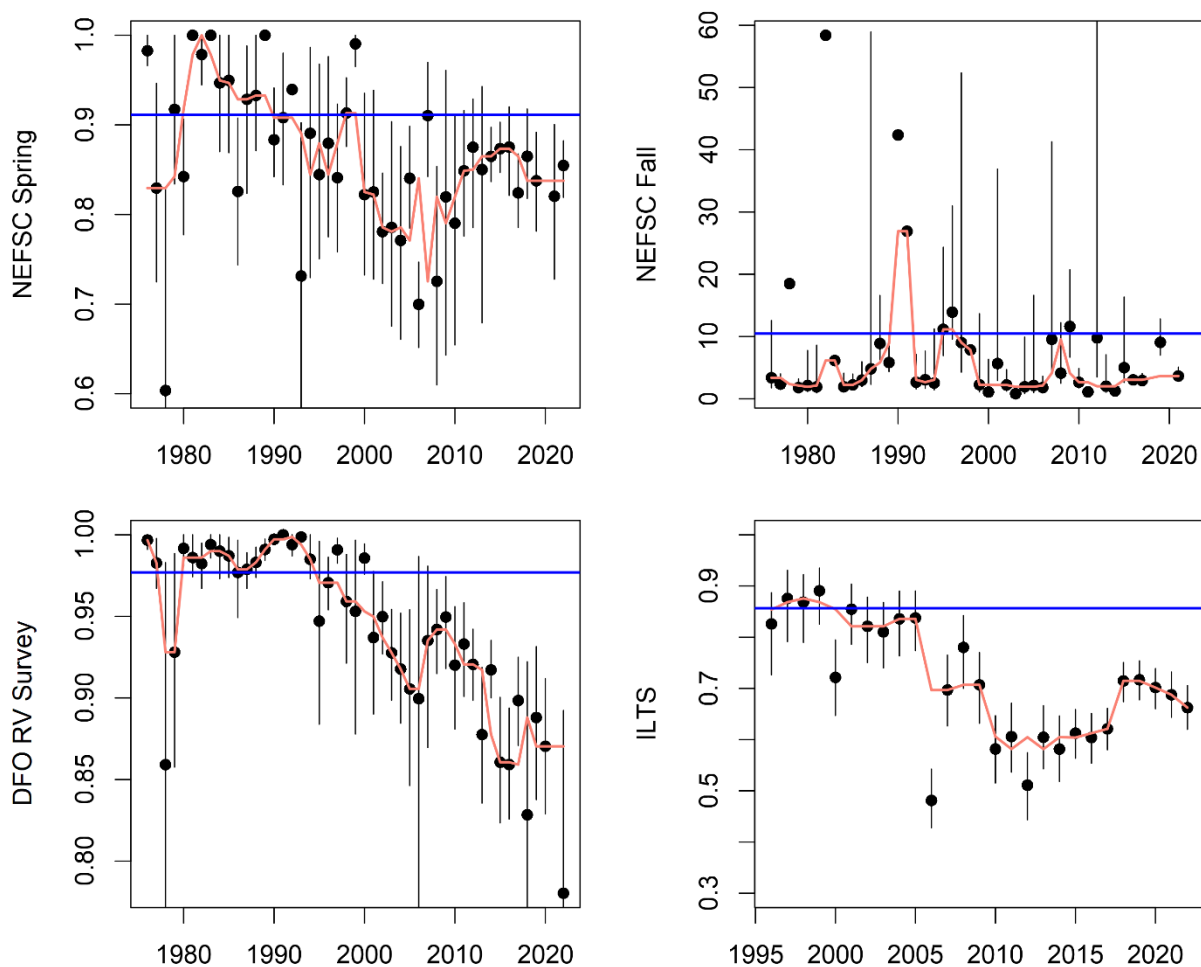


Figure 3. Relative fishing mortality in LFA 34 from landings divided by trawl survey commercial biomass estimates from the NEFSC Spring, NEFSC Fall, DFO RV survey, and Inshore Lobster Trawl Survey (ILTS) in LFA 34. Red line is the 3-year running median. The blue line represents the Removal Reference 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 fishing 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 estimated catch rate and total slip reported landings, as a small proportion of logbooks contain errors.

Over the past 6 seasons, both total landings and total effort have decreased from the record high landings in 2016 (Figure 4). In 2022, landings (orange bar in Figure 4) were lower than previous 2 seasons and effort was similar to 2020 (with 10% logs remaining outstanding). CPUE increased from 2009–2014 and has varied between 1.34 and 1.08 kg/TH since 2016 (Figure 5). CPUE in 2022 was similar to 2019 and 2021, and remains high relative to historic levels.

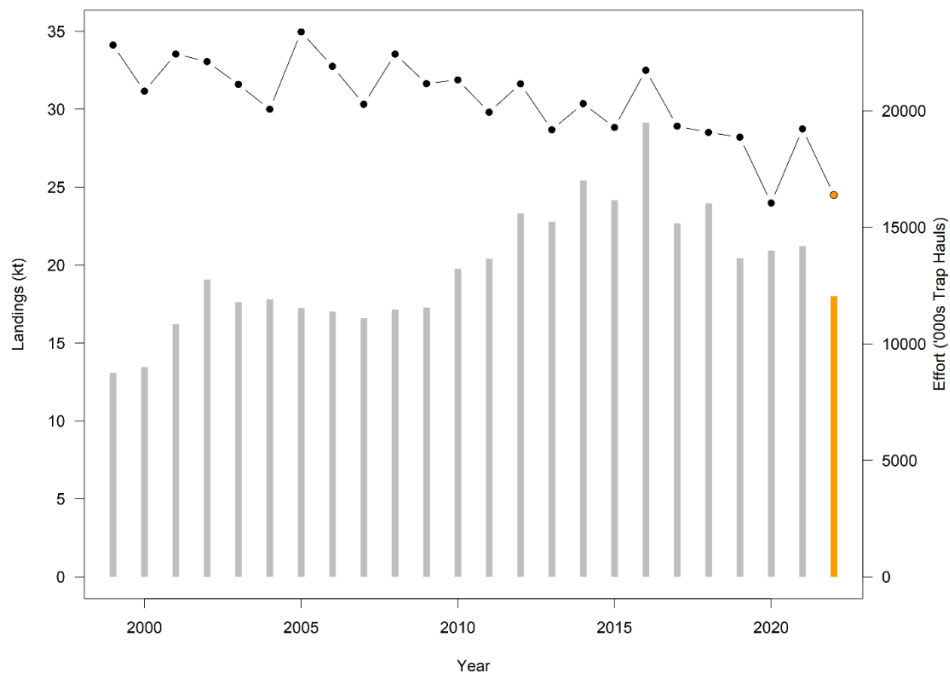


Figure 4. Time series of landings (bars) and effort (solid line with points) by fishing season. Year refers to end year of season. Data (in orange) for the 2021–22 fishing season are incomplete due to outstanding fishing logs<sup>1</sup>.

<sup>1</sup> 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.

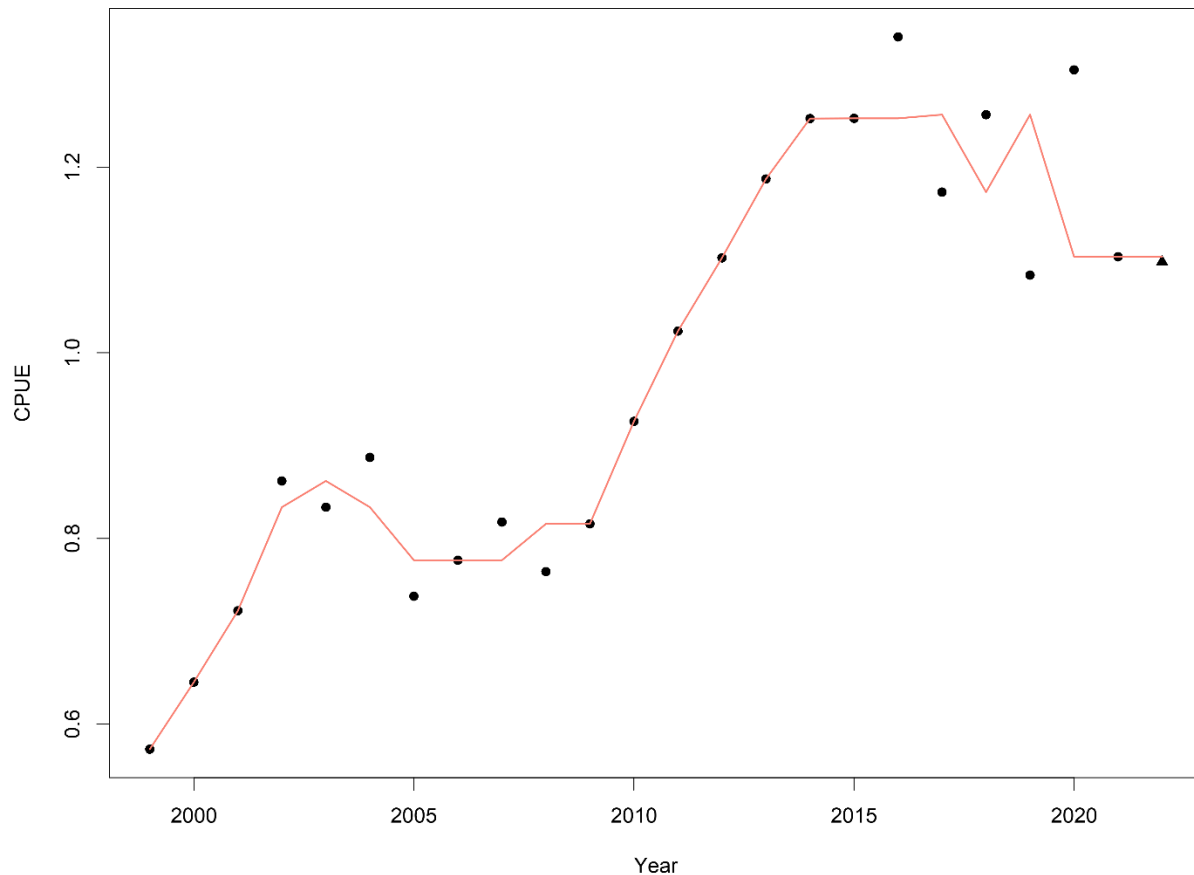


Figure 5. Time series of commercial catch rates (CPUE kg/trap haul - symbols) and their 3-year running median for LFA 34 (red line). The data for 2021–2022 fishing season are incomplete due to outstanding logs (triangle).

## Conclusions

The primary indicators increased from 2010 through 2016 to the highest levels on record. Since then, commercial 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.

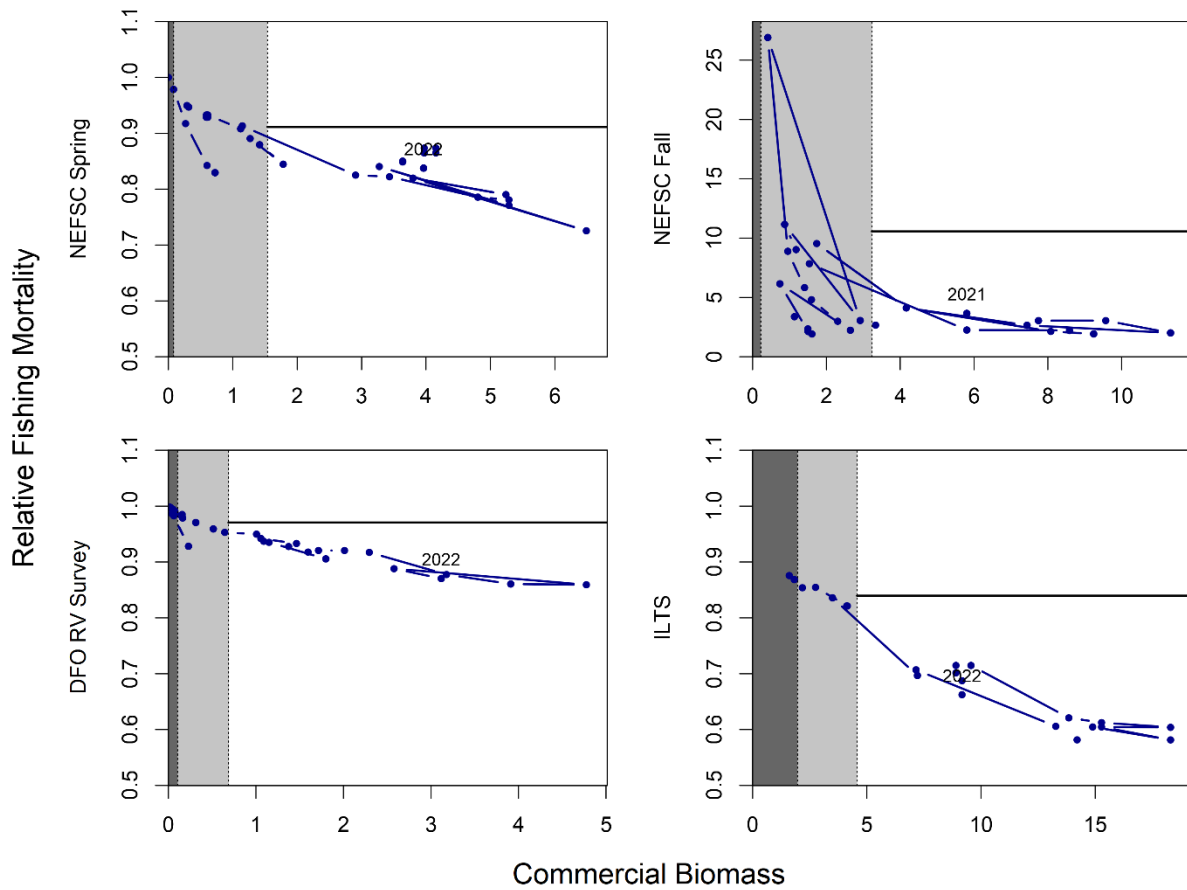


Figure 6. Phase plots of the running median of commercial biomass and relative fishing mortalities for the NEFSC Spring, NEFSC Fall, DFO RV survey, and the Inshore Lobster Trawl Survey (ILTS). Within each plot, the last year's data point is labelled and the Removal Indicator (horizontal black line), Limit Reference Indicator (vertical line between dark and light grey zones), and Upper Stock Indicator (vertical line between light grey and white zones) are shown.

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Date: November 17, 2022

## Sources of Information

- Cook, A.M., Hubley B., Howse V., and Denton C. In press. 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.
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- DFO. 2021. [Assessment of Lobster \(\*Homarus americanus\*\) in Lobster Fishing Area 34](#). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2021/015.

## This Report is Available from the:

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ISSN 1919-3769

ISBN 978-0-660-48163-0 Cat. No. Fs70-7/2023-021E-PDF

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Correct Citation for this Publication:

DFO. 2023. Stock Status Update for American Lobster (*Homarus americanus*) in Lobster Fishing Area 34 for 2022. DFO Can. Sci. Advis. Sec. Sci. Resp. 2023/021.

*Aussi disponible en français :*

*MPO. 2023. Mise à jour sur l'état du stock de homard d'Amérique (*Homarus americanus*) dans la zone de pêche du homard 34 en 2022. Secr. can. des avis sci. du MPO. Rép. des Sci. 2023/021.*