Fisheries and Oceans Canada / Pêches et Océans Canada
Ecosystems and Oceans Science / Sciences des écosystèmes et des océans

Maritimes Region
Canadian Science Advisory Secretariat
Science Response 2021/020

STOCK STATUS UPDATE OF AMERICAN LOBSTER (*HOMARUS AMERICANUS*) IN LOBSTER FISHING AREAS 36 AND 38 FOR 2020

Context

Advice on the stock status of American Lobster (*Homarus americanus*) in Lobster Fishing Areas (LFAs) 36 and 38 is requested annually by Fisheries and Oceans Canada (DFO) Fisheries Management. A Framework Assessment for LFAs 35–38 was reviewed in September 2019 (Cook et al. In prep.[1]), and the last assessment occurred on September 2019 (DFO 2020). This document will be the first update since the 2019 assessment. The assessment identified one primary indicator and three secondary indicators that describe changes in Lobster abundance and biomass, as well as proposed reference points for the primary indicator. This Science Response updates these indicators to the end of the 2019–2020 fishing season. The Science Response Report results from the Science Response Process of September 22, 2020, on the Stock Status Update of American Lobster in Lobster Fishing Areas (LFAs) 36 and 38.

Background

Description of the fishery

Commercial Lobster fishing in LFAs 36 and 38 occurs in the Bay of Fundy (Figure 1) and has had active fisheries for over 150 years. These two LFAs border either one (LFA 36) or both (LFA 38) of the two biggest Lobster fisheries in the Northwest Atlantic: LFA 34, with the highest Lobster landings in Canada; and Downeast Maine, with the highest landings in the US. Landings in LFAs 36 and 38 began a long-term increase in the mid-1990s, and current landings are near record highs. A similar increase in landings was also observed in most of the Gulf of Maine regions and other LFAs in Atlantic Canada.

The fishery is managed by input controls including a Minimum Legal Size (MLS, 82.5 mm Carapace Length [CL]), prohibition on landing of both egg-bearing and v-notched (with no setal hairs) females, limited entry licencing and trap limits, and season length. LFA 36 has a split fishing season starting the second Tuesday in November to January 14 and from March 31st to June 29th, with a trap limit of 300, while LFA 38 occurs from the second Tuesday in November to June 29th, with a trap limit of 375. Other management measures include the requirement of vents to allow sublegal-sized Lobster to escape and biodegradable trap mechanisms to mitigate ghost fishing by 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.

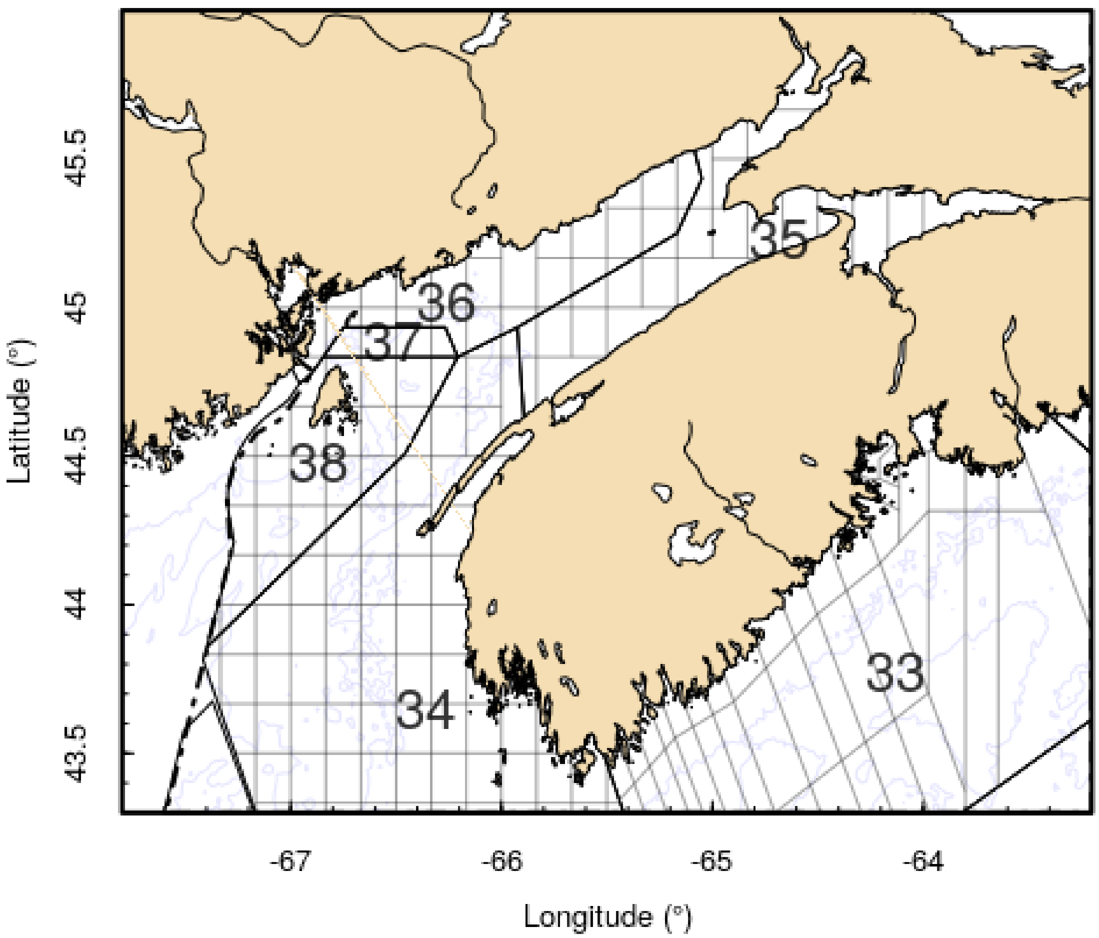

Figure 1: Map of Lobster Fishing Areas (LFAs) 36 and 38 with logbook reporting grids outlined in grey.

Analysis and Response

Indicators of Stock Status

The stock status of Lobster in LFAs 36 and 38 are assessed using primary, secondary, and contextual indicators. This update will include the primary indicator, which is used to define stock status in relation to reference points defined in Cook et al. (In prep.[1]), and secondary indicators, which display time-series trends but do not have reference points. The data sources available for establishing indicators for LFAs 36 and 38 come from both fishery-dependent and fishery-independent data sources. Fishery-dependent data consist of commercial logbooks that report information on date, location (grid), effort (Trap Hauls [THs]), and estimated catch. The fishery-independent data sources are from the DFO Maritimes Region Summer Trawl Survey (herein RV survey).

Primary Indicator

Stock status in LFAs 36 and 38 are evaluated separately through one primary indicator, which describes the time-series trends relative to reference points. The primary indicator for describing stock status is standardized commercial Catch Per Unit Effort (CPUE). There is currently no primary indicator of fishing pressure or exploitation in either LFA.

Catch Per Unit Effort

Commercial catch rates are a preferred indicator over landings data as they are standardized to account for the level of fishing effort, which is essential in effort-controlled fisheries. The commercial fishing data used to estimate CPUE were obtained from mandatory logbooks that were implemented in the mid-2000s. It has been well documented that trap-based catch rates will vary throughout a fishing season due to factors apart from available biomass, including fishing behavior, localized depletion, and environmental conditions (Drinkwater et al. 2006, Miller and Rodger 1996). In an effort to account for these factors, CPUE data were standardized through generalized linear modelling with explanatory variables of Year, Day of Season, Temperature, and the interaction between Day of Season and Temperature. Year effects were treated as factors rather than a continuous variable to reduce smoothing across years and increase the potential for inter-annual variability.

Model predictions were made for the first day of the fishing season at the median day-one temperature across all years. The available time series covers both a high and a low productivity period. 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 Lower Reference Point (LRP) were set to 40% and 20% of the K proxy, respectively. The 3-year running median is used to compare the standardized CPUE to the USR and LRP. This value will dampen the impact of any anomalous years, which may occur due to factors unrelated to changes in abundance.

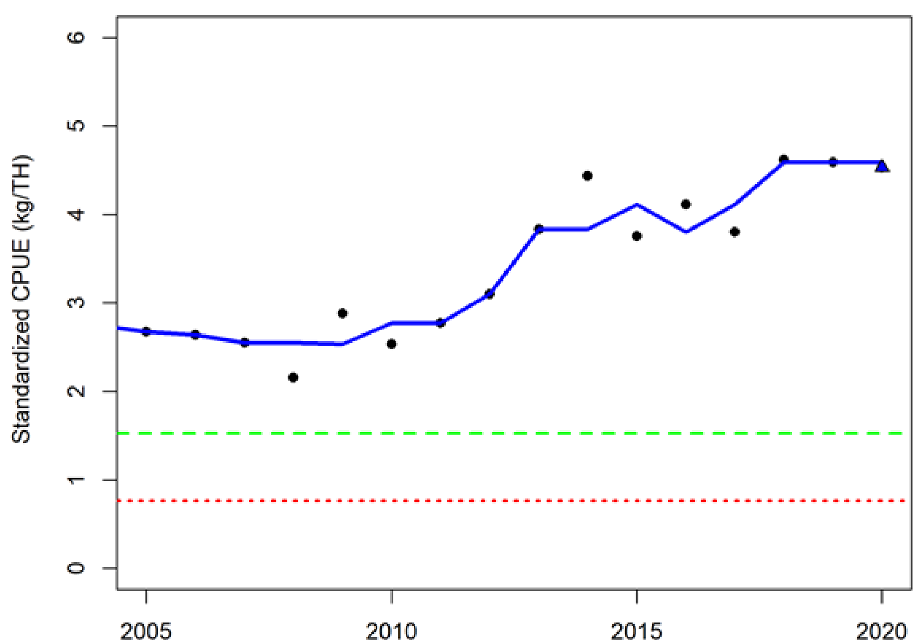

Figure 2. Time series of standardized commercial catch rates (kg/trap haul [TH]; black dots) for LFA 36, along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (USR; dashed green line) and Limit Reference Point (LRP; dotted red line). The data for 2019–2020 fishing season (blue triangle) are incomplete due to outstanding logs[2].

[2] Outstanding 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.

The trend in CPUE indicates that an increase in stock biomass in LFA 36 occurred around 2010 (Figure 2). The CPUE has remained high (more than twice the USR) since 2013. The 3-year running median for CPUE for the 2019–2020 season is 4.59 kg/TH, which is above the USR (1.53 kg/TH) and LRP (0.76 kg/TH). CPUE for 2019–2020 is 4.53 kg/TH but may not be representative of the season due to outstanding logs[2], which range from 30% to 80% by month (as of August 31st, 2020).

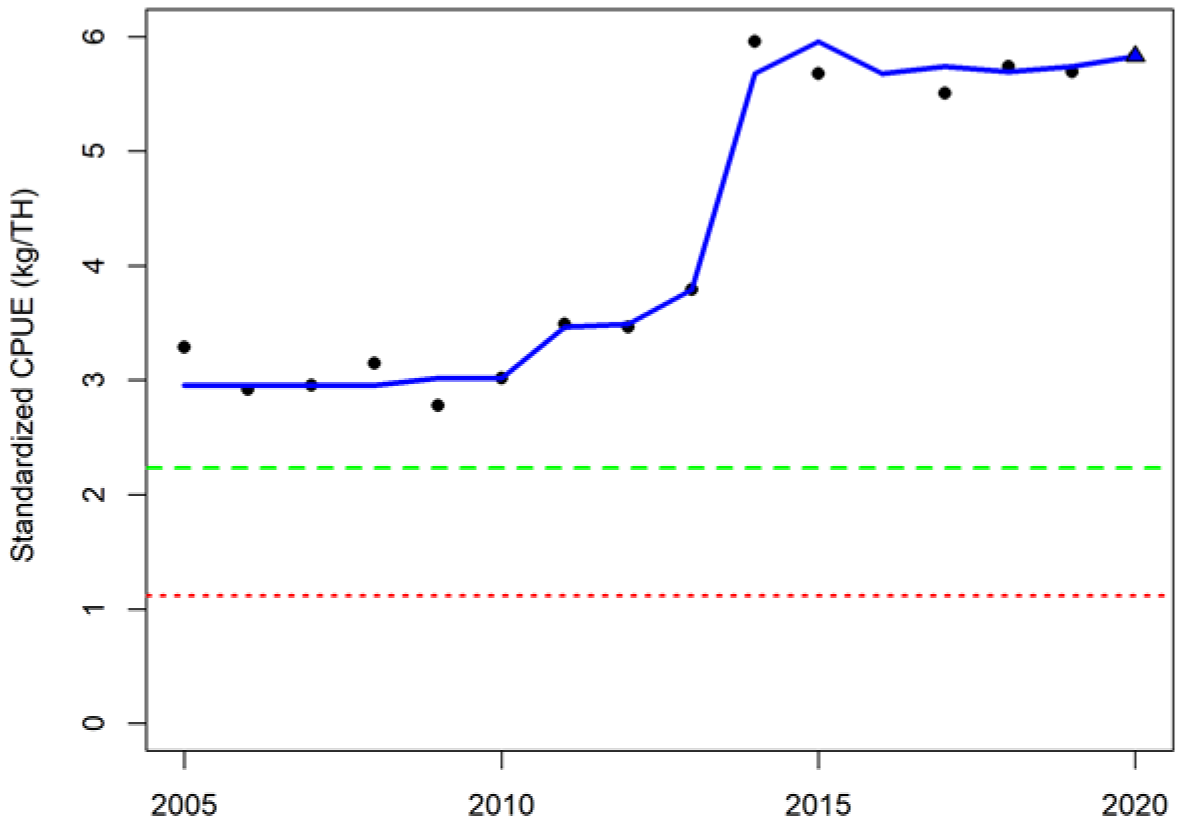

Figure 3. Time series of standardized commercial catch rates (kg/trap haul [TH]; black dots) for LFA 38, along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (dashed green line) and Limit Reference Point (dotted red line). The data for 2019–2020 fishing season (blue triangle) are incomplete due to outstanding logs[2].

The trend in CPUE indicates that an increase in stock biomass for LFA 38 occurred between 2010 and 2014 (Figure 3). The CPUE has remained high (more than twice the USR) since 2014. The 3-year running median for CPUE for the 2019–2020 season is 5.83 kg/TH, which is above the USR (2.24 kg/TH) and LRP (1.12 kg/TH). CPUE for 2019–2020 is 5.83 kg/TH but may not be representative of the season due to outstanding logs[2], which range from 17% to 60% by month (as of August 31, 2020).

Secondary Indicators

Secondary indicators represent time-series trends that are tracked individually, without defined reference points. The secondary indicators for LFAs 36 and 38 include the LFA-specific landings and total effort, recruit abundance, commercial biomass, and relative fishing mortality estimates from the DFO RV survey Bay of Fundy region (strata 484, 490–495). Recruit abundance from the Scallop survey is not included in this update because the survey data were not available.

Landings and Effort

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, and gear efficiency), Lobster size distribution, and the spatial overlap between distribution of Lobster biomass and effort.

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 as factors such as weather conditions, seasonally variable catch rates, and fishing partnerships limit the total number of THs. Total fishing effort is calculated from mandatory logbooks.

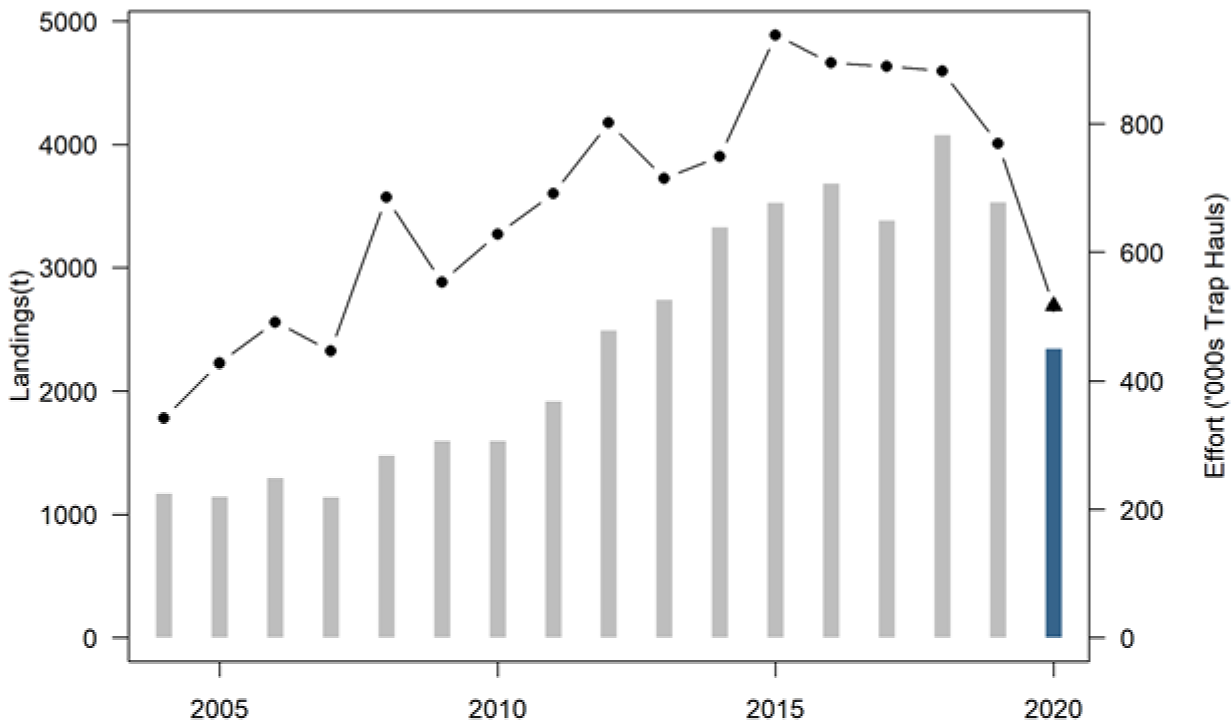

Figure 4. Time series of landings (grey bars) and effort (black line with points) for LFA 36. The data for 2019–2020 fishing season are incomplete (blue bar for landings, black triangle for effort).

The historical landings in LFA 36 between 1947 and 1980 had a median of 227 t with a range of 47 to 338 t, then increased slightly between 1981 and 1996 to a median of 268.5 t (range 156–427 t), and again from 1997 to 2010 there was a steady increase in landings to 1594 t (Cook et al. In prep.[1]). In the more recent years, LFA 36 landings have varied but still remain relatively high for the time series. The landings for 2019–2020 season are 2339 t, which are not representative of the season due to outstanding logs.

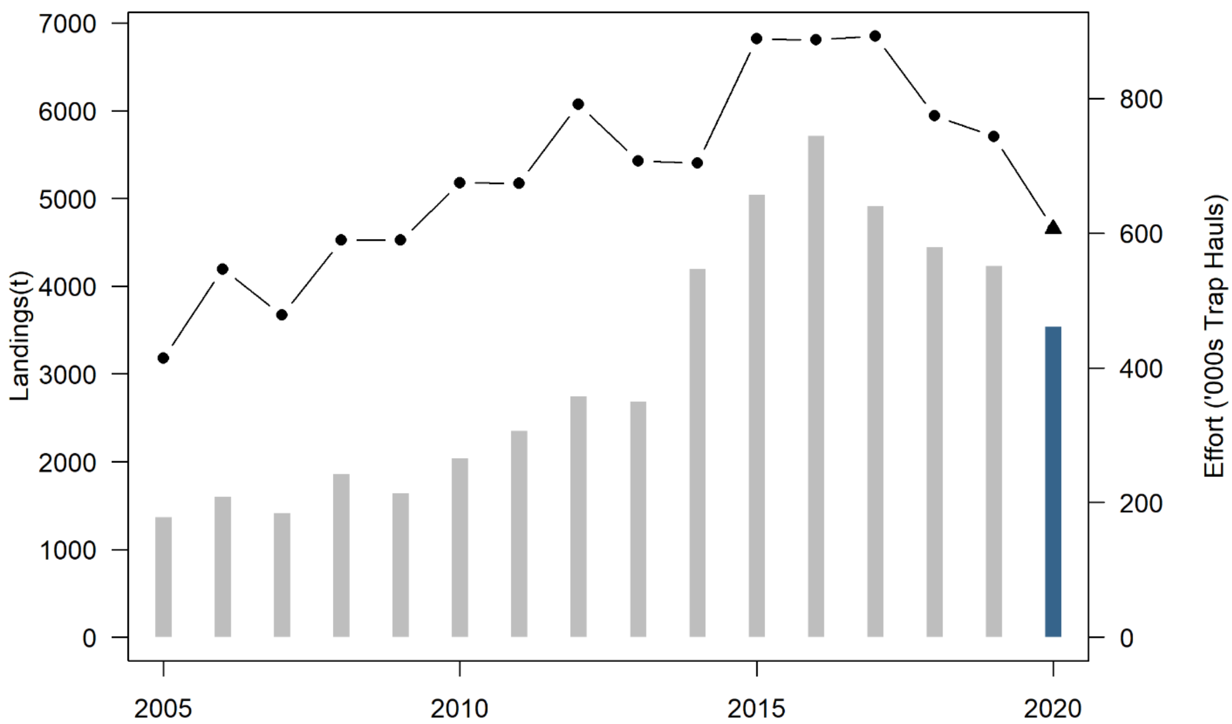

Figure 5: Time series of landings (grey bars) and effort (black line with points) for LFA 38. The data for 2019–2020 fishing season are incomplete (blue bar for landings, black triangle for effort).

The historical landings in LFA 38 between 1947 and 1988 had a median of 325 t with a range of 170 to 450 t, then increased between 1989 and 1997 to a median of 512 t (range 467–661 t), and again from 1997 to 2013 there was a steady increase in landings to 2682 t (Cook et al. In prep.). In the more recent years, LFA 38 landings have varied and are showing a decline since 2017. Landings for the 2019–2020 season are 3536 t, which is not representative of the season due to outstanding logs.

DFO RV Survey Commercial Biomass and Recruit Abundance

Despite strata boundaries having significant overlap with LFA 35–38, there were few sets (< 20 per year) within each LFA suggesting that the value of indicators derived from these data was limited. Extending the commercial biomass survey index to years prior to 1999, when size information was not collected, was performed using the ratio of commercial to total biomass estimated between 1999 and 2018 (0.746). The time series of commercial biomass showed a pulsed increase in 2000–2004, with a variable but increasing trend from 2010 to 2018; however, survey catch rates in the last two years were the lowest in the last 10 years (Figure 6). The size at maturity (95 mm) for the Bay of Fundy (Gaudette et al. 2014) is substantially greater than the MLS (82.5 mm) and, as such, the commercial biomass available post-fishery will constitute those individuals entering the spawning population in the upcoming year.

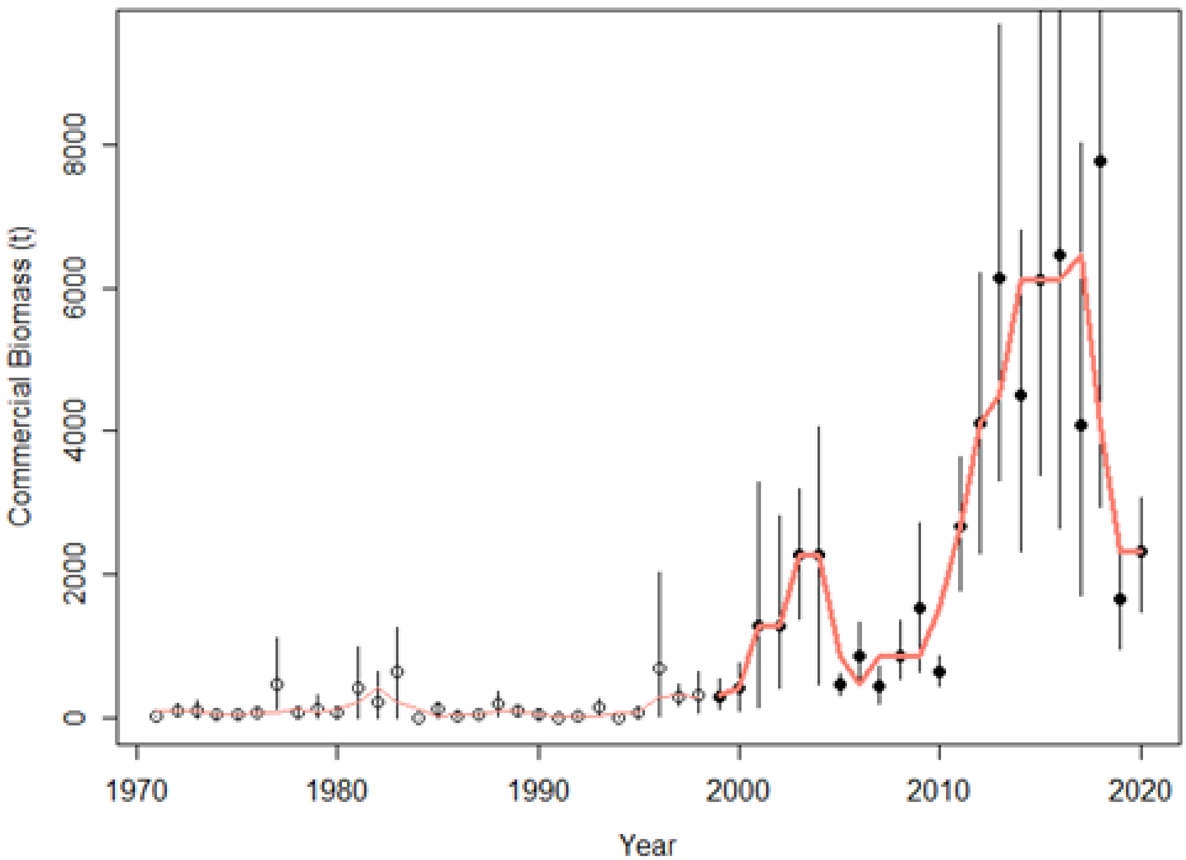

Figure 6. Time series of DFO RV survey trends for LFAs 35–38 commercial biomass. Values prior to 1999 were derived using the mean proportion of commercial to total biomass between 1999 and 2018 (0.746). Red line represents the 3-year running median; error bars are 95% bootstrapping confidence intervals.

DFO RV survey recruit abundance (70–82 mm CL) (Figure 7) has followed a similar pattern to the commercial biomass (Figure 6), with increases from 2010 to 2013 and it has remained high and variable over the last 6 years. The last two years of recruit abundance are among the lowest in the last 10 years.

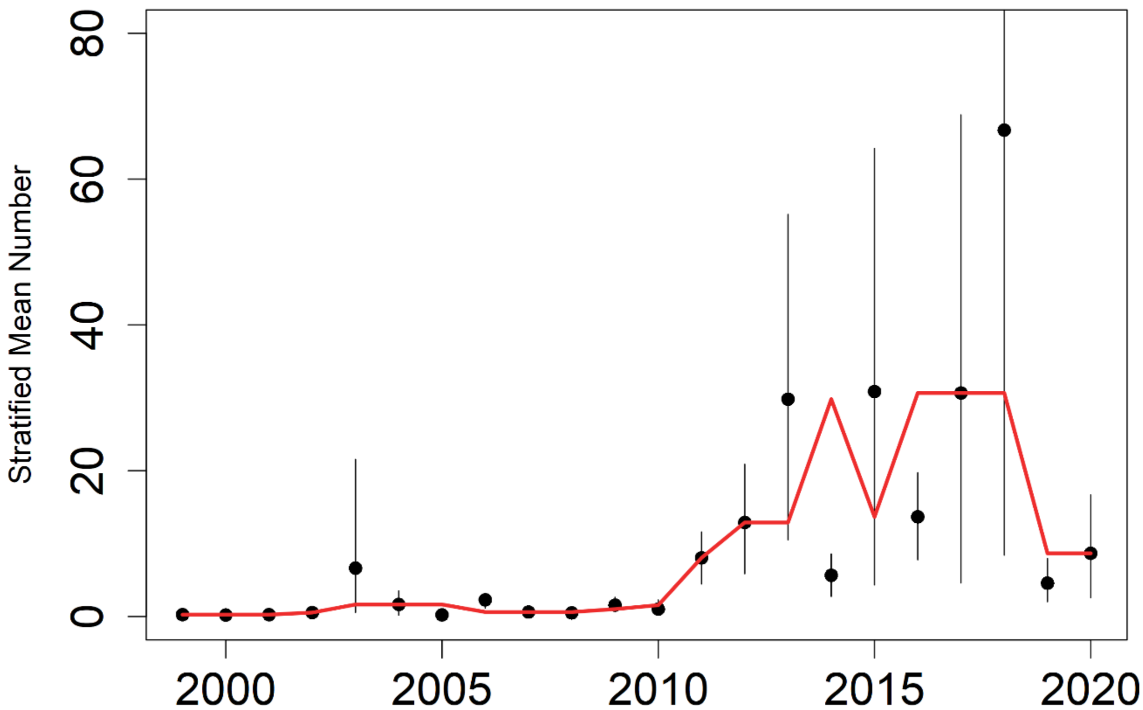

Figure 7. Time series of recruit abundance from DFO RV survey for strata overlapping LFAs 35–38. Red line represents the 3-year running median; error bars are 95% bootstrapping confidence intervals.

Relative Fishing Mortality

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

$$relF_t = \frac{C_t}{(I_t + C_t)}$$

Assuming that survey catchabilities were constant, and the index of commercial biomass was proportional to true commercial biomass, *relF* represented an index of Fishing Mortality (*F)*. The estimates of *relF* decrease between the late 1990s and early 2000s, increase to 2010, then decrease to 2013, with variable but low estimates of *relF* since (Figure 8). Tracking the *relF* for the Bay of Fundy provides a depiction of the patterns observed across the larger area.

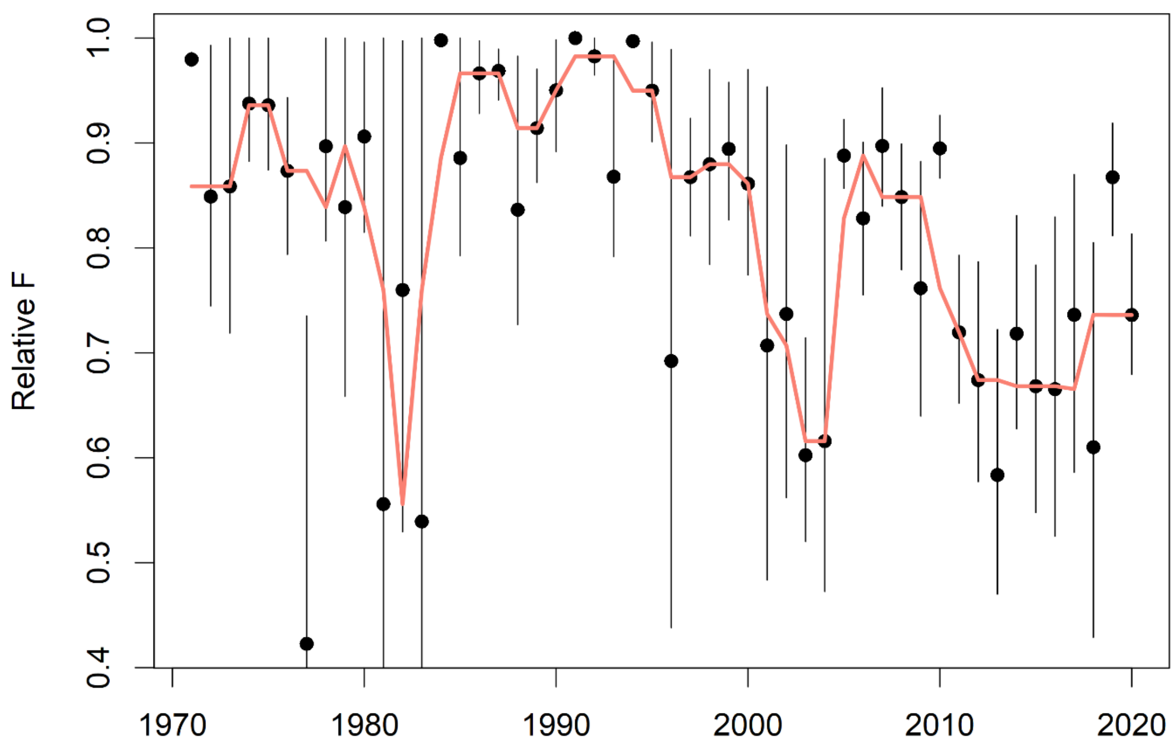

Figure 8. Relative fishing mortality (relF) from the DFO RV survey commercial biomass estimates and the landings in LFAs 35–38. Red line represents the 3-year running median; error bars are 95% bootstrapping confidence intervals.

Conclusions

The primary indicator of stock status, CPUE, remains well above the USR in both LFAs 36 and 38, and both LFAs remain in the healthy zone. Given the monthly reporting rate is currently between 30–80% for LFA 36 and 17–60% for LFA 38, landings appear to be on track with recent years. From the fisheries-independent survey, there was an increase in total commercial biomass after 2010 followed by a decrease in 2017 to present. Recruit abundance shows high variability since 2010. In recent years, however, the RV survey indices of commercial biomass and recruitment abundance have decreased to the lowest levels in the last 10 years.

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Date: October 29, 2020

Sources of information

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This Report is Available from the:

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ISSN 1919-3769
ISBN 978-0-660-38796-3 Cat. No. Fs70-7/2021-020E-PDF

Correct Citation for this Publication:

DFO. 2021. Stock Status Update of American Lobster (*Homarus americanus*) in Lobster Fishing Areas 36 and 38 for 2020. DFO Can. Sci. Advis. Sec. Sci. Resp. 2021/020.

Aussi disponible en français :

MPO. 2021. Mise à jour de l’état du stock de homard d’Amérique (Homarus americanus) dans les zones de pêche du homard 36 et 38 pour l'année 2020. Secr. can. de consult. sci. du MPO, Rép. des Sci. 2021/020.