STOCK STATUS UPDATE OF LOBSTER (*HOMARUS AMERICANUS*) IN LOBSTER FISHING AREAS 36 AND 38 FOR 2021

Context

The scientific basis for assessing the status of American Lobster (*Homarus americanus*) in Lobster Fishing Areas (LFAs) 36 and 38 were examined at an assessment framework review meeting in September 2019, followed by an assessment of the status of the Lobster resources in LFA 36 and 38 in October 2019 (DFO 2021a), and a stock status update in September 2020 (DFO 2021b). One primary indicator and three secondary indicators that describe changes in Lobster abundance and biomass were defined, and reference points for the primary indicator were proposed and subsequently adopted. In this update, a suite of indicators is applied from the 2019 framework review to the stock status up to the end of the 2020–2021 fishing season wherever possible.

This Science Response Report results from the Regional Science Response Process of September 23, 2021, 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), with 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 United States of America (USA). Access to LFA 37 is provided to both LFA 36 and 38 licence holders by way of licence conditions. Landings from LFA 37 are attributed to the respective LFAs stated on the licence. A long-term increase in landings in LFAs 36 and 38 began in the mid-1990s, and current landings are above the long-term average. 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, trap limits, and season length. LFA 36 has a split fishing season starting the second Tuesday in November to January 14th 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.

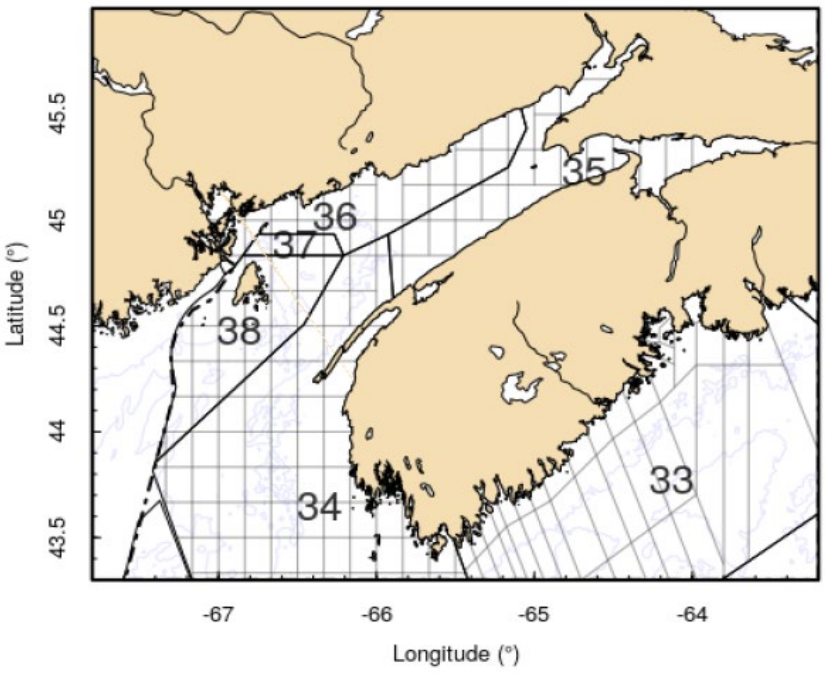

Figure 1. Map of Lobster Fishing Areas (LFAs) 36 and 38 with logbook reporting grids outlined in grey.

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 press[1]), and secondary indicators, which display time-series trends but do not have reference points. The data available for establishing indicators for LFAs 36 and 38 come from both fishery-dependent and fishery-independent sources. Fishery-dependent data consist of commercial logbooks that provide information on date, location (grid), effort (Trap Hauls [THs]), and estimated catch. The fishery-independent data are from the Fisheries and Oceans (DFO) Maritimes Region Summer Research Vessel 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

[1] 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 January 2019 at the Framework Assessment meeting.

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. This is especially important 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 allow for data to better inform 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 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 Limit Reference Point (LRP) were set to 40% and 20% of the K proxy, respectively. A 3-year running median[1] was used to smooth data points and 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.

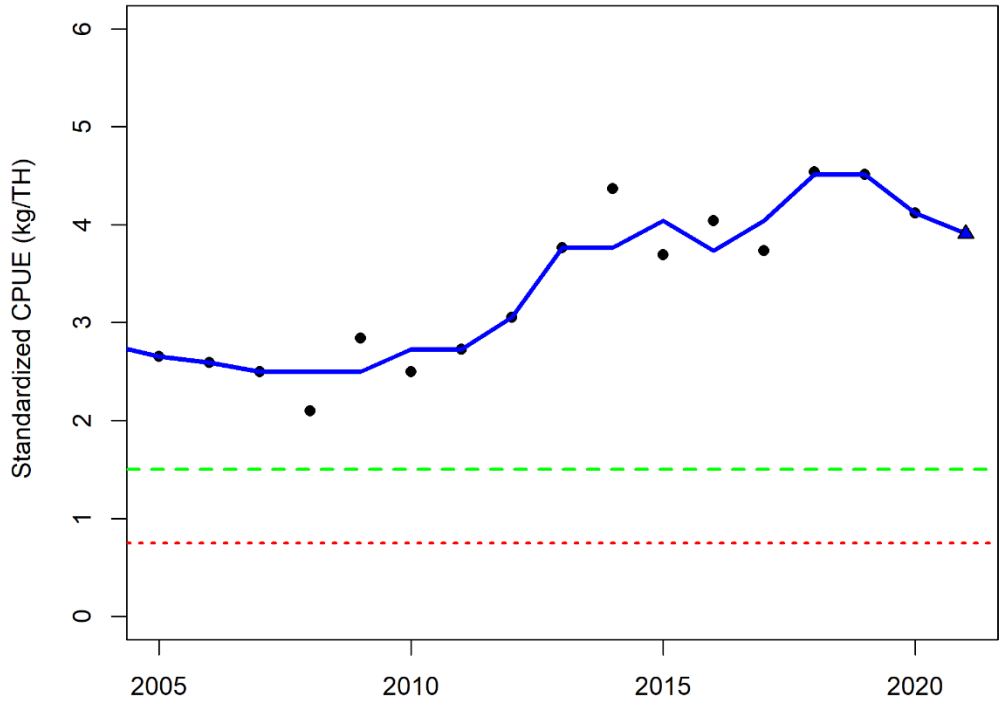

Figure 2. Time series of standardized commercial catch rates (kg/trap haul; black dots) for LFA 36, along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (dashed green line) and Limit Reference Point (dotted red line). The data for 2020–2021 fishing season are incomplete (grey triangle).

The trend in CPUE for LFA 36 indicates that an increase in stock biomass 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 2020–2021 season is 3.75 kg/TH. This is above the USR (1.50 kg/TH) and LRP (0.75 kg/TH). The CPUE for 2020–2021 is 3.91 kg/TH. This is preliminary due to outstanding logs[2]; as of September 17, 2021, the monthly reporting rate was between 68% to 76% by month.

[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.

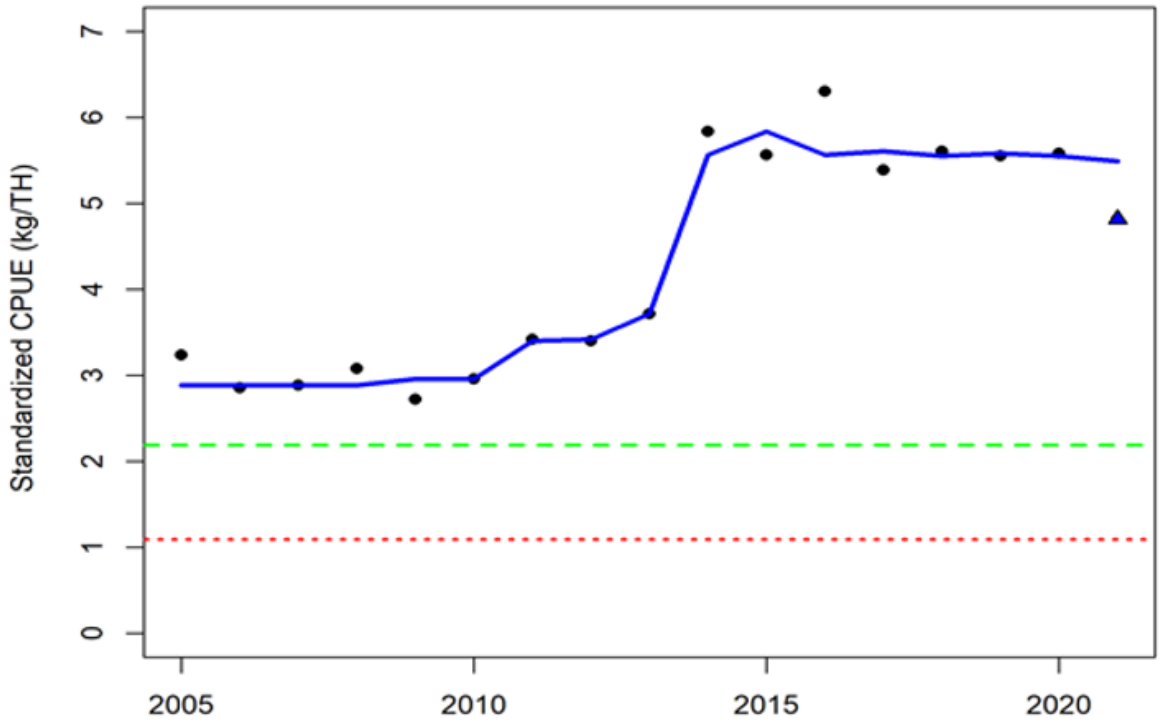

Figure 3. Time series of standardized commercial catch rates (kg/trap haul; black dots) for LFA 38, along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (dashed green line) and Limit Reference Point (dotted red line). The data for 2020–2021 fishing season are incomplete (grey triangle).

The CPUE trend for LFA 38 indicates an increase in stock biomass occurred between 2013 and 2014 (Figure 3). The CPUE time-series has remained high (more than twice the USR) since 2014. The 3-year running median for CPUE for the 2020–2021 season is 4.82 kg/TH. This is above the USR (2.19 kg/TH) and the LRP (1.09 kg/TH). The CPUE for 2020–2021 is 4.82 kg/TH. This is preliminary due to outstanding logs; as of September 17, 2021, the monthly reporting rate was between 80% to 88% by month.

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, as well as recruit abundance, commercial biomass, and relative fishing mortality estimates from the RV survey Bay of Fundy region (strata 484, 490–495 with sets occurring within the boundaries of LFAs 35–38). Scallop survey Lobster recruit abundance is not included in this update as the survey was not conducted in 2020, and it was not completed for the 2021 season at the time of this update.

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. Figures 4 and 5 have been updated to include the preliminary data for the 2020–2021 fishing season. Effort in the corresponding 2020 figures were calculated incorrectly due to the use of the wrong calibration (DFO 2021b), and that has been corrected in the figures below.

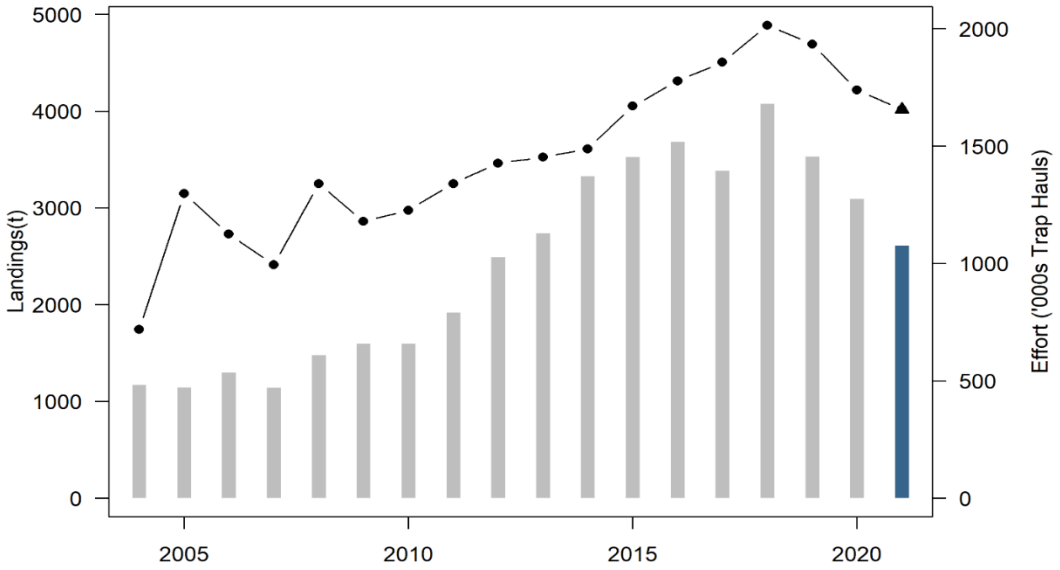

Figure 4. Time series of landings (grey bars) and effort (black line with points) for LFA 36. The data for 2020–2021 fishing season are incomplete due to outstanding logs (blue bar for landings, black triangle for effort). The effort time-series has been corrected to address an error in the previous calculation in the 2020 stock status update (DFO 2021b).

The historical landings in LFA 36 between 1947 and 1980 had a median of 227 t with a range of 47–338 t, then increased slightly between 1981 and 1996 to a median of 268.5 t (range of 156–427 t), and again from 1997 to 2010 there was a steady increase in landings to 1,594 t (Cook et al. In press[1]). From 2010–2020, median landings were 3,325 t (range of 1,594–4,073 t). In recent years, LFA 36 landings have varied and, despite a decline since 2018, remain relatively high for the time series. The landings for 2020–2021 season are 2,612 t but do not represent the total for the season due to the outstanding logs previously mentioned.

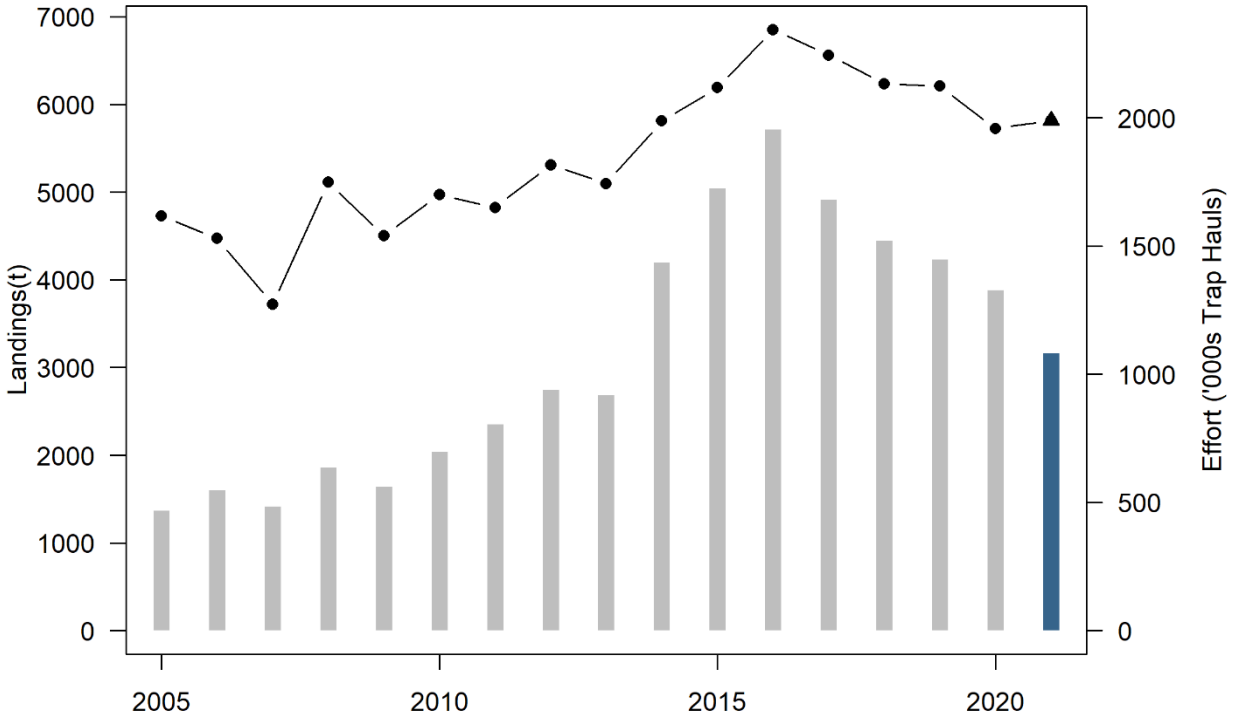

Figure 5. Time series of landings (grey bars) and effort (black line with points) for LFA 38. The data for 2020–2021 fishing season are incomplete due to outstanding logs (blue bar for landings, black triangle for effort). The effort time-series has been corrected to address an error in the previous calculation in the 2020 stock status update (DFO 2021b).

The historical landings in LFA 38 between 1947 and 1988 had a median of 325 t with a range of 170–450 t, then increased between 1989 and 1997 to a median of 512 t (range 467–661 t), and again from 1997–2013 there was a steady increase in landings to 2,682 t (Cook et al. In press[1]). From 2010–2020, median landings were 4,196 t (range of 2,035–5,711 t) and, in the more recent years, LFA 38 landings have varied. Despite a decline since 2016, landings remain relatively high for the time series. The landings for 2020–2021 season are 3,163 t but do not represent the total for the season due to the outstanding logs previously mentioned.

DFO RV Survey Commercial Biomass and Recruit Abundance

Despite strata boundaries from the RV survey having significant overlap with LFAs 35–38, there were few (< 20 per year) sets within each LFA, suggesting that the value of indicators derived from these data was limited. Extending the commercial survey biomass 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 from 2000–2004, with a variable but increasing trend from 2010–2018; however, survey catch rates in the last two years were the lowest in the last 10 years (Figure 6). The size-at-maturity for Lobster in 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.

Data from the 2021 RV survey were not available; Figures 6, 7, and 8 only include results up to the end of the 2020 survey. Continued monitoring of fisheries-independent data sources is a high priority for DFO Science.

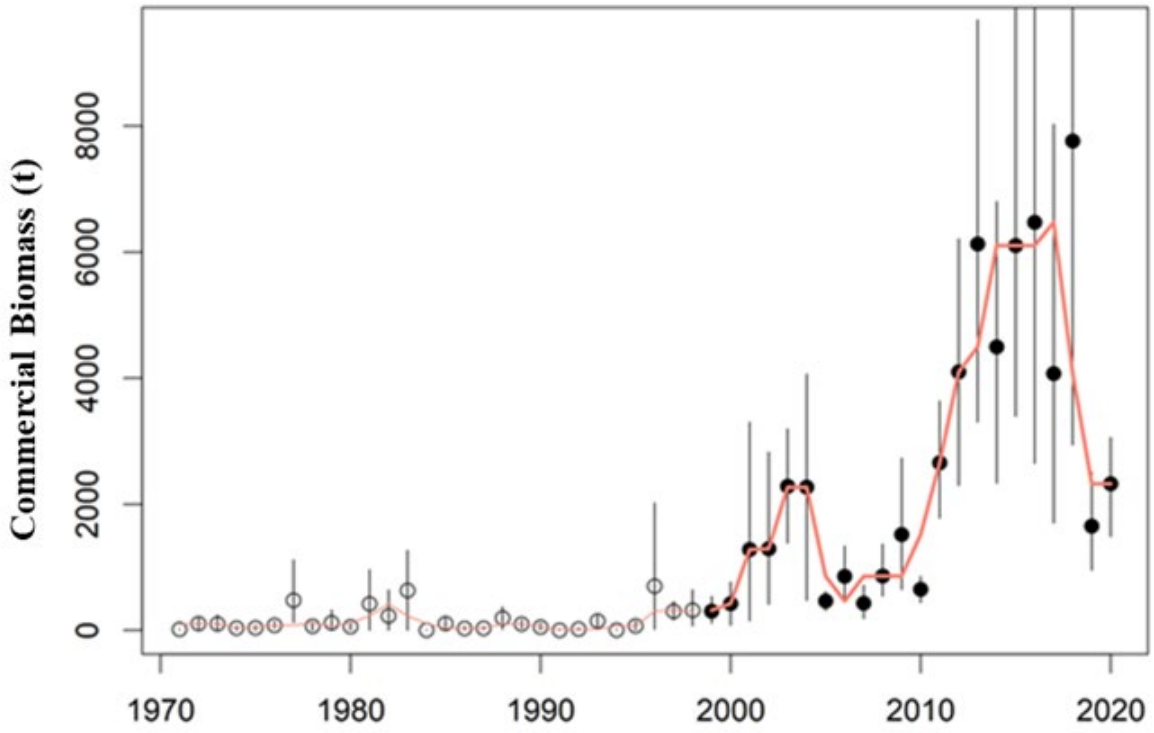

Figure 6. Time series of RV survey trends for LFA 35–38 commercial biomass. Values prior to 1999 (open circles) were derived using the mean proportion of commercial to total biomass between 1999 and 2018 (0.746), error bars are 95% bootstrapping confidence intervals.The red line represents the 3-year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

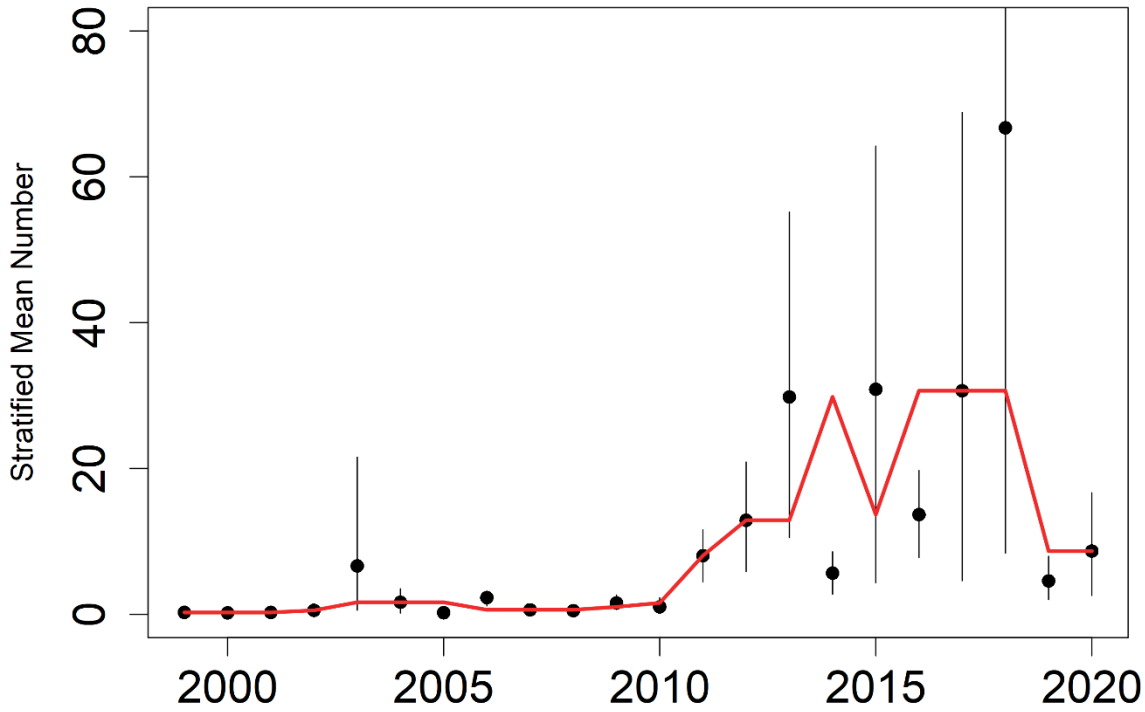

Figure 7. Time series of DFO Summer RV Survey trends for LFAs 35–38 recruit abundance (70–82 mm carapace length). Y-axis represents the stratified mean number of recruits per tow from the Summer RV Survey. The red line represents the 3-year running median. Error bars are 95% bootstrapping confidence intervals.

RV survey recruit abundance (70–82 mm CL) exhibits increases from 2010–2013, followed by variable catch rates at a substantially higher level than has been observed in the time series (Figure 7). Recruit abundance has decreased in 2019 and 2020.

Relative Fishing Mortality

Relative fishing mortality (relF) uses both the RV survey commercial biomass estimates and landings from LFA 35–38 to show the changes in removals (C_t) relative to the survey indices (I_t; assuming a catchability of 1). As the 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 is an index of fishing mortality (F).

The 3-year running median of relF reflects the variation in the commercial biomass index. A dramatic decline in the early 1980s is a result of few sampling stations with low and variable catches in the RV survey. RelF decreases between the late 1990s and early 2000s, increases to 2010, then decreases to 2013 with variable but low estimates since 2013 (Figure 8). Tracking

the relF for the Bay of Fundy provides a depiction of the patterns observed across the larger area.

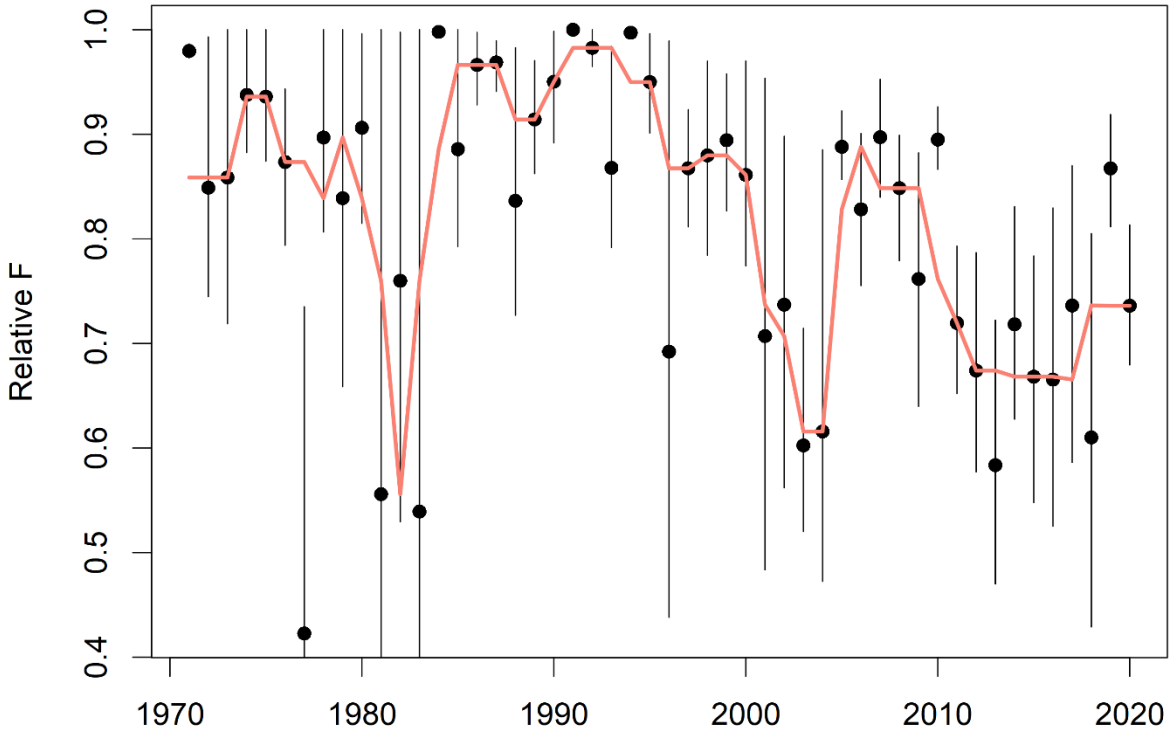

Figure 8. Relative fishing mortality (F) from the Research Vessel survey commercial biomass estimates and the landings in LFA 35–38. Red line represents the 3-year running median, error bars are 95% bootstrapping confidence intervals.

Conclusions

The primary indicator of stock status, CPUE, remains well above the USR in both LFAs 36 and 38. Both LFAs 36 and 38 remain in the healthy zone despite declines since 2018 and 2016, respectively. Given the monthly reporting rate is currently between 68% to 76% for LFA 36 and 80% to 88% for LFA 38, landings appear to be on track. As of 2020, there has been an increase in total, commercial, and recruit abundance. Between 2018 and 2019, however, a large decline was evident in both commercial biomass and recruit abundance. In 2020, these values were marginally higher than 2019 but well below the highs observed between 2012 and 2018. Across most of the indicators (CPUE, commercial biomass, and recruit abundance), the productivity of the last two years was low compared to 2012–2018. LFA 36 and 38 Lobster stocks continue to be in a productive period and currently remain in the Healthy Zone.

Contributors

Name	Affiliation
Victoria Howse (Lead)	DFO Science, Maritimes Region
Adam Cook	DFO Science, Maritimes Region
Yanjun Wang	DFO Science, Maritimes Region
Melanie Barrett	DFO Science, Maritimes Region
Ben Zisserson	DFO Science, Maritimes Region
Cheryl Denton	DFO Science, Maritimes Region
Geraint Element	DFO Science, Maritimes Region
Rabindra Singh	DFO Science, Maritimes Region
Una Goggin	DFO Science, Maritimes Region
Verna Docherty	DFO Resource Management, Maritimes Region

Approved by

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

Date: 29 November 2021

Sources of Information

DFO. 2009. A fishery decision-making framework incorporating the precautionary approach.

DFO. 2021a. Assessment of American Lobster (*Homarus americanus*) in Lobster Fishing Areas 35–38. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2021/020.

DFO. 2021b. 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.

Drinkwater, K.F., M.J. Tremblay, and M. Comeau. 2006. The influence of wind and temperature on the catch rate of the American Lobster (*Homarus americanus*) during spring fisheries off eastern Canada. Fish. Oceanogr. 15(2): 150–165.

Miller R.J., and Rodger R.S. 1996. Soak Times and Fishing Strategy for American Lobster. Fisheries Research. 26(3–4): 199–205.

This Report is Available from the:

Center for Science Advice (CSA)
Maritimes Region
Fisheries and Oceans Canada
Bedford Institute of Oceanography
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/

ISSN 1919-3769
ISBN 978-0-660-41641-0 Cat. No. Fs70-7/2022-006E-PDF

Correct Citation for this Publication:

DFO. 2022. Stock Status Update of Lobster (*Homarus americanus*) in Lobster Fishing Areas 36 and 38 for 2021. DFO Can. Sci. Advis. Sec. Sci. Resp. 2022/006.

Aussi disponible en français :

MPO. 2022. Mise à jour de l'état du stock de homard (Homarus americanus*) des zones de pêche du homard 36 et 38 for 2021. Secr. can. des avis sci. du MPO. Rép. des Sci. 2022/006.*