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Canadian Science Advisory Secretariat
Maritimes Region **Science Response 2023/008**

STOCK STATUS UPDATE OF LOBSTER (*HOMARUS AMERICANUS*) IN LOBSTER FISHING AREAS 36 AND 38 FOR 2022

Context

The scientific basis for assessing the status of American Lobster (*Homarus americanus*) in Lobster Fishing Areas (LFAs) 36 and 38 was reviewed at a framework meeting in September 2019 (Cook et al. In press), followed by an assessment of the status of the Lobster resources in LFAs 35–38 in October 2019 (DFO 2021a), and yearly updates (DFO 2021b, DFO 2022). One primary indicator and three secondary indicators that describe changes in Lobster abundance and biomass, along with reference points for the primary indicator, were defined at the framework meeting. A suite of indicators is applied from the 2019 assessment framework to update the stock status of Lobster to the end of the 2021–2022 fishing season, where data are available.

This Science Response Report results from the Regional Peer Review of September 23, 2022 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 LFAs 36 and 38 licence holders by way of licence conditions. Landings from LFA 37 are attributed to the respective LFA 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 licensing, 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 (per licence), 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. As the fishing season spans two calendar

years, each season is referred to using the year the season ended, i.e., the 2021–2022 season will be referred to throughout as the 2022 season.

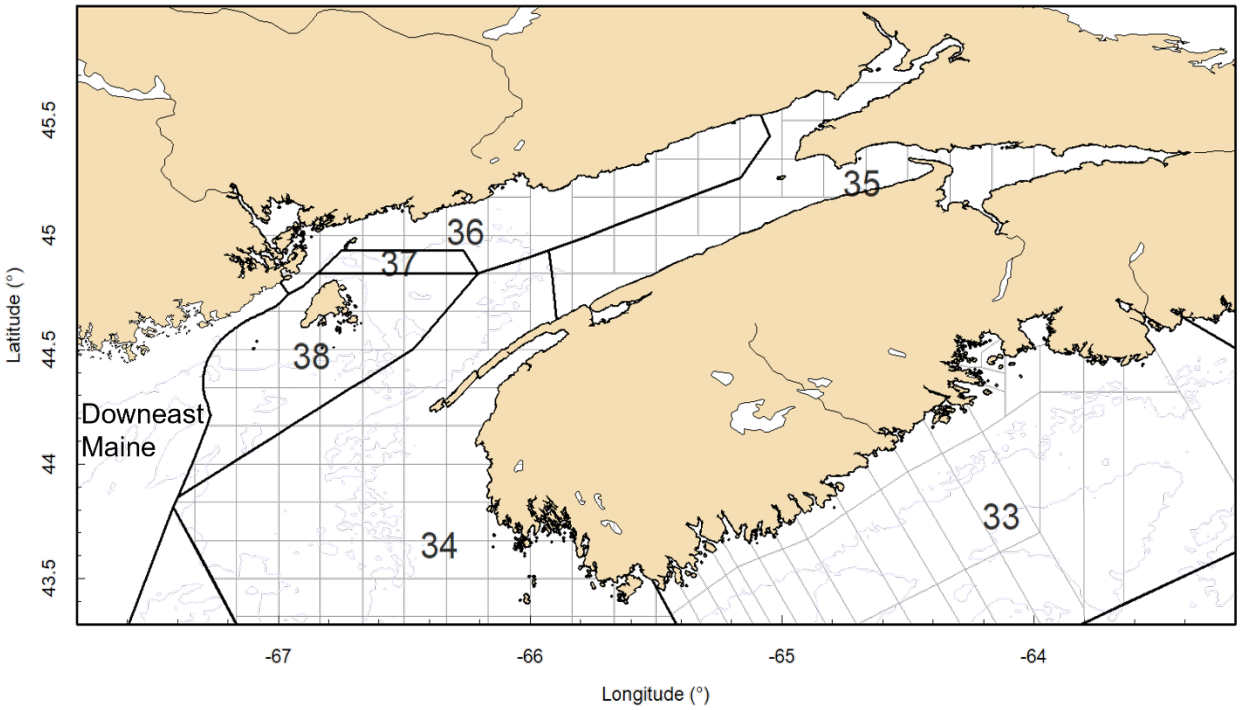

Figure 1. Map of Lobster Fishing Areas (LFAs) 36–38 with logbook reporting grids outlined in grey.

Analysis and Response

Indicators of stock status

The stock status of the Lobster in LFAs 36 and 38 is assessed using primary, secondary, and contextual indicators. This update includes the primary indicator that is used to define stock status in relation to reference points defined in Cook et al. (In press.[1]) and secondary indicators that 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. Fishery-dependent data consist of commercial logbooks that report information on date, location (grid), effort (number of traps hauled), and estimated catch. The fishery-independent data sources are from the DFO Maritimes Region Summer Research Vessel Survey (herein RV survey), and the DFO Inshore Scallop Science survey. Indicators from surveys are updated where data are available.

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. This is especially important in effort-controlled fisheries. The commercial fishing data used to estimate CPUE were obtained from mandatory logbooks that have been implemented since 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 on 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 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.

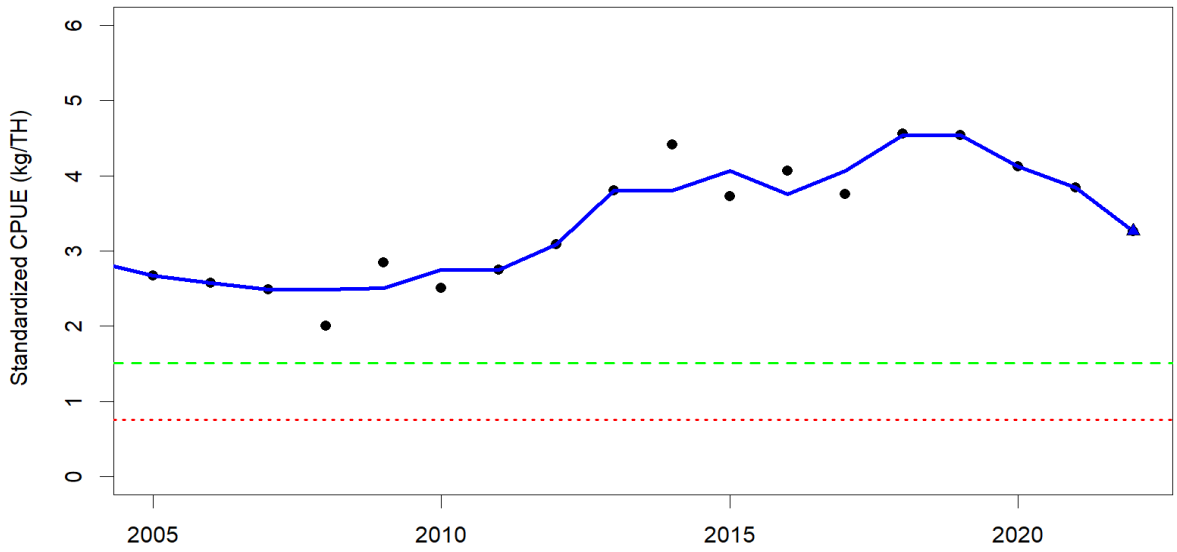

Figure 2. Time series of standardized commercial catch rates (kg/trap haul; black dots) for LFA 36, along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (dashed green line) and Limit Reference Point (dotted red line). The data point for 2021–2022 is uncertain due to incomplete fishing data and lack of 2022 temperature data in the CPUE standardizations (blue triangle).

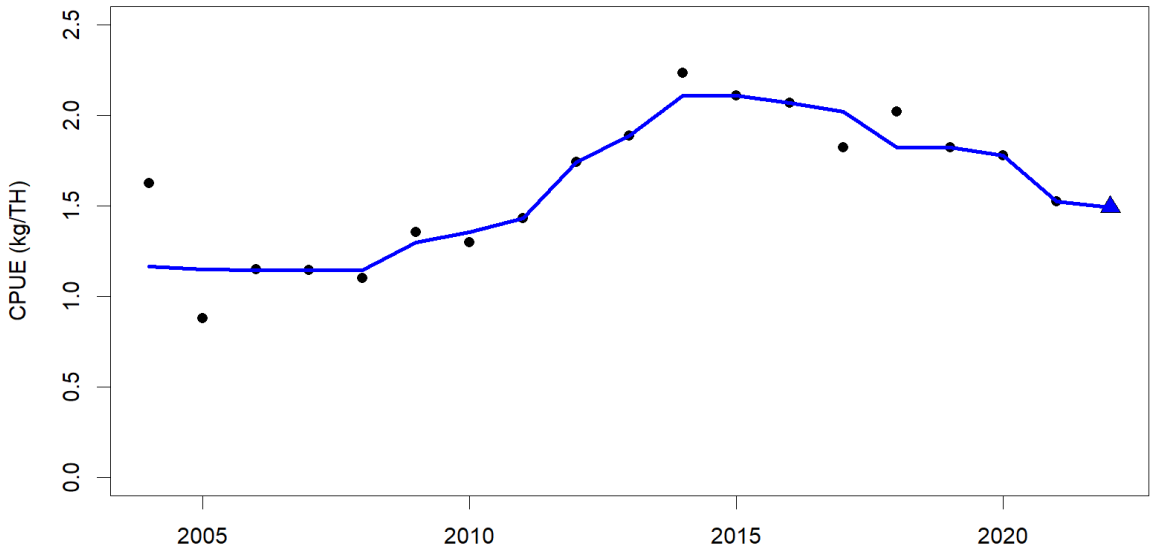

Figure 3. Time series of unstandardized commercial catch rates (kg/trap haul; black dots) for LFA 36. The data for 2021–2022 fishing season are incomplete (blue triangle).

The trend in the standardized CPUE for LFA 36 indicates that an increase in stock biomass occurred between 2009–2012 (Figure 2). Standardized CPUE has remained high (more than twice the USR) since 2013. The 3-year running median for CPUE for the 2022 season is 3.27 kg per Trap Haul (kg/TH), which is above the USR (1.51 kg/TH) and LRP (0.75 kg/TH). There are uncertainties in the Standardized CPUE estimate for 2022. Firstly, it is preliminary due to outstanding logs; as of August 23rd, the monthly reporting rate was between 51% to 72% for the 2021–2022 fishing season. Secondly, temperature data incorporated into the standardized CPUE estimates were unavailable for 2022 at the time of this update, so the CPUE standardization model only includes temperature data up to 2021. In the standardized CPUE model, the average daily temperatures from the previous 3 years were used for 2022 (Figure 2). Despite the uncertainties, it is believed that the stock status in 2022 is well above USR for LFA 36. Unstandardized CPUE, calculated from logbook data was included for comparison purposes (Figure 3).

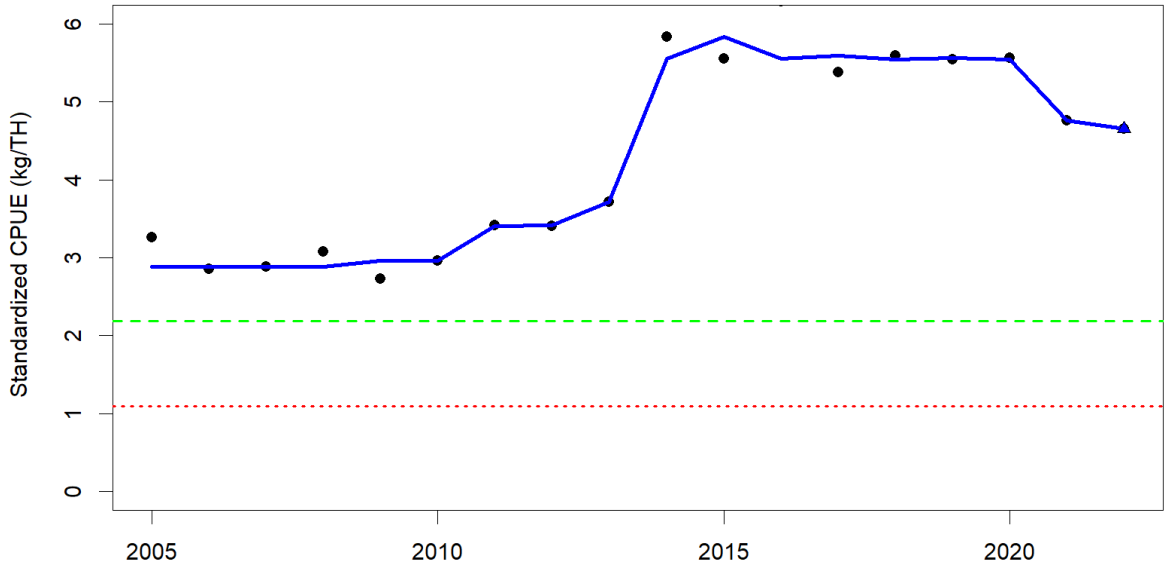

Figure 4. Time series of standardized commercial catch rates (kg/trap haul; black dots) for LFA 38, along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (dashed green line) and Limit Reference Point (dotted red line). The data point for 2021–2022 is uncertain due to incomplete fishing data and lack of 2022 temperature data in the CPUE standardizations (blue triangle).

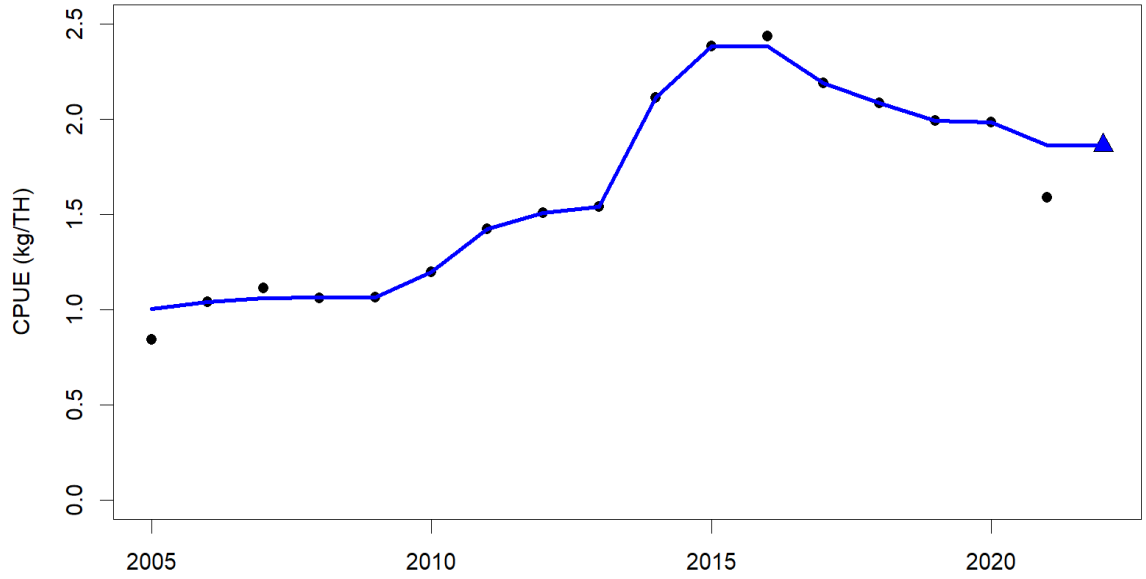

Figure 5. Time series of unstandardized commercial catch rates (kg/trap haul; black dots) for LFA 38. The data for 2021–2022 fishing season are incomplete (blue triangle).

The trend in the standardized CPUE for LFA 38 indicates an increase in stock biomass occurred between 2013 and 2014 (Figure 4). The CPUE time-series has remained high (more than twice the USR) since 2014. The 3-year running median for CPUE for the 2021–2022 season is

4.65 kg/TH. This is above the USR (2.18 kg/TH) and the LRP (1.09 kg/TH). For the same reasons, related to uncertainties, as that of LFA 36, this CPUE estimate is preliminary due to outstanding logs; as of August 23rd, 2022, the monthly reporting rate was between 67% to 86% by month for the 2021–2022 fishing season. Temperature data incorporated into the standardized CPUE estimates were unavailable for 2022 at the time of the update, so the model CPUE model only includes temperature data up to 2021. In the standardized CPUE model, the average daily temperatures from the previous 3 years were used for 2022 (Figure 4). Despite the uncertainties, it is believed that the stock status in 2022 is well above USR for LFA 38. Unstandardized CPUE, calculated from logbook data was included for comparison purposes (Figure 5).

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). This update does not include total, commercial and recruit abundance from the DFO RV survey due to incomplete surveys (COVID-19 global pandemic), and unavailable survey data until calibration coefficients for the new research vessel and gear are generated. Additionally, recruit abundance from the DFO Inshore Scallop Science survey are included in this update for the first time since the assessment with the data available at the time of this meeting (DFO 2021a).

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 trap hauls (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.

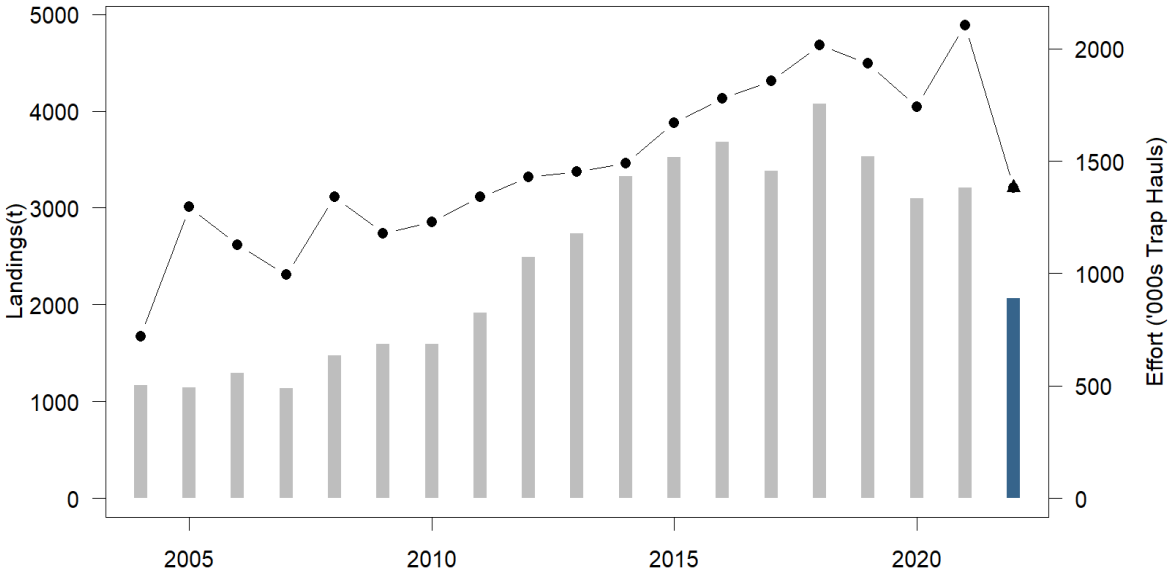

Figure 6. Time series of landings (bars) and effort (sold line with points) for LFA 36. The data for 2021–2022 fishing season is incomplete (blue bar for landings, black triangle for effort).

The historical landings in LFA 36 between 1947 and 1980 had a median of 227 t with a range of 47–338 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). From 2010–2022, median landings were 3,205 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 2021–2022 season are 2,064 t but do not represent the total for the season due to the outstanding logs (Figure 6).

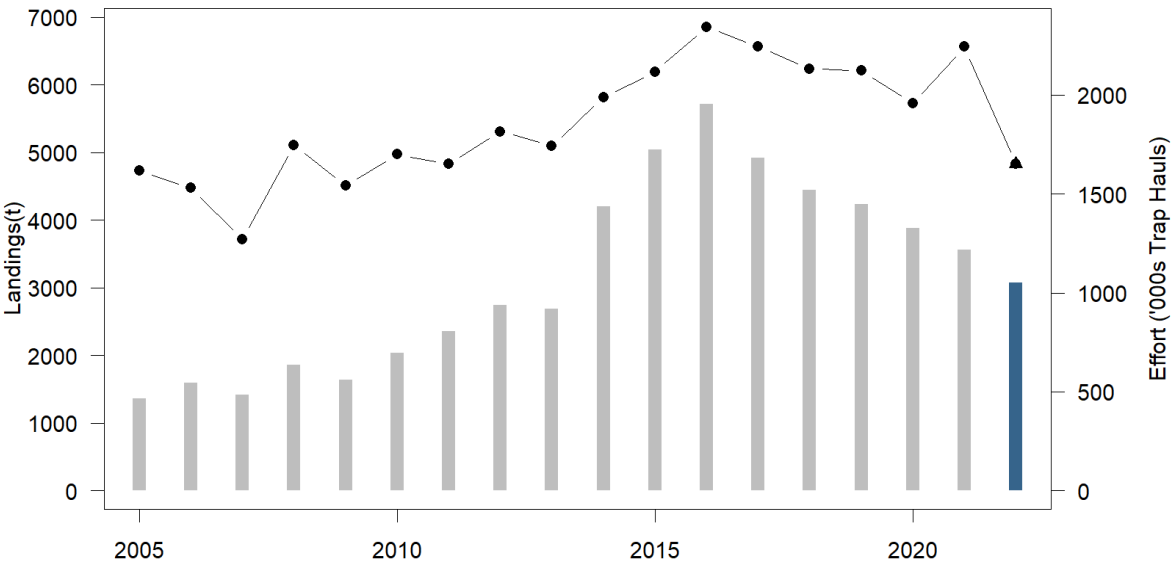

Figure 7. Time series of landings (bars) and effort (sold line with points) for LFA 38. The data for 2021–2022 fishing season is incomplete (blue bar for landings, black triangle for effort).

The historical landings in LFA 38 between 1947 and 1988 had a median of 325 t with a range of 170–450 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 2010–2022, median landings were 3,882 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 2021–2022 season are 3,076 t but do not represent the total for the season due to the outstanding logs (Figure 7).

Scallop Survey Recruit Abundance

Annual DFO surveys for Sea Scallops have been conducted since the early 1980s to assess abundance (Sameoto et al. 2012, Smith et al. 2012). These surveys started in the Bay of Fundy in 1981 and were extended into southwest Nova Scotia in 1991. Lobster are caught as bycatch in a subset of the stations and are measured prior to being released. Scallops are typically found on gravel sea bottoms, a habitat not favored by Lobster (Tremblay et al. 2009), but the two species do overlap in some areas. The surveys are primarily conducted in July for the Bay of Fundy (LFAs 35 and 36) and August around Grand Manan Island (LFA 38); scallop dredges tend to capture Lobster that are under the legal size, and the survey is a useful indicator of recruitment.

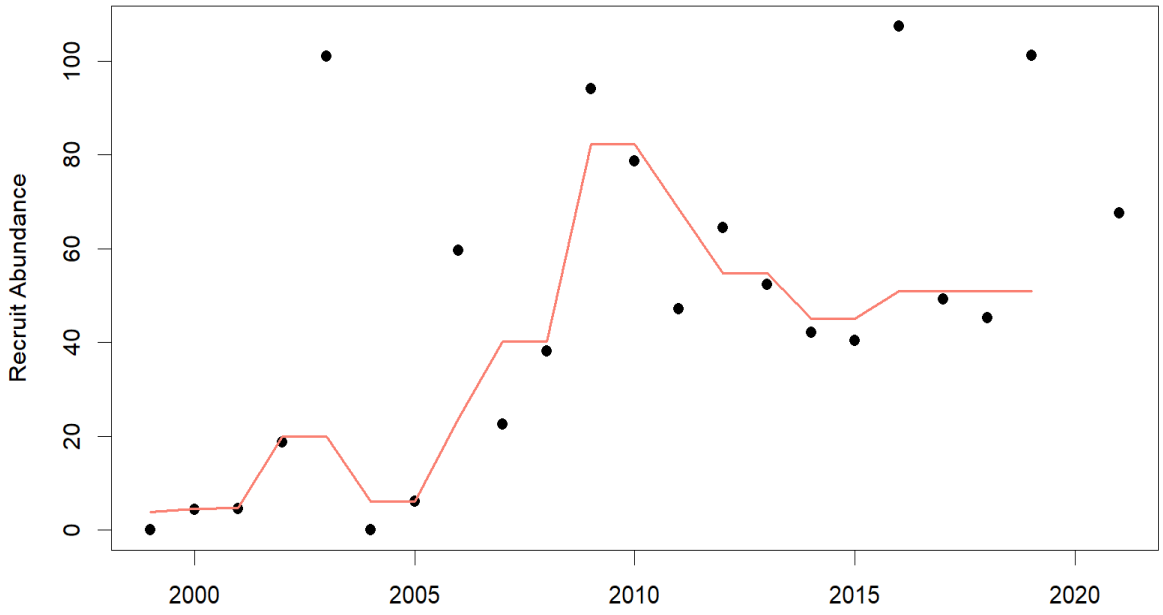

Figure 8. Time series of recruit abundance from the DFO Inshore Scallop Science survey in LFA 36. Black dots represent recruit abundance The red line represents the 3-year running median. Due to missing survey data in 2020, the 3-year running median could not be continued into 2021.

The abundance of Lobster recruits (70–82 mm CL) from DFO Inshore Scallop Science survey tows within LFA 36 had been increasing after 2005 and were variable but staying at higher levels compared to pre-2005. The most recent data point (2021) shows a decline from 2020. Surveys were not completed in 2020 due to the COVID-19 global pandemic (Figure 8), and 2022 data were not yet available at the time of this update.

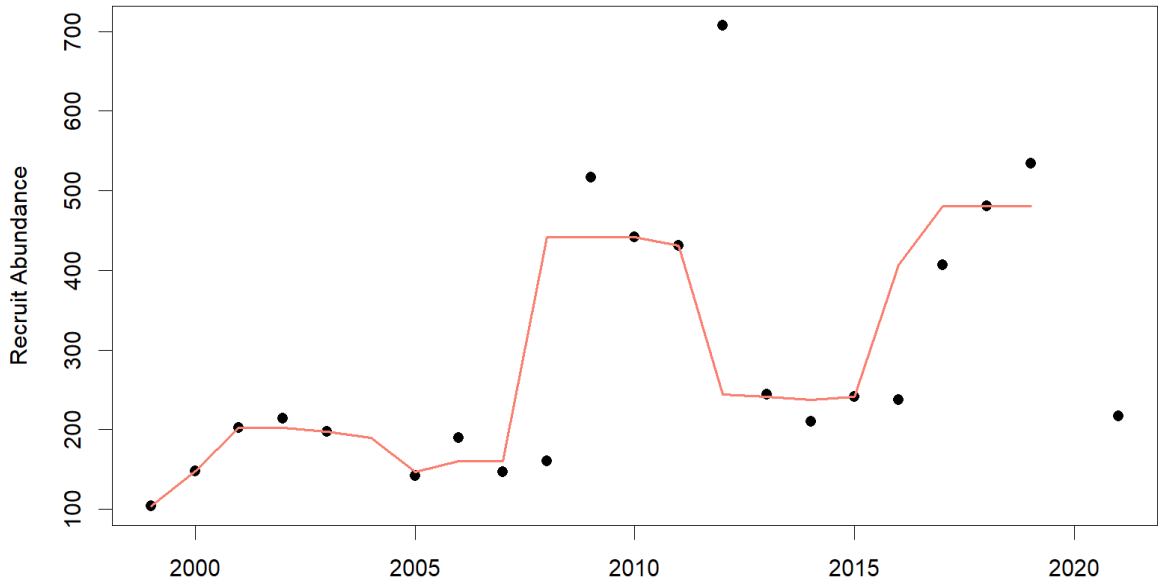

Figure 9. Time series of recruit abundance from the DFO Inshore Scallop Science survey in LFA 38. The red line represents the 3-year running median. Due to missing data in 2020, the 3-year running median could not be continued into 2021.

The abundance of Lobster recruits (70–82 mm CL) from DFO Inshore Scallop Science survey tows within LFA 38 have been variable. The early 2000s showed low recruit abundance, which was followed by 4 years of high (2009–2012) and then 4 years of low recruitment (2013–2016). Since 2016, abundance estimates increased with a return to low recruit abundance in 2021. Surveys were not completed in 2020 due to the COVID-19 global pandemic (Figure 9), and 2022 data were not yet available at the time of this update.

Conclusions

The primary indicator of stock status, CPUE, remains well above the USR in both LFAs 36 and 38. Given the reporting rate for landings is currently between 44% to 88% by month for LFA 36 and between 67% to 88% by month for LFA 38, annual landings appear to be on track with recent years. This update did not include total, commercial and recruit abundance from the DFO RV survey due to incomplete surveys, unavailable trawl calibration coefficients, and unavailable data. The most updated figures (to 2020) on commercial biomass, recruit abundance and relative fishing mortality can be found in the previous Science Response for LFA 36 and 38 (DFO 2022).

In LFA 36, CPUE shows a steady decline since 2019, and recruit abundance from the scallop survey shows high but variable estimates for recent years (2020 data not collected and 2022 not yet available). The LFA 36 stock remains in the Healthy Zone. In LFA 38, CPUE remains high with a small decline in 2021 and 2022, and recruit abundance from the scallop survey shows highly variable estimates in recent years with a low in 2021 (2020 data not collected and 2022 not yet available). The LFA 38 stock remains in the Healthy Zone.

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