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

Canadian Science Advisory Secretariat
Maritimes Region **Science Response 2021/029**

STOCK STATUS OF AMERICAN LOBSTER (*HOMARUS AMERICANUS*) IN LOBSTER FISHING AREAS 27–32 FOR 2020

Context

The scientific basis for assessing the status of American Lobster (*Homarus americanus*) in Lobster Fishing Areas (LFAs) 27–33 was examined at a framework meeting in January 2018, followed by an assessment of the status of the Lobster resources in LFAs 27–32 in February 2019. This update applies a suite of indicators from the 2018 framework to the stock status up to the end of the 2020 season, wherever possible. Primary stock-status indicators for Lobster in LFAs 27–32 meet the intent of Fisheries and Oceans Canada (DFO) precautionary approach and allow for the evaluation of stock status. This Science Response Report results from the Science Response Process of January 27, 2021, on the Stock Status Update of American Lobster in Lobster Fishing Areas (LFAs) 27–32.

The advent of the COVID-19 global pandemic early in 2020 affected the Lobster fishery in various ways. See “Sources of Uncertainty” section in this document for details.

This update contains information to the end of the commercial fishing seasons in 2020. Following the commercial season, a “moderate livelihood” fishery was prosecuted by Indigenous fishers in some LFAs. These commercial landings are not included in annual landings reported herein. Any removals after the commercial season would not affect the stock status indicators presented herein but will need to be considered in future assessments.

Background

Description of the Fishery

The commercial fishery for American Lobster has been active for over 100 years in LFAs 27–32. LFAs 27–32 cumulatively cover 62,800 km^2 from northern Cape Breton to Hartland Point. Although the LFAs extend out to 92 km (50 nautical miles), colder water temperatures with increasing depth generally limit fishing to 5 km offshore in northeastern Cape Breton and to within 20 km from shore along the south coast of Nova Scotia. The fishery is effort controlled, with restrictions on the number of licences, the number of traps per licence (250 in LFAs 28–32 or 275 in LFA 27), the Minimum Legal Size (MLS) (82.5 mm in LFAs 27 and 30–32, and 84 mm in LFAs 28 and 29), and a prohibition on the retention of berried females (Cook et al. 2020).

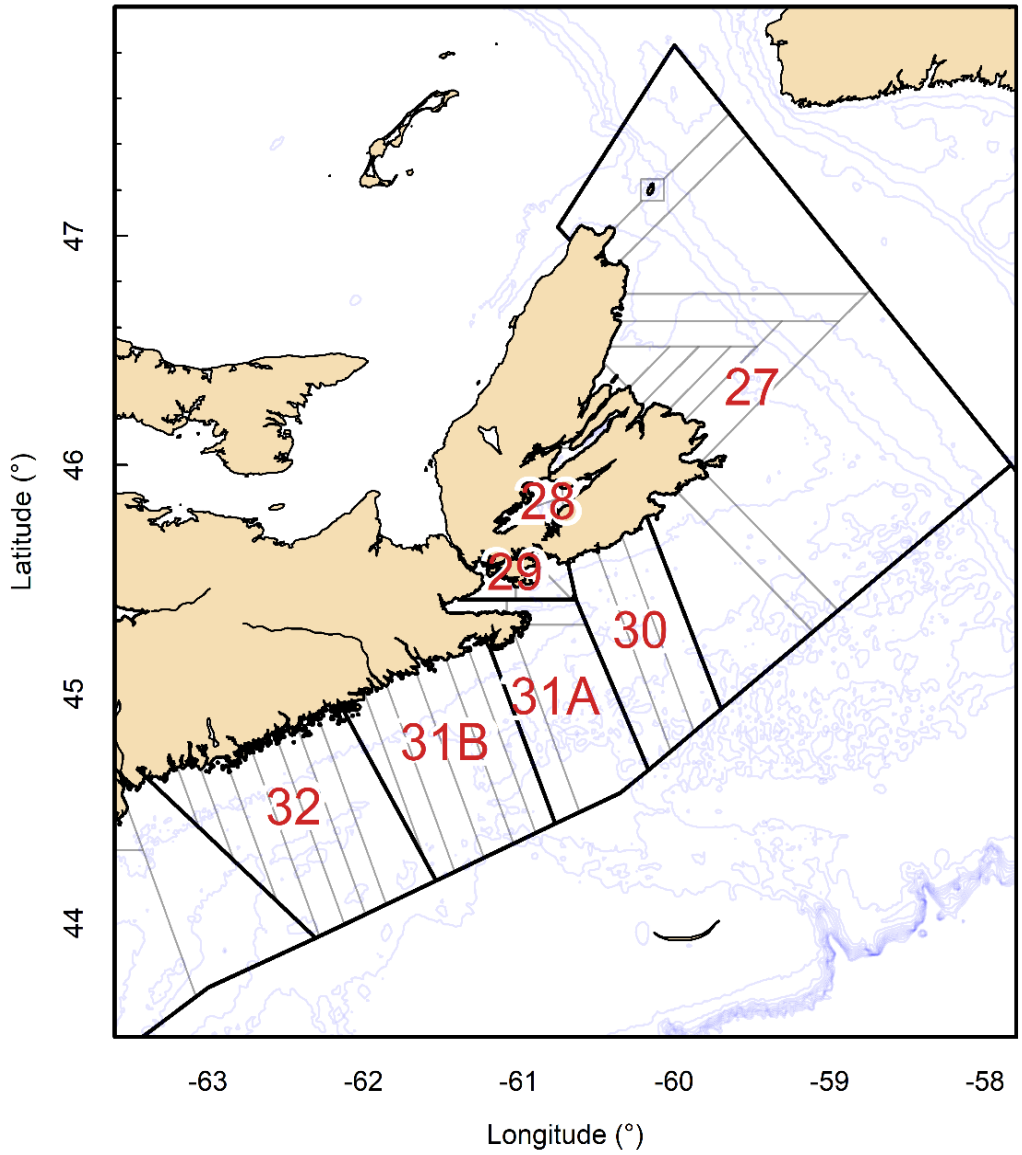

Figure 1. Map of Lobster Fishing Areas 27–32 with logbook reporting grids outlined in grey.

Analysis and Response

Indicators of Stock Status

The status of the Lobster stocks in LFAs 27–32 are fully assessed using primary, secondary, and contextual indicators. This update will include the primary indicators that are used to define stock status in relation to reference points defined in Cook et al. (2020) and secondary indicators that display time-series trends but do not have reference points. The data sources available for establishing indicators for LFAs 27–32 are primarily fishery dependent. Commercial logbooks report information on date, location (grid), effort, and estimated catch.

Primary Indicators

In LFAs 27 and 29–32, there are two primary indicators: one to define stock status and one to describe the level of fishing pressure. Both indicators are compared to reference points. Due to the data limitations for LFA 28, it is not possible to estimate the primary indicator describing the level of fishing pressure. The primary indicator for describing stock status is the commercial Catch Per Unit Effort (CPUE). Fishing pressure is described using an exploitation index estimated from the Continuous Change In Ratio (CCIR) method (Claytor and Allard 2003).

Stock Status: Catch Per Unit Effort

In LFAs 27–32, the time series of commercial catch rates comprise two data sources: (1) voluntary logbooks, which began in the 1980s and continued until 2013; and (2) mandatory logbooks, which have been in place since the mid-2000s and provide a more complete data set (across entire fleet) to evaluate changes in catch rates (Tremblay et al. 2012). In years where both voluntary and mandatory logbooks were available, the magnitude and trends over time were similar (Tremblay et al. 2013), so both datasets were used as a continuous time series. The combined catch-rate data series from 1990–2016 was used to define the Upper Stock Reference (USR) and Limit Reference Point (LRP). This period represents both low- and high-productivity time periods and covers approximately 2 generations. The median of this time series was used as a proxy of Biomass at Maximum Sustainable Yield (B_{MSY}). Following the recommendations of DFO (2009), the USR and LRP were set to 80% and 40% of the B_{MSY} proxy. The 3-year running median is used to compare the commercial catch rates to the USR and LRP. This value will dampen the impact of any inter-annual variability, which may occur due to factors outside of changes in abundance.

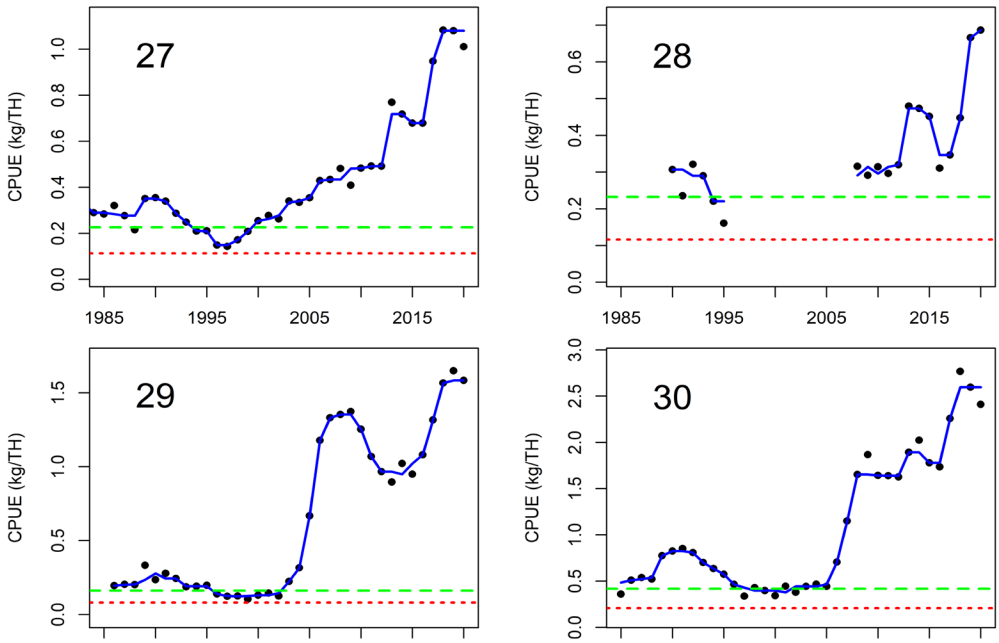

Figure 2. Time series of commercial catch rates in kg/trap hauls (black points), along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (dashed green line) and Limit Reference Point (dotted red line). Limited data and privacy rules (disallowing the showing of information for < 5 fishers) account for the apparent data gap in LFA 28. Note: Different scales used on y-axes.

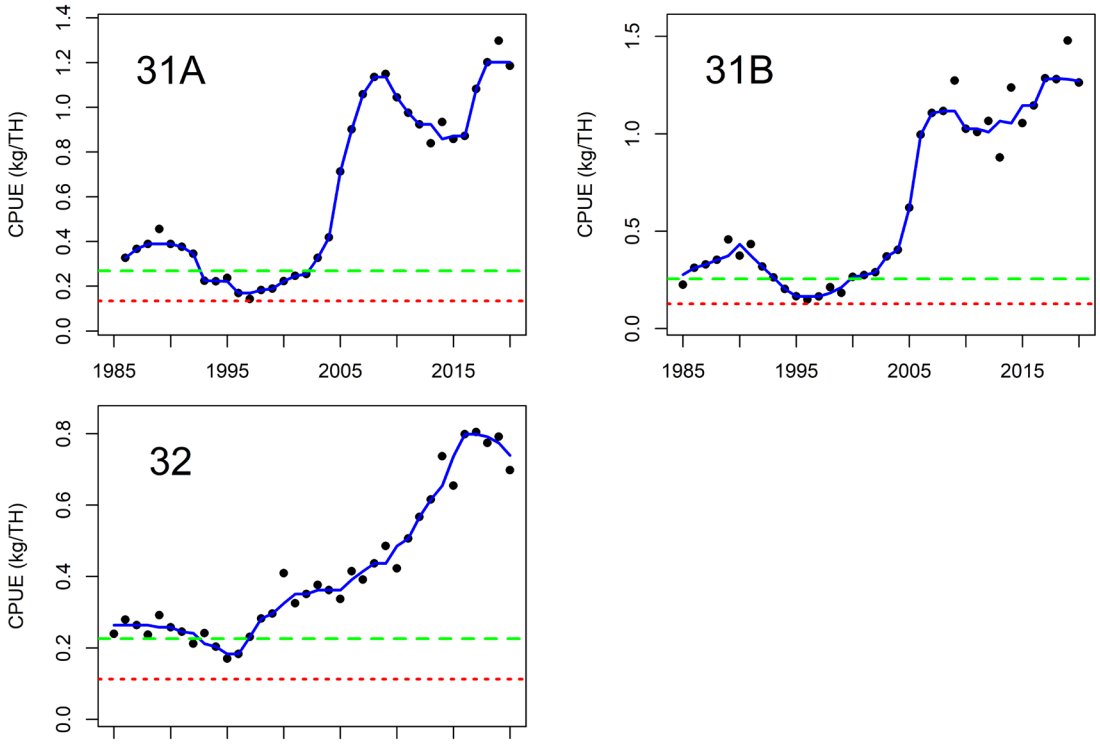

Figure 3. Time series of commercial catch rates in kg/trap hauls (black points), along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (dashed green line) and Limit Reference Point (dotted red line). Note: Different scales used on y-axes.

Except for LFA 28, all the LFAs show an increasing CPUE / biomass trend over the past 20 years, with minor decreases in 2020 as compared to 2019 (Figures 2 and 3). The 2020 catch rates may be affected by modified fishing practices as a result of COVID-19. See “Sources of Uncertainty” section for more details.

CPUE trends for LFA 27 indicate a constant increasing trend in biomass since a low in 1997. The 2020 CPUE was down slightly but remains near historic highs. In LFA 28, CPUE continues to rise after a dip in 2015–2016. CPUE for LFA 29 has been rising since 2015, after a five-year declining/flat trend. The 2020 catch rates for LFA 29 were only slightly lower than 2019. LFA 30 CPUE has declined each of the last two seasons but remains near historic highs. In LFA 31A, CPUE declined slightly last season from a historic high in 2019. CPUE increases began in 2004 in LFA 31B and continued to rise until 2019 with a slight decrease in 2020. LFA 32 has experienced a steady increase in CPUE since an extreme low in 1995. It had been relatively constant at historic high levels from 2016–2019 with a minor decrease in 2020. For all LFAs from 27–32, CPUE is well above the USR and LRP, and CPUEs are among the highest levels in the time series. As such, all stocks are considered to be in a healthy productivity state.

Fishing Pressure: Continuous Change In Ratio

The CCIR method is used as an indicator of fishing pressure. It is based on recruitment-trap data and reflects trends in exploitation. It provides indices of exploitation by modelling the change in proportion of two monitored components of the population, consisting of a reference (non-exploited) component and an exploited component. The premise of this method is the

proportion of reference individuals within the population will increase with the cumulative removals from the exploitable component (Claytor and Allard 2002).

The Removal Reference (RR) was defined as the 75th quantile of the posterior distribution of the maximum modeled CCIR exploitation rate. Given that regional Lobster stocks are currently in a highly productive state and population growth has not decreased under the range of estimated exploitation, it is reasonable to assume the RR is less than the fishing mortality (F) corresponding to Maximum Sustainable Yield, F_{MSY}.

The time series of exploitation estimates is shown in Figure 4. Though trends are variable across LFAs, all show a relatively flat trend over the entire time series and remain below the RR. Exploitation estimates have never exceeded the RR in any LFA within this time series. Exceeding the RR could indicate overfishing.

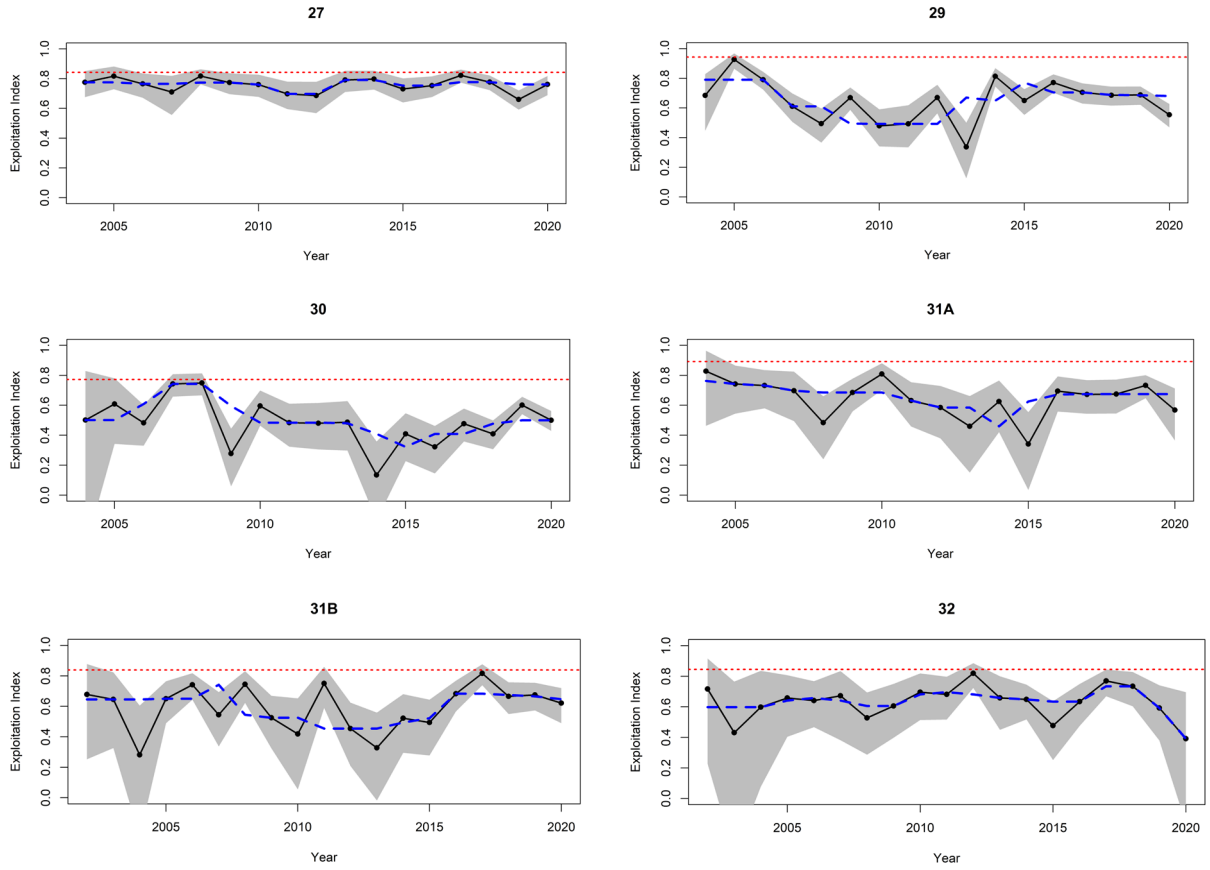

Figure 4. Time series of Continuous Change in Ratio exploitation indices (black), three-year running median (blue) with removal reference (dotted red line). 95% credible intervals are shaded.

Secondary Indicators

Secondary indicators represent time-series trends that are tracked individually, without defined reference points. The secondary indicators for LFAs 27–32 are landings and total effort, as well as the recruitment-trap project sub-legal- and legal-catch-rate series.

Landings and Effort

Levels of commercial landings are related to population biomass, as fishery controls are input based (effort controls) rather than output based (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 and effort.

Fishing effort can be used as a proxy for fishing pressure. It is an indicator of fisheries performance, as changes in landings can be due to changes in commercial-size biomass, fishing effort, or both. Fishing effort, recorded as the number of Trap Hauls (THs), in the Lobster fishery, is controlled by fishing-season length, trap limits, and a 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; however, prior to their widespread adoption, effort was calculated from CPUE and total catch.

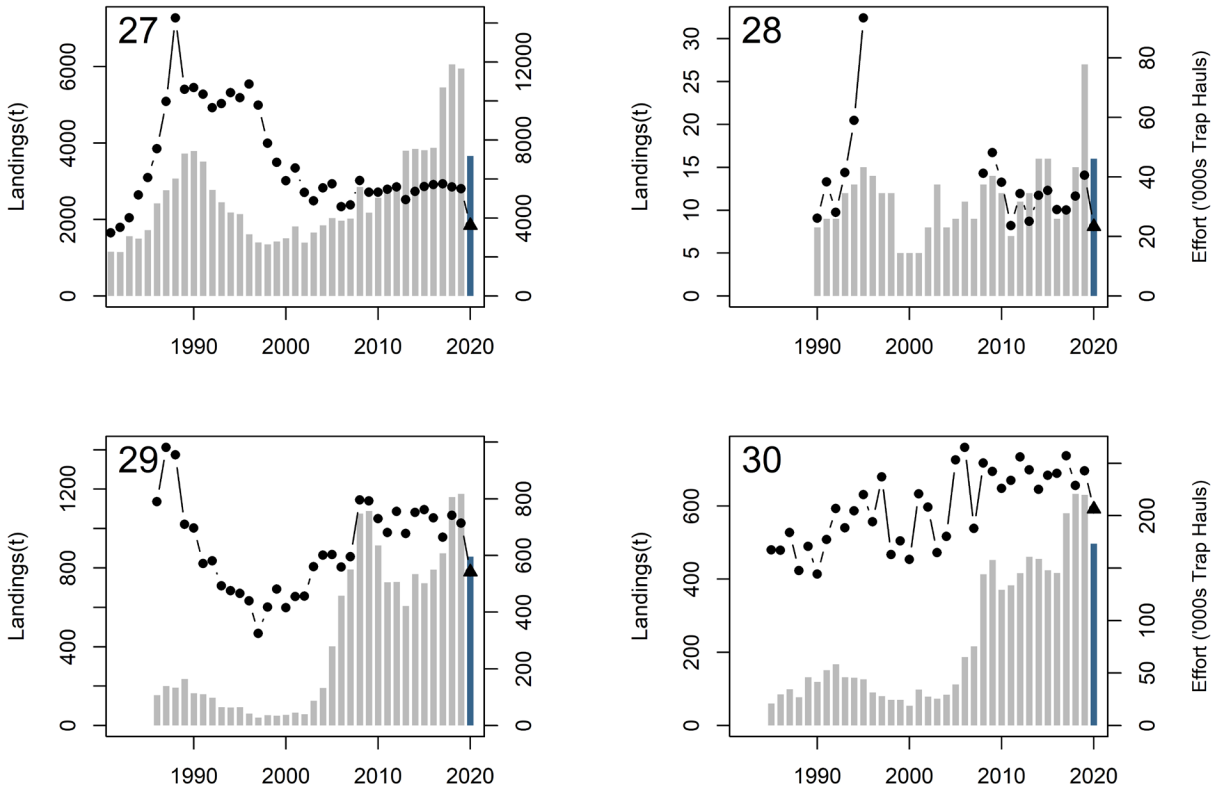

Figure 5. Time series of landings in tonnes (grey bars) and effort (line with points). Data for 2020 are incomplete (blue bar, triangle). Note: Different scales used on y-axes.

The 2020 landings for LFAs 27–32 are preliminary (as of January 4th, 2021), as there remains outstanding logbooks (approximately 10–15% in most LFAs), and 2019 and 2020 landings in LFA 27 do not include information from the Gulf Region (one port). COVID-related adverse market conditions likely affected landings in 2020, more so in some areas than others. (Further details are in the “Sources of Uncertainty” section of this document).

Landings in LFA 27 are expected to be below the record-high levels of 2018–2019 (Figure 5) though > 30% of logs are still outstanding. In LFA 28, even with incomplete data, the landings for 2020 already exceed recent years, other than the historic high landings of 2019. Landings in LFAs 29, 30, 31A, 31B, and 32 will likely not meet the historic high landings of 2018 and 2019 (Figures 5 and 6) even with inclusion of outstanding logs. Landings in these areas are still well above the 35-year mean. In recent years, effort has remained relatively consistent within each LFA, with only minor fluctuations. In most LFAs, effort reductions from 2019 to 2020 are proportional to the outstanding logs for that LFA.

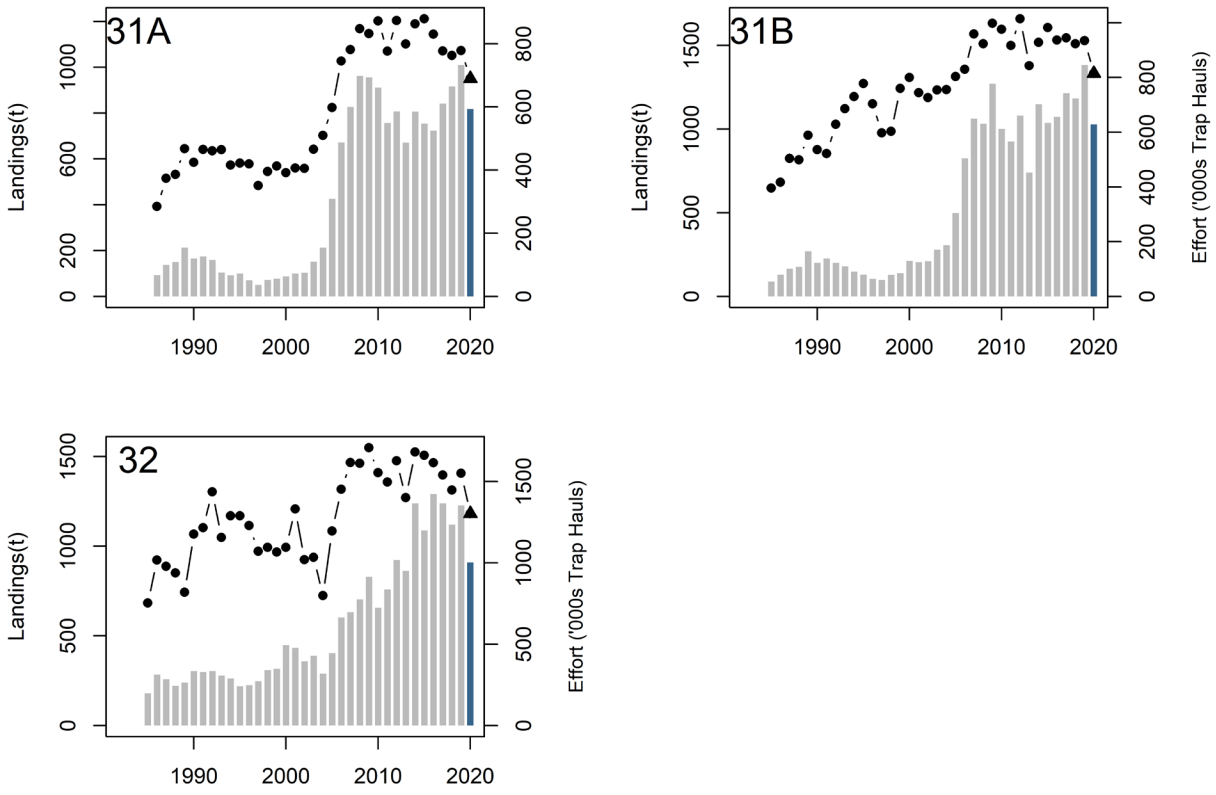

Figure 6. Time series of landings in tonnes (grey bars) and effort (line with points). Data for 2020 are incomplete (blue bar, triangle). Note: Different scales used on y-axes.

Recruitment Trap Legal and Sub-legal Catch Rates

The recruitment trap survey coordinated by the Fishermen and Scientist Research Society (FSRS) provides the best available information on the abundance of sub-legal-size Lobster. It is also the only source of abundance data for LFAs 27–32 that is collected in a standardized manner. All areas have shown an increasing trend over the entire time series for both sub-legal- and legal-size Lobster catch rates. In LFA 27, the catch of sub-legal-size Lobster has shown an increasing trend over the past 20 years, with a minor decrease in 2020; the catch of legal-size Lobster has been higher in the past three seasons than the rest of the time series (Figure 7). In LFA 28, there is no participation in the recruitment trap project. LFA 29 showed trends in catches of legal- and sub-legal-size Lobster similar to the commercial CPUE trends and are just below historic highs in 2019. LFA 30 also showed similar trends in legal-size catch rates to CPUE; sub-legal-size catches have increased over the past 5 seasons after 10 years of relative stability. Sub-legal-size-Lobster catch rates in LFA 31A decreased markedly in 2020 after

8 years of increases; legal-size Lobster catches have been relatively stable since 2016. Sub-legal- and legal-size catch rates showed similar trends (within the LFA) in both LFAs 31B and 32. Declines in both size classes were observed in both of these LFAs in 2020.

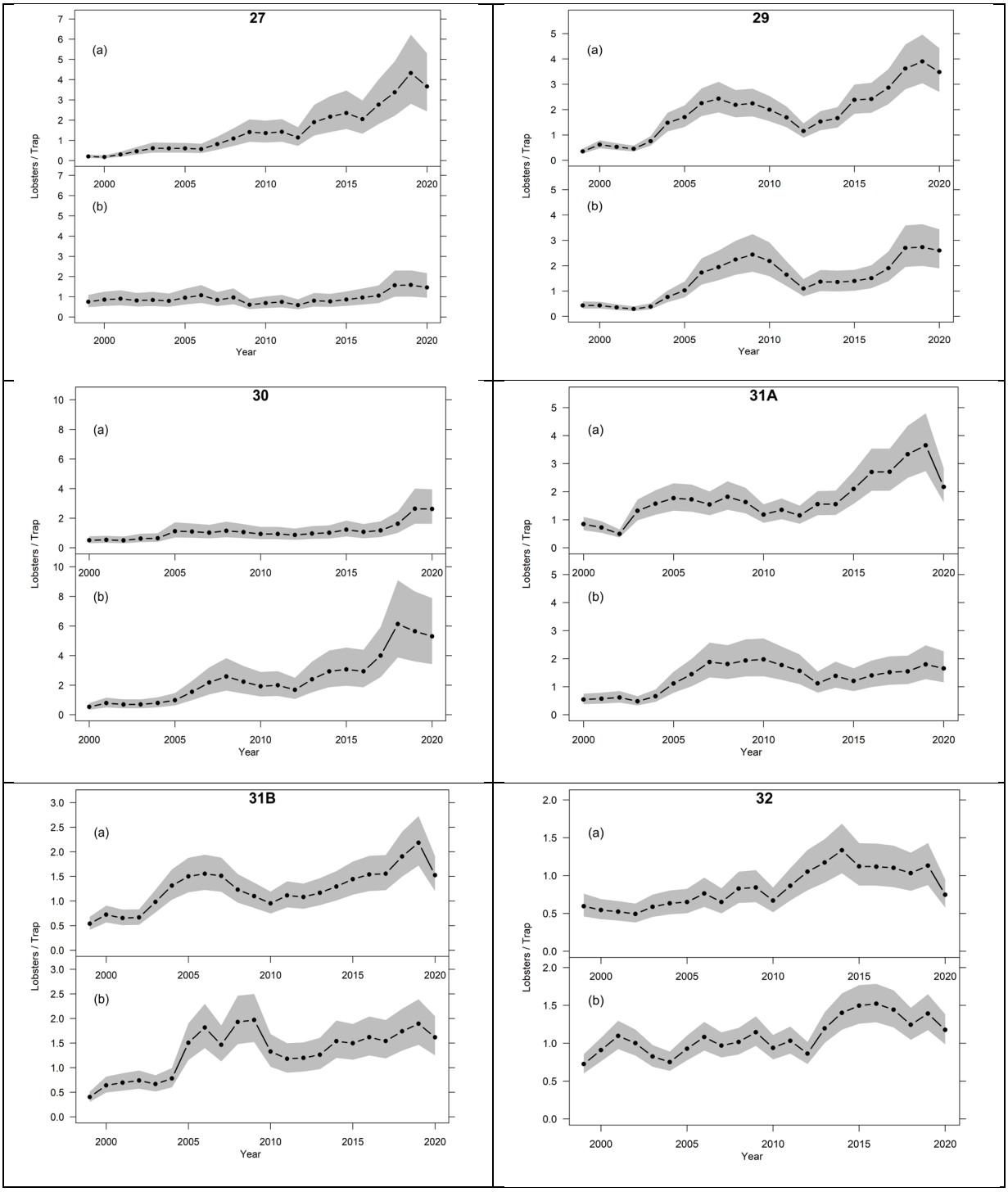

Figure 7. Time series of FSRS recruitment-trap catch rates (black line), with 95% credible intervals (grey shading) from modelled results for (a) sub-legal (70 mm to minimum legal size) and (b) > minimum legal size. Note that y-axis values are not consistent between LFAs (figure panels).

Bycatch

At-sea sampling data collected during commercial fishing were used to estimate the incidental catch in the Lobster fishery. For each bycatch species, mean weight per trap haul was estimated using the observed number-at-length and length-weight conversion factors for each LFA. The fishery-level bycatch estimates were calculated by prorating the mean weight per trap haul to the total fishery effort (total trap hauls). The estimated weights of the top five bycatch species are presented for recent fishing seasons.

The total fishery effort used in the calculation of bycatch estimates is obtained from logbook data for LFAs 31A and 31B but not LFA 27. To calculate bycatch estimates in LFA 27, effort was estimated from the combined Gulf logbooks and Maritimes logbooks using the median CPUE and landings from the Gulf logbooks and logbook effort from the Maritimes Region. Gulf landings for 2019 in LFA 27 are calculated by adding estimated slip landings based on previous years to the logbook landings. Bycatch estimates for LFAs 28, 29, 30, and 32 are not able to be calculated due to low sampling numbers or no data being available. No bycatch sampling occurred in 2020 because COVID-19 precautions precluded sampling technicians from going on commercial fishing vessels.

Table 1. Bycatch estimates (tonnes) for LFA 27. No bycatch sampling occurred in 2020 as a result of COVID-19. (A "-" indicates no data.)

Species	2012	2013	2014	2015	2016	2017	2018	2019	2020
Atlantic Cod	36.05	5.10	5.68	4.69	16.14	20.96	13.00	6.49	-
Atlantic Rock Crab	64.54	10.13	4.92	3.46	21.05	9.45	13.73	3.58	-
Cunner	6.65	1.90	1.89	4.84	16.39	24.33	22.55	17.67	-
Sea Raven	5.92	0.87	2.15	3.11	19.01	10.39	19.29	9.36	-
Shorthorn Sculpin	48.86	5.18	5.93	9.43	25.19	20.64	29.26	27.47	-

Table 2. Bycatch estimates (tonnes) for LFA 31A. No bycatch sampling occurred in 2020 as a result of COVID-19. (A "-" indicates no data.)

Species	2015	2016	2017	2018	2019	2020
Atlantic Cod	2.11	2.27	5.71	2.60	1.17	-
Atlantic Rock Crab	6.95	7.57	5.85	8.21	7.42	-
Cunner	1.89	4.71	2.28	2.13	4.02	-
Sculpin (NS[1])	8.18	12.07	9.96	17.40	7.01	-
Sea Raven	0.36	0.39	0.11	0.81	1.06	-

[1] Not Specified (contains Longhorn and Shorthorn Sculpin)

Table 3. Bycatch estimates (tonnes) for LFA 31B. No bycatch sampling occurred in 2020 as a result of COVID-19. (A "-" indicates no data.)

Species	2012	2013	2014	2015	2016	2017	2018	2019	2020
Atlantic Cod	6.61	2.68	2.51	12.40	7.95	21.94	6.03	3.01	-
Atlantic Rock Crab	3.95	8.08	1.06	15.65	16.72	9.67	12.82	10.66	-
Cunner	0.87	0.13	0.00	0.14	1.44	1.02	1.85	1.10	-
Sculpin (NS[1])	6.37	4.35	0.88	12.55	17.51	7.83	17.32	12.43	-
Jonah Crab	7.07	1.39	0.31	0.20	0.32	0.77	2.02	0.41	-

[1] Not Specified (contains Longhorn and Shorthorn Sculpin)

Sources of Uncertainty

The advent of the COVID-19 global pandemic early in 2020 affected global markets for Lobster, lowering both demand and ex-vessel price throughout Atlantic Canada. This market uncertainty affected the Lobster fishery in various ways, such as: lower prices, less market demand, daily landing limits, no market for animals with one claw ("culls"), and modified work routines with COVID precautions. These effects on the fishery varied between (and even within) LFAs. As such, effort, catch rate, and landings data for 2020 may not be directly comparable to past years. The adoption of precautionary COVID-19 measures aboard fishing vessels in the 2020 fishing season prevented at-sea sampling technicians from being onboard commercial fishing vessels. Thus, at-sea bycatch sampling, performed by fishing associations, did not take place as planned in 2020.

The reliance on fishery-dependent data for the assessment of Lobster stocks in these LFAs adds inherent uncertainty as Lobster behavior (such as catchability) can affect results. Nonetheless, the use of consistent stock-status indicators annually creates an informative index of stock health.

Conclusions

The two primary indicators, CPUE and CCIR exploitation rate, are summarized for each of the LFAs in Figure 8. The primary indicator of stock status, CPUE, decreased marginally in all LFAs (other than LFA 28) in 2020 from 2019. CPUE still remains at very high levels, at or near the highest value in the time series for each LFA, and remains well above the USR and LRP. The CCIR exploitation rate remains below the RR for all areas. Landings, though not yet complete, remain high in all LFAs for their respective time series, with effort staying relatively consistent. The stocks in all LFAs are considered to be in the healthy zone and are not overfished.

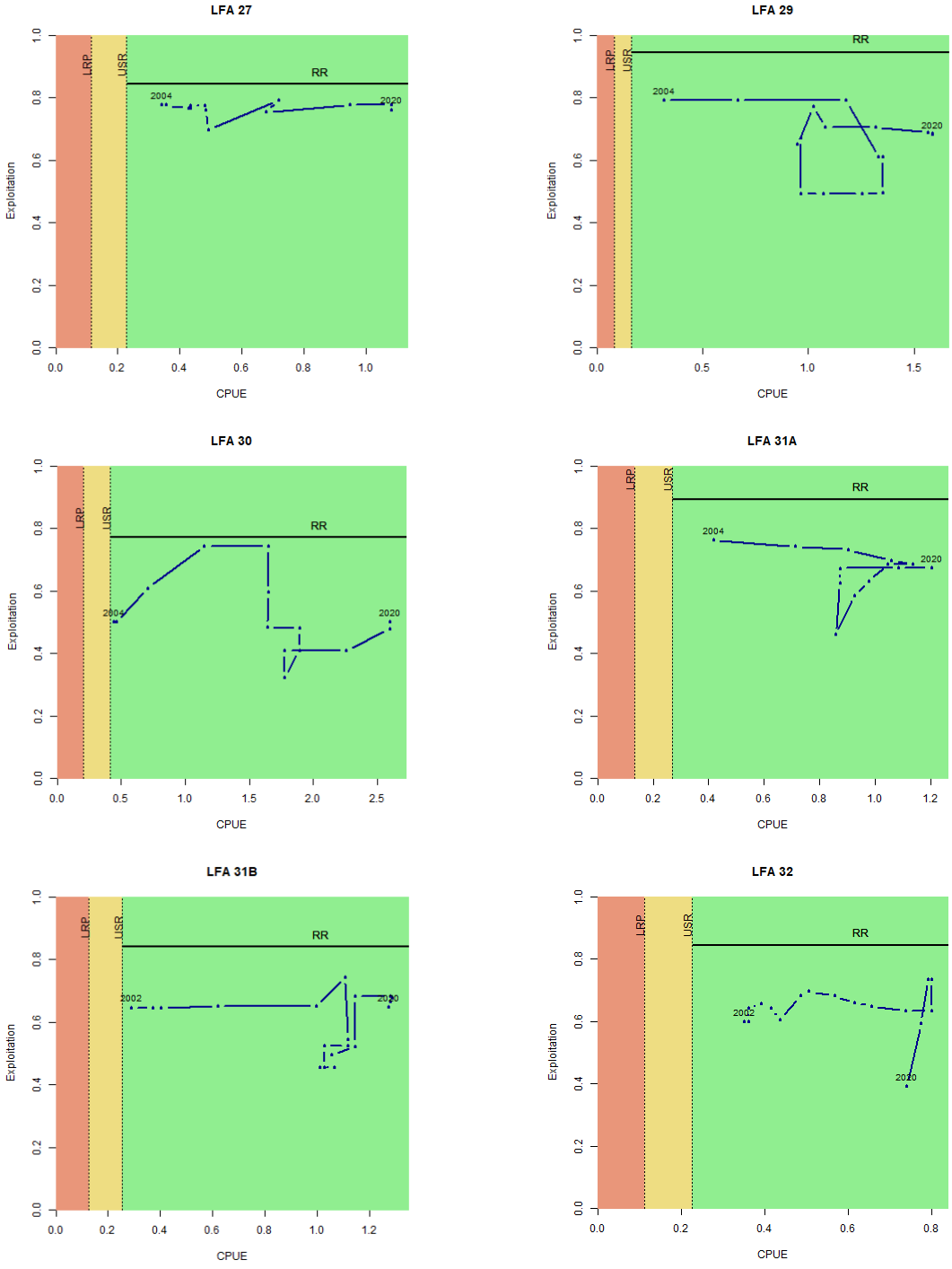

Figure 8. Phase plots using the 3-year running median of CPUE (kg/trap haul) and 3-year running median of Continuous Change in Ratio exploitation index compared against the Upper Stock Reference and Limit Reference Point based on commercial catch rates. The Removal Reference is the 75th quantile break of the posterior distribution for the maximum exploitation index respectively. Green shading refers to healthy stock-status zone, yellow to cautious zone and red to critical zone.

Contributors

Name	Affiliation
Ben Zisserson (Lead)	DFO Science, Maritimes Region
Cheryl Denton	DFO Science, Maritimes Region
Adam Cook	DFO Science, Maritimes Region
Victoria Howse	DFO Science, Maritimes Region
Geraint Element	DFO Science, Maritimes Region
Melanie Barrett	DFO Science, Maritimes Region
Catriona Regnier-McKellar	DFO Science, Maritimes Region
Rabindra Singh	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
Maritimes Region
Dartmouth, Nova Scotia
Ph. 902-426-3490

Date: February 9th, 2021

Sources of Information

Claytor, R. and Allard, J. 2003. Change-in-ratio Estimates of Lobster Exploitation Rate Using Sampling Concurrent with Fishing. Can. J. Fish. Aquatic Sci. 60(10): 1190–1203.

Cook, A.M., Hubley, P.B., Denton, C., and Howse, V. 2020. 2018 Framework Assessment of American Lobster (*Homarus americanus*) in LFA 27–33. DFO Can. Sci. Advis. Sec. Res. Doc. 2020/017.

DFO. 2009. A fishery decision-making framework incorporating the Precautionary Approach.

Tremblay, M.J., Pezzak, D.S., and Gaudette, J. 2012. Development of Reference Points for Inshore Lobster in the Maritimes Region (LFAs 27–38). DFO Can. Sci. Advis. Sec. Res. Doc. 2012/028.

Tremblay, M.J., Pezzack, D.S., Gaudette, J., Denton, C., Cassista-Da Ros, M., and Allard, J. 2013. Assessment of Lobster (*Homarus americanus*) off Southwest Nova Scotia and in the Bay of Fundy (Lobster Fishing Areas 34–38). DFO Can. Sci. Advis. Sec. Res. Doc. 2013/78.

This Report is Available from the:

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/

ISSN 1919-3769
ISBN 978-0-660-39217-2 Cat. No. Fs70-7/2021-029E-PDF

Correct Citation for this Publication:

DFO. 2021. Stock Status of American Lobster (*Homarus americanus*) in Lobster Fishing Areas 27–32 for 2020. DFO Can. Sci. Advis. Sec. Sci. Resp. 2021/029.

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 27 à 32 en 2020. Secr. can. de consult. sci. du MPO, Rép. des Sci. 2021/029 .