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Canadian Science Advisory Secretariat
Maritimes Region **Science Response 2023/014**

STOCK STATUS OF AMERICAN LOBSTER (*HOMARUS AMERICANUS*) IN LOBSTER FISHING AREAS 27–32 FOR 2022

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. Annual updates have occurred since 2020. This update applies a suite of indicators from the 2018 framework (Cook et al. 2020) to the stock status up to the end of the 2022 fishing 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 Regional Peer Review of January 24, 2023 on the Stock Status update for Lobster Fishing Areas 27-32.

This update contains information to the end of the commercial fishing seasons in 2022. Outside of commercial fishing seasons, rights-based fisheries were prosecuted by Indigenous fishers in some LFAs. These landings are not included in annual landings reported herein. Any removals from treaty-based fisheries would not be accounted for in the stock status indicators presented herein.

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, near Halifax (Figure 1). 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 and 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). Additional management measures are in place in specific LFAs. These include such measures as non-retention of V-notched Lobster, non-retention of female Lobsters of certain sizes, etc.

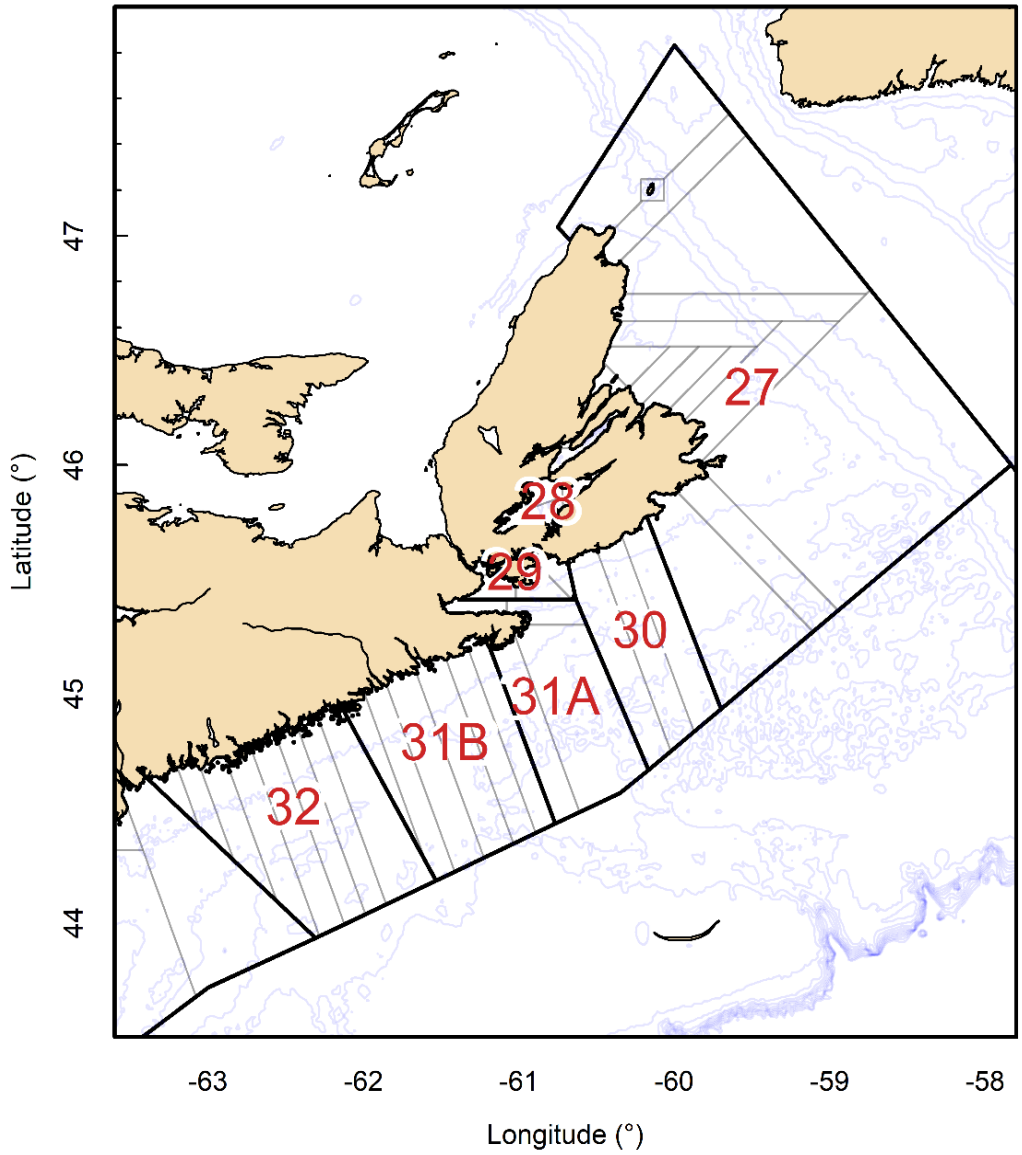

Figure 1. Map of Lobster Fishing Areas 27–32 with logbook reporting grids outlined in grey.

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 in that LFA. 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) (Cook et al.,2020). This period represents both low- and high-productivity time periods covering multiple 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 (Figures 2 and 3). This median CPUE value will dampen the impact of any inter-annual variability, which may occur due to factors outside of changes in abundance.

CPUE trends for LFA 27 indicate a consistent increasing trend in biomass since a low in 1997. The LFA 27 CPUE has remained at (or very near) historic highs for the past five seasons with 2022 being the highest on record. In LFA 28, CPUE was at (or very near) historic highs since 2019 after a dip in 2015–2016. CPUE for LFA 29 increased annually from 2016–2019, after a five-year declining/flat trend. The 2022 catch rates for LFA 29 were higher than 2021. This follows two years of declines in 2020 and 2021. LFA 30 CPUE in 2022 was consistent with 2021 but remains below the historic highs experienced in 2018 and 2019. In LFA 31A, CPUE in 2022 was consistent with the 2021 season and remains very near historic highs. CPUE increases began in 2004 in LFA 31B and continued to rise until 2019 with a slight decrease in 2020. The 2022 CPUE for LFA 31B was consistent with 2021. LFA 32 has experienced a steady increase in CPUE since an extreme low in 1995. The LFA 32 CPUE was at a record high in 2022.

For all LFAs from 27–32, CPUE is well above the USR with CPUEs among the highest levels in the time series. As such, all stocks are considered to be in a healthy productivity state.

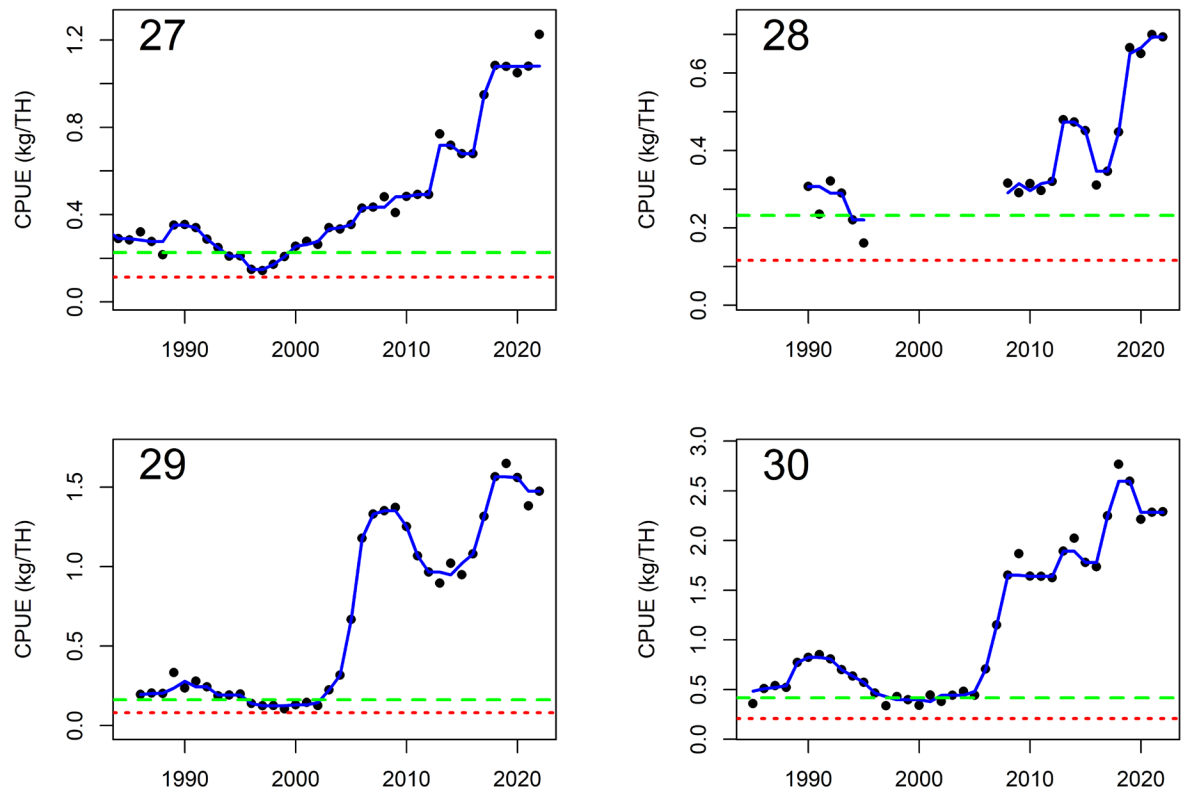

Figure 2. Time series of commercial catch rates in kg/trap hauls (black points), along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (dashed green line) and Limit Reference Point (dotted red line). Limited data and privacy rules (disallowing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

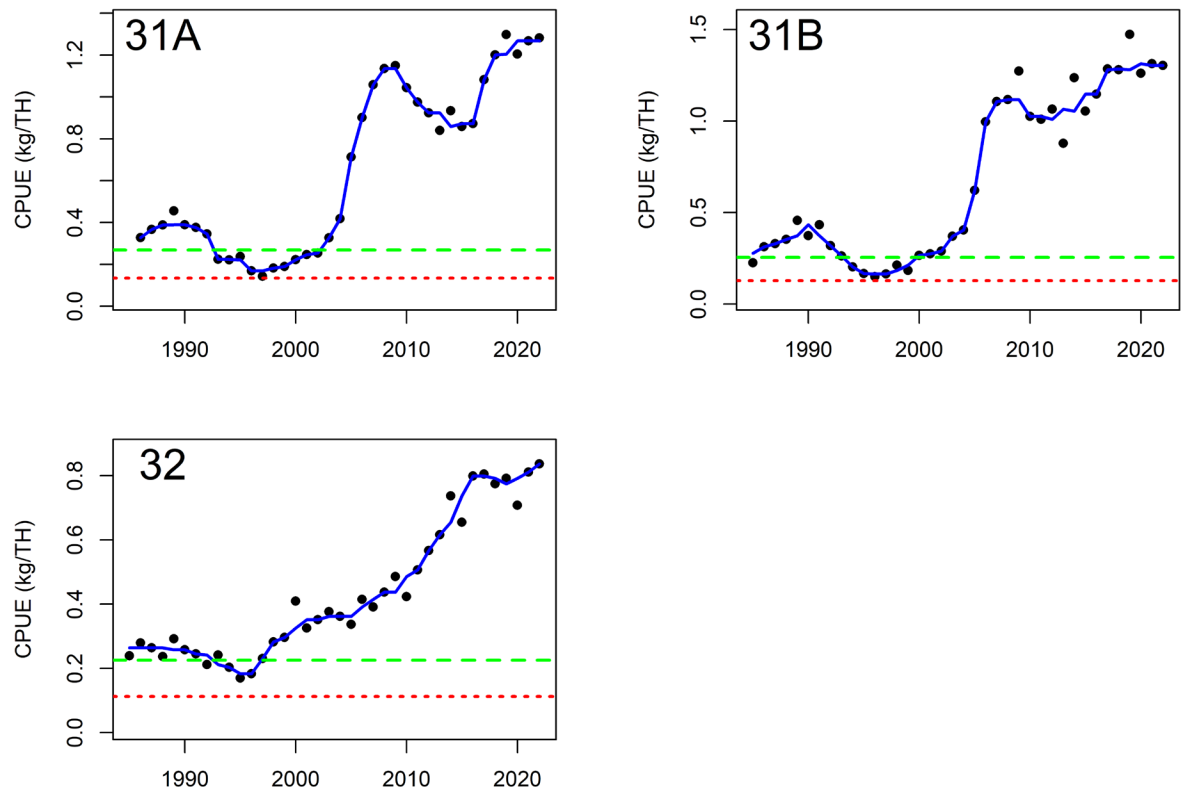

Figure 3. Time series of commercial catch rates in kg/trap hauls (black points), along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (dashed green line) and Limit Reference Point (dotted red line). Note: Different scales used on y-axes.

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 changes in the proportion of two monitored components of a 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 removal of individuals 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 corresponding to maximum sustainable yield, F_{MSY}.

The time series of exploitation estimates is shown in Figure 4. No exploitation estimate exists for LFA 28 due to data limitations. Though trends are variable across LFAs, the 3-year running medians of CCIR for each LFA generally show a relatively flat trend over the entire time series and remain below the RR for most LFAs with LFA31B showing a slight decreasing trend in recent years. Inexplicably, the 2021 single-year exploitation estimate for LFA 29 was the lowest in the time series with very little change in the relative abundance of sub-legal (reference) and

exploited animals over the course of the fishery. The 2022 estimate for LFA 29 has returned to a value much closer to those for the 6 years preceding 2021.

Exploitation estimates have never exceeded the RR in any LFA within this time series, indicating that overfishing is likely not occurring.

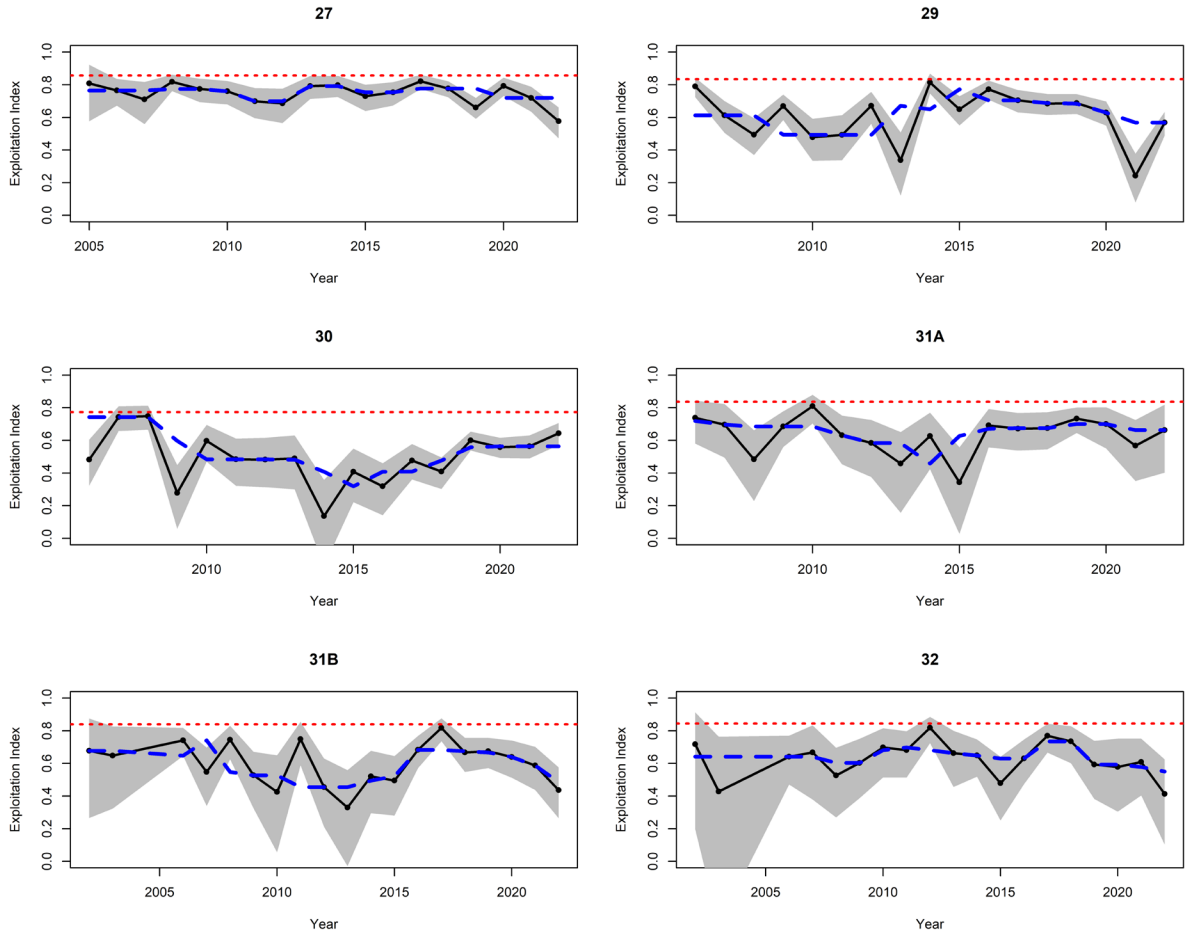

Figure 4. Time series of Continuous Change in Ratio exploitation indices (black), with 3-year running medians (blue) and removal references (dotted red line). 95% credible intervals are shaded. No exploitation estimates exists for LFA 28.

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 fishing effort, catchability (including the effects of environment and gear efficiency), Lobster size distribution and the spatial overlap between distribution of Lobster and fishing effort.

Fishing effort can be considered as a proxy for fishing pressure and landings (both indicators 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 various 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.

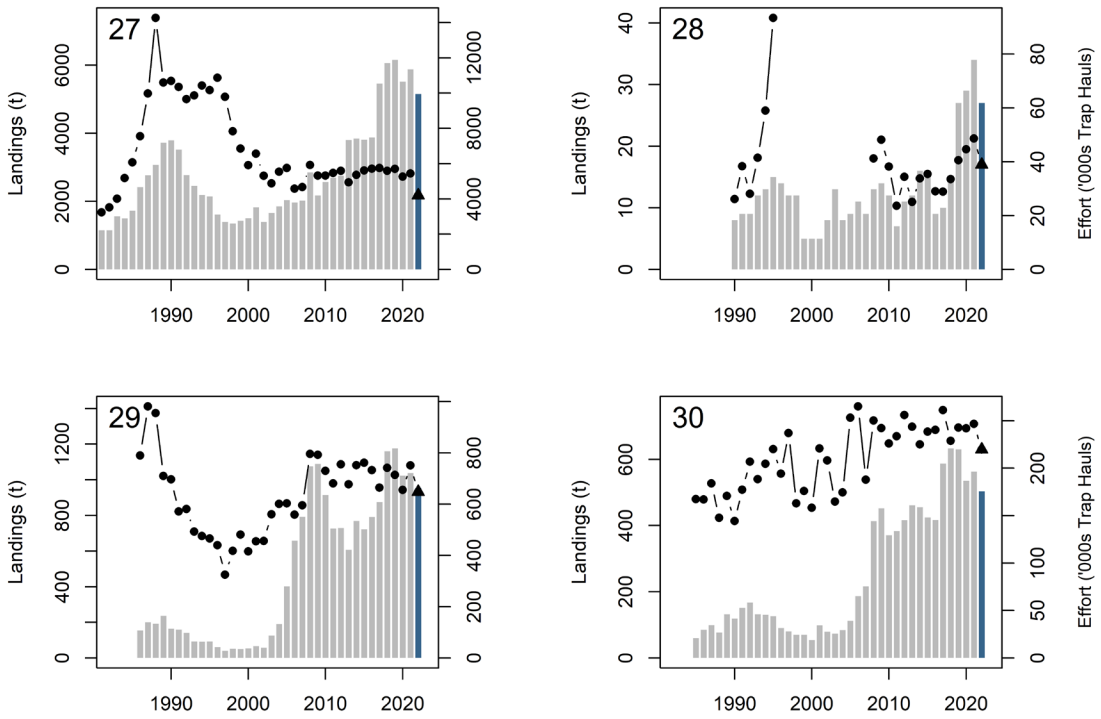

Figure 5. Time series of landings in tonnes (grey bars) and effort (line with points). Data for 2022 are incomplete (blue bar, triangle) due to outstanding logbooks. Limited data and privacy rules (disallowing the showing of information for < 5 fishers) account for the apparent data gap in LFA 28. Note: Different scales used on y-axes.

The 2022 landings for LFAs 27–32 are preliminary (as of January 23rd, 2023), as there remains outstanding logbooks (approximately 5–24% in most LFAs, and 38% in LFA 28).

Landings in LFA 27 are expected to exceed the record-high levels of 2018–2019 (Figure 5; with 23% of logs still outstanding). In LFA 28, 38% of logs are outstanding. Based on available logs, LFA 28 landings are expected to exceed the record-high landings of 2021. Landings in LFAs 29, 30, 31A and 31B will likely not reach the historic high landings of 2018 and 2019 (Figures 5 and 6), but likely meet (or just exceed) 2021 landings with the inclusion of outstanding logs (between 8–19%, depending on LFA). Landings in these areas are still well above the 35-year mean. LFA 32 (with 15% logs outstanding) is expected to reach a new record-high for the time series. In recent years, effort has remained relatively consistent within each LFA, with only minor fluctuations. In most LFAs, effort is expected to be near 2021 levels once all logbooks are received.

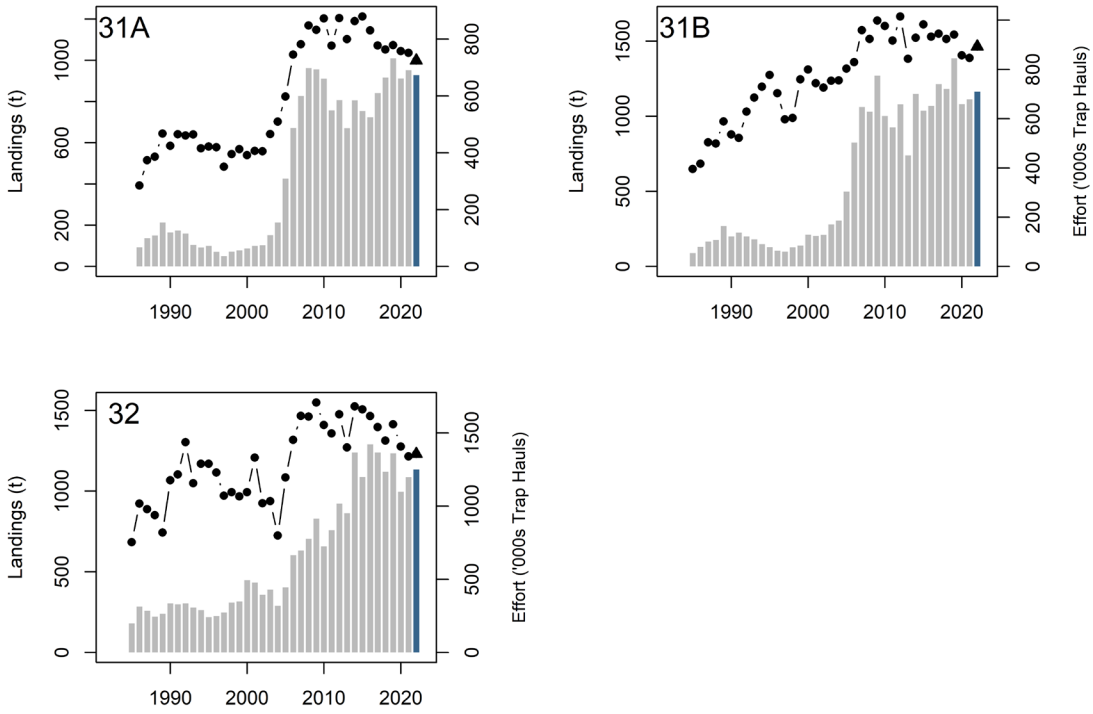

Figure 6. Time series of landings in tonnes (grey bars) and effort (line with points). Data for 2022 are incomplete (blue bar, triangle) due to outstanding logbooks. Note: Different scales used on y-axes.

In 2022, DFO reached interim understandings with two First Nation communities in support of community-developed fishing plans for moderate livelihood harvest across LFAs 27–32. Both have reported landings in 2022. These landings were in LFAs 27, 29, 30 and 31A. Figures 5 and 6 do not include these landings.

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 decreases in 2020 and 2021; while the catch of legal-size Lobster had been decreasing slightly in the past four seasons. Both size classes have increased for the 2022 season (Figure 7). In LFA 28, there is no participation in the recruitment trap project so no data are available. Catches of legal- and sub-legal-size Lobster in LFA 29 decreased in 2020 and 2021, and remained consistent between 2021 and 2022. In LFA 30, the catch rate of sub-legal sized Lobster has been consistent over the past four seasons while the catch of legal size had been showing a decreasing trend over the same time period and then levelled off for the 2022 season. This pattern for legal-size catch rates in LFA 30 mirrors that of commercial catch rates for this area. In LFA 31A, sub-legal-size and legal-size Lobster catch rates have shown a decreasing trend for the past three seasons (more pronounced in sub-legals). The catch rate of sub-legal size Lobsters increased in both LFA 31B and LFA 32 for the 2022 season; however LFA 31B saw an increase in legal-size catch rates where LFA 32 remained consistent with 2021.

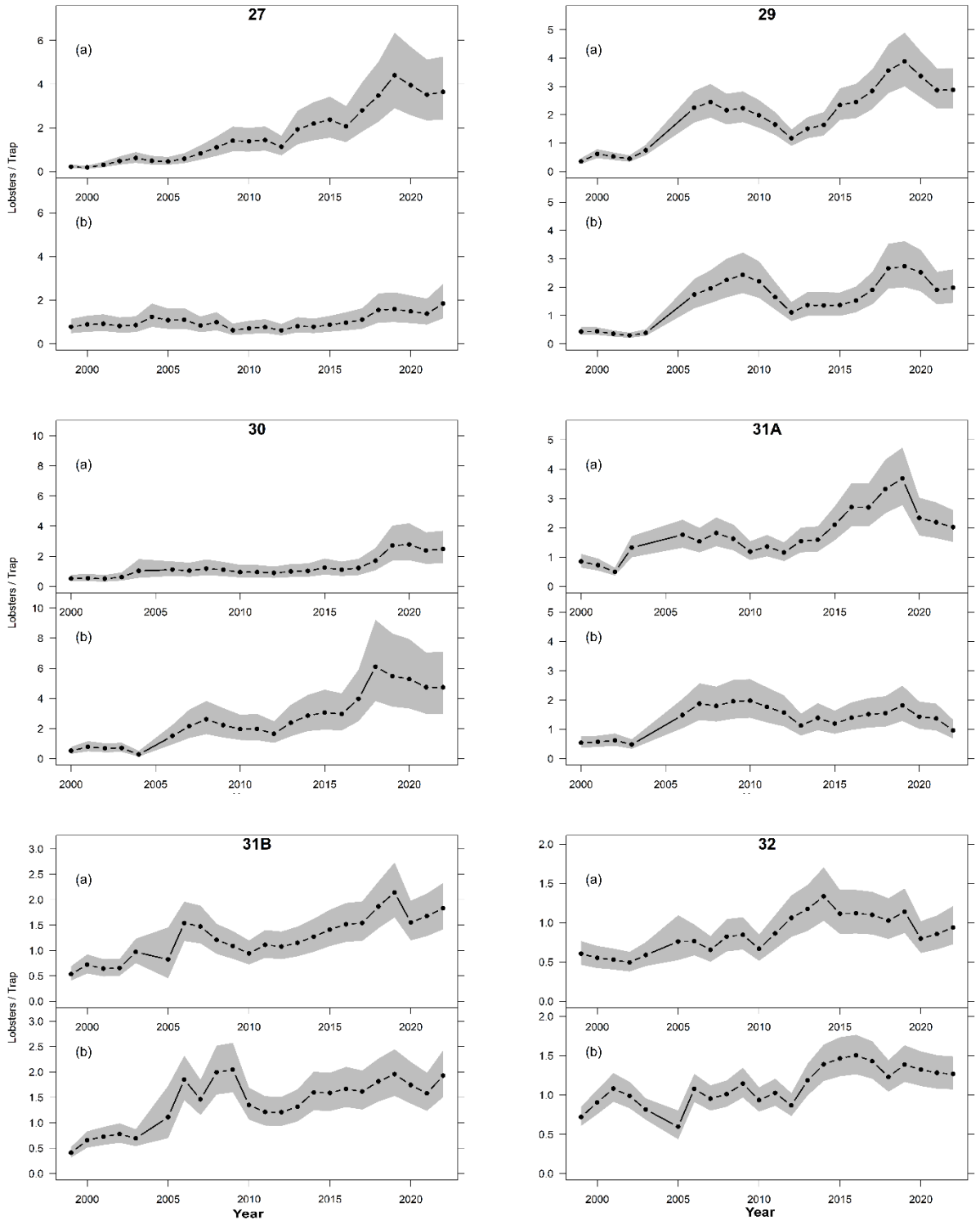

Figure 7. Time series of FSRS recruitment-trap catch rates (black line), with 95% credible intervals (grey shading) from modelled results for (a) sub-legal (70 mm to minimum legal size), and (b) > minimum legal size. Note that y-axis values are not consistent among LFAs (figure panels).

Sources of Uncertainty

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

Widespread closures of mackerel (Atlantic Region) and Atlantic Herring (Gulf Region) in 2022 have forced some harvesters to move to other bait types in their Lobster traps. Catch rates could be affected for harvesters changing baits from those traditionally used. It is unknown whether these changes in catch rate would be positive or negative.

DFO issues Lobster Harvest Documents (LHD) for food, social and ceremonial (FSC) fisheries in LFAs 27–32, both within and outside the commercial season. Reported landings for these FSC LHD totaled approximately 27.3 mt at the time of stock assessment for the period between June–November 2022. The quantitative detail and fisheries coverage of the FSC landing reports vary by LHD holder, and demonstrate collaboration with Indigenous partners on the accounting of rights-based removals and progress toward integrating FSC fisheries into the Lobster stock assessment. These FSC removals are not included in the landings indices elsewhere in this document.

Standardized reporting for all landings (commercial, FSC, and moderate livelihood) is required by DFO Science to understand the effects of removals on the Lobster population. These rights-based landings reports will eventually be able to further inform stock assessments in conjunction with commercial removals.

Illegal fishing may represent further removals throughout the year. Unauthorized fishing activities outside of commercial fishing seasons in LFAs 27–32 have increased in 2021 and 2022 as compared to previous years which has resulted in increased seizures of Lobster traps without valid trap tags linking them to a DFO-authorized fishery (Scott Phillips, Area Chief, DFO Conservation & Protection Eastern Nova Scotia, January 2023; pers. comm.). As an example, DFO Conservation and Protection officers seized 513 traps, approximately two commercial gear complements, in LFA 29 over a 4-month period outside of the commercial season in 2021. The impact of additional removals cannot currently be accounted for in science advice, leading to increased uncertainty in stock status.

Any fishing that occurs outside of the established commercial season may differentially affect stock components (size, sex, maturity) as compared to the commercial fishery. If fishing occurs at a different time of Lobsters biological cycle (mating, molting ,egg extrusion, etc.), this can affect catch rates of stock components. Further information on the size / sex composition of the catch within and outside the commercial season is required to assess what (if any) effect this would have on stock assessment indices.

Conclusions

The two primary indicators, CPUE and CCIR exploitation rate, are summarized for each of the LFAs in Figure 8. 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.

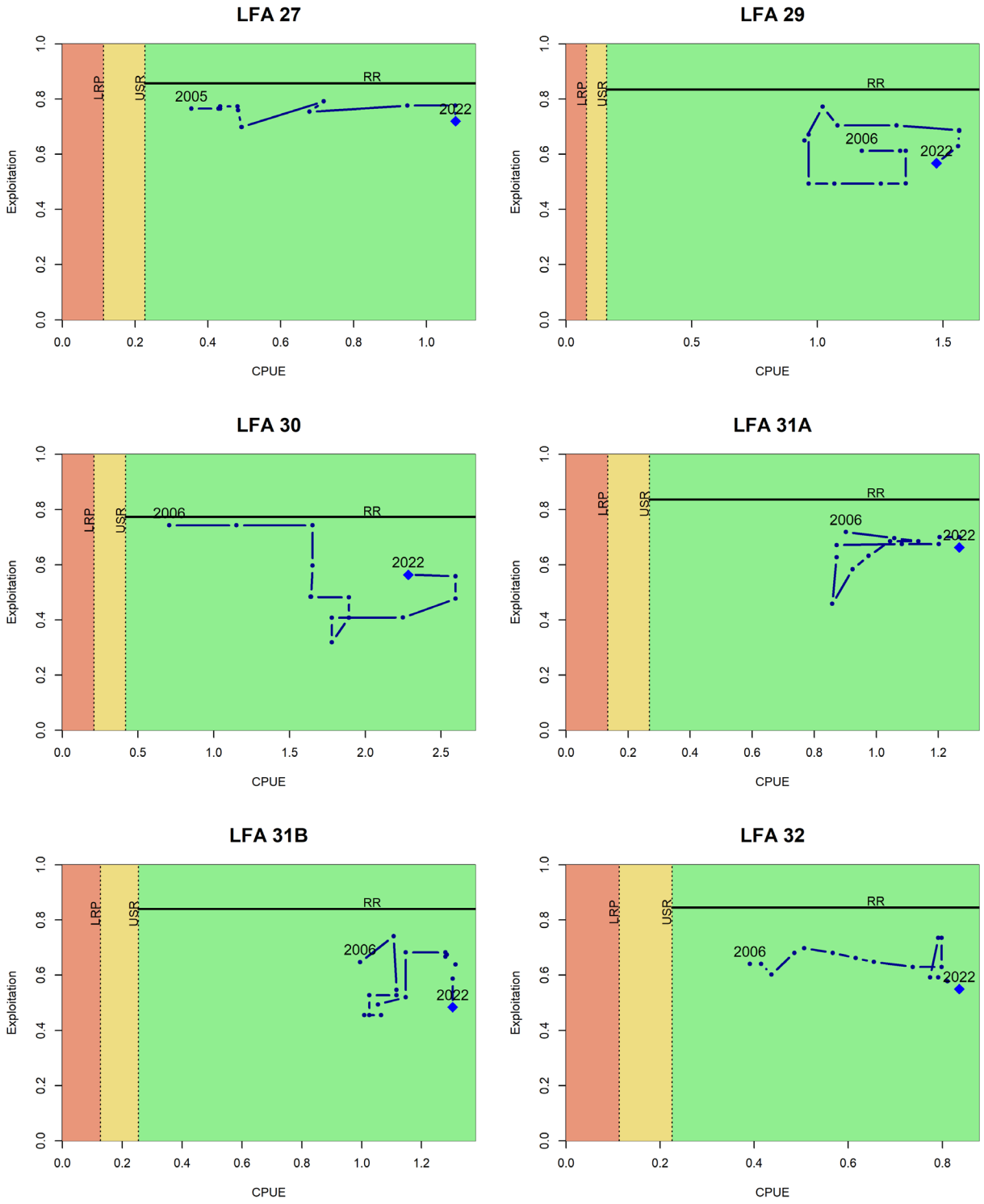

Figure 8. Phase plots using the 3-year running median of CPUE (kg/trap haul) and 3-year running median of Continuous Change in Ratio exploitation index compared against the Upper Stock Reference (USR) and Limit Reference Point (LRP) based on commercial catch rates. The Removal Reference (RR) is the 75th 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
Geraint Element	DFO Science, Maritimes Region
Emily Way-Nee	DFO Science, Maritimes Region
Gregory Puncher	DFO Science, Maritimes Region
Rabindra Singh	DFO Science, Maritimes Region
Victoria Howse	DFO Science, Maritimes Region
Danny Ings	DFO Science, National Capital Region
Ian McLean	DFO Resource Management, Maritimes Region

Approved by

Tana Worcester
A/Regional Director of Science
Maritimes Region
Dartmouth, Nova Scotia
Ph. 902-220-8371

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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. vi + 251 p.

DFO. 2009. A fishery decision-making framework incorporating the Precautionary Approach. Fisheries and Oceans Canada.

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. iv + 18 p.

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. viii + 125 p.

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Center for Science Advice (CSA)
Maritimes Region
Fisheries and Oceans Canada
PO Box 1006, 1 Challenger Drive
Dartmouth, Nova Scotia
Canada B2Y 4A2

E-Mail: MaritimesRAP.XMAR@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

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