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Canadian Science Advisory Secretariat
Maritimes Region **Science Response 2022/043**

STOCK STATUS OF AMERICAN LOBSTER (*HOMARUS AMERICANUS*) IN LOBSTER FISHING AREAS 27–32 FOR 2021

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, and updates in January 2020 and 2021. This update applies a suite of indicators from the 2018 framework to the stock status up to the end of the 2021 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 Science Response Process of February 3, 2022 on the Stock Status Update of American Lobster in LFAs 27–32.

This update contains information to the end of the commercial fishing seasons in 2021. Outside of commercial fishing seasons, treaty-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.

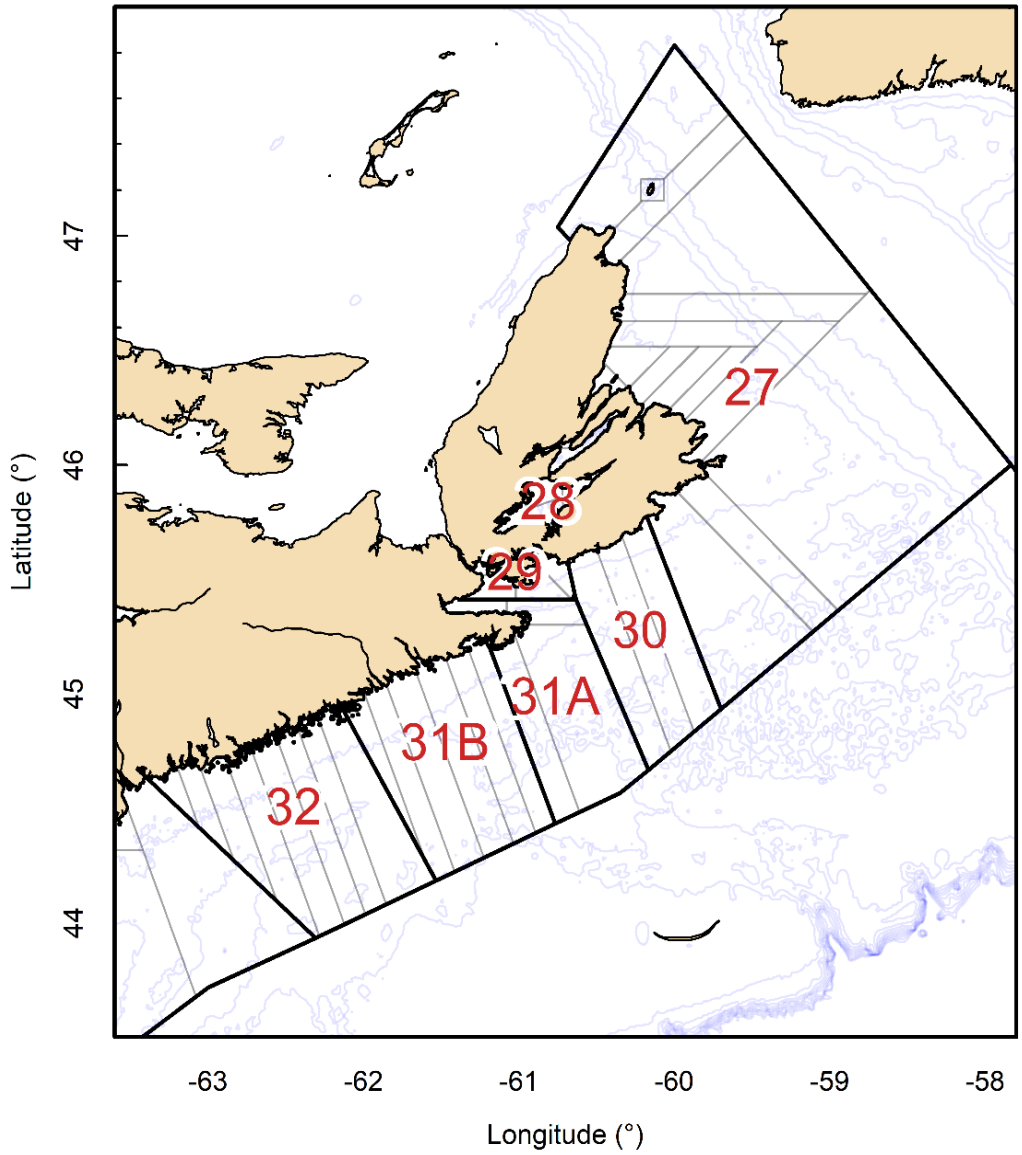

Figure 1. Map of Lobster Fishing Areas 27–32 with logbook reporting grids outlined in grey.

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). 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 (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 constant increasing trend in biomass since a low in 1997. The CPUE has remained at (or very near) historic highs for the past four seasons. In LFA 28, CPUE was at historic highs for 2019 and 2020 after a dip in 2015–2016. The 2021 CPUE for LFA 28 is inconclusive as only 20% of commercial logs were available. CPUE for LFA 29 increased annually from 2016–2019, after a five-year declining/flat trend. The 2020 catch rates for LFA 29 were only slightly lower than 2019 but decreased again in 2021 by 11%. LFA 30 CPUE increased slightly in 2021 but remains below the historic highs experienced in 2018 and 2019. In LFA 31A, CPUE increased slightly in 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 2021 CPUE for LFA 31B increased slightly from 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. The LFA 32 CPUE returned to record highs in 2021. LFAs 31B and 32 may have been disproportionately affected by the COVID-19 pandemic in 2020, as they were the first of the eastern Nova Scotia LFAs (27–32) to open in the spring when market and other fishing operation conditions were still extremely volatile.

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.

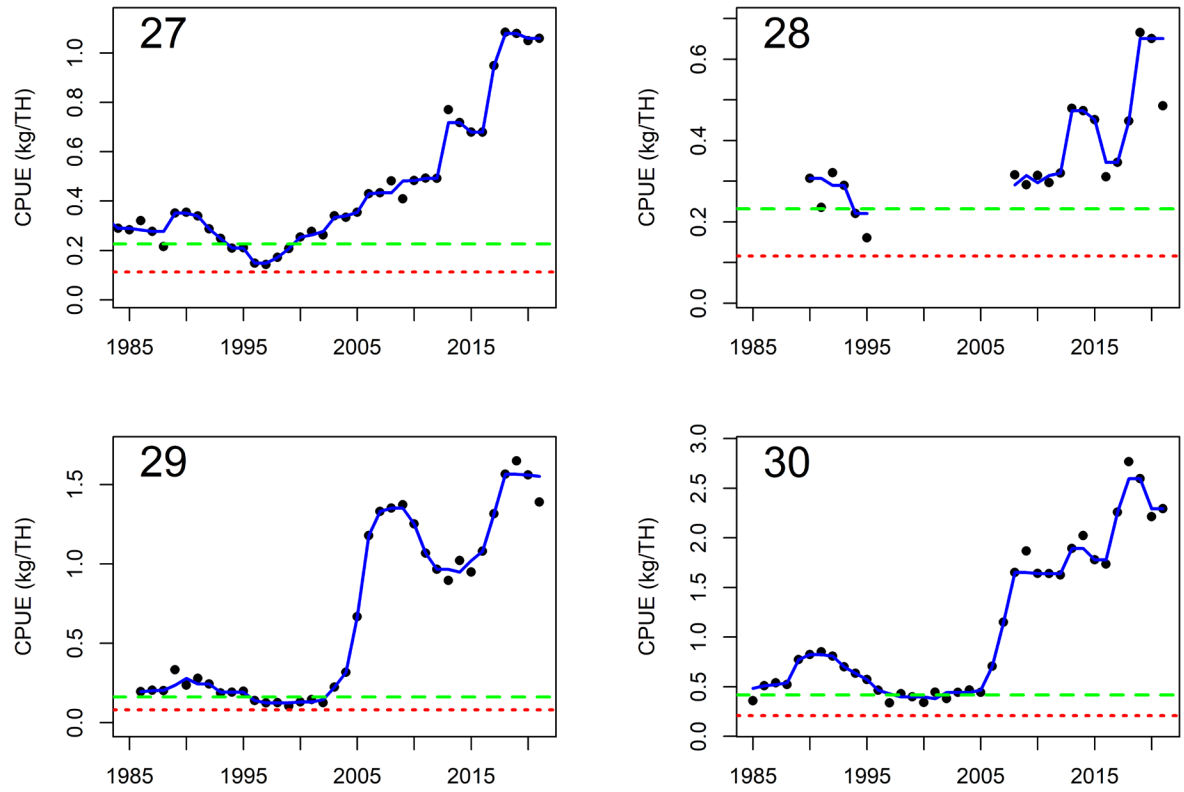

Figure 2. Time series of commercial catch rates in kg/trap hauls (black points), along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (dashed green line) and Limit Reference Point (dotted red line). Limited data and privacy rules (disallowing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

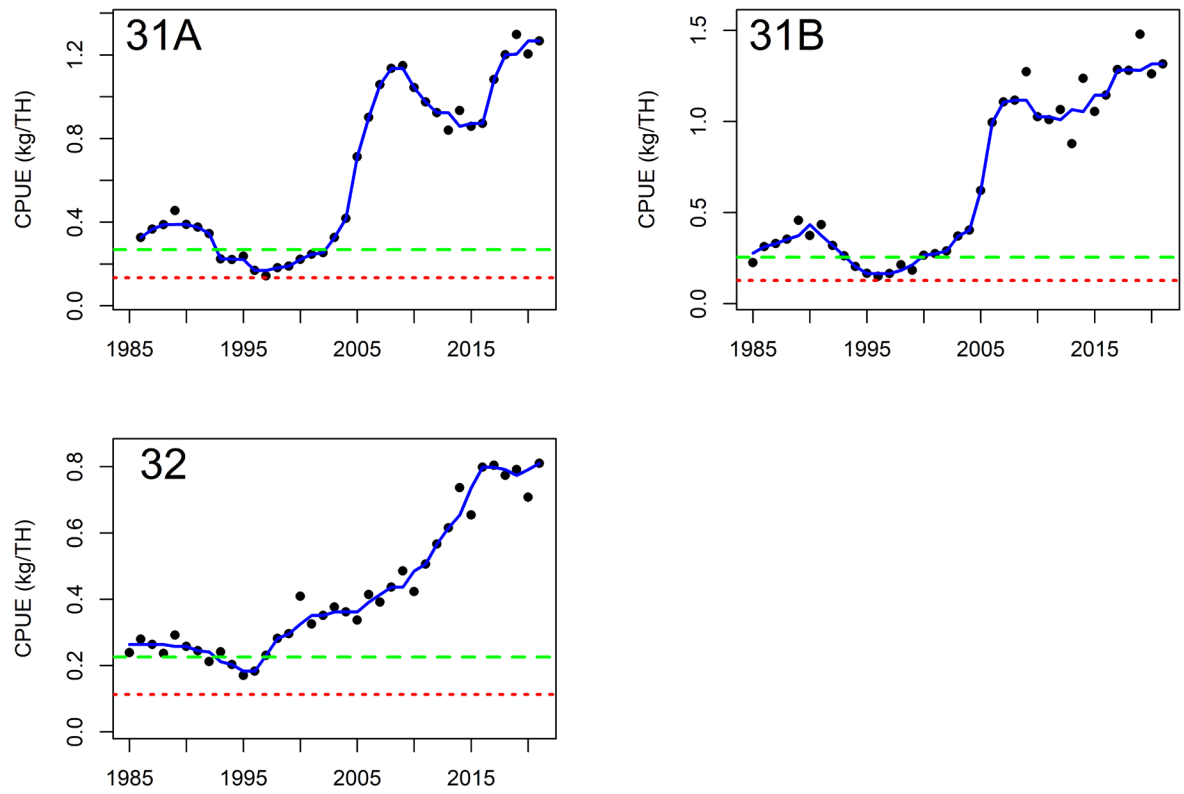

Figure 3. Time series of commercial catch rates in kg/trap hauls (black points), along with the 3-year running median (solid blue line). The horizontal lines represent the Upper Stock Reference (dashed green line) and Limit Reference Point (dotted red line). Note: Different scales used on y-axes.

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 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 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 show a relatively flat trend over the entire time series and remain below the RR. The single-year estimates for both LFAs 31A and 32 both show a decrease in the exploitation index from the past season. The single-year exploitation estimate for LFA 29 is 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.

Exploitation estimates have never exceeded the RR in any LFA within this time series. Exceeding the RR could indicate overfishing.

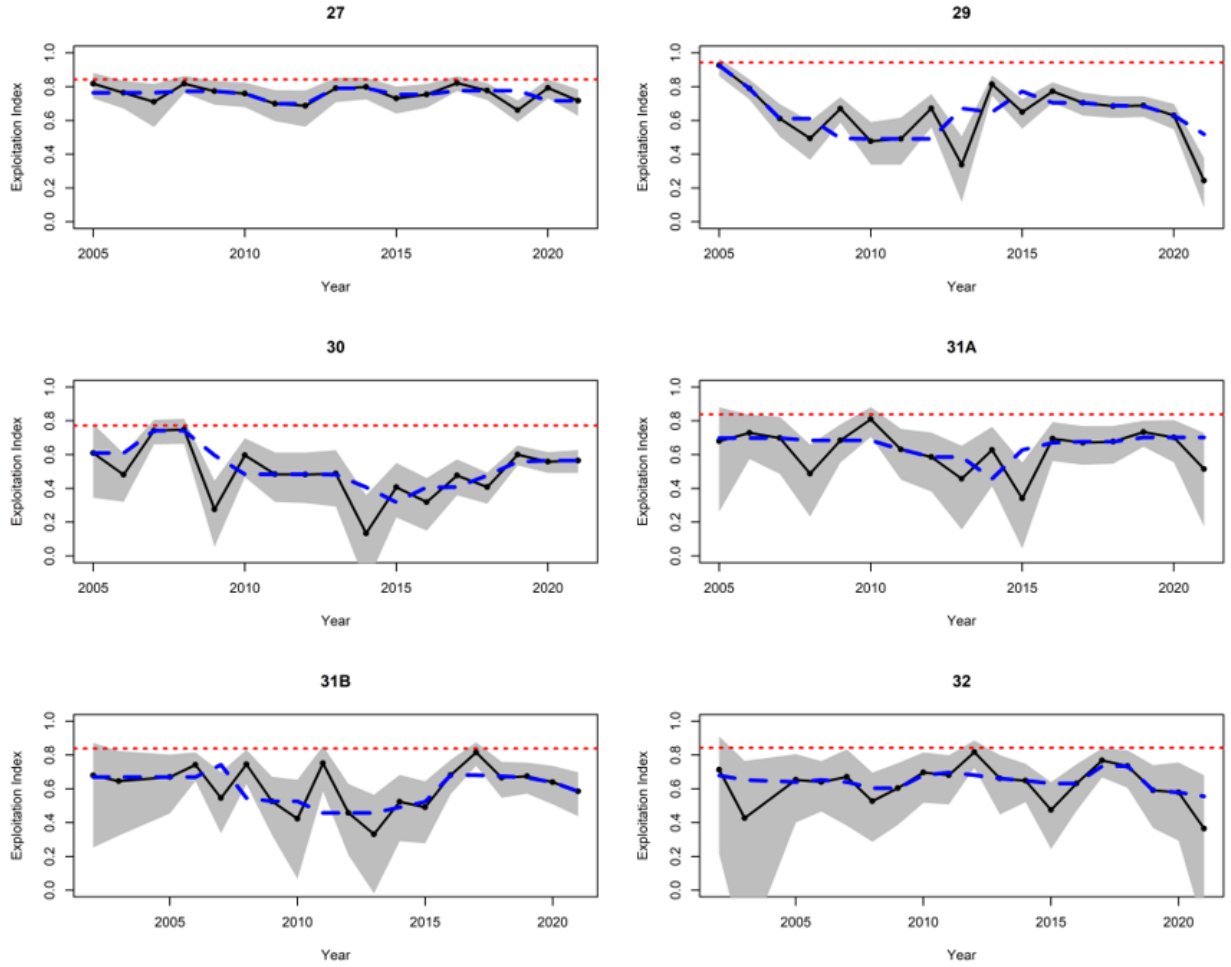

Figure 4. Time series of Continuous Change in Ratio exploitation indices (black), 3-year running median (blue) with removal reference (dotted red line). 95% credible intervals are shaded. No exploitation estimates exists for LFA 28.

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 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 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 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.

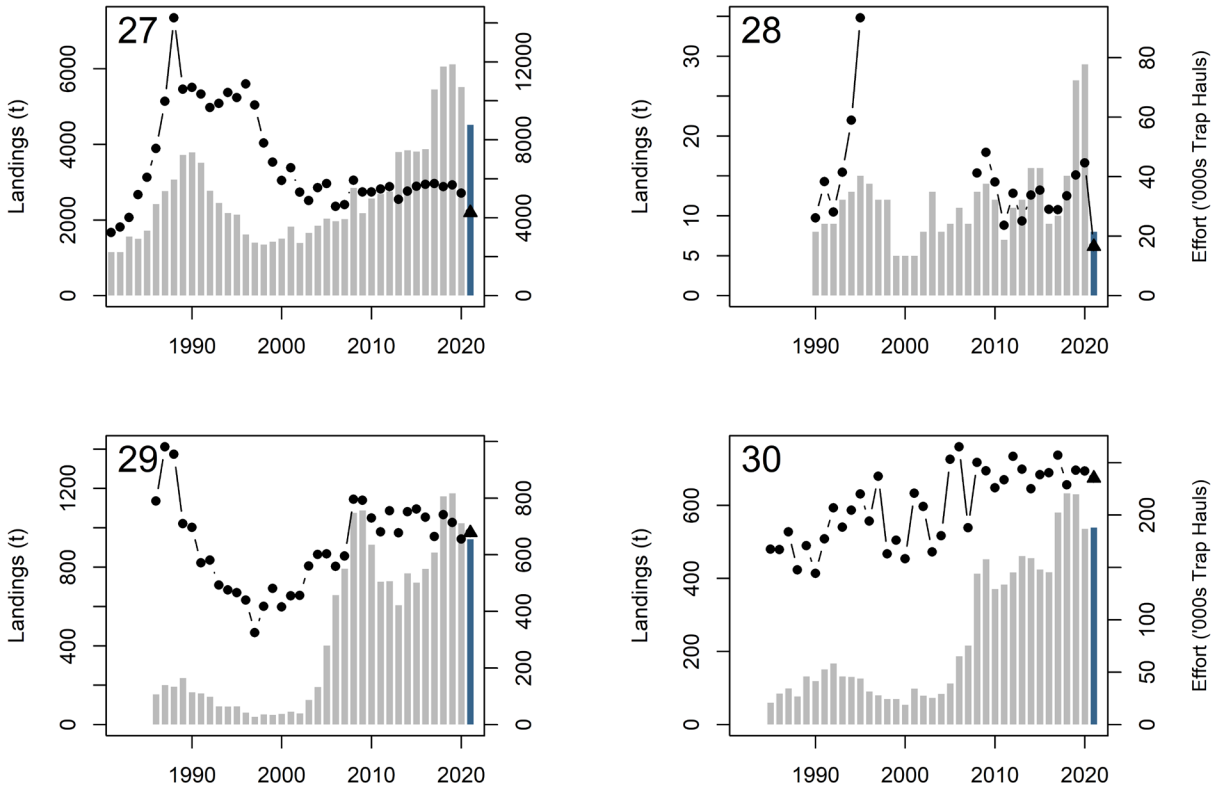

Figure 5. Time series of landings in tonnes (grey bars) and effort (line with points). Data for 2021 are incomplete (blue bar, triangle). Note: Different scales used on y-axes.

The 2020 landings for LFAs 27–32 are preliminary (as of January 30th, 2022), as there remains outstanding logbooks (approximately 5–12% in most LFAs, 23% in LFA 27, and 80% in LFA 28). COVID-related adverse market conditions likely affected landings in 2020, more so in some areas than others, so the 2020 landings may not be directly comparable to other years (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 above 2020 (with 23% of logs still outstanding). In LFA 28, 80% of logs are not available so the 2021 landings remain unknown. 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), though will likely exceed 2020 with the inclusion of outstanding logs (between 5–12%, depending on LFA). 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 is expected to be near 2020 levels once all logbooks are received.

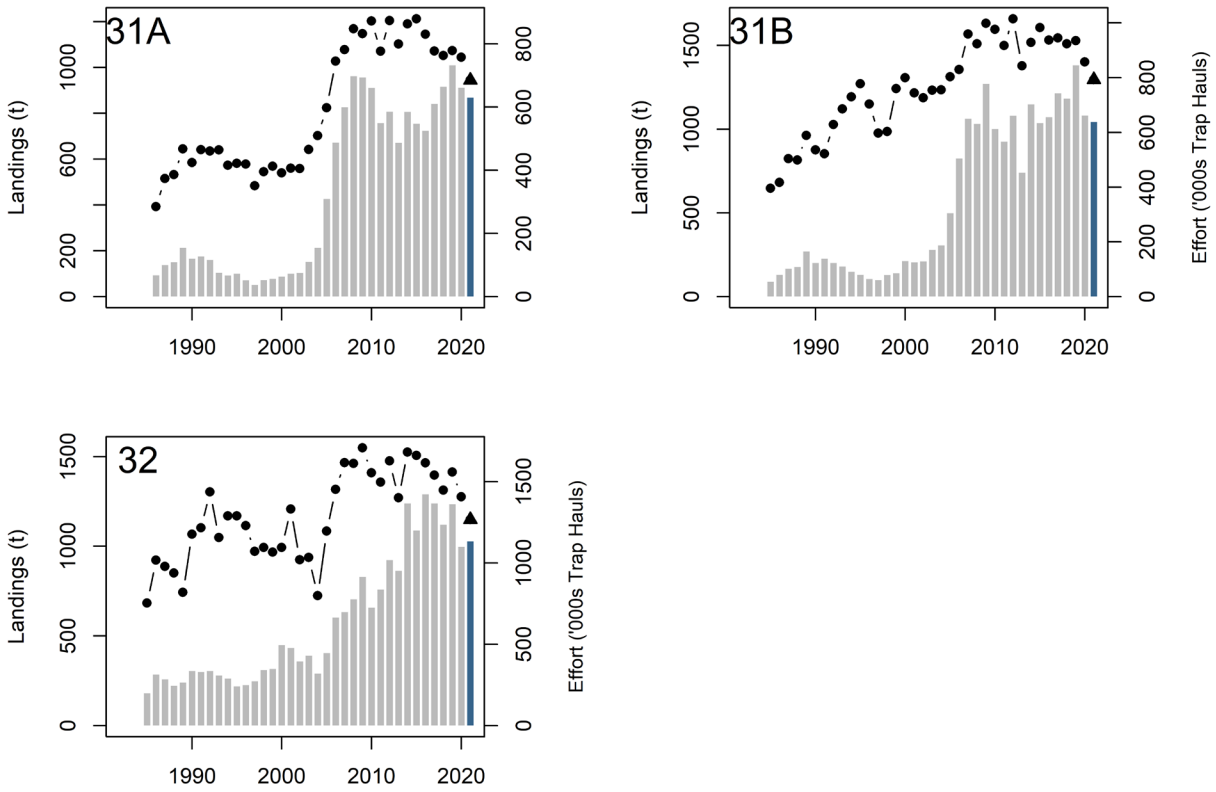

Figure 6. Time series of landings in tonnes (grey bars) and effort (line with points). Data for 2021 are incomplete (blue bar, triangle). Note: Different scales used on y-axes.

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 a general 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; the catch of legal-size Lobster has been decreasing slightly in the past four seasons. (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 have been below historic highs in 2019. LFA 30 also showed similar trends in legal-size catch rates to CPUE with time-series highs in 2018; sub-legal-size catches have decreased slightly since a high in 2020. In LFA 31A, sub-legal-size and legal-size Lobster catch rates are consistent with the 2020 season when there was a decrease in both (more pronounced in sub-legals). A similar trend is observed in LFA 31B but with a slight decrease in the legal-size catch rate. Sub-legal- and legal-size Lobster catch rates in LFA 32 both decreased slightly in 2021. Sub-legal catch rates are near the mean of the time series and legal-size catch rates remain high.

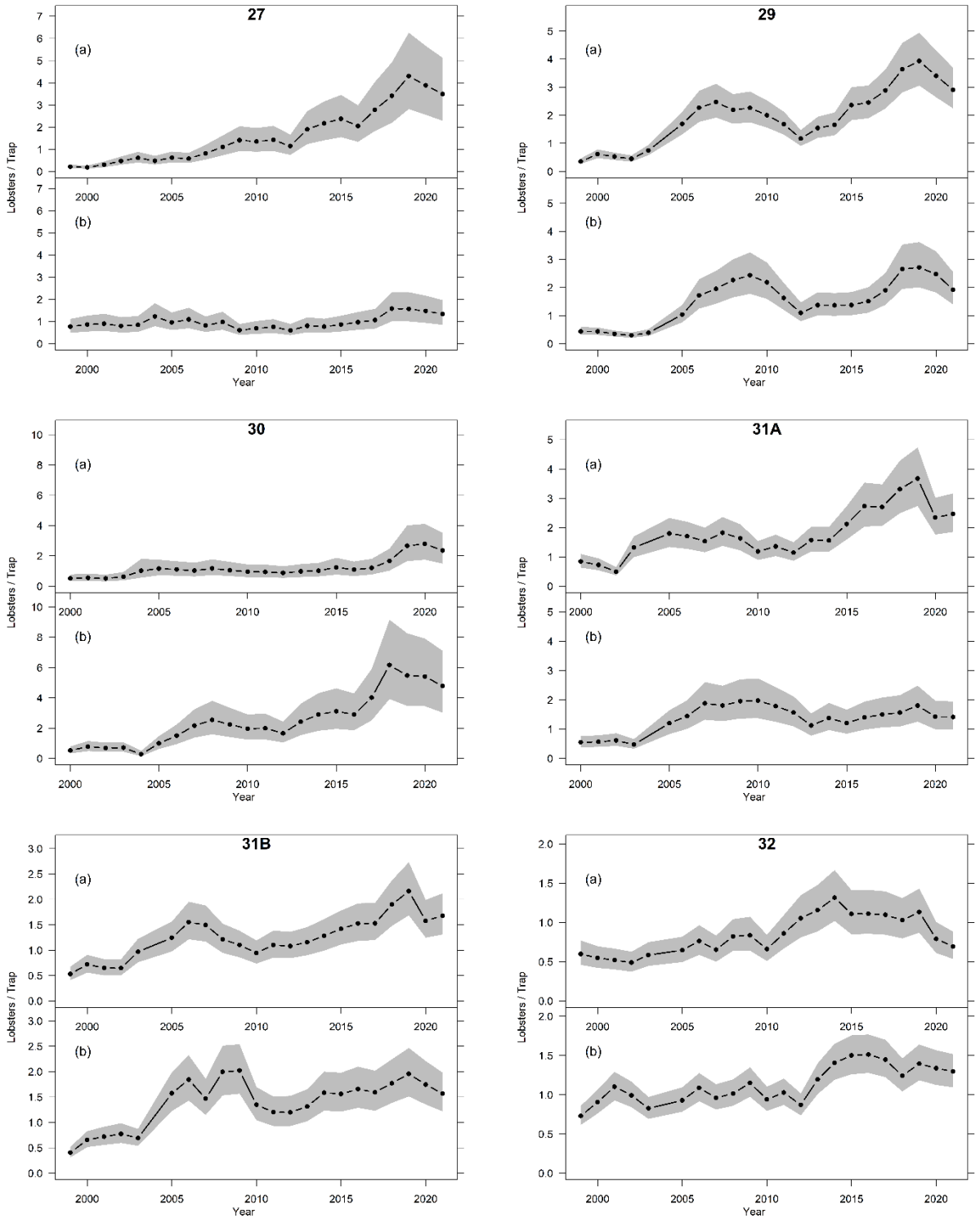

Figure 7. Time series of FSRS recruitment-trap catch rates (black line), with 95% credible intervals (grey shading) from modelled results for (a) sub-legal (70 mm to minimum legal size), and (b) > minimum legal size. Note that y-axis values are not consistent among LFAs (figure panels).

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.

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, buyer-imposed daily landing limits, no market for animals with one claw (“culls”), and modified work routines with COVID-19 precautions. These effects on the fishery varied among (and even within) LFAs. As such, effort, catch rate, and landings data for 2020 may not be directly comparable to other years.

In any given LFA and season, there may be unaccounted for landings both within and outside the commercial season from the food, social and ceremonial (FSC) fishery. There may also be unaccounted for landings as a result of illegal fishing. In June 2021, a new moderate livelihood licence authorizing fishing in LFAs 27–31A was issued by DFO. To date, complete reports of landings from these activities have not been received by DFO Science, and reported landings in this document do not represent total annual fisheries removals for LFAs where the new moderate livelihood and existing FSC fisheries occurred.

It also appears there may have been an increase in illegal fishing outside of the commercial season. DFO Conservation and Protection officers seized 513 traps in LFA 29 over a 4-month period outside of the commercial season in 2021 (Trevor Lushington, Acting Area Chief, DFO Conservation & Protection Eastern Nova Scotia, Jan 2022; pers. comm.). These traps did not have valid tags and, therefore, could not be traced to a DFO-authorized harvest. Such a high number of traps, approximately 2 commercial gear complements, indicates that removals are occurring in this area without an ability to adequately account for the removals in science advice.

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. Fishing that occurs outside of the established commercial season may differentially affect stock components (size, sex, maturity) as compared to the commercial fishery. 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.

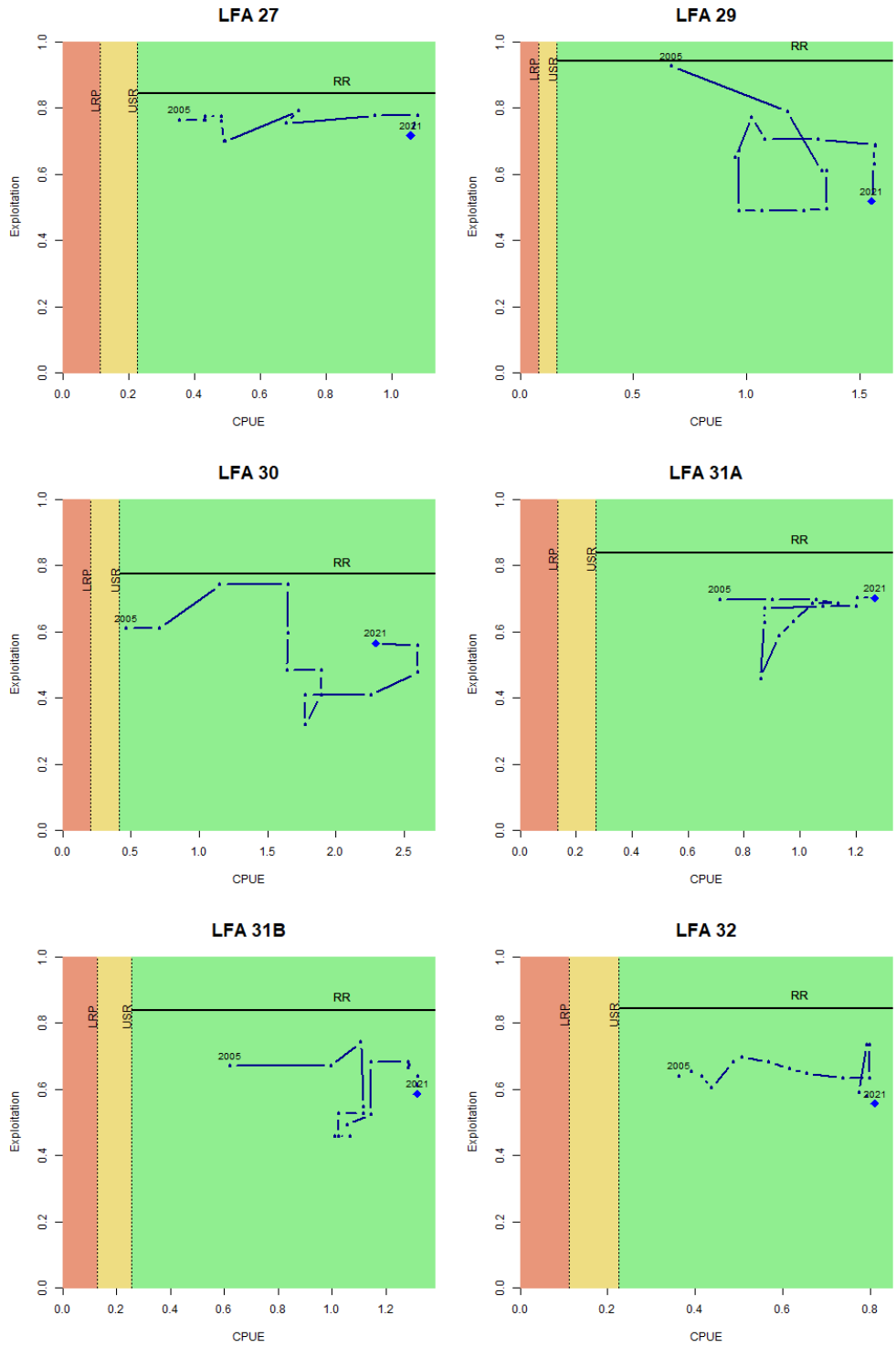

Figure 8. Phase plots using the 3-year running median of CPUE (kg/trap haul) and 3-year running median of Continuous Change in Ratio exploitation index compared against the Upper Stock Reference and Limit Reference Point based on commercial catch rates. The Removal Reference is the 75th quantile break 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.

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Sources of Information

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