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Ecosystems and Oceans Science
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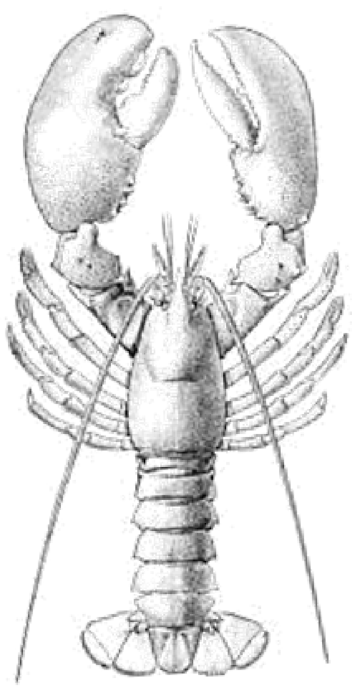
Maritimes Region

Canadian Science Advisory Secretariat
Science Advisory Report 2023/032

BYCATCH ANALYSES FROM THE INSHORE LOBSTER FISHERIES IN LOBSTER FISHING AREAS 27, 31A, 31B, 33, 34, AND 35



American Lobster

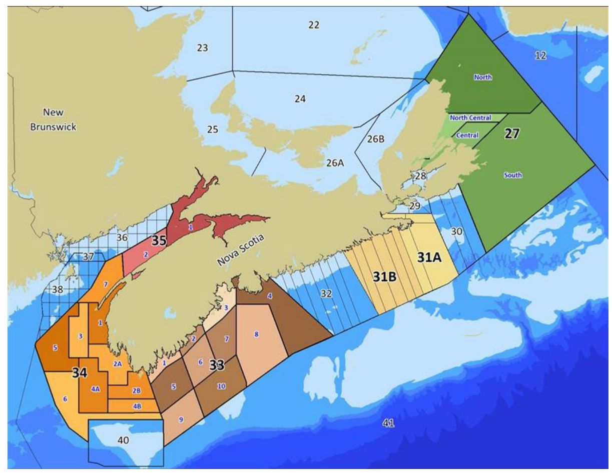


Figure 1. Lobster Fishing Areas (LFAs), grids, and grid groupings in Fisheries and Oceans Canada's Maritimes Region.

Context:

Fisheries and Oceans Canada's (DFO) Policy on Managing Bycatch was introduced in 2013. This policy identified Canada's need to systematically address bycatch in all fisheries and included the objective of accounting for total catch including retained and non-retained bycatch Implementing the policy in the Lobster fishery is a priority for DFO, as a variety of species are caught regularly in Lobster traps, and the fishery has been identified as a potential threat to the recovery of several depleted groundfish stocks. These include Atlantic Cod in Northwest Atlantic Fisheries Organization (NAFO) Divisions 4X5 and Cusk, which have been assessed as endangered by the Committee on the Status of Endangered Wildlife in Canada.

In 2018, standardized protocols were introduced to an at-sea data collection program in Lobster Fishing Areas (LFAs) 33, 34, and 35. Pre-existing voluntary industry-led programs in LFAs 27, 31A, 31B, and 32 were aligned with these protocols in 2018.

Maritimes Region Resource Management has requested a review of the available data collected in these programs to provide estimates of incidental catch (bycatch) of key species in the inshore Lobster fishery, along with recommendations on improvements to sampling methods or targets, if required.

The main objective of this meeting was the review of summary statistics of at-sea data collected in Maritimes Region Lobster fisheries between 2018–2021, following standardized data collection protocols. Estimates of incidental catch were reviewed for Atlantic Cod, Cusk, Jonah Crab, and Cunner and recommendations were provided to improve sampling methods and targets.

This Science Advisory Report is from the May 19–20, 2022 meeting on the Review of the Maritimes Region Lobster Bycatch Program. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- In 2013, the Government of Canada released the Policy on Managing Bycatch as part of the Sustainable Fisheries Framework. This policy identified Canada's need to systematically address bycatch in all fisheries and included the objective of accounting for total catch, including retained and non-retained bycatch.
- In 2018, standardized protocols were introduced to an at-sea data collection program in Lobster Fishing Areas (LFAs) 33, 34, and 35 with sampling by two groups: an industry association and at-sea observer companies. Pre-existing voluntary industry-led programs in LFAs 27, 31A, 31B, and 32 were aligned with these protocols in 2018.
- The at-sea data collection program sought to sample a sufficient number of trap hauls to be representative of the entirety of the fishery. This program set a preliminary target to collect data from 1% of commercial fishing trips within each LFA in the inshore Lobster fishery.
- Combining all available years (2018–2021) and sampling sources (i.e., industry-led association and at-sea observer companies), more than 60,000 traps were sampled for bycatch with a total of 46 species or species groupings. These efforts represent between 0.09% and 0.59% of total commercial fishing trips and between 0.03% and 0.4% of total commercial trap hauls. Although these sampling targets were not met, analyses suggested sampling was representative of the fishery in most LFAs.
- Species richness varied between LFAs, but also between sampling sources within the same LFA. Results indicate the diversity of bycatch species in Lobster traps is well described in these sampling data.
- A generalized modelling framework that explicitly incorporates spatial-temporal dependence structure was applied to the at-sea sampled data to predict incidental capture of Atlantic Cod, Cusk, Jonah Crab, and Cunner. Sampling source and depth were evaluated as covariates in these models.
- The predicted incidental capture (bycatch) of Atlantic Cod in the Lobster fishery ranged from 1.02 tons (t)/fishing season in LFA 27 to 243 t/fishing season in LFA 34.
- Cusk were only present in at-sea samples from LFAs 33–35. The predicted incidental capture (bycatch) of Cusk in the Lobster fishery was 33.3 t/fishing season in LFA 33, 220.4 t/fishing season in LFA 34, and 1.8 t/fishing season in LFA 35.
- The predicted incidental capture (bycatch) of Jonah Crab ranged from less than 0.2 t/fishing season in LFAs 31A and 31B to 3,098 t/fishing season in LFA 34.

- While Cunner were present in all LFAs, bycatch analyses focused on LFA 27 where a Cunner retention pilot project is in place, and neighbouring LFAs 31A and 31B. The predicted incidental capture (bycatch) of Cunner was 9.8 t/fishing season in LFA 27, 1.05 t/fishing season in LFA 31A, and 0.57 t/fishing season in LFA 31B.
- To track annual changes in estimates of bycatch, increased spatial and temporal coverage of sampling would be required. Expanding the analyses to include data from sampling in western LFA 31B would improve spatial representativity of the LFA.
- The explicit incorporation of spatial and temporal effects should be considered in future investigations of bycatch.

BACKGROUND

It is well known that fishing methods and gears are rarely precise enough to target just the species, or size, of interest. This lack of perfect selectivity leads to the incidental capture of others species. In some instances, this incidental catch, or bycatch, may be retained by the fishery depending on licence conditions. Often it is returned to the water, where rates of survival vary. In 2013 the Government of Canada released the Policy on Managing Bycatch (DFO 2013a) as part of the Sustainable Fisheries Framework (DFO 2013b). This policy identified Canada’s need to systematically address bycatch in all fisheries and included the objective of accounting for total catch including retained and non-retained bycatch. Here we define bycatch as the capture in lobster traps as all non-lobster species. In 2018, standardized protocols were introduced to an at-sea data collection program in Lobster Fishing Areas (LFAs) 33, 34, and 35 with sampling by two groups: an industry association and at-sea observer companies (ASOC). Pre-existing voluntary industry-led programs in LFAs 27, 31A, 31B, and 32 were aligned with these protocols in 2018.

The inshore Lobster fishery in the Maritimes Region, LFAs 27–38, has several LFAs with regular monitoring of bycatch through their fishing associations (LFA 27- Cape Breton Fish Harvesters Association; LFA 31A & LFA 31B Guysborough County Inshore Fishermen’s Association [GCIFA]; LFA 31B & LFA 32 Eastern Shore Fishermen’s Protective Association [ESFPA]). Reports focusing on bycatch monitoring of the inshore Lobster fisheries have been limited to an overview of bycatch and discards in LFAs 27–34 published in 2014 (Pezzack et al. 2014). A lack of bycatch reporting and analyses triggered an initiative to describe bycatch in the Maritimes Lobster fisheries through at-sea monitoring. A pilot project initiated in LFAs 33, 34, and 35 mandated all licence holders to join Southwest Lobster Science Society (SWLSS) or have an agreement in place with an at-sea observer company. Fishing associations in LFAs 27, 31A, 31B, and 32 have been voluntarily performing at-sea sampling following the same sampling protocols and results from these data will be presented here. A portion of the data from LFA 31B and data from LFA 32 were not available at the time of this meeting. The at-sea data collection program set a preliminary target to collect data from 1% of commercial fishing trips within each LFA in the inshore Lobster fishery.

The goals of the meeting were to: 1) review the Lobster fishery bycatch program; 2) assess the representativity of the sampling to the fisheries; and 3) provide incidental bycatch estimates for several key species, specifically Atlantic Cod (*Gadus morhua*), Cusk (*Brosme brosme*), Jonah Crab (*Cancer borealis*), and Cunner (*Tautogolabrus adspersus*). Bycatch mortality estimates were not developed during these analyses.

PROGRAM DESIGN

Sampling programs should be representative of the populations being sampled to reduce the potential of bias in the results. The at-sea data collection program sought to sample a sufficient number of trap hauls to be representative of the entirety of the fishery. Results are not readily transferable between LFAs (i.e., spatial effects) due to considerable differences among LFAs (e.g., season timing; habitat; species composition). Within LFAs, there is considerable spatial and temporal variability in fishing effort. The 1% sampling target within LFAs was allocated based on commercial logbook reporting within grid groupings and fishing periods (Figure 1).

Sampling of commercial Lobster fishing trips was performed by fishing associations in all LFAs, or ASOC in LFAs 33–35. Within a trip, traps were selected following a systematic sampling design (e.g., every 5th trap sampled). All specimens within a trap were identified to the species level (where possible), all crustaceans and finfish were measured, and biological information and condition were recorded. Non-measured specimens included whelks, sea urchins, and sea stars.

Gaps in at-sea sampling data resulted from logistic constraints due to COVID-19 restrictions in 2020 and 2021. In LFAs 27, 31A, and 31B, data were available from 2018 and 2019 and sampling occurred across all strata; therefore, data were analyzed on an annual basis. In LFAs 33, 34, and 35, the fisheries cover a much broader area and data density was insufficient to produce annual estimates of bycatch; therefore, analyses were conducted on the combined data across all three fishing seasons. Through combining the data, implicit stationarity was assumed (constant mean and variance) for the fishery and bycatch species among the fishing seasons. The data from the fishery logbooks suggest this was a valid assumption for Lobster. This assumption likely holds for Atlantic Cod, Jonah Crab, and Cusk. The recent assessment on 4X5Y Atlantic Cod indicated a stable and low productivity state during the study time period (DFO 2021). The Inshore Lobster Trawl Survey in LFA 34 supports this assumption of stationarity for Jonah Crab and Cusk. Although stationarity was also assumed for Cunner, there is no available information to validate this assumption.

COMMERCIAL FISHERY DATA

DFO mandatory logbooks completed by commercial harvesters provide the finest spatial and temporal resolution of landings and effort data available. The logbook and harvester data used in these analyses do not include the Rights-Based Moderate Livelihood and the Food, Social and Ceremonial fisheries that also occur within these LFAs. The logbooks used provide trip level data on fishing location (fishing grid), total number of trap hauls, and estimated total landings. In addition, weighed out landings are included in the sales slip portion of the logbook. The analyses presented below relied heavily on these logbook data. Patterns in space and time from the logbooks were assumed to be representative of the fishery. Landings from the sales slips are assumed to be a census of the commercial fishery landings (for more details see Cook et al. 2020).

ANALYSIS

Modelling At-Sea Data

A generalized modelling framework that explicitly incorporates spatial-temporal dependence structure was applied to the at-sea sampled data to predict incidental capture of Atlantic Cod, Cusk, Jonah Crab, and Cunner (sdmTMB; Anderson et al. 2022). Sampling source (fishing association or ASOC) and depth were evaluated as covariates in these models.

Modelled predictions of catch per trap haul were generated through bilinear interpolation on a regular 1 km^2 grid bounded to the polygons in LFAs 33, 34, and 35. In LFAs 27, 31A, and 31B the prediction surface was limited to the area from the shoreline to the maximum observed depth of sampled traps, as lobster habitat is known to be smaller than the LFA boundaries in this area (Cook et al. 2020).

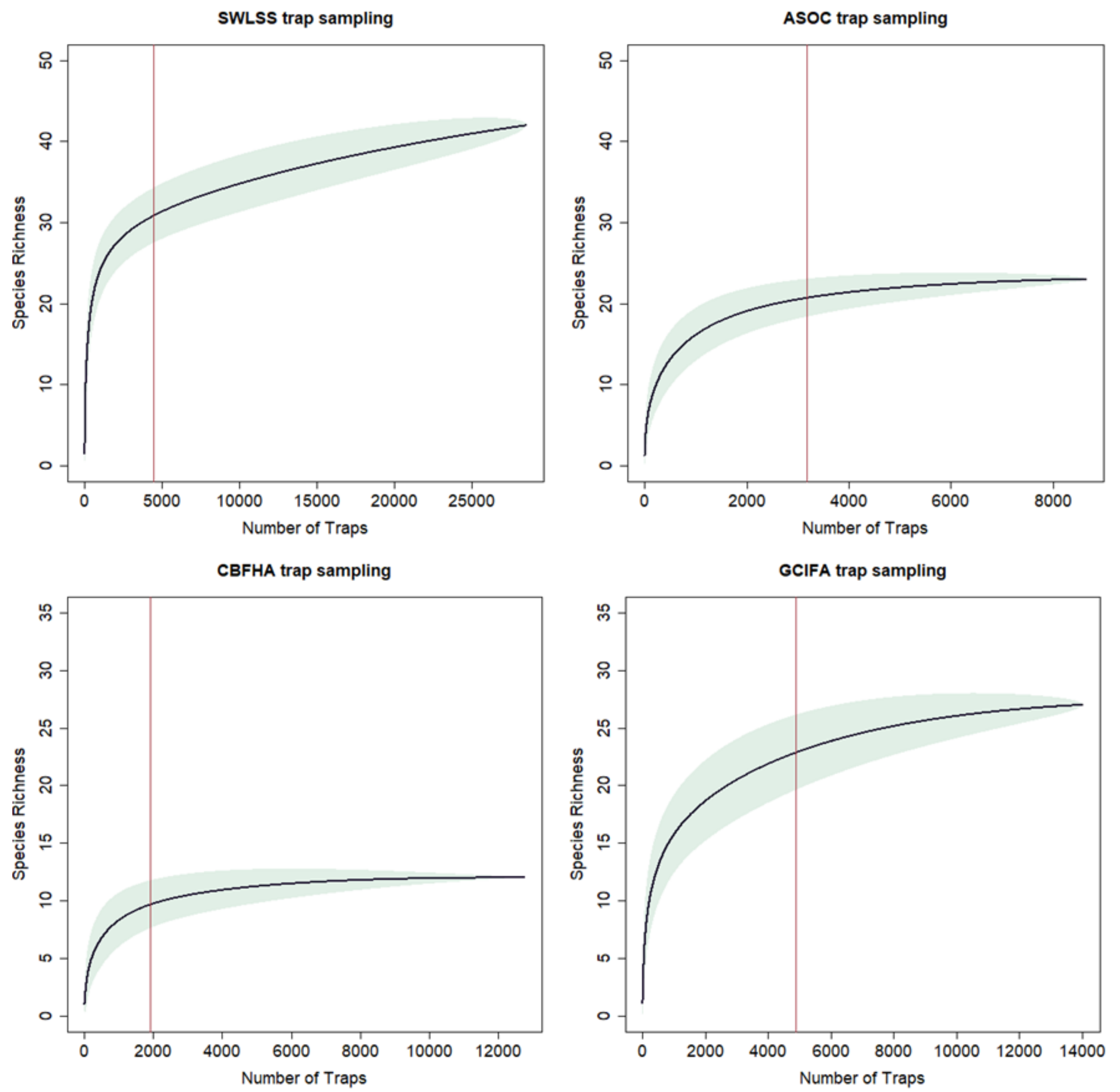


Figure 2. Species accumulation curves (solid line) with 95% confidence intervals (green shading). Data from Southwest Lobster Science Society (SWLSS) and At-Sea Observer Companies (ASOC) include trap sampling in LFAs 33, 34, 35 from 2019–2021 (top row panels). Data from Cape Breton Fish Harvesters Association (CBFHA) include LFA 27 in 2019 (bottom left panel). Data from Guysborough County Inshore Fishermen's Association (GCIFA) include trap sampling in 2018 and 2019 in LFA 31A and LFA 31B (bottom right panel). Vertical line represents the asymptote where 1000 traps results in 1 additional species. Note differences in axes.

Representativity

An evaluation of the bycatch sampling program and its representativity of the Lobster fisheries was performed through three analyses: one trip level and two fishery level analyses.

To evaluate trip level representativity, estimates of total catch were determined using mean catch of commercial lobster within sampled traps and total reported trap hauls. These estimated total catches within a trip were compared to the reported trip landings for the matching logbook entry. Simple and robust linear regressions through the origin were performed on subsets of data grouped by individual LFAs and data providers. Regression slopes near unity indicate representativity.

To evaluate the fishery level representativity of the sampling program to the fishery within an LFA, the distribution of catch per unit effort (CPUE) from trap samples (obtained from Trip level representativity analyses above) was compared to the CPUE from the commercial fishery. General agreement of distributions indicates samples are representative of the fishery.

Models of commercial Lobster catch were developed and predictions of total Lobster landings were generated using total logbook commercial trap hauls. These were compared to total landings reported from sales slips, allowing for direct evaluation of fisheries representativity.

RESULTS

Summary of At-Sea Collected Data

Combining all available years (2018–2021) and sampling sources (fishing associations and ASOC), more than 60,000 traps were sampled for bycatch with a total of 46 species or species groupings. These efforts represent between 0.09% and 0.59% of commercial fishing trips and between 0.03% and 0.4% of total commercial trap hauls.

Species accumulation curves were produced for each LFA and sampling source to evaluate the species richness in sampled Lobster traps. Species richness varied between LFAs, but also between sampling sources within an LFA (Figure 2). In each of the LFAs 33, 34, and 35, SWLSS technicians recorded more species than the ASOC, even while accounting for the larger number of traps sampled by SWLSS (Figure 2). In LFA 27, CBFHA had the lowest number of species recorded, which is consistent with reports of low bycatch within the LFA (Pezzack et al 2014). In LFAs 31A and 31B, GCIFA recorded an intermediate number of species, relative to the other LFAs. Results indicated the diversity of bycatch species in Lobster traps is well described in the sampling data (Figure 2).

Jonah Crab median observed size was higher in LFAs 33–35 (114–118 mm carapace width [CW]) when compared to LFAs 31A and 31B (85–96 mm CW). The median size of Atlantic Cod captured was similar across all LFAs, between 45 cm and 49 cm fork length (FL), with a range of 10–88 cm FL. Cusk in LFA 33 were predominately large with a median of 65.5 cm FL and a range of 51–80 cm FL, whereas Cusk in LFA 35 were smaller, ranging from 24–42 cm FL. LFA 34 Cusk samples were intermediate in size, ranging from 13–80 cm FL with a median of 55 cm. The minimum and median sizes of Cunner were smaller in LFA 27 compared to all other LFAs.

Trip Level Representativity

Across all trips conducted in LFAs 33–35, there was good correspondence between the reported total landings and the predicted total landings of Lobster. Robust regression consistently provided better fit than linear regression to relationships across all subsets of data. There was slight overprediction in landings from SWLSS (robust regression slope 1.03). In comparison, ASOC trap samples had substantially more variability and influential records in the data as reflected by the comparison of the slopes from simple linear (0.897) and robust regression (0.975), and slightly underpredicted landings.

In LFAs 31A and 31B the predicted landings were typically higher than the landings reported in logbooks, with the robust regression slope between 1.01 and 1.08. LFA 27, had high correspondence between predicted and reported trip landings with a robust regression slope of 1.0.

Fishery Level Representativity

The cumulative distribution of CPUE from the sampled trips in LFAs 33, 34, and 27 all closely follow those from the commercial fishery; however, there is some indication of under-sampling trips with high CPUEs in LFAs 33 and 34, and over sampling trips with high CPUEs in LFA 27 (Figure 3). LFA 35 displayed under-sampling of trips with high CPUEs. LFAs 31A and 31B showed similar patterns of having samples from higher CPUE trips than are observed throughout their respective fisheries. Data available from at-sea sampling in LFA 31B do not cover the entire LFA, focusing on the easternmost three grids, and may account for some of the difference in CPUE.

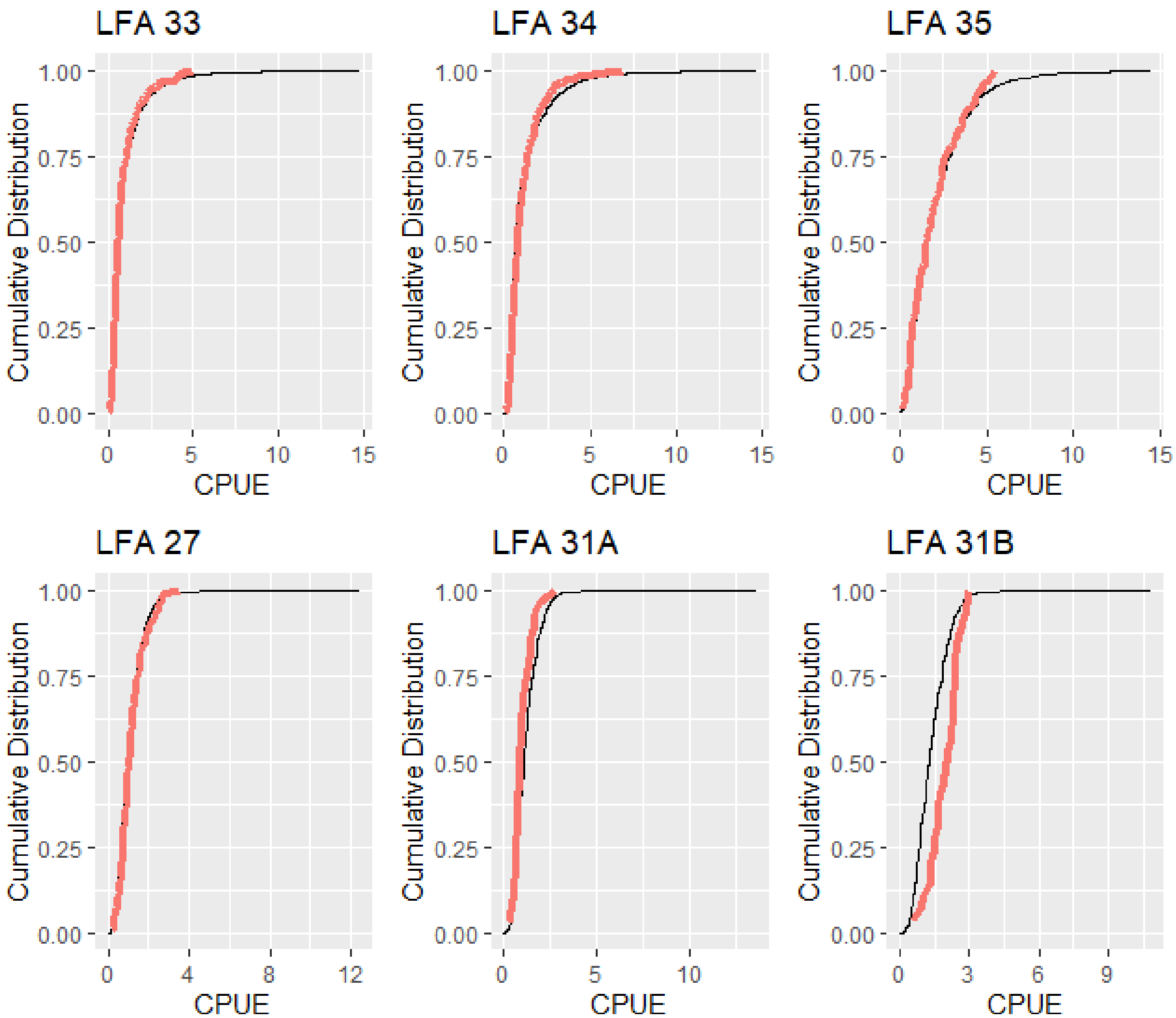


Figure 3. Cumulative distribution of CPUE from sampled (red line) and total trips (black line) for Lobster Fishing Areas (LFAs) 33, 34, and 35 during 2019–2021 commercial fishing seasons, and during commercial fishing seasons 2019 for LFA 27 and 2018 and 2019 for LFAs 31A and 31B.

Within the LFAs the best model structure varied. For LFAs 27, 33, and 34, there was strong indication of predictive skill of the model indicated by the percent difference between predicted total landings and sales slip report landings (Table 1). For LFAs 31A, 31B, and 35, the lack of spatial and temporal representativity of the data led to underpredictions in LFA 35 and overpredictions in LFAs 31A and 31B (Table 1). The lack of spatial representativity could negatively bias the bycatch estimates for species with localized high densities that may be present in unsampled areas. Inclusion of additional data in future analyses will likely alleviate this uncertainty.

Table 1. Model predictions of annual Lobster landings (t) by Lobster Fishing Area (LFA) and fishing season using the at sea sampled data. A single spatial model for LFAs 33–35, combining all at-sea samples and years was used to predict total Lobster landings within each LFA. For comparison, landings for LFAs 33–35 were averaged from reported logs in 2019–2021.

LFA	Fishing Season	Predicted Lobster Landings (t)	Quartile Range of Predicted Landings (t)	Reported Landings (t)
27	2019	6,313	(4,725– 8,513)	6,122
31A	2018	1,283	(1,057–1,582)	916
31A	2019	1,083	(878.9–1,363)	1,010
31B	2018	1,703	(1,443–2,022)	1,182
31B	2019	1,778	(1,489–2,189)	1,382
33	2019-2021*	7,493	(5,263–10,837)	7,399
34	2019-2021*	20,930	(15,503–28,583)	20,856
35	2019-2021*	2,298	(1,748–2,726)	2,735

BYCATCH ANALYSES

Atlantic Cod

For Atlantic Cod bycatch in the sampled Lobster fisheries, spatial models incorporating the effects of depth and data source (only in LFAs 33–35) were selected as the models to use for predictions. For each LFA, areas of high capture of Atlantic Cod were identified (Figure 4–6) and were temporally stable across the season. The predicted incidental capture (bycatch) of Atlantic Cod in the Lobster fishery ranged from 1.02 t/fishing season in LFA 27 to 243 t/fishing season in LFA 34 (Table 2).

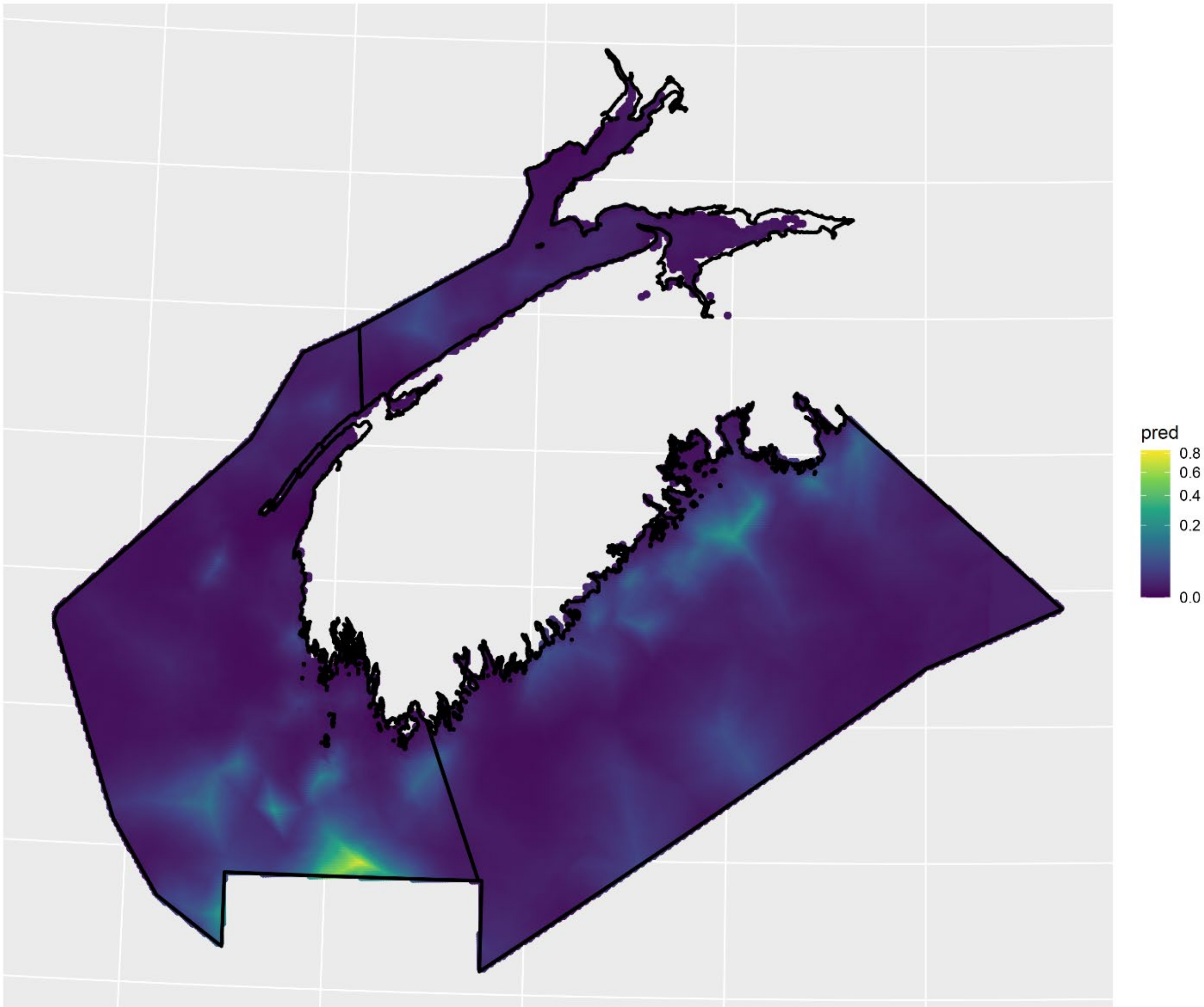


Figure 4. Predictions (pred) of Atlantic Cod bycatch in the Lobster fishery (kg/trap haul) estimated from the at-sea sampling of Lobster traps during the commercial fishery in Lobster Fishing Areas 33–35 between 2019 and 2021. Colour shading represents predictions of known lobster fishing distribution. Black lines represent LFA boundaries.

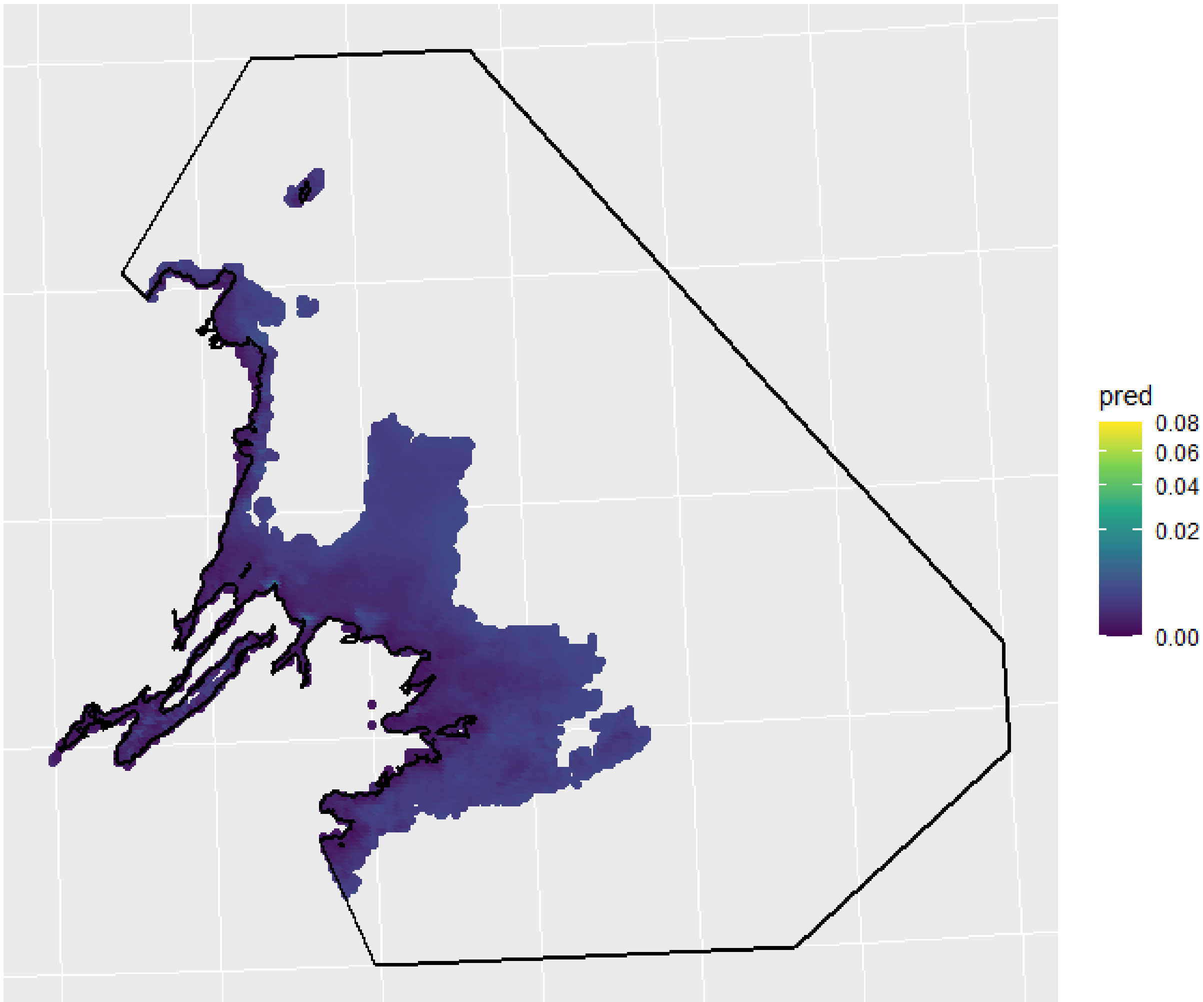


Figure 5. Predictions (pred) of Atlantic Cod bycatch in the Lobster fishery (kg/trap haul) estimated from the at-sea sampling of Lobster traps during the commercial fishery in Lobster Fishing Area 27 in 2019. Colour shading represents predictions of known lobster fishing distribution. Black lines represent LFA boundaries.

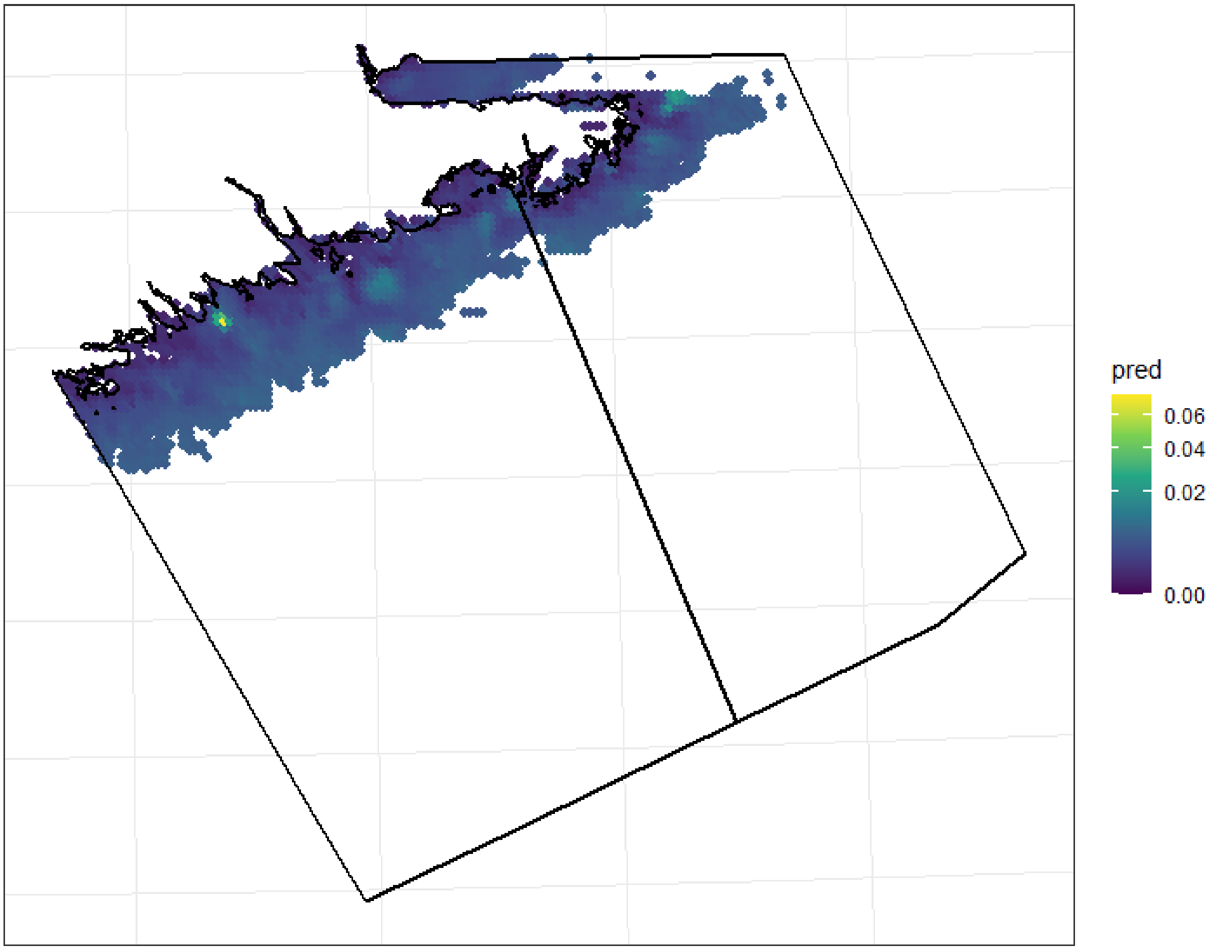


Figure 6. Predictions (pred) of Atlantic Cod bycatch in the Lobster fishery (kg/trap haul) estimated from the at-sea sampling of Lobster traps during the commercial fishery in Lobster Fishing Areas 31A and 31B in 2018–2019. Colour shading represents predictions of known lobster fishing distribution. Black lines represent LFA boundaries.

Table 2. Predictions of annual Atlantic Cod bycatch (t) by Lobster Fishing Area (LFA) over a fishing season. Due to unsampled areas, at-sea samples used for predictions in LFAs 33–35, were combined from 2019–2021 fishing seasons.

LFA	Predicted Annual Atlantic Cod Bycatch (t)	Quartile Range of Predictions (t)
27	1.02	(0.4–2.1)
31A	3.68	(1.8–7.1)
31B	4.7	(2.7–8.4)
33	139.9	(93.2–217.4)
34	243	(197.1–415.8)
35	7.7	(4.5–13.3)

Cusk

Cusk were only present in at-sea samples from LFAs 33–35. The spatial model with a smoothed effect of depth was selected as the model for predicting Cusk bycatch (Figure 7). Estimates of total bycatch of Cusk ranged from 1.8 t/fishing season in LFA 35 to 220.4 t/fishing season in LFA 34 (Table 3).

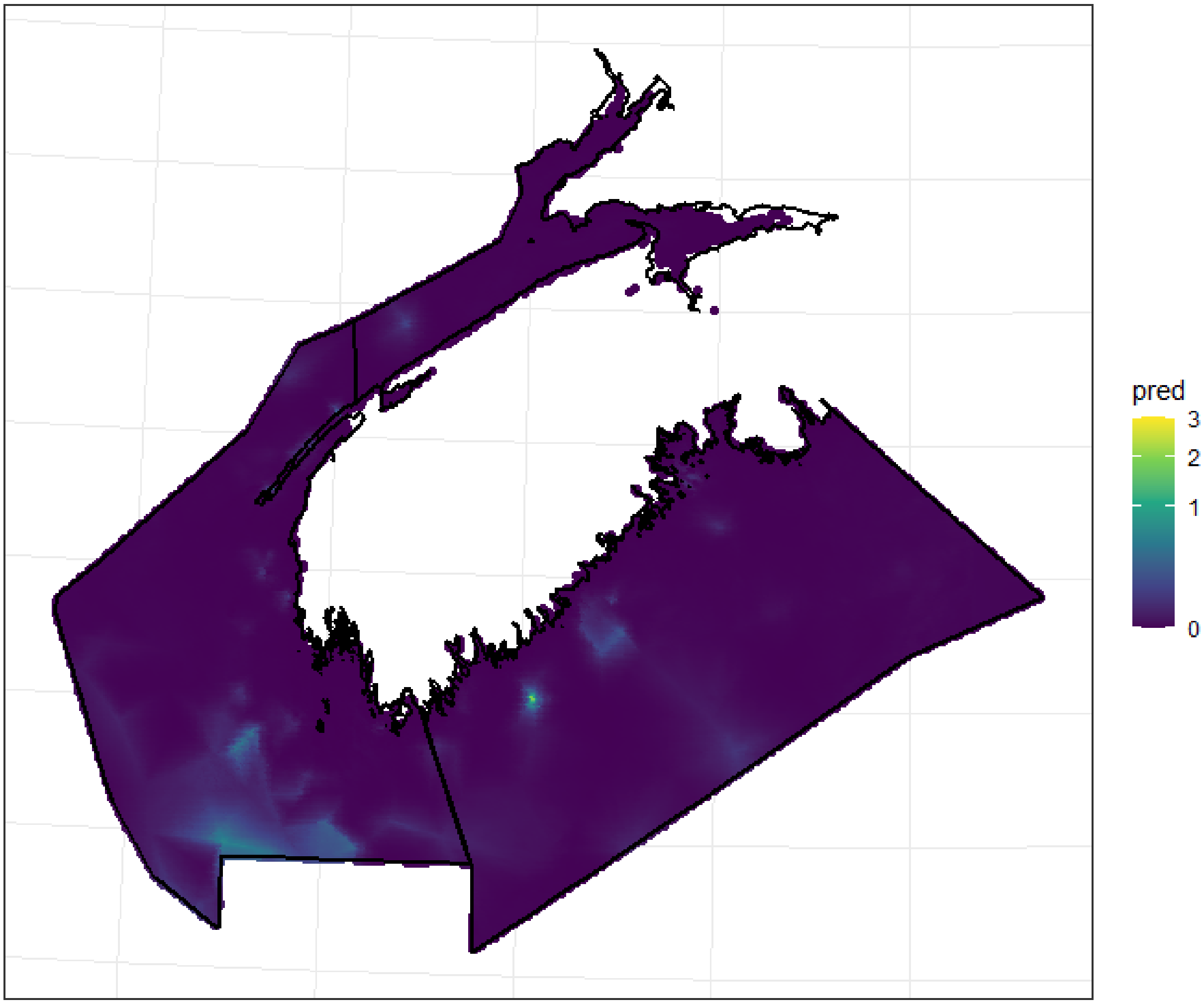


Figure 7: Prediction (pred) of Cusk bycatch in the Lobster fishery (kg/trap haul) estimated from the at-sea sampling of Lobster traps during the commercial fishery in Lobster Fishing Areas 33–35 during 2019–2021. Colour shading represents predictions of known lobster fishing distribution. Black lines represent LFA boundaries.

Table 3. Predictions of annual Cusk bycatch (t) by Lobster Fishing Area over a fishing season. Due to unsampled areas, at-sea samples used for predictions in LFAs 33–35, were combined from 2019–2021 fishing seasons.

LFA	Predicted Annual Cusk Bycatch (t)	Quartile Range of Predictions (t)
33	33.3	(13.9–96.5)
34	220.4	(137.2–376.8)
35	1.8	(0.88–4.3)

Jonah Crab

Jonah Crab catch in Lobster traps was present in all areas; however, there were insufficient encounters in LFA 27 to explore generalized models. In LFAs 33–35, Jonah Crab is frequently captured in Lobster traps. Applying a hurdle model, the capture (presence-absence) process model incorporating spatial-temporal dependence structure was selected. Positive densities (kg/trap haul > 0) with a spatial component and depth smooths were the selected model (Figure 8).

In LFAs 31A and 31B there were localized catches of Jonah Crab that were persistent throughout the season and the selected model for predicting catch used space and smoothed depth as predictors (Figure 9). The predicted incidental capture (bycatch) of Jonah Crab ranged from less than 0.2 t/fishing season in LFAs 31A and 31B to 3,098 t/fishing season in LFA 34 (Table 4).

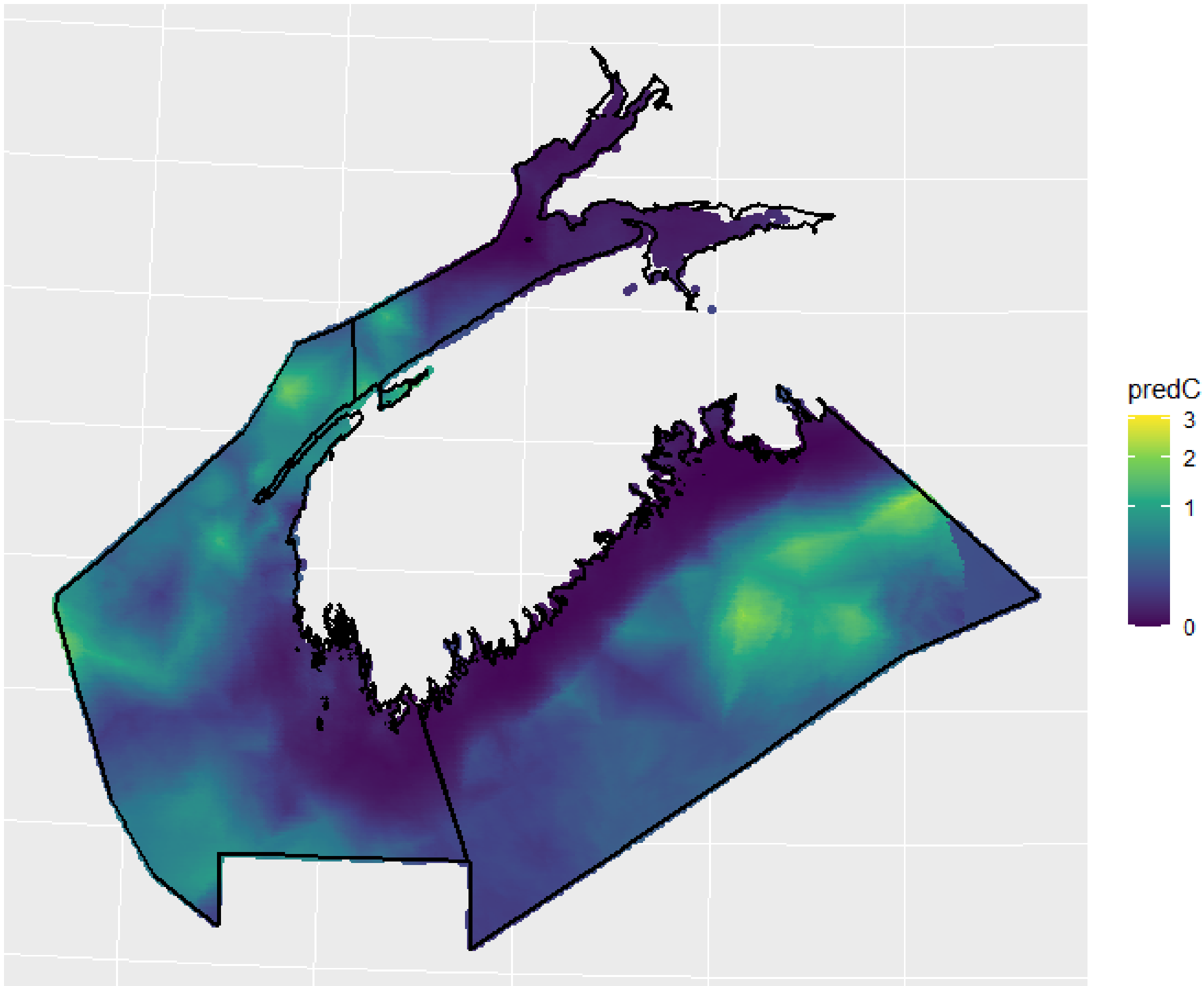


Figure 8. Predictions (predC) of Jonah Crab bycatch in the Lobster fishery (kg/trap haul) estimated from the at-sea sampling of Lobster traps during the commercial fishery in LFAs 33–35 during 2019–2021. Colour shading represents predictions of known Lobster fishing distribution. Black lines represent LFA boundaries.

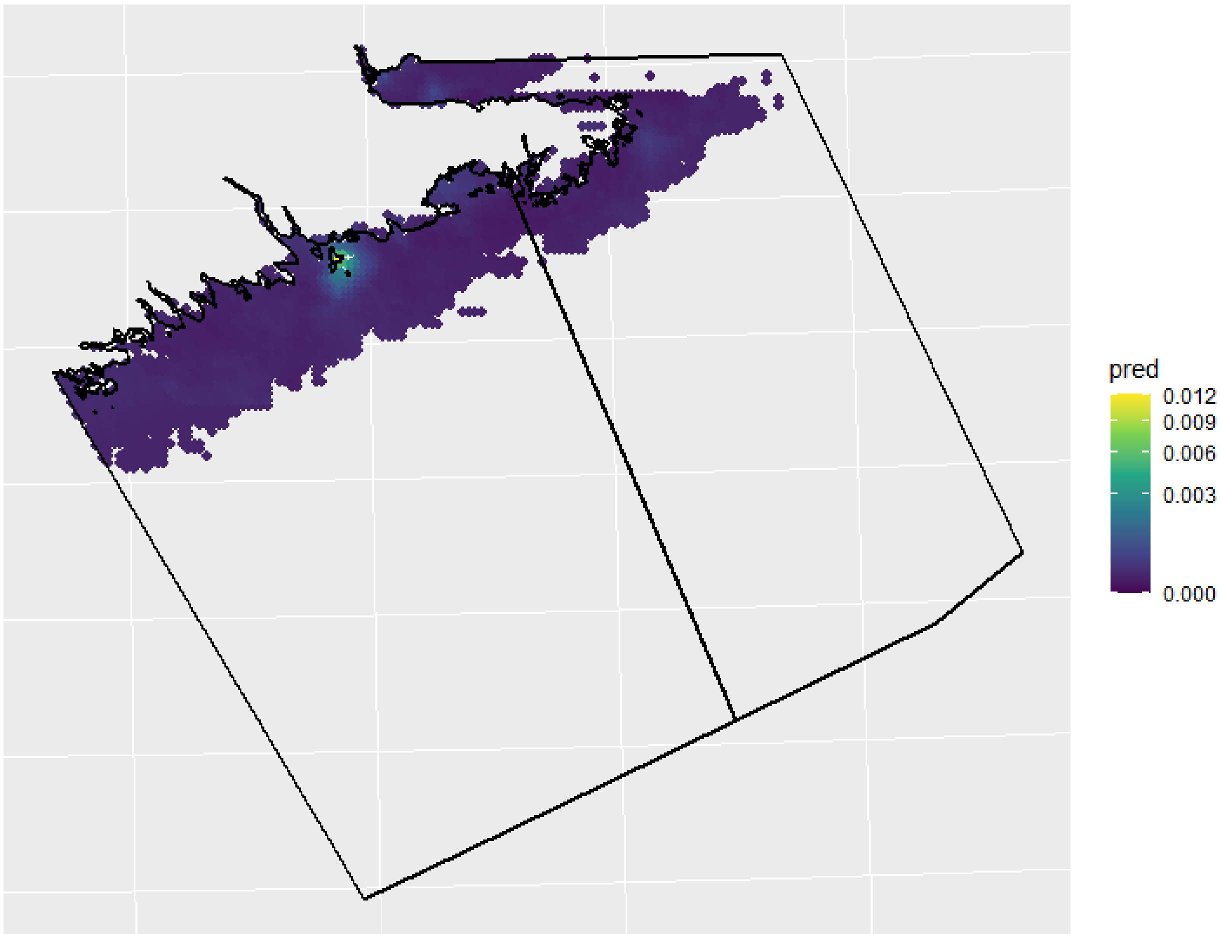


Figure 9. Predictions (pred) of Jonah Crab bycatch in the Lobster fishery (kg/trap haul) estimated from the at-sea sampling of Lobster traps during the commercial fishery in LFAs 31A and 31B during 2018–2019. Colour shading represents predictions of known Lobster fishing distribution. Black lines represent LFA boundaries.

Table 4. Predictions of annual Jonah Crab bycatch (t) by Lobster Fishing Area (LFA). Due to unsampled areas, at-sea samples used for predictions in LFAs 33–35 were combined from 2019–2021 fishing seasons. Data for predicted retainable Jonah Crab refers to male only crabs above 130 mm carapace width. Note: In LFA 33 retention of incidentally caught Jonah Crab is not authorized.

LFA	Predicted Jonah Crab Bycatch (t)	Quartile Range of Predictions of Jonah Crab Bycatch (t)	Predicted Retainable Jonah Crab Bycatch (t)	Quartile Range of Predictions of Retainable Jonah Crab (t)
31A	0.068	(0.028–0.187)	---	---
31B	0.170	(92.3–356.0)	---	---
33	544	(254–1,009)	232	(199–427)
34	3,098	(1,949–4,567)	1,207	(764–1,842)
35	491	(384–601)	131	(86–197)

Cunner

While Cunner were present in all LFAs, bycatch analyses focused on LFA 27 where a Cunner retention pilot project is in place, and neighboring LFAs 31A and 31B. The spatial-temporal dependence model with a smoothed effect of depth was selected as the model for predicting Cunner bycatch in LFA 27 (Figure 10). In LFAs 31A and 31B, the spatial dependence model with a depth smooth was the selected model (Figure 11). The predicted incidental capture (bycatch) of Cunner ranged from 0.57 t/fishing season in LFA 31B to 9.8 t/fishing season in LFA 27 (Table 5).

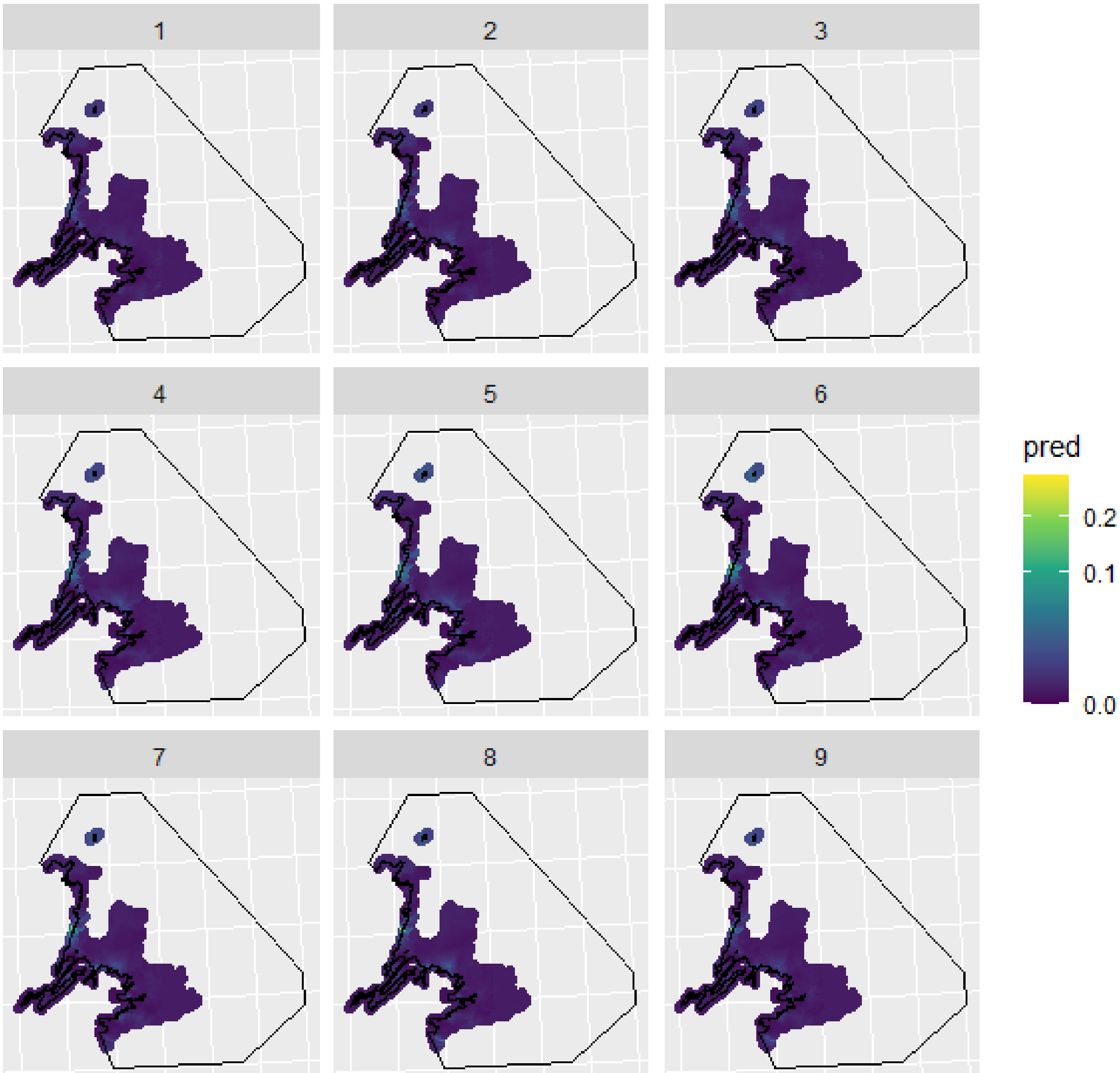


Figure 10. Predictions (pred) of Cunner bycatch by week of season (1–9) in the Lobster fishery (kg/trap haul) estimated from the at-sea sampling of Lobster traps during the commercial fishery in Lobster Fishing Area 27 in 2019. Colour shading represents predictions of known lobster fishing distribution. Black lines represent LFA boundaries.

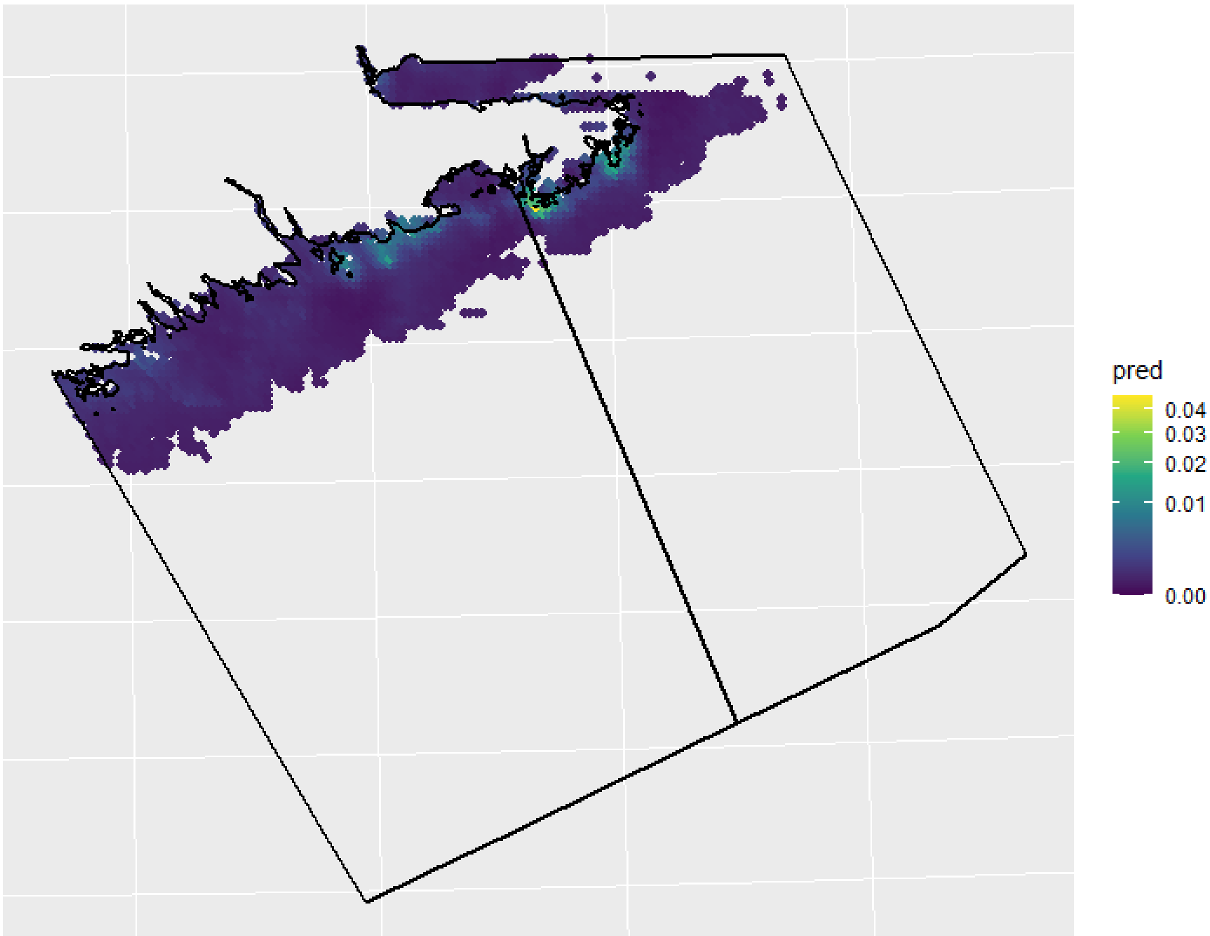


Figure 11. Predictions (pred) of Cunner bycatch in the Lobster fishery (kg/trap haul) estimated from the at-sea sampling of Lobster traps during the commercial fishery in Lobster Fishing Areas 31A and 31B in 2018–2019. Colour shading represents predictions of known lobster fishing distribution. Black lines represent LFA boundaries.

Table 5. Predictions of annual Cunner bycatch (t) in the Lobster fishery by Lobster Fishing Area (LFA)

LFA	Predicted Annual Cunner Bycatch (t)	Quartile Range of Predictions (t)
27	9.8	(3.3–30.2)
31A	1.05	(0.66–1.61)
31B	0.57	(0.34–1.02)

CONCLUSIONS AND RECOMMENDATIONS

A preliminary target of the bycatch monitoring project was the collection of bycatch data from 1% of trips in the fishery with sampling targets divided into spatial and temporal strata. Although these sampling targets were not met, analyses suggested sampling was representative of the fishery in most LFAs. There were indications of oversampling of trips with high Lobster catch rates in LFAs 31A and 31B and under sampling of trips with high catch rates in LFA 35 suggesting that components of the fishery may not be well characterized. In LFAs 33–35, data were pooled across fishing seasons in order to achieve results due to gaps in sampling. Through pooling data, the implicit assumption of stationarity of Lobster and bycatch distributions was made, and presumed valid based on available fishery data on Lobster and fisheries independent surveys or stock assessments on bycatch species. To track annual changes in estimates of bycatch, increased spatial and temporal coverage of sampling would be required. Expanding the analyses to include data from sampling in western LFA 31B would improve spatial representativity of the LFA.

Data from two sampling sources (SWLSS and ASOC) in overlapping time periods (2019–2021) and LFAs (33–35) provided the opportunity to conduct between sampling source comparisons. In terms of sampling intensity, SWLSS sampled more trips, more traps per trip, and identified more species than ASOC. Additionally, the inclusion of sampling source improved the model prediction skill. Where data are available, inclusion of sampling source should be considered. Data from SWLSS more consistently matched estimated total landings to reported trip landings, perhaps due to the larger number of traps sampled.

Estimates of bycatch were determined using a generalized modeling framework that explicitly incorporates a spatial-temporal dependence structure. Through the modeling approach, the spatial (and in some instances temporal) structure of the catches were directly estimated in the model, a desirable characteristic given the high spatial and temporal variability in the Lobster fishery. As demonstrated here, the explicit incorporation of spatial and temporal effects should be considered in future investigations of bycatch.

Sources of Uncertainty

In LFAs 33, 34, and 35, the fisheries cover a much broader area and data density was insufficient to produce annual estimates of bycatch; therefore, analyses were conducted on the combined data across all three fishing seasons.

There is some indication of under-sampling trips with high CPUEs in LFAs 33 and 34, and over sampling trips with high CPUEs in LFA 27 (Figure 3). LFA 35 displayed under-sampling of trips with high CPUEs. LFAs 31A and 31B showed similar patterns of having samples from higher CPUE trips than are observed throughout their respective fisheries. Data available from at-sea sampling in LFA 31B do not cover the entire LFA, focusing on the easternmost three grids, and may account for some of the difference in CPUE.

For LFAs 31A, 31B, and 35, the lack of spatial and temporal representativity of the data led to underpredictions in LFA 35 and overpredictions in LFAs 31A and 31B (Table 1). The lack of spatial representativity could negatively bias the bycatch estimates for species with localized high densities that may be present in unsampled areas. Inclusion of additional data in future analyses will likely alleviate this uncertainty.

LIST OF MEETING PARTICIPANTS

Name	Affiliation
Asselin, Natalie	DFO Science - Gulf Region
Baker, Lori	Eastern Shore Fisherman’s Protective Association LFAs 31B & 32
Barrett, Melanie	DFO Science - Maritimes Region
Bartlett, Mike	Woodstock First Nation
Berry, Bernie	Coldwater Lobster Assoc.
Boudreau, Virginia	Guysborough Co. Inshore Fisherman’s Assoc LFAs 29, 31A & 31B
Boyd, Catherine	Clearwater Seafoods LP
Campbell-Miller, Jill	DFO Science - Maritimes Region
Chetwynd, Tim	New Brunswick Aboriginal People's Council
Cleveland, Kenneth	Southwest Lobster Science Society
Cook, Adam	DFO Science - Maritimes Region
Couture, John	Oceans North
Dean, Alissa	Atlantic Catch Data
Delorey, Stephanie	Eastern Shore Fishermen's Protective Association
Denton, Cheryl	DFO Science - Maritimes Region
D'Entremont, Nancy	Coldwater Lobster
Docherty, Verna	DFO Resource Management - Maritimes Region
Fleck, Dan	Brazil Rock 33 34 Lobster Association
Harris, Lei	DFO Science - Maritimes Region
Hatt, Terry	New Brunswick Agriculture, Aquaculture and Fisheries
Hayman, Tim	DFO Resource Management - Maritimes Region
Hodgson, Michelle	Confederacy of Mainland Mi’kmaq
Howse, Victoria	DFO Science - Maritimes Region
Kavanagh, Sana	Confederacy of Mainland Mi’kmaq
Langille, Janet	DFO Resource Management - Eastern NS Area Office
McIntyre, Tara	DFO Science - Maritimes Region
Mitchell, Lillian	Fundy North Fishermen's Association / LFA 36
Moore, Albert	Javitech
Morse, Bonnie	Grand Manan Fishermen's Association/ LFA 38
Mugridge, Adam	Nova Scotia Fisheries and Aquaculture
Mullock, Heather	Coldwater Lobster Assoc.
Mussells, Claire	DFO Science - Maritimes Region
Nicholas, Hubert	Membertou First Nation

Name	Affiliation
Oravecz, Michaela	Cape Breton Fish Harvesters Association LFA 27 Board
Paul, Tyson	Unama'ki Institute of Natural Resources
Quigley, Sara	DFO Resource Management - Maritimes Region
Robichaud, Cody	Southwest Lobster Science Society
Sameoto, Jessica	DFO Science - Maritimes Region
Scott-Tibbetts, Shannon	Fishermen and Scientists Research Society
Surette, Dwayne	DFO Resource Management - Southwest NS Area Office
Themelis, Daphne	DFO Science - Maritimes Region
Townsend, Kathryn	Maritime Indigenous Peoples Council
Vascotto, Kris	Atlantic Groundfish Council

SOURCES OF INFORMATION

This Science Advisory Report is from the May 19–20, 2022 Regional Peer Review on the Review of the Maritimes Lobster Bycatch Program. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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

E-Mail: DFO.MARCSA-CASMAR.MPO@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

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MPO. 2023. Analyses des prises accessoires de la pêche côtière du homard dans les zones de pêche du homard 27, 31A, 31B, 33, 34 et 35. Secr. can. des avis sci. du MPO. Avis sci. 2023/032.