# Mapping Inshore Lobster Landings and Fishing Effort on a Maritimes Region Statistical Grid (2015-2019)

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## ABSTRACT

Serdynska, A., Rozalska, K. and Coffen-Smout, S. 2022. Mapping Inshore Lobster Landings and Fishing Effort on a Maritimes Region Statistical Grid (2015–2019). Can. Tech. Rep. Fish. Aquat. Sci. 3509: vii + 51 p.

This report describes an analysis of Maritimes Region inshore lobster logbook data reported at a grid level, including Bay of Fundy Disputed Zone data reported at the coordinate level. Annual and composite (2015–2019) grid maps were produced for landings, number of trap hauls, and the same series standardized by grid area, as well as maps of catch weight per number of trap hauls as an index of catch per unit effort (CPUE). Spatial differences in fishing pressure, landings, and CPUE are indicated, and potential mapping applications are outlined. Mapping the distribution and intensity of inshore lobster fishing activity has management applications for spatial planning and related decision support. The lack of region-wide latitude and longitude coordinates for inshore lobster effort and landings limits the utility of commercial logbook data for marine spatial planning purposes.



## RÉSUMÉ

Serdynska, A., Rozalska, K. and Coffen-Smout, S. 2022. Mapping Inshore Lobster Landings and Fishing Effort on a Maritimes Region Statistical Grid (2015–2019). Can. Tech. Rep. Fish. Aquat. Sci. 3509: vii + 51 p.

Le présent rapport décrit une analyse des données provenant des journaux de bord de la pêche côtière au homard dans la région des Maritimes déclarées à l’échelle du quadrillage, y compris des données relatives à la zone grise de la baie de Fundy consignées sous forme de coordonnées. On a dressé des cartes annuelles et combinées (2015–2019) avec quadrillage pour consigner les débarquements, le nombre de casiers levés et la même série d’éléments normalisés par zone des grilles. En outre, on a dressé des cartes indiquant le poids des prises par nombre de casiers levés comme indice des prises par unité d’effort. Les différences spatiales relatives à la pression de la pêche, aux débarquements et aux prises par unité d’effort figurent dans les cartes; on y décrit également les applications de cartographie possibles. La cartographie de la répartition et de l’intensité des activités de pêche au homard côtière a des applications de gestion pour la planification spatiale et l’aide à la prise de décision connexe. L’absence de coordonnées de latitude et de longitude à l’échelle régionale pour l’effort et les débarquements de homard côtière limite l’utilité des données des journaux commerciaux pour des fins de planification spatiale marine.

# INTRODUCTION

In 2013 and 2017, Fisheries and Oceans Canada (DFO) mapped landings and fishing effort for the inshore lobster fishery in DFO Maritimes Region. The 2013 report (Coffen-Smout et al., 2013) mapped lobster logbook data for 2008 through 2011, using a modified statistical grid. The 2017 report (Serdynska and Coffen-Smout, 2017) mapped logbook data for years 2012 through 2014 using the original, unmodified statistical grid to reflect the full extent of region-wide Lobster Fishing Areas (LFAs). The current report updates inshore lobster landings and effort mapping with logbook data for 2015 to 2019 displayed on the original, unmodified statistical grid.

Mapping fishing activity at effective planning scales provides the potential for multiple applications in the context of integrated oceans and coastal management and planning as mandated under Canada's *Oceans Act*. However, mapping the spatial distribution of inshore lobster fishing in the Maritimes Region is constrained by the lack of region-wide coordinate data reporting requirements for fisheries effort and landings. This report describes the analysis of Maritimes Region lobster logbook data reported at a grid level, including Bay of Fundy Disputed Zone data reported at the coordinate level as a condition of licence.

## The Inshore Lobster Fishery

American lobster (*Homarus americanus*) is distributed throughout the coastal Northwest Atlantic from Labrador to Maryland, U.S.A. (Figure 1; Tremblay et al., 2011). The largest inshore fisheries are concentrated in the Gulf of St. Lawrence and the Gulf of Maine. Lobster distribution in the Maritimes Region, based on DFO summer research vessel surveys from 1999 to 2019, is shown in Figure 2.

In DFO Maritimes Region there are 13 regulated Lobster Fishing Areas (LFAs) that comprise the inshore lobster fishery. They are found from the northern tip of Cape Breton, along the Atlantic Coast of Nova Scotia, and into the Bay of Fundy. The LFAs are defined based on historical boundaries rather than biological ones (Cook et al., 2020). A statistical grid overlaying the LFAs acts as the smallest reporting unit for fishers' logbook data (Figure 3). The statistical grid is not coincident with all LFA boundaries, particularly in the Bay of Fundy.

Historic lobster landings records (1892–1946) were reported by calendar year and summarized by county, while annual landings from 1947 to 1995 were summarized by statistical districts (Tremblay et al., 2011). In 1995, the mandatory catch reporting system changed for all LFAs in the Maritimes Region, with fishers reporting daily catch by port of landing and date. The spatial reporting of lobster fishing activity started in November 1998 when fishers in LFA 34, off southwest Nova Scotia, adopted a Lobster Catch and Settlement Report requiring them to submit spatial information on daily catch and effort by reference to a 10 x 10-minute statistical grid system that provided the first visual portrayal of landings and effort distribution in LFA 34 (Figure 3). This 10-minute statistical grid reporting system was later implemented in LFAs 35–38 in the Bay of Fundy in 2003 (DFO, 2007; Robichaud and Pezzack, 2007) and was in full use for LFAs 34–38 by 2005. Similar data were obtained in 2004 and 2005 during a pilot project in LFAs 27–32 (i.e., the Eastern Shore of Nova Scotia to northern Cape Breton), using a non-uniform statistical grid of inshore-offshore rectangles along the Atlantic coast of Nova Scotia as shown in Figure 3. By 2006 (2005–2006 for LFA 33, i.e., Baccaro Point to Halifax), a mandatory Lobster Catch and Settlement Report was introduced to all fishers in LFAs 27–33 and participation rates increased thereafter. The percentages of licences reporting at the statistical grid level did not consistently exceed 70% until 2008 (J. Tremblay, DFO Science (Retired), pers. comm.).

The terms 'statistical grid' and 'grid' are used interchangeably, and 'statistical grid cell' and 'grid cell' both refer to the individual reporting units within that grid. It should be noted that lobster landings and effort data from the offshore LFA 41 fishery were not incorporated in this grid analysis. The offshore LFA 41 fishery occurs year-round beyond LFAs 33, 34 and 40 in the areas of southeast and southwest Browns Bank, Georges Basin, Georges Bank, and Crowell Basin (Pezzack et al., 2015). Geographic coordinates are reported with this fishery, and landings maps for 2014 through 2018 have been published (Rozalska and Coffen-Smout, 2020).

### Applications of Lobster Mapping to Marine Spatial Planning

Spatial analysis and mapping the distribution and intensity of inshore lobster fishing activity are important information sources in management applications beyond classifying fishing pressure, harvest levels, and potential differences in lobster production. DFO's Marine Spatial Planning Program emphasizes the importance of spatial and temporal approaches to oceans and coastal planning and management of the Scotian Shelf-Bay of Fundy planning area. In a marine spatial planning context, lobster mapping products support decision-making in applications such as: mitigating human use conflicts with seabed cables and marine shipping terminals; informing environmental emergency response operations and protocols; monitoring compliance and threats in marine protected areas (MPAs); assessing use intensity in the context of ecosystem approaches to management, e.g., cumulative impacts assessment; providing information for eco-certification programs; assessing the risk and relative probability of interactions with Schedule 1-listed species under the *Species at Risk Act*, e.g., North Atlantic right whales; informing federal and provincial government-mandated environmental assessment processes; addressing marine conservation objectives and planning a bioregional conservation network of MPAs; and decision support in the sectoral management of aquaculture development and ocean renewable (tidal, wind and wave) energy projects. It is important to note that the results of this report are for planning purposes only; they are not meant to be used for stock assessment or any other scientific advice.

## METHODS

### Lobster Logbook Data

Logbook data from January 2015 to December 2019 from the Commercial Data Division (CDD), DFO Policy and Economics Branch, were used in the analysis. The data included date fished, number of traps fished, and catch weight (kg) per grid cell. Within the 2015–2019 logbook grid data, 2.9% of records did not report in which statistical grid cell the fishing occurred, and in 2.8% of records LFAs and reported grid numbers were inconsistent (i.e., the grid cell reported does not fall within the LFA reported). As a result, these data could not be included in the analysis and were removed. The removal meant that, over five years, 5.8% of the total catch weight and 5.5% of total trap hauls could not be attributed to the correct grid cells. For a detailed breakdown of the excluded data by LFA and by year, see Appendix 2: Tables.

### Disputed Zone Logbook Data

In addition to the grid-level logbook data reported in the Bay of Fundy Disputed Zone in Area 38B (formerly known as the Grey Zone), lobster fishing in the Disputed Zone is reported as latitude and longitude coordinates (see Figure 4). Multiple positional errors exist in the Disputed Zone latitude and longitude data outside the Disputed Zone (see red-lined polygon) in Canadian and U.S. waters. These are most likely entry errors, as there should be no fishing outside the Disputed Zone (Colin O'Neil, DFO Policy and Economics, pers. comm.). Within the Disputed Zone data for 2015–2019, 22.2% of records had no reported coordinates, or incorrect coordinates (the entry errors mentioned above), and were therefore removed from the analysis. The Disputed Zone landings and effort data in the MARFIS system for Area 38B are complementary to the Disputed Zone statistical grid record data and are considered in this analysis. The coordinate information was used to isolate those records that fell within the statistical grid between 2015 and 2019, and to assign a statistical grid number to each record. The statistical grid cells that contained the Disputed Zone records were: 49, 61, 62, 63, 74, 75, 86 and 87. For each grid cell, the catch weight (kg) and number of trap hauls were combined with the grid-level logbook data prior to calculating the total for each year and the five-year interval..

### Preparation of the Grid

As with the previous report (Serdynska and Coffen-Smout, 2017), this report uses the original, non-uniform statistical grid of inshore-offshore rectangles in LFAs 27–33. It is important to note that in some rectangular grids along the Eastern Shore of Nova Scotia (i.e., east of Halifax in LFAs 27–32) lobster fishing extends only to the 100-m depth contour, and in others there may be occasional exploratory effort outside the 100-m depth contour but still inside the LFA outer boundary. For the standardized grid area maps, all area calculations for grid cells abutting the coastline were based on trimming to the coastline of the statistical grid.

### Data Processing and Mapping

Total catch weight (kg) and total number of traps fished were calculated for each grid cell and summed to produce annual and five-year composite (2015–2019) maps of landings and effort. Catch weight and trap haul totals were then standardized by area,[1] to account for differences in grid sizes. The numbers of trap hauls and catch weight in kilograms were divided by the area ($km^2$) per corresponding grid cell to calculate trap hauls/$km^2$, and catch weight (kg)/$km^2$ respectively. A 'trap fished' as reported in the database is equated with a 'trap haul' for the purposes of this analysis.

Catch Per Unit Effort (CPUE) was calculated by dividing the total catch weight by the total number of traps for each individual grid cell. . This was calculated separately for each year of

[1] The coordinate system used for the area calculations was NAD 83 UTM Zone 20N.

data to produce annual CPUE maps, as well as across all years (2015–2019) to produce a composite map. Records with trap hauls but no reported catch (0.9% of the total records) were removed from CPUE ratio calculations to avoid bias, as they were most likely errors (Colin O'Neil, DFO Policy and Economics, pers. comm.), rather than instances where nothing was caught. Records with reported catch but no trap hauls (2.2%) were also removed, so as not to affect the CPUE calculations.

Annual and five-year composite maps of catch weight, trap hauls, and CPUE were produced for this report (see Appendix 1: Maps). Composite maps were displayed using a quantile classification. For the annual maps, data were divided into five classification intervals using modified quantile breaks, i.e., combining data for all five years and assigning the same intervals for each year to allow for comparisons between years. Five quantile breaks were calculated from the combined values from five years of data to include the complete range of values. These class breaks were then manually applied to the data for individual years.

Examination of the dataset revealed cases of null values for individual grid cells in single years during 2015 to 2019, and three grid cells with null values across all years. For purposes of comparison, grid cells with no reported data (null values) in single years were treated as zero values during the classification and are noted as such with black-outlined grids in the composite maps. Missing grid cell data could mean the following: 1) no fishing activity occurred in the grid cell during those years; 2) fishing activity occurred in the grid cell, but it was unreported; 3) fishing activity occurred in the grid cell, but it was reported in an adjacent grid cell(s); and 4) as observed, reporting for the grid cell was inconsistent, e.g., catch weights were reported, but the number of trap hauls was unreported.

Landings and effort values were totalled on a calendar-year basis rather than on a fishing-season basis, which extends over two calendar years in LFAs 33, 34, 35, 36, 37 and 38. The official open season dates and the variable number of fishing days per season by LFA are listed in Table 1 (Atlantic Fishery Regulations, 1985).[2]

To comply with Government of Canada privacy policy (Treasury Board Directive, 2010), privacy assessments were conducted on all annual map layers to identify LFAs containing data from less than five vessel IDs, license IDs and fisher IDs. The "Rule of Five" threshold was met for all LFAs and all years for the 2015–2019 time period, and thus no data was withheld due to privacy screening.

## Data Deficiencies

Data deficiencies related to inshore lobster fishing activity are discussed below. Deficiencies relate to data not being available, or data not being collected at a scale that allows comparisons between grid cells. Combined, these data deficiencies contribute to a potential underestimation of the true fishing effort and landings associated with the entire inshore lobster fishery.

[2] The number of fishing days can vary from one season to the next, particularly in LFAs 33–38 where weather delays can affect the opening date and reduce the overall season length.

First, data deficiencies relate to the disputed lobster fishing area known as the Disputed Zone (Area 38B) (formerly known as the Grey Zone) in the Bay of Fundy, southwest of Grand Manan, New Brunswick, which is fished by both Canadian and Maine-based lobster fishers. Canadian effort and landings are well represented in the Disputed Zone data; however, enquiries with U.S. federal and state authorities indicated there were no data reporting requirements at a scale or frequency in the Disputed Zone that would enable pooling U.S. and Canadian lobster logbook data. Hence, only Canadian data are used in the analysis, and the grid data classifications of Disputed Zone lobster effort and landings are likely underestimated due to unknown U.S. fishing activity. Eight grid cells or portions thereof are potentially affected by missing U.S. data.

As described earlier in this section, another data deficiency relates to the reported trap haul and catch weight logbook data that did not have associated grid cell information. In order to help quantify the resulting annual and composite underestimation, the total trap hauls and catch weights were summarized by LFA for 2015–2019 in Appendix 2.

Another data deficiency involves records where the LFAs and grid numbers are inconsistent (i.e., the grid cell reported does not fall within the LFA reported). In these cases, the LFA was treated as correct, and the grid number was removed, as the LFA field is considered more reliable (Colin O’Neil, DFO Policy and Economics, pers. comm.).

An additional data deficiency involves records where there are traps reported but no weight. This does not mean there was no catch, as these records are likely errors rather than true zeroes (Colin O’Neil, DFO Policy and Economics, pers. comm.). These records were considered incomplete and were removed from this analysis. Similarly, there were also records where there was catch weight but no trap haul information. For CPUE calculations, these records were considered incomplete and were removed from this analysis.

Another data gap in the mapping analysis is effort and landings data from DFO Gulf Region fishers in northwest Cape Breton who fish lobster off northern Cape Breton in LFA 27. This data, which is managed by DFO Gulf Region in Moncton, was not included in this analysis. Gulf-based landings during 2015–2019 in LFA 27 by 37 licence holders totalled 893 tonnes and averaged ~179 tonnes per year (Gaëlle Lemay, DFO Statistics, Strategic Services, Gulf Region, pers. comm.).

A final data deficiency stems from incomplete data from the Indigenous Food, Social and Ceremonial (FSC) fishery. DFO Indigenous Fisheries Management advised that the effort level in these fisheries is a small fraction (< 1%) of the total number of traps in the commercial fishery in LFAs 27–38 (Megan Folkins, DFO Indigenous Fisheries Management, pers. comm.). Overall, during the 2016 through 2020 time period, an average of 44,687 lbs (20,270 kg) of lobster were reported per fishing season (see Table 1 for fishing season dates). The numbers provided here are not comprehensive or complete; they are just a recognized data deficiency.

**Caveats**

There are several caveats associated with the data and maps provided in this report, which should be taken into account when interpreting the results. Logbook data represent landings estimates only. Lobster stock assessments use “slip” data (i.e., data from dealer sale slips) as they provide the actual weight of lobster sold, as opposed to an estimate (Cook et al., 2020). The differences between logbook and slip data are usually small. Logbook data were used for this report as the results are intended for planning purposes only.

In addition, the catch weight and trap haul maps that were standardized by area (Figure 11 through Figure 16 and Figure 23 through Figure 28 respectively) can be misleading, particularly along the east coast of Nova Scotia, off Cape Breton. The grid cells in that location (Figure 3) are much larger than those along the south-west coast and the Bay of Fundy, and the full extent of eastern LFAs may not be fished. Therefore the landed weight and traps fished per $km^2$ reported here may not be accurate.

## RESULTS

Composite catch weight and catch weight standardized by area for 2015–2019 are shown in Figure 5 and Figure 11 respectively. The highest composite catches (grid cells in brown) in Figure 5 included a large proportion of LFA 34 grids off southwest Nova Scotia, grids in LFA 33 (south shore of Nova Scotia), LFAs 36, 37, and 38 (Bay of Fundy), and grids in LFAs 27 and 31A (eastern Nova Scotia). The lowest composite catches (grid cells in yellow) were located in the offshore portions of LFA 33 (south of Halifax), in some of LFAs 35 and 36 in the Bay of Fundy, and the western-most portion of LFAs 34 and 38 near the Gulf of Maine. Yearly maps are shown in Figure 6 though Figure 10.

When catch weight was standardized by the area of the grid cells (Figure 11), high standardized catches remained in LFAs 33, 34, 36, 37, and 38 in the Bay of Fundy. In LFAs 27 and 31, off eastern Nova Scotia, the standardized catch weights were lower due to the large area of those grid cells. Standardized area grids with the lowest catch were located in LFAs 27, 30, 31A, 31B, and 32 (off Cape Breton and eastern Nova Scotia), LFA 28 (the Bras d’Or Lakes), offshore in LFAs 33 and 34, and in portions of LFA 35 in the upper Bay of Fundy/Minas Basin. Yearly maps are shown in Figure 13 though Figure 16.

Composite maps of the number of traps hauled and trap hauls standardized by area are shown in Figure 17 and Figure 23 respectively. Similarly to the catch weight maps, the highest composite trap hauls (grid cells in brown) in Figure 7 were in inshore LFAs 33 and 34 (south and southwest of Nova Scotia) and in LFAs 27, 29, and 31 (off eastern Nova Scotia and Cape Breton). Yearly maps are shown in Figure 18 though Figure 28.

When trap hauls were standardized by the area of the grid cells, the highest numbers of standardized trap hauls remained in inshore LFAs 33 and 34. In LFAs off eastern Nova Scotia and Cape Breton, the standardized trap hauls were lower, again due to the large area of those grid cells. Standardized trap hauls in the grid cells immediately north of Sydney, Cape Breton (LFA 27) remained high. Yearly maps are shown in Figure 24 though Figure 28.

Catch per unit effort (CPUE) over five years was measured by the total catch weight per trap haul for each grid cell, and is shown in Figure 29. CPUE was the highest (grid cells in brown) in LFAs 35, 36 and 38 (the Bay of Fundy), in the offshore portion of LFA 34 (off southwest Nova Scotia), in the southwest corner of LFA 33, and in LFA 30 (south of Cape Breton). CPUE was lowest (grid cells in yellow) in some nearshore grids in LFAs 33 and 34 (off southwest Nova Scotia), LFAs 31A, 31B and 32 (off eastern Nova Scotia), LFA 27 (off eastern Cape Breton), and in LFA 28 (the Bras d'Or Lakes). Yearly maps are shown in Figure 30 though Figure 34.

Both composite and yearly summaries of the catch weight and trap hauls per LFA are displayed in Table 2 through Table 7, along with information about missing records. LFA 34 reported the highest catch weights and number of traps hauled, while LFA 28 (the Bras d'Or Lakes) reported the lowest catch weights and trap hauls. LFA 28 and Area 38B had the highest percentage of records with missing grid information.

## DISCUSSION

The spatial patterns of catch weight, trap hauls, and CPUE were consistent with previous reports (Coffen-Smout et al., 2013; Serdynska and Coffen-Smout, 2017), and therefore suggest little change in the spatial distribution of the fishery. Although the near-coastal grids in LFA 34 have the highest catch weight over the five years examined, the CPUE there is lower, likely due to the relatively high levels of effort (i.e., trap hauls), resulting in lower LFA 34 yields relative to unit of effort (traps).

Spatial differences that emerge from the standardization by area analyses are sensitive to the interpretations made regarding the size of actively fished areas (e.g., grids east of Halifax in LFAs 27 to 32 are only fished to the 100-m contour line yet the LFA boundaries extend beyond actively fished areas). If the actual areas fished are different, then the pattern of spatial differences may change.

It is also important to note that visualization of catch and effort distributions is time-sensitive and not static. There may be differences in the distribution of the fishery from year to year, depending on changes in lobster distribution (e.g., due to climate change). Accordingly, updates of these fishing activity maps should be produced every three to five years.

Finer scale maps may be used in marine spatial planning to assess use intensity in the context of ecosystem approaches to management, to identify risks and interactions with other potential ocean uses, e.g., aquaculture development and marine renewable energy, and to address marine conservation objectives and conservation area network planning for MPAs. Hence, sub-regional analyses conducted for management applications in coastal areas could be made more relevant by integrating finer spatial and temporal scales and by reclassifying the data with modified quantile classifications for specific spatial scales.

Limitations and potentially confounding factors in the analysis include region-wide variations among LFAs in terms of the timing of fishing seasons, the number of active licenses, the number of traps per licence, and variable fishing season length in days (Table 1). No effort was made to standardize for these factors in this regional mapping analysis. In addition, several deficiencies exist in the dataset (described in detail in the methods section), including records with missing or incorrect location, weight, and/or traps. Data from DFO Gulf Region are missing from the spatial analysis, as well as data on FSC fisheries. Finally, the logbook data used for this analysis are estimates rather than accurate numbers. These deficiencies mean that the numbers reported here are likely an underestimate. Therefore, it may be of more use to look at the spatial patterns in these results rather than the actual numbers.

Overall, the spatial analysis was limited by the application of combining a 10-minute grid with a non-uniform, rectangular statistical grid to produce a regional data classification on irregular-sized polygons. The region-wide adoption of latitude and longitude coordinate reporting in logbooks for catch weight and effort would enhance spatial information for marine spatial planning and related decision support, as well as for environmental emergency response. This shift may require increased capacity in government (e.g., management and analysis of large datasets), as well as discussions with industry (e.g., to provide high resolution effort data).

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## APPENDIX 1: MAPS

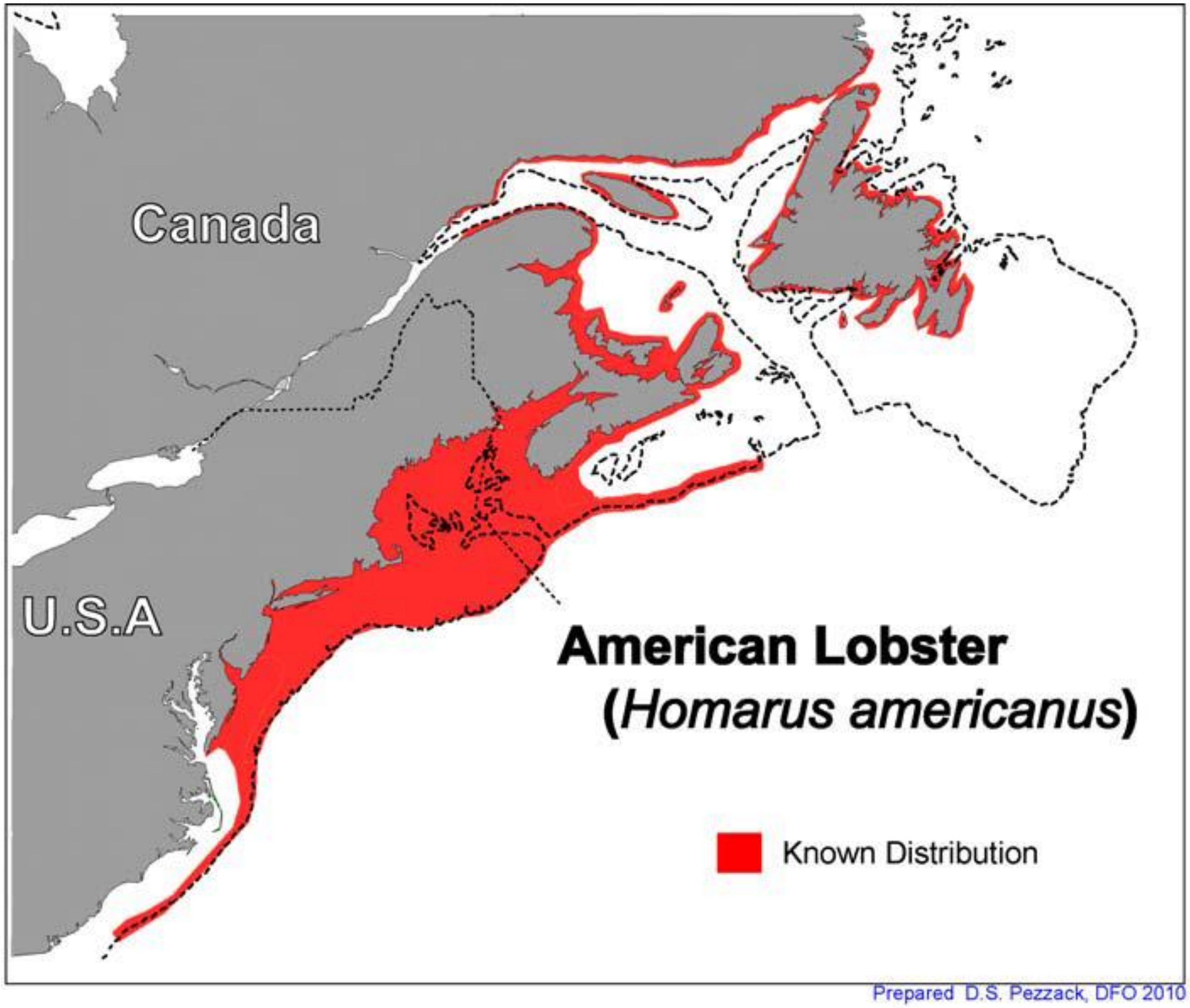


Figure 1. Lobster distribution based on known fishing areas and DFO and NMFS bottom trawl surveys. Prepared by D. Pezzack, DFO Science, 2010. Source: Tremblay et al. 2011.

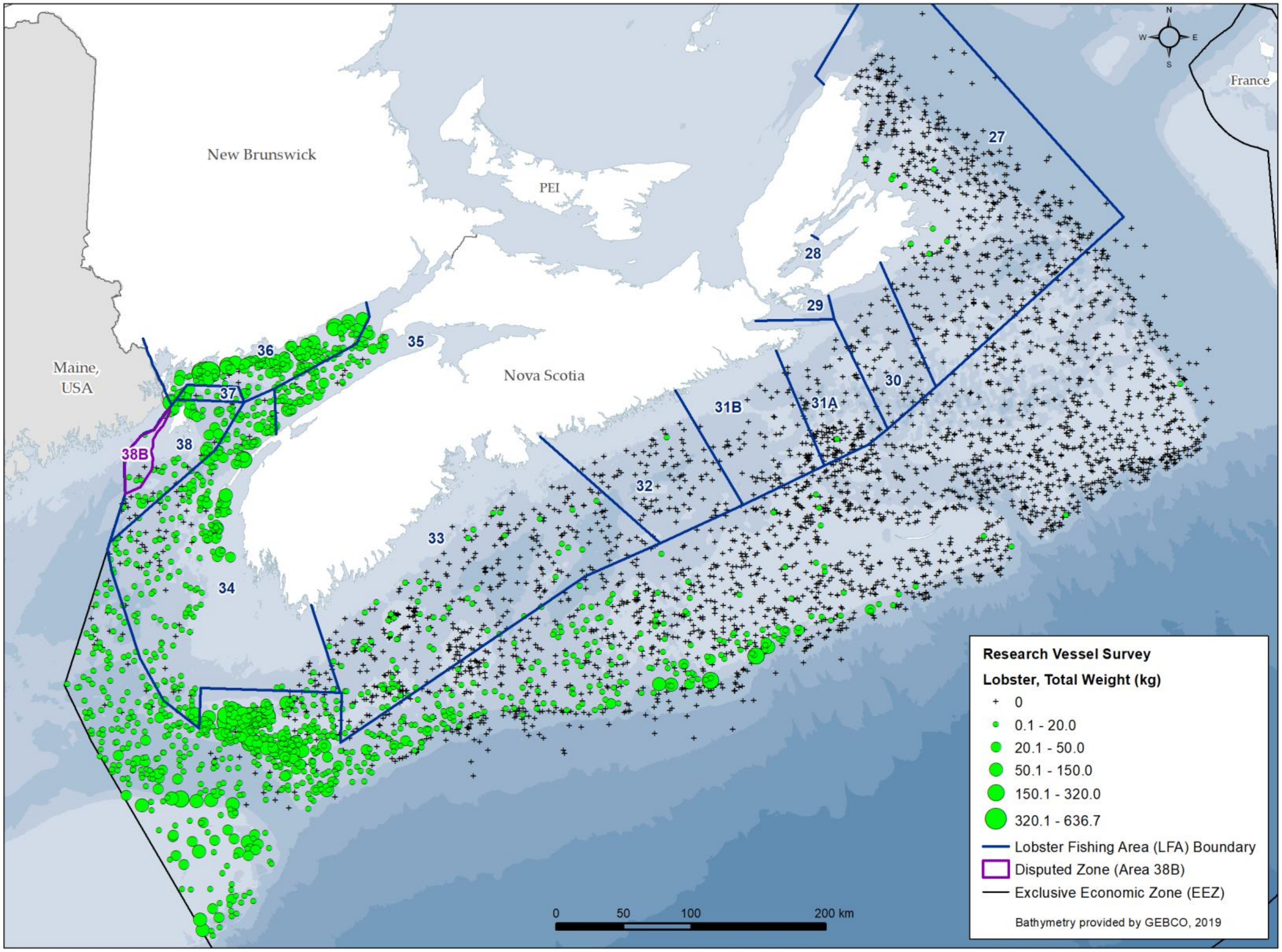


Figure 2. Lobster catch in summer research vessel surveys, 1999–2019 (stratified random survey). Crosses indicate zero catches. Source: DFO Research Vessel Survey Database, November 2021. The survey does not include areas off coastal or southwest Nova Scotia.

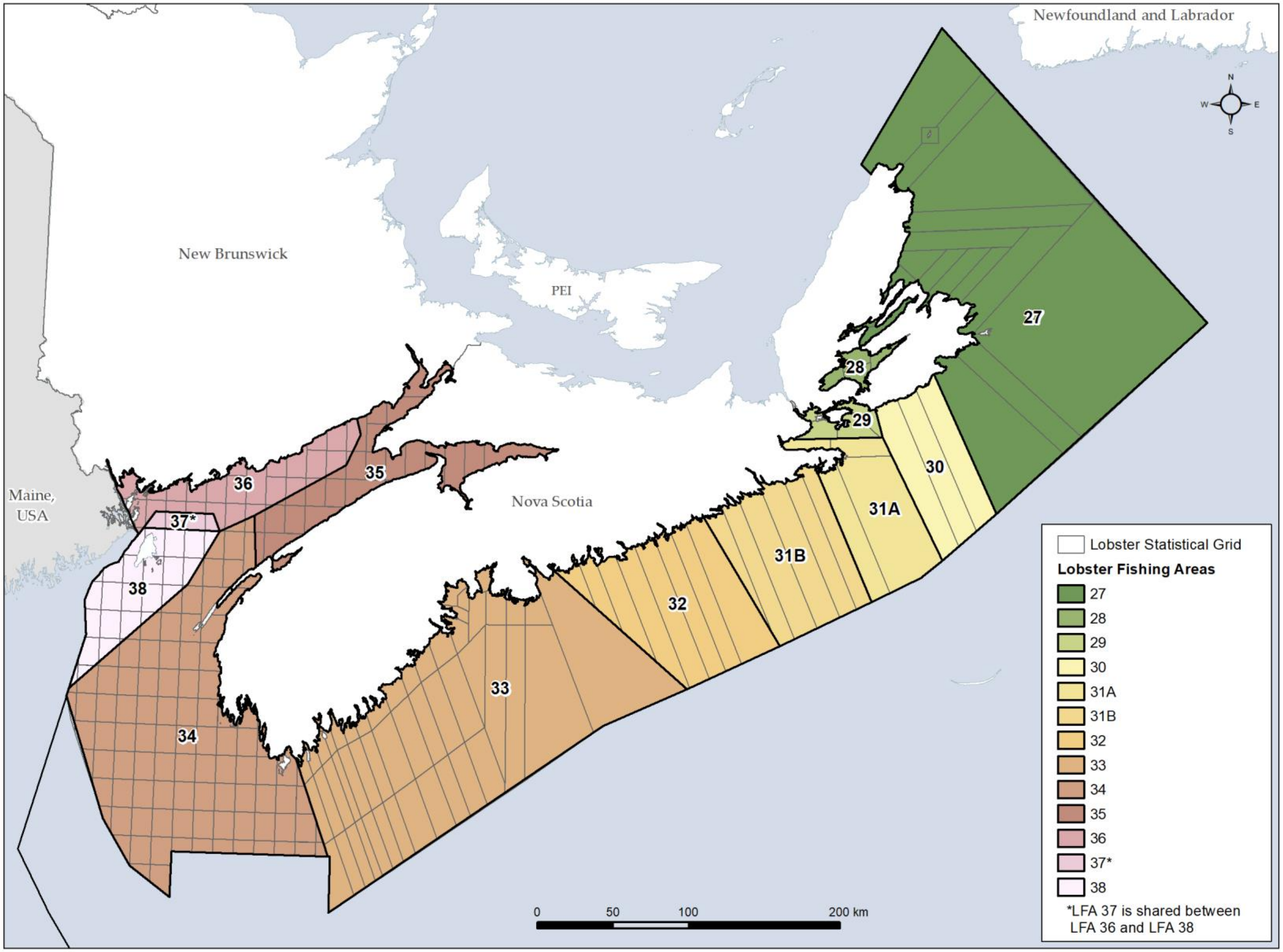


Figure 3. Lobster Fishing Areas (LFAs) with statistical grids.

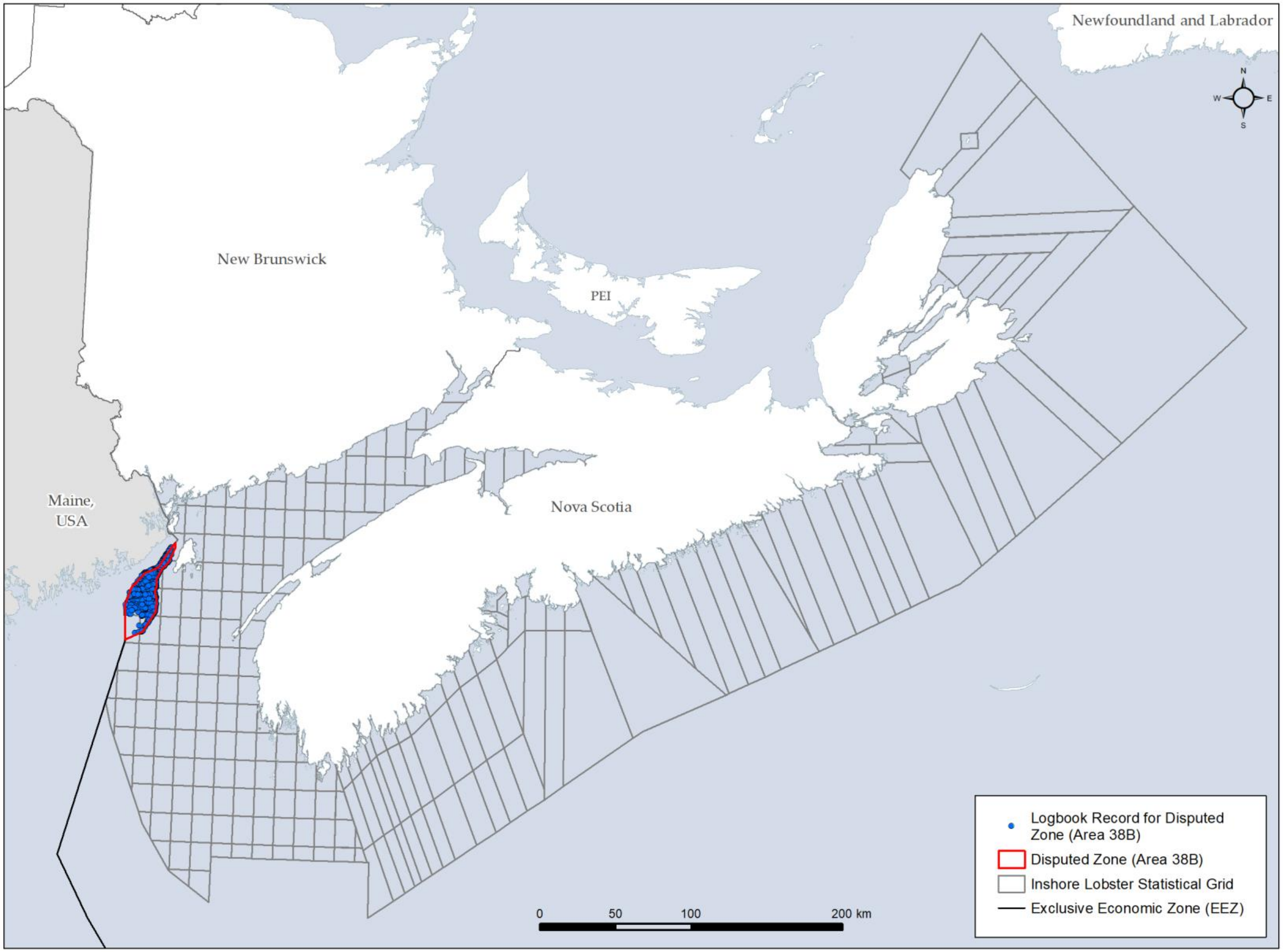


Figure 4. Location of Maritime Fishery Information System (MARFIS) data (blue) in relation to the statistical grid and red-lined Disputed Zone.

## Catch Weight

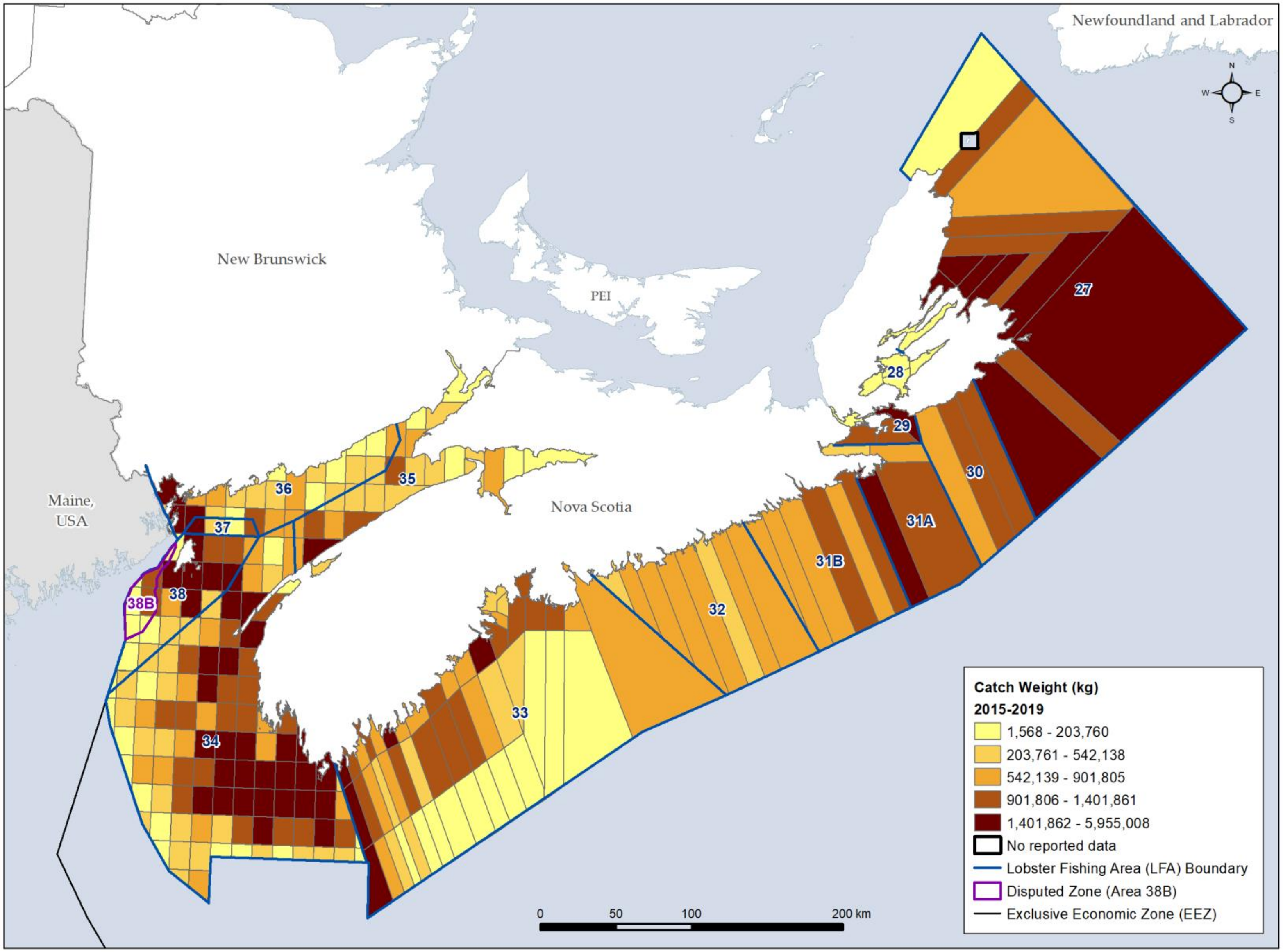


Figure 5. Composite catch weight (kg) for the inshore lobster fishery (2015-2019)

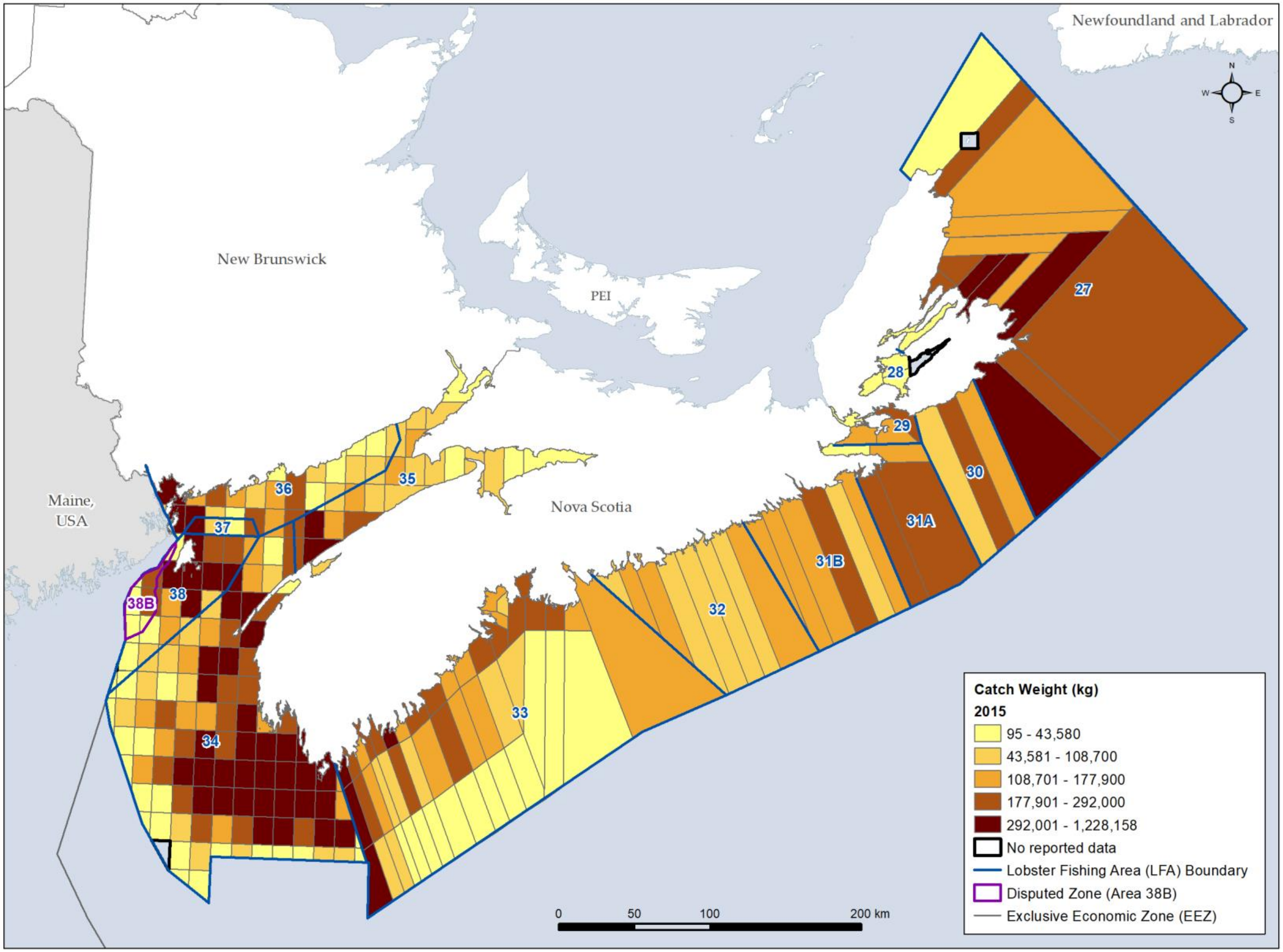


Figure 6. Catch weight (kg) for the inshore lobster fishery (2015)

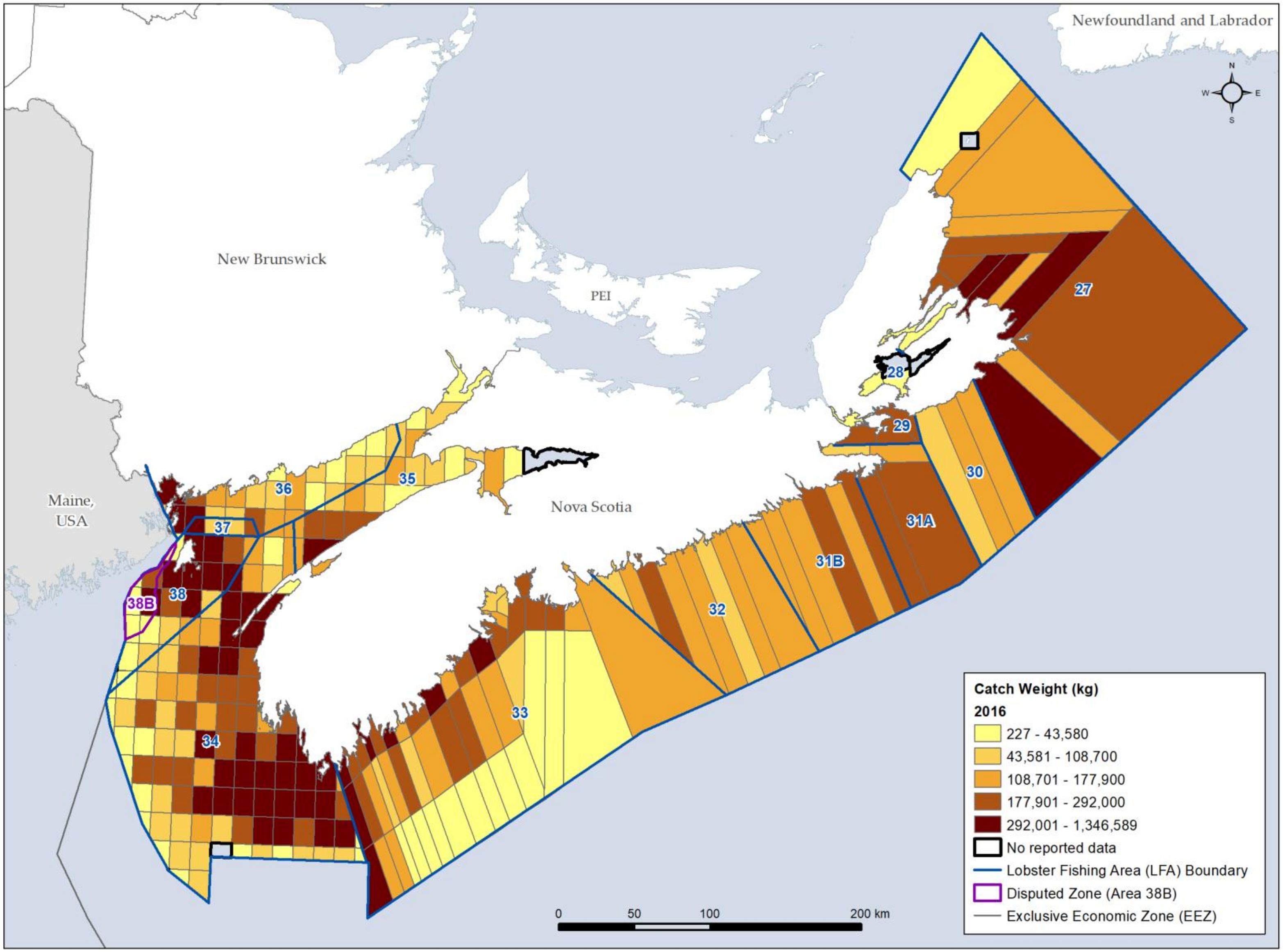


Figure 7. Catch weight (kg) for the inshore lobster fishery (2016)

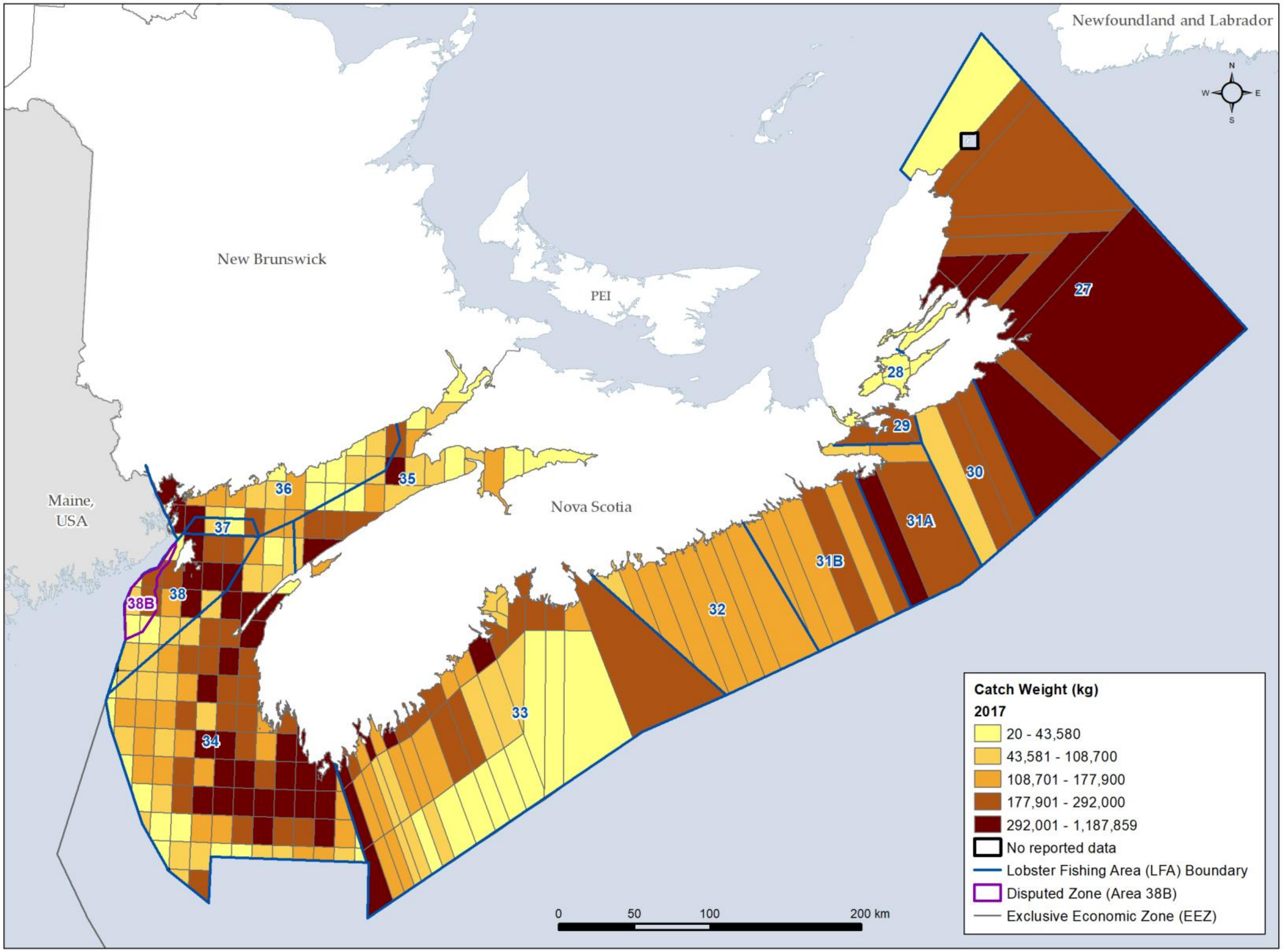


Figure 8. Catch weight (kg) for the inshore lobster fishery (2017)

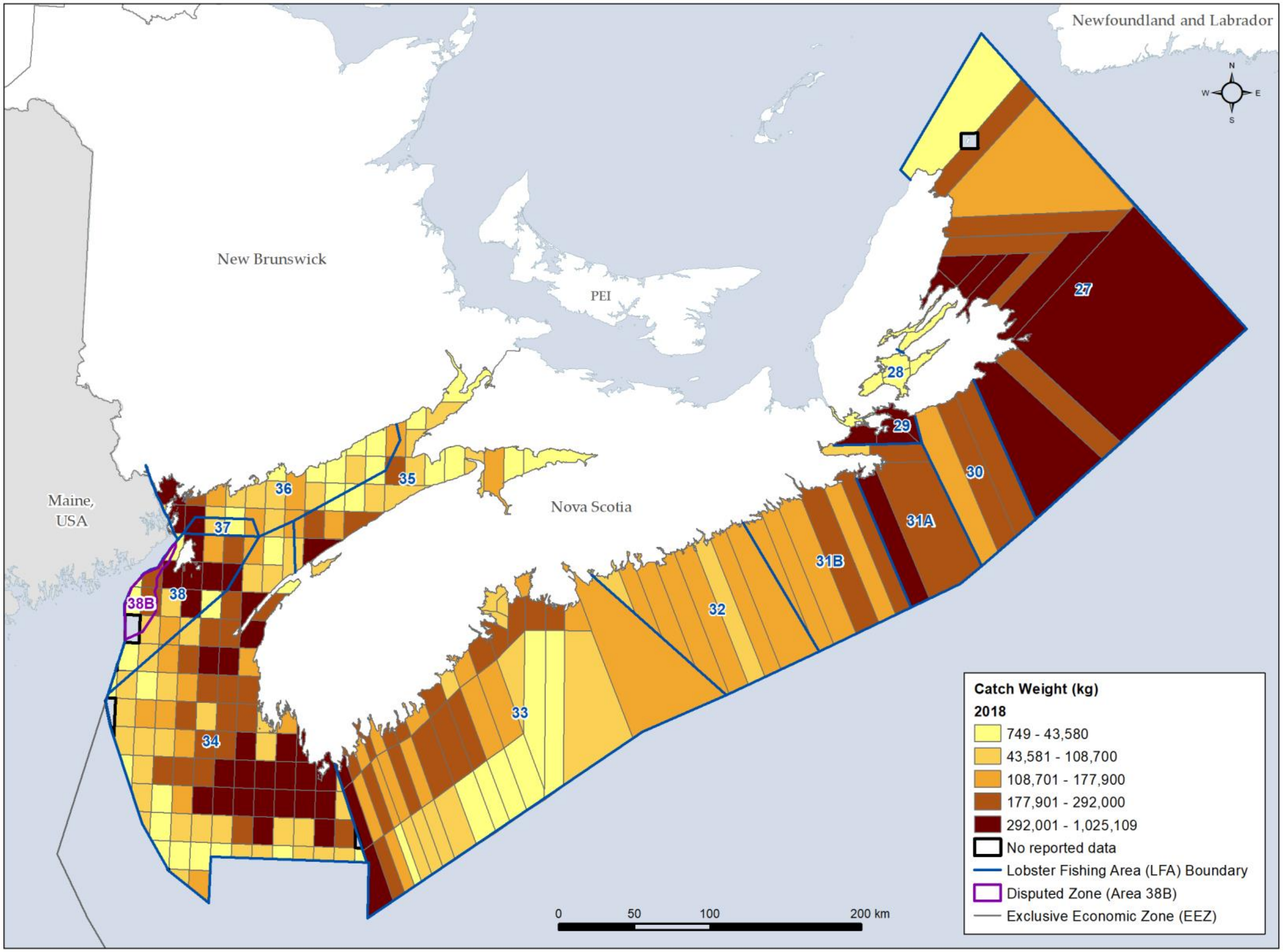


Figure 9. Catch weight (kg) for the inshore lobster fishery (2018)

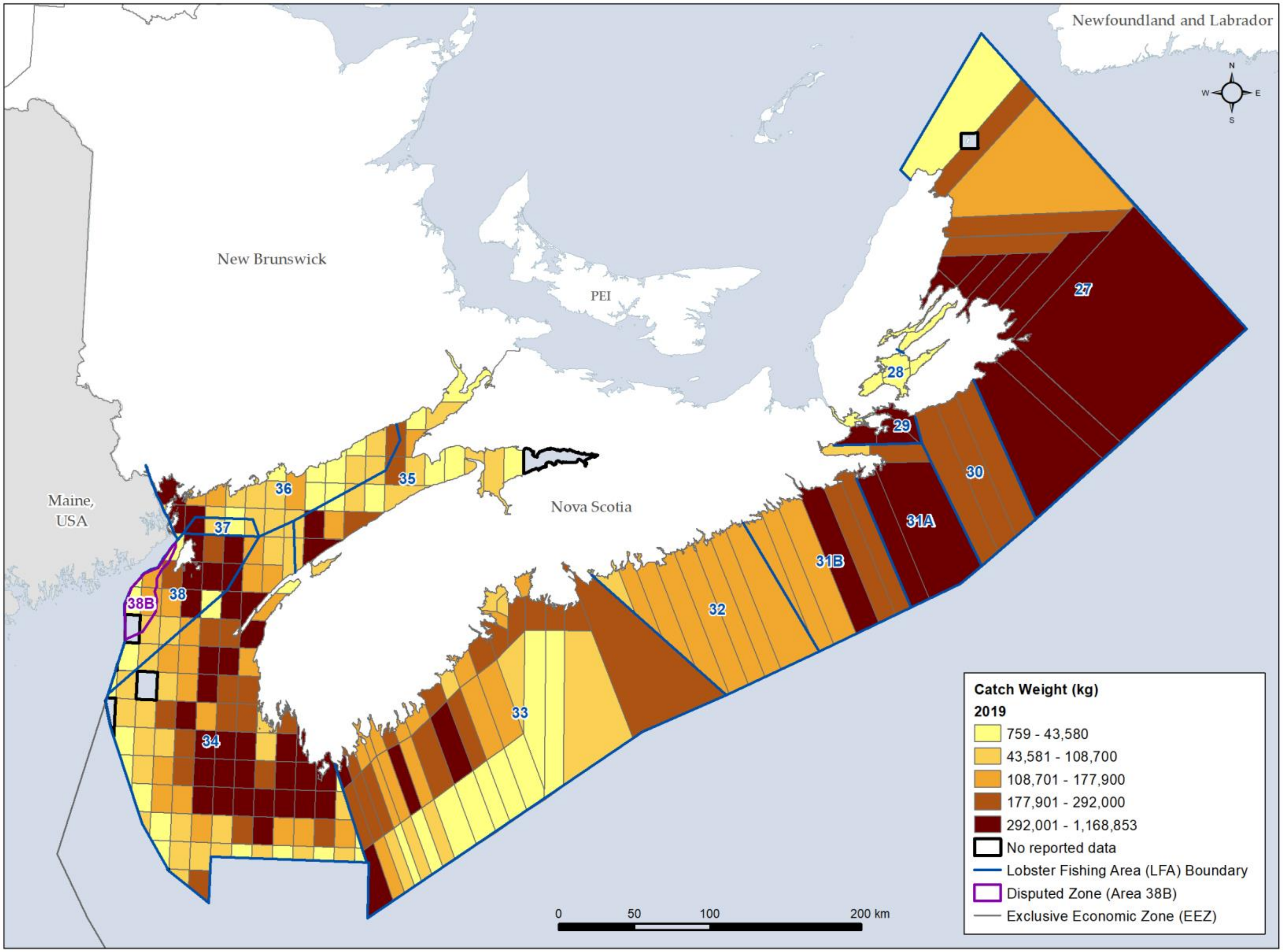


Figure 10. Catch weight (kg) for the inshore lobster fishery (2019)

## Standardized weight

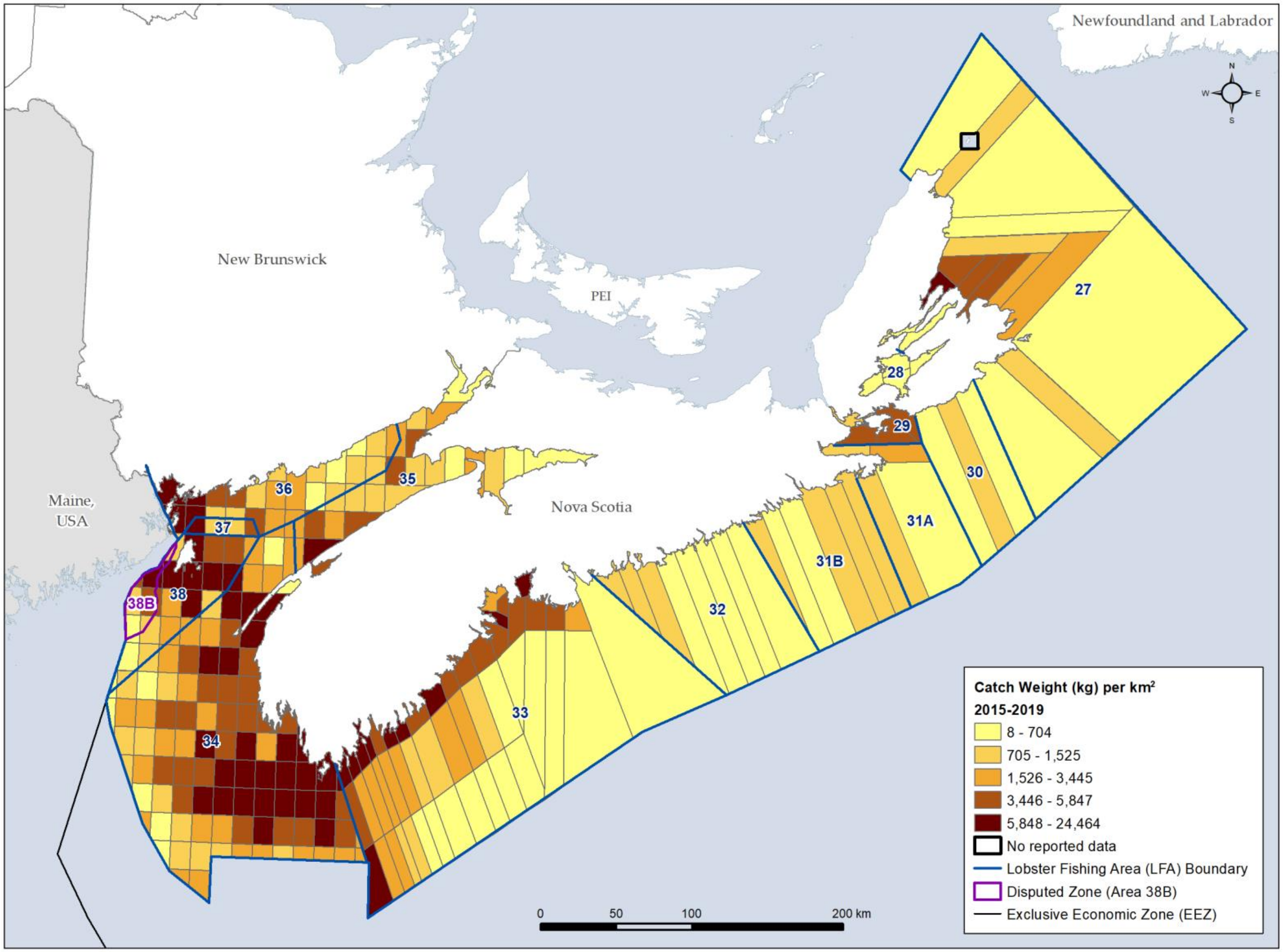


Figure 11. Composite catch weight standardized by area (kg/km$^2$) for the inshore lobster fishery, 2015-2019.

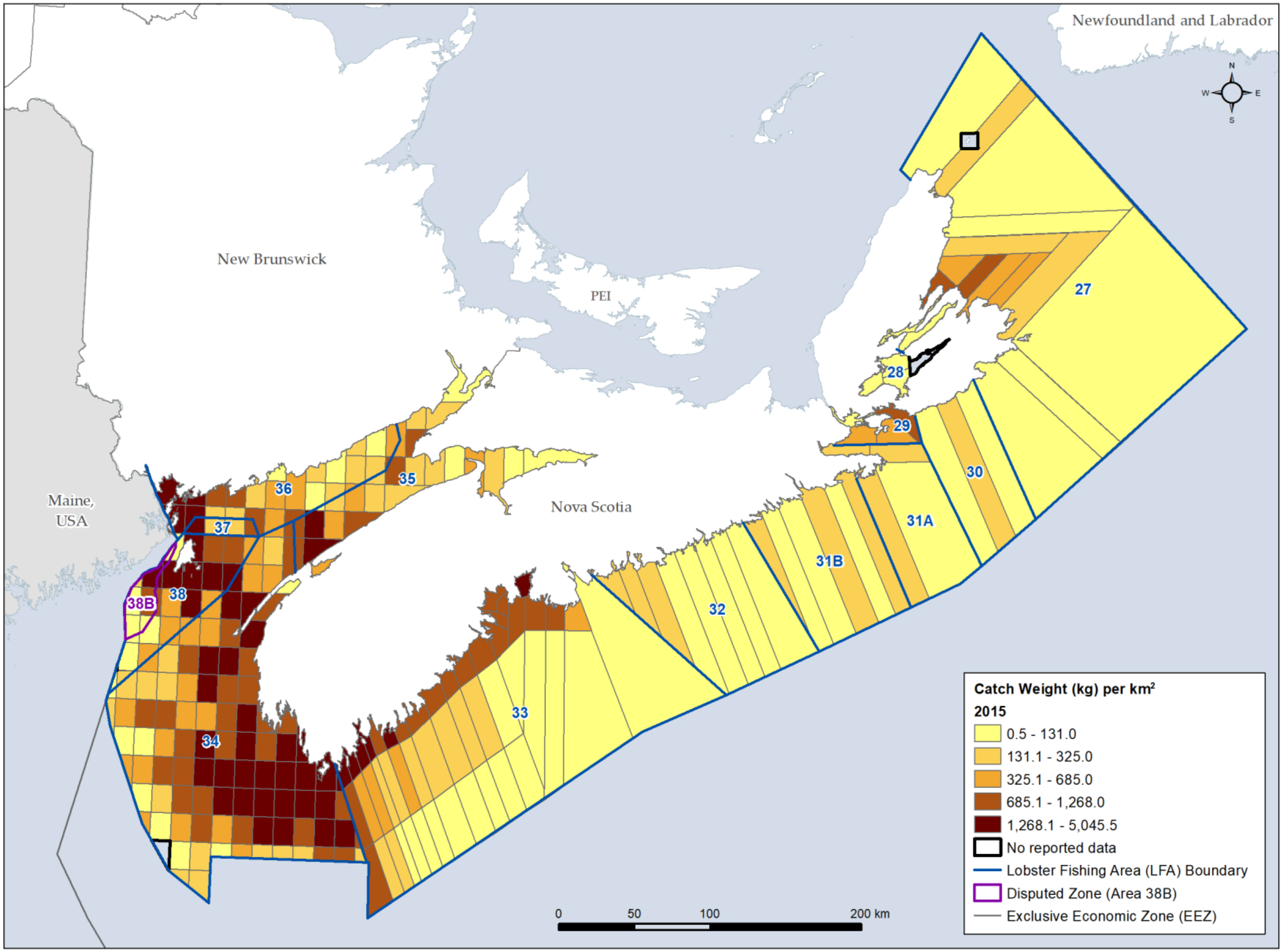


Figure 12. Catch weight standardized by area (kg/km$^2$) for the inshore lobster fishery (2015)

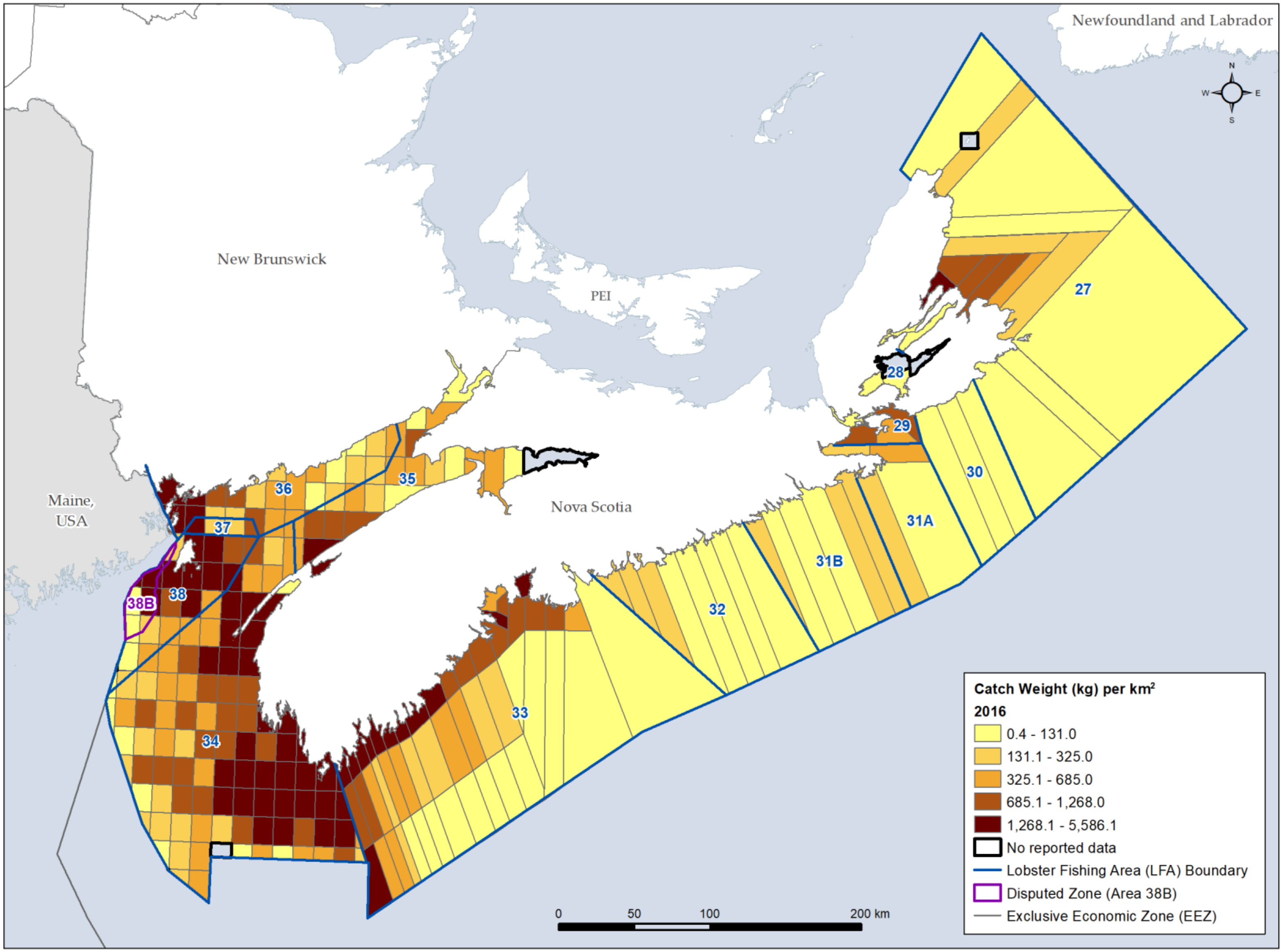


Figure 13. Catch weight standardized by area (kg/km$^2$) for the inshore lobster fishery (2016)

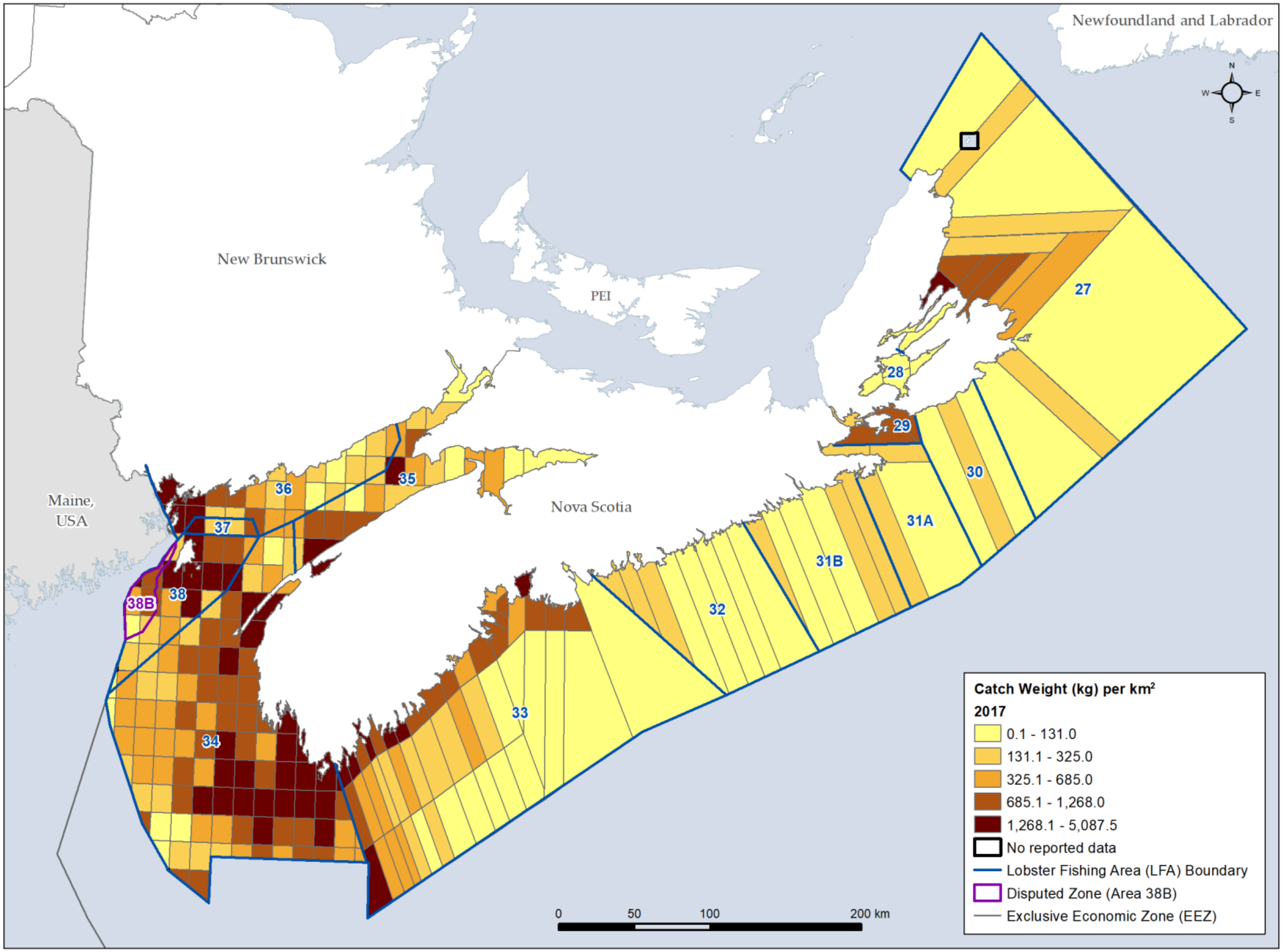


Figure 14. Catch weight standardized by area (kg/km$^2$) for the inshore lobster fishery (2017)

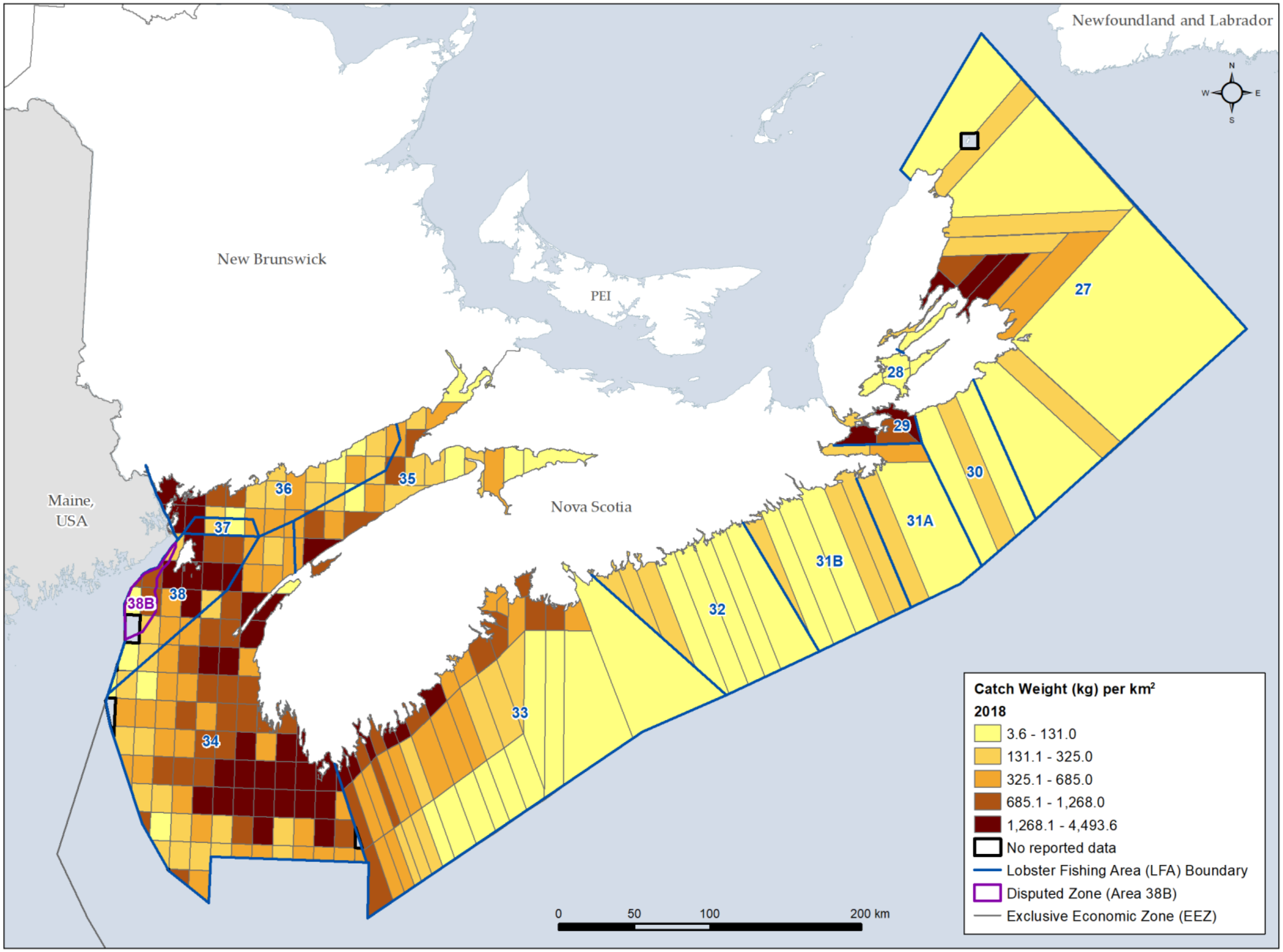


Figure 15. Catch weight standardized by area (kg/km$^2$) for the inshore lobster fishery (2018)

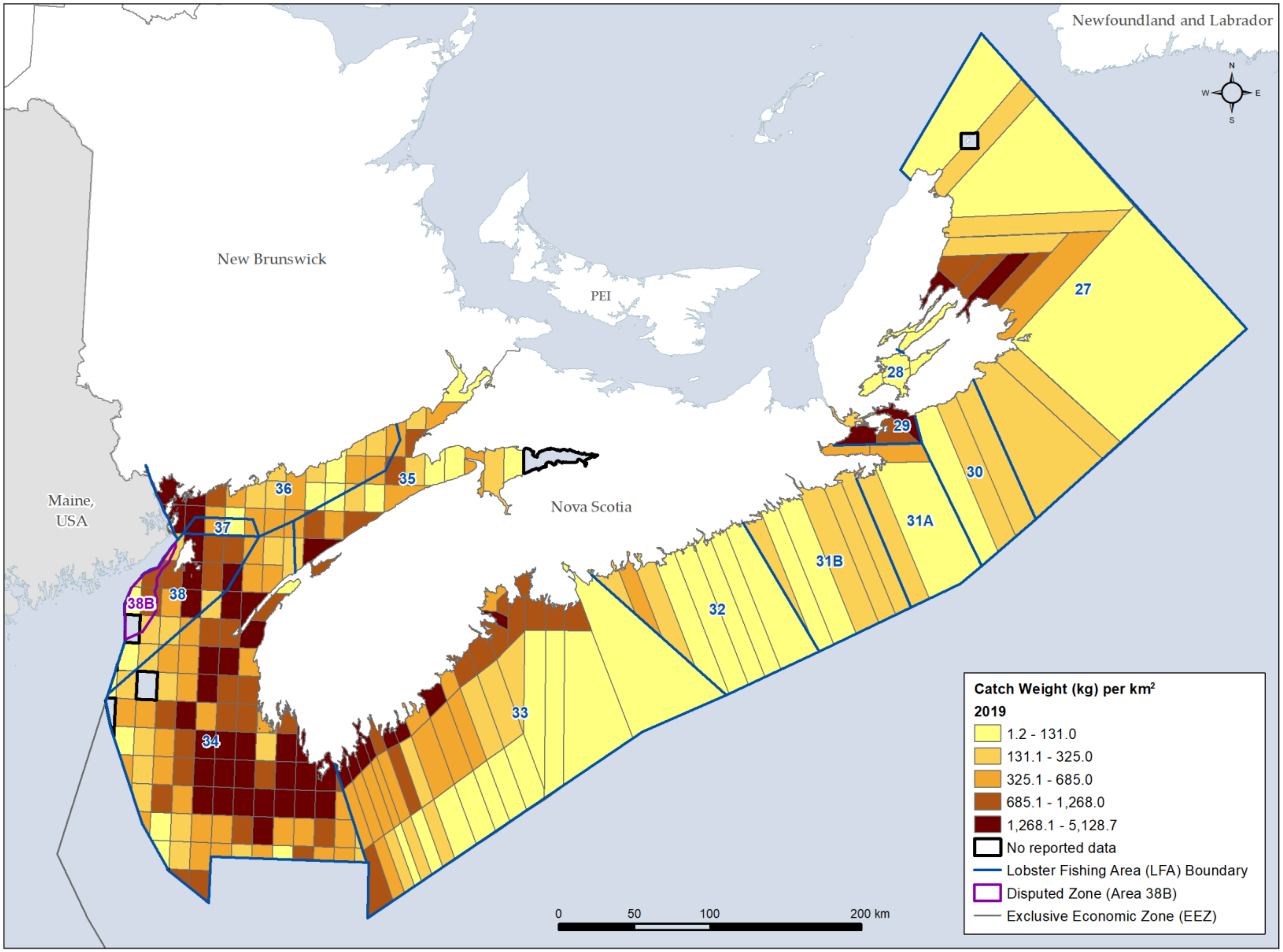


Figure 16. Catch weight standardized by area (kg/km$^2$) for the inshore lobster fishery (2019)

## Trap hauls

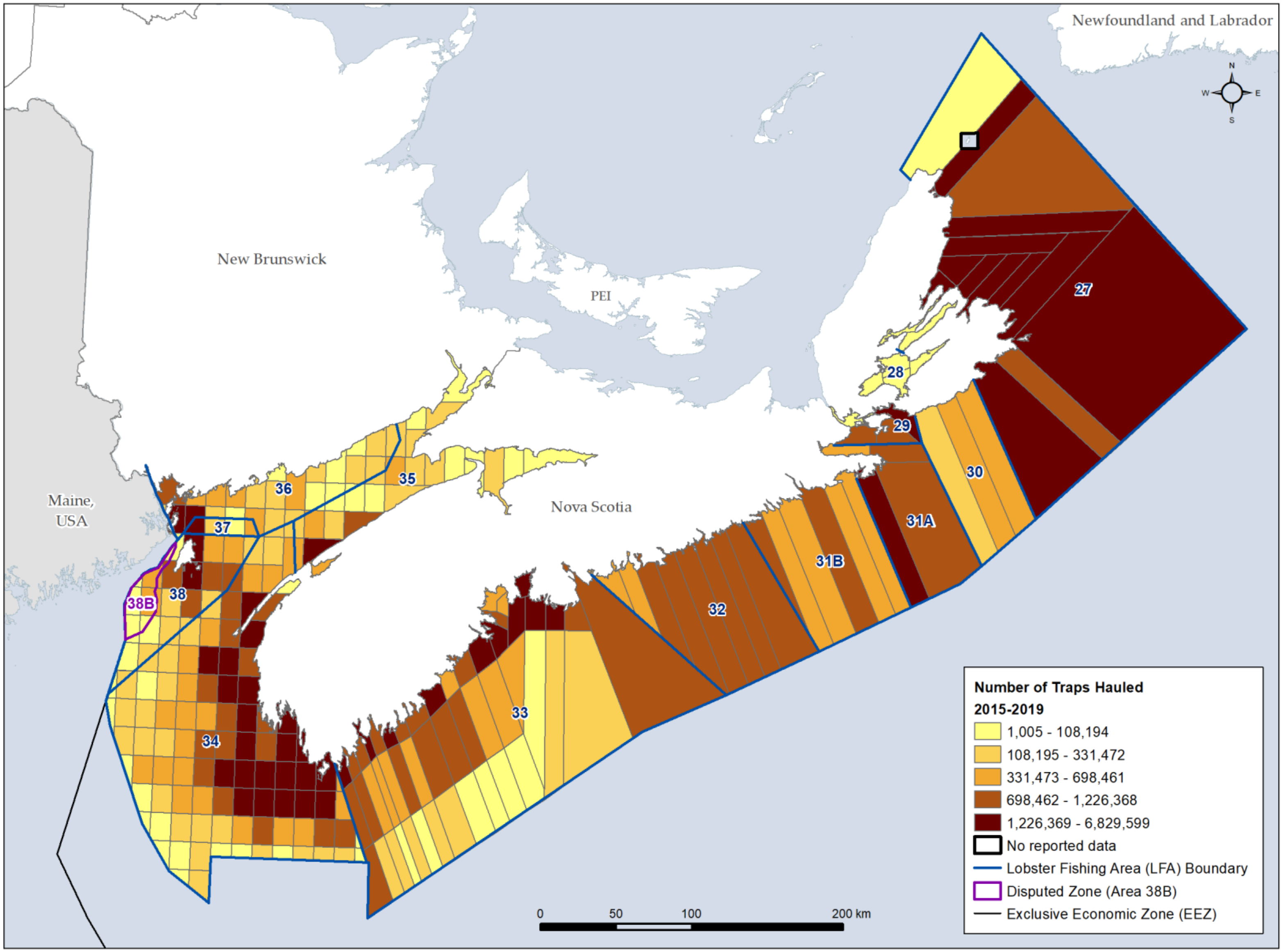


Figure 17. Composite number of trap hauls for the inshore lobster fishery, 2015-2019.

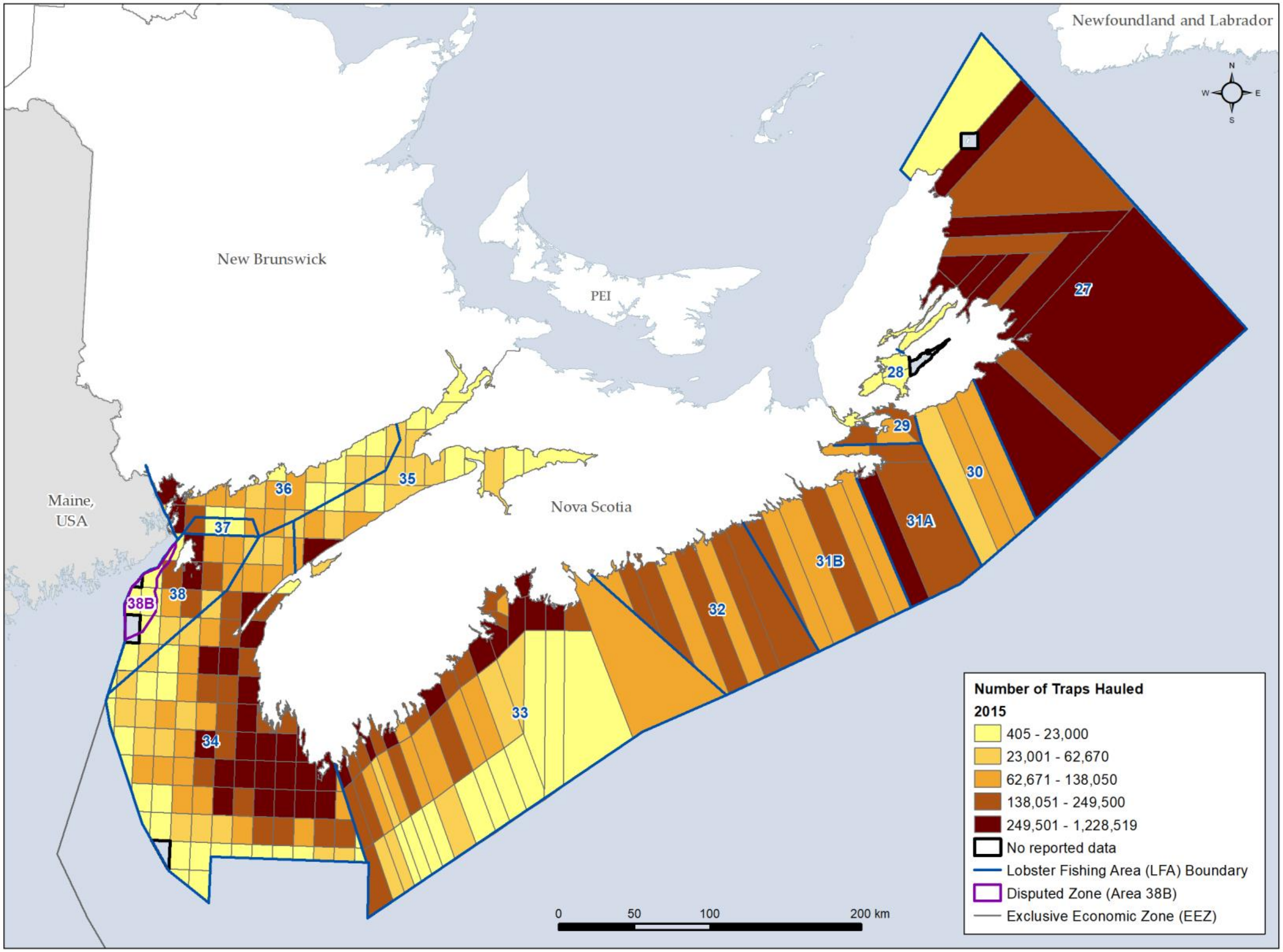


Figure 18. Number of trap hauls for the inshore lobster fishery (2015)

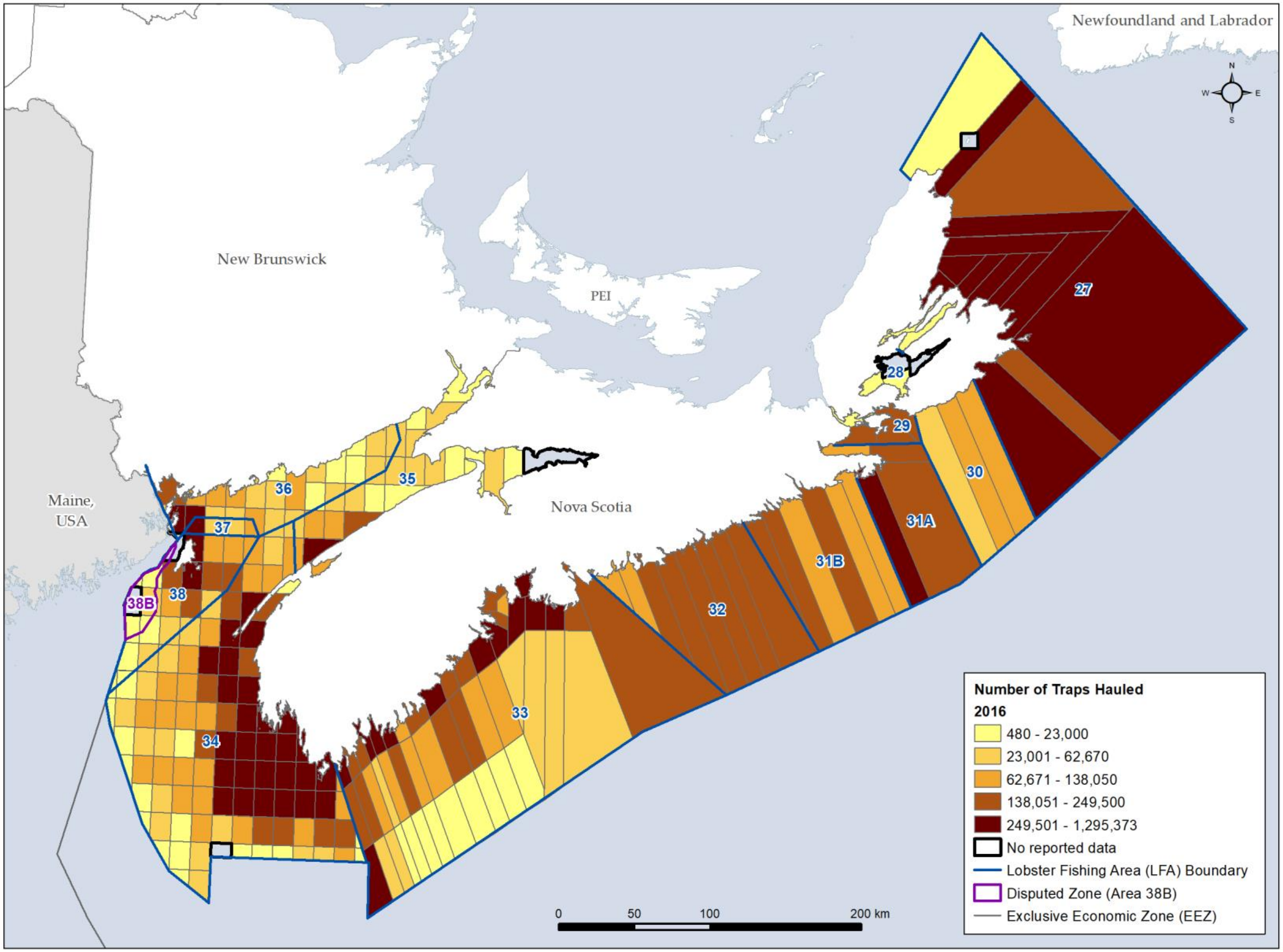


Figure 19. Number of trap hauls for the inshore lobster fishery (2016)

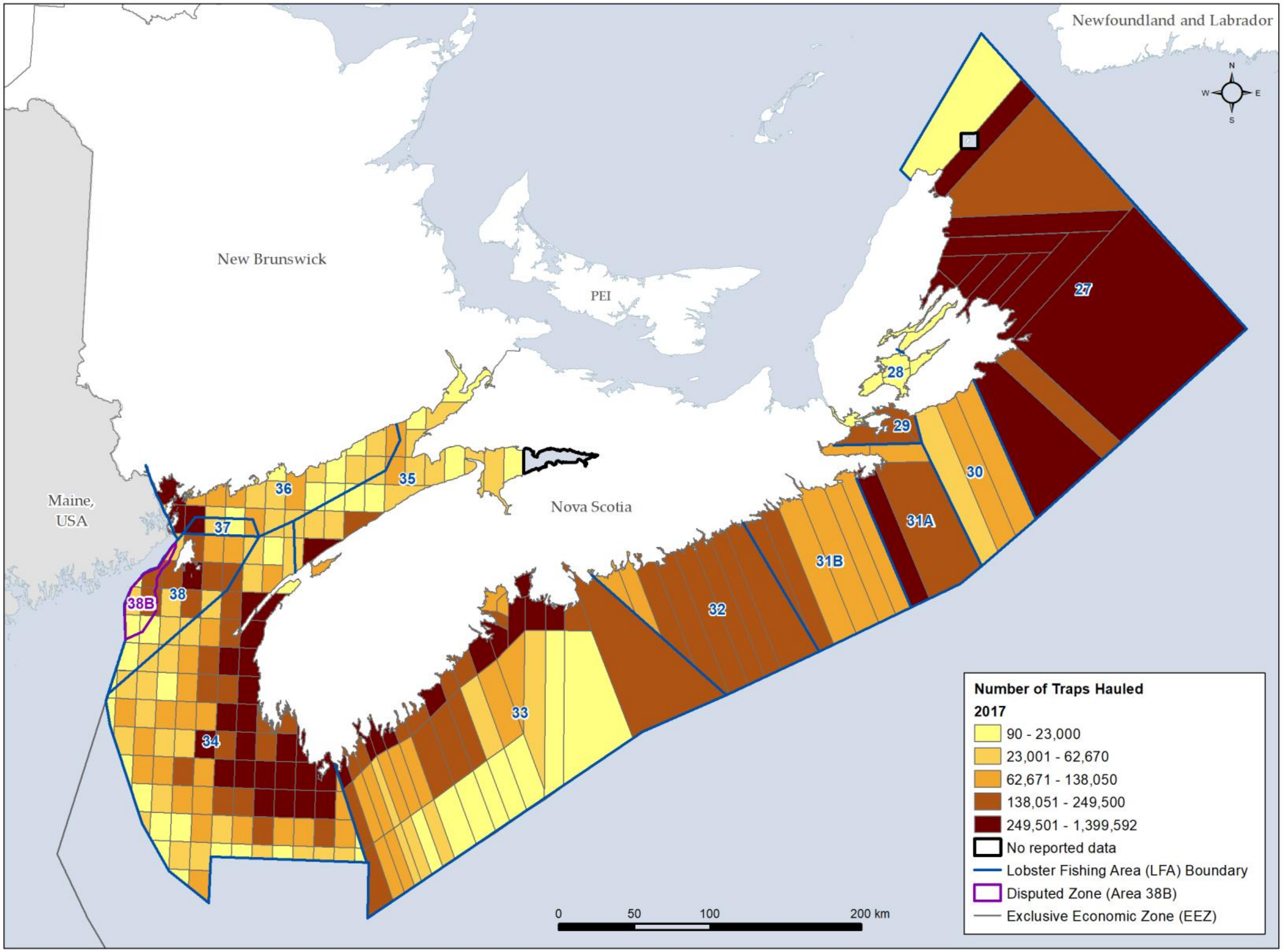


Figure 20. Number of trap hauls for the inshore lobster fishery (2017)

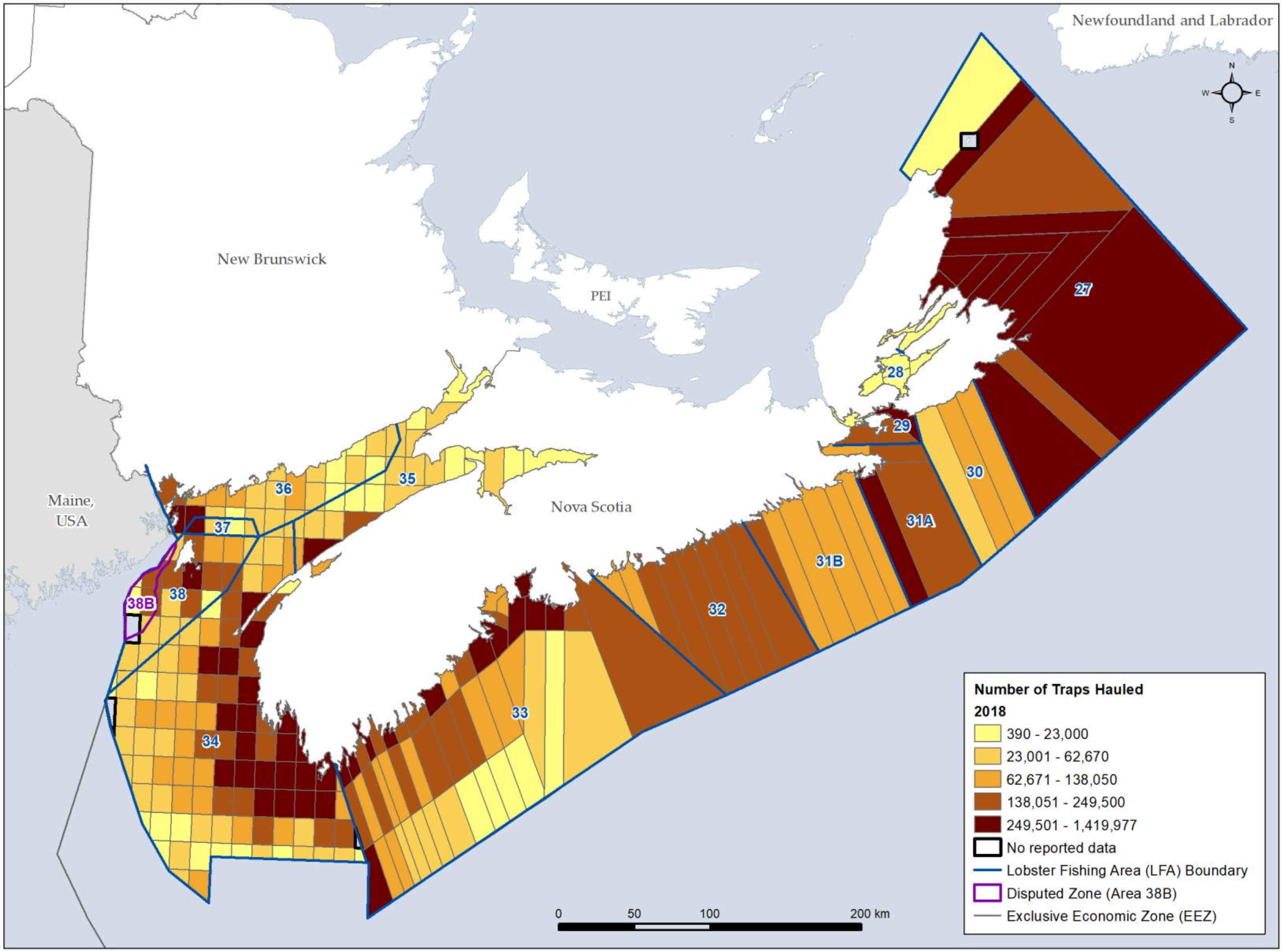


Figure 21. Number of trap hauls for the inshore lobster fishery (2018)

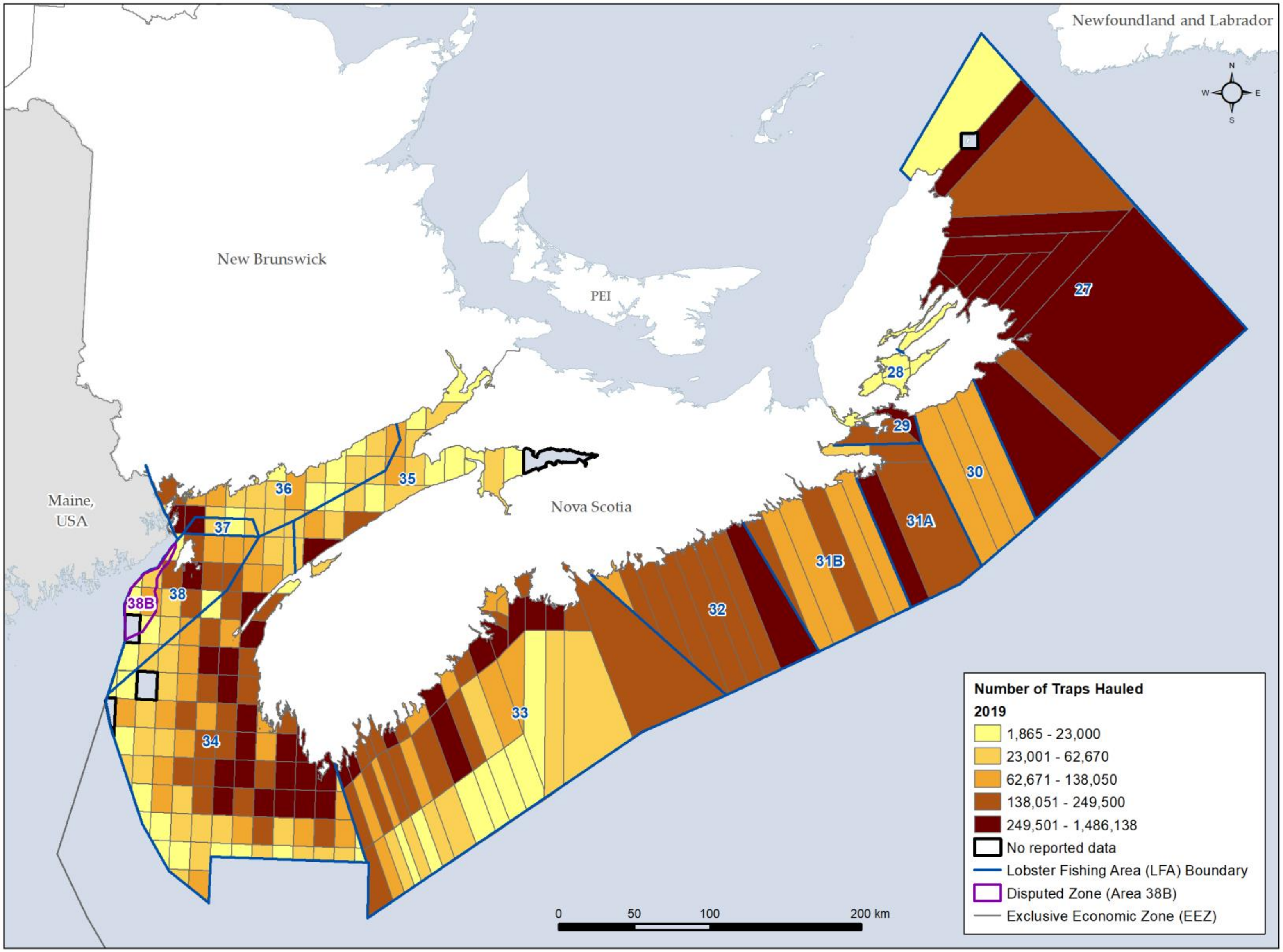


Figure 22. Number of trap hauls for the inshore lobster fishery (2019)

## Standardized trap hauls

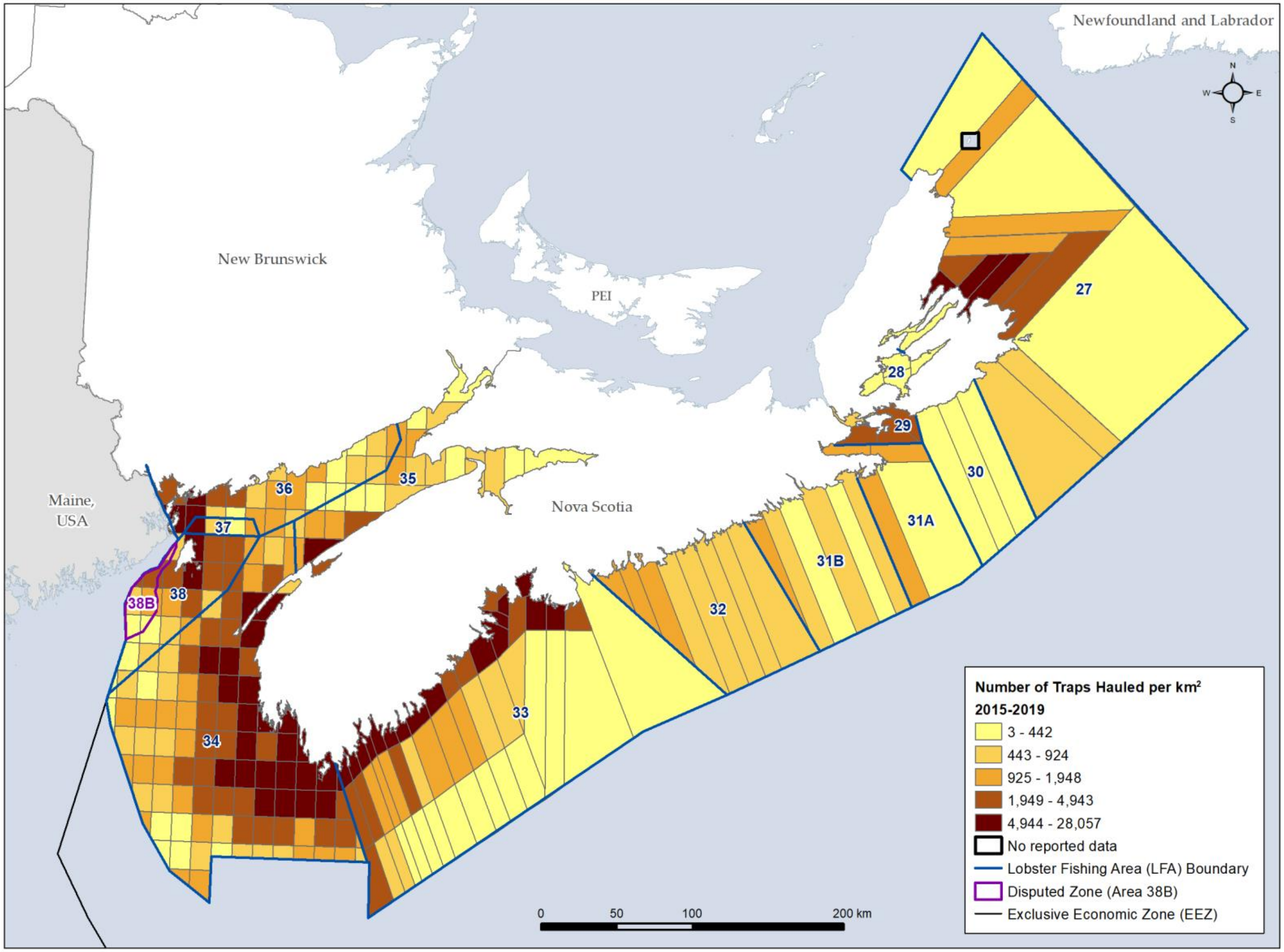


Figure 23. Composite number of trap hauls standardized by area (traps/km$^2$) for the inshore lobster fishery, 2015-2019.

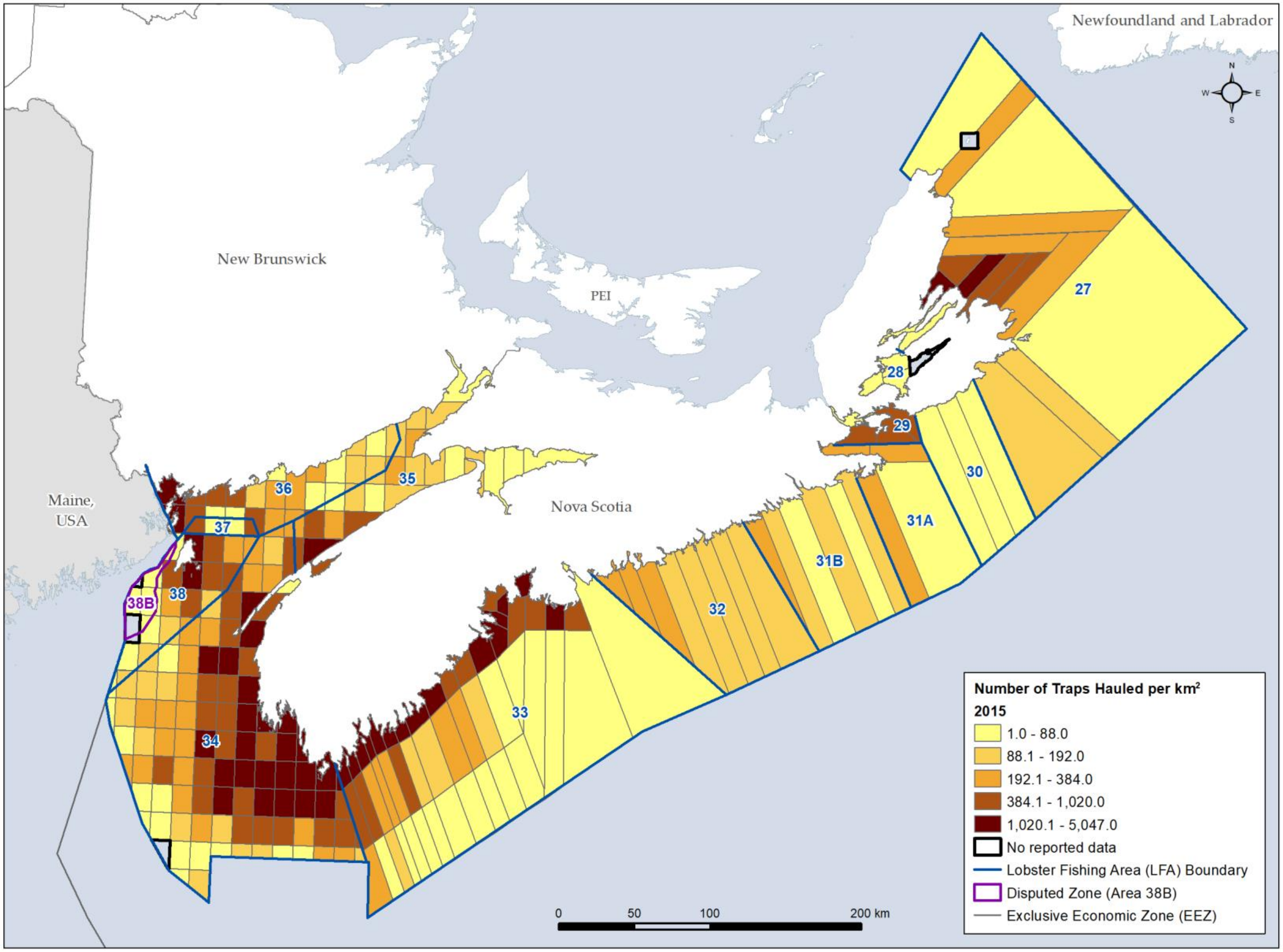


Figure 24. Number of trap hauls standardized by area (traps/km$^2$) for the inshore lobster fishery (2015)

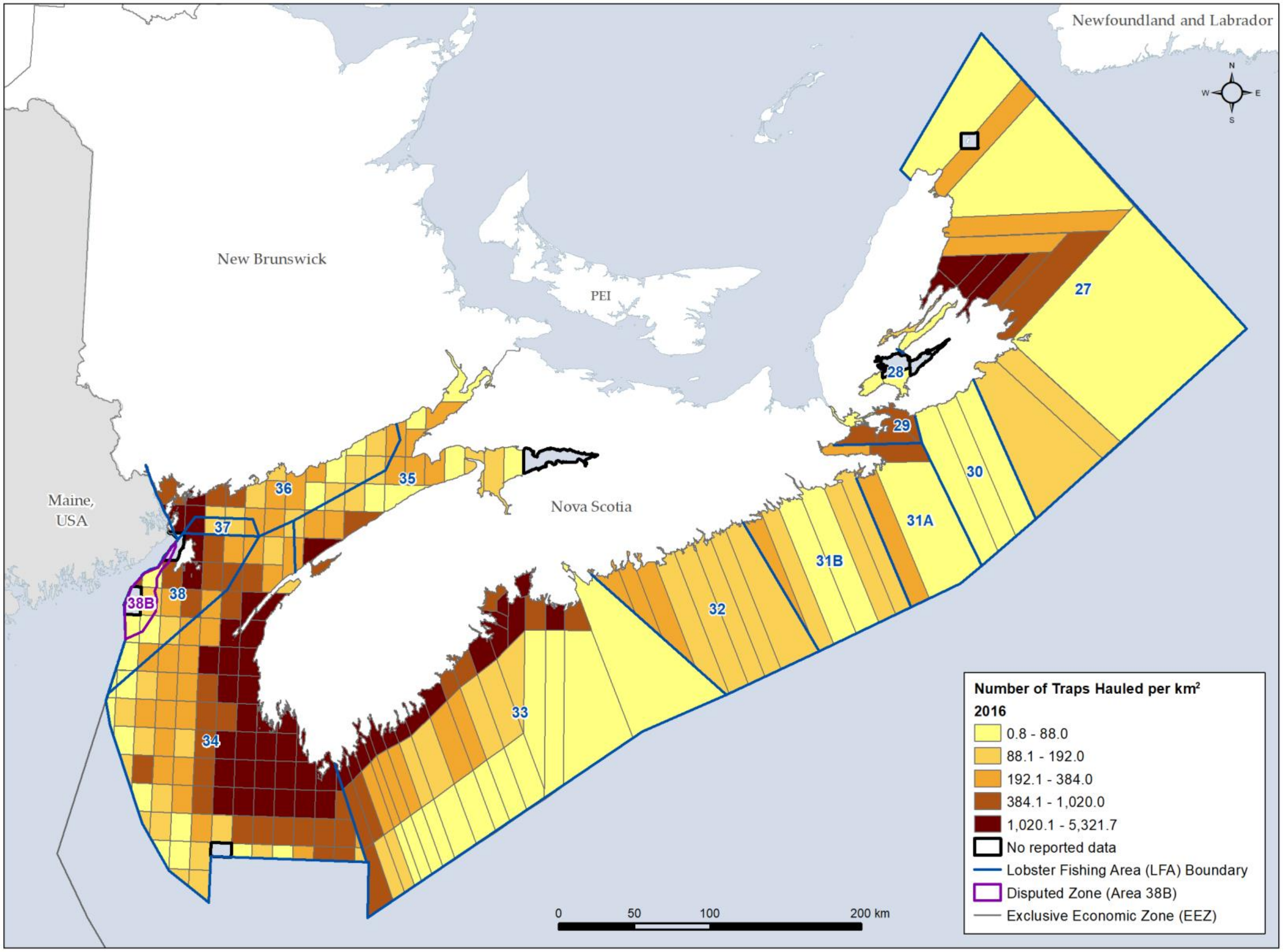


Figure 25. Number of trap hauls standardized by area (traps/km$^2$) for the inshore lobster fishery (2016)

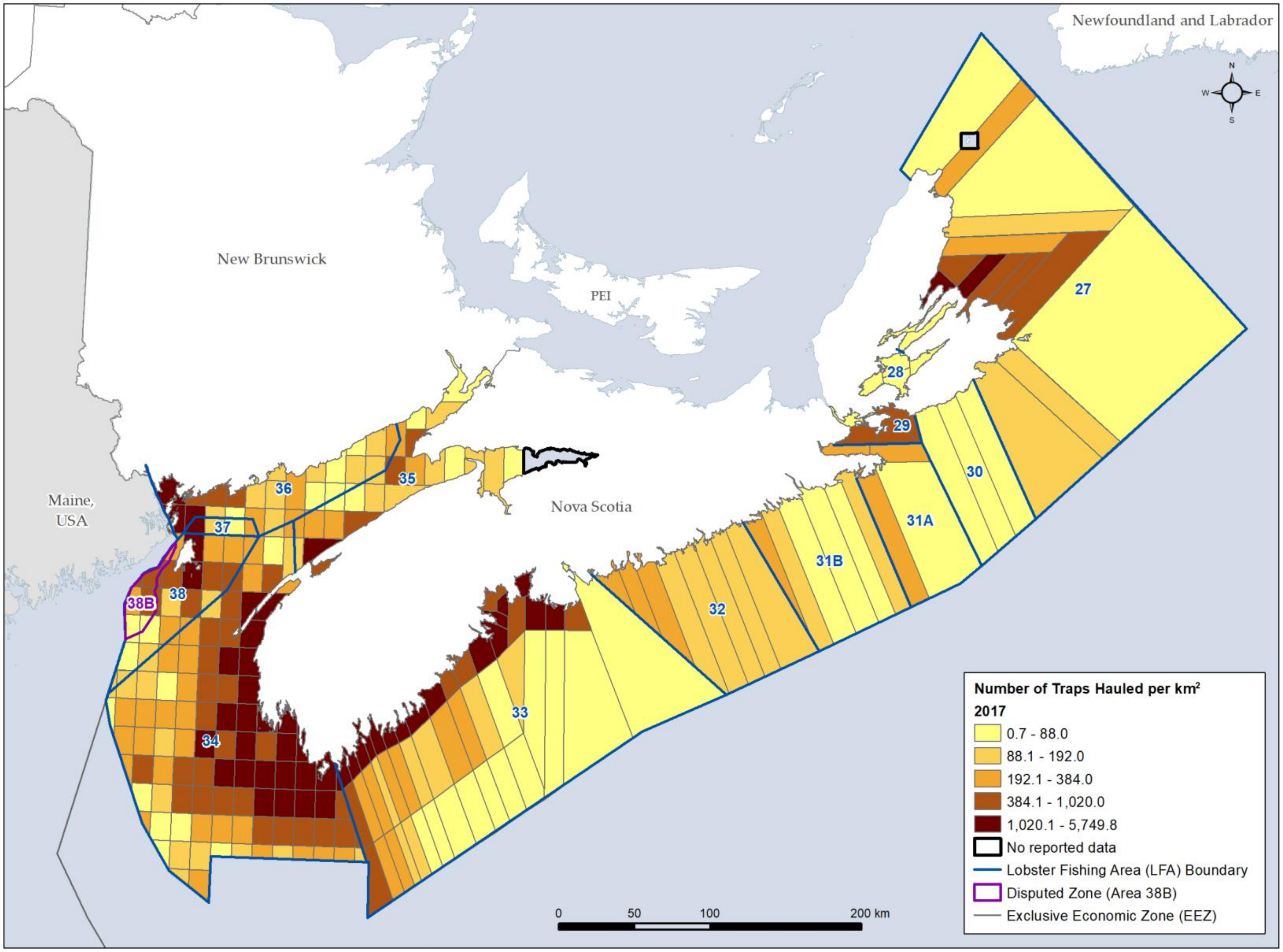


Figure 26. Number of trap hauls standardized by area (traps/$km^2$) for the inshore lobster fishery (2017)

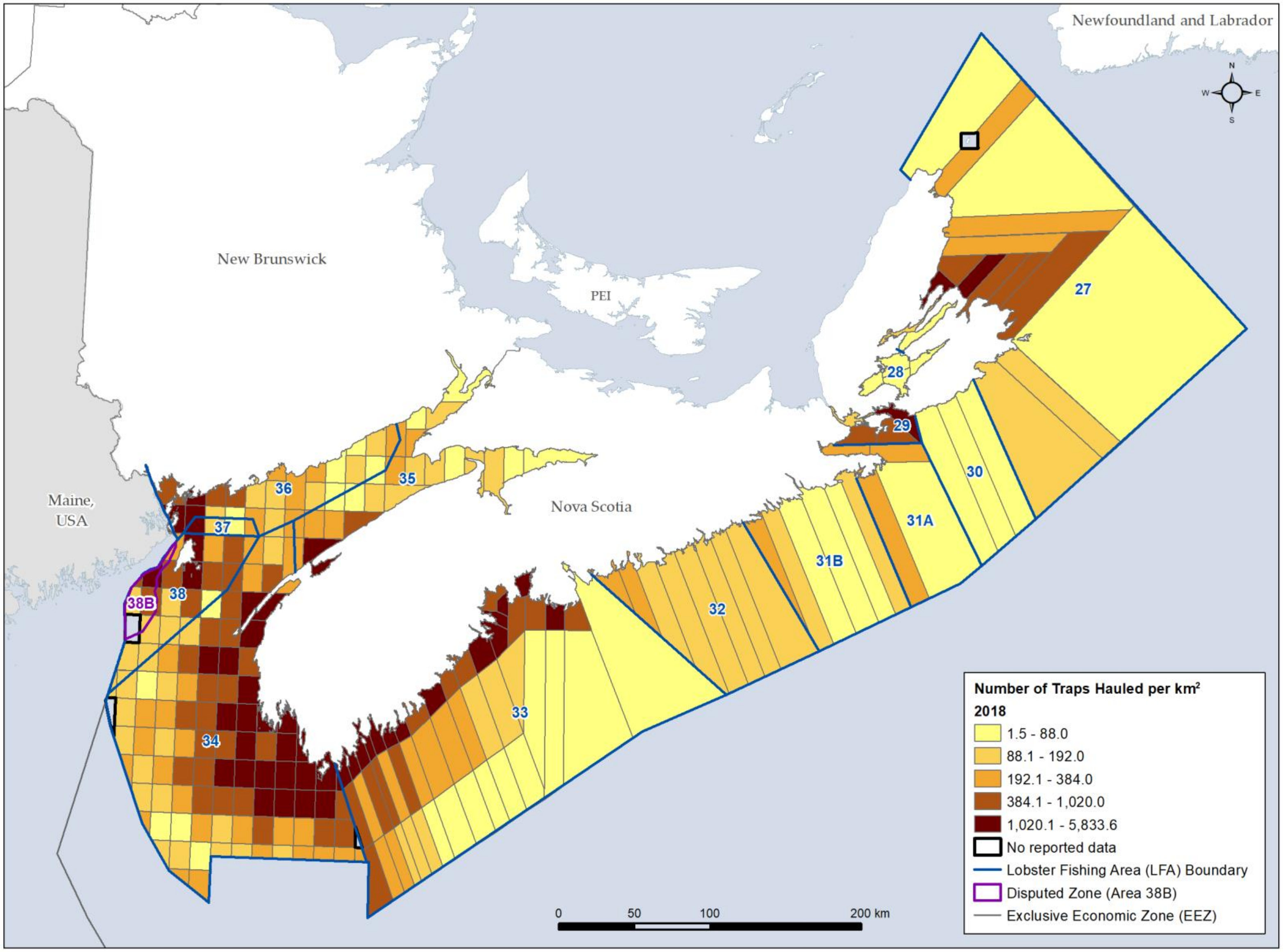


Figure 27. Number of trap hauls standardized by area (traps/km$^2$) for the inshore lobster fishery (2018)

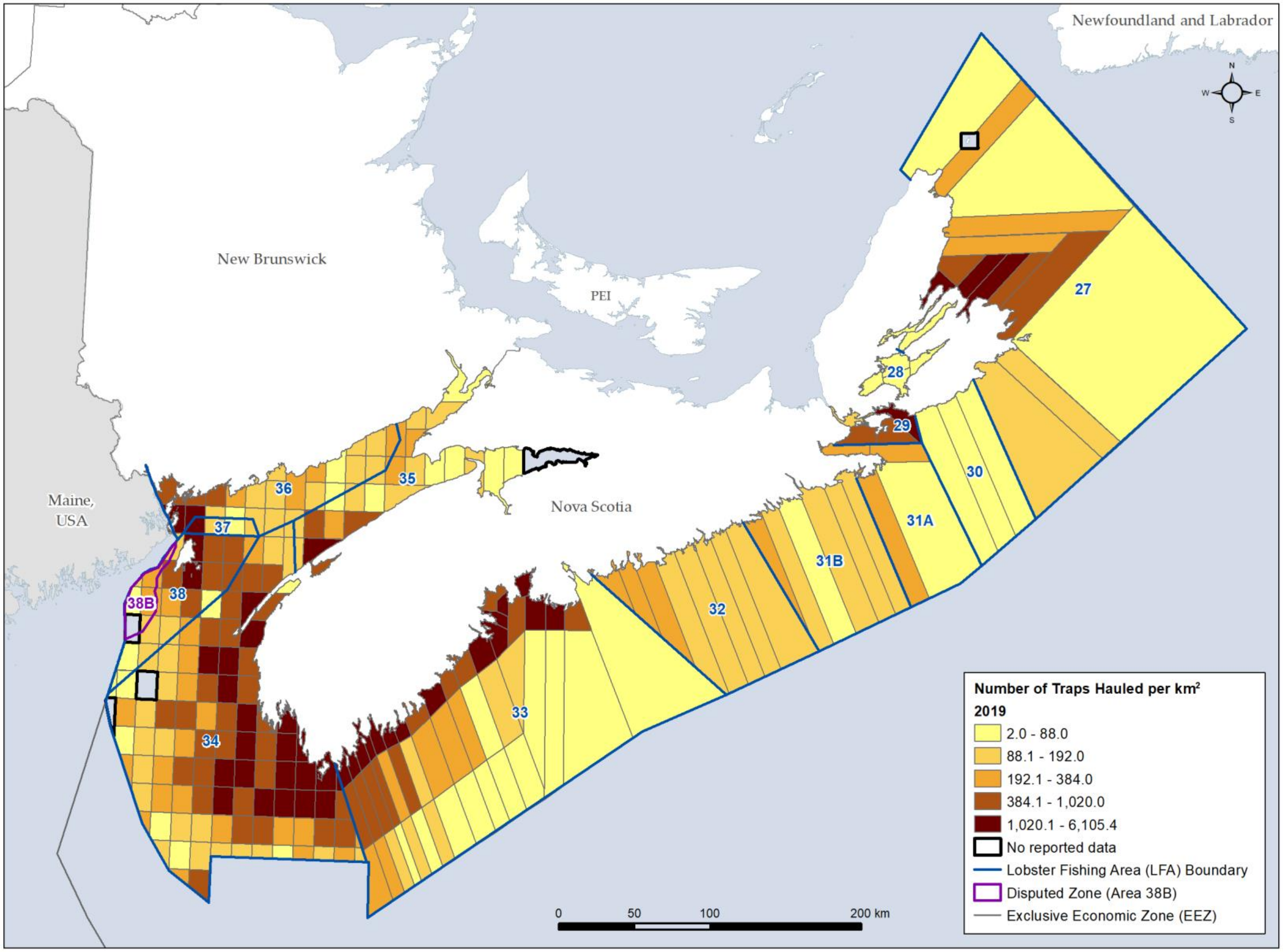


Figure 28. Number of trap hauls standardized by area (traps/km$^2$) for the inshore lobster fishery (2019)

## Catch weight per trap haul

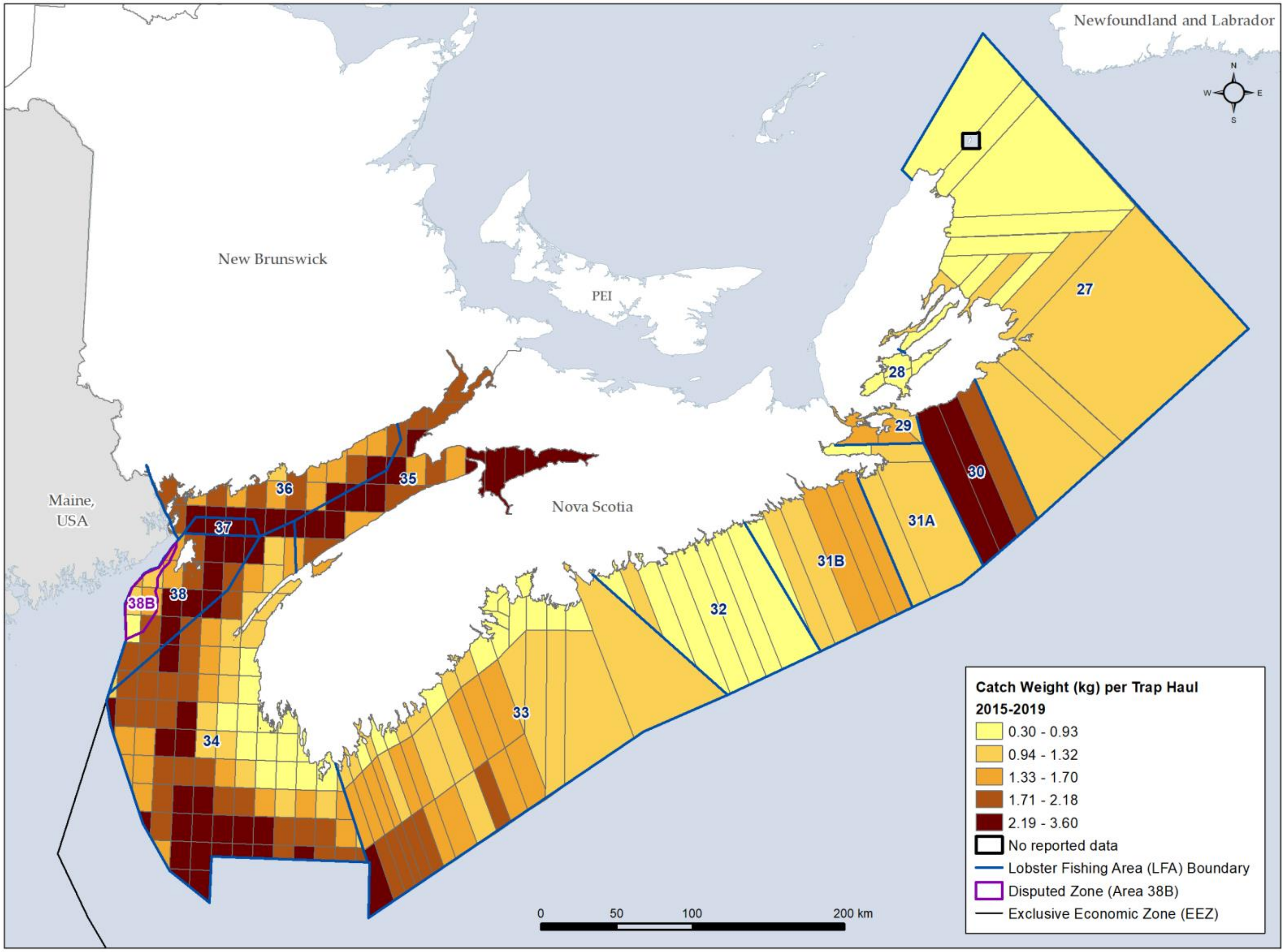


Figure 29. Composite catch weight per trap haul (kg/trap), for the inshore lobster fishery, 2015-2019.

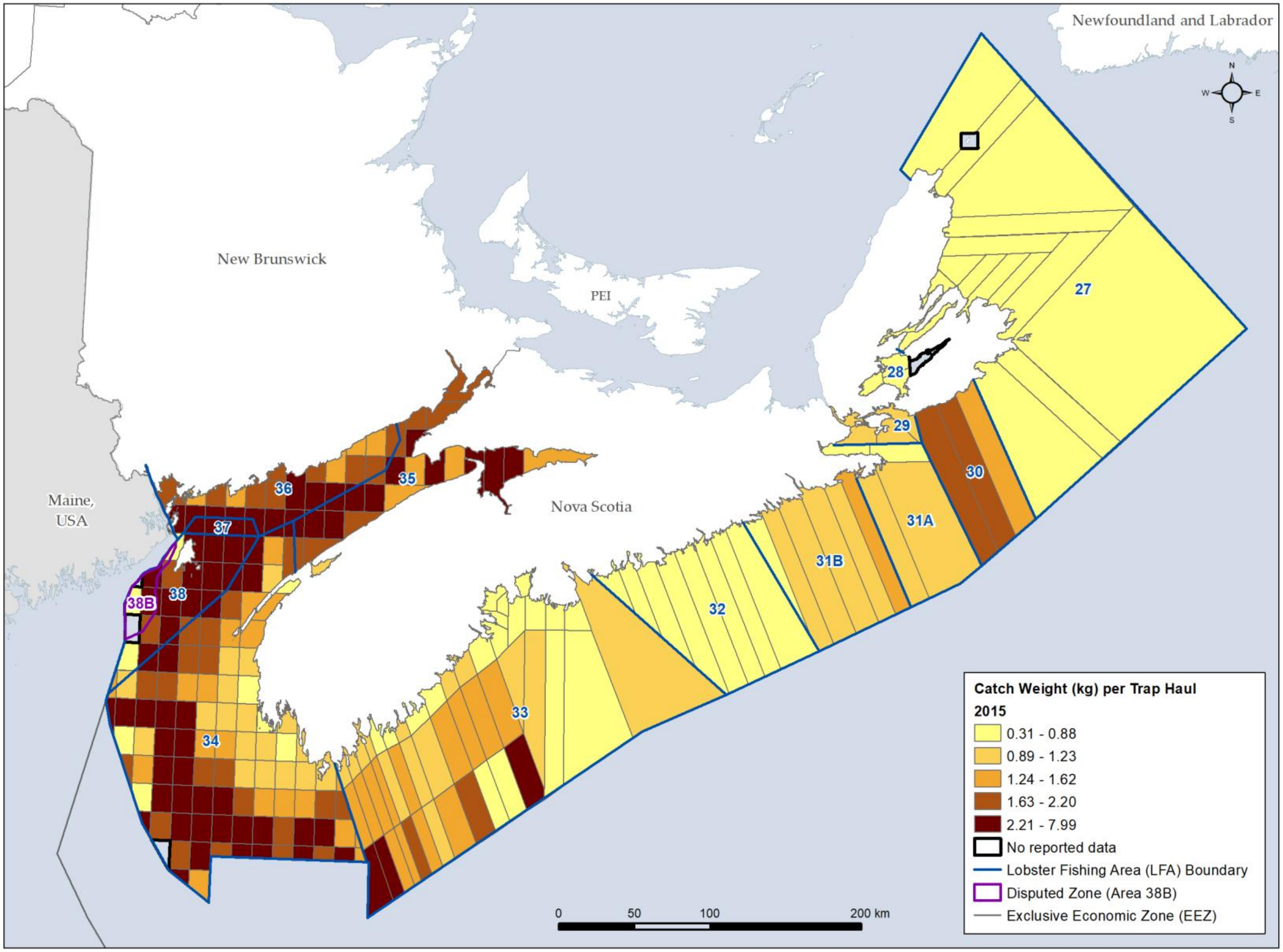


Figure 30. Catch weight per trap haul (kg/trap), for the inshore lobster fishery (2015)

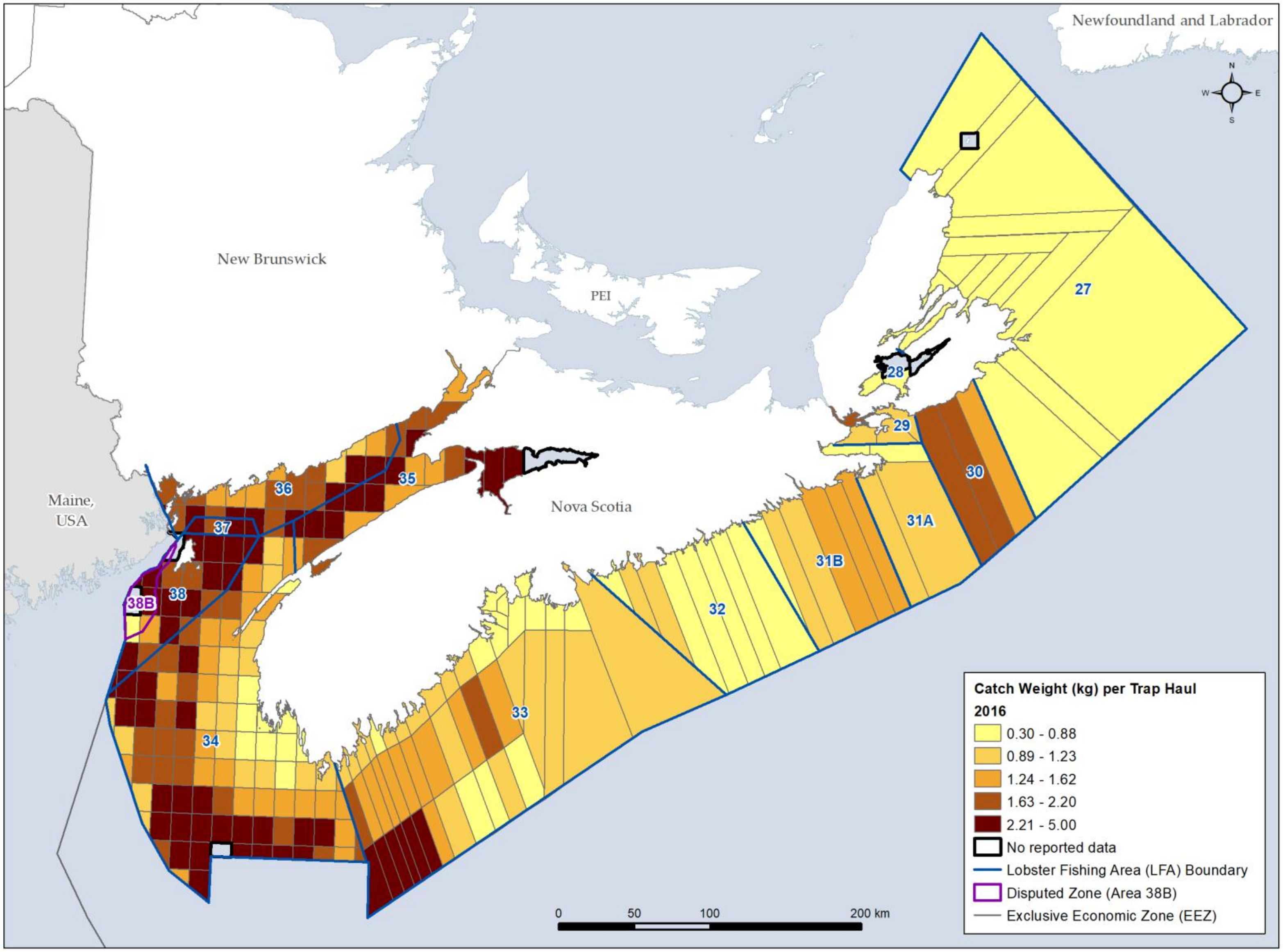


Figure 31. Catch weight per trap haul (kg/trap), for the inshore lobster fishery (2016)

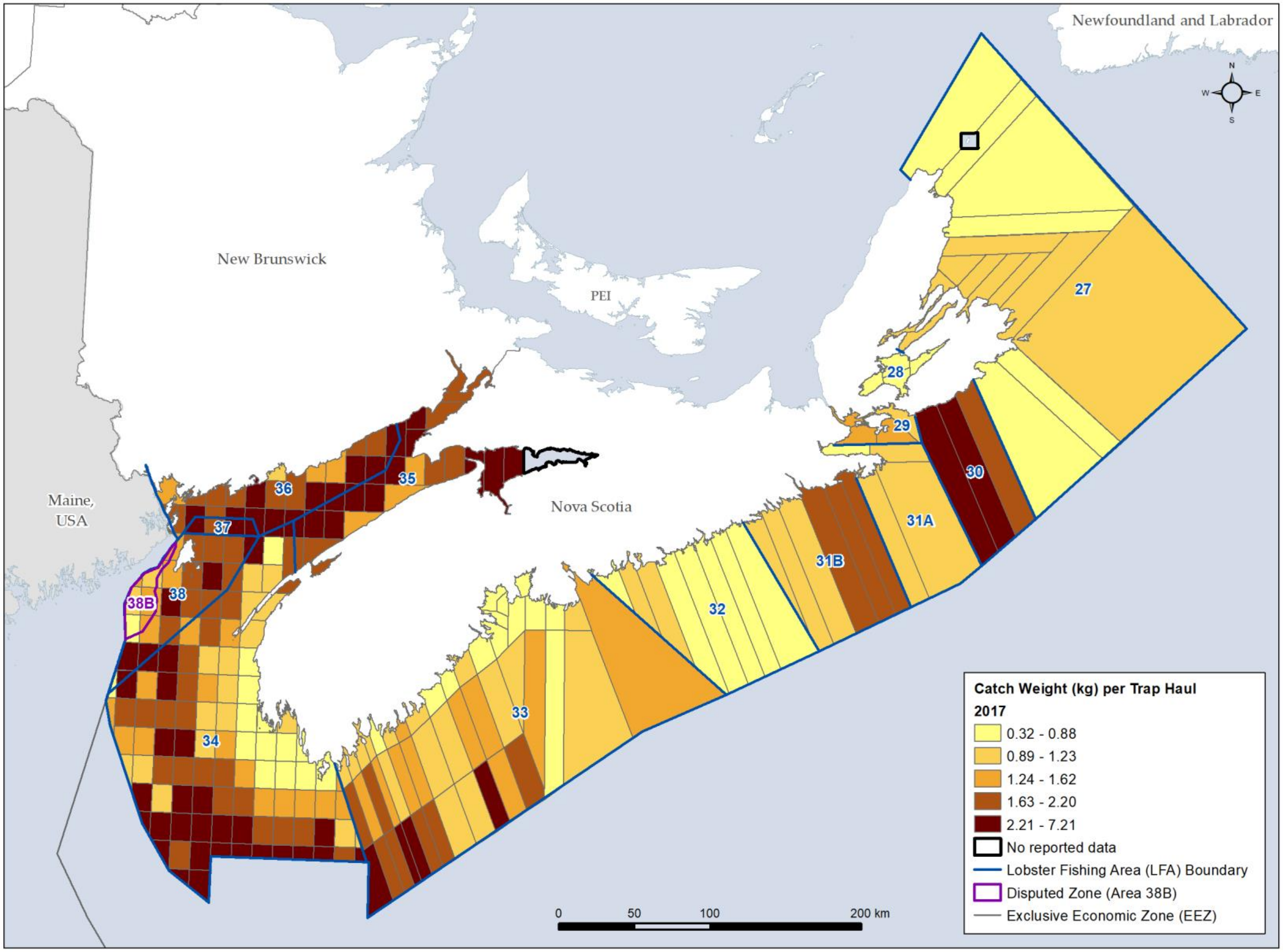


Figure 32. Catch weight per trap haul (kg/trap), for the inshore lobster fishery (2017)

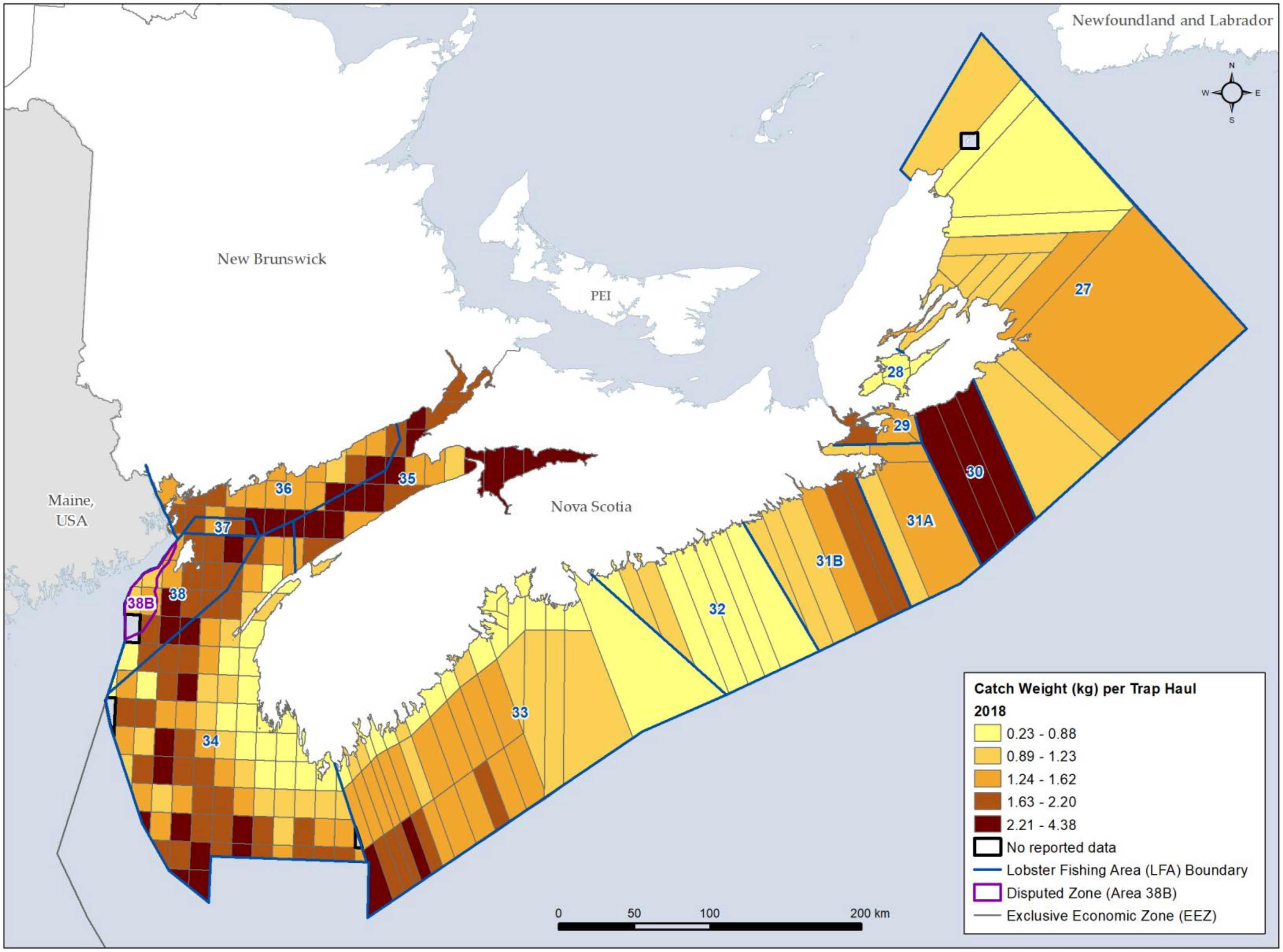


Figure 33. Catch weight per trap haul (kg/trap), for the inshore lobster fishery (2018)

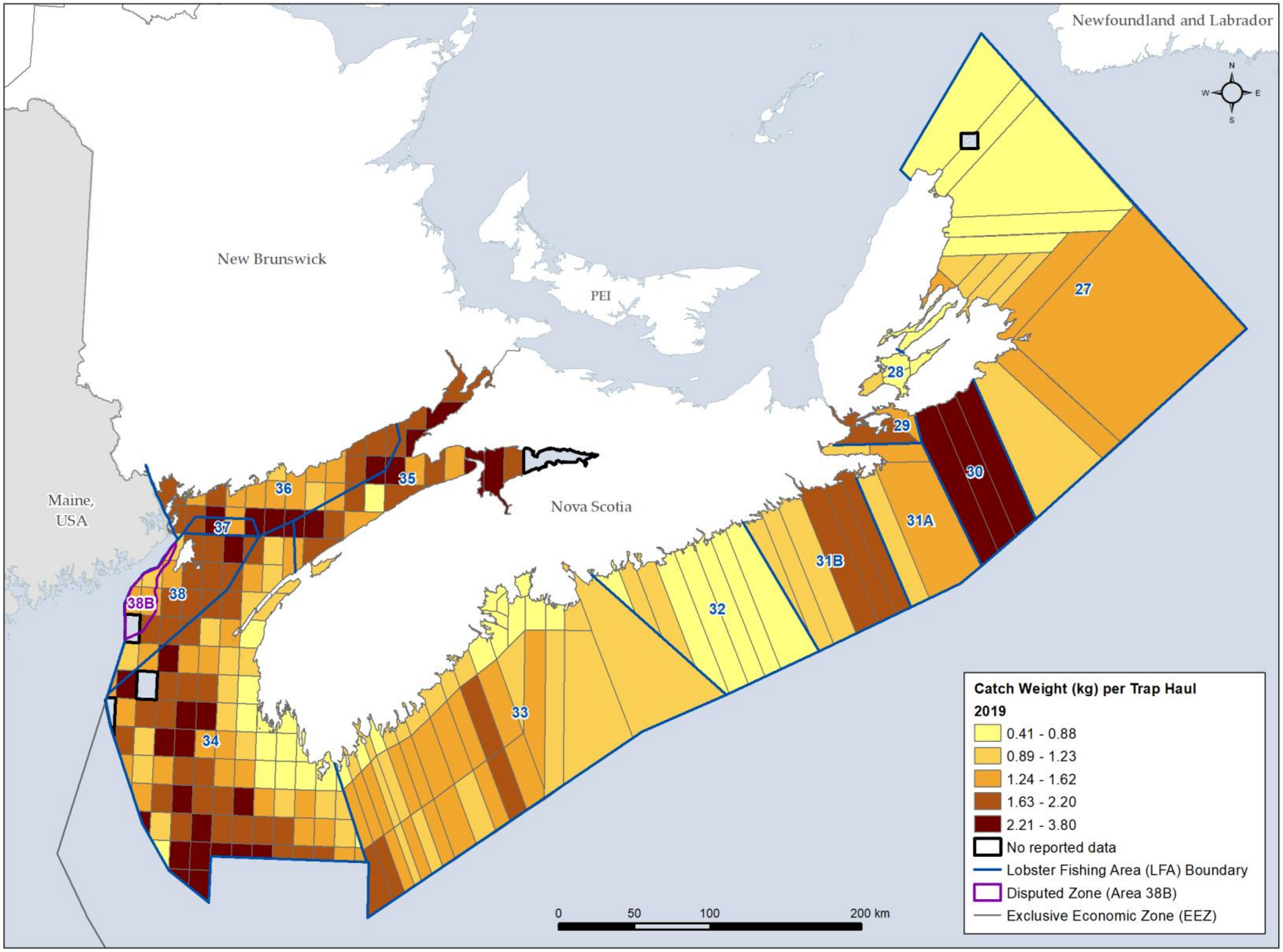


Figure 34. Catch weight per trap haul (kg/trap), for the inshore lobster fishery (2019)

## APPENDIX 2: TABLES

Table 1. Inshore LFA Open Dates and Number of Fishing Days*

| Inshore LFA | Open Dates as per *Atlantic Fishery Regulations, 1985* | Fishing Days per Season | Comments |
|---|---|---|---|
| 27 | May 15 – July 15 | 62 | |
| 28 | May 9 – July 9 | 62 | Typically varied to April 30 to June 30 |
| 29 | May 10 – July 10 | 62 | Typically varied to April 30 to June 30 |
| 30 | May 19 – July 20 | 63 | |
| 31A | April 29 – June 30 | 63 | |
| 31B | April 19 – June 20 | 63 | |
| 32 | April 19 – June 20 | 63 | |
| 33 | Last Monday in Nov – May 31 | 185 | |
| 34 | Last Monday in Nov – May 31 | 185 | |
| 35 | Oct 14 – Dec 31 and Last day in Feb – July 31 | 234 | |
| 36 | Second Tuesday in Nov – Jan 14 and March 31 – June 29 | 159 | There has been a 10 day season extension in place since the 2017/2018 fishing season |
| 37 | Second Tuesday in Nov – Jan 14 and March 31 – June 29 | 159 | |
| 38 | Second Tuesday in Nov – June 29 | 234 | |
| 38B | June 30 – Friday before second Tuesday in Nov | 128 | |

* The number of fishing days can vary from one season to the next, particularly in LFAs 33–38 where weather delays can affect the opening date and reduce the overall season length

Table 2. Summary of reported logbook catch weight (kg) and trap haul data for years 2015 through 2019.

| LFA | Weight (mt) with correct grid cells | Weight (mt) without correct grid cell | Total weight (mt) | % weight without correct grid cell | Average weight (mt) per year | Number of traps with correct grid cells | Number of traps without correct grid cell | Total number of traps | % of traps without correct grid cell | Average number of traps per year |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 | 21,758.1 | 2,063.2 | 23,821.3 | 8.7 | 4,764.3 | 23,445,596 | 1,947,679 | 25,393,275 | 7.7 | 5,078,655.0 |
| 28 | 61.2 | 17.5 | 78.6 | 22.2 | 15.7 | 123,831 | 34,367 | 158,198 | 21.7 | 31,639.6 |
| 29 | 4,139.9 | 452.2 | 4,592.1 | 9.8 | 918.4 | 3,067,599 | 331,206 | 3,398,805 | 9.7 | 679,761.0 |
| 30 | 2,503.7 | 127.9 | 2,631.6 | 4.9 | 526.3 | 1,079,669 | 46,604 | 1,126,273 | 4.1 | 225,254.6 |
| 31A | 3,800.3 | 395.3 | 4,195.6 | 9.4 | 839.1 | 3,533,389 | 267,679 | 3,801,068 | 7.0 | 760,213.6 |
| 31B | 5,071.8 | 451.6 | 5,523.4 | 8.2 | 1,104.7 | 3,946,997 | 332,247 | 4,279,244 | 7.8 | 855,848.8 |
| 32 | 5,080.5 | 893.2 | 5,973.7 | 15.0 | 1,194.7 | 6,558,316 | 1,151,231 | 7,709,547 | 14.9 | 1,541,909.4 |
| 33 | 40,051.7 | 1,638.6 | 41,690.3 | 3.9 | 8,338.1 | 37,836,656 | 1,316,570 | 39,153,226 | 3.4 | 7,830,645.2 |
| 34 | 114,471.0 | 4,805.9 | 119,276.9 | 4.0 | 23,855.4 | 92,223,809 | 4,037,232 | 96,261,041 | 4.2 | 19,252,208.2 |
| 35 | 14,531.2 | 1,618.2 | 16,149.4 | 10.0 | 3,229.9 | 6,631,658 | 836,623 | 7,468,281 | 11.2 | 1,493,656.2 |
| 36 | 16,374.3 | 761.9 | 17,136.2 | 4.4 | 3,427.2 | 8,389,322 | 430,195 | 8,819,517 | 4.9 | 1,763,903.4 |
| 38 | 21,018.8 | 1,153.0 | 22,171.8 | 5.2 | 4,434.4 | 9,550,872 | 495,568 | 10,046,440 | 4.9 | 2,009,288.0 |
| 38B | 2,567.6 | 1,089.1 | 2,567.6 | 42.4 | 513.5 | 949,982 | 278,858 | 1,228,840 | 22.7 | 245,768.0 |
| Total | 251,430.1 | 15,467.5 | 266,897.6 | 5.8 | 53,379.5 | 197,337,696 | 11,506,059 | 208,843,755 | 5.5 | 41,768,751.0 |

Table 3. Summary of reported logbook catch weight (kg) and trap haul data for 2015.

| LFA | Weight (mt) with valid grid cell | Weight (mt) without valid grid cell | Total weight (mt) | % weight without valid grid cell | Number of traps with valid grid cells | Number of traps without valid grid cell | Total number of traps | % of traps without valid grid cell |
|---|---|---|---|---|---|---|---|---|
| 27 | 3,116.5 | 394.8 | 3,511.3 | 11.2 | 4,464,687 | 452,776 | 4,917,463 | 9.2 |
| 28 | 6.7 | 9.2 | 15.9 | 58.1 | 14,738 | 11,910 | 26,648 | 44.7 |
| 29 | 565.8 | 79.5 | 645.3 | 12.3 | 559,229 | 78,373 | 637,602 | 12.3 |
| 30 | 409.3 | 0.0 | 409.3 | 0.0 | 216,493 | 0 | 216,493 | 0.0 |
| 31A | 635.4 | 88.0 | 723.4 | 12.2 | 734,986 | 92,492 | 827,478 | 11.2 |
| 31B | 837.6 | 118.8 | 956.4 | 12.4 | 777,140 | 107,427 | 884,567 | 12.1 |
| 32 | 811.6 | 275.6 | 1,087.3 | 25.4 | 1,232,533 | 381,862 | 1,614,395 | 23.7 |
| 33 | 7,304.6 | 423.2 | 7,727.8 | 5.5 | 7,058,733 | 319,220 | 7,377,953 | 4.3 |
| 34 | 24,435.1 | 1,212.0 | 25,647.1 | 4.7 | 17,438,251 | 1,107,437 | 18,545,688 | 6.0 |
| 35 | 3,018.1 | 400.3 | 3,418.4 | 11.7 | 1,311,674 | 190,313 | 1,501,987 | 12.7 |
| 36 | 3,390.3 | 167.6 | 3,557.9 | 4.7 | 1,551,839 | 77,503 | 1,629,342 | 4.8 |
| 38 | 4,730.9 | 442.0 | 5,172.9 | 8.5 | 1,835,063 | 162,634 | 1,997,697 | 8.1 |
| 38B | 449.3 | 185.2 | 634.5 | 29.2 | NA | NA | NA | NA |
| Total | 49,711.2 | 3,796.1 | 53,507.3 | 7.1 | 37,195,366 | 2,981,947 | 40,177,313 | 7.4 |

Table 4. Summary of reported logbook catch weight (kg) and trap haul data for 2016.

| LFA | Weight (mt) with valid grid cell | Weight (mt) without valid grid cell | Total weight (mt) | % weight without valid grid cell | Number of traps with valid grid cells | Number of traps without valid grid cell | Total number of traps | % of traps without valid grid cell |
|---|---|---|---|---|---|---|---|---|
| 27 | 3,334.4 | 271.9 | 3,606.3 | 7.5 | 4,797,249 | 335,423 | 5,132,672 | 6.5 |
| 28 | 6.2 | 2.1 | 8.3 | 25.2 | 19,995 | 6,435 | 26,430 | 24.3 |
| 29 | 651.4 | 100.1 | 751.5 | 13.3 | 591,902 | 91,497 | 683,399 | 13.4 |
| 30 | 366.0 | 50.1 | 416.1 | 12.1 | 210,442 | 20,750 | 231,192 | 9.0 |
| 31A | 657.2 | 70.7 | 727.9 | 9.7 | 752,214 | 52,478 | 804,692 | 6.5 |
| 31B | 969.2 | 33.5 | 1,002.7 | 3.3 | 819,935 | 30,371 | 850,306 | 3.6 |
| 32 | 1,073.2 | 186.2 | 1,259.5 | 14.8 | 1,339,261 | 216,028 | 1,555,289 | 13.9 |
| 33 | 9,001.7 | 347.3 | 9,349.0 | 3.7 | 7,986,509 | 253,035 | 8,239,544 | 3.1 |
| 34 | 24,834.2 | 885.8 | 25,720.0 | 3.4 | 19,542,991 | 615,991 | 20,158,982 | 3.1 |
| 35 | 2,946.3 | 252.8 | 3,199.2 | 7.9 | 1,406,909 | 142,858 | 1,549,767 | 9.2 |
| 36 | 3,410.8 | 81.5 | 3,492.3 | 2.3 | 1,694,905 | 56,193 | 1,751,098 | 3.2 |
| 38 | 5,044.9 | 257.6 | 5,302.5 | 4.9 | 2,075,157 | 105,098 | 2,180,255 | 4.8 |
| 38B | 687.5 | 220.6 | 908.1 | 24.3 | NA | NA | NA | NA |
| Total | 52,983.0 | 2,760.3 | 55,743.4 | 5.0 | 41,237,469 | 1,926,157 | 43,163,626 | 4.5 |

Table 5. Summary of reported logbook catch weight (kg) and trap haul data for 2017.

| LFA | Weight (mt) with valid grid cell | Weight (mt) without valid grid cell | Total weight (mt) | % weight without valid grid cell | Number of traps with valid grid cells | Number of traps without valid grid cell | Total number of traps | % of traps without valid grid cell |
|---|---|---|---|---|---|---|---|---|
| 27 | 4,614.1 | 497.4 | 5,111.5 | 9.7 | 4,646,602 | 467,373 | 5,113,975 | 9.1 |
| 28 | 10.1 | 1.3 | 11.4 | 11.4 | 22,362 | 3,787 | 26,149 | 14.5 |
| 29 | 740.0 | 100.5 | 840.5 | 12.0 | 561,953 | 62,590 | 624,543 | 10.0 |
| 30 | 487.3 | 35.4 | 522.7 | 6.8 | 194,456 | 12,250 | 206,706 | 5.9 |
| 31A | 707.9 | 112.3 | 820.1 | 13.7 | 642,514 | 58,557 | 701,071 | 8.4 |
| 31B | 1,020.9 | 122.8 | 1,143.7 | 10.7 | 771,894 | 80,339 | 852,233 | 9.4 |
| 32 | 1,073.0 | 160.2 | 1,233.3 | 13.0 | 1,335,475 | 222,828 | 1,558,303 | 14.3 |
| 33 | 8,005.2 | 317.5 | 8,322.6 | 3.8 | 7,601,780 | 241,602 | 7,843,382 | 3.1 |
| 34 | 23,735.1 | 1,144.6 | 24,879.7 | 4.6 | 18,974,315 | 888,572 | 19,862,887 | 4.5 |
| 35 | 3,164.2 | 392.0 | 3,556.1 | 11.0 | 1,374,640 | 192,292 | 1,566,932 | 12.3 |
| 36 | 3,303.5 | 154.4 | 3,457.9 | 4.5 | 1,625,290 | 72,862 | 1,698,152 | 4.3 |
| 38 | 4,038.5 | 174.7 | 4,213.2 | 4.1 | 1,882,424 | 89,325 | 1,971,749 | 4.5 |
| 38B | 554.7 | 257.4 | 812.1 | 31.7 | 437,872 | 97,421 | 535,293 | 18.2 |
| Total | 51,454.3 | 3,470.5 | 54,924.8 | 6.3 | 40,071,577 | 2,489,798 | 42,561,375 | 5.8 |

Table 6. Summary of reported logbook catch weight (kg) and trap haul data for 2018.

| LFA | Weight (mt) with valid grid cell | Weight (mt) without valid grid cell | Total weight (mt) | % weight without valid grid cell | Number of traps with valid grid cells | Number of traps without valid grid cell | Total number of traps | % of traps without valid grid cell |
|---|---|---|---|---|---|---|---|---|
| 27 | 5,192.8 | 401.4 | 5,594.2 | 7.2 | 4,568,691 | 329,661 | 4,898,352 | 6.7 |
| 28 | 15.0 | 1.4 | 16.4 | 8.3 | 31,979 | 3,205 | 35,184 | 9.1 |
| 29 | 1,041.7 | 78.9 | 1,120.5 | 7.0 | 665,099 | 49,971 | 715,070 | 7.0 |
| 30 | 603.3 | 42.3 | 645.6 | 6.6 | 213,051 | 13,604 | 226,655 | 6.0 |
| 31A | 848.1 | 84.4 | 932.5 | 9.1 | 694,844 | 44,305 | 739,149 | 6.0 |
| 31B | 954.6 | 151.1 | 1,105.7 | 13.7 | 723,891 | 93,094 | 816,985 | 11.4 |
| 32 | 964.6 | 191.2 | 1,155.8 | 16.5 | 1,243,814 | 230,595 | 1,474,409 | 15.6 |
| 33 | 7,849.6 | 248.0 | 8,097.6 | 3.1 | 7,713,355 | 222,174 | 7,935,529 | 2.8 |
| 34 | 19,469.5 | 733.5 | 20,203.0 | 3.6 | 18,583,765 | 756,869 | 19,340,634 | 3.9 |
| 35 | 2,870.5 | 279.6 | 3,150.1 | 8.9 | 1,321,428 | 127,559 | 1,448,987 | 8.8 |
| 36 | 3,064.4 | 118.9 | 3,183.4 | 3.7 | 1,760,080 | 80,716 | 1,840,796 | 4.4 |
| 38 | 3,535.5 | 124.3 | 3,659.8 | 3.4 | 1,874,466 | 57,457 | 1,931,923 | 3.0 |
| 38B | 510.2 | 252.4 | 762.7 | 33.1 | 377,588 | 130,611 | 508,199 | 25.7 |
| Total | 46,919.8 | 2,707.6 | 49,627.4 | 5.5 | 39,772,051 | 2,139,821 | 41,911,872 | 5.1 |

Table 7. Summary of reported logbook catch weight (kg) and trap haul data for 2019.

| LFA | Weight (mt) with valid grid cell | Weight (mt) without valid grid cell | Total weight (mt) | % weight without valid grid cell | Number of traps with valid grid cells | Number of traps without valid grid cell | Total number of traps | % of traps without valid grid cell |
|---|---|---|---|---|---|---|---|---|
| 27 | 5,500.4 | 497.6 | 5,998.0 | 8.3 | 4,968,367 | 362,446 | 5,330,813 | 6.8 |
| 28 | 23.1 | 3.5 | 26.6 | 13.1 | 34,757 | 9,030 | 43,787 | 20.6 |
| 29 | 1,141.1 | 93.2 | 1,234.3 | 7.6 | 689,416 | 48,775 | 738,191 | 6.6 |
| 30 | 637.8 | 0.0 | 637.8 | 0.0 | 245,227 | 0 | 245,227 | 0.0 |
| 31A | 951.8 | 39.8 | 991.7 | 4.0 | 708,831 | 19,847 | 728,678 | 2.7 |
| 31B | 1,289.5 | 25.4 | 1,314.9 | 1.9 | 854,137 | 21,016 | 875,153 | 2.4 |
| 32 | 1,158.0 | 79.9 | 1,237.9 | 6.5 | 1,407,233 | 99,918 | 1,507,151 | 6.6 |
| 33 | 7,890.7 | 302.6 | 8,193.3 | 3.7 | 7,476,279 | 280,539 | 7,756,818 | 3.6 |
| 34 | 21,997.1 | 830.0 | 22,827.1 | 3.6 | 17,684,487 | 668,363 | 18,352,850 | 3.6 |
| 35 | 2,532.1 | 293.5 | 2,825.6 | 10.4 | 1,217,007 | 183,601 | 1,400,608 | 13.1 |
| 36 | 3,205.3 | 239.5 | 3,444.7 | 7.0 | 1,757,208 | 142,921 | 1,900,129 | 7.5 |
| 38 | 3,669.1 | 154.3 | 3,823.4 | 4.0 | 1,883,762 | 81,054 | 1,964,816 | 4.1 |
| 38B | 365.9 | 173.5 | 539.3 | 32.2 | 134,522 | 50,826 | 185,348 | 27.4 |
| Total | 50,361.9 | 2,732.9 | 53,094.8 | 5.1 | 39,061,233 | 1,968,336 | 41,029,569 | 4.8 |