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Summary of the 2016 snow crab trawl survey activities in the southern Gulf of St. Lawrence

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

The present document summarizes the details of the 2016 snow crab bottom trawl survey of the southern Gulf of St. Lawrence including the details of protocols used for the 2016 trawl survey, survey activities and characteristics of individual tows during the 2016 trawl survey as well as the basic information on the catch of snow crab and other species. The primary objective of the survey is to provide the data on abundance and distribution of snow crab and other by-catch species. The results of in-depth analysis of the survey data were presented in the assessment document. The survey was conducted from July 10 to October 4 using a chartered commercial fishing vessel, the "*Jean Mathieu*". A total of 355 grids were visited and 354 grids were successfully sampled. The total duration of the survey was 87 days with 42 days at sea. Total number of immature male crab captured went from 11,431 individuals in 2015 to 11,431 in 2016, whereas mature male crab catches decreased from 3,755 to 5,453. For commercial-male crabs, the number captured increased from 1,741 in 2015 to 2,896 in 2016. For females, the total number of immature female crabs captured increased from 4,904 in 2015 to 5,547 in 2016, and the number of mature female crabs increased from 7,398 in 2015 to 7,854 in 2016. Recorded by-catch (including snow crab) during the 2016 survey consisted of 71 species/groups comprised of 43 fish including skate egg capsules and 28 invertebrates including whelk capsules and one marine plant.

Résumé des détails sur le relevé de crabe des neiges dans le sud du golfe du Saint-Laurent en 2016

RÉSUMÉ

Ce document fournit un résumé des détails sur le relevé au chalut de fond du crabe des neiges entrepris dans le sud du golfe Saint-Laurent en 2016 incluant les détails sur le protocole, le déroulement du relevé, les caractéristiques de chaque trait ainsi que le sommaire des captures du crabe des neiges et des espèces accessoires ont été décrits. L'objectif principal de ce relevé est de fournir les données d'abondance et la distribution du crabe des neiges et d'autres espèces de capture accessoires. Le relevé a été entrepris du 10 juillet au 4 octobre à bord d'un navire de pêche commerciale nolisé «Jean-Mathieu». Au total, 355 quadrilatères ont été visités parmi lesquelles 354 quadrilatères ont été chalutés avec succès. Il n'y a eu aucun changement majore du protocole utilisé pour le relevé en 2016 comparativement à celui de 2014. Les caractéristiques des traits étaient comparables à celles des années précédentes (2014 et 2013). La durée totale (en jours) du relevé a été de 86 jours avec 42 jours en mer. Le nombre total des males immatures capturés a changé de 11 498 individus en 2015 à 11 431 en 2016. La capture de males matures a diminué de 3 755 à 5 452 de 2015 à 2016. Pour les mâles de taille commerciale le nombre capturé a augmenté de 1 741 en 2015 à 2 896 en 2016. Pour les femelles, le nombre total des immatures capturées a augmenté de 4 904 en 2015 à 5 547 en 2016, et le nombre de femelles matures capturées a également augmenté de 7 398 en 2015 à 7 854 en 2016. Les espèces (ou groupe d'espèces) accessoires enregistrées (incluant le crabe des neiges) capturées durant le relevé de 2016 comprenaient 71 espèces/groupes dont 43 poissons incluant les œufs des raies et 28 invertébrés incluant les capsules des buccins, et une algue marine.

INTRODUCTION

The snow crab fishery in the southern Gulf of St. Lawrence (sGSL) began in the mid-1960s and entered into a development phase in the 1970s when initial landings by fishermen from the Maritime Provinces and Quebec were relatively low. Record landings were reached however during the early 1980s (Hébert et al. 2015). Throughout this time, the status of snow crab population in the area was poorly understood and was based mostly on fishery statistics. In 1989, the Area 12 fishery was closed prematurely due to a rapid decline in catch rates associated with an increasing incidence of soft-shelled crabs being captured, consequently, new management measures were introduced in 1990.

One of the measures used was to determine the total allowable catch (TAC) based on the biomass index of adult male crab ≥ 95 mm (CW) as estimated from a bottom trawl survey. The annual snow crab survey is fishery independent and is the main assessment tool used by biologists for determining the status of the snow crab population as it provides indices of recruitment several years before crabs enter the fishery. Female snow crabs, inherently smaller than males, are also caught in the trawl net, therefore enabling the creation of an index of the stock's reproductive potential. Other indices such as sex ratios, natural mortality, molting probabilities and relative exploitation rates can also be estimated through the trawl survey data analyses.

The snow crab trawl survey has been conducted since 1988 in Areas 12 and 25/26 (except for 1996), since 1990 in Area 19, since 1992 in Area 18 (except for 1997 and 1998) and since 1997 in Areas E and F. In Areas 12, 18, 25/26, E and F, the survey was conducted after the fishing season, which usually opened in late April and finishes by mid-July. The regular trawl survey normally started early to mid-July and ended in September. In Area 19, the fishing season was opened in two periods (spring and summer) between 1990 and 1992 and the survey was conducted between the two seasons. Since 1993, the survey in Area 19 has been conducted after the summer fishing season.

A systematic random sampling design was used to determine the location of trawl stations (Moriyasu et al. 1998). One or two locations were randomly chosen within each grid of 10 by 10 minutes latitude-longitude. The locations of trawl stations were remained fixed each year. In small areas such as Areas 18, 19, 25/26, E, F and in Chaleur Bay two stations within a 10 by 10 latitude-longitude grid were randomly chosen to increase the precision of the estimates in these small zones. In 1988, the survey area covered the expected boundaries of the commercial fishery in Area 12 only, and has since expanded to cover a much larger area.

There have been progressive changes in the sampling design and protocols of the sGSL trawl survey since its inception in 1988. Originally, the survey area was sub-divided using a lattice of 10 by 10 minute latitude-longitude grids. One or two sampling locations were then randomly selected and used as fixed stations in subsequent survey years. Initially, the survey area only covered Area 12 but was expanded to Area 19 in 1990. Area 12 was sampled before its fishery (July to October) for all years (except 1996 where there was no survey) and Area 19 was sampled before its fishery from 1990 to 1992 and then after its fishery from 1993 onward (Moriyasu *et al*. 2008).

In 1997, the survey area was again extended to include the new management Areas 12E and 12F. New stations were added randomly within grids as the survey expanded or if areas were targeted for more intensive sampling. Further details of these survey design changes are provided by Moriyasu et al. (2008).

The sampling design from 2006 to 2011 was modified in accordance with recommendations from the 2005 Assessment Framework Workshop on the sGSL snow crab (Moriyasu et al. 2008). The new design was introduced to achieve spatial sampling homogeneity. While this survey design was spatially unbiased in the sense that the expected number of stations per 10 by 10 minute grid was proportional to its surface area, in practice the realized number of stations per grid was either one or two stations, and grids along the survey area margins often had zero stations. Past survey stations were retained as much as possible, but others were removed or added to grids as prescribed by the sampling method (Moriyasu et al. 2008).

In 2012, the sampling design was again modified following recommendations from the 2011 Snow Crab Assessment Methods Framework Science Review (DFO 2012). The boundaries of the survey area were extended to the 20 and 200 fathom isobaths, encompassing the vast majority of favorable snow crab habitat (i.e. bottom temperatures less than 5°C) and thus the sGSL biological unit. To further improve spatial homogeneity, grids were set to be square rather than rectangular with dimensions defined as a function of the number of total samples, so that each grid included only a single sampling station (DFO 2012). This protocol resulted in an entirely new set of sampling stations. The revised survey sampling design in 2012 is presented in Wade et al. (2014).

For 2013, the number of stations increased from 325 to 355 following recommendations from the snow crab advisory committee to increase the precision of the biomass estimates in smaller fishing zones. The survey area was partitioned into square grids of 12.7 km x 12.7 km and a new set of sampling stations was generated. In 2014, the number of sampling stations remained at 355. However, the 352 successful sampling stations from the 2013 trawl survey were used as fixed stations in 2014 and a new set of 3 sampling stations (the 3 sampling stations that were abandoned in 2013) was generated randomly.

A new 3-year charter vessel contract was issued to ‘Jean-Mathieu’ that has conducted the trawl survey in the last three seasons.

In the present document, the summary of the survey activities including detailed information on the protocol deployed and characteristics of each tow as well as the catches of snow crab and by-catch species are provided.

SURVEY DESIGN AND PROTOCOL FOR 2016

SURVEY PROTOCOL

The survey protocol (sampling grid setting, target number of stations, and their positions) modified/established was maintained for 2016 from previous years (2012 to 2015) (DFO 2016; Hébert et al. 2016) except when the original position at a given grid was not amenable during the survey in a given year and an alternative position was successful, this alternative position was considered as the original position for the subsequent surveys. The same approach was applied to the 2016 survey.

The survey spatial sampling design for the 2016 season is based on a survey area partitioned into 355 square grids of 12.7 km x 12.7 km (Fig. 1) as in the 2013, 2014 and 2015 surveys. In each grid identified for sampling, a primary station and 3 (three) alternative stations (A1-3) in case that the primary station cannot be trawled were randomly chosen prior to the survey. If the trawl net was damaged while fishing at the primary station (P) and the station was considered untrawlable by the onboard biologist, a tow at the first alternate sampling station (A1) within the same grid was done. If the trawl net was considered as unsuccessful at the first alternative station (A1), a tow was conducted at the second alternate station (A2) up to the third alternative station (A3). If the primary (P) and the three alternative stations (A1 to A3) within a given grid were considered untrawlable, the grid was considered to be untrawlable and no further sampling was done.

Only good tows are considered in the analysis (see Hébert et al. 2016). Bad tows are defined as torn or damaged nets resulting in loss of specimens and/or uncompleted tows due to the weather or sea conditions. In the case when the net has physically performed well but a malfunction of the electronic net sensors occurred (no real net behavior data available), the tow was considered good and the swept area for that tow was estimated as the mean swept area of the nearest 10 neighboring tows which were fully successful.

For the 2014 season, a new attempt for estimating swept area was introduced in order to compare with the traditional method (using mean swept surface of 10 neighboring successful stations) by using a known tow length at each station multiplied by the mean of the net spread in neighboring 10 stations. As no significant difference was observed between two results, we maintained the traditional method (i.e. using mean swept surface of 10 neighboring successful stations when a set of net spread measurements was not available at a given station).

Standard tows were made using a *Nephrops* trawl at a speed of 2 knots with a target-duration of five minutes, based on the time the trawl touches the sea floor as determined by the analysis of hydro acoustic system (Moriyasu et al. 2008). In 2016, Star Oddi® temperature/depth and temperature/depth/tilt sensors (Star Oddi®, Skeidaras 12210 Gardabaer, Iceland) introduced in the previous survey were deployed together with traditionally used with the VEMCO® temperature/depth probes to try to improve the definition of net touch down. The VEMCO® temperature and depth probe is no longer available on the market and the information obtained by these new probes was used to determine the net touch-down by comparing with the VEMCO® probe. The 2016 survey is the last year for which the VEMCO® probes can be used (for the 2016 survey a new battery was inserted into discontinued VEMCO probes, which extended the probe life at least for the 2016 survey). Information about the geometry of the trawl (horizontal spread of the doors and wings, vertical opening of the trawl and depth) was recorded for each tow using hydro acoustic sensors (e-Sonar®). Descriptions of the methodology for estimating the swept surface are provided by Moriyasu et al. (2008).

Trawling was always done during civil twilight time (civil twilight begins prior to sunrise when the geometric center of the sun reaches 6° below the horizon and ends when the geometric center of the sun reaches 6° below the horizon after the sunset). There is enough light from the sun during this period that artificial sources of light may not be needed to carry on outdoor activities; this usually occurs approximately 30 minutes earlier than sunrise and later than sunset.

The sampling protocol calls for the survey to be postponed in the event of adverse weather conditions; i.e., winds above 20 to 25 knot or sea conditions that may hinder the proper maneuverability of the boat.

At all visited sampling stations in 2016, a vertical profile of the water column was made using a newer model of CTD (SeaBird 19 plus®) as a replacement of older model (SeaBird 19 plus®) to obtain the information on the temperature, conductivity (salinity) and pressure (depth) information. The water temperatures are also measured with the Star Oddi® sensors placed on both head and foot rope of the trawl net and with the Vemco® minilog probe placed on the head rope. The water temperature data (Appendix 1) are from the VEMCO® minilog probe attached to the head rope.

For each successful trawl tow, the catch was sorted by species, the number of individuals for fish and invertebrates was recorded, and each tow was photographed (a poster showing photography of catches of each tow superimposed on the map of sGSL is separately presented from this document and a DVD copy is available on demand). Species identifications were made based on taxonomic information in Scott and Scott (1988), Pohle (1990), Squires (1990), and Brunel et al. (1998). Although species identification other than snow crab were recorded since the first year of the survey, the protocol and effort put on species other than snow crab have not been consistent over the years. It is only since 2006 that more complete collection of information on the count per species began and since 2010, size measurements of sub-sampled (maximum of 100 individuals per station) fish species from 100 pre-selected stations was conducted. All other catches were sorted by species or species group, counted, and returned to the sea.

For snow crab, detailed measurements included the carapace width (CW), chela height (for males larger than 40mm in CW only), carapace conditions (1-5: see Hébert et al. 2015 for details), gonad color (for all immature females), egg color, missing legs, and presence/absence of carapace disease and abnormalities such as malformation of carapace and appendices, and cigarette burn (chitinivorous bacteria) and BCD (Bitter Crab Disease).

NET SENSORS

Information about the geometry of the trawl (horizontal spread of the doors and wings, vertical opening of the trawl and depth) was recorded for each tow using hydro acoustic sensors (e-Sonar®). Descriptions of the methodology for estimating the swept surface are provided by Moriyasu et al. (2008). Trawling distances are derived from positions fixed between the start and end of each trawl using a DGPS on the vessel. Trawl widths are measured using trawl monitoring instrumentation which were manufactured by ScanMar®, Netmind®, and more recently e-Sonar®.

Locations of the e-Sonar sensor placement on the trawl are shown in Figure 2. A pair of distance (width) sensors (main and slave) are mounted slightly behind the wing to provide basic protection. The height sensor is mounted at the midpoint of the headline (Fig. 2). Floats are attached to counteract the negative buoyancy of the sensor and to avoid distortion of the headline. The sensors are deployed for all samples during the snow crab survey. They provide data on headline height, distance between the wings and distance from the bottom. A laptop PC on-board the vessel is used to log the data using a program provided by the suppliers.

The e-Sonar system, used since the 2014 survey, records data at seven second intervals. The performance of the trawl is monitored during each tow. By evaluating information from these instruments during the trawling process, the on-board scientist is able to make decisions as to when the trawl reaches the bottom, and the overall quality of the trawl geometry. Because the trawl width sensor needs to be aligned correctly with the transponder on the opposite wing of the trawl, it often occurs that erroneous or very noisy trawl width information is transmitted to the laptop. The readings from the height sensor are generally more consistent than those from the wing spread sensors although they can be very noisy as well at times depending on factors such as bottom type, depth, and terrain profiles. The speed of the trawl through the water or the distance travelled by the trawl was not measured directly. Trawl speed during each sample was deduced from the distance travelled as measured from the ship's DGPS and the duration of the interval. This is assumed to provide the best approximation of the distance travelled by the trawl through the water.

The change in the pre-set maximum measurement range for the depth sensor from 2,000 m to 500 m and height sensor to 0 from 1.5 m (minimum measured value) made in 2014 provided better / clearer determination of net touch down duration (Table 1) (Moriyasu et al. 2015).

TEMPERATURE/DEPTH PROBE FOR SWEPT AREA ESTIMATION

The information on when the net touches the bottom and when the end of tow occurs is a prerequisite for accurate estimation of swept area. A calculation of the swept area by the net at each tow requires an estimate of the distance covered over the sea-floor. On the snow crab surveys, the on-board scientist estimates the time when the net arrives on the sea-floor based on information available from the hydro acoustic instruments. The end of the trawl, or when the trawl is deemed to stop fishing is taken as the time when the warps are hauled. In order to maintain continuity of the survey time series, the same protocol was used since the early years of the survey.

In addition to the hydro acoustic instruments attached to the trawl since the mid-90's, an additional instrument called the 'minilog' sensor (VEMCO®) is attached to the headline of the trawl. It measures depth and temperature at one second intervals and provides much more reliable information on depth than the hydro acoustic data, and is very useful in establishing the touchdown time. However these data are analysed after the trawling operation is completed.

Once the survey is completed, a second estimate of the start time is calculated using information from the minilog sensor. Specifically, the data are analysed to estimate an inflection point in the minilog data depth profile using piecewise linear regression with assumption of having one inflection point. Data from the distance height sensors, depth sensors and the minilog sensors are plotted against time to provide profiles of the approach of the trawl on the bottom. Lines are drawn to indicate the start times and end times based on the scientist on board the vessel and the estimate from breakpoint analysis of the minilog data. The horizontal opening of the trawl provided by the width sensors is also charted. Graphical representation of the track of the boat and its speed over ground are provided.

Production of the traditionally used VEMCO® minilog sensor was discontinued in 2013 and the currently used probes will lose their battery power soon, therefore, new probes i.e. temperature/depth (TD) and temperature/depth/tilt (TDT), (Star Oddi®,Skeidaras 12210 Gardabaer, Iceland) were introduced for the 2014 survey as a replacement of the VEMCO® minilog. In 2014 and 2015, both VEMCO® minilog and Star Oddi® (TD and TDT) sensors were deployed.

The VEMCO® minilog functioned throughout the 2015 survey. For the 2016 survey the exhausted battery in the existing minilog sensors was replaced in house to extend the usability of the sensor. This allows us to extend the period of usage of both sensors so that comparative study can be made between the sensors on biomass estimates.

One Star Oddi® TD was attached to head rope next to VEMCO® minilog and another TD and a TDT were placed into a separate plastic protective housing and placed into stainless steel carrier attached to the footrope of the trawl net (outside of the net) (Fig. 2). TD sensor attached to both head rope and foot rope measure the temperature and pressure (depth) at one second intervals. The TDT sensor attached to the foot rope measures in addition to the temperature and pressure (depth), the tilt angle of the x-axis, y-axis, and z-axis at every second (Moriyasu et al. 2015). All these information's are compiled in a graphical report and then processed individually in order to make a proper selection of the start time based on all the information available. Ultimately these selected start times are used in the calculation of the swept area.

For the 2014 trawl survey, inflection-point models were applied to the data collected by e-Sonar net sensors, a VEMCO® minilog, two Star Oddi® TDs and a TDT to compare the net touch down and subsequent net swept surface. The preliminary analysis obtained (Moriyasu et al. 2015) suggested that the tilt sensor placed on the footrope provided a clearer definition of the net touch down. In addition, the sensors located on the headline seem to have are taking more time to settle compare to the footrope sensors, therefore more prone to giving a wider range of outcomes for start times, as opposed to a sensor located on the footrope. The estimates of start times based on protocols put in place in the late 1990's concur with those estimates from the Star Oddi® probes. The preliminary results obtained during the 2014 and 2015 trawl surveys have shown that the performance of e-Sonar net sensors and Star Oddi® TDT facilitated the determination of net touch down and ensured the continuation of net swept surface estimation without VEMCO® minilog. However, the comparison of the results in net touch down determination between the minilog and the Star Oddi® TDT showed that minilog sensor enabled the determination of the acceptable start time. The replacement of the minlog sensor along with the more advanced post analysis method will ensure a continuation of proper determination of the start time. The swept area estimation for the 2016 survey was done by following traditional protocol using solely a VEMCO® probe as it has been done for the previous surveys.

SURVEY ACTIVITIES IN 2016

VESSEL, PERSONNEL AND ONBOARD TASKS

For the 2016 survey, we continued to use "Jean-Mathieu" (64' 11" in length, 99 t, with a 720 horse power engine and steel hull) introduced in the 2013 survey. The snow crab trawl survey has started in 1988 and four chartered vessels have been used until now:

- side trawler 'Emy-Serge' (64 ft in length with 375 hp engine and wooden hull).from 1988 to 1998,
- stern trawler 'Den C Martin' (64 ft in length with a 402 hp diesel engine and steel hull) from 1999 to 2002,
- stern trawler 'Marco-Michel' (65 ft in length with a 660 hp engine and a fiberglass hull) from 2003 to 2012, and
- stern trawler Jean-Mathieu (64' 11" in length with a 720 hp engine and steel hull).

No catchability comparisons were made during the transitions.

Ghislain Bourgeois took command on "Jean-Mathieu" and there were always five crew members during the survey: Tommy Turbide (winch operator, net repair master, engineer, left door setting), Jocelyn Deveaux (net repairs, crab measurement data recording, helper in by-catch species measurements), Denis Poirier (CTD, net repairs, right door setting), Denis Cormier, a new member for the 2016 survey, (net repairs, helper in by-catch species measurements), and Denis Bénard (cook, net repairs).

Four employees (Pierre DeGrâce, Marc-André McCaie, Marcel Hébert, and Jean-François Landry) from DFO Science participated in the 2016 survey such that there were always at least two DFO Science employees on board at any given time throughout the survey period.

One DFO Science member was responsible for the operation of the e-Sonar®, CTD data recording, measurement of by-catch and determining the tow quality. CTD casting was ensured by Denis Poirier. The second DFO Science member was responsible for the measurement of crabs.

DURATION AND TIMING OF THE SURVEY

The 2016 survey started on July 10 and ended on the October 4 (86 days) (Fig. 3). The starting dates were the same as the last two years, and ending date was ten (10) and seven (7) days earlier than the 2015 and 2014 survey, respectively. It took nine (9) trips (8 in 2015 and 10 in

2014) to complete the survey with each total trip duration varying from 4 to 9 days (3 to 7 sea days) and the number of stations visited varied from 26 (trip II) to 69 (trip III) (Table 2). Approximately fifty two percent (45 days) of the total duration of the survey (87 days) were spent at sea with at least one successful tow, comparable to the previous two years (50/99 days in 2015 and 47/97 days in 2014). In 2016, a serious net damage (the crew cannot repair onboard and need to be done at wharf) occurred 24 times (30 and 20 in 2015 and 2014, respectively) and 2 out of 7 nets were deemed to be unrepairable during the season (3 in 2015 and 1 in 2014). Historical information of the survey timing and duration are summarized in Figure 3. The first tow was meant to be started later than the morning civil twilight time and the last tow earlier than the evening twilight time. However, this year the last tow of the day was later than evening twilight time in 16 occasions out of 45 sea days (Table 3).

SURVEY ITINERARY

There were nine (9) trips for the 2016 survey, departing from different locations (Table 2; Figures 4a to 4i and 5).

- The first trip departed from the port of Cheticamp on July 10 and trawled in the Area 12E and F as well as southernmost 13 grids off St. Georges Bay. The trip was shortened due to mechanical problems of the vessel. The vessel docked in Souris (PE) after three days of work at sea until the following departure on July 15 (Fig. 4a).
- The second trip departed from Souris on July 15 and conducted sampling off Souris and north of the Magdalen Islands including Area 12E and back to Magdalen Islands (Fig. 4b).
- The third trip departed from Magdalen Islands on July 23, sampled off Prince Edward Island following galley towards Area 12E and returned to Souris on July 30. Total of 69 stations were trawled with success and it was the highest number of stations successfully trawled in the 2016 survey (Fig. 4c).
- The fourth trip started from Souris on August 6 and sampled mainly in the west of Bradelle Bank and some stations in the eastern side too then returned to Caraquet NB on August 14 (Fig. 4d).
- The fifth trip departed from Caraquet on August 18 and trawled in Baie des Chaleurs and in the vicinity of the western corner of Area 12E. The vessel returned to Caraquet on August 21 (Fig. 4e).
- The sixth trip departed from Cap-aux-Meules (QC) on Augsut 25 and trawled from the Baie des Chaleurs to northernmost area of the survey off Gaspé peninsula. The vessel returned to Cap-aux-Meules on August 28 (Fig. 4f).
- The seventh trip departed from Cap-aux-Meules September 3 and trawled in Bradelle Bank, and returned to Cap-aux-Meules (Magdalene Islands) on September 7 (Fig. 4g).
- The eighth trip departed from Cap-aux-Meules (Magdalen Islands) on September 15 and trawled the remaining stations in the southern part of Bradelle Bank, one station in Area 18 and Area 19, and returned to Cheticamp on September 21 (Fig 4h).
- The ninth (the last) trip departed from Cheticamp on September 27 and trawled southern part of Magadalen Islands and around the buffer zone (C), around the northern corner of Area 19 as well as the northern part of Area 19. The survey was

completed on October 4 and unloaded equipment on the same day. Strong wind prevented us to continue the survey by losing 3 and half days (Fig 4i).

The comparison in the monthly pattern of the trawl survey among the three years (2014 to 2016) by CFA showed consistency of trawl timing in CFA 12E (August) and in CFA 12F (July in northern portion and October in the southern portion. CFA 19 was visited in October in 2014 and 2015, but in 2016 the southern portion of the CFA was visited in September. In CFA 12 Bradelle Bank area was visited in August-September with small portion in July in 2014 and 2015, however, in 2016 this area was covered exclusively in August-September. Magdalen trough was visited in July in 2016, whereas this area was visited in July and September in 2014 and July-September in 2015 (Fig. 6).

CHARACTERISTICS OF TOWS

A total of 355 grids were visited with 354 grids successfully sampled and one grid which was deemed to be untrawlable (Table 4). A total of 410 tows were attempted in 2016 compared to 423 tows in 2015 and 409 tows in 2014. The 355 grids in the sampling design covered all crab fishing areas (CFA) and the number of grids in each CFA was similar among years. The majority of grids are found in CFA 12 (Fig. 7).

The distribution of samples for CFA 12, E, F and 19 was 298, 13, 18 and 25 stations, respectively (Fig. 8).

Direction of a given trawl depends on the current and/or wind direction and in some cases the starting point falls in the neighboring grid. In 2016, there were 7 vacant/double grids i.e. AG16, AI26, AK28, AR27, AS09, AT10 and AV08 (7 in 2015 and 4 in 2014), (Fig. 8).

Among the 354 completed grids, trawling in 319 grids (303 and 312 in 2015 and 2014, respectively) were completed at the primary stations, whereas trawling in 27 grids (39 and 36 in 2015 and 2014, respectively) was completed at the first alternate station (A1), for 6 grids (10 and 3 in 2015 and 2014, respectively) at the second alternate station (A2) and for 2 grids (1 and 2 in 2015 and 2014, respectively) at the third alternate station (A3). One grid was abandoned after four tow attempts (2 both in 2015 and 2014). There were a total of 56 failed tows in 2016, representing 14% of the total number of tows tried (410). The failed tows were mostly located around Magdalen Islands, off the Gaspe Peninsula, and off Prince Edward Island towards Miscou Island (Fig. 8). In 2015, there were 70 failed tows out of 423 attempts (17%) and in 2014, there were 56 failed tows out of 409 attempts (14%). In grid AH27 (in CFA 19), we trawled the original primary station instead of the successful alternative station in 2015 at which more than 1,000 lobsters were caught (at 40m).

One survey grid (AK13) was deemed to be untrawlable after four attempts, once at the primary station and at each of the three alternate stations. This grid is located north of PEI (Fig. 12). The untrawlable grids have differed among years; AK13 in 2016, AZ10 and AT9 in 2015, AO10 and AS23 in 2014, and AI14, AR26 and AU18 in 2013.

The details of each tow (date, tow number, position, swept area estimation, depth, temperature (measured with a VEMCO® minilog attached to the head rope of the net), catch in number and estimated weight per tow of commercial crabs with carapace conditions 1 to 5 (total commercial crabs) and carapace conditions 3 to 5, quality indicator of each tow, type of successful tow, annual sequence of tow, as well as grid number completed are summarized in Appendix 1.

The depth of the trawl station (measured with the vessel's depth sounder) varied from 33 m to 382 m which was quasi-constant over three years of the survey (33 to 382 m in 2015 and 33 to 384 m in 2014). The bottom temperature at each station varied from -0.5 to 6.2ºC with an average of 1.4ºC (-1.0 to 12.9ºC with an average of 1.3ºC in 2015, -1.3 to 6.2ºC with an average of 0.9ºC in 2014).

HISTORIC CHANGES IN ONBOARD MEASUREMENT OF SNOW CRAB AND OTHER SPECIES

Among the traditionally conducted measurements of previous years, the fifth abdominal width for females was not collected since the 2014 survey, as this morphometric information provides no meaningful information and has never been used so far. Also the shell hardness measurement was dropped as this measurement provides no useful information for the survey which extends for up to four months during which the carapace hardness increases. However, this measurement is valid during commercial fishery in order to identify soft or white crabs in spring fishery (CFA 12, E and F) and fall fishery (CFA 19).

Another measurement ceased since 2014 is onboard weight measurement of hard-shelled, terminally molted commercial sized male crabs with a Marel (Austurhraun 9, IS-210 Gardabaer Iceland) M1100 PL2260 marine scale (maximum weight of 3kg). This measurement was introduced in 2013, however the balance was not appropriate for a smaller vessel like ours and reliable weight measurements of individual snow crab could not be obtained. However, the weight measurement of by-catch species which began in 2013 was continued using a Marel M1100 PL4600 marine scale (max. weight of 60kg).

CATCH OF SNOW CRAB AND OTHER SPECIES

Snow crab

Snow crabs were captured at 324 of 354 grids sampled in 2016 and the total catch was 30,342 individuals, sex and sizes combined. The total number of snow crab caught has increased gradually since 2013 (27,734 in 2015, 24,504 in 2014; 21,621 in 2013). Thirty (30) grids in 2016 had no snow crab catch compared with 30 of 353 grids in 2015, and 33 of 353 grids in 2014. The geographic distribution of grids with no snow crab were the same in 2013 to 2015, occurring mainly along the Laurentian Channel, south of the Magdalen Islands, northeast of Prince Edward Island and between Miscou Island and western PEI (Fig. 9). The number of grids with no commercial-sized male snow crab was 90 in 2016, compared to 98 in 2015 and 99 in 2014.

The historical trends in the mean number per tow of all male snow crab caught (sizes and maturity confounded) and sampled during the surveys are shown in Table 6 and Figure 10. The mean number per tow of male snow crab has fluctuated throughout the time series with notable peak values in 1990 of 72.4 male snow crabs per tow, in 1999 with 70.2 male snow crab per tow, and in 2011 with 46.5 male snow crab per tow. The lowest value was recorded in 2009 at 33.7 male snow crabs per tow. The 1996 value should be disregarded as the survey was only conducted in Area 19 in that year. Of all the male snow crab caught in 2016, 67.2% were immature or adolescent, compared with 75.4% in 2015 and 70.2% in 2014 (Fig. 10).

The total number of commercial-sized male snow crab captured was highest in 2004 at 3,321 individuals and was at its lowest level of 900 individuals in 2009. Since the recent peak of 2,093 individuals in 2012, the number of individuals was 2,896 in 2016 (Table 7). Since 1997, the peak catch of commercial-sized adult male snow crab per tow was in 2004, at approximately 10 crabs per tow (Table 7). In 2016, the number of adult male crab per tow was 8.2 and the second highest value after that in 2004 (9.6). The mean individual weight of commercial-sized adult male in 2016 was 574 grams, lower than the historic average (1997-2015) of 585 g (Table 7).

The estimated density (number per km²) of 2,998 crabs per km² in 2016 is higher than the historic average (1997-2015) of 1,827 crabs per km².

The mean number of females per tow has also fluctuated throughout the time series (Table 8; Fig. 11) with peaks in 1990 of 91.3 females per tow, in 1999 of 62.4 females per tow, and in 2012 of 39.7 females per tow. The lowest value for females was in 2006 at 25.5 females per tow. The 1996 value should be disregarded as the survey was only conducted in Area 19 that year. In 2016, the mean number of females per tow was 31.0 which is below the historic average (1997-2015) of 39.1 females per tow (Table 8). In 2016, the percentage of mature female was 58.5% of total females caught compared to 60.1% in 2015 and 62.8% in 2014 (Fig. 11).

By-catch species (all species)

The information on by-catch species during the 2016 survey and for 2014 and 2015 are summarized in Table 9. Species identifications (Landry et al. 2014; Moriyasu et al. 2015) were established for the snow crab survey in the southern Gulf of St. Lawrence based on Scott and Scott (1988), Pohl (1990), Squires (1990), Brunel et al. (1998), Nozères et al. (2010) and using an unpublished species identification guide developed for the Scotian Shelf snow crab survey.

The list contains a total of 91 species/groups comprised of 58 fish including skate egg capsules, 33 invertebrates including whelk capsules, and two algae. The majority of the invertebrates were not identified to the species level rather gathered into common name groups. From the species list, eel, pollock and gelatinous snail fish, barnacle, Jonah crab, gastropod, and seaweed were either not caught during the surveys or not counted. Kelp was counted as ‘Laminaria’ if any. A total of 28 species/groups of invertebrates (including egg capsules of whelk) and 43 species of fish (including egg capsules of skate) were collected/recorded during the 2016 survey (Table 9).

The most common invertebrate species captured (and counted), by number, were snow crab (30,392 in 2016, 25,915 in 2015, and 32,095 in 2014) followed by shrimp (17,640 in 2016, 8,828 in 2015 and 3,947 in 2014), sea urchin (17,385 in 2016, 14,997 in 2015, and 15,672 in 2014), and sand dollar (10,848 in 2016, 12,220 in 2015, 11,000 in 2014).

For fish species, American plaice had the highest count (37,611) (35,915 in 2015, 32,095 in 2014) followed by redfish (7,694), (1,690 in 2015, and 2,279 in 2014), and cod (2,802), (4,002 in 2015, 5,175 in 2014). The three highest total count species for fish have not changed in the past three years of surveys, whereas for invertebrates, shrimp replaced sand dollar in 2016 (Table 9).

In terms of frequency of observation (presence within 354 or 353 grids sampled) for invertebrates, snow crab was most frequently observed (324, 323 and 320 grids in 2016, 2015 and 2014, respectively) followed by the starfish group (289, 292 and 282 grids in 2016, 2015 and 2014, respectively) and sea urchin (219 in 2016, 202 in 202 and 214 in 2014) (Table 9).

For fish species, American plaice (331, 331 and 323 grids in 2016, 2015 and 2014, respectively), cod (239, 252 and 243 grids in 2015, 2014 and 2013, respectively) and Arctic staghorn sculpin (134, 137 and 126 grids in 2016, 2015 and 2014, respectively) were the most frequently observed species. The highest catch species for both invertebrates (snow crab) and fish groups (American plaice) has not changed in the past three years of the survey.

By-catch of sedentary invertebrate species

With changes in sampling coverage and survey vessel as well as the length of the survey (longer than three months), it is very difficult to interpret the historical catch data of by-catch species especially for fish species and other migratory species. However, the catches of sedentary benthic invertebrate species should be efficiently caught by a *Nephrops* trawl net that digs into the sediment and these catch trends may be used as an indication of the relative performance of the gear, assuming equal relative abundance over time of these species.

By-catch of sedentary/benthic invertebrate species or groups of species which are always present in the catch since the early 1990's include a number of crustaceans (hermit crab, northern stone crab, lobster, rock crab, toad crab), echinoderms (basket star, sand dollar, sea cucumber, sea potato, starfish, sea urchin), mollusks (clams, mussels, octopus/squid, scallop, whelk), annelids (sea mouse, sea worms), and cnidarians (sea anemone). In the present document, jellyfish is not plotted as they are not considered to be benthic/sedentary species.

Among these 21 sedentary/benthic invertebrate species or groups, it is noteworthy that a continuous increase in catch number is observed in basket star and sea potato, wheras opposite trend observed in *Hyas* (toad crab comprised of *H. araneus* and *H. coarctatus*) (Fig. 12). Further in-depth analysis is necessary to elucidate the fluctuation pattern of these species/groups of species.

Collecting data on by-catch species is important to monitor and understand the ecosystem and habitat of snow crab. These oceanographic and biological data are essential sources of information to monitor and understand changes in the ecosystem that will certainly be issues with climate change. In coming years, DFO intends to add the collection of surface and bottom water at selected stations to measure ocean acidity that could have an impact on organisms, including snow crab.

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Table 1. Information on the total number of data set used, mean door spread with standard deviation of door spread, sonar type and survey vessel from 2010 to 2016.

Survey year	Count[1]	Mean Door Spread (m)[1]	Standard Deviation of Door Spread (m)	Mean swept surface (m²)	Sonar Type	Trawl Vessel
2010	331	8.40	1.78	2,734	NetMind	Marco-Michel
2011	302	8.45	2.44	2,708	NetMind	Marco-Michel
2012	281	8.71	1.61	2,677	NetMind	Marco-Michel
2013	281	8.19	1.48	2,600	e-Sonar	Jean-Mathieu
2014	338	7.89	1.54	2,600	e-Sonar[2]	Jean-Mathieu
2015	321	7.93	1.64	2,707	e-Sonar[2]	Jean-Mathieu
2016	321	8.30	1.73	2,763	e-Sonar[2]	Jean-Mathieu

[1] Estimation was made using only good tows with usable door spread and tow distance information.

[2] Using decreased door spread setting, maximum measured values from 150 m to 30 m.

Table 2. Survey performance statistics (duration of each trip, number of days at sea, number of station visited, number of successful tows at primary station, number of tows succeeded at alternative station(s), number of abandoned grids and frequency of serious net damage) for the 2016 trawl survey in comparison with previous surveys in 2015 and 2014.

	Trip Number										
Statistics	I	II	III	IV	V	VI	VII	VIII	IX	X	Total
2016											
Duration (day) of each trip	4	4	8	9	4	5	5	7	8	na	54
Number of days at sea (day)	2	3	7	9	4	5	5	4	5	na	44
Number of stations visited	27	26	69	68	28	30	42	27	38	na	355
Tows completed at primary station	27	22	58	60	24	26	38	27	36	na	318
Tows completed at 1st alternate station	0	4	6	7	4	4	1	0	2	na	28
Tows completed at 2nd alternate station	0	0	3	1	0	0	2	0	0	na	6
Tows completed at 3rd alternate station	0	0	0	0	0	0	1	0	0	na	1
Number of untrawlable grids	0	0	0	0	0	0	1	0	0	na	1
Number of tows with serious net damage	0	1	4	2	3	4	9	0	1	na	24
2015											
Duration (day) of each trip	6	14	12	10	8	8	10	13	na	na	81
Number of days at sea (day)	3	8	7	6	5	6	6	9	na	na	50
Number of stations visited	17	51	69	40	24	34	50	70	na	na	355
Tows completed at primary station	13	43	56	32	18	27	46	68	na	na	303
Tows completed at 1st alternate station	4	5	8	5	4	7	3	2	na	na	38
Tows completed at 2nd alternate station	0	2	4	3	1	0	1	0	na	na	11
Tows completed at 3rd alternate station	0	0	0	0	1	0	0	0	na	na	1
Number of untrawlable grids	0	1	1	0	0	0	0	0	na	na	2
Number of tows with serious net damage	1	3	3	4	11	3	3	2	na	na	30
2014											
Duration (day) of each trip	7	8	8	9	6	7	5	5	11	4	70
Number of days at sea (day)	6	5	6	6	5	3	4	3	7	2	47
Number of stations visited	39	45	40	42	50	24	24	19	54	18	355
Tows completed at primary station	28	40	35	40	46	23	21	14	47	18	312
Tows completed at 1st alternate station	10	4	5	2	2	1	3	2	7	0	36
Tows completed at 2nd alternate station	0	0	0	0	0	0	0	3	0	0	3
Tows completed at 3rd alternate station	0	1	0	0	1	0	0	0	0	0	2
Number of untrawlable grids	1	0	0	0	1	0	0	0	0	0	2
Number of tows with serious net damage	3	3	3	1	3	0	0	1	6	0	20

Table 3. Start and end time of daily fishing operations and corresponding morning (mCtwt) (sunrise) and evening (eCtwt; sunset) civil twilight times during the 2015 trawl survey. Civil twilight times were for Charlottetown, PE (46º 39' N, 63º 13' W) based on Sunrise/sunset calculator - National Research Council Canada.

Trip number	Date	First tow	mCtwt	Last tow	eCtwt
1	July 10 2016	05:06	04:52	19:14	21:44
1	July 11 2016	05:01	04:53	n/a	21:43
1	July 13 2016	05:00	04:55	20:00	21:42
2	July 16 2016	05:13	04:58	19:26	21:39
2	July 17 2016	05:39	05:00	n/a	21:38
2	July 18 2016	05:08	05:01	20:29	21:37
3	July 24 2016	05:10	05:08	n/a	21:30
3	July 25 2016	05:16	05:09	20:35	21:29
3	July 26 2016	05:22	05:11	19:50	21:27
3	July 27 2016	05:18	05:12	20:00	21:26
3	July 28 2016	05:22	05:13	19:32	21:24
3	July 29 2016	05:32	05:15	n/a	21:23
3	July 30 2017	05:31	05:16	17:05	21:22
4	Aug 6 2016	16:22	05:26	18:50	21:11
4	Aug 7 2016	05:46	05:27	20:45	21:09
4	Aug 8 2016	07:04	05:29	09:38	21:07
4	Aug 9 2016	12:04	05:30	19:58	21:06
4	Aug 10 2016	05:58	05:31	19:10	21:04
4	Aug 11 2016	05:59	05:33	19:03	21:02
4	Aug 12 2016	06:06	05:34	19:32	21:01
4	Aug 13 2016	06:05	05:36	19:19	20:59
4	Aug14 2016	06:14	05:37	11:41	20:57
5	Aug 18 2016	16:58	05:43	18:38	20:50
5	Aug 19 2016	06:15	05:44	18:30	20:48
5	Aug 20 2016	06:16	05:45	19:04	20:46
5	Aug 21 2016	06:26	05:47	19:19	20:44
6	Aug 24 2016	06:26	05:51	20:09	20:38
6	Aug 25 2016	06:30	05:52	19:34	20:36
6	Aug 26 2016	06:32	05:54	17:47	20:34
6	Aug 27 2016	16:43	05:55	19:37	20:32
6	Aug 28 2016	06:34	05:56	15:48	20:30
7	Sep 3 2016	06:39	06:05	19:25	20:18
7	Sep 4 2016	06:33	06:06	19:36	20:16
7	Sep 5 2016	06:38	06:07	19:43	20:14
7	Sep 6 2016	06:37	06:09	18:49	20:12
7	Sep 7 2016	06:38	06:10	09:30	20:10
8	Sep 16 2016	06:59	06:22	13:34	19:52
8	Sep 19 2016	06:59	06:26	17:13	19:46
8	Sep 20 2016	06:50	06:27	18:15	19:44
8	Sep 21 2016	06:52	06:29	06:52	19:42
9	Sep 28 2016	07:00	06:38	15:32	19:28
9	Sep 30 2016	12:19	06:41	17:10	19:24
9	Oct 1 2016	06:55	06:42	18:19	19:22
9	Oct 2 2016	07:08	06:43	18:39	19:20
9	Oct 4 2016	09:08	06:46	17:31	19:16

Table 4. Number of grids sampled in total and by tow characteristics (TC) for surveys in 1997 to 2016.Tow information labels are as follows: TC1 = successful trawl catch with acceptable area swept data at primary station; TC2 = successful trawl catch with unusable area swept data; TC3 = successful tow at the first alternative station (A1) with acceptable area swept data; TC4 = successful tow at the first alternative station (A1) with unusable area swept data, TC5 = successful tow at the second alternative station (A2) with acceptable area swept data, TC6 = successful tow at the second alternative station (A2) with unusable area swept data, TC7 = successful tow at the third alternative station (A3) with acceptable area swept data, TC8 = successful tow at the third alternative station (A3) with unusable area swept data, TC9 = unsuccessful tows and grid deemed to be untrawlable.

Survey year	Total successful tows	Primary		A1		A2		A3			Total tows attempted
		TC1	TC2	TC3	TC4	TC5	TC6	TC7	TC8	TC9	
1997	259	190	51	15	3	0	0	0	0	0	277
1998	261	152	95	9	3	1	1	0	0	0	277
1999	277	127	127	14	6	1	2	0	0	0	303
2000	280	232	30	10	1	6	0	0	0	0	302
2001	292	253	15	13	7	1	2	1	0	0	321
2002	319	285	13	15	4	1	1	0	0	0	342
2003	317	283	10	13	1	6	1	3	0	0	354
2004	333	271	46	4	5	6	0	1	0	0	357
2005	344	290	11	32	3	8	0	0	0	0	395
2006	354	294	34	17	1	8	0	0	0	1	395
2007	355	294	31	13	3	12	1	1	0	0	400
2008	355	284	37	23	0	8	1	2	0	0	402
2009	355	293	39	10	0	11	1	0	0	0	388
2010	354	285	32	23	7	7	0	0	0	1	401
2011	353	274	46	24	3	3	2	1	0	2	401
2012	321	220	50	36	5	7	1	2	0	4	400
2013	352	230	52	45	13	10	1	1	0	3	447
2014	353	295	17	36	0	2	1	2	0	2	409
2015	353	275	28	36	3	9	1	1	0	2	423
2016	354	292	27	27	0	6	0	2	0	1	410

Table 5. Number of mature and immature males captured during the survey, mean number of immature, mature, and total male crabs per tow (unadjusted for swept area), and estimated mean density (number per km²) of total (mature and immature) male crabs during 1997 to 2016.

	Total counts		Crabs/tow			Mean density
Year	Immature	Mature	Immature	Mature	Total	(number per km²)
1997	10,996	3,134	42.5	12.1	54.6	24,322
1998	12,300	3,848	47.1	14.7	61.8	26,563
1999	13,948	5,489	50.4	19.8	70.2	28,035
2000	13029	5,249	46.5	18.8	65.3	23,779
2001	12,962	5,405	44.4	18.5	62.9	23,208
2002	10,574	5,500	33.1	17.2	50.3	20,417
2003	11,468	6,301	36.2	19.9	56.1	19,613
2004	10,424	6,655	30.0	19.2	49.2	15,424
2005	8,590	4,910	24.2	13.8	38.0	13,863
2006	7,923	4,364	22.4	12.3	34.7	12,252
2007	8,279	3,964	23.3	11.2	34.5	12,602
2008	8,705	3,502	24.5	9.9	34.4	13,007
2009	9,030	2,954	25.4	8.3	33.7	11,954
2010	12,514	3,800	35.4	10.7	46.1	16,818
2011	11,316	5,073	32.1	14.4	46.5	16,959
2012	10,019	4,778	31.2	14.9	46.1	17,036
2013	8281	3,961	23.5	11.3	34.8	13,383
2014	9736	4,129	27.6	11.7	39.3	15,228
2015	11,498	3,755	32.6	10.6	43.2	16,317
2016	11,427	5,452	32.3	15.4	47.7	17,332

Table 6. Number of commercial-sized (>= 95 mm carapace width) adult male crabs captured during the survey, mean number of crabs per tow (unadjusted for swept area), estimated mean weight of commercial-sized adult crab, and estimated mean density (number per km²) of commercial crab, 1997 to 2016.

Year	Number of crabs sampled	Crabs per tow	Mean weight (g)	Mean density (number per km²)
1997	1,335	5.2	600	2,383
1998	1,419	5.4	596	2,258
1999	1,472	5.3	563	2,166
2000	1,346	4.8	587	1,798
2001	1,724	5.9	540	2,168
2002	1,913	6.0	546	2,530
2003	2,682	8.5	560	3,150
2004	3,321	9.6	577	3,221
2005	2,327	6.8	585	2,656
2006	2,302	6.5	616	2,558
2007	1,911	5.4	610	2,252
2008	1,431	4.0	611	1,787
2009	900	2.5	610	1,029
2010	1,057	3.0	607	1,280
2011	1,970	5.6	584	2,036
2012	2,093	6.5	566	2,359
2013	1,886	5.4	596	1,994
2014	1,884	5.3	581	2,011
2015	1,741	4.9	584	1,784
2016	2,896	8.2	574	2,998

Table 7. Number of mature and immature females captured during the survey, mean catch number of immature, mature and total female crabs per tow (unadjusted for swept area), and estimated mean density (number per km²) of female crab (mature and immature combined) during 1997 to 2016.

	Total counts		Mean catch per tow			Density
Year	Immature	Mature	Immature	Mature	Total	(number per km²)
1997	7,577	6,663	29.3	25.7	55.0	23,975
1998	7,176	7,753	27.5	29.7	57.2	24,486
1999	6,168	11,109	22.3	40.1	62.4	24,792
2000	3,966	11,168	14.2	39.9	54.1	19,931
2001	1,746	12,128	6.0	41.5	47.5	17,696
2002	1,610	10,775	5.0	33.8	38.8	15,246
2003	2,655	10,677	8.4	33.7	42.1	14,534
2004	3,366	9,578	9.7	27.6	37.3	12,129
2005	3,718	6,633	10.5	18.7	29.2	10,611
2006	4,527	4,490	12.8	12.7	25.5	9,062
2007	5,489	5,069	15.5	14.3	29.8	10,716
2008	5,063	4,969	14.3	14.0	28.3	10,649
2009	4,590	5,118	12.9	14.4	27.3	9,680
2010	5,983	7,841	16.9	22.2	39.1	14,079
2011	5,467	7,866	15.5	22.3	37.7	13,796
2012	5,271	7,470	16.4	23.3	39.7	14,690
2013	3,055	6,231	8.7	17.7	26.4	10,062
2014	3,939	6,700	11.2	19.0	30.2	11,404
2015	4,904	7,398	13.9	21.0	34.9	12,822
2016	5,547	5,453	15.6	15.4	31.0	11,294

Table 8. *Summary of total catches (by number and total weight in kg) by species of invertebrates and fish, and number of grids sampled where the species were present in the catches of the survey in 2014 to 2016. *Identified only to group, not to genus or species. A dash indicates no catch except for snow crab for which total weights are not recorded (individual weight can be estimated based on size-weight relationship (Hébert et al. 2016).*

		2016			2015			2014		
Species common name	Latin name	Count	Grids	Weight (kg)	Count	Grids	Weight(kg)	Count	Grid	Weight (kg)
Invertebrates										
Anemone*	Actiniaria	993	81	168	1,984	74	154	990	65	187
Basket star	*Gorgonocephalus sp*	3,548	153	731	3,326	137	690	2,525	132	522
Brittle star*	Ophiuroidea	15	11	415	445	15	251		14	389
Hermit crab*	*Pagurus sp.*	437	111	15	469	115	17	509	111	17
Toad Crab (Hyas araneus)	*Hyas araneus*	617	78	74	597	82	70	352	81	42
Toad Crab (H. coarctatus)	*Hyas coarctatus*	2,127	167	143	1,610	168	111	1,326	154	93
Iceland clam	*Clinocardium islandicum*	542	29	21	1,121	19	49	45	11	3
Jellyfish*	*Atolla sp.*	44	42	57	-	-	-	7	1	< 1
Lobster	*Homarus americanus*	27	11	7	1,283	11	342	59	5	20
Mussel*	*Mytilidae*	-	-	-	10	5	687	-	-	-
Northern stone crab	*Lithodes maja*	91	32	32	71	30	30	113	28	37
Octopus/Bobtail squid*	*Rossia spp, Bathypolypus bairdii*	6	6	1	19	11	1	5	5	< 1
Quahog	*Arctica islandica*	62	7	2	192	17	10	277	10	14
Rock crab	*Cancer irroratus*	39	7	3	209	8	19	38	7	4
Sand dollar	*Echinarachnius parma*	10,848	82	208	12,220	74	247	11,000	87	315
Scallop	*Placopecten magellanicus*	120	39	11	77	19	6	33	16	3
Sea cucumber*	Holothuroidea	1,061	62	726	461	66	172	711	82	334
Sea mouse	*Aphrodita hastate*	14	8	1	15	6	2	10	3	< 1
Sea potato	*Boltenia ovifera*	2,782	92	303	1,831	101	190	1,619	72	170
Sea urchin*	*Strongylocentrotus sp.*	17,385	219	653	14,997	202	582	15,672	214	748
Sea worm*	*Polychaeta sp.*	3	3	0	1	1	< 1	1	1	< 1
Shrimp*	*Decapoda*	17,640	100	71	8,828	95	46	3,947	75	44
Snow crab	*Chionoecetes opilio*	30,290	-	na	27,734	323	na	24,504	320	-
Soft shelled clam	*Mya arenaria*	1	1	0	-	-	-	-	-	-
Sponge*	*Porifera*	12	50	147	20	41	80	85	30	47
Squid	*Illex illecebrosus*	1	1	0	-	-	-	2	2	< 1
Starfish*	Asteroidea	6,636	289	745	8,076	291	533	3,976	282	548
Whelk*	Buccinidae	874	169	31	710	154	30	858	148	31
Whelk eggs*	Buccinidae	298	42	10	106	38	6	97	35	4
Fish										
Alewife	*Alosa pseudoharengus*	-	-	-	1	1	< 1	-	-	-
American plaice	*Hippoglossoides platessoides*	37,611	333	2,831	35,915	331	3,012	32,095	323	2,734
Arctic hookear sculpin	*Artediellus uncinatus*	-	-	-	-	-	-	8	2	1
Arctic stughorn sculpin	*Gymnocanthus tricuspis*	778	134	69	834	137	59	772	126	58
Atlantic alligatorfish	*Aspidophoroides monopterygius*	310	57	2	151	52	2	53	28	1
Atlantic cod	*Gadus morhua*	2,802	208	1,363	4,002	239	1,502	5,175	252	2,207
Atlantic eelpout	*Lycodes terraenovae*	3	3	1	5	3	1	10	9	3
Atlantic hookear sculpin	*Artediellus atlanticus*	4	3	0	1	1	< 1	12	3	1
Atlantic poacher	*Leptagonus decagonus*	200	74	6	211	60	7	230	75	6

Species common name	Latin name	2016			2015			2014		
		Count	Grids	Weight (kg)	Count	Grids	Weight(kg)	Count	Grid	Weight (kg)
Atlantic wolf fish	*Anarhichas lupus*	8	6	5	12	6	6	77	32	3
Capelin	*Mallotus villosus*	148	23	2	184	10	2	684	32	10
Common wolf eel	*Lycenchelys paxillus*	3	2	0	5	5	2	9	7	3
Dogfish	*Centroscyllium fabricii*	-	-	-	3	2	1	8	3	4
Doubed shanny	*Leptoclinus maculatus*	-	-	-	1	1	< 1	1	1	< 1
Four-beareded rockling	*Enchelyopus cimbrius*	53	21	2	52	23	3	44	20	2
Fourline skate blenny	*Eumesogrammus praecisus*	115	28	4	59	31	3	77	32	3
Greenland halibut	*Reinhardtius hippoglossoides*	52	27	36	68	25	34	62	20	29
Grubby sculpin	*Myoxocephalus aenaeus*	-	-	-	8	6	6	47	15	5
Haddock	*Melanogrammus aeglefinus*	3	2	2	10	3	8	6	3	4
White Hake	*Urophycis tenuis*	420	42	139	361	38	136	289	26	89
Halibut	*Hippoglossus hippoglossus*	11	9	55	9	9	67	11	10	30
Herring	*Clupea harengus*	33	8	4	241	23	30	104	8	17
Laval's eelpout	*Lycodes lavalaei*	155	80	65	171	94	70	112	73	41
Longfin hake	*Phycis chesteri*	19	8	3	73	9	9	78	8	8
Longhorn Sculpin	*Myoxocephalus octodecemspinosus*	164	46	18	210	36	26	165	32	22
Lumpfish	*Cyclopterus lumpus*	2	2	1	4	4	1	3	3	2
Mackerel	*Scomber scombrus*	-	-	-	2	2	< 1	-	-	-
Monkfish	*Lophius americanus*	7	6	1	3	3	17	2	2	4
Moustache sculpin	*Triglops murrayi*	422	104	8	281	73	5	31	16	1
Redfish	*Sebastes sp.*	7,694	62	701	1,690	75	209	2,279	77	291
Rock cod	*Gadus ogac*	91	8	43	49	10	20	51	17	18
Roundnose grenadier	*Nezumia bairdii*	591	26	22	409	24	13	388	22	14
Sea raven	*Hemitripterus americanus*	14	8	5	30	9	15	14	8	6
Sea tadpole	*Careproctus reinhardti*	4	3	0	2	2	< 1	3	3	< 1
Shorthorn Sculpin	*Myoxocephalus scorpius*	199	67	44	119	41	23	146	46	19
Silver hake	*Merluccius bilinearis*	24	11	6	16	8	5	18	11	4
Skate eggs*	*Rajidae egg case*	132	11	2	23	3	< 1	7	3	< 1
Smelt	*Osmerus mordax*	-	-	-	218	27	3	1	1	< 1
Smooth skate	*Malacoraja senta*	111	41	69	117	34	59	99	26	52
Snake blenny	*Lumpenus lampretaeformis*	120	25	4	124	27	3	165	23	3
Spatulate sculpin	*Icelus spatula*	45	15	1	19	3	1	74	33	2
Spiny lump sucker	*Eumicrotremus spinosus*	19	14	1	58	42	3	29	25	1
Spotted wolf fish	*Anarhichas minor*	-	-	-	2	1	< 1	-	-	-
Stout eel blenny	*Anisarchus medius*	34	20	0	3	1	< 1	-	-	-
Thorny skate	*Amblyraja radiata*	528	79	184	520	68	188	359	76	180
Two horn sculpin	*Icelus bicornis*	159	38	2	167	41	4	134	34	3
Variegated snailfish	*Liparis gibbus*	40	20	4	723	59	40	283	40	17
Winter flounder	*Pseudopleuronectes*	188	7	15	542	11	52	118	9	18
Winter skate	*Leucoraja ocellata*	1	1	2	2	1	< 1	11	10	14
Witch flounder	*Glyptocephalus cynoglossus*	967	83	291	724	75	199	859	85	230
Wolf eelpout	*Lycenchelys verrillii*	-	-	-	1	1	2	-	-	-
Wrymouth	*Cryptacanthodes maculatus*	-	-	-	1	1	< 1	-	-	-
Yellowtail flounder	*Limanda ferruginea*	1,273	92	90	2,236	74	133	1,314	77	84

FIGURES

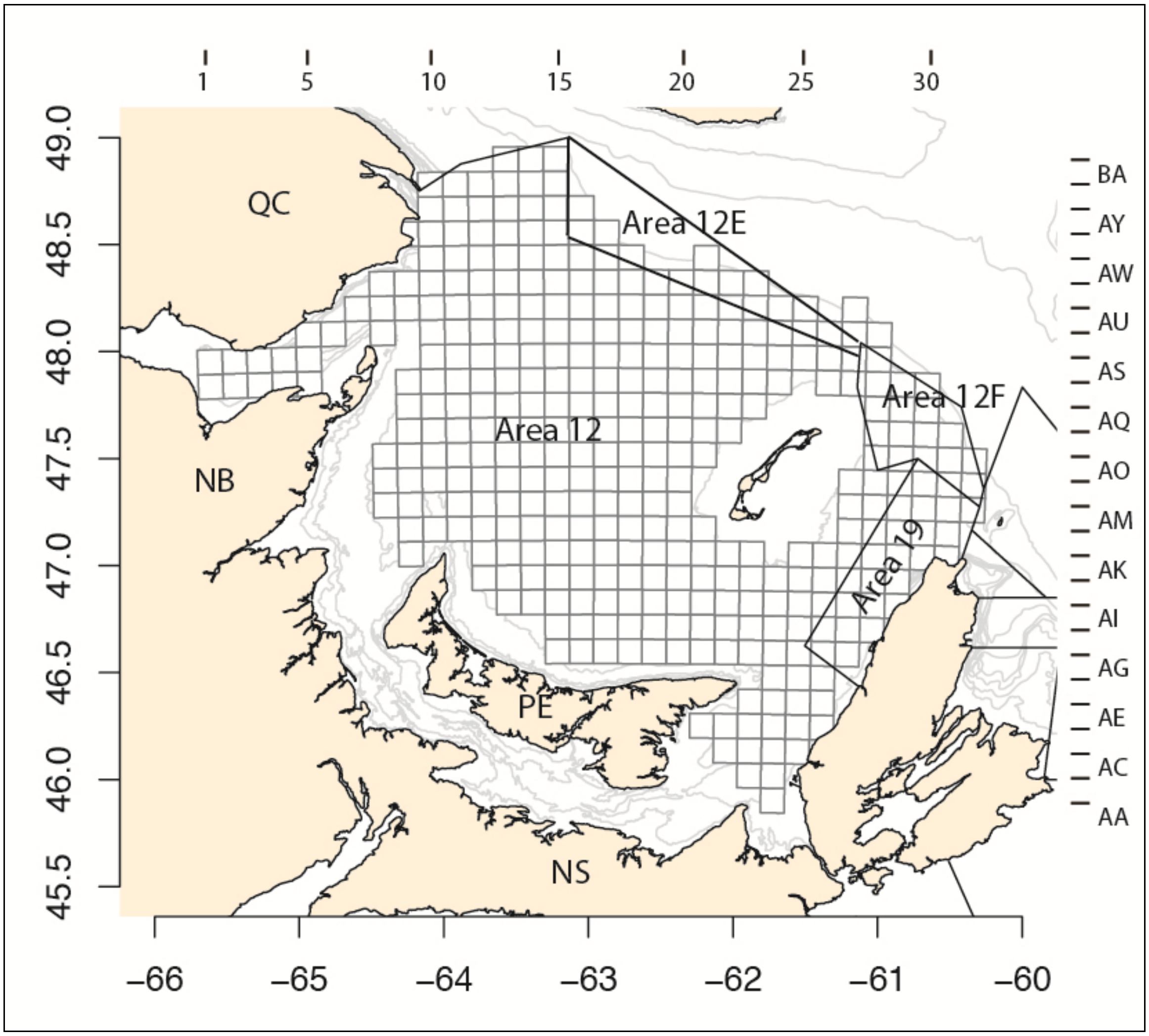


Figure 1. Snow crab trawl survey grid sampling design for the southern Gulf of St. Lawrence deployed since 2013. There are a total of 355 sampling grids defined by squares measuring 12.7 by 12.7 kilometres.

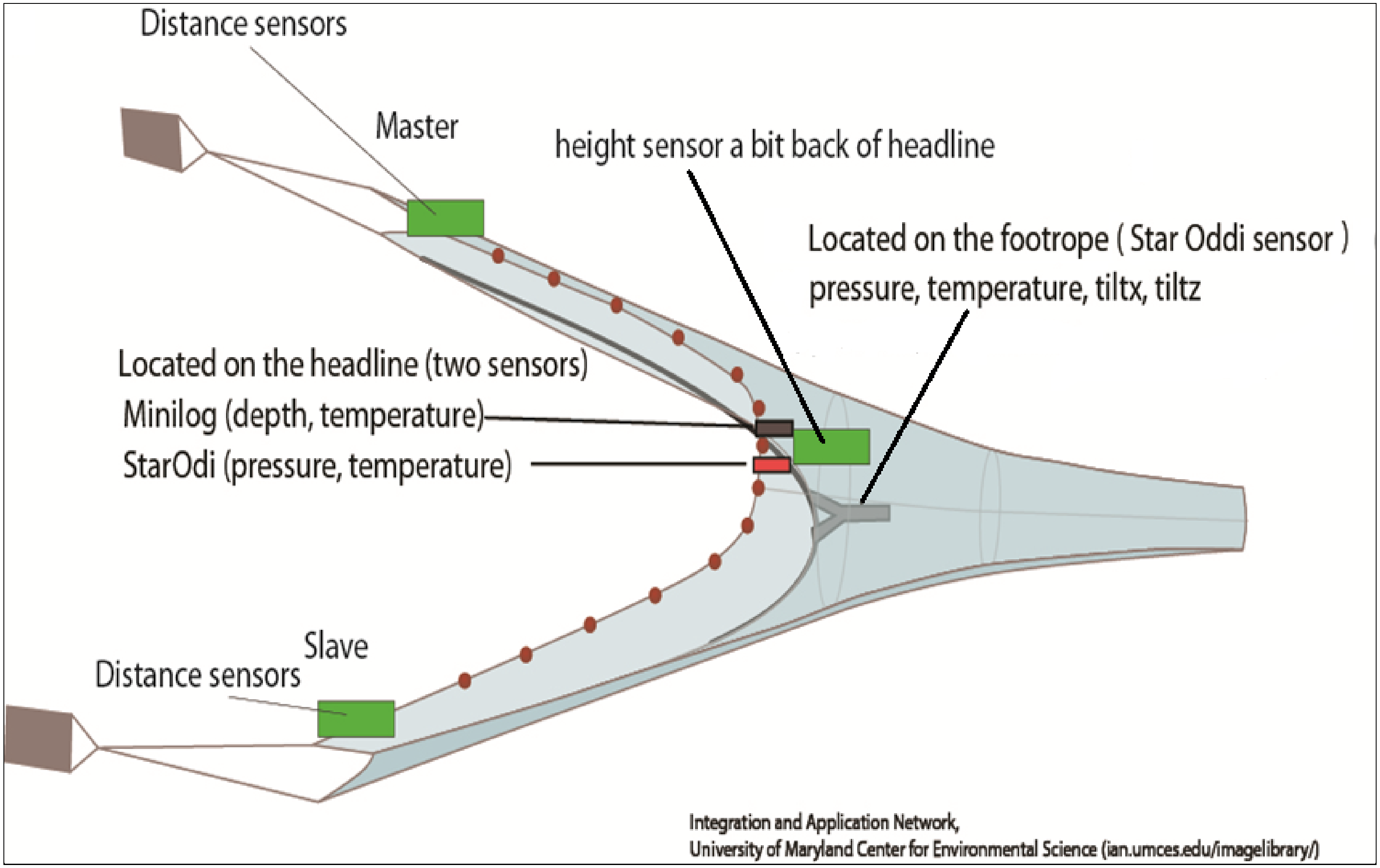
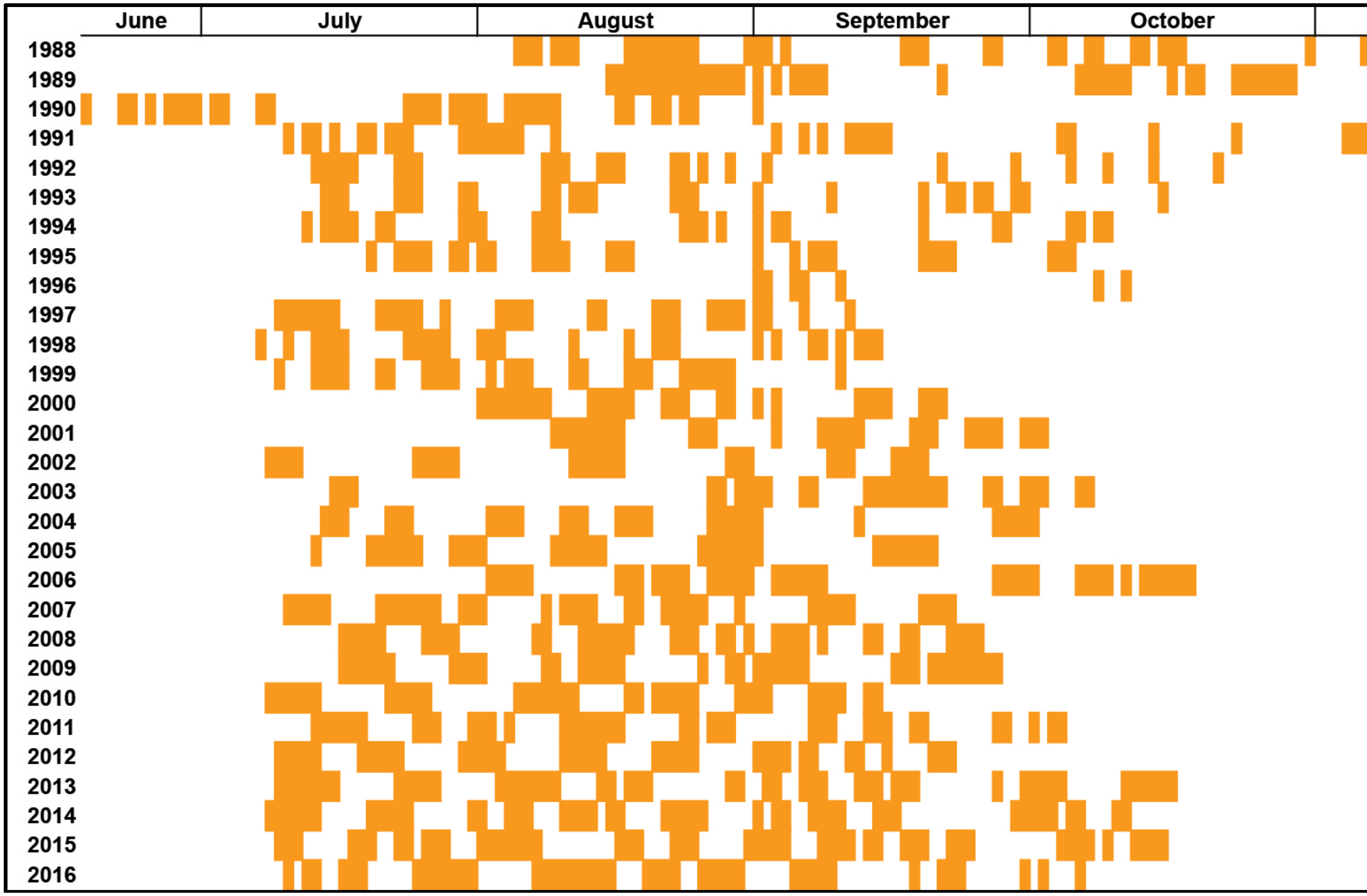


Figure 2. Schematic view of the various sensors deployed for the 2016 snow crab bottom trawl survey; e-Sonar net sensors (a pair of distance sensors and height sensor), Star Oddi temperature/depth sensors, and temperature/depth/tilt sensor together with a Vemco mini-log temperature/depth sensor.



Year	days	stations	stations/day
1988	34	154	4.53
1989	38	155	4.08
1990	33	212	6.42
1991	32	215	6.72
1992	25	233	9.32
1993	26	208	8.00
1994	27	259	9.59
1995	28	261	9.32
1996	7	72	10.29
1997	30	259	8.63
1998	27	261	9.67
1999	27	277	10.26
2000	27	280	10.37
2001	27	292	10.81
2002	25	319	12.76
2003	27	317	11.74
2004	29	347	11.97
2005	31	355	11.45
2006	39	354	9.08
2007	37	355	9.59
2008	36	355	9.86
2009	37	355	9.59
2010	35	354	10.11
2011	38	352	9.26
2012	37	321	8.68
2013	49	352	7.18
2014	45	353	7.84
2015	50	353	7.06
2016	45	354	7.87

Figure 3. Timing and duration of the snow crab bottom trawl surveys, 1988 to 2016.

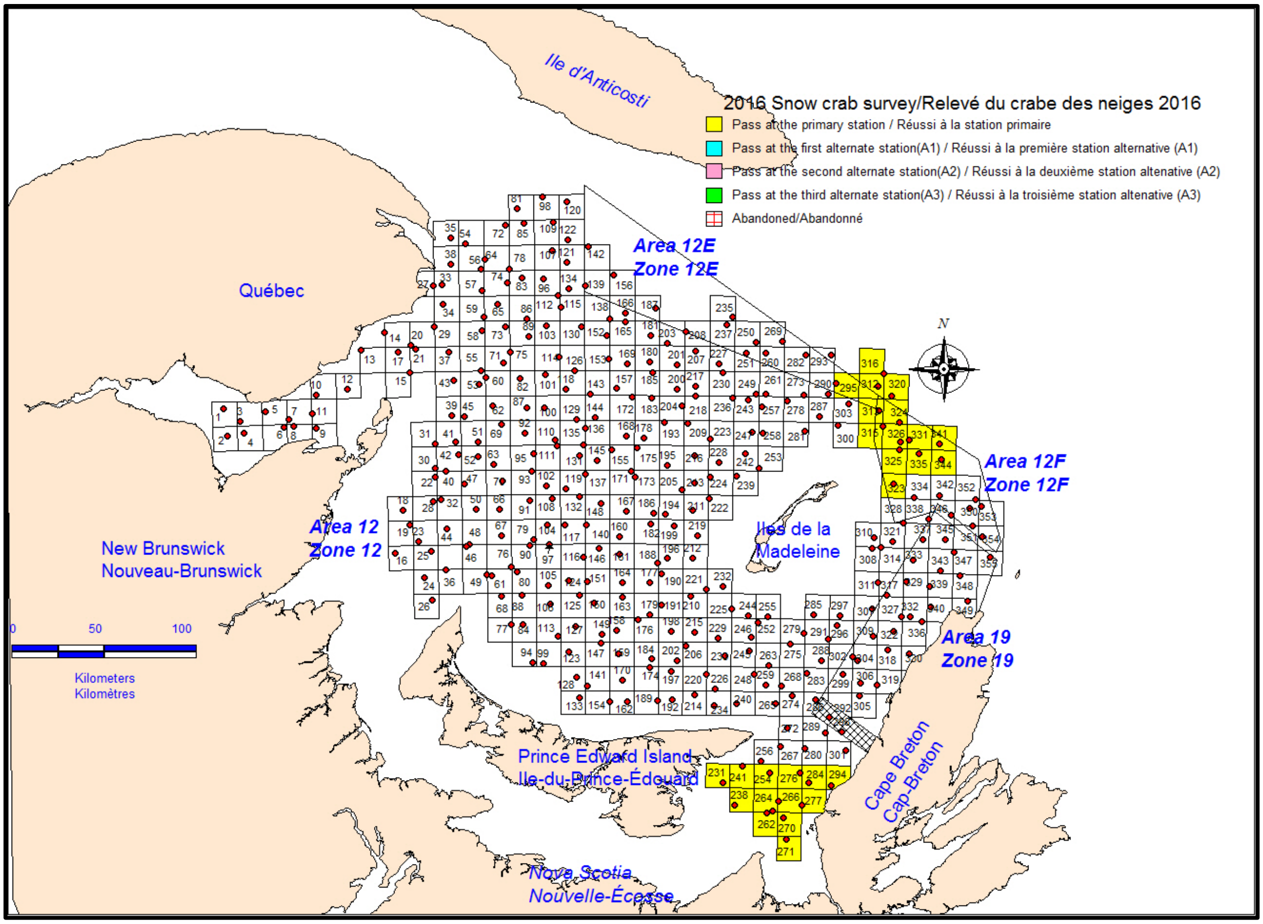


Figure 4a. The first trip departed from the port of Cheticamp on July 10 and trawled in the Area 12E and 12F as well as southernmost 13 grids off St. Georges Bay. The trip was shortened due to mechanical problems of the vessel. The vessel docked in Souris (PE) after three days of work at sea until the following departure on July 15.

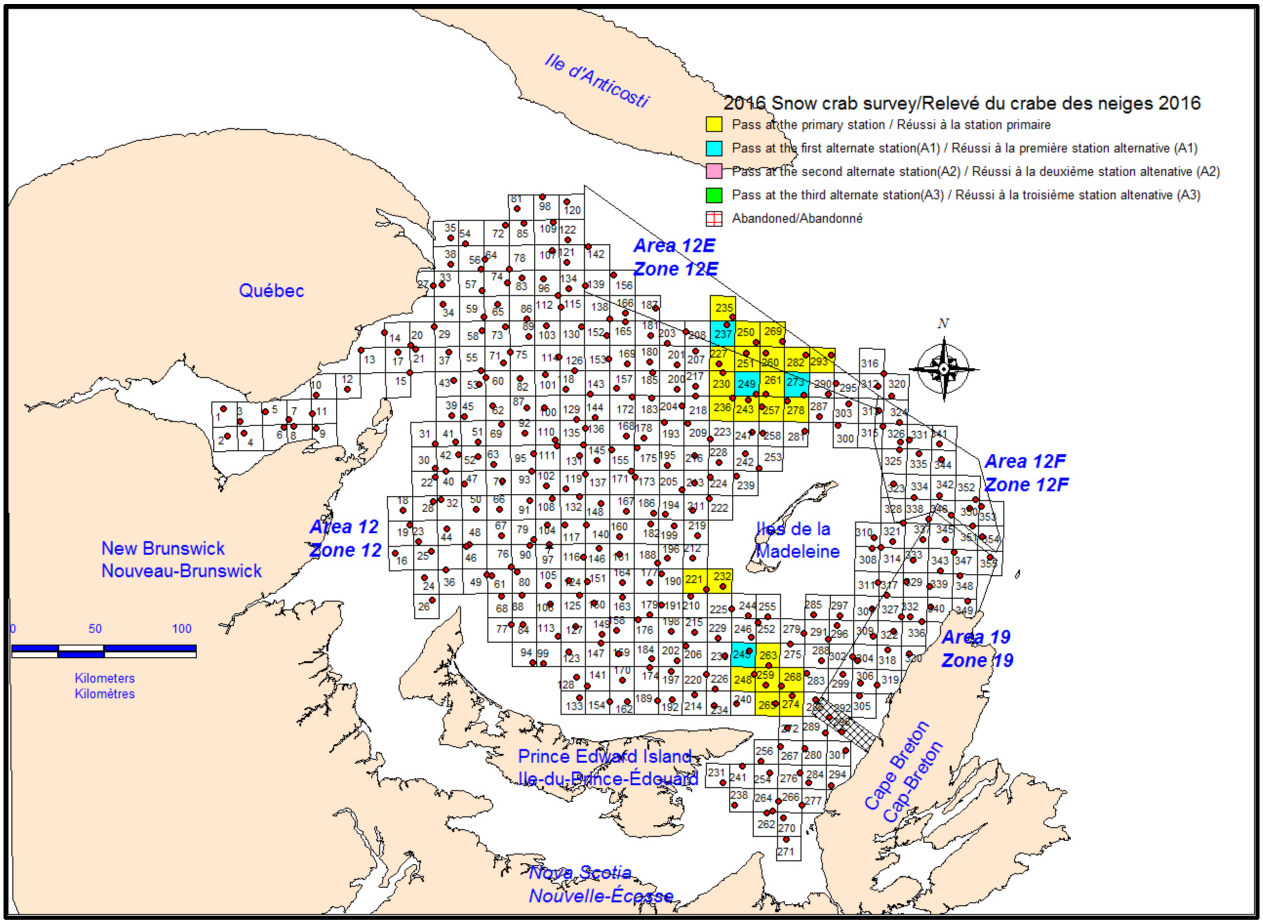


Figure 4b. The second trip departed from Souris on July 15 and conducted sampling off Souris and north of the Magdalen Islands including Area 12E and back to Magdalen Islands.

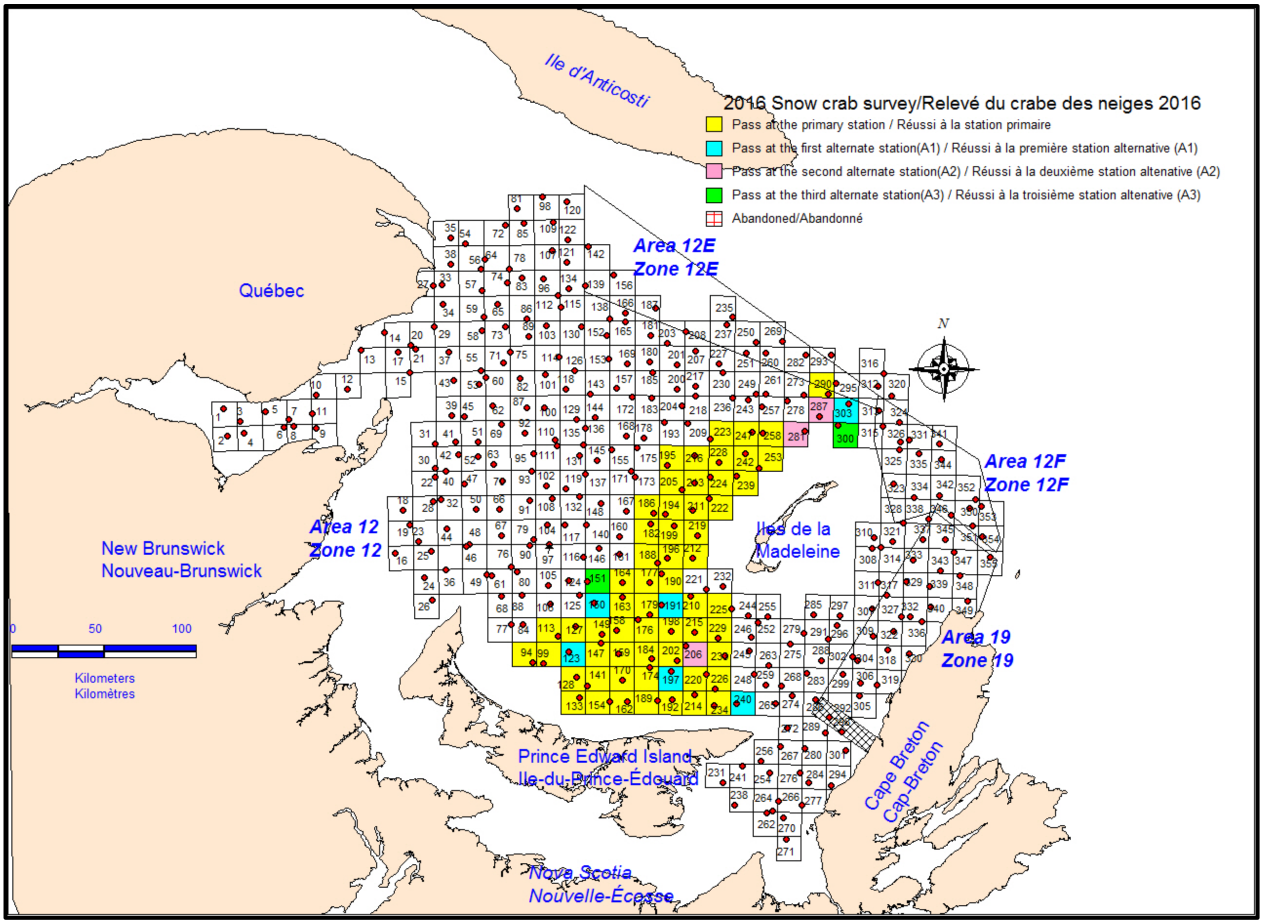


Figure 4c. The third trip departed from Magdalen Islands on July 23, sampled off Prince Edward Island following galley towards Area 12E and returned to Souris on July 30. Total of 69 stations were trawled with success and it was the highest number of stations successfully trawled in the 2016 survey.

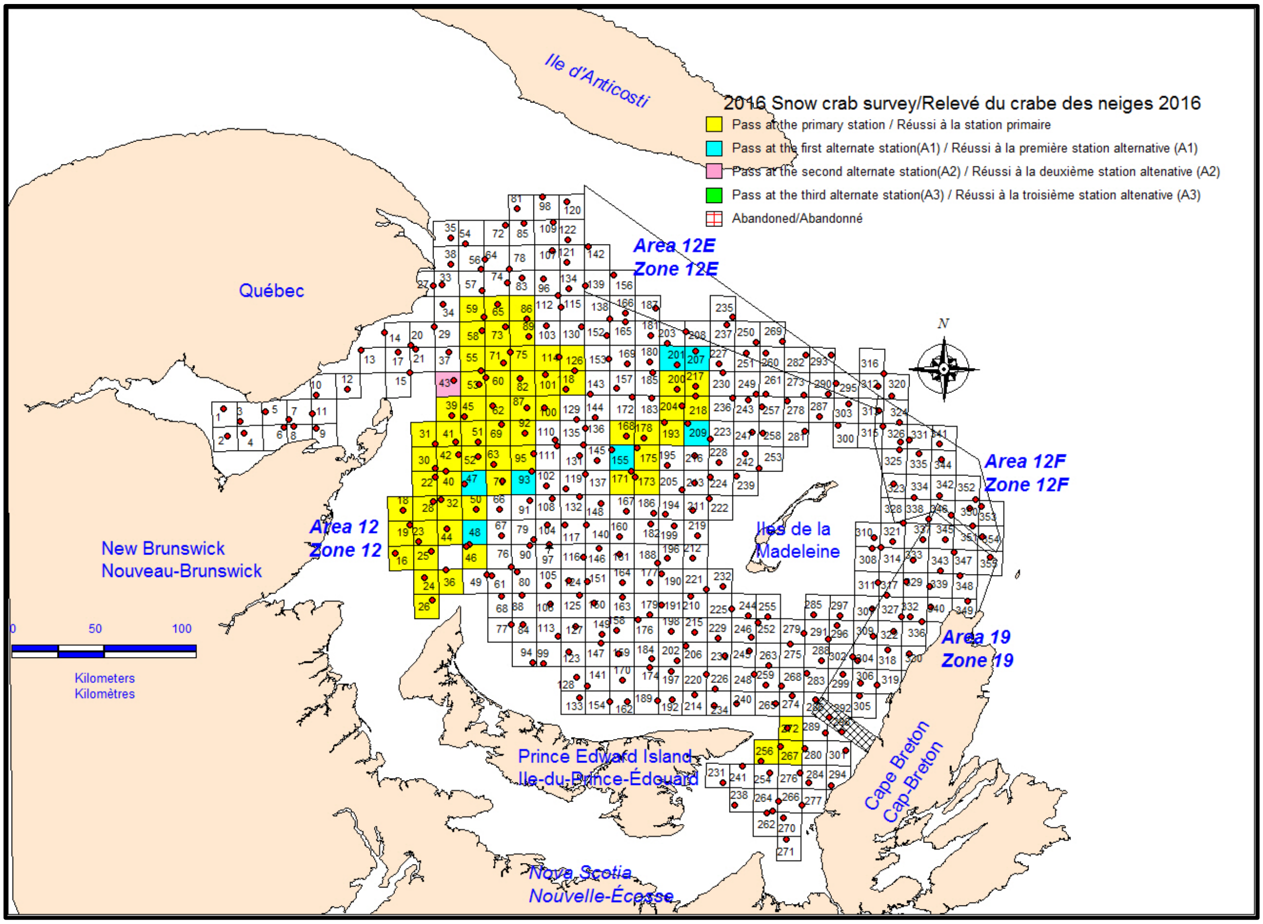


Figure 4d. The fourth trip started from Souris on August 6 and sampled mainly in the west of Bradelle Bank and some stations in the eastern side too then returned to Caraquet NB on August 14.

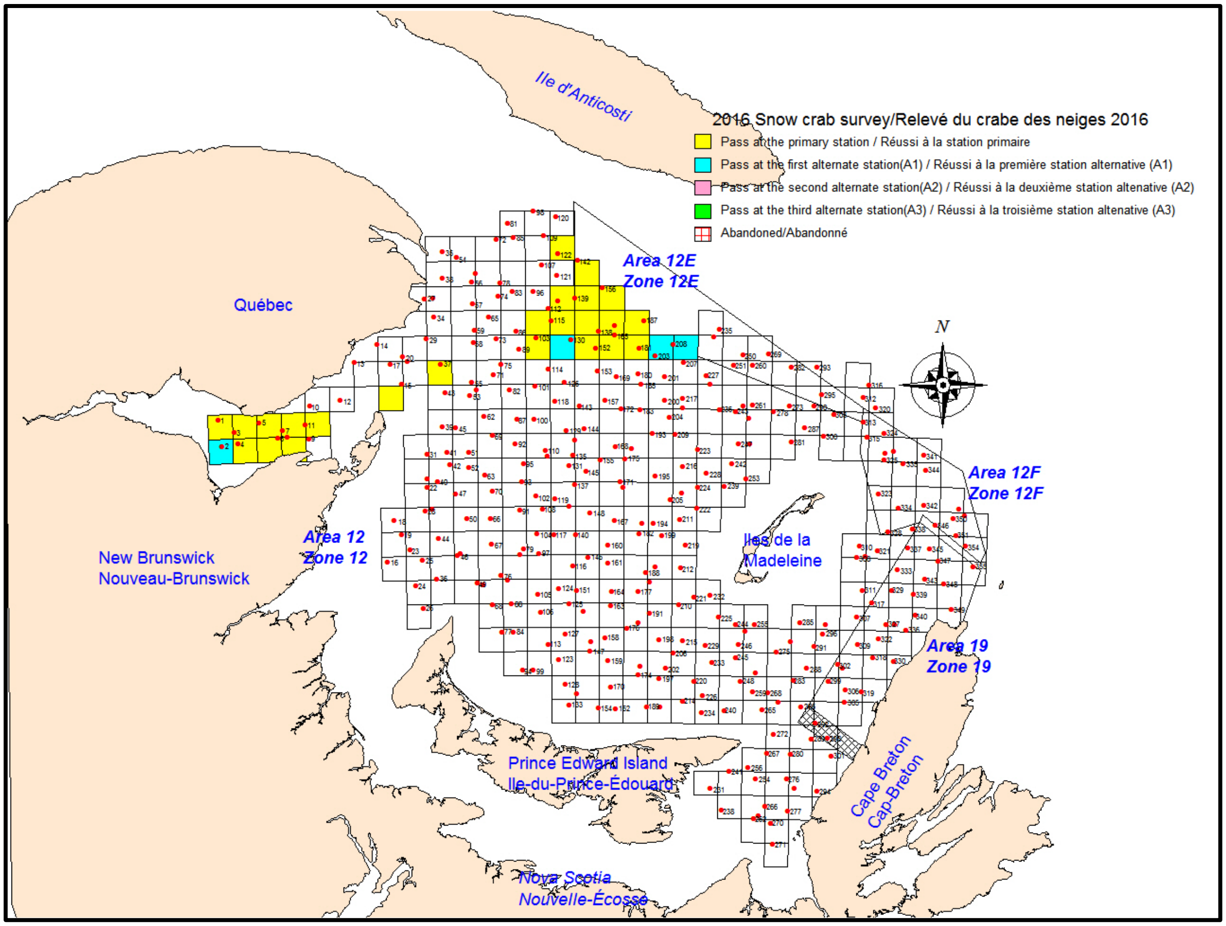


Figure 4e. The fifth trip departed from Caraquet on August 18 and trawled in Baie des Chaleurs and in the vicinity of the western corner of Area 12E. The vessel returned to Caraquet on August 21.

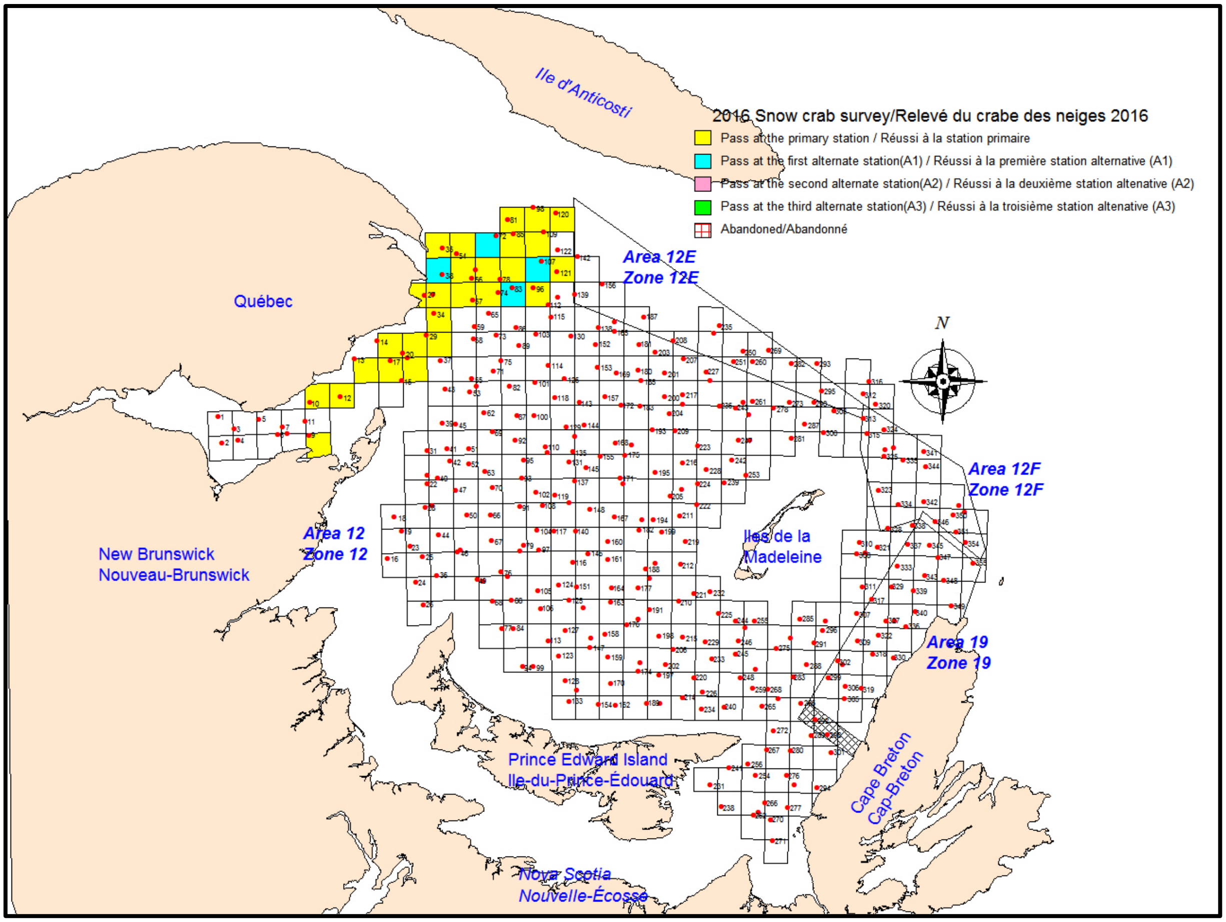


Figure 4f. The sixth trip departed from Cap-aux-Meules (QC) on Augsut 25 and trawled from the Baie des Chaleurs to northernmost area of the survey off Gaspé peninsula. The vessel returned to Cap-aux-Meules.

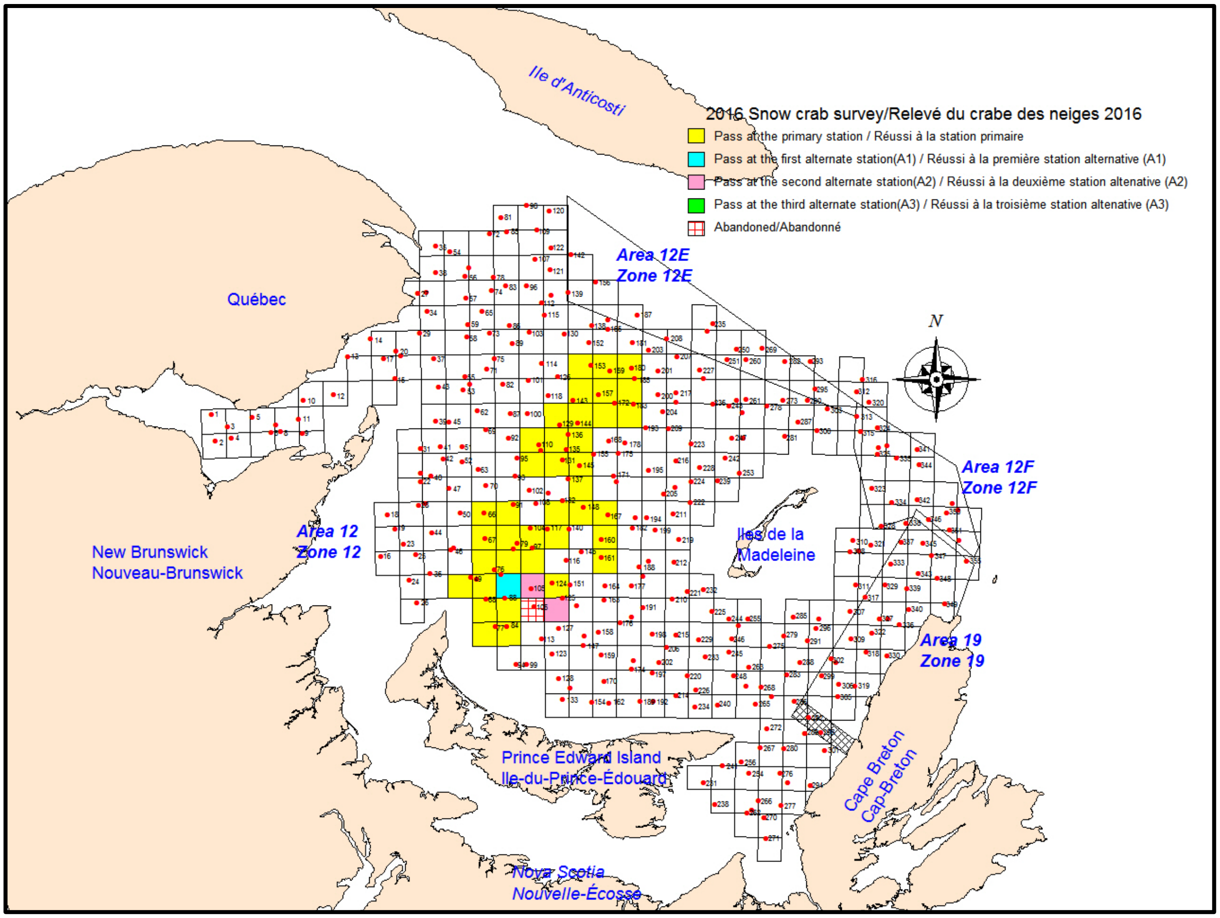


Figure 4g. The seventh trip departed from Cap-aux-Meules September 3 and trawled in Bradelle Bank, and returned to Cap-aux-Meules (Magdalene Islands) on September 7.

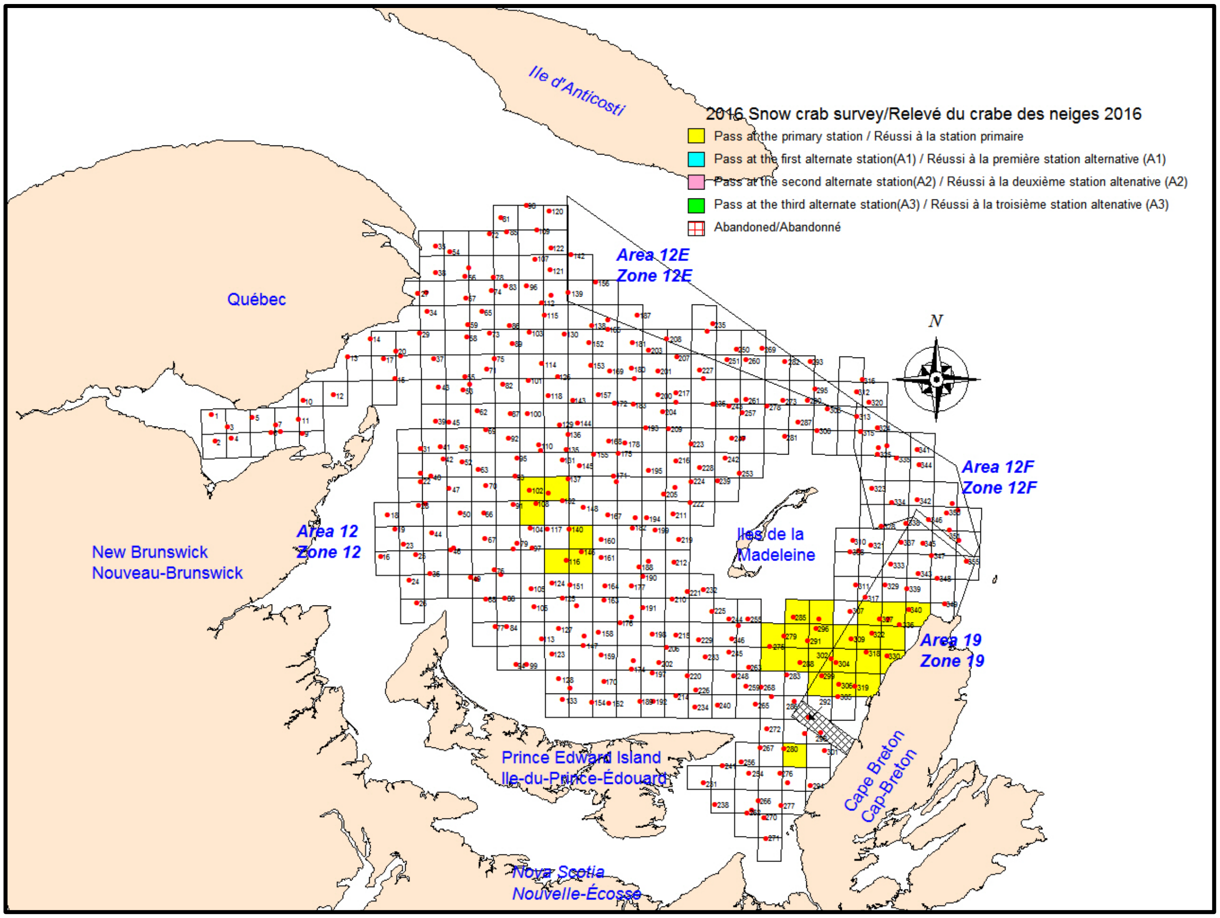


Figure 4h. The eighth trip departed from Cap-aux-Meules (Magdalen Islands) on September 15 and trawled the remaining stations in the southern part of Bradelle Bank, one station in Area 18 and Area 19, and returned to Cheticamp on September 21.

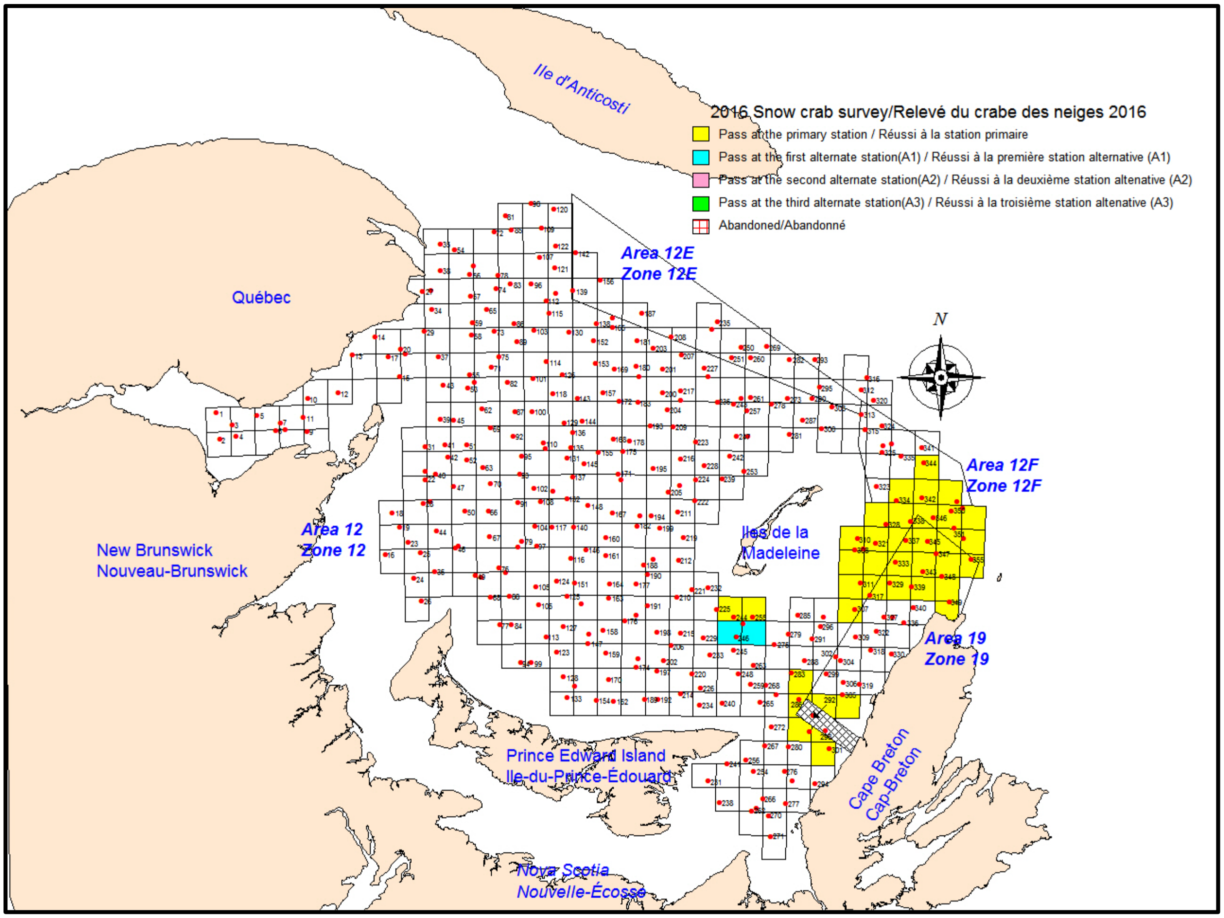


Figure 4i. The ninth (the last) trip departed from Cheticamp on September 27 and trawled southern part of Magadalen Islands and around the buffer zone (C), around the northern corner of Area 19 as well as the northern part of Area 19. The survey was completed on October 4 and equipment was unloaded on the same day. Strong wind prevented us to continue the survey by losing 3 and half days.

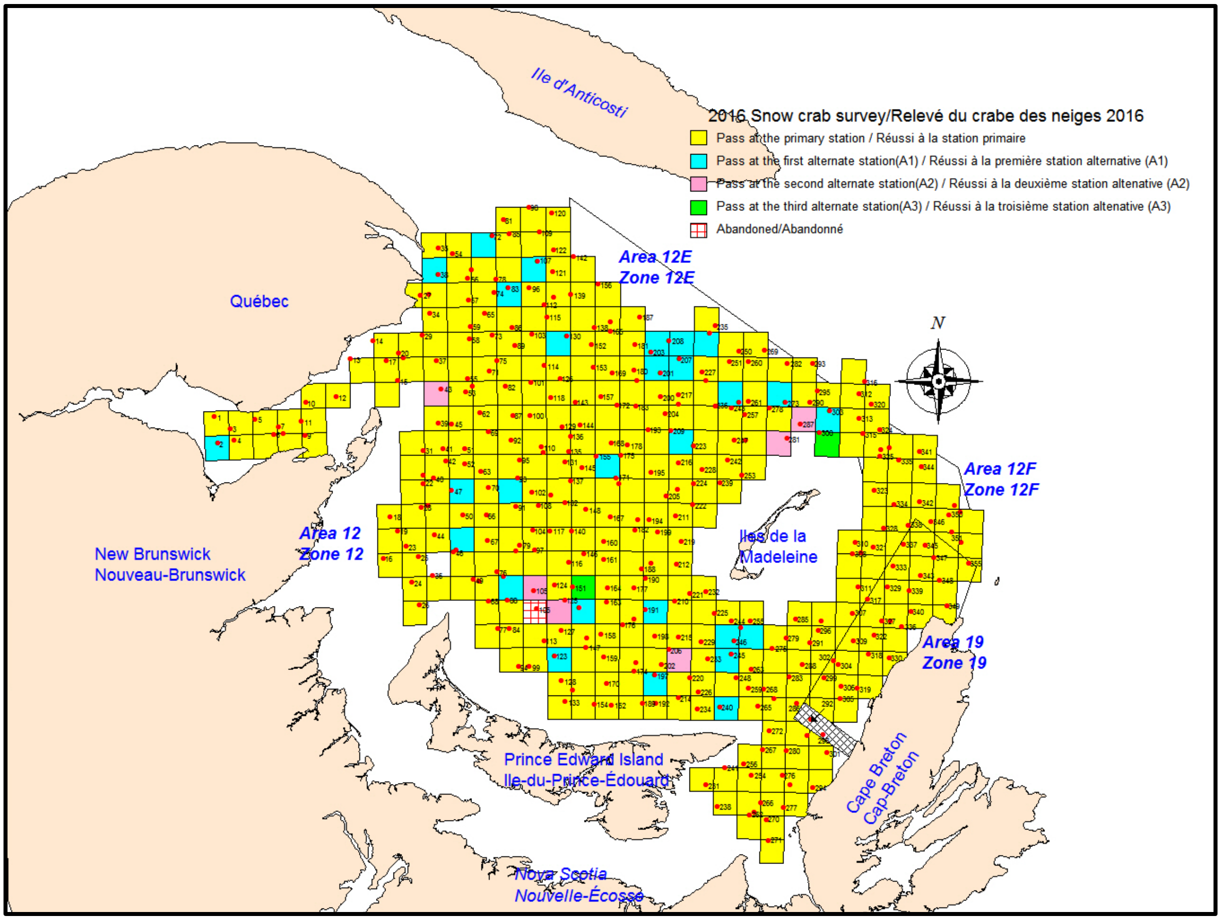


Figure 5. Summary of the 2016 trawl survey showing the geographic distribution of grids by tow characteristics.

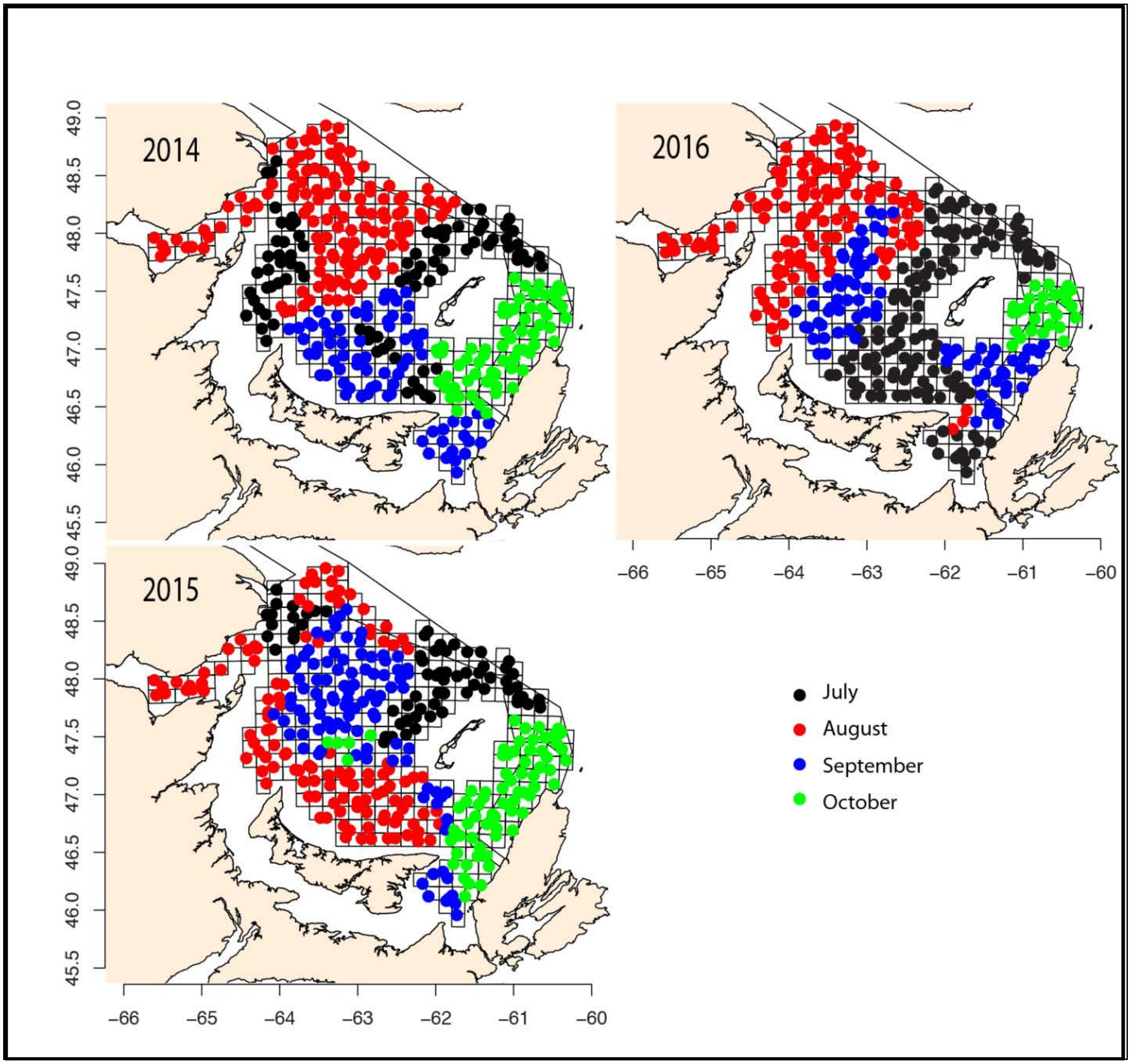


Figure 6. Monthly geographic distributions of visited stations during the snow crab survey during 2014 and 2016.

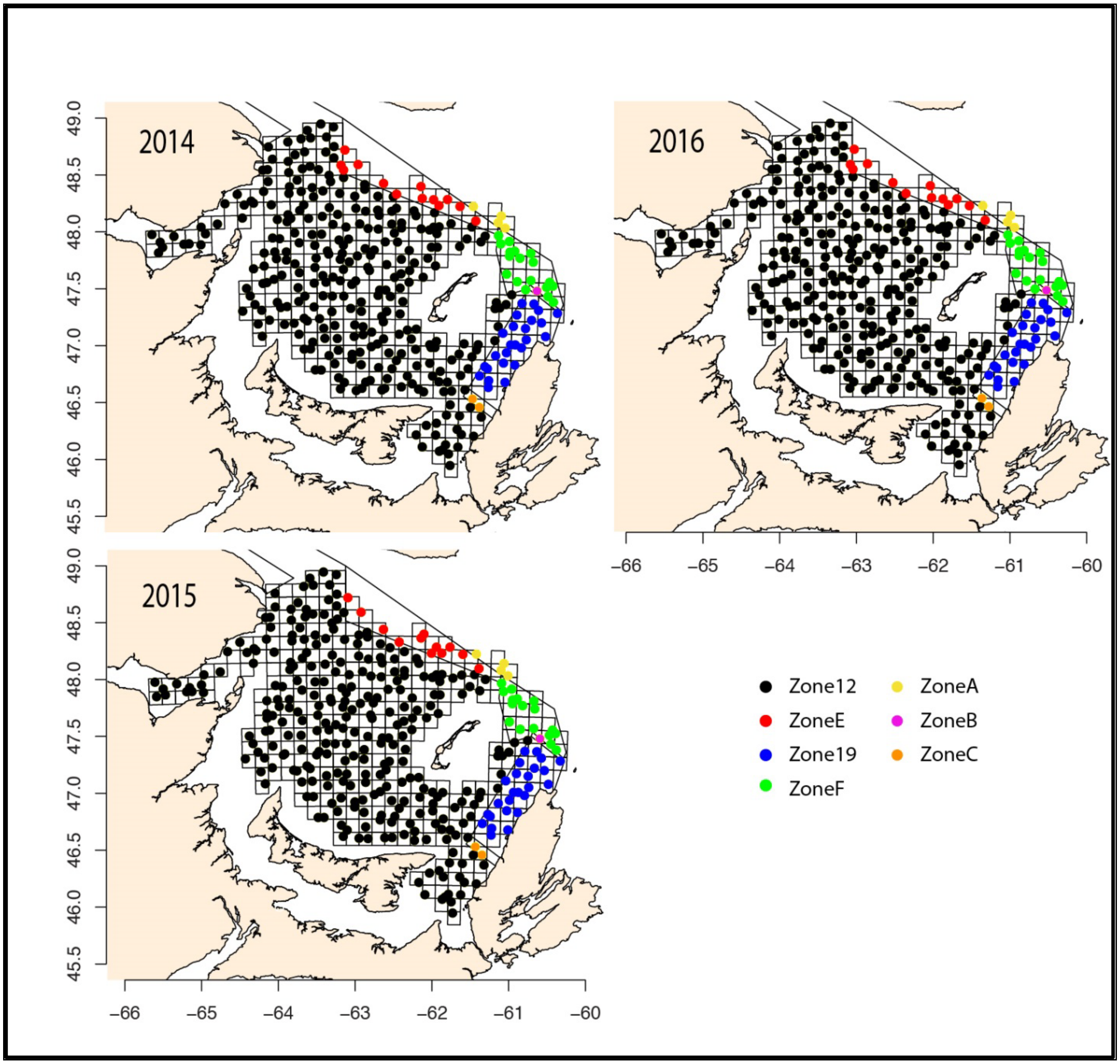


Figure 7. Geographic distribution of trawl stations by crab fishing zone (12, E, 19, F) and buffer zones (A, B and C), during 2014 to 2016.

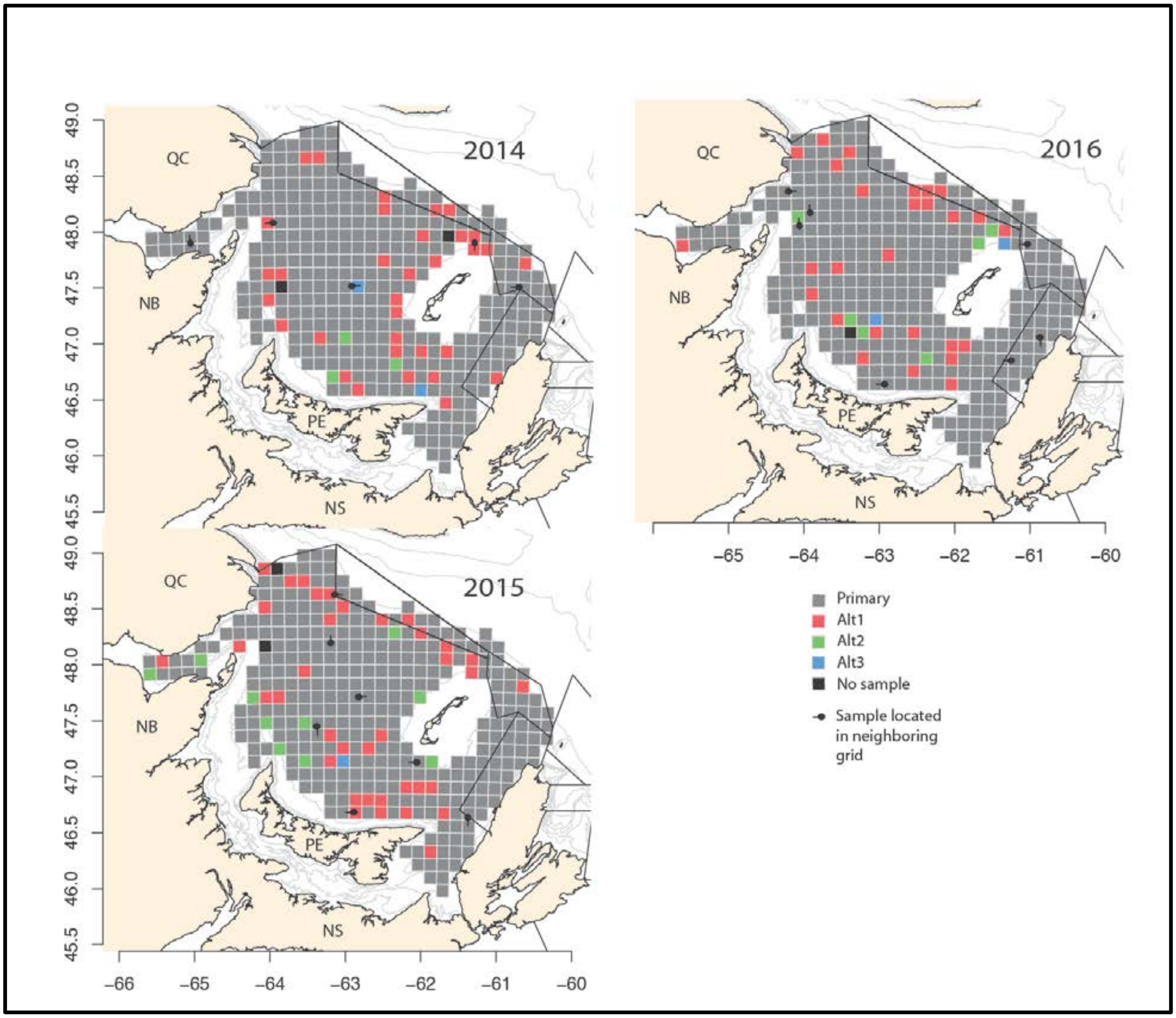


Figure 8. Geographic presentation of trawl tow quality and characteristics showing primary, alternative 1, alternative 2, alternative 3 and abandoned grids together with targeted grids not realized in annual trawl surveys of 2014 to 2016.

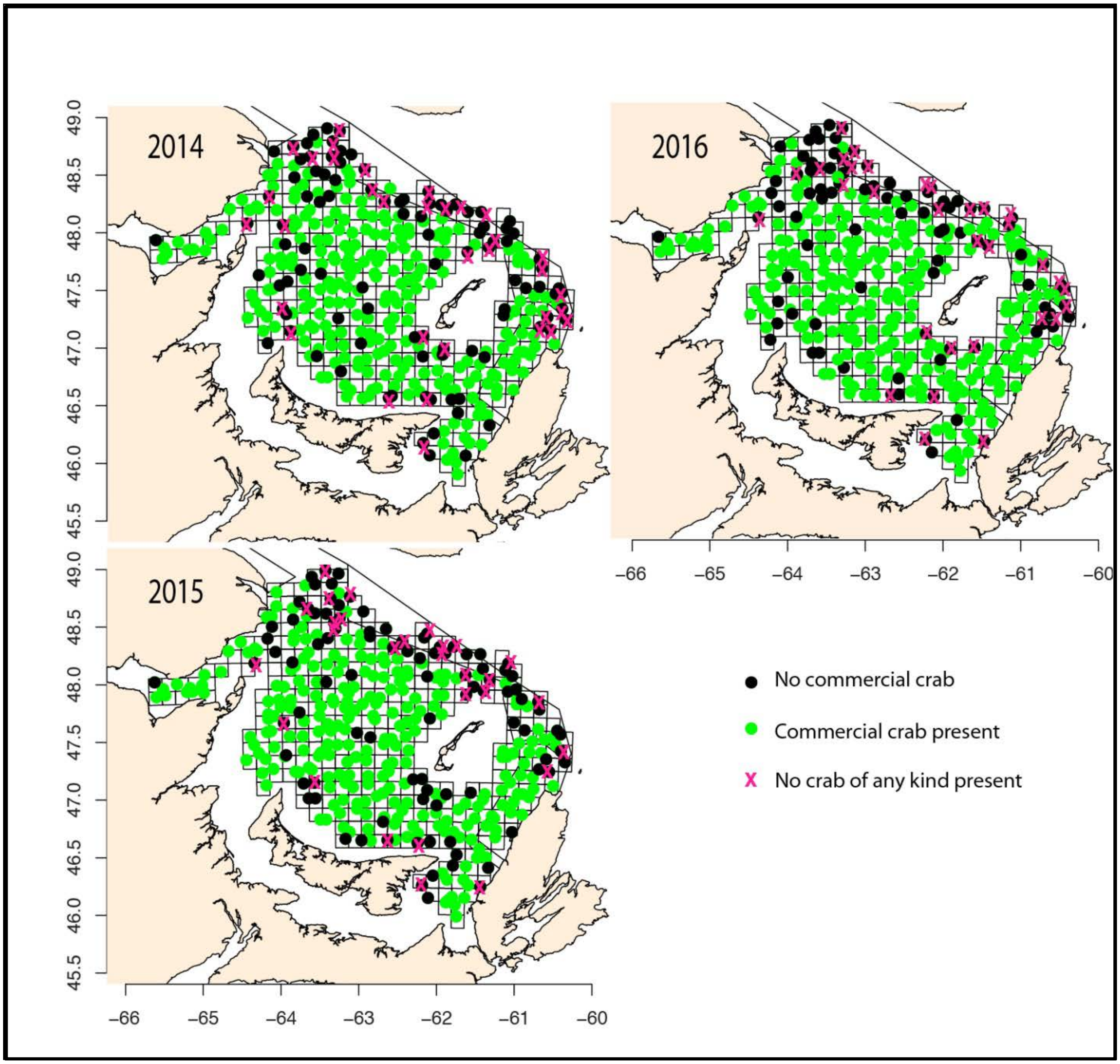


Figure 9. Geographic distribution of grids with no commercial sized snow crab captured, commercial sized snow crab captured, and no snow crab captured during the trawl surveys of 2014 to 2016.

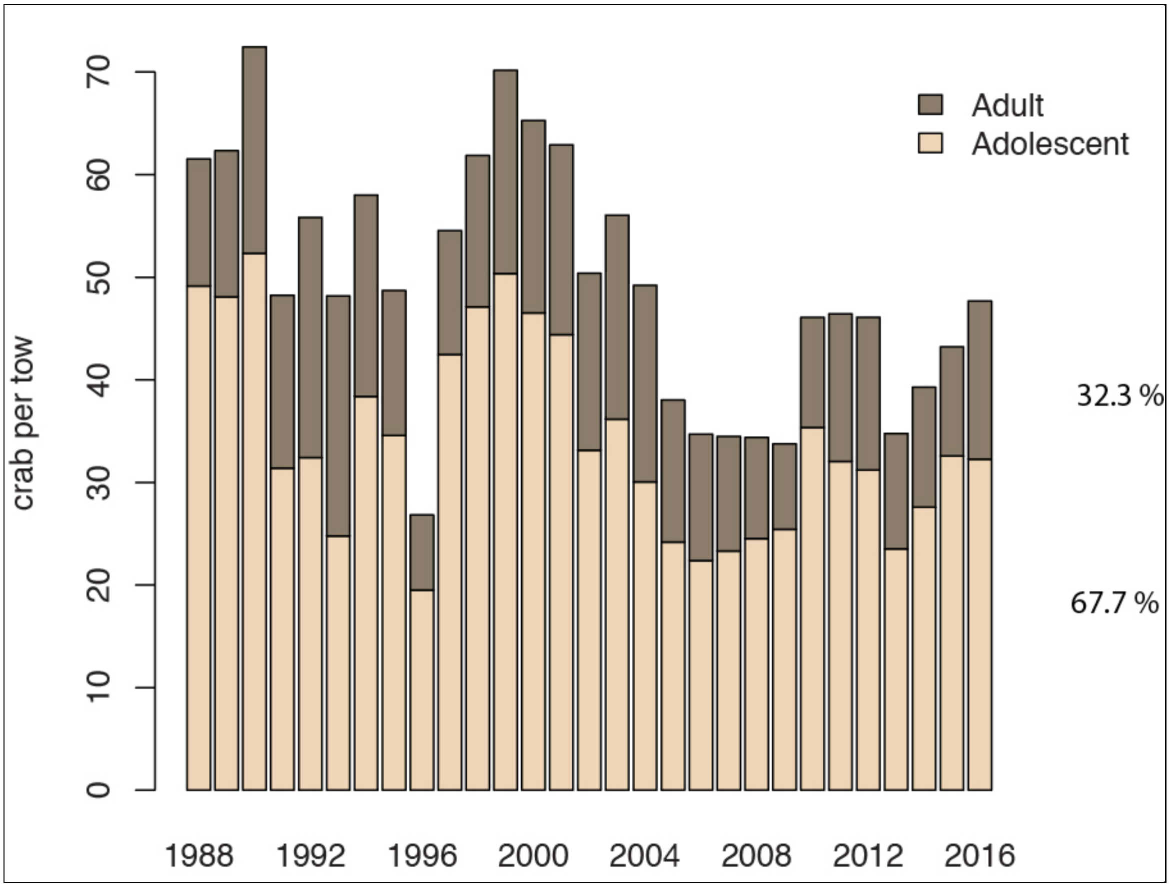


Figure 10. Mean number of male snow crab per tow, by maturity stage, sampled during the snow crab bottom trawl survey, 1988 to 2016. Percentage of the maturity stages in the catches for 2016 are shown in the panel (32.3% adult, 67.7% adolescent). Corresponding values for 2015 were 24.6% adult, 75.3% adolescent, respectively, and for 2014 were 29.7% and 70.2%, respectively.

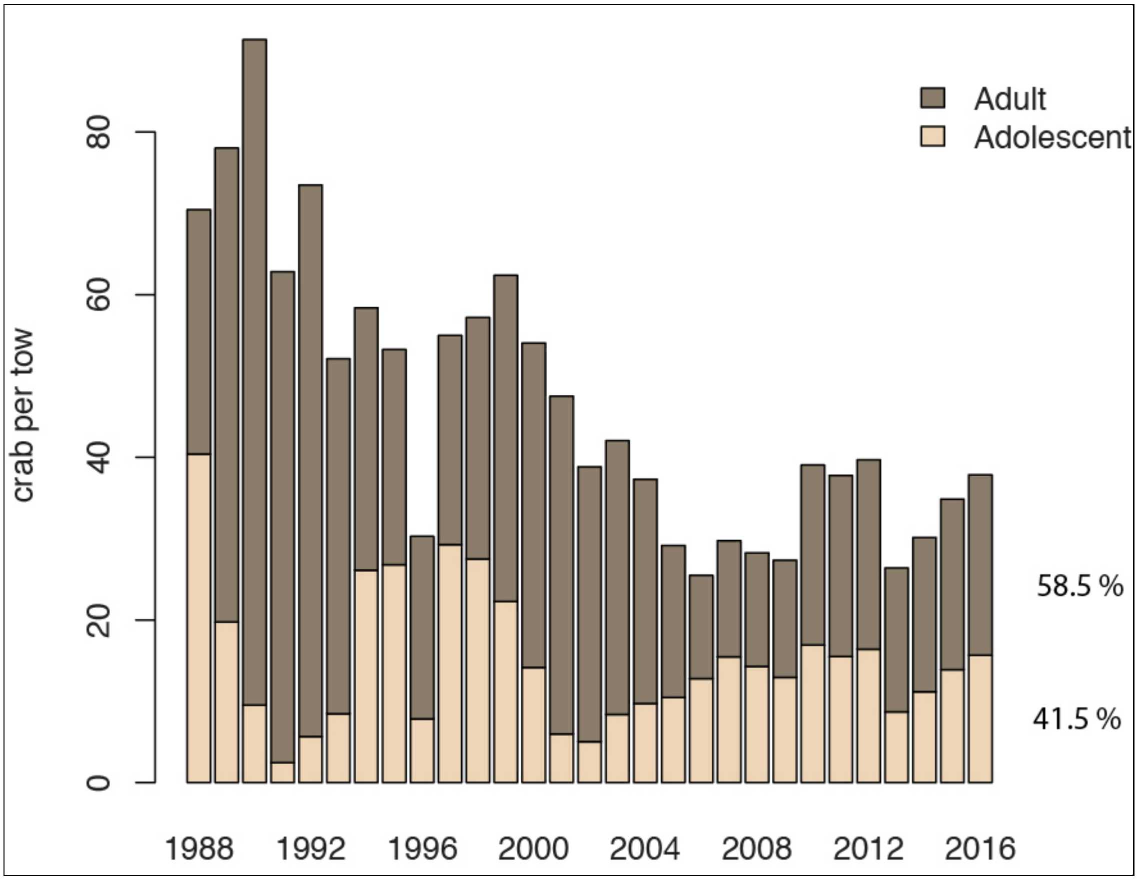


Figure 11. Mean number of female snow crab per tow, by maturity stage, sampled during the snow crab bottom trawl survey, 1988 to 2016. The percentages by the maturity stage in the catches for 2016 are shown in the panel (58.5% adult, 41.5% adolescent).). Corresponding values for 2015 were 60.1% adult, 39.8% adolescent, respectively, and for 2014 were 62.8% and 37.1%, respectively.

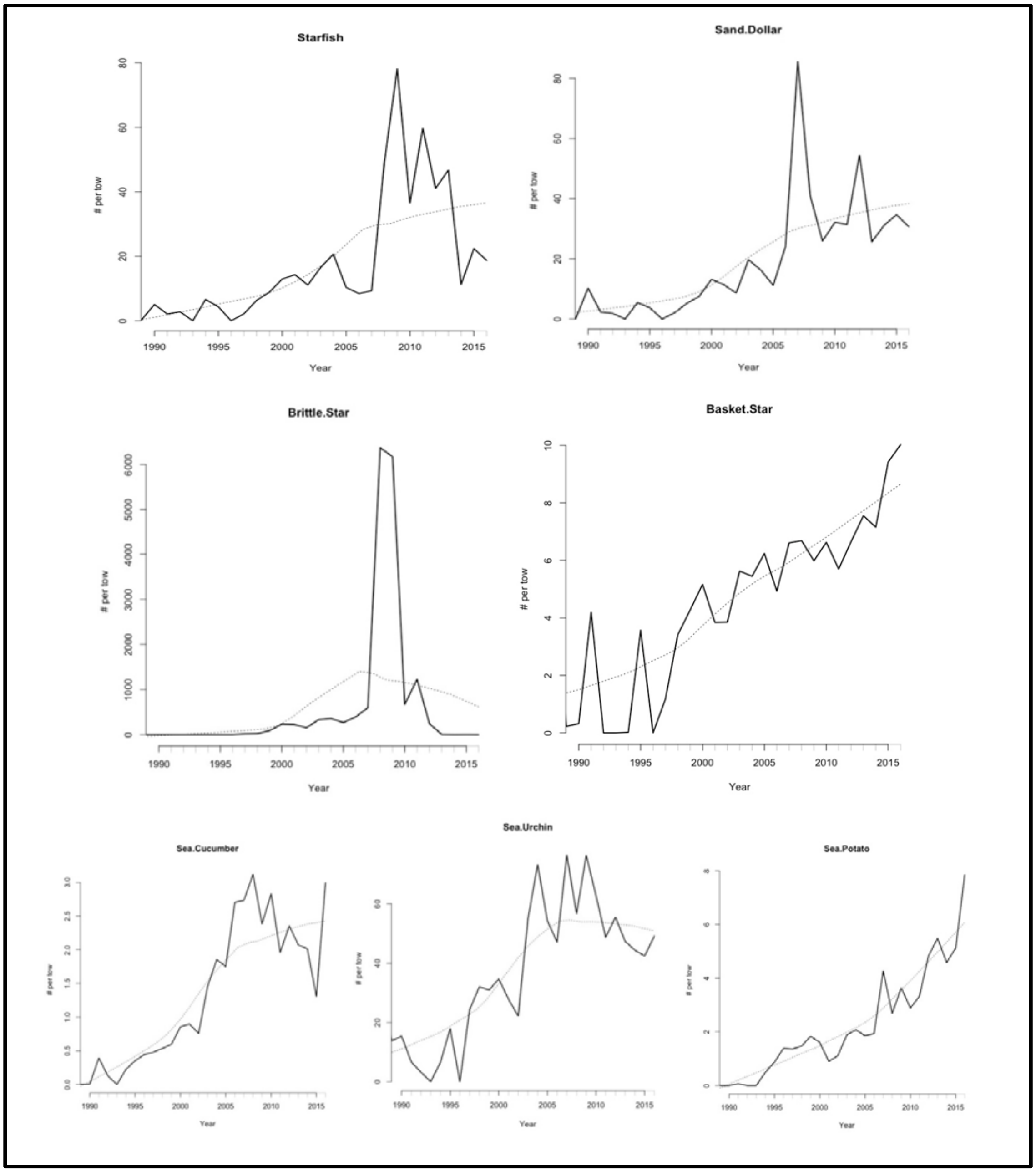


Figure 12a. Historic pattern in catch of sedentary invertebrate species or group of species (Echinodermata) during the annual snow crab trawl survey, 1988 to 2016 (grey line is a LOESS smoothing curve).

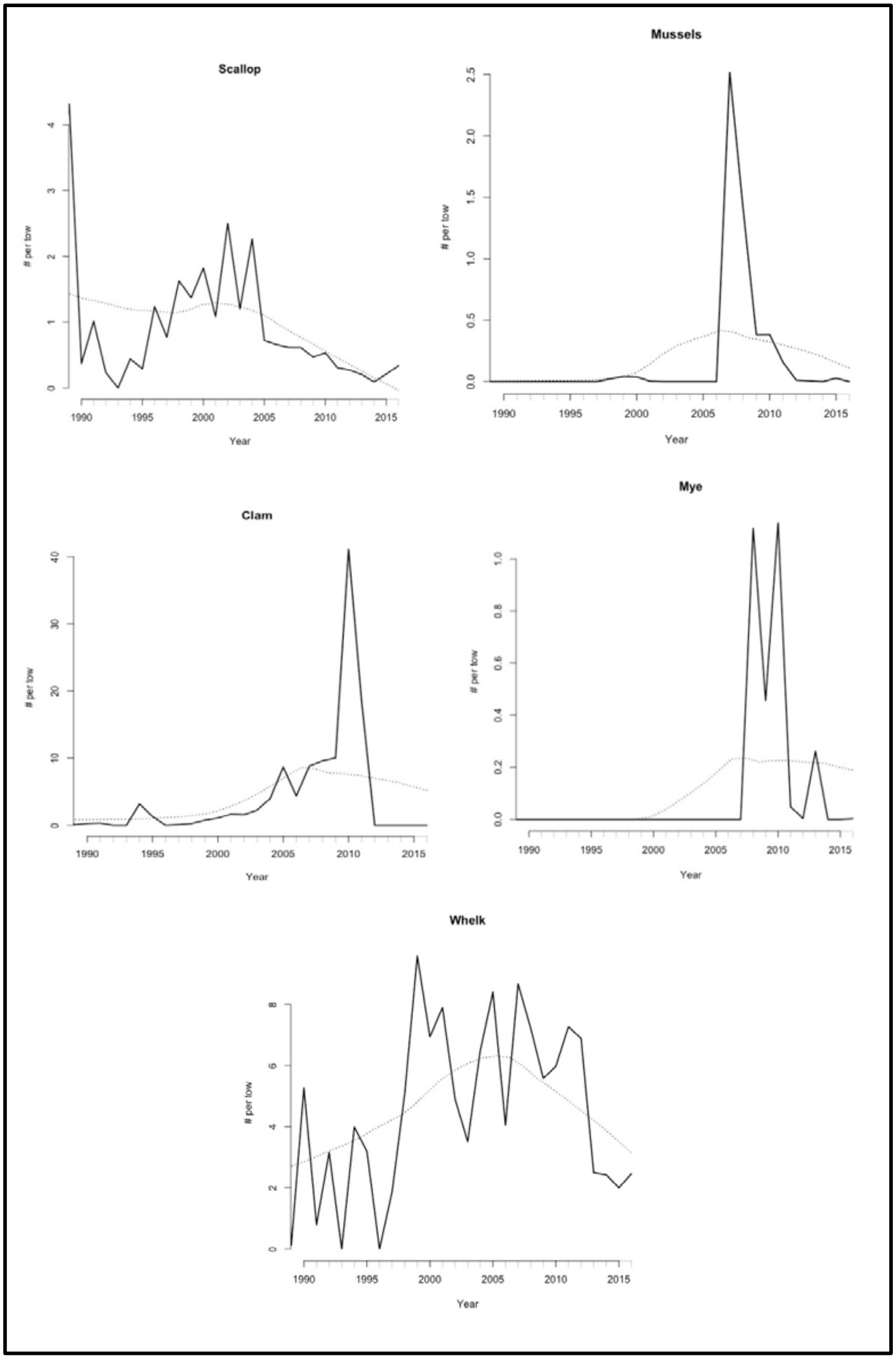


Figure 12b. Historic pattern in catch of sedentary invertebrate species or group of species (Mollusc) during the annual snow crab trawl survey, 1988 to 2016 (grey line is a LOESS smoothing curve).

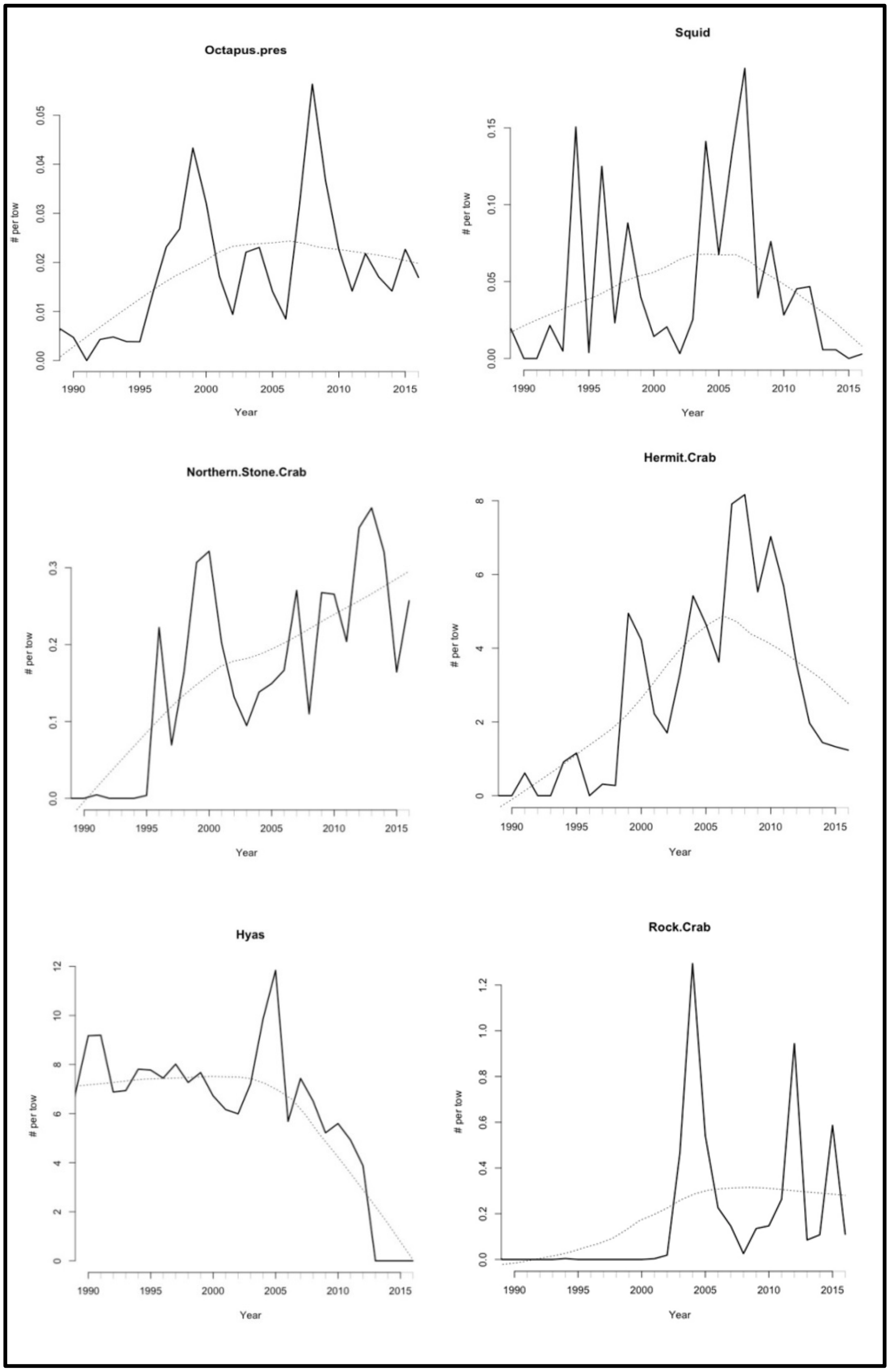


Figure 12c. Historic pattern in catch of sedentary invertebrate species or group of species (Mollusc , Cephalopoda: upper panel; Crustacea, Anomura: middle panel and Crustacea Brachyura: lower panel (Hyas comprised of two species H. coarctatus and H. araneus) during the annual snow crab trawl survey, 1988 to 2016 (grey line is a LOESS smoothing curve).

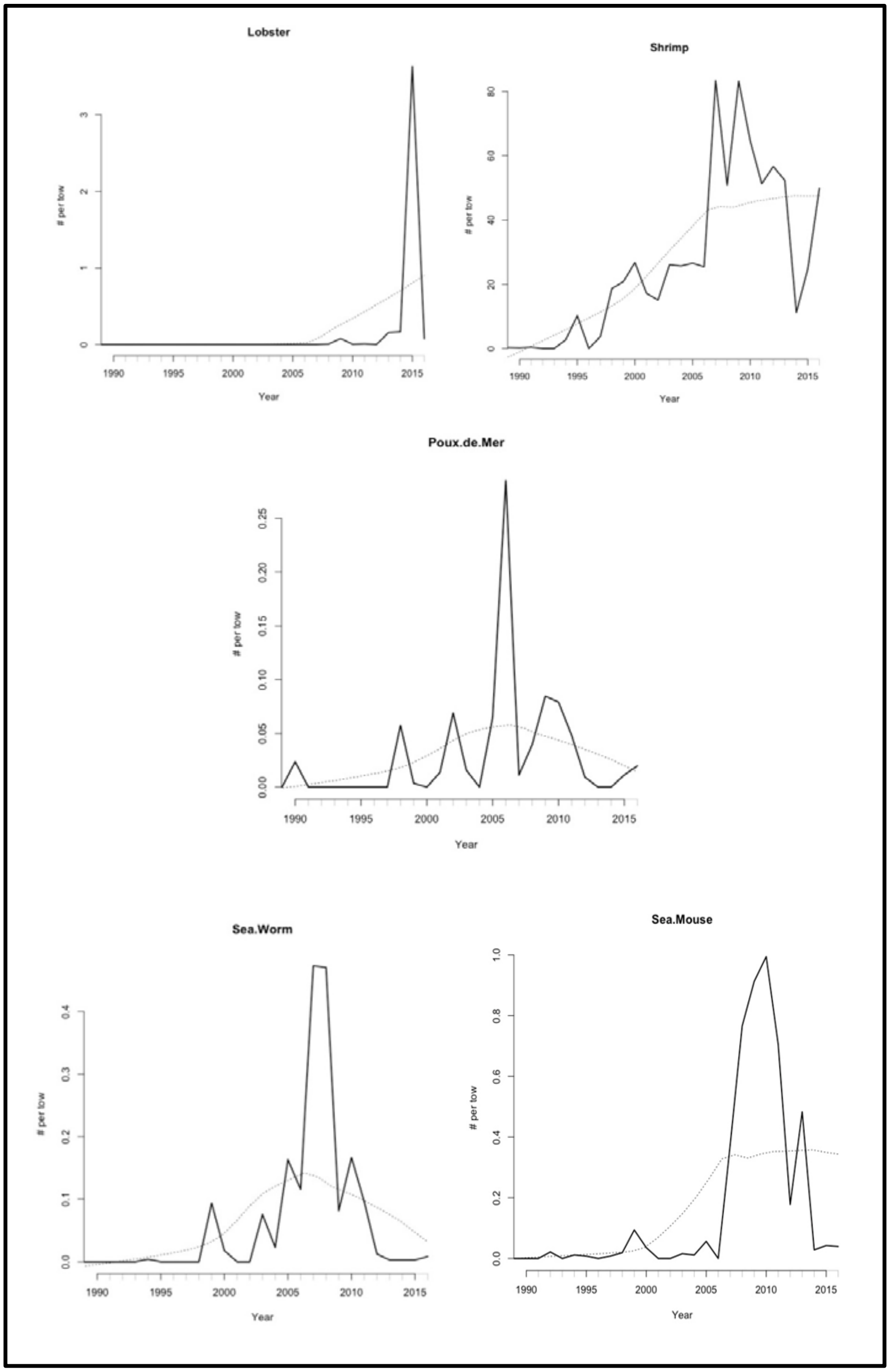


Figure 12d. Historic pattern in catch of sedentary invertebrate species or group of species (Crustacea, Natantia: upper panel, Crustacea, Isopoda: middle panel, Polychaeta: Lower panel) during the annual snow crab trawl survey, 1988 to 2016 (grey line is a LOESS smoothing curve).

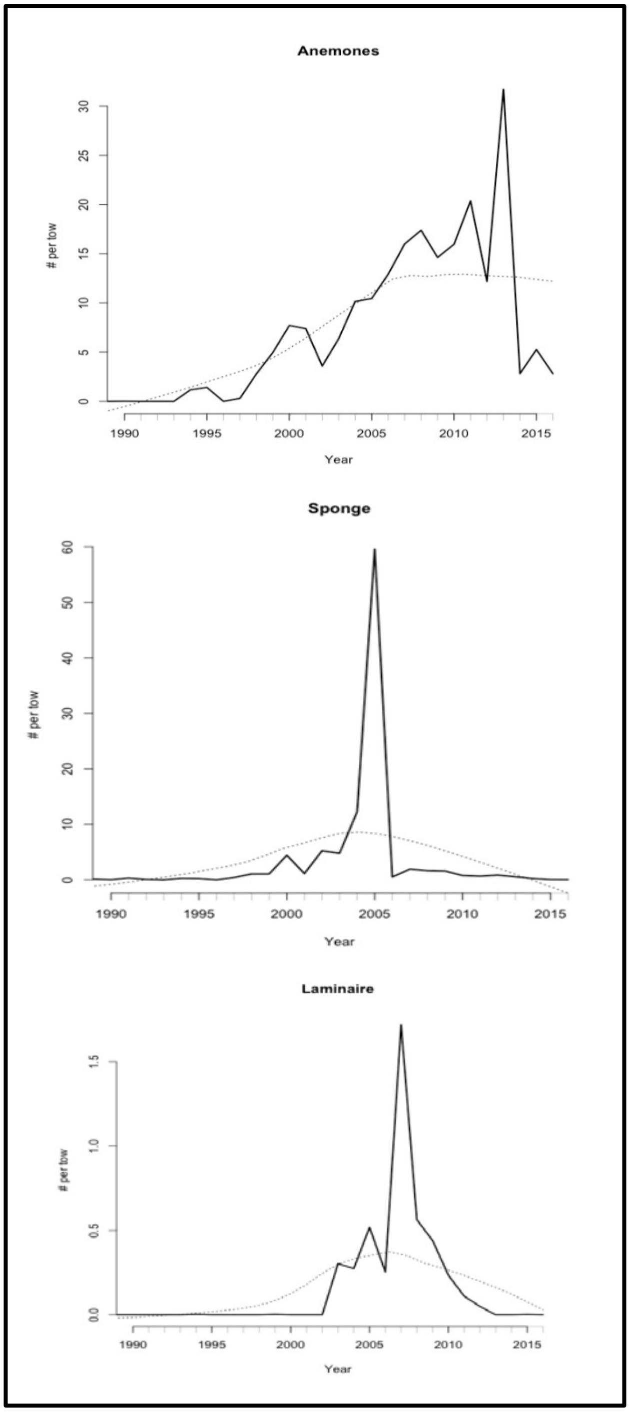


Figure 12e. Historical pattern in catch of sedentary invertebrate and marine plant species or group of species (Cnidaria: upper panel, Porifera: Middle panel, Heterokonta (brown algae): lower panel) during the annual snow crab trawl survey, 1988 to 2016 (grey line is a LOESS curve).

APPENDIX

Appendix 1. Individual trawl sample details for 2016. Data by column are: Date (day, month in 2015), CFA (crab fishing area), T# (sequential daily tow number), Lat (latitude degree decimal), Lon (longitude degree decimal), AS (swept area estimate in m²), D (depth of the trawl station in m), T (bottom temperature at station in ºC), CC/t and CW/t (catches in number and estimated weight in g per tow, respectively, of commercial-sized adult male snow crab of carapace conditions 1 to 5), RC/t and RW/t (catches in number and estimated weight in g per tow, respectively of commercial-sized adult male snow crab of carapace conditions 3 to 5), Tq (tow quality indicator), SI (Successful station index as P = primary, A1 = alternative 1, A2 = alternative 2, and A3 = alternative 3), Se (trawl sequential number for the survey), Grid (grid id trawled). The tow information indicator (Tq) values are coded as: 1 = successful trawl sample and acceptable area swept data; 2 = successful trawl sample and the area swept data was estimated by the average area swept of 10 neighboring stations; 3 = original trawl set unsuccessful, repeated successful tow at alternative station and acceptable area swept data; 4 = original trawl set unsuccessful, repeated successful tow at alternative station and the area swept data was estimated by the average area swept of 10 neighboring stations.

Date	CFA	T#	Lat	Lon	AS	D(m)	T(ºC)	CC/t	CW/t	RC/t	RW/t	Tq	SI	Se	Grid
10-Jul	F	1	47.62844	61.00470	2690	38.4	2.1	2	1041	0	0	1	P	1	AP27
10-Jul	F	2	47.78056	60.95491	2783	54.9	0.8	10	6951	2	1387	1	P	2	AQ27
10-Jul	F	3	47.76929	60.83219	2587	69.5	0.7	5	2700	2	1269	1	P	3	AQ28
10-Jul	F	4	47.74111	60.67654	1457	84.1	0.9	0	0	0	0	1	P	4	AQ29
10-Jul	F	5	47.81546	60.69189	2544	192	5.3	1	471	0	0	2	P	5	AR29
10-Jul	F	6	47.83064	60.90079	2935	71.3	0.7	1	762	0	0	1	P	6	AR28
10-Jul	F	7	47.82170	60.96411	2402	60.4	0.7	2	1319	1	522	1	P	7	AR27
10-Jul	F	8	47.89374	61.08104	2133	67.7	0.6	0	0	0	0	1	P	8	AR27
10-Jul	F	9	47.91603	60.97054	3361	86	0.8	2	747	2	747	1	P	9	AS27
10-Jul	F	10	47.96742	61.11017	2935	82.3	0.6	0	0	0	0	1	P	10	AS26
10-Jul	12	11	48.03351	61.02652	2676	285.3	6.1	1	595	1	595	2	P	11	AT27
10-Jul	12	12	48.08099	61.11497	2706	301.8	6.1	0	0	0	0	2	P	12	AT26
11-Jul	12	2	48.13897	61.07358	2706	362.1	6.1	0	0	0	0	2	P	13	AU26
11-Jul	E	3	48.09496	61.40554	2918	96.9	1.4	2	1212	0	0	1	P	14	AT25
13-Jul	12	1	46.26390	61.65141	2112	60.4	1	1	599	0	0	1	P	15	AD23
13-Jul	12	2	46.21854	61.59400	3644	54.9	1.1	1	665	0	0	1	P	16	AD24
13-Jul	12	3	46.20660	61.43496	2705	38.4	2.6	0	0	0	0	1	P	17	AD25
13-Jul	12	4	46.10979	61.63805	1864	49.4	2.1	5	3148	0	0	1	P	18	AC24
13-Jul	12	5	46.12894	61.79795	1850	49.4	1.4	3	1911	0	0	1	P	19	AC23
13-Jul	12	6	46.08552	61.84316	2122	47.5	1.7	5	2651	0	0	1	P	20	AC22
13-Jul	12	7	46.04858	61.76261	2268	51.2	1.7	4	2081	0	0	1	P	21	AB23
13-Jul	12	8	45.94688	61.74491	2105	40.2	3	19	10578	0	0	1	P	22	AA23
13-Jul	12	9	46.07182	61.88018	1944	45.7	1.7	7	4704	0	0	1	P	23	AB22
13-Jul	12	11	46.11075	62.10111	3541	38.4	3.7	0	0	0	0	3	P	24	AC21
13-Jul	12	12	46.21537	62.18261	1814	32.9	5.7	0	0	0	0	1	P	25	AD20
13-Jul	12	13	46.29986	62.04885	3564	40.2	3.8	1	436	0	0	1	P	26	AD21
13-Jul	12	14	46.26336	61.86243	2731	49.4	1.8	4	2503	1	617	1	P	27	AD22
16-Jul	12	1	46.59551	61.81987	2590	56.7	0.3	4	3049	0	0	1	P	28	AG22
16-Jul	12	2	46.63365	61.70580	3060	62.2	0.2	4	2367	1	409	1	P	29	AG23
16-Jul	12	3	46.67966	61.77816	2197	65.8	-0.1	9	5585	2	845	1	P	30	AH23
16-Jul	12	4	46.68165	61.89010	2651	56.7	-0.2	17	10084	0	0	1	P	31	AH22
16-Jul	12	5	46.73427	61.97317	3929	82.3	-0.1	24	13062	3	1349	1	P	32	AH21

Date	CFA	T#	Lat	Lon	AS	D(m)	T(ºC)	CC/t	CW/t	RC/t	RW/t	Tq	SI	Se	Grid
16-Jul	12	6	46.77460	61.86907	2845	67.7	-0.2	11	5515	6	3123	1	P	33	AI22
16-Jul	12	8	46.79160	61.98922	2628	67.7	0	4	2337	1	370	3	A1	34	AI21
16-Jul	12	10	47.14677	62.18332	3030	36.6	1.4	0	0	0	0	1	P	35	AL20
16-Jul	12	11	47.13692	62.29671	2356	49.4	-0.1	3	2030	0	0	1	P	36	AL19
17-Jul	12	1	48.21949	61.43283	2676	362.1	5.9	0	0	0	0	2	P	37	AU24
17-Jul	E	2	48.22239	61.61214	2540	314.6	6.1	0	0	0	0	2	P	38	AU23
17-Jul	E	3	48.28355	61.77294	2686	340.2	6	0	0	0	0	1	P	39	AV22
17-Jul	E	5	48.23194	61.88931	2357	214	5.5	0	0	0	0	3	P	40	AU22
17-Jul	E	6	48.28536	61.95702	2648	241.4	5.9	0	0	0	0	1	P	41	AV21
17-Jul	E	8	48.39896	62.11656	2466	362.1	5.9	0	0	0	0	2	P	42	AW20
18-Jul	E	1	48.36970	62.13713	2062	287.1	6	0	0	0	0	3	A1	43	AV20
18-Jul	E	2	48.23262	62.02041	1989	102.4	1	0	0	0	0	1	P	44	AU21
18-Jul	12	3	48.18531	62.21141	2716	86	2.1	0	0	0	0	1	P	45	AU20
18-Jul	12	4	48.14166	62.18502	2512	87.8	0.7	5	2898	3	1670	1	P	46	AT20
18-Jul	12	5	48.02558	62.12035	1582	58.5	0.3	1	433	1	433	1	P	47	AS20
18-Jul	12	6	48.01719	62.00916	2497	56.7	0.2	2	867	2	867	1	P	48	AS21
18-Jul	12	8	48.04203	61.98465	2315	58.5	0.2	0	0	0	0	3	A1	49	AT21
18-Jul	12	9	47.98284	61.91418	2011	58.5	0.2	6	3429	4	2276	1	P	50	AS22
18-Jul	12	10	48.04352	61.88547	2174	62.2	0.3	5	2543	5	2543	1	P	51	AT22
18-Jul	12	11	48.01380	61.75582	3194	73.2	0.5	6	2815	3	1475	1	P	52	AS23
18-Jul	12	13	48.10919	61.71097	2290	93.3	0.8	1	569	0	0	3	A1	53	AT23
24-Jul	12	1	48.04293	61.45868	2053	69.5	0.2	1	387	1	387	1	P	54	AT24
24-Jul	12	3	47.95283	61.37931	2734	58.5	0.2	7	3809	0	0	3	A1	55	AS25
24-Jul	12	7	47.90508	61.37901	2501	54.9	0.1	0	0	0	0	3	A3	56	AR25
24-Jul	12	10	48.02672	61.55349	3089	60.4	0.2	0	0	0	0	3	A2	57	AS24
24-Jul	12	13	47.89590	61.74043	2438	58.5	0.3	9	5098	0	0	3	A2	58	AR23
24-Jul	12	14	47.86450	61.90689	2953	54.9	0.1	26	17815	0	0	1	P	59	AR22
25-Jul	12	1	47.86741	61.98394	2036	53	0.1	8	5381	0	0	1	P	60	AR21
25-Jul	12	2	47.77073	62.03286	2726	49.4	-0.1	0	0	0	0	1	P	61	AQ21
25-Jul	12	3	47.70032	61.93247	2560	38.4	1.8	3	1844	0	0	1	P	62	AQ22
25-Jul	12	4	47.66503	62.08241	2921	42.1	-0.1	0	0	0	0	1	P	63	AP21
25-Jul	12	5	47.72709	62.20710	2181	56.7	0	9	4069	3	1261	1	P	64	AQ20
25-Jul	12	6	47.83635	62.27230	2805	60.4	0.1	1	428	1	428	1	P	65	AR20
25-Jul	12	7	47.75995	62.37452	2959	64	0.2	4	1604	4	1604	1	P	66	AQ19
25-Jul	12	8	47.71317	62.56642	3390	80.5	0.3	8	4211	4	1926	1	P	67	AQ18
25-Jul	12	9	47.60108	62.46499	3233	73.2	0.3	16	7746	9	4076	1	P	68	AP18
25-Jul	12	10	47.63210	62.38277	2716	54.9	0.1	5	2595	1	492	1	P	69	AP19
25-Jul	12	11	47.66065	62.27255	2293	54.9	0	10	5261	0	0	1	P	70	AP20
25-Jul	12	12	47.55817	62.27583	2605	54.9	-0.1	4	2111	1	505	1	P	71	AO20
25-Jul	12	13	47.50645	62.39128	2637	60.4	0.1	9	4738	4	2414	1	P	72	AO19
25-Jul	12	14	47.48783	62.57553	2456	67.7	0	26	13525	11	5508	1	P	73	AO18
26-Jul	12	1	47.48882	62.65801	2451	58.5	-0.1	12	7240	2	835	1	P	74	AO17
26-Jul	12	2	47.44153	62.67909	2563	64	-0.2	25	14200	2	1101	1	P	75	AN17
26-Jul	12	3	47.43080	62.51619	2047	75	0.1	13	6129	6	2570	1	P	76	AN18
26-Jul	12	4	47.38528	62.35780	2189	51.2	0.1	26	16110	1	426	1	P	77	AN19
26-Jul	12	5	47.27745	62.39226	2569	54.9	0	2	943	0	0	3	P	78	AM19
26-Jul	12	6	47.27886	62.56818	2450	64	-0.1	11	5480	5	2331	1	P	79	AM18
26-Jul	12	7	47.25653	62.63107	2845	64	-0.1	11	5939	5	2406	1	P	80	AM17
26-Jul	12	8	47.20812	62.60966	2906	65.8	0	27	14061	8	4237	1	P	81	AL18

Date	CFA	T#	Lat	Lon	AS	D(m)	T(ºC)	CC/t	CW/t	RC/t	RW/t	Tq	SI	Se	Grid
26-Jul	12	9	47.16491	62.68538	2815	65.8	-0.1	23	11061	9	3921	1	P	82	AL17
26-Jul	12	10	47.16554	62.87468	2484	60.4	-0.3	31	17735	2	1385	1	P	83	AL16
26-Jul	12	11	47.09733	62.87517	2715	58.5	-0.5	32	18039	4	1666	1	P	84	AK16
26-Jul	12	12	46.98946	62.76518	3102	64	-0.2	53	28021	16	7697	1	P	85	AJ17
26-Jul	12	13	47.01300	62.68665	2726	67.7	-0.1	34	17506	20	9520	1	P	86	AK17
27-Jul	12	1	46.93684	62.54072	2523	64	-0.3	6	3791	2	923	1	P	87	AJ18
27-Jul	12	3	47.03021	62.56449	2805	62.2		9	4500	5	2494	3	A1	88	AK18
27-Jul	12	4	47.10030	62.40457	2828	56.7	-0.1	3	1619	0	0	1	P	89	AK19
27-Jul	12	5	47.04583	62.12239	2417	51.2	-0.2	2	1299	0	0	1	P	90	AK20
27-Jul	12	6	46.90499	62.21849	3654	62.2	-0.1	8	5086	0	0	1	P	91	AJ20
27-Jul	12	7	46.82499	62.17370	3500	82.3	-0.1	28	14515	6	2328	1	P	92	AI20
27-Jul	12	8	46.93017	62.37466	2585	62.2	0	9	5241	0	0	1	P	93	AJ19
27-Jul	12	11	46.85469	62.33182	2684	64		23	13690	1	553	3	A2	94	AI19
28-Jul	12	1	46.79661	62.49728	2789	60.4	-0.3	15	9257	1	369	1	P	95	AI18
28-Jul	12	2	46.80606	62.67385	2179	58.5	-0.3	31	18939	0	0	1	P	96	AI17
28-Jul	12	3	46.76531	62.68865	2450	54.9	-0.1	2	1233	1	795	1	P	97	AH17
28-Jul	12	5	46.71985	62.48576	2361	53	0	0	0	0	0	3	A1	98	AH18
28-Jul	12	6	46.73466	62.29795	2706	65.8	-0.1	27	16299	2	1008	1	P	99	AH19
28-Jul	12	7	46.66511	62.23551	2543	58.5	0.1	15	8631	1	411	1	P	100	AH20
28-Jul	12	9	46.56289	62.08691	2847	43.9	2.4	0	0	0	0	3	A1	101	AG21
28-Jul	12	10	46.58545	62.24165	1985	49.4	1.2	1	450	0	0	1	P	102	AG20
28-Jul	12	11	46.63873	62.37530	2253	58.5	0.6	6	3942	2	1043	1	P	103	AG19
28-Jul	12	12	46.61149	62.53571	2522	47.5	0.9	0	0	0	0	1	P	104	AG18
28-Jul	12	13	46.60972	62.63104	2428	47.5	1.3	0	0	0	0	1	P	105	AG17
29-Jul	12	1	46.60482	62.84682	2717	53	0.8	2	1311	0	0	1	P	106	AG16
29-Jul	12	2	46.70437	62.87904	2666	54.9	0.6	21	12578	0	0	1	P	107	AH16
29-Jul	12	3	46.60565	62.96397	2498	43.9	1	2	1528	0	0	2	P	108	AG16
29-Jul	12	4	46.67656	63.11908	2589	45.7	0.7	7	3745	1	368	2	P	109	AH15
29-Jul	12	5	46.62056	63.16874	2278	43.9	1.7	1	391	1	391	1	P	110	AG14
29-Jul	12	6	46.71754	63.19569	2243	45.7		13	8481	1	421	1	P	111	AH14
29-Jul	12	7	46.83117	62.90117	2636	54.9	-0.4	29	18133	0	0	1	P	112	AI16
29-Jul	12	8	46.94031	62.91467	2605	60.4	-0.5	77	41893	23	12021	1	P	113	AJ16
29-Jul	12	9	46.92534	63.01660	3188	60.4	-0.5	27	14685	9	4177	1	P	114	AJ15
29-Jul	12	10	46.88146	63.02136	2866	60.4	-0.5	6	3027	0	0	1	P	115	AI15
29-Jul	12	12	46.82597	63.25898	2414	49.4	0.2	0	0	0	0	3	A1	116	AI14
30-Jul	12	1	46.78742	63.41938	2160	43.9	2.4	6	3342	0	0	1	P	117	AI13
30-Jul	12	2	46.78658	63.49504	2184	42.1	4.2	5	3410	0	0	1	P	118	AI12
30-Jul	12	3	46.91231	63.31803	2722	56.7	-0.1	18	11073	1	365	1	P	119	AJ13
30-Jul	12	4	46.95931	63.20050	2286	58.5	-0.4	47	27706	1	417	1	P	120	AJ14
30-Jul	12	6	47.02791	63.07720	2745	58.5	-0.2	37	20389	2	898	3	A1	121	AK15
30-Jul	12	10	47.18759	63.01124	2520	60.4	-0.1	51	29512	1	720	3	A3	122	AL15
06-Aug	12	1	46.32098	61.91786	3324	40.2		6	4554	5	3908	1	P	123	AE22
06-Aug	12	2	46.38844	61.78663	2996	40.2	2.4	0	0	0	0	1	P	124	AE23
06-Aug	12	3	46.47821	61.74151	2657	40.2	1.5	1	840	1	840	1	P	125	AF23
07-Aug	12	1	47.66064	62.79236	3330	58.5	0	5	2046	3	1155	1	P	126	AP17
07-Aug	12	2	47.68709	62.81398	2786	58.5	0.1	5	2333	3	1290	1	P	127	AP16
07-Aug	12	3	47.79472	62.77847	3103	64	0.2	3	1867	2	1244	1	P	128	AQ17
07-Aug	12	5	47.70801	62.92976	2690	58.5	0.2	2	1141	0	0	3	A1	129	AQ16
07-Aug	12	6	47.85211	62.84767	2929	76.8	0.5	22	10696	12	5422	1	P	130	AR16

Date	CFA	T#	Lat	Lon	AS	D(m)	T(ºC)	CC/t	CW/t	RC/t	RW/t	Tq	SI	Se	Grid
07-Aug	12	7	47.84041	62.73160	2704	69.5	0.4	11	5443	6	2830	1	P	131	AR17
07-Aug	12	8	47.91325	62.58798	2499	64	0.3	4	2543	2	896	1	P	132	AR18
07-Aug	12	10	47.91154	62.42624	2919	73.2	0.7	10	4665	8	3755	3	P	133	AR19
07-Aug	12	11	47.99050	62.46615	2779	69.5	0.6	4	1588	4	1588	1	P	134	AS18
07-Aug	12	12	48.03478	62.37309	2744	80.5	1.1	16	8044	14	7036	1	P	135	AS19
07-Aug	12	13	48.06756	62.50045	3182	60.4	0.5	2	974	1	391	1	P	136	AT18
07-Aug	12	14	48.07822	62.37526	3826	73.2	0.6	11	5598	7	3509	1	P	137	AT19
08-Aug	12	2	48.21860	62.46493	1523	64	0.2	0	0	0	0	3	A1	138	AU18
08-Aug	12	4	48.15435	62.30268	2813	78.6	0.6	5	2256	2	863	3	A1	139	AU19
09-Aug	12	1	48.35798	63.68238	4371	89.6	1.7	0	0	0	0	1	P	140	AV11
09-Aug	12	2	48.33804	63.84245	2158	107.9	1.9	10	6086	3	2104	1	P	141	AV10
09-Aug	12	3	48.39979	63.83402	2802	109.7	2.4	1	883	0	0	1	P	142	AW10
09-Aug	12	4	48.45760	63.73547	2375	151.8	2.9	6	3172	6	3172	1	P	143	AW11
09-Aug	12	5	48.38993	63.53895	2859	122.5	2.1	0	0	0	0	1	P	144	AW12
09-Aug	12	6	48.30894	63.52118	3953	96.9	2.2	0	0	0	0	1	P	145	AV12
09-Aug	12	7	48.23854	63.64431	2921	98.8	2.9	5	2624	2	871	1	P	146	AU12
10-Aug	12	1	47.08406	64.18430	2578	40.2	3	0	0	0	0	2	P	147	AK08
10-Aug	12	2	47.18962	64.24489	2662	40.2	1.1	4	2186	0	0	1	P	148	AL08
10-Aug	12	3	47.22293	64.09869	2226	40.2	2.8	0	0	0	0	1	P	149	AL09
10-Aug	12	4	47.31130	64.19643	1820	45.7	0.8	4	2297	0	0	1	P	150	AM08
10-Aug	12	5	47.36013	64.28531	2727	54.9	0.6	8	4977	1	515	1	P	151	AN08
10-Aug	12	6	47.41759	64.08431	2007	36.6	1.7	0	0	0	0	1	P	152	AN09
10-Aug	12	7	47.33439	63.94955	2605	40.2	1.8	0	0	0	0	1	P	153	AM10
10-Aug	12	9	47.43676	63.83706	3132	60.4	0.5	12	6068	4	1886	3	A1	154	AN10
10-Aug	12	10	47.50951	63.88718	3835	58.5	0.9	4	2026	0	0	1	P	155	AO10
10-Aug	12	12	47.63390	63.97143	2493	49.4	0.8	0	0	0	0	3	A1	156	AP10
11-Aug	12	1	47.30172	64.44377	2554	42.1	0.2	5	2561	1	393	1	P	157	AM07
11-Aug	12	2	47.43663	64.34573	3000	53	0.7	21	11342	0	0	1	P	158	AN07
11-Aug	12	3	47.50178	64.39225	2606	45.7	0.5	13	7923	0	0	1	P	159	AO07
11-Aug	12	4	47.54512	64.17826	2413	64	0.6	55	29167	9	4341	1	P	160	AO08
11-Aug	12	5	47.55390	64.12853	2161	65.8	0.7	13	7107	2	1061	1	P	161	AO09
11-Aug	12	6	47.65947	64.16600	2467	69.5	0.6	33	20349	13	7778	1	P	162	AP08
11-Aug	12	7	47.68346	64.09238	2394	75	0.7	13	6578	3	1411	1	P	163	AP09
11-Aug	12	8	47.69824	64.16469	2566	71.3	0.5	17	8785	8	3785	1	P	164	AQ08
11-Aug	12	9	47.76429	64.00293	2381	82.3	0.8	3	1390	2	827	1	P	165	AQ09
11-Aug	12	10	47.82434	64.02288	2591	89.6	0.8	5	2730	3	1720	2	P	166	AR09
11-Aug	12	11	47.81249	64.16502	3056	58.5	2.5	2	780	2	780	1	P	167	AR08
12-Aug	12	1	47.94466	64.05612	3675	62.2	1	6	4143	1	497	1	P	168	AS09
12-Aug	12	2	47.93952	63.96559	2148	91.4	0.7	6	2933	2	796	1	P	169	AS10
12-Aug	12	3	47.82359	63.87368	2404	82.3	0.9	6	3123	1	384	1	P	170	AR10
12-Aug	12	4	47.75355	63.87466	2323	76.8	0.6	13	7558	3	1861	1	P	171	AQ10
12-Aug	12	5	47.71747	63.76484	3286	64	0.5	1	745	1	745	1	P	172	AQ11
12-Aug	12	6	47.64164	63.70465	3876	71.3	0.6	10	5747	3	1664	1	P	173	AP11
12-Aug	12	8	47.60426	63.59739	3112	69.5	0.8	28	16617	3	1647	3	A1	174	AP12
12-Aug	12	9	47.77135	63.48978	3950	76.8	0.5	3	1781	0	0	1	P	175	AQ12
13-Aug	12	1	47.86308	63.54744	3281	64	0.5	1	601	0	0	1	P	176	AR12
13-Aug	12	2	47.90582	63.70799	3137	65.8	0.6	0	0	0	0	1	P	177	AR11
13-Aug	12	3	47.99172	63.76841	2581	96.9	0.9	8	4858	2	1022	1	P	178	AS11
13-Aug	12	4	47.97970	63.53431	4159	76.8	0.6	23	15489	10	6070	1	P	179	AS12

Date	CFA	T#	Lat	Lon	AS	D(m)	T(ºC)	CC/t	CW/t	RC/t	RW/t	Tq	SI	Se	Grid
13-Aug	12	5	47.98025	63.41499	4155	76.8	0.7	9	5414	1	418	1	P	180	AS13
13-Aug	12	6	48.06716	63.26622	3824	76.8	0.3	10	5118	2	1001	1	P	181	AT14
13-Aug	12	7	48.15313	63.20489	2864	73.2	0.7	5	2963	3	1516	1	P	182	AU14
13-Aug	12	8	48.21414	63.31578	4111	95.1	0.9	7	4302	4	2206	1	P	183	AU13
13-Aug	12	9	48.13728	63.40483	3897	109.7	1.3	12	6701	5	2987	1	P	184	AT13
13-Aug	12	10	48.11898	63.58387	3655	91.4	1.5	5	4193	0	0	1	P	185	AT12
13-Aug	12	11	48.18822	63.69962	2299	104.2	1.3	12	7180	9	5435	1	P	186	AU11
14-Aug	12	1	48.11727	63.81673	3725	91.4	1.1	7	3731	5	2644	1	P	187	AT11
14-Aug	12	2	48.08788	63.86347	2520	95.1	0.7	18	11976	9	6452	1	P	188	AT10
14-Aug	12	3	48.14847	63.85307	2205	71.3	0.7	0	0	0	0	1	P	189	AT10
14-Aug	12	6	48.03356	63.99270	3285	54.9	0.8	28	16231	9	5617	3	A2	190	AS09
18-Aug	12	1	48.14250	64.33921	2173	34.7	3.3	0	0	0	0	1	P	191	AT07
18-Aug	12	2	48.23721	64.06867	3745	62.2	0.8	0	0	0	0	1	P	192	AU09
19-Aug	12	1	48.26943	62.37803	2844	75	1.2	0	0	0	0	3	A1	193	AV19
19-Aug	E	3	48.36037	62.45084	3319	241.4	6	1	477	1	477	3	A1	194	AV18
19-Aug	12	4	48.31254	62.68313	3574	93.3	1.9	0	0	0	0	1	P	195	AV17
19-Aug	E	5	48.44001	62.65090	3209	334.7	6	0	0	0	0	2	P	196	AW17
19-Aug	12	6	48.41780	62.85849	2502	166.4	5.8	0	0	0	0	1	P	197	AW16
19-Aug	12	7	48.37535	62.85520	3218	91.4	1.8	0	0	0	0	1	P	198	AV16
19-Aug	12	8	48.31337	62.98241	2956	78.6	1.2	6	3451	5	2573	1	P	199	AV15
19-Aug	12	9	48.39076	62.96296	2764	75	0.6	1	644	1	644	1	P	200	AW15
20-Aug	12	1	48.33011	63.15046	3327	51.2	0.5	1	500	0	0	3	A1	201	AV14
20-Aug	12	2	48.36013	63.39855	3272	86	3	0	0	0	0	1	P	202	AV13
20-Aug	12	3	48.44158	63.29770	3526	98.8	3.3	0	0	0	0	1	P	203	AW14
20-Aug	12	4	48.49704	63.31745	2962	122.5	3	0	0	0	0	1	P	204	AW13
20-Aug	12	5	48.53097	63.24666	2806	126.2	4.6	0	0	0	0	1	P	205	AX14
20-Aug	E	6	48.54656	63.12874	2473	223.1	5.4	0	0	0	0	1	P	206	AX15
20-Aug	E	7	48.59573	62.94528	2876	362.1	5.9	0	0	0	0	2	P	207	AX16
20-Aug	E	8	48.71493	63.11127	2506	340.2	6	0	0	0	0	2	P	208	AY15
20-Aug	12	9	48.75352	63.25333	2315	276.1	6	1	474	1	474	2	P	209	AZ14
21-Aug	12	1	47.95235	65.01784	1984	80.5	0.9	3	1840	1	678	1	P	210	AS04
21-Aug	12	2	47.89602	65.14091	3026	76.8	0.7	12	8114	6	4021	1	P	211	AR03
21-Aug	12	3	47.92936	65.17570	2050	75	0.8	8	6061	3	2646	1	P	212	AS03
21-Aug	12	4	47.96197	65.33875	2609	45.7	1.3	8	4456	5	2914	1	P	213	AS02
21-Aug	12	5	47.91647	65.51405	2439	47.5	0.9	5	2415	2	925	1	P	214	AS01
21-Aug	12	6	47.97560	65.62423	1708	45.7	1.8	0	0	0	0	1	P	215	AS00
21-Aug	12	8	47.78451	65.54224	1402	42.1	0.9	1	552	1	552	3	A1	216	AR00
21-Aug	12	9	47.86254	65.48955	2101	60.4	0.7	8	3829	6	2900	1	P	217	AR01
21-Aug	12	10	47.89293	65.20881	2219	69.5	0.7	18	10182	4	2477	2	P	218	AR02
24-Aug	12	1	47.88713	64.98860	2258	47.5	0.9	1	702	1	702	2	P	219	AR04
24-Aug	12	2	48.04098	64.98581	2678	86	0.8	3	1964	1	662	1	P	220	AT04
24-Aug	12	3	48.06781	64.77112	2194	84.1	0.9	4	2620	3	2253	1	P	221	AT05
24-Aug	12	4	48.24644	64.67578	2101	87.8	0.7	6	3932	4	2419	1	P	222	AU06
24-Aug	12	5	48.23637	64.51227	2702	87.8	0.7	8	6508	2	938	2	P	223	AU07
24-Aug	12	6	48.32909	64.51575	3030	75	0.9	5	2983	0	0	1	P	224	AV07
24-Aug	12	7	48.54260	64.12115	2659	100.6	1.6	5	3779	3	2373	1	P	225	AX09
24-Aug	12	8	48.54029	64.18299	1334	78.6	1.3	5	2960	4	2337	1	P	226	AX08
25-Aug	12	1	48.25105	64.30452	2396	100.6	1.2	18	14313	8	6198	1	P	227	AU08
25-Aug	12	2	48.27023	64.33514	2415	111.6	1.4	15	9722	1	619	1	P	228	AV08

Date	CFA	T#	Lat	Lon	AS	D(m)	T(ºC)	CC/t	CW/t	RC/t	RW/t	Tq	SI	Se	Grid
25-Aug	12	3	48.35524	64.17295	3156	80.5	1.4	0	0	0	0	1	P	229	AV08
25-Aug	12	4	48.45590	64.11661	3134	65.8	1.4	0	0	0	0	1	P	230	AW09
25-Aug	12	5	48.51824	63.84525	3836	58.5	1.4	0	0	0	0	1	P	231	AX10
25-Aug	12	6	48.55477	63.66687	2626	140.8	3.1	0	0	0	0	1	P	232	AX11
25-Aug	12	7	48.61459	63.65401	2324	120.7	3.2	0	0	0	0	1	P	233	AY12
25-Aug	12	9	48.62478	64.04975	1577	84.1	1.2	1	444	1	444	3	A1	234	AY09
26-Aug	12	1	48.76083	64.06041	3371	76.8	1.7	0	0	0	0	1	P	235	AZ09
26-Aug	12	3	48.81441	63.77210	2121	182.9	4.8	0	0	0	0	3	A1	236	AZ11
26-Aug	12	4	48.83044	63.55558	2337	237.7	5.7	0	0	0	0	2	P	237	AZ12
26-Aug	12	5	48.89591	63.59890	2058	296.3	6	0	0	0	0	1	P	238	BA12
26-Aug	12	6	48.94142	63.42596	1818	351.1	6	0	0	0	0	1	P	239	BA13
26-Aug	12	7	48.92218	63.26188	2231	382.2	5.9	0	0	0	0	2	P	240	BA14
27-Aug	12	1	48.62132	63.84981	2723	168.2	3.7	2	879	2	879	2	P	241	AY10
27-Aug	12	2	48.65985	63.82140	2723	142.6	3.8	0	0	0	0	2	P	242	AY11
27-Aug	12	3	48.72991	63.95993	2814	144.5	3.7	1	431	1	431	1	P	243	AZ10
28-Aug	12	1	48.83642	63.35330	1656	305.4	6.2	0	0	0	0	1	P	244	AZ13
28-Aug	12	3	48.62839	63.45991	2224	157.3	4.2	0	0	0	0	3	A1	245	AY13
28-Aug	12	4	48.64500	63.25473	2223	206.7	5.4	0	0	0	0	1	P	246	AY14
28-Aug	12	5	48.57549	63.42115	2610	131.7	3.8	0	0	0	0	1	P	247	AX13
28-Aug	12	7	48.54890	63.62138	3526	118.9	2.5	0	0	0	0	3	A1	248	AX12
03-Sep	12	1	47.30277	62.89653	3358	58.5	0.3	10	5668	1	519	1	P	249	AM16
03-Sep	12	2	47.38493	62.90025	2213	49.4	0.1	16	9683	2	917	1	P	250	AN16
03-Sep	12	3	47.50095	62.84925	1939	51.2	0.3	1	546	0	0	1	P	251	AO16
03-Sep	12	4	47.53910	63.02191	2779	53	0.2	0	0	0	0	1	P	252	AO15
03-Sep	12	5	47.57327	63.17183	2848	65.8	0.3	19	10913	8	4736	1	P	253	AO14
03-Sep	12	6	47.67272	63.13044	2750	65.8	0.3	26	14885	9	5028	1	P	254	AP15
03-Sep	12	7	47.73617	63.05447	3439	71.3	0.3	11	6370	6	3168	1	P	255	AQ15
03-Sep	12	8	47.75979	63.17360	3142	71.3	0.4	4	2130	1	474	1	P	256	AQ14
03-Sep	12	9	47.80990	63.14776	4263	73.2	0.3	14	8265	7	3840	1	P	257	AR14
03-Sep	12	10	47.88278	63.13047	3513	69.5	0.2	11	6196	5	3082	1	P	258	AR15
03-Sep	12	11	47.93642	63.05656	2911	62.2	0.3	2	1376	0	0	1	P	259	AS15
04-Sep	12	1	48.02908	62.80958	3452	80.5	0.5	5	2687	3	1442	1	P	260	AS16
04-Sep	12	2	48.02473	62.67618	3177	86	0.6	9	5150	4	1889	1	P	261	AS17
04-Sep	12	3	48.14766	62.66513	3941	98.8	1.1	13	7310	7	3806	1	P	262	AT17
04-Sep	12	4	48.19409	62.68546	3798	91.4	1	5	2553	5	2553	1	P	263	AU17
04-Sep	12	5	48.18174	62.84199	3171	75	0.4	5	2731	4	1881	1	P	264	AU16
04-Sep	12	6	48.20750	62.96877	3132	73.2	0.5	5	2449	4	1726	1	P	265	AU15
04-Sep	12	7	48.06967	62.91984	2867	65.8	0.4	13	5820	12	5345	1	P	266	AT16
04-Sep	12	8	48.04240	63.09855	3654	58.5	0.3	0	0	0	0	1	P	267	AT15
04-Sep	12	9	47.92750	63.18767	3003	64	0.2	4	2214	0	0	1	P	268	AS14
04-Sep	12	10	47.83363	63.34036	4244	75	0.3	12	5500	1	362	1	P	269	AR13
04-Sep	12	11	47.80299	63.32374	4311	80.5	0.3	8	3863	3	1163	1	P	270	AQ13
05-Sep	12	1	47.20205	63.81452	2910	47.5	0.6	1	760	0	0	1	P	271	AL10
05-Sep	12	2	47.19433	63.77388	3171	54.9	0.4	13	6918	2	1126	1	P	272	AL11
05-Sep	12	3	47.09892	63.70903	3102	54.9	0.5	10	6121	1	1012	1	P	273	AK11
05-Sep	12	4	46.96959	63.64312	3543	43.9	1.7	0	0	0	0	1	P	274	AJ11
05-Sep	12	5	46.97074	63.55948	3102	45.7	1.3	0	0	0	0	1	P	275	AJ12
05-Sep	12	10	47.00646	63.28655	2737	56.7	0.3	13	7219	0	0	3	A2	276	AK14
05-Sep	12	11	47.17614	63.24394	3733	65.8	0	15	8320	0	0	1	P	277	AL14

Date	CFA	T#	Lat	Lon	AS	D(m)	T(ºC)	CC/t	CW/t	RC/t	RW/t	Tq	SI	Se	Grid
06-Sep	12	3	47.16804	63.35103	1982	60.4	-0.2	1	849	0	0	3	A2	278	AL13
06-Sep	12	4	47.10753	63.57253	3528	54.9	0.7	5	2618	0	0	1	P	279	AK12
06-Sep	12	6	47.15603	63.60432	2489	51.2	0.7	0	0	0	0	3	A1	280	AL12
06-Sep	12	7	47.23951	63.64252	3268	65.8	0.4	6	3919	3	2063	1	P	281	AM11
06-Sep	12	8	47.34011	63.51361	2331	69.5	0.3	29	15259	5	2671	1	P	282	AM12
06-Sep	12	9	47.36607	63.48705	3382	73.2	0.3	27	13469	6	3492	1	P	283	AN12
06-Sep	12	10	47.34625	63.38149	3556	73.2	0.3	12	6083	7	3870	1	P	284	AM13
06-Sep	12	11	47.43845	63.39776	2046	80.5	0.4	5	2746	3	1603	1	P	285	AN13
06-Sep	12	12	47.43372	63.27525	3489	69.5	0.3	33	18303	9	4580	1	P	286	AN14
07-Sep	12	1	47.38708	63.71241	3232	65.8	0.4	15	7644	2	851	1	P	287	AN11
07-Sep	12	2	47.50771	63.72215	2894	69.5	0.5	6	3283	2	943	1	P	288	AO11
07-Sep	12	3	47.54904	63.51260	4444	71.3	0.4	17	9290	1	505	1	P	289	AO12
16-Sep	12	1	47.61527	63.39984	2850	78.6	0.4	25	14799	5	2961	1	P	290	AP13
16-Sep	12	2	47.55693	63.35848	3373	76.8	0.4	29	15985	6	3514	1	P	291	AO13
16-Sep	12	3	47.60393	63.26790	2424	86	0.4	12	5926	3	1639	1	P	292	AP14
16-Sep	12	4	47.43536	63.12796	2944	69.5	0.3	27	13949	12	6511	1	P	293	AN15
16-Sep	12	5	47.32757	63.05368	2553	64	0.2	67	37654	15	7541	1	P	294	AM15
16-Sep	12	6	47.28619	63.14572	3396	67.7	0.1	19	9459	5	2397	1	P	295	AM14
19-Sep	19	1	46.68357	61.12313	1756	84.1	1.9	1	647	0	0	1	P	296	AH27
19-Sep	19	2	46.69186	61.23803	2577	113.4	2.4	21	13298	16	10035	1	P	297	AH26
19-Sep	19	3	46.84869	61.04427	1661	102.4	1.9	18	12134	4	2722	1	P	298	AI27
19-Sep	19	4	46.83148	60.90227	3627	89.6	2.4	3	1867	1	454	1	P	299	AI28
19-Sep	19	5	46.93763	61.00655	3399	98.8	1.7	21	14709	7	4827	1	P	300	AJ27
19-Sep	19	6	47.00878	60.95286	3030	102.4	2.4	3	1486	0	0	2	P	301	AK27
19-Sep	19	7	47.00798	60.89093	2802	113.4	3.8	10	7499	1	1018	1	P	302	AK28
19-Sep	19	8	46.98150	60.81038	2711	135.3	5.5	9	6017	1	585	1	P	303	AK28
19-Sep	19	9	47.05401	60.74845	2681	146.3	5.7	13	8398	2	1544	1	P	304	AK29
20-Sep	19	1	46.91261	61.14829	3145	62.2	1.9	13	9430	3	2559	1	P	305	AJ26
20-Sep	19	2	46.79804	61.25279	2803	65.8	1.5	11	7322	4	2686	2	P	306	AI26
20-Sep	19	3	46.81475	61.28733	3096	62.2	1.5	20	13371	5	3337	1	P	307	AI26
20-Sep	19	4	46.73463	61.35554	2850	67.7	1.6	10	6920	5	3205	1	P	308	AH25
20-Sep	12	5	46.79609	61.50534	3050	64	1.4	10	5422	2	1032	1	P	309	AI24
20-Sep	12	6	46.90256	61.45538	3655	58.5	1.3	2	1289	0	0	1	P	310	AJ24
20-Sep	12	7	46.96331	61.39606	2928	49.4	1.3	33	19091	0	0	1	P	311	AJ25
20-Sep	12	8	47.00871	61.37576	1968	45.7	1.3	11	6711	0	0	1	P	312	AK25
20-Sep	12	9	47.01705	61.55608	2574	32.9	5	0	0	0	0	1	P	313	AK24
20-Sep	12	10	46.92829	61.62220	2387	49.4	1.3	8	4211	1	446	1	P	314	AJ23
20-Sep	12	11	46.87450	61.71851	2919	54.9	1.3	21	13785	4	2769	1	P	315	AI23
21-Sep	12	1	46.38254	61.62061	2193	54.9	1.4	15	9083	2	1218	1	P	316	AE24
28-Sep	19	1	46.63320	61.24313	3309	78.6	2.5	13	6584	6	2921	1	P	317	AG26
28-Sep	12	2	46.73804	61.60330	3693	73.2	0.9	9	4858	2	1019	1	P	318	AH24
28-Sep	12	3	46.61249	61.54636	3081	60.4	0.8	26	16964	12	7895	1	P	319	AG24
28-Sep	12	4	46.53319	61.44722	3442	64	0.9	8	6136	5	4326	1	P	320	AG25
28-Sep	12	5	46.45698	61.47761	1954	64	1.2	1	672	0	0	1	P	321	AF24
28-Sep	12	6	46.45955	61.36022	2820	62.2	1.3	7	3650	3	1639	1	P	322	AF25
28-Sep	12	7	46.37291	61.33432	2060	51.2	3.3	4	2550	2	1174	1	P	323	AE25
30-Sep	12	1	46.96256	62.04511	2168	53	0.3	0	0	0	0	3	A1	324	AJ21
30-Sep	12	2	47.00914	62.00924	2370	49.4	1	7	4205	0	0	1	P	325	AK21
30-Sep	12	4	46.88959	61.85420	2521	58.5	0.7	20	12361	2	899	3	A1	326	AJ22

Date	CFA	T#	Lat	Lon	AS	D(m)	T(ºC)	CC/t	CW/t	RC/t	RW/t	Tq	SI	Se	Grid
30-Sep	12	5	47.00713	61.87226	2586	40.2	3.3	0	0	0	0	2	P	327	AK22
01-Oct	19	1	47.28281	60.34914	2358	182.9	4.5	0	0	0	0	1	P	328	AM31
01-Oct	F	2	47.38207	60.39436	2972	80.5	1.6	0	0	0	0	1	P	329	AN31
01-Oct	F	3	47.42992	60.46655	3073	95.1	2.1	1	358	0	0	1	P	330	AN30
01-Oct	F	4	47.47974	60.60956	2811	76.8	1.1	5	2823	0	0	1	P	331	AO29
01-Oct	F	5	47.51122	60.48501	2461	140.8	3.1	5	3035	0	0	1	P	332	AO30
01-Oct	F	6	47.52484	60.40452	2597	301.8	6.2	0	0	0	0	2	P	333	AO31
01-Oct	F	7	47.55914	60.44609	2598	234.1	5.9	0	0	0	0	2	P	334	AP30
01-Oct	F	8	47.57171	60.69069	2729	56.7	0.9	4	2274	3	1738	1	P	335	AP29
01-Oct	F	9	47.56304	60.86325	2367	49.4	0.7	0	0	0	0	1	P	336	AP28
02-Oct	19	1	47.07926	60.49902	1670	135.3	4.3	1	372	1	372	1	P	337	AK30
02-Oct	19	2	47.19908	60.55084	1980	164.6	5.8	0	0	0	0	1	P	338	AL30
02-Oct	19	3	47.22220	60.67933	3577	95.1	2.1	0	0	0	0	1	P	339	AM29
02-Oct	19	4	47.30838	60.58925	2912	64	0	0	0	0	0	1	P	340	AM30
02-Oct	19	5	47.36552	60.64910	2667	64	2.2	0	0	0	0	1	P	341	AN29
02-Oct	12	6	47.46269	60.76581	2530	56.7	0.9	2	804	2	804	1	P	342	AO28
02-Oct	12	7	47.44761	60.93562	2283	49.4	0.8	2	1136	1	426	1	P	343	AO27
02-Oct	19	8	47.37083	60.80527	2643	64	1.3	16	8920	15	8331	1	P	344	AN28
02-Oct	19	9	47.27068	60.87013	2410	84.1	2	18	9192	7	3480	1	P	345	AM28
02-Oct	19	10	47.14974	60.75782	2476	142.6	3.4	0	0	0	0	1	P	346	AL29
04-Oct	12	1	47.04516	61.15682	3608	58.5	1.8	13	8776	3	1764	1	P	347	AK26
04-Oct	19	2	47.10960	61.05387	3802	76.8	2.1	15	9787	2	1496	1	P	348	AL27
04-Oct	12	3	47.16811	61.11446	3250	58.5	1.5	2	1003	2	1003	1	P	349	AL26
04-Oct	19	4	47.16971	60.91649	2869	82.3	2.2	5	3104	1	608	1	P	350	AL28
04-Oct	12	5	47.32944	61.09924	2719	51.2	1	3	1709	1	728	1	P	351	AM27
04-Oct	12	6	47.32564	61.15648	2383	45.7	1	5	2542	3	1354	1	P	352	AM26
04-Oct	12	7	47.37896	61.14186	2208	43.9	1.4	2	1049	1	403	1	P	353	AN26
04-Oct	12	8	47.36002	61.01302	2419	51.2	0.8	5	2992	3	1919	1	P	354	AN27