Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Research Document 2015/082

Gulf Region

Summary of 2014 snow crab trawl survey activities in the southern Gulf of St. Lawrence

M. Moriyasu, E. Wade, J.F. Landry, P. DeGrâce, T. Surette and M. Hébert

Science Branch, Gulf Region
Fisheries and Oceans Canada
P.O. Box 5030
Moncton, New Brunswick E1C 9B6

January 2016

Canada

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.

Research documents are produced in the official language in which they are provided to the Secretariat.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

ISSN 1919-5044

Correct citation for this publication:

Moriyasu, M., Wade, E., Landry, J.F., DeGrâce, P., Surette, T., and Hébert, M. 2016. Summary of 2014 snow crab trawl survey activities in the southern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/082. v + 39 p.

TABLE OF CONTENTS

ABSTRACT

This document summarizes the details of the 2014 snow crab bottom trawl survey of the southern Gulf of St. Lawrence. The primary objective of the survey is to provide the data on abundance and distribution of snow crab and other by-catch species. The survey was conducted from July 9 to October 12 using a chartered commercial fishing vessel, the “Jean Mathieu”. A total of 409 stations (including alternative stations) were trawled and 353 stations were successfully completed. This year new depth/temperature probes (Star Oddi®) were added to the net for obtaining more accurate net touch down information for the 2015 survey and beyond. In addition, a series of modification to the existing net sensors’ default settings was done. The range of measurement of the net spread, the depth of sensors, and the height of sensors were modified from 150 to 30 m, 2000 to 500 m, and 0 to 1.5 m (minimum value), respectively in attempt to diminish the information reception noise and increase the accuracy of swept surface estimations. Details on the survey protocols, timing of the survey, the characteristics of the individual trawl tow, and summary of snow crab and by-catch species are provided.

Résumé des détails sur le relevé de crabe des neiges dans le sud du golfe du Saint-Laurent en 2014

RÉSUMÉ

Ce document fournit un résumé des détails sur le relevé au chalut de fond du crabe des neiges et multi-espèces entrepris dans le sud du golfe Saint-Laurent en 2014. 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 9 juillet au 12 octobre à bord d'un navire de pêche commerciale nolisé "Jean-Mathieu. Au total, 409 stations (incluant les stations alternatives) ont été visitées parmi lesquelles 353 stations ont été chalutées avec succès. Cette année, les nouvelles sondes température/profondeur (Star Oddi®) ont été ajoutées afin d'obtenir les informations plus précises sur la touche du fond par le chalut pour le relevé à partir de 2015. De plus la portée de sonde de l'ouverture, de la profondeur et de la hauteur a été modifiée de 150 à 30 m, de 2000 à 500 m et de 0 à 1.5m, respectivement pour essayer de diminuer des bruits de réception des informations et augmenter la précision des estimés de la surface balayée. 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.

INTRODUCTION

This document summarizes the details of the 2014 snow crab bottom trawl survey of the southern Gulf of St. Lawrence. The primary objective of the survey is to provide the fishery-independent data to assess the status of the snow crab (*Chionoecetes opilio*) resource of the southern Gulf of St. Lawrence. The detail of the results of the snow crab stock assessment for the 2014 season was prepared separately (Hebert et al., unpublished).

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 2014

The survey protocol (target number of stations, their positions and sampling grid setting) was maintained for 2014 from previous years (2012-2013) (DFO 2014; Hébert et al. 2014) except for that the original position at a given square was not amenable during the 2013 survey and an alternative position was successful, this alternative position was considered as original position for the 2014 survey. The survey spatial sampling design for the 2014 season is based on a survey area partitioned into 355 square grids of 12.7 x 12.7 km (Figure. 1) as in the 2013 survey. In each grid identified for sampling, a primary station and two alternative stations 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 and the station was considered untrawlable by the onboard biologist, a tow at the first alternate sampling station within the same grid was done. If the trawl net was considered as unsuccessful at the first alternative station, a tow was conducted at the second alternate station up to the third alternative station. If the primary and the three alternative stations 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. 2014). 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 case that 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.

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). This year, new temperature/depth and temperature/depth/tilt sensors (Star Oddi®, Skeidaras 12210 Gardabaer, Iceland) were deployed together with traditionally used VEMCO temperature/depth probe to try to improve the definition of net touch down. However, the information obtained by these new probes was considered preliminary and the net touch-down was determined by traditional protocol using a VEMCO probe. 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 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 knots or sea conditions that may hinder the proper maneuverability of the boat.

For most of the sampling stations visited, a vertical profile of the water column was made using a CTD (SeaBird 19 plus®) equipped with a dissolved oxygen sensor (SBE 43) and a WetStar® fluorometer. The sensors sampled the following variables: temperature, conductivity (salinity), pH, and fluorescence.

For each successful trawl tow, the catch was sorted by species and the number of individuals, fish and invertebrates, was recorded. Species identifications were made based on taxonomic information in Scott and Scott (1988), Brunel et al. (1998), Pohle (1990), and Squires (1990). For snow crab, detailed measurements included the carapace width, chela height, shell hardness, gonad color, egg color, missing legs, and disease identification.

In addition, whole specimen from different fish and invertebrate taxa were collected, either for taxonomic identification purposes or for more in-depth laboratory analysis. 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 by groundfish research scientist was conducted (Annex 1). All other catches were sorted by species or species group, counted, and discarded.

SURVEY ACTIVITIES IN 2014

VESSEL, PERSONNEL AND THEIR ONBOARD TASKS

For the 2014 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.

There were always at least five crew members during the survey, Ghislain Bourgeois took command on “Jean-Mathieu” and acted as a winch operator with Daniel Langford (net repair master, helper in by-catch species measurement), Daniel Lapierre (crab measurement data recording, net repair), Denis Poirier (CTD, net repairs, right door setting), and O’Neil Poirier (net repairs, engineer, left door setting).

Three (3) employees (Marcel Hébert, Jean-François Landry and Pierre DeGrâce) from DFO Science participated in the 2014 survey such that there were always 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 data on crab, assisted by Daniel Lapierre.

DURATION AND TIMING OF SURVEY

The 2014 survey started on July 9 and ended on the 12th of October (96 days) (Figure 2). The starting dates were the same as, and ending date was two days earlier than the 2013 survey. A total of 355 stations were visited with the results of 353 successful stations (2 stations were deemed to be untrawlable) with total number of 409 tows.

It took 10 (8 in 2013) trips to complete the survey with a trip duration varying from 2 to 7 days and the number of stations visited varied from 18 (trip X) to 54 (trip IX) (Table 1, Figures 3-10). Approximately fifty percent (47 days) of the total duration of the survey (96 days) were spent at sea with at least one tow. Serious net damage (when the crew cannot repair onboard) occurred 20 (28 in 2013) times throughout the survey. We have used 7 Nephrops trawl nets during the survey. Historical information of the survey timing/duration was summarized in Figure 2. All trawl activity took place during civil twilight time (Table 2).

SURVEY ITINERARY

There were ten (10) trips for the 2014 survey, departing from different locations (Tables 1-2 and Figures 3-10).

1. The first trip departed from the port of Cheticamp and trawled in the Area 12/12F, the northern part of Magdalen Islands, and returned to Cap-aux-Meules, Magdalen Islands, QC.
2. The second trip departed from Cap-aux-Meules and conducted sampling in Shediac Valley and off western PEI and berthed at the wharf in Caraquet NB. The trip was shortened due to mechanical problems of the vessel.
3. The third trip departed from Caraquet, sampling the northern Bradelle Bank and the northern most part of the survey area, and returned to Caraquet.
4. The fourth trip started from Caraquet and sampled mainly in the Baie des Chaleurs, and off Gaspé then returned to Cap-aux-Meules.
5. The fifth trip departed from Cap-aux-Meules and trawled in Area 12F as well as in the Bradelle Bank areas and then returned to Cap-aux-Meules.
6. The sixth trip departed from Cap-aux-Meules and trawled off PEI and returned to Souris, PE.
7. The seventh trip departed from Souris and trawled in Area 18 and returned to Cap-aux-Meules.
8. The eighth trip departed Cap-aux-Meules and trawled off the south shore of the Magdalen Islands and returned to Cap-aux-Meules.
9. The ninth trip departed from Cap-aux-Meules and trawled the southern parts of Areas 12F and 19 and and returned to Cheticamp, NS.
10. The last trip departed from Cheticamp and trawled the northern part of Area 19 and returned to Cheticamp.

Monthly progression/completion of trawl stations (Figure 11) showed that in July the stations along the Laurentian Channel and in the Shediac Valley area and in August, Baie des Chaleurs, Gaspésie, Bradelle Bank and Magdalen trough were visited. In September and October, the southeastern corner of Area 12F, and stations in Magdalen Trough towards the western-Cape Breton Island were visited. This pattern was comparable to that observed in 2013.

QUALITY OF TOWS

A total of 409 (447 in 2013) tows were conducted in 2014 among which 312 (282 in 2013) tows were completed at the primary stations, 36 stations (58 in 2013) stations were completed at the first alternative station, 3 (11 in 2013) stations at the second alternative stations and 2 (1 in 2013) at the third alternative stations and 2 abandoned stations after 4 trials, which summed up to 56 bad tows accounted for 14% of total number of tows tried in 2014 (significant improvement from the 2013 survey 92 bad tows out of 447 trials). The bad tows were mostly located around Magdalen Islands and off Prince Edward Island towards Miscou Island. Tow abandoned tows also occurred in the same areas (Figures 12 and 13).

Two survey grids were deemed to be untrawlable after four attempts (one primary and three alternative stations). These grids (grid# AS23 and AO10) are located off north east of Magdalen Islands and in the Shediac Valley regions, respectively (Figure 12).

The details of each tow (date, tow number, position, swept area estimation, depth, temperature, catch in number and estimated weight/ tow of commercial crabs with carapace condition 1-2 and 3-5 as well as quality indicator of each tow) were summarized in Annex 1. The depth of trawl station varied from 27 m (15 fathoms) to 378 m (210 fathoms), temperature from -1.3 to 6.2˚C. The number per tow of commercial crab and of commercial crab with a carapace condition of 3-5 ranged from 0 to 38 and from 0 to 24, respectively. The highest number (38) of commercial crab caught was observed at lat. 46.959458˚N, long. 63.199378˚W (Area 12) on September 10th.

There were 5 tows that ended in a neighboring grid as the starting trawl position was closer/on the grid border. They are stations AR25 (AS25), AT9 (AT10), AS 3 (AR3), AO16 (AO15) and AO28 (AO29), (original intended grid and (ended grid)), which resulted in 5 vacant grids (Figure 13).

CATCH OF SNOW CRAB AND OTHERSPECIES

The historical trend in the mean number per tow of all male snow crabs caught (sizes and maturity confounded) sampled during the surveys are shown in Figures 14. The mean number per tow of male snow crab has fluctuated throughout the time series with notable peak values in 1990 and 1999 and the lowest in 2009 (the 1996 value should be disregarded as the survey was conducted only in Area 19). In all males crabs caught, 70.2% were immature/adolescent, which is consistent over the last decade (Figure 14).

The total number of commercial male snow crab captured has decreased from 2,093 in 2012 to 1,886 in 2013 and 1,885 in 2014 (Table 4). Since 1997, commercial-sized adult male snow crab per tow peaked in 2004 at approximately 10 crabs per tow (Table 4). The mean individual weight of commercial-sized adult male was 581 grams, lower than the previous year (2013) and historical average (585 g) (Table 4). The density values (crab/tow and number / km^2) were at 5.3 and 2,011, respectively, and were comparable to the previous year (5.4 and 1,994, respectively) also slightly below the historical average (5.7 / tow and 2,202 / km^2). The mean number per tow of crab with shell condition 5 has been low compared to the period between 1994 and 1999 (Figure 15). The percentage of carapace composition of the 2014 catch for adult commercial sized males was 13.2%, 49.0%, 26.4%, 11.3% and 0% for shell conditions 1, 2, 3, 4, and 5, respectively (Figure 15) , showing that more than 50% was composed of new recruits and no old crab.

The mean number of females per tow has also fluctuated throughout the time series (Figure 16) showing peaks in 1990, 1999, and 2012 and the lowest value in 2006 (1996 value should be disregarded as the survey was conducted only in Area 19). In 2014, the percentage of mature

female was 62% of total female catch (Figure 16). Further details of snow crab catch (e.g. size frequency of immature/adolescent and adult males and immature and adult females) were dealt by Hébert et al. (2015).

The information of by-catch species during the 2013 survey was summarized in Table 5. For invertebrates, some species are gathered into common name group (e.g. anemone, brittle star, sea cucumber, shrimp, starfish and whelk). A total of 27 species of invertebrates or groups and 47 species of fish were collected during the 2014 survey (Table 5). The most common invertebrate species captured (and counted), in number, were snow crab (24,504 versus 21,621 in 2013) followed by Sea urchin (15,672 compared to 16,669 in 2013), and sand dollar (11,000 compared to 9,010 in 2013).There was a notable change in the catch of group of shrimp which was 3,947 in 2014 whereas the count was 18,436 versus in 2013 as well as of group of starfish (3,976 compared to 16,447 in 2013).

For fish species, American plaice had the highest count in 2014 (32,095 versus 28,209 in 2013) followed by cod (5,175 compared to 3179 in 2013) and redfish (2,279 compared to 1,166 in 2013) (Table 5).

In terms of frequency of observation (number of grid with presence out of 353 stations) for invertebrates, snow crab was most frequently observed (320 stations) followed by the starfish group (281 stations, 282 in 2013) and the sea urchin group (214 stations, 213 in 2013), and for fish species, American plaice (323 stations compared to 325 in 2013) followed by cod (252 stations compared to 243 in 2013) and Atlantic staghorn sculpin (126 stations compared to114 in 2013) were the most frequently observed (Table 5).

MEASUREMENT OF GEOMETRY OF THE TRAWL NET

NET SONARS AND TEMPERATURE / DEPTH PROBE

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 eSonar®.

Locations of the e-Sonar sensor placement on the trawl are shown in Figure 17. 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 (Figure 17). 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, also used during the 2014 survey, records data at intervals of 7 (seven) seconds. 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 but 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 ships' 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.

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, 20 Angus Morton Drive, Bedford NS) is attached to the headline of the trawl. It measures depth and temperature at intervals of 1 (one) second and provides much more reliable information on depth than the hydro acoustic data, and therefore are 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.

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.

Finally results of swept area calculations for a number of combinations are examined and one of which is selected based on all the information available and is used during the biomass calculation, and start times based on this selection process are called the 'selected start times'.

NEW ADDITION OF SENSORS TO THE TRAWL NET

Production of the traditionally used VEMCO minilog sensor was discontinued in 2013 and the currently used probes will soon lose their battery power, therefore, this probe has to be replaced for the 2015 survey and beyond by another probe.

This year, two types of sensor i.e. temperature/depth (TD) and temperature/depth/tilt (TDT), (Star Oddi®, Skeidaras 12210 Gardabaer, Iceland) were chosen for trial and comparison with traditionally used VEMCO temperature/depth probe. These sensors (TD and TDT) are 15 mm in diameter and 47 mm in length (Figure 18A). Two TD and one TDT Star Oddi® probes were used during the 2014 trawl survey. One TD was attached to head rope next to VEMCO minilog and another TD and a TDT were placed into a separate plastic protective housing (Figure 18C)

and placed into stainless steel carrier (Figure 18D, E) attached to the footrope of the trawl net (outside of the net). TD sensor attached to both head rope and foot rope measure the temperature and pressure (depth) at an interval of 1 second. 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 (Figure 18B) at every second.

PRELIMINARY RESULTS OF NET TOUCH DOWN DETERMINATION WITH NEW PROBES

For the 2014 trawl survey, inflection-point models are applied to the data collected by e-Sonar net sensors, a VEMCO minilog, Star Oddi® 2 TDs and a TDT to compare the net touch down and subsequent net swept surface. The preliminary analysis obtained suggested that the tilt sensor placed on the footrope clearer definition of the net touch down. In addition, the sensors located on the headline seem to have a more gradual interaction with the bottom, 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 90's concur with those estimates from the Star Oddi® probes. The preliminary results (Figure 19) 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 a relatively precise and unbiased determination of the start time (Figure 19). The mean difference between the selected start times based on the information obtained from e-Sonar net sensors and a VEMCO minilog and those selected manually from the Star Oddi® TDT tilt x-axis sensor (not inflexion point model results) was -1.8 seconds. The tilt sensor indicated net touchdown 1.8 second earlier compared to the traditionally selected 'start (touchdown)' time. The median is -0.96 and the first and third quantiles are -4.9 and 2.6 seconds, respectively (Figure 19).

The replacement of the minilog sensor along with the more advanced post analysis method will ensure a continuation of proper determination of the start time.

The information obtained by the Star Oddi® TD/TDT probes was intended only for preliminary study and the swept area estimation for the 2014 survey was done by following traditional protocol using solely a VEMCO probe.

MODIFICATION OF THE EXISTING NET SENSORS' SETTING

This survey year, the setting of net spread sensors and depth sensors was modified in order to diminish the information noise during the tow, which may help for the improvement of the accuracy of measured values as well as better interpretation of the results. The range (maximum measured value) for the net spread sensors (e-Sonar E7010 Door Master as well as ES6000 Door Master) was decreased from 150 m to 30 m. Also the maximum measured value for the depth sensors (e-Sonar E2210 and E1210 Depth sensors) was decreased from 2000 to 50 m. For the head line sensor (height sensor: e-Sonar ES3200), the range of minimum and maximum measured values set at 0 and 60 m (manufacturer's default values) were modified to 1.5 to 60 m, respectively.

Comparing mean door spread values over years is difficult due to change of sampling protocol, survey vessel and net sensors. However, the last two years (2013 and 2014), the number of stations to trawl, survey polygon, survey vessel and net sensors were identical with only change in the range (maximum measured value) of the door spread sensors from 150 to 30 m. We found that the mean door spread values between 2013 and 2014 decreased by 0.3 m, which

was expected to occur. The difference was statistically different (The variances were homogeneous, t-test, p=0.015).

Information on the total number of data used, mean door spread with standard deviation of door spread, sonar type and survey vessel from 2010 to 2014 are summarized in Table 6

The values measured by depth sensors and height sensors were not directly used to estimate the net spread. The change of measured range for the depth sensor from 2000 to 500 m and height sensor to 0 to 1.5 m (minimum measured value) helped the determination of net touch down timing.

REFERENCES CITED

Brunel, P., Bossé, L., and Lamarche, G. 1998. Catalogue des invertébrés marins de l'estuaire et du golfe du Saint-Laurent. Publication spéciale canadienne des sciences halieutiques et aquatiques 126. 405 p.

DFO. 2014. Assessment of snow crab in the southern Gulf of St. Lawrence (Areas 12, 19, 12E and 12F) and advice for the 2014 fishery. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/008.

Hébert, M., Wade, E., DeGrâce, P., Landry, J.-F., and Moriyasu, M. 2014. The 2013 assessment of the snow crab (*Chionoecetes opilio*) stock in the southern Gulf of St. Lawrence (Areas 12, 19, 12E and 12F). DFO Can. Sci. Advis. Sec. Res. Doc. 2014/084.v + 45 p.

Hébert, M., Wade, E., DeGrâce, P., Landry, J.-F., and Moriyasu, M. 2016. The 2014 assessment of the snow crab (*Chionoecetes opilio*) stock in the southern Gulf of St. Lawrence (Areas 12, 19, 12E and 12F). DFO Can. Sci. Advis. Sec. Res. Doc. 2015/083.v + 45 p.

Moriyasu, M., Wade, E., Hébert, M., and Biron, M. 2008. Review of the survey and analytical protocols used for estimating abundance indices of southern Gulf of St. Lawrence snow crab from 1988 to 2006. DFO Can. Sci. Advis. Sec. Res. Doc. 2008/069. iv + 36 p.

Pohle, G. W. 1990. A guide to decapod Crustacea from the Canadian Atlantic: Anomura and Brachyura. Can. Tech. Rep. Fish. Aqua1. Sci. 1771: iv + 30 p.

Scott, W.B., and Scott, M.G. 1988. Atlantic Fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 731 p.

Squires, H.J. 1990. Decapod crustacean of the Atlantic coast of Canada. Canadian Bulletin of Fisheries and Aquatic Sciences 221. 532 p.

Wade, E., Moriyasu, M., and Hébert, M. 2014. Assessment methods and model used in the 2012 estimation of the snow crab, *Chionoecetes opilio*, stock in the southern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/113.

TABLES

Table 1. Survey performance statistics (duration of each trip, number of days at sea, number of tows visited, number of successful tows, number of tows succeeded at alternative station(s), number of abandoned stations and frequency of serious net damage) for the 2014 trawl survey.

	Trip Number										
Statistics	I	II	III	IV	V	VI	VII	VIII	IX	X	Total
Duration (days)	7	8	8	9	6	7	5	5	11	4	70
Number of days at sea (days)	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 without alternatives	28	40	35	40	46	23	21	14	47	18	312
Repeated tows succeeded at 1st alt.	10	4	5	2	2	1	3	2	7	0	36
Repeated tows succeeded at 2nd alt.	0	0	0	0	0	0	0	3	0	0	3
Repeated tows succeeded at 3rd alt.	0	1	0	0	1	0	0	0	0	0	2
Number of abandonned stations	1	0	0	0	1	0	0	0	0	0	2
Serious net damage (frequency)	3	3	3	1	3	0	0	1	6	0	20

Table 2. Start and end time of daily fishing operations and corresponding morning (mCtwt) (sunrise) and evening (eCtwt; sunset) civil twilight times during the 2014 trawl survey. Civil twilight and sun rise and sunset times were for Charlottetown, PE(46◦ 39' deg N, 63◦ 13' deg W). Sunrise/sunset calculator - National Research Council Canada

Trip number	Date mCtwt	mCtwt	First tow	Last tow	eCtwt
1	July 9, 2014	4:51	08:12:54	11:03:59	21:45
1	July10, 2014	4:52	05:19:48	19:18:28	21:44
1	July11, 2014	4:53	05:12:04	19:50:15	21:44
1	July12, 2014	4:54	10:19:30	20:47:23	21:43
1	July13, 2014	4:55	07:08:14	20:39:03	21:42
1	July14, 2014	4:56	06:09:12	07:31:04	21:41
2	July 20, 2014	5:03	05:27:54	19:16:58	21:35
2	July 21, 2014	5:04	07:38:00	17:48:12	21:34
2	July 22, 2014	5:05	05:29:40	20:22:01	21:33
2	July 24, 2014	5:07	07:07:06	20:11:26	21:30
2	July 25, 2014	5:09	06:30:39	15:54:56	21:29
3	July 31, 2014	5:17	17:51:43	20:36:18	21:21
3	August 1, 2014	5:18	05:43:15	19:41:14	21:19
3	August 2, 2014	5:19	06:47:35	17:36:06	21:18
3	August 5, 2014	5:24	10:03:04	19:40:10	21:13
3	August 6, 2014	5:25	06:57:14	19:55:30	21:12
3	August 7, 2014	5:26	05:37:23	13:04:06	21:10
4	August 11, 2014	5:32	15:11:16	19:35:09	21:03
4	August 12, 2014	5:33	05:54:06	20:07:04	21:01
4	August 13, 2014	5:35	05:55:25	19:22:14	21:00
4	August 14, 2014	5:36	06:02:32	11:10:58	20:58
4	August 16, 2014	5:39	13:29:45	20:02:21	20:54
4	August 17, 2014	5:40	06:05:21	19:38:40	20:52
5	August 22, 2014	5:47	06:18:00	20:03:31	20:43
5	August 23, 2014	5:49	06:16:52	19:50:14	20:41
5	August 24, 2014	5:50	06:12:53	18:16:23	20:39
5	August 25, 2014	5:52	06:13:38	18:57:02	20:37
5	August 26, 2014	5:53	06:20:12	20:10:00	20:35
6	September 2, 2014	6:03	06:29:02	13:20:35	20:21
6	September 4, 2014	6:05	06:19:18	19:47:02	20:17
6	September 5, 2014	6:07	06:31:41	16:42:13	20:15
7	September 8, 2014	6:11	19:31:36	19:31:36	20:09
7	September 9, 2014	6:12	06:31:26	19:17:49	20:07
7	September 10, 2014	6:13	06:38:45	19:07:31	20:05
7	September 11, 2014	6:15	06:32:31	08:53:30	20:03
8	September 15, 2014	6:20	07:59:30	17:54:32	19:55
8	September 16, 2014	6:21	08:02:24	18:48:12	19:53
8	September 17, 2014	6:23	06:51:05	11:18:39	19:51
9	September 30, 2014	6:40	07:10:37	17:34:15	19:25
9	October 1, 2014	6:41	07:04:59	17:31:53	19:23
9	October 2, 2014	6:43	08:49:50	16:41:24	19:21
9	October 3, 2014	6:44	11:46:42	18:37:41	19:19
9	October 4, 2014	6:45	08:10:53	17:10:43	19:17
9	October 6, 2014	6:48	07:13:09	17:55:19	19:13
9	October 7, 2014	6:49	07:02:26	18:32:58	19:11
10	October 11, 2014	6:55	07:12:49	18:24:00	19:04
10	October 12, 2014	6:56	07:09:19	16:23:29	19:02

Table 3. Number of stations sampled in total and by quality of tow (QT) for surveys in 1997 to 2014. Quality of tow labels are as follows: QT1 = successful trawl catch with acceptable area swept data; QT2 = successful trawl catch with unusable area swept data; QT3 = successful tow at the first alternative station with acceptable area swept data; QT4 = successful tow at the first alternative station with unusable area swept data, QT5 = successful tow at the second alternative station with acceptable area swept data, QT6 = successful tow at the second alternative station with unusable area swept data, QT7 = successful tow at the third alternative station with acceptable area swept data, QT8 = successful tow at the third alternative station with unusable area swept data, QT9 = unsuccessful tows and deemed to be untrawlable.

Year of survey	Total successful stations	QT1	QT2	QT3	QT4	QT5	QT6	QT7	QT8	QT9	Total tows conducted
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	444
2014	353	295	17	36	0	2	1	2	0	2	409

Table 4. Number of commercial-sized (>= 95 mm carapace width) adult male crabs captured during the survey, mean number of crabs per tow (unadjusted), estimated mean weight of commercial-sized adult crabs, and mean density (number per km²) of commercial crab, number of grids sampled and mean swept area of successful tows, 1997 to 2014.

Year	Number of crabs sampled	Crabs per tow	Mean weight (g)	Crab density (number per km²)	Number of grids sampled	Mean swept area (m²)
1997	1,335	5.2	600	2,383	213	2,245
1998	1,419	5.4	596	2,258	215	2,352
1999	1,472	5.3	563	2,166	225	2,542
2000	1,346	4.8	587	1,798	224	2,717
2001	1,724	5.9	540	2,168	225	2,658
2002	1,913	6.0	546	2,530	229	2,504
2003	2,682	8.5	560	3,150	226	2,921
2004	3,321	9.6	577	3,221	229	3,200
2005	2,327	6.8	585	2,656	233	2,778
2006	2,302	6.5	616	2,558	259	2,850
2007	1,911	5.4	610	2,252	259	2,768
2008	1,431	4.0	611	1,787	259	2,658
2009	900	2.5	610	1,029	259	2,847
2010	1,057	3.0	607	1,280	258	2,734
2011	1,970	5.6	584	2,036	257	2,708
2012	2,093	6.5	566	2,359	321	2,677
2013	1,886	5.4	596	1,994	352	2,600
2014	1,884	5.3	581	2,011	353	2,668

Table 5. Summary of total catches (number) by species of invertebrates and fish, and number of grids out of 353 sampled where the species were present in the catches of the survey in 2014. Invertebrates are in bold. Anemone, brittle stars, sea cucumbers, shrimps, sponges, starfish, and whelks were not identified to species. The total catch of brittle stars was not counted.

Scientific name	Common name	Total Catch	Number of Grids	Total weight (g)
Aspidophoroides monopterygius	Alligator-fish	53	28	1,322
Hippoglossoides platessoides	American plaice	32,095	323	2,733,973
Actiniaria	**Anemones**	**990**	**65**	**187,390**
Artediellus uncinatus	Artic hook ear sculpin	8	2	590
Gymnocanthus tricuspis	Artic staghorn sculpin	772	126	57,585
Lycodes terraenovae	Atlantic eel pouts	10	9	2,680
Artediellus atlanticus	Atlantic hook-ear sculpin	12	3	660
Leptagonus decagonus	Atlantic poacher	230	75	5,531
Anarhichas lupus	Atlantic Wolf fish	77	32	3,213
Gorgonocephalus sp.	**Basket star**	**2,525**	**132**	**522,280**
Ophiuroidea	**Brittle star**	**N/A**	**14**	**388,875**
Mallotus villosus	Capelin	684	32	10,442
Gadus morhua	Cod	5,175	252	2,207,284
Lycenchelys paxillus	Common wolf eelpout	9	7	3,380
Leptoclinus maculatus	Daubed shanny	1	1	20
Centroscyllium fabricii	Dogfish	8	3	3,830
Liparis gibbus	Dusky snail fish	283	40	17,116
Enchelyopus cimbrius	Four bearded rockling	44	20	2,216
Eumesogrammus praecisus	Four-line snake blenny	77	32	3,213
Myoxocephalus aenaeus	Grubby sculpin	47	15	5,410
Melanogrammus aeglefinus	Haddock	6	3	3,970
Hippoglossus hippoglossus	Halibut	11	10	29,920
Pagurus sp.	**Hermit Crab**	**509**	**111**	**16,738**
Clupea harengus	Herring	104	8	16,620
Hyas araneus	**Toad crab**	**352**	**81**	**41,557**
Hyas coarctatus	**Toad crab**	**1,326**	**154**	**92,512**
Clinocardium islandicum	Iceland clam	45	11	2,890
Atolla sp.	**Jellyfish**	**7**	**1**	**220**
Lycodes lavalaei	Laval eelpout	112	73	40,518
Homarus americanus	**Lobster**	**59**	**5**	**19,990**
Phycis chesteri	Long-fin hake	78	8	8,338
Myoxocephalus octodecemspinosus	Long-horn sculpin	165	32	21,800
Cyclopterus lumpus	Lump-fish	3	3	1,760
Lophius americanus	Monkfish	2	2	3,860
Triglops murrayi	Moustache sculpin	31	16	504
Lithodes maja	**Northern stone crab**	**113**	**28**	**36,590**
Rossia megaptera	**Octopus**	**5**	**5**	**216**
Arctica islandica	**Quahog**	**277**	**10**	**13,570**
Sebastes sp.	Redfish	2,279	77	291,118
Gadus ogac	Rock Cod	51	17	17,690
Cancer irroratus	**Rock Crab**	**38**	**7**	**3,745**
Nezumia bairdii	Round-nose Grenadier	388	22	13,781
Echinarachnius parma	**Sand Dollar**	**11,000**	**87**	**314,994**
Placopecten magellanicus	**Scallop**	**33**	**16**	**3,381**
Holothuroidea	**Sea Cucumber**	**711**	**82**	**333,552**
Aphrodita hastate	**Sea Mouse**	10	3	430
Boltenia ovifera	**Sea Potato**	**1,619**	**72**	**169,853**
Hemitripterus americanus	Sea Raven	14	8	5,560
Careproctus reinhardti	Sea Tadpole	3	3	221
Strongylocentrotus sp.	**Sea Urchin**	**15,672**	**214**	**747,977**
Polychaeta	**Sea Worm**	**1**	**1**	**10**
Myoxocephalus scorpius	Short-horn sculpin	146	46	19,330
Decapoda	**Shrimps**	**3,947**	**75**	**43,691**
Merluccius bilinearis	Silver hake	18	11	4,290
Rajidae egg case	Skate egg case	7	3	60
Malacoraja senta	Smooth Skate	99	26	51,850
Lumpenus lampretaeformis	Snake blenny	165	23	3,432
Chionoecetes opilio	**Snow crab**	**24,504**	**320**	**N/A**

Scientific name	Common name	Total Catch	Number of Grids	Total weight (g)
Icelus spatula	Spatulate sculpin	74	33	1,686
Eumicrotremus spinosus	Spiny lump sucker	29	25	1,217
Porifera	**Sponge**	**85**	**30**	**46884**
Illex illecebrosus	**Squid**	**2**	**2**	**470**
Asteroidea	**Starfish**	**3,976**	**282**	**547607**
Amblyraja radiata	Thorny skate	359	76	18,0400
Reinhardtius hippoglossoides	Turbot	62	20	28,690
Icelus bicornis	Two-horn Sculpin	134	34	2,513
Buccinidae	**Whelk**	**858**	**148**	**30,658**
Buccinidae	**Whelk egg**	**97**	**35**	**4,303**
Urophycis tenuis	White hake	289	26	88,770
Pseudopleuronectes americanus	Winter flounder	118	9	17,800
Leucoraja ocellata	Winter skate	11	10	13,530
Glyptocephalus cynoglossus	Witch flounder	859	85	229,854
Limanda ferruginea	Yellowtail	1,314	77	83,984

Table 6. The total number of data used (count), mean door spread with standard deviation of door spread, sonar type and survey vessel from 2010 to 2014.

Survey year	Count[1]	Mean Door Spread (m)	Standard Deviation of Door Spread (m)	Sonar Type	Trawl Vessel
2010	331	8.40	1.78	NetMind	Marco-Michel
2011	302	8.45	2.44	NetMind	Marco-Michel
2012	281	8.71	1.61	NetMind	Marco-Michel
2013	281	8.19	1.48	e-Sonar	Jean Mathieu
2014	338	7.89	1.54	e-Sonar[2]	Jean-Mathieu
Total	1533	8.32	1.82	-	-

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

[2] The maximum range of door spread was reduced from 150m to 30m.

FIGURES

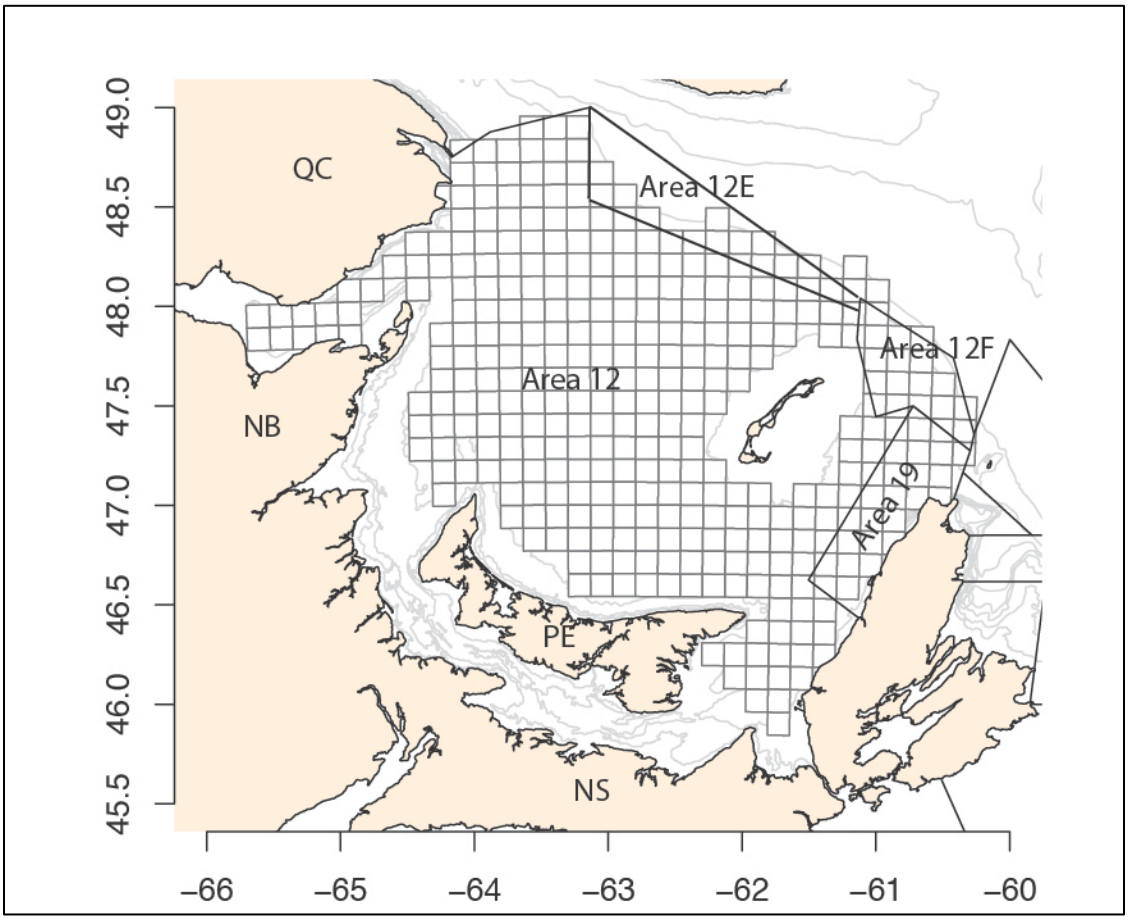

Figure 1. Snow crab survey grid sampling design for the southern Gulf of St. Lawrence in 2014. There are a total of 355 sampling grids defined by squares measuring 12.7 by 12.7 kilometres.

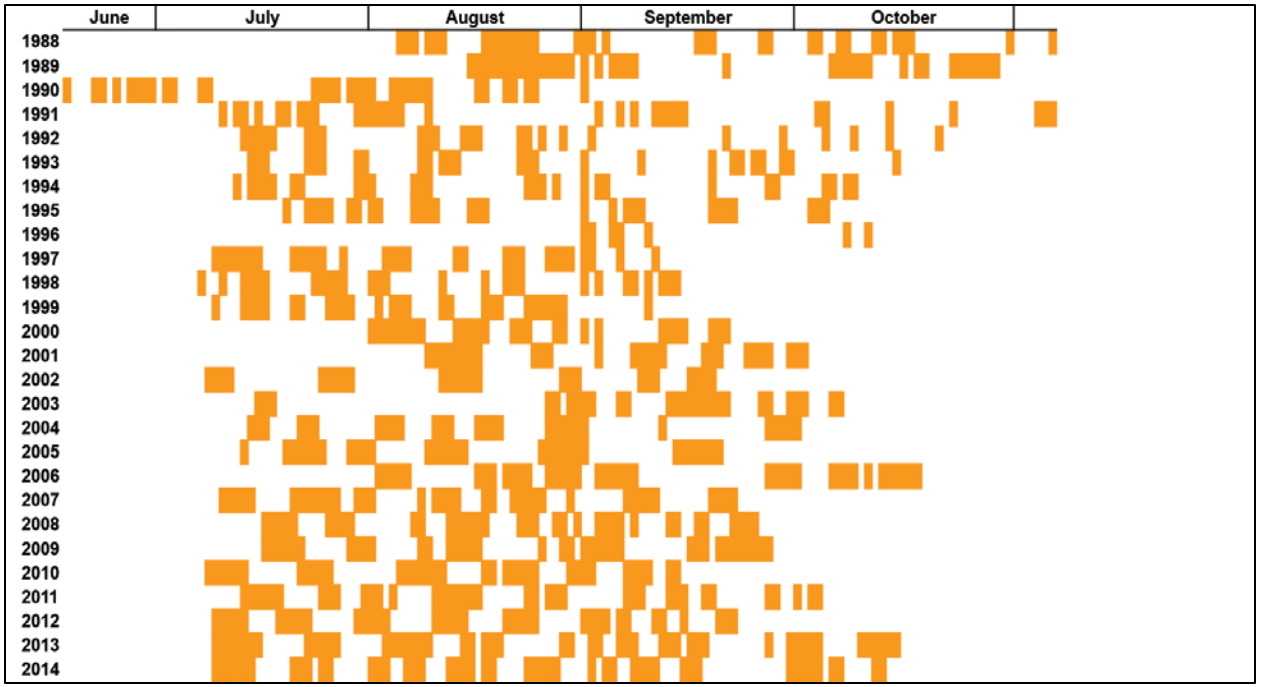

Figure 2. Historic information of the timing and duration of snow crab survey.

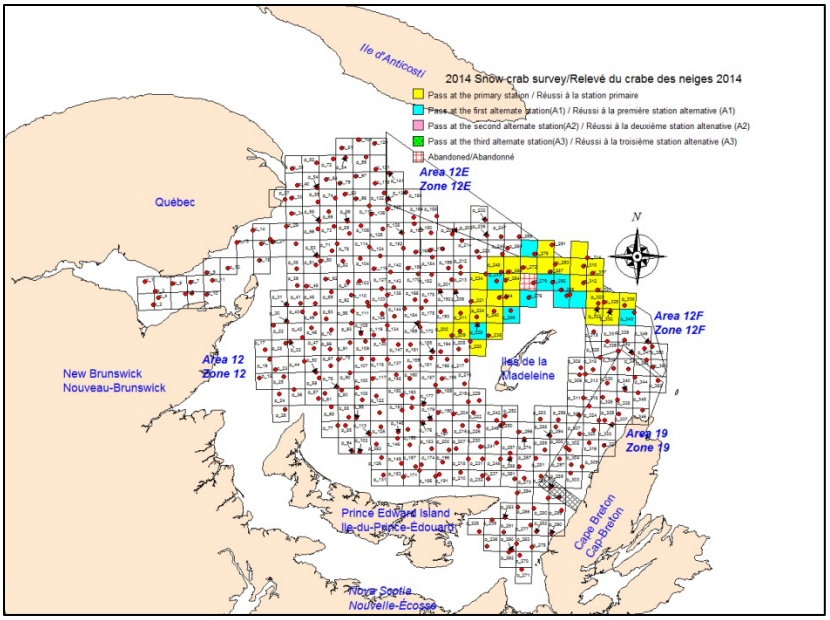

Figure 3. Snow crab trawl survey progress during the first trip. Station 279 was abandoned. During the 2013 survey, station 354 was abandoned in the same sector. It is important to note that the station numbering in 2014 is different than 2013. The squares are however identical.

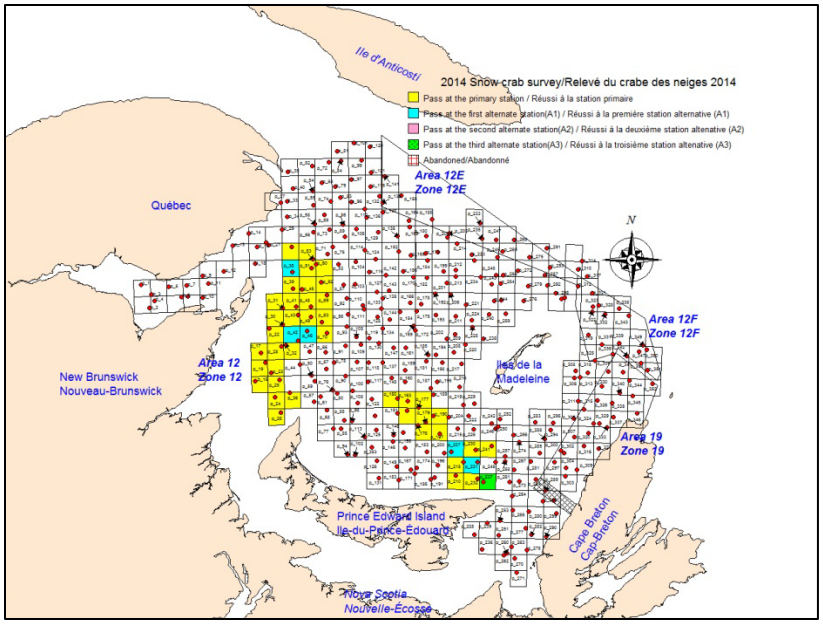

Figure 4. Snow crab trawl survey progress during the trip #2. The trawl damages after the first two days of the trip have caused changes to the sampling plan so to end the trip in the Shediac Valley. A temperature / depth recorder attached to the footrope was lost.

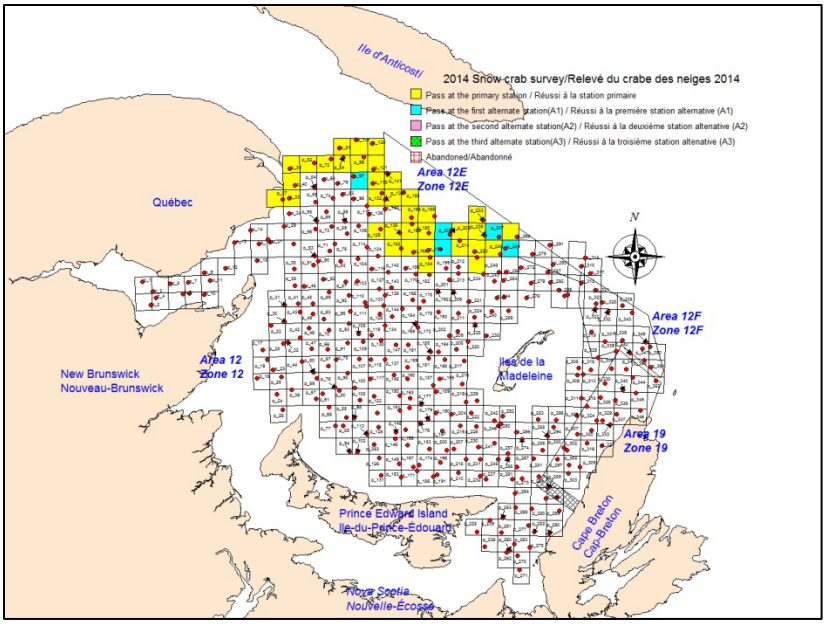

Figure 5. Snow crab trawl survey progress during the trip #3. Two pairs of trawl doors are damaged during the trip. Some mechanical problems with the ship occurred.

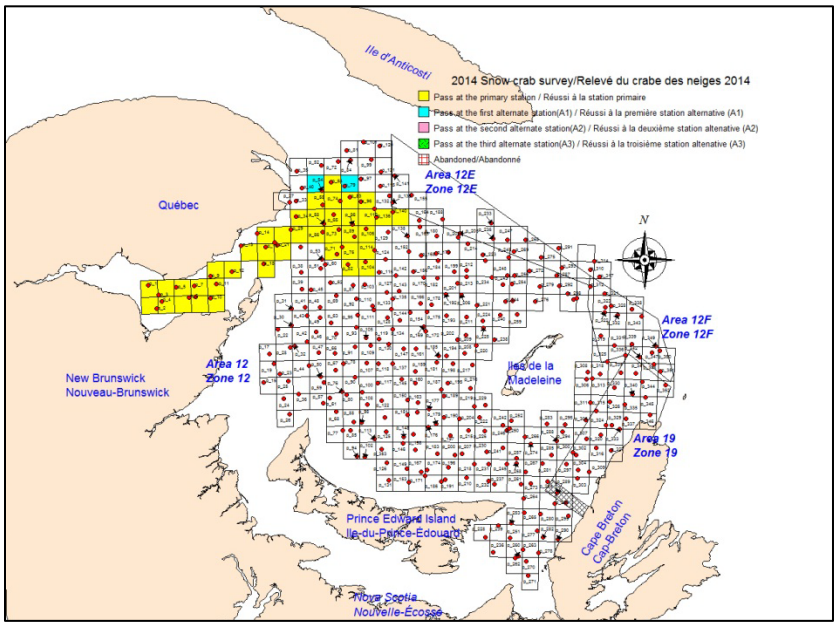

Figure 6. Snow crab trawl survey progress during the trip #4. Vessel visited stations in Baie des Chaleurs and Bradelle Bank.

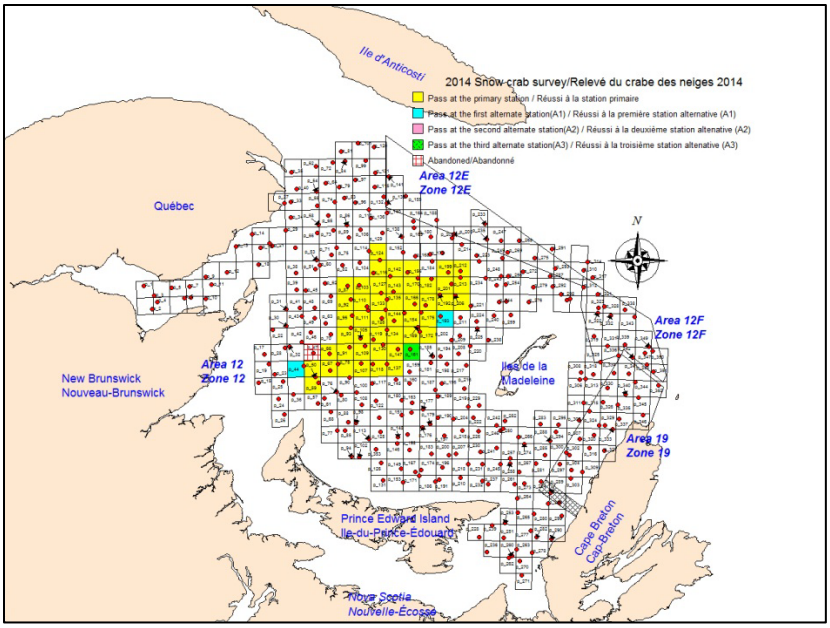

Figure 7. Snow crab trawl survey progress during the trip #5. Vessel visited stations in the region of Bradelle Bank towards eastern Prince Edward Island. One station off West Point, PEI was abandoned after 4 trials. Three trawl nets were seriously damaged at the last day of this trip. A 'Star-Oddi® Temperature/depth' recorder was damaged.

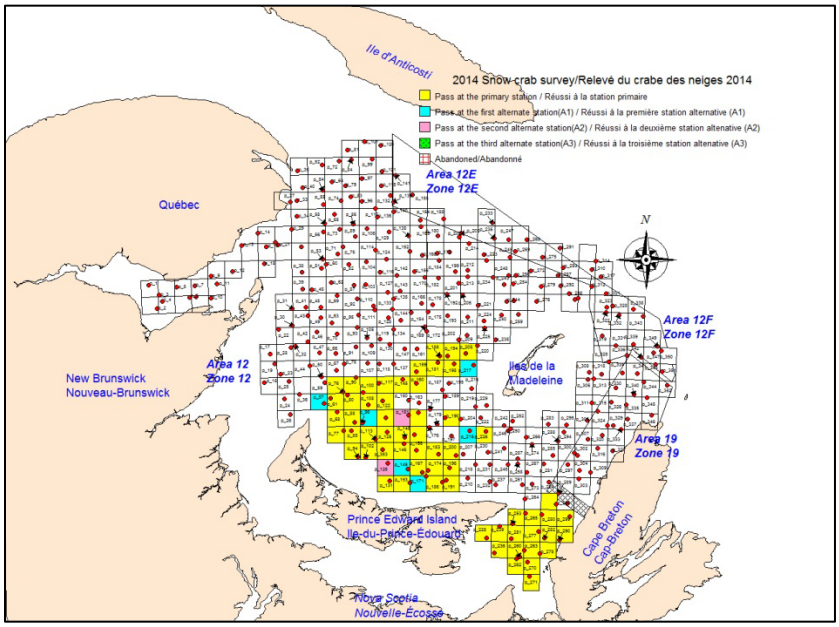

Figure 8. Snow crab trawl survey progress during the trips #6-8.Vessel visited stations in the region of Prince Edward Island towards Area 18. The survey trips 6-8 were slowed down because of strong wind and mechanical problem of the vessel. In total 283 stations have been visited with 281 success and 2 abandoned stations. There are 72 stations to be trawled which are located in the south of Magdalen Island, Area F and Area 19.

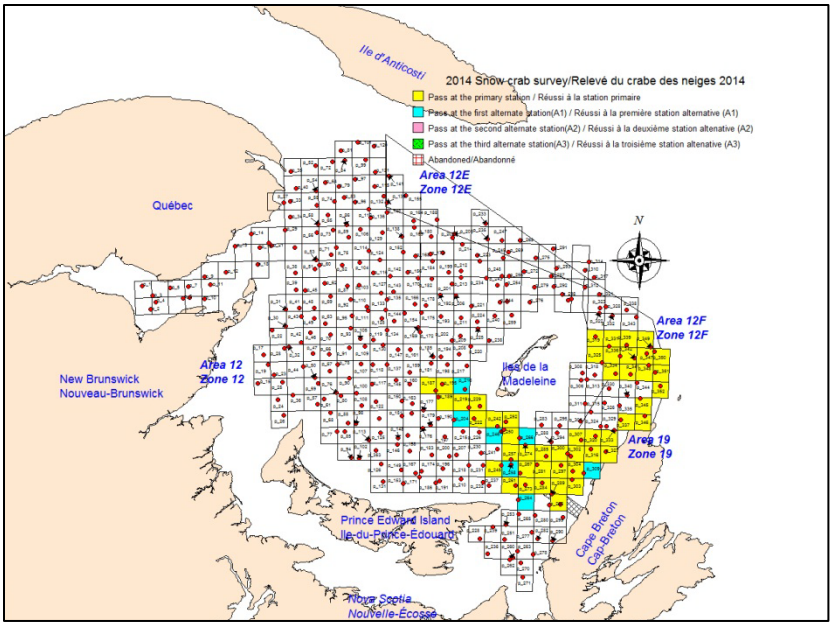

Figure 9. Snow crab trawl survey progress during the trips #9. Vessel visited stations in the region south of Magdalen Islands, south and north of Area 19 and southern half of Area F. 54 stations have been visited with success. Due to strong winds, the survey was interrupted twice. Trawl nets have been damaged 6 times in the region between Prince Edward Island and Magdalen Islands, and temperature/depth and temperature/depth/tilt sensors were lost.

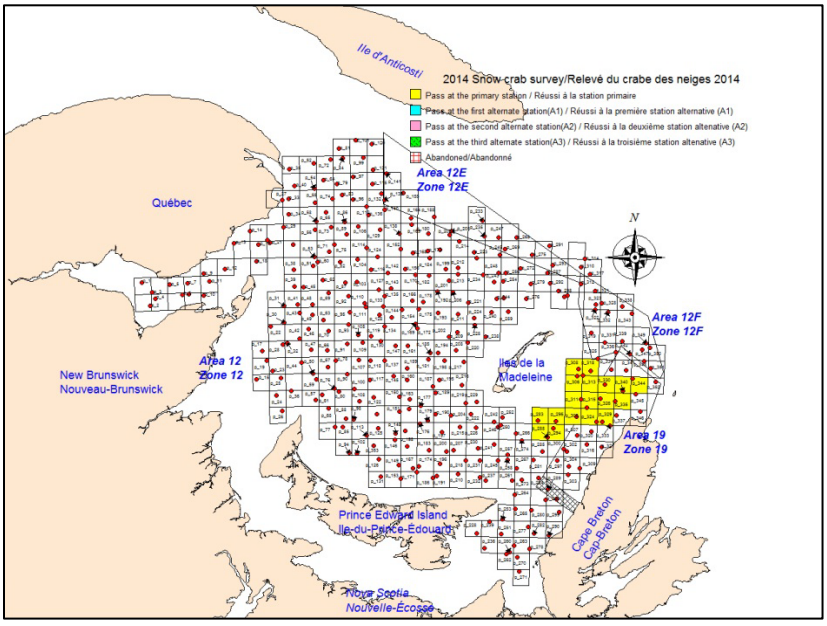

Figure 10. Snow crab trawl survey progress during the trips #10. The vessel visited stations in the region of north-west of Area 19 and east of Magdalen Islands. In total 355 stations have been visited as planned with 353 success and 2 abandoned stations. This year's survey was completed 2 days earlier than last year's (October 14th) with the same starting date on July 9th. Overall performance was better (312 primaries, 36 alternative-1, 3 alternative-2 and 2 alternative-3 with 2 abandoned in 2014 vs 282 primaries, 58 alternative-1, 1 alternative-2, 1 alternative-3 with 3 abandoned in 2013).

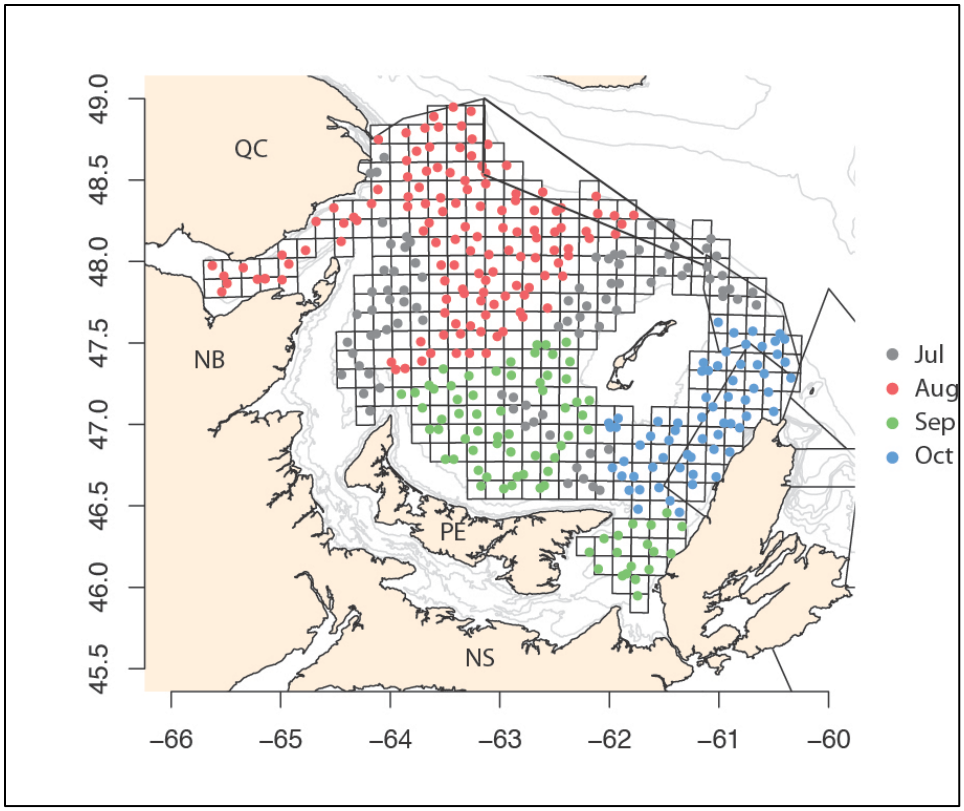

Figure 11. Monthly geographic distribution of stations trawled during the 2014 snow crab survey.

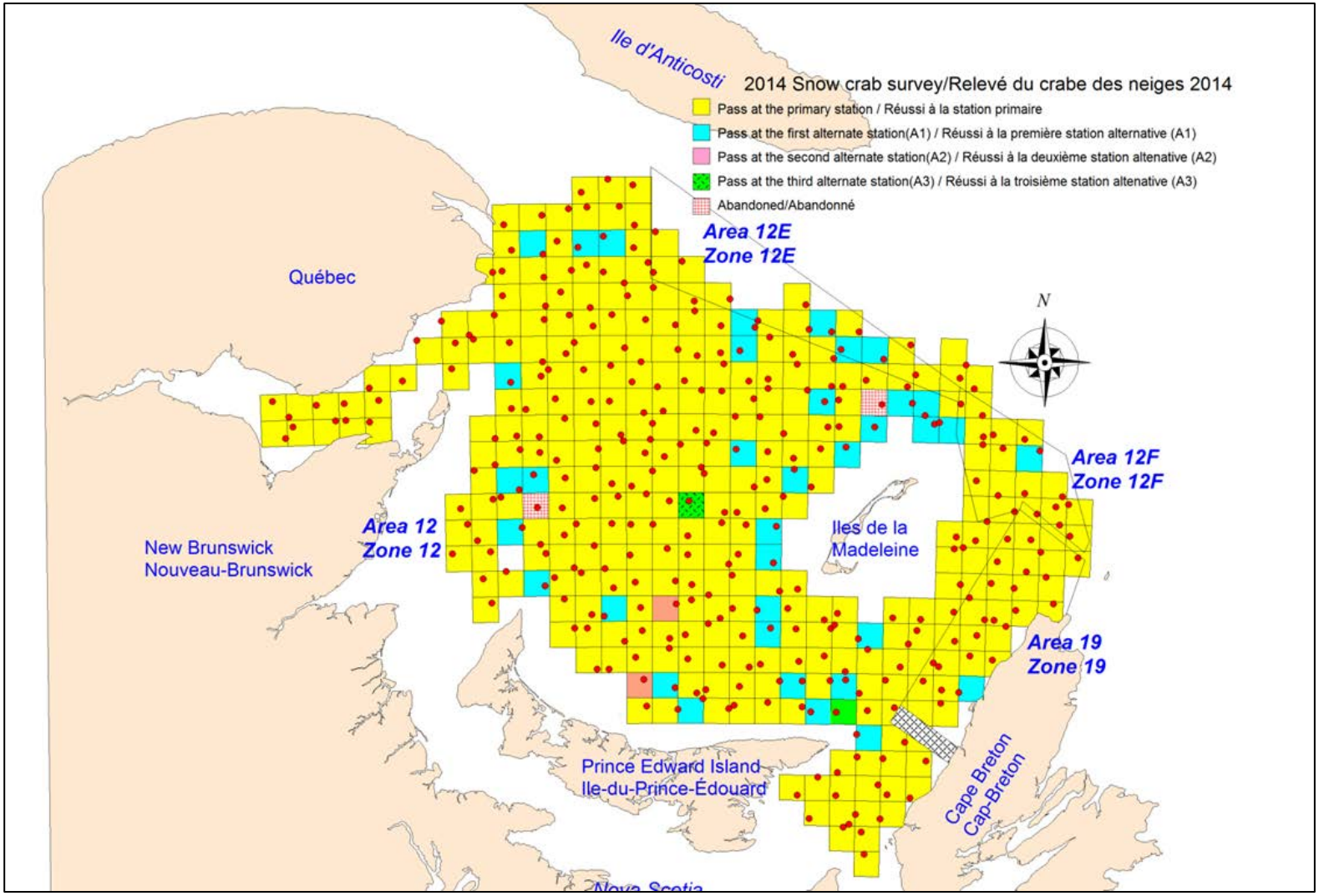

Figure 12. Distribution of survey stations with tow quality during the 2014 snow crab survey.

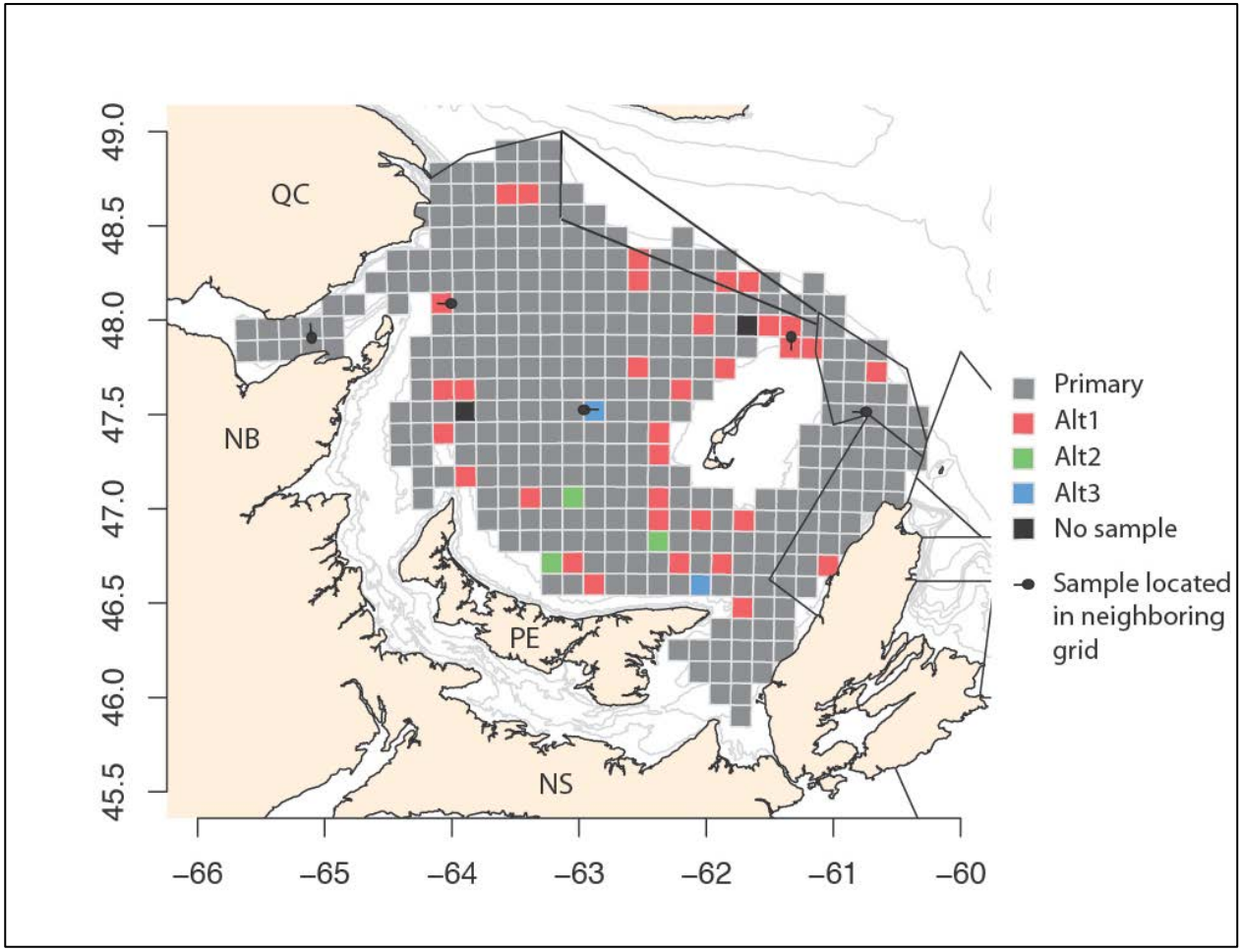

Figure 13. Geographic position of sampling stations versus sampling grids. Total of 2 stations (grids) were deemed to be untrawlable and there were 5 vacant grids (grid with no trawl station, AR25, AT9, AS3, AO16 and AO28) resulted in 5 grids containing 2 trawl stations (AS25, AT10, AR3, AO15 and AO29).

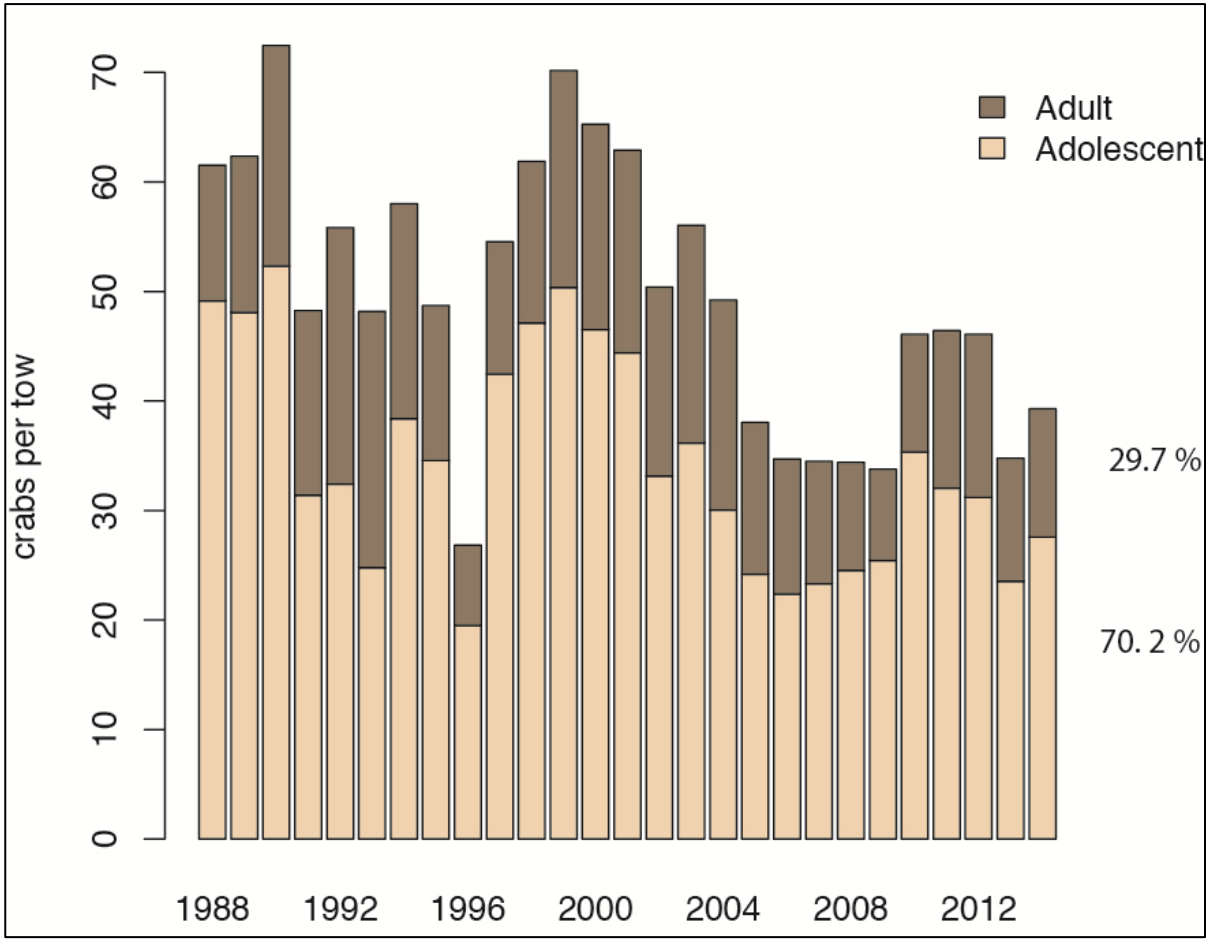

Figure 14. Historical mean number of all male snow crabs per tow by maturity observed during the snow crab survey since 1988.

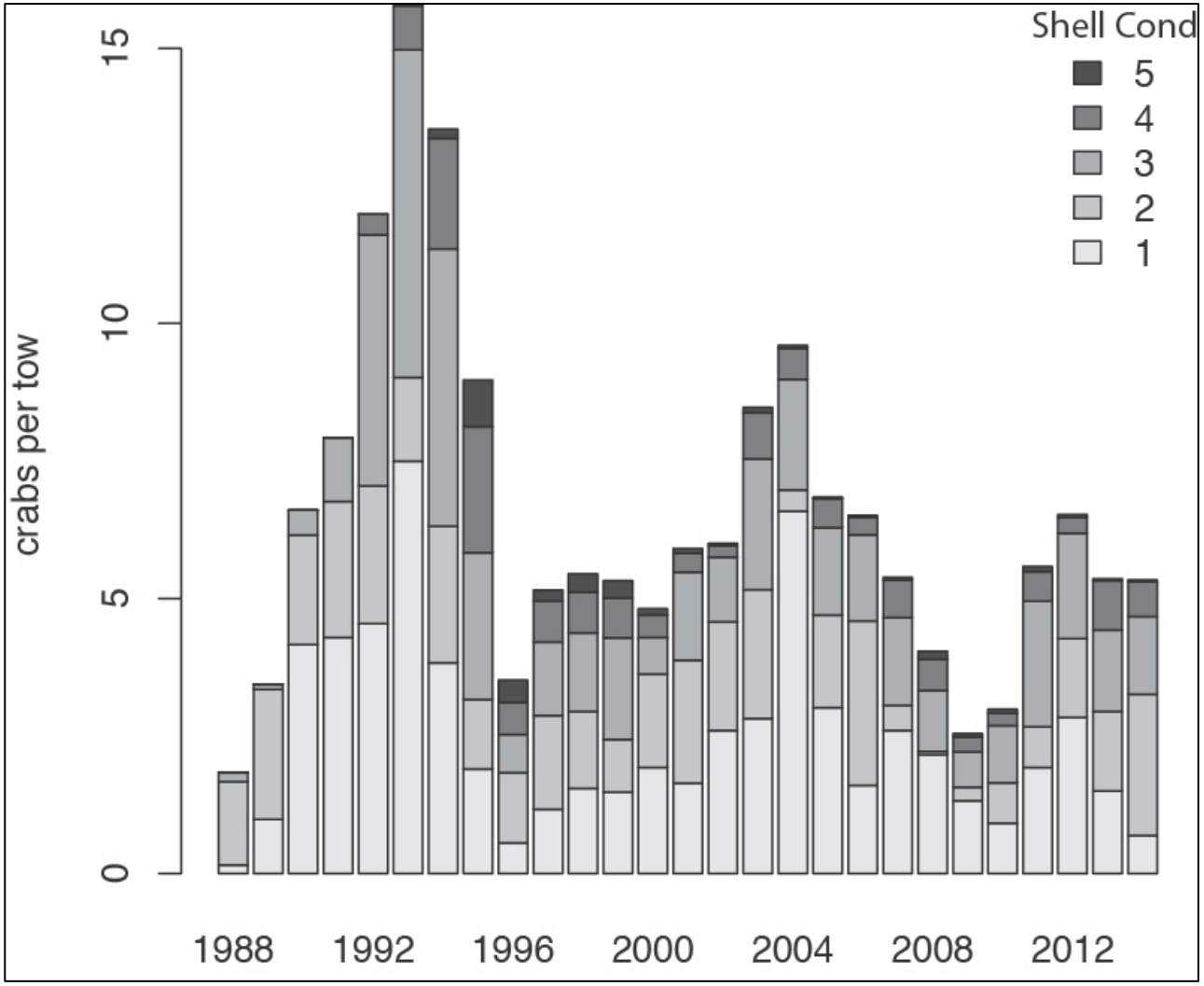

Figure 15. Historical mean number of commercial-sized adult male snow crabs per tow by shell condition observed during the snow crab survey since 1988.

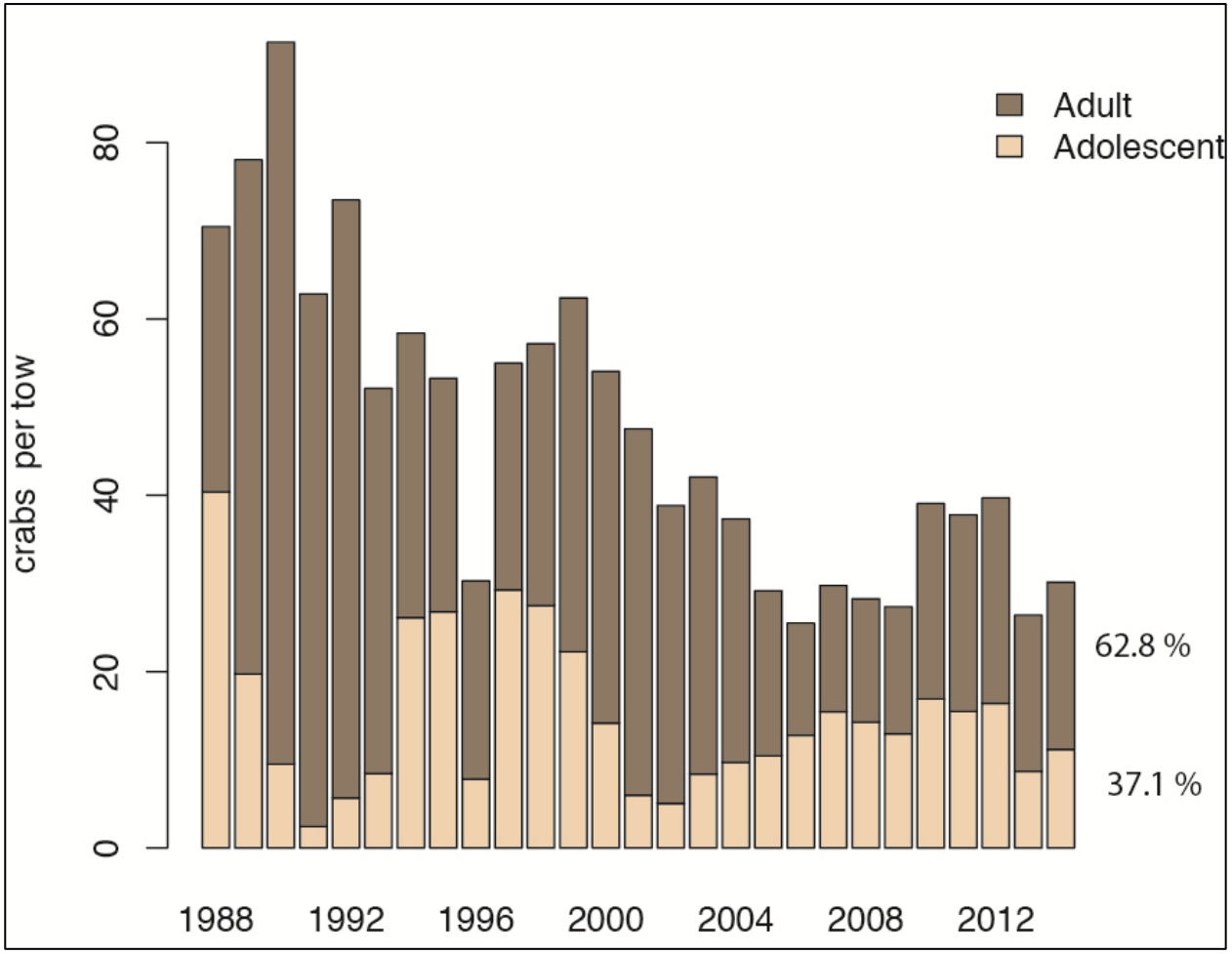

Figure 16. Historical mean number of female snow crabs per tow by maturity observed during the snow crab survey since 1988.

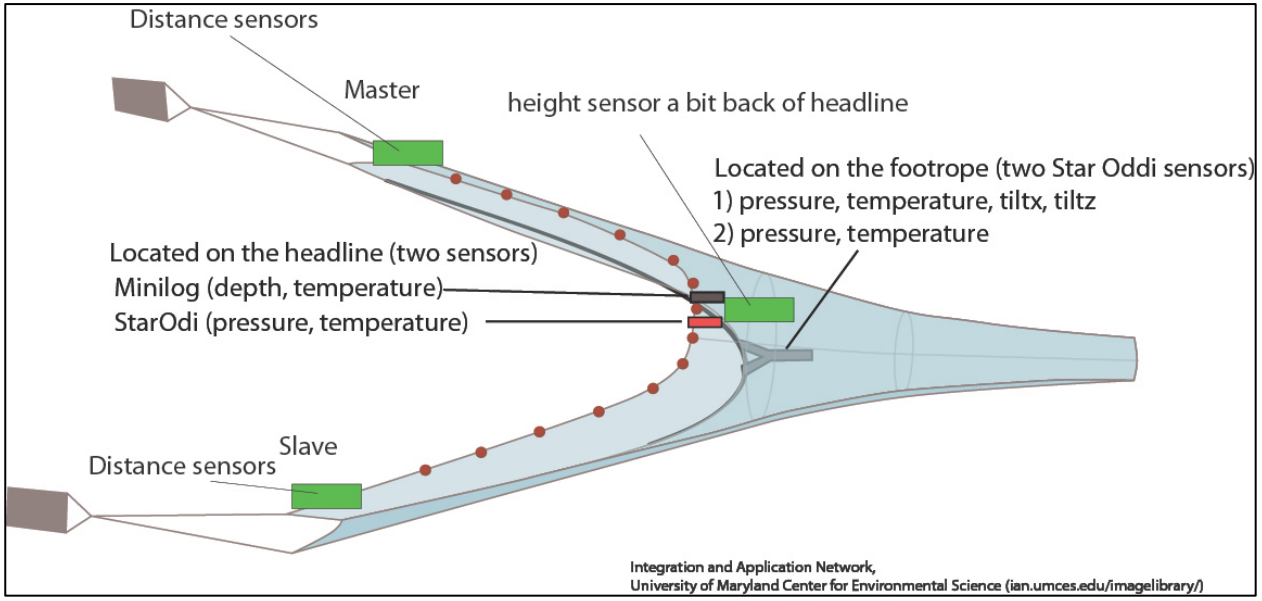

Figure 17. Schematic view of the various sensors deployed for the 2014 snow crab bottom trawl survey. e-Sonar net sensors (a pair of distance sensors and height sensor), Star Oddi® temperature/depth sensors, and temperature/depth/tilt sensor together with a Vemco minilog temperature/depth sensor.

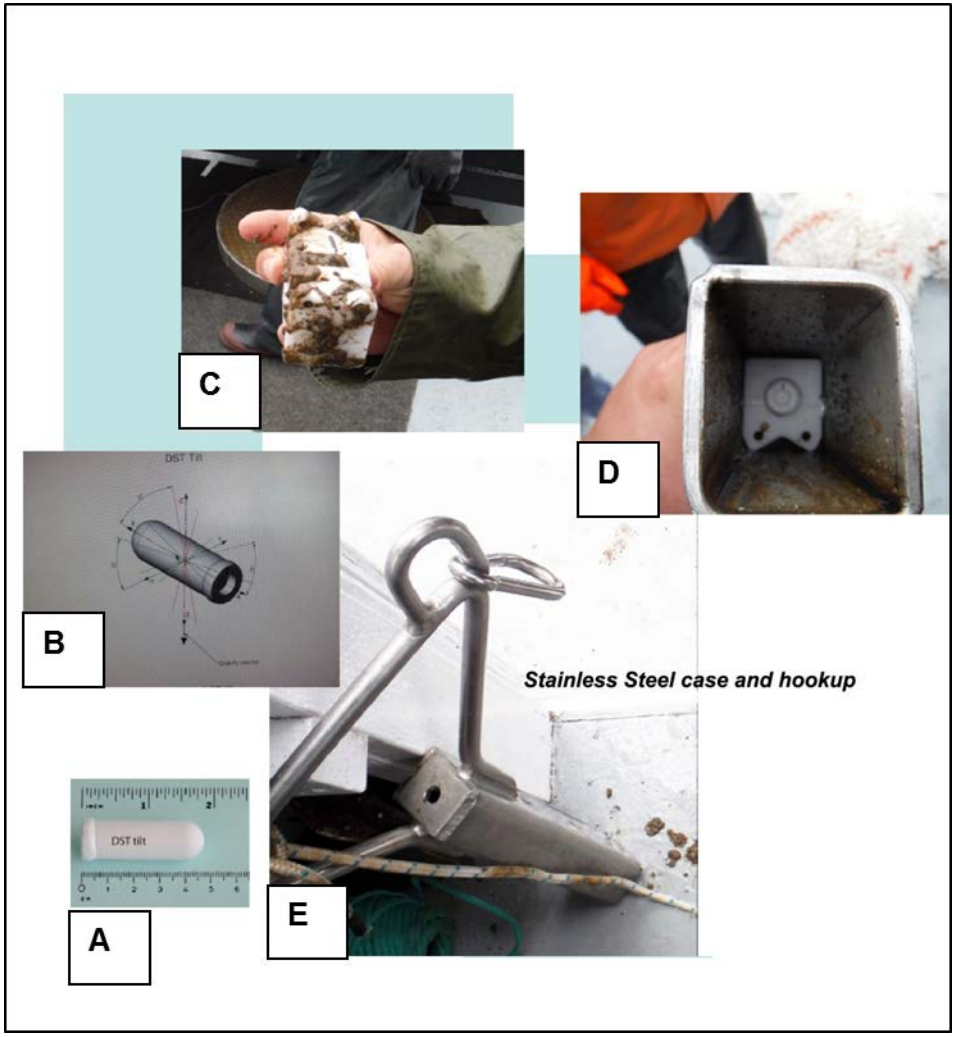

Figure 18. The Star Oddi® tilt sensor (temperature/depth/tilt) is attached to the foot rope using a stainless steel encasement. The sensor (A and B) itself measure approximately 2 inches in length and in inserted within a plastic case (C) which is inserted in the stainless steel case (D) and attached to the ground rope (E). The tilt sensor measures the x, y and z axis as well as pressure and temperature (B). A Star Oddi® depth/temperature sensor (the same size as the tilt sensor) was also attached to the head rope as well as the ground rope in the same stainless steel case as the tilt sensor.

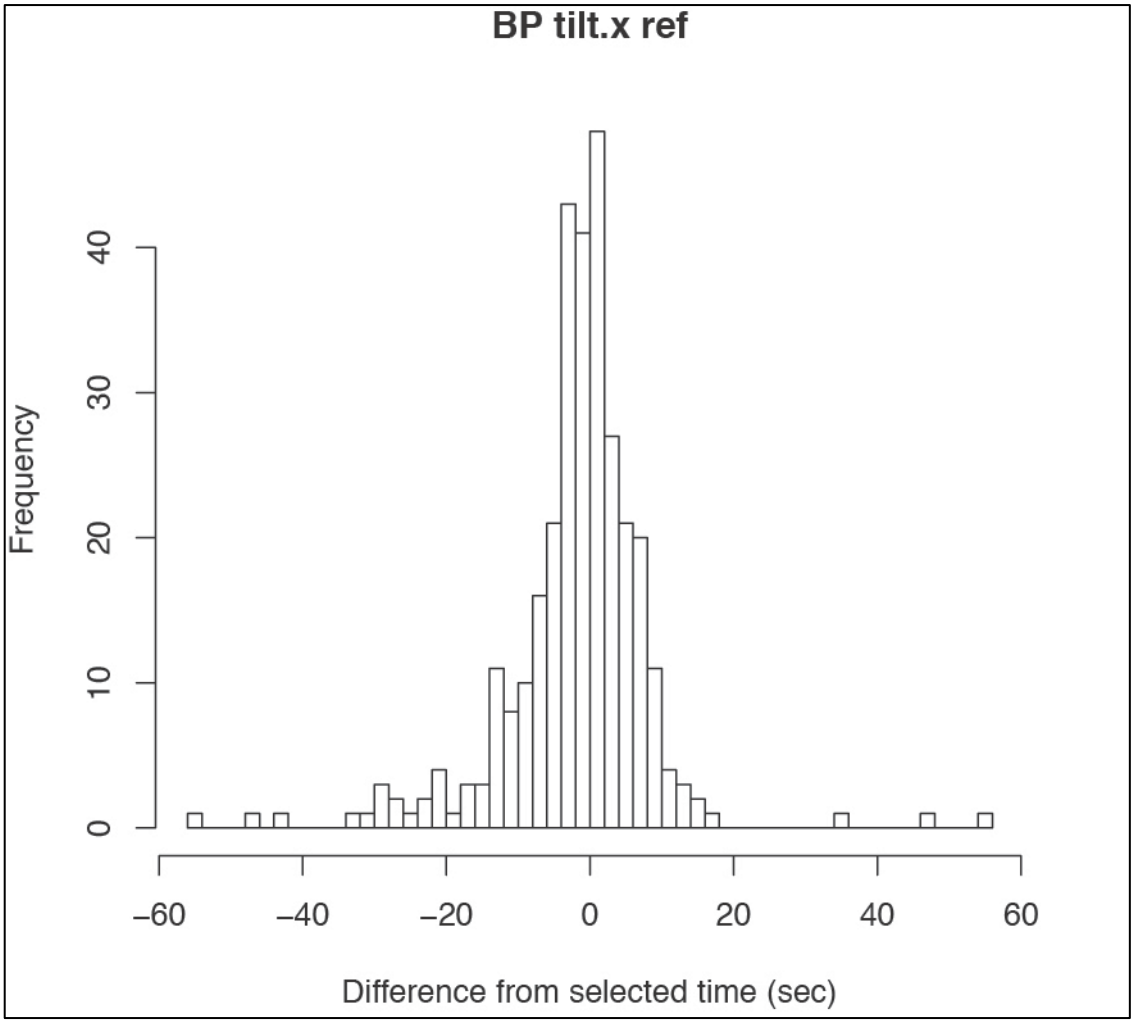

Figure 19. Frequency distribution of the time differences between the 'selected start (net touch down) time' and those selected manually from the tilt x-axis sensor data. The mean differences are -1.8 seconds i.e. the Star Oddi® tilt sensor indicated the net touchdown 1.8 second prior to the traditionally selected 'start (touchdown)' time. The median is -0.96 and the first and third quantiles are -4.9 and 2.6 seconds, respectively.

APPENDIX

Appendix 1: Individual trawl sample details for 2014: date, sequential daily tow number, position (Latitude, Longitude), swept area estimate (m²), depth (fathom) of station, bottom temperature (ºC) at station, catches in number and estimated weight of commercial-sized adult male snow crab of carapace condition 1 and 2 (rC/tow and rW/tow, respectively), catches in number and estimated weight of commercial-sized adult male snow crab of carapace conditions 3, 4 and 5 (RC/tow and RW/tow, respectively), and tow quality indicator (TQ). *Tow quality indicator represents: 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 (dd/mm/yyyy)	Tow number	Latitude	Longitude	AS (m²)	Depth (Fthm)	T (ºC)	rC/tow (number)	rW/tow (kg)	RC/tow (number)	RW/tow (kg)	TQ*
09/07/2014	2	47.7329	-60.6577	2227	49	2.3	0	0	0	0	3
09/07/2014	3	47.8115	-60.6903	2516	105	5.6	0	0	0	0	1
09/07/2014	4	47.7694	-60.831	2729	39	-0.1	1	0.369	1	0.369	1
10/07/2014	1	47.7865	-60.9658	2766	30	-0.3	1	0.384	1	0.384	1
10/07/2014	2	47.8214	-60.9628	2663	32	-0.5	3	1.465	2	1.053	1
10/07/2014	3	47.8305	-60.9001	1862	40	0	2	0.851	2	0.851	1
10/07/2014	4	47.915	-60.9689	1919	47	1.7	7	3.894	7	3.894	1
10/07/2014	5	48.0334	-61.023	2602	156	5.9	0	0	0	0	1
10/07/2014	6	48.1397	-61.074	2592	197	5.5	0	0	0	0	1
10/07/2014	7	48.0809	-61.114	2536	163	5.8	0	0	0	0	1
10/07/2014	8	47.9673	-61.1098	2870	45	0.7	0	0	0	0	1
10/07/2014	10	47.8947	-61.082	1944	37	-0.5	2	1.267	2	1.267	3
11/07/2014	1	47.9123	-61.3383	2644	30	-0.3	0	0	0	0	3
11/07/2014	3	47.9615	-61.2844	3382	34	-0.5	0	0	0	0	3
11/07/2014	5	47.9389	-61.5212	2376	31	-0.5	1	0.557	0	0	3
11/07/2014	6	48.0426	-61.4587	2669	38	-0.1	0	0	0	0	1
11/07/2014	7	48.0957	-61.4055	2695	52	1.5	0	0	0	0	1
11/07/2014	8	48.223	-61.438	2629	197	5.6	0	0	0	0	1
11/07/2014	10	48.2228	-61.6125	2822	170	5.6	0	0	0	0	3
11/07/2014	11	48.0719	-61.7289	2819	45	0.7	4	2.624	4	2.624	1
12/07/2014	5	47.8725	-61.6178	1809	28	-0.5	0	0	0	0	1
12/07/2014	7	47.7008	-61.9327	2319	21	1.6	8	4.815	0	0	3
12/07/2014	8	47.8651	-61.9085	2570	30	-0.6	12	7.107	2	1.117	1
12/07/2014	9	47.9841	-61.9129	1777	32	-1	2	1.116	2	1.116	1
12/07/2014	10	48.0444	-61.8853	2037	34	-0.5	4	2.396	4	2.396	1
12/07/2014	11	48.042	-61.9556	2759	34	-0.5	2	0.975	2	0.975	1
12/07/2014	12	48.0262	-62.1188	3484	33	0.4	0	0	0	0	1
13/07/2014	2	48.0175	-62.0078	2628	32	-0.8	1	0.518	0	0	3
13/07/2014	3	47.866	-61.9834	1585	30	-0.5	16	10.36	1	0.526	1
13/07/2014	4	47.7693	-62.032	2045	27	-1.1	0	0	0	0	1

Date (dd/mm/yyyy)	Tow number	Latitude	Longitude	AS (m²)	Depth (Fthm)	T (ºC)	rC/tow (number)	rW/tow (kg)	RC/tow (number)	RW/tow (kg)	TQ*
13/07/2014	5	47.7273	-62.2077	2733	31	-1.3	9	4.057	8	3.598	1
13/07/2014	6	47.8368	-62.2731	2493	33	-1	16	8.35	3	1.339	2
13/07/2014	7	47.7591	-62.3753	2649	35	-0.6	10	4.914	5	2.327	1
13/07/2014	9	47.6608	-62.2698	2249	30	-1.1	1	0.771	0	0	3
13/07/2014	10	47.6014	-62.0921	2199	21	0	1	0.388	1	0.388	1
13/07/2014	11	47.5584	-62.2762	2468	31	1.1	7	3.531	6	2.994	1
14/07/2014	1	47.6322	-62.3817	2481	30	-1.1	15	8.274	4	1.777	1
14/07/2014	2	47.6003	-62.4649	3437	41	-0.3	14	6.999	14	6.999	1
20/07/2014	1	46.8464	-62.0051	2406	35	-1	10	5.278	8	4.391	1
20/07/2014	2	46.8231	-62.1733	3458	44	-0.8	18	10.176	16	9.304	1
20/07/2014	4	46.6655	-62.2365	2571	33	-0.4	7	4.167	0	0	3
20/07/2014	8	46.5944	-62.088	2072	28	0.1	0	0	0	0	3
20/07/2014	9	46.6173	-62.1507	2273	27	0.1	0	0	0	0	1
20/07/2014	10	46.6371	-62.3777	2764	30	-0.4	2	1.097	0	0	1
20/07/2014	11	46.7336	-62.2986	1833	36	-0.6	9	5.161	0	0	1
21/07/2014	2	46.9357	-62.5401	2283	35	-0.7	15	8.428	4	1.75	1
21/07/2014	3	47.0602	-62.608	2196	35	-0.7	3	1.602	3	1.602	1
21/07/2014	4	47.0155	-62.6887	2230	37	-0.7	18	8.664	16	7.911	1
21/07/2014	5	46.9898	-62.767	2954	34	-0.4	1	0.664	0	0	1
21/07/2014	6	47.1188	-62.7627	3286	35	-0.6	3	1.357	3	1.357	1
21/07/2014	7	47.0969	-62.8767	2303	32	-0.6	3	1.465	0	0	1
21/07/2014	8	47.1656	-62.8754	2719	33	-0.6	5	3.173	1	0.738	1
21/07/2014	9	47.1825	-62.9827	3153	32	-0.6	6	4.041	0	0	1
22/07/2014	1	47.0833	-64.187	3056	22	0.9	0	0	0	0	1
22/07/2014	2	47.1901	-64.2433	2565	22	0.7	6	3.332	0	0	1
22/07/2014	3	47.2244	-64.0949	2243	21	1.5	1	0.44	0	0	1
22/07/2014	4	47.3118	-64.1946	1886	28	0.1	13	7.741	0	0	1
22/07/2014	5	47.3035	-64.4435	1515	30	0.1	4	2.419	0	0	1
22/07/2014	6	47.3609	-64.283	3148	29	-0.1	13	8.68	0	0	1
22/07/2014	7	47.437	-64.3447	2576	30	-0.1	29	17.602	1	0.612	1
22/07/2014	8	47.5037	-64.3916	2144	26	0.7	1	0.887	0	0	1
22/07/2014	9	47.5459	-64.1775	2277	35	-0.2	15	8.894	3	1.617	1
22/07/2014	10	47.5549	-64.127	1850	37	-0.4	8	4.1	3	1.475	1
22/07/2014	11	47.6749	-64.3026	2402	28	0.6	0	0	0	0	1
22/07/2014	12	47.7	-64.1646	2300	39	-0.2	6	3.327	6	3.327	1
24/07/2014	2	47.5827	-64.0343	2632	27	-0.2	0	0	0	0	3
24/07/2014	4	47.6193	-63.9331	2082	27	-0.2	0	0	0	0	3
24/07/2014	5	47.6411	-63.7042	3405	39	-0.4	8	4.395	3	1.636	1
24/07/2014	6	47.7189	-63.7615	3368	35	-0.4	0	0	0	0	1
24/07/2014	7	47.7532	-63.8738	2563	41	-0.4	2	0.908	1	0.39	1
24/07/2014	8	47.7641	-64.0034	2281	45	-0.1	8	4.483	2	1.041	1
24/07/2014	9	47.814	-64.1643	2581	32	-0.1	1	0.549	1	0.549	1

Date (dd/mm/yyyy)	Tow number	Latitude	Longitude	AS (m²)	Depth (Fthm)	T (ºC)	rC/tow (number)	rW/tow (kg)	RC/tow (number)	RW/tow (kg)	TQ*
24/07/2014	10	47.8242	-64.0239	2169	49	-0.2	11	5.652	9	4.863	1
24/07/2014	11	47.824	-63.8738	3382	46	-0.1	3	1.491	2	1.13	1
24/07/2014	12	47.9047	-63.7075	3306	37	-0.4	0	0	0	0	1
25/07/2014	2	48.1083	-63.9922	2448	27	0.6	0	0	0	0	3
25/07/2014	3	47.9463	-64.0546	3243	33	-0.1	6	3.482	3	1.784	1
25/07/2014	4	47.9402	-63.9631	2051	50	-0.1	0	0	0	0	1
25/07/2014	5	47.9916	-63.7676	2129	53	-0.4	7	4.606	2	1.36	1
25/07/2014	6	48.0892	-63.865	2928	52	0.4	12	7.79	1	0.45	1
25/07/2014	7	48.1188	-63.8179	3754	51	0.2	6	3.133	0	0	1
25/07/2014	8	48.1508	-63.8528	3362	39	-0.1	2	1.284	1	0.54	1
25/07/2014	9	48.2386	-64.0709	3293	37	0.1	5	3.848	2	1.618	1
31/07/2014	1	48.5417	-64.1819	2582	44	0.4	27	17.477	1	0.449	1
31/07/2014	2	48.5475	-64.1207	2637	55	1	20	12.718	1	0.51	1
31/07/2014	3	48.639	-64.0565	2915	47	0.4	5	2.892	2	1.269	1
01/08/2014	1	48.313	-62.6833	2669	51	1.3	0	0	0	0	2
01/08/2014	2	48.1915	-62.6854	2762	50	1.6	6	2.881	6	2.881	2
01/08/2014	3	48.1453	-62.6648	2692	54	1.6	13	6.886	10	5.122	2
01/08/2014	5	48.1811	-62.4997	2502	39	-0.4	5	2.992	2	1.249	3
01/08/2014	6	48.2067	-62.441	2344	34	-0.6	0	0	0	0	1
01/08/2014	7	48.1846	-62.2122	2255	47	2.1	0	0	0	0	1
01/08/2014	8	48.1427	-62.1846	2522	48	1.5	24	12.233	24	12.233	1
01/08/2014	9	48.1679	-61.945	2882	41	1	3	1.541	3	1.541	1
01/08/2014	11	48.231	-61.8861	1981	113	5.6	0	0	0	0	3
01/08/2014	12	48.2847	-61.7749	2345	187	5.6	0	0	0	0	1
02/08/2014	2	48.2825	-61.9548	2979	132	5.8	0	0	0	0	1
02/08/2014	3	48.2949	-62.104	2015	59	3	0	0	0	0	1
02/08/2014	4	48.399	-62.1195	1013	198	5.6	0	0	0	0	1
02/08/2014	5	48.3304	-62.4396	3350	83	4	0	0	0	0	1
02/08/2014	7	48.3089	-62.4817	1799	47	2.1	0	0	0	0	3
02/08/2014	8	48.4256	-62.6083	2312	176	5.8	1	0.766	1	0.766	1
05/08/2014	1	48.7477	-64.1079	3142	45	0.1	0	0	0	0	1
05/08/2014	2	48.7908	-63.8563	3049	93	4.4	0	0	0	0	2
05/08/2014	3	48.8184	-63.6823	2873	119	5.3	0	0	0	0	2
05/08/2014	4	48.826	-63.5586	2382	130	5.5	3	1.706	3	1.706	1
05/08/2014	5	48.8918	-63.6013	2906	161	5.6	0	0	0	0	1
05/08/2014	6	48.9478	-63.4252	2998	192	5.6	0	0	0	0	1
05/08/2014	7	48.9226	-63.2611	2560	210	5.6	0	0	0	0	1
06/08/2014	2	48.701	-63.361	2026	103	5	0	0	0	0	3
06/08/2014	3	48.8336	-63.3506	2525	166	5.6	0	0	0	0	1
06/08/2014	4	48.7507	-63.2527	2344	152	5.6	0	0	0	0	1
06/08/2014	5	48.7198	-63.1113	2310	186	5.6	0	0	0	0	1
06/08/2014	6	48.6497	-63.2563	2104	115	5.2	0	0	0	0	1

Date (dd/mm/yyyy)	Tow number	Latitude	Longitude	AS (m²)	Depth (Fthm)	T (ºC)	rC/tow (number)	rW/tow (kg)	RC/tow (number)	RW/tow (kg)	TQ*
06/08/2014	7	48.5858	-63.1626	2510	121	5.5	3	1.448	3	1.448	1
06/08/2014	8	48.5917	-62.9399	2299	199	5.6	0	0	0	0	1
06/08/2014	9	48.5435	-63.1293	2515	122	5.5	1	0.493	1	0.493	1
07/08/2014	1	48.4171	-62.8538	2614	91	2.9	0	0	0	0	2
07/08/2014	2	48.3752	-62.8548	2768	50	0.7	1	0.409	1	0.409	1
07/08/2014	3	48.313	-62.9823	2679	44	0.6	6	2.58	6	2.58	1
07/08/2014	4	48.1815	-62.8424	2904	41	-0.1	10	4.735	8	3.822	1
07/08/2014	5	48.2073	-62.9691	2410	40	0.1	3	1.448	3	1.448	1
07/08/2014	6	48.3378	-63.1784	3184	30	-0.1	2	1.065	0	0	1
11/08/2014	1	47.8867	-64.9885	2351	26	0.2	1	0.815	1	0.815	2
11/08/2014	2	47.895	-65.1463	1954	42	-0.4	8	6.911	5	3.62	1
11/08/2014	3	47.8919	-65.2108	1986	39	-0.2	9	6.958	3	2.543	1
11/08/2014	4	47.8151	-65.5386	2174	24	0.4	1	0.624	1	0.624	1
12/08/2014	1	47.9763	-65.6248	2604	25	0.1	0	0	0	0	1
12/08/2014	2	47.9092	-65.5186	2900	27	-0.2	4	2.233	0	0	1
12/08/2014	3	47.8644	-65.4873	2152	33	-0.4	2	1.589	0	0	1
12/08/2014	4	47.9613	-65.3394	2977	26	-0.1	7	5.566	1	0.705	1
12/08/2014	5	47.8949	-65.1413	1977	43	-0.2	4	2.587	3	1.641	1
12/08/2014	6	48.0407	-64.9861	3052	47	-0.1	3	2.157	1	0.687	1
12/08/2014	7	47.9832	-64.9277	1924	45	-0.1	6	3.503	1	0.664	1
12/08/2014	8	48.0682	-64.773	2417	46	-0.1	13	9.456	0	0	1
12/08/2014	9	48.1225	-64.4485	2885	26	0.1	0	0	0	0	1
12/08/2014	10	48.247	-64.6755	2369	49	0.1	2	1.071	2	1.071	1
13/08/2014	1	48.3294	-64.5154	2875	42	0.4	1	0.628	1	0.628	1
13/08/2014	2	48.2366	-64.423	2154	56	0.2	9	6.735	2	1.135	1
13/08/2014	3	48.2704	-64.3325	2743	61	0.2	12	7.644	3	1.687	1
13/08/2014	4	48.2517	-64.303	2215	56	0.2	8	6.118	1	0.439	1
13/08/2014	5	48.3558	-64.1708	3147	45	0.4	0	0	0	0	1
13/08/2014	6	48.4417	-64.1143	3785	38	0.2	1	0.564	0	0	1
13/08/2014	7	48.3375	-63.8413	3476	59	1.2	8	4.836	2	1.461	1
13/08/2014	8	48.3978	-63.8339	2758	62	1.6	4	2.626	1	0.366	1
13/08/2014	9	48.3561	-63.6798	3651	47	-0.4	0	0	0	0	1
13/08/2014	10	48.456	-63.7343	2711	84	2.7	10	7.246	2	1.644	1
14/08/2014	1	48.5212	-63.8432	3255	33	0.1	0	0	0	0	1
14/08/2014	3	48.6199	-63.8504	2734	92	2.9	14	8.65	8	3.958	1
14/08/2014	4	48.6784	-63.7614	3137	77	2.9	0	0	0	0	1
16/08/2014	2	48.7026	-63.6389	2840	78	2.9	0	0	0	0	3
16/08/2014	3	48.5544	-63.6672	3448	79	2.3	11	7.63	6	3.654	1
16/08/2014	4	48.5765	-63.5666	3735	72	2.7	0	0	0	0	1
16/08/2014	5	48.5471	-63.4557	3530	71	2.1	0	0	0	0	1
16/08/2014	6	48.4973	-63.3179	3348	64	2.4	0	0	0	0	1
17/08/2014	1	48.4779	-63.1296	2557	47	-0.1	1	0.465	0	0	1

Date (dd/mm/yyyy)	Tow number	Latitude	Longitude	AS (m²)	Depth (Fthm)	T (ºC)	rC/tow (number)	rW/tow (kg)	RC/tow (number)	RW/tow (kg)	TQ*
17/08/2014	2	48.4419	-63.2985	3005	55	1.8	1	0.392	1	0.392	1
17/08/2014	3	48.3597	-63.3996	2440	47	0.7	0	0	0	0	1
17/08/2014	4	48.39	-63.5379	3485	60	1.7	2	1.224	0	0	1
17/08/2014	5	48.3082	-63.5205	3517	53	1	0	0	0	0	1
17/08/2014	6	48.2377	-63.6464	3066	56	0.6	2	1.133	1	0.461	1
17/08/2014	7	48.1883	-63.6996	4035	56	0.7	12	7.711	1	0.686	1
17/08/2014	8	48.1178	-63.5842	3304	49	0.6	2	1.028	1	0.444	1
17/08/2014	9	48.1358	-63.4063	3240	60	0.6	11	5.892	2	0.906	2
17/08/2014	10	48.2139	-63.3151	3632	52	0.4	14	7.124	4	1.813	1
22/08/2014	1	47.9129	-62.5877	2297	35	0.7	12	7.017	0	0	1
22/08/2014	2	47.9107	-62.4269	2601	41	0.6	12	6.134	9	4.569	1
22/08/2014	3	47.9903	-62.4663	2657	38	0.7	1	0.467	1	0.467	1
22/08/2014	4	48.0352	-62.3731	2447	44	-0.1	7	3.442	6	3.049	1
22/08/2014	5	48.0782	-62.375	2761	41	-0.1	9	4.247	8	3.666	1
22/08/2014	6	48.068	-62.5008	2801	32	-0.2	1	0.415	1	0.415	1
22/08/2014	7	48.0244	-62.6767	3320	48	1	11	5.414	5	2.152	1
22/08/2014	8	48.0293	-62.809	3225	46	0.1	21	10.314	14	6.516	1
22/08/2014	9	48.0697	-62.9198	2694	36	0.1	7	3.713	1	0.398	1
22/08/2014	10	48.0426	-63.0984	2884	32	-0.2	2	1.006	0	0	1
22/08/2014	11	48.1533	-63.2049	2604	40	0.2	16	9.014	4	2.457	1
22/08/2014	12	48.066	-63.2683	3399	42	0.2	15	7.713	3	1.405	1
23/08/2014	1	47.9792	-63.4157	3518	42	0.1	5	2.562	2	1.216	1
23/08/2014	2	47.9789	-63.537	3164	42	0.1	10	5.931	3	1.455	1
23/08/2014	3	47.882	-63.5033	2000	35	0.1	1	0.517	0	0	1
23/08/2014	4	47.7701	-63.4879	3245	42	-0.1	8	4.542	1	0.395	1
23/08/2014	5	47.6863	-63.5026	2319	40	-0.1	0	0	0	0	1
23/08/2014	6	47.5502	-63.5123	3045	39	-0.2	6	2.938	2	0.886	1
23/08/2014	7	47.6165	-63.4	3413	43	-0.4	17	10.588	5	2.768	1
23/08/2014	8	47.5573	-63.3579	3131	42	-0.4	7	4.68	2	1.272	1
23/08/2014	9	47.6036	-63.268	2515	47	-0.7	25	14.514	18	9.998	1
23/08/2014	10	47.5704	-63.1718	2710	36	-0.7	7	3.669	5	2.697	1
23/08/2014	11	47.6713	-63.1302	2388	36	-0.4	21	11.7	8	4.005	1
23/08/2014	12	47.736	-63.054	3099	40	-0.2	17	9.42	6	3.085	1
24/08/2014	1	47.7594	-63.1727	3137	40	-0.1	8	4.382	1	0.764	1
24/08/2014	2	47.8106	-63.1465	3292	41	-0.1	11	6.262	3	1.577	1
24/08/2014	3	47.8043	-63.3237	3293	43	0.4	17	8.803	3	1.347	1
24/08/2014	4	47.8317	-63.3391	2992	42	0.4	12	6.411	1	0.47	1
24/08/2014	5	47.9284	-63.189	2459	35	0.2	23	14.323	1	0.603	1
24/08/2014	6	47.936	-63.064	2248	35	-0.4	9	5.031	1	0.384	1
24/08/2014	7	47.8837	-63.131	2321	38	0.2	14	8.05	8	4.156	1
24/08/2014	8	47.7884	-62.9499	3168	39	-0.1	13	7.679	5	2.561	1
24/08/2014	9	47.8519	-62.8473	3676	42	-0.1	32	16.16	15	7.071	1

Date (dd/mm/yyyy)	Tow number	Latitude	Longitude	AS (m²)	Depth (Fthm)	T (ºC)	rC/tow (number)	rW/tow (kg)	RC/tow (number)	RW/tow (kg)	TQ*
24/08/2014	10	47.8405	-62.7306	2611	38	-0.1	7	3.743	2	0.792	1
24/08/2014	11	47.7945	-62.777	3151	35	-0.1	14	7.978	1	0.618	1
25/08/2014	1	47.7131	-62.5666	3834	42	0.1	17	8.299	14	6.555	3
25/08/2014	2	47.6879	-62.8131	2548	31	-0.4	10	5.386	1	0.51	1
25/08/2014	3	47.6603	-62.792	2629	32	-0.4	6	2.655	4	1.68	1
25/08/2014	7	47.5691	-62.971	1546	28	-0.6	0	0	0	0	3
25/08/2014	8	47.5385	-63.0219	2516	29	-0.4	2	1.335	0	0	1
25/08/2014	9	47.4358	-63.1265	2897	40	-0.4	13	6.558	9	4.429	1
25/08/2014	10	47.4354	-63.2754	3071	38	-0.4	5	2.799	2	1.108	1
25/08/2014	11	47.438	-63.3973	3029	45	-0.4	19	10.838	11	6.162	1
26/08/2014	1	47.4358	-63.632	3111	33	-0.4	1	0.92	1	0.92	1
26/08/2014	2	47.3879	-63.711	3321	36	-0.4	8	4.717	1	0.464	1
26/08/2014	3	47.5091	-63.7215	3648	38	-0.2	13	6.661	4	1.748	1
26/08/2014	9	47.381	-63.9909	2782	24	0.7	0	0	0	0	3
26/08/2014	10	47.3442	-63.8656	3797	31	-0.1	1	0.772	0	0	1
26/08/2014	11	47.3357	-63.9487	2300	22	0.7	0	0	0	0	1
02/09/2014	1	47.4413	-62.6791	2505	35	-0.4	5	2.5	3	1.676	1
02/09/2014	2	47.4888	-62.6592	2590	32	-0.4	12	6.329	5	2.659	1
02/09/2014	3	47.4881	-62.5786	2881	36	-0.1	9	4.986	6	3.245	1
02/09/2014	4	47.432	-62.519	2442	41	-0.2	10	5.208	6	3.066	1
02/09/2014	5	47.5055	-62.3935	2839	33	0.2	2	1.09	1	0.469	1
02/09/2014	7	47.3862	-62.3576	2425	28	-0.2	9	4.927	1	0.452	3
04/09/2014	1	46.2162	-62.1838	2144	18	4.6	0	0	0	0	1
04/09/2014	2	46.1111	-62.1031	2682	21	3	0	0	0	0	1
04/09/2014	3	46.0719	-61.8809	2013	25	0.6	1	0.701	0	0	1
04/09/2014	4	46.0841	-61.8438	2072	26	0.6	9	5.588	7	4.022	1
04/09/2014	5	46.1292	-61.8008	1873	27	0.6	6	3.801	3	1.794	1
04/09/2014	6	46.0481	-61.7635	1832	27	0.6	2	1.705	1	0.739	1
04/09/2014	7	45.9472	-61.744	2283	21	1.3	6	3.758	0	0	1
04/09/2014	8	46.1085	-61.6393	1918	27	0.6	0	0	0	0	1
04/09/2014	9	46.2046	-61.4355	3374	21	1.6	1	0.878	0	0	1
04/09/2014	10	46.2182	-61.594	2260	31	0.4	3	1.669	1	0.38	1
05/09/2014	1	46.2641	-61.6512	2146	31	-0.1	1	0.578	0	0	1
05/09/2014	2	46.3725	-61.3359	3760	28	0.6	0	0	0	0	1
05/09/2014	3	46.4576	-61.4772	1781	33	0.2	2	1.308	2	1.308	1
05/09/2014	4	46.3829	-61.6198	3336	30	-0.1	6	3.511	1	0.405	1
05/09/2014	5	46.3892	-61.7876	2593	22	1.6	1	0.804	0	0	1
05/09/2014	6	46.3192	-61.9191	2114	22	1.3	20	15.266	3	2.496	1
05/09/2014	7	46.2139	-61.9295	3453	24	1	1	0.891	0	0	1
05/09/2014	8	46.2995	-62.0504	2664	22	2.3	0	0	0	0	1
08/09/2014	2	46.9302	-62.3758	1993	33	-0.6	3	1.778	0	0	3
09/09/2014	1	47.34	-63.5143	3137	38	-0.2	8	4.221	6	3.086	2

Date (dd/mm/yyyy)	Tow number	Latitude	Longitude	AS (m²)	Depth (Fthm)	T (ºC)	rC/tow (number)	rW/tow (kg)	RC/tow (number)	RW/tow (kg)	TQ*
09/09/2014	2	47.2174	-63.6015	3262	35	0.9	1	0.741	0	0	1
09/09/2014	3	47.24	-63.644	3478	35	0.6	8	4.974	3	1.72	1
09/09/2014	4	47.1968	-63.774	2435	30	2.3	5	2.763	1	0.426	1
09/09/2014	6	47.1864	-63.8973	1962	15	5.9	0	0	0	0	3
09/09/2014	7	47.1003	-63.7091	2905	30	1.8	3	1.79	0	0	1
09/09/2014	8	46.9697	-63.6423	2489	25	1.5	1	0.669	0	0	1
09/09/2014	9	46.9711	-63.5589	1844	26	1.3	0	0	0	0	1
09/09/2014	10	47.0311	-63.5305	2633	30	1	4	2.706	0	0	2
09/09/2014	12	47.0649	-63.3716	1824	29	0.7	1	0.474	0	0	3
10/09/2014	1	47.2989	-63.2814	3206	31	-0.1	0	0	0	0	1
10/09/2014	2	47.2372	-63.4424	2499	30	0.2	1	0.642	0	0	1
10/09/2014	3	47.153	-63.3869	3350	31	0.2	1	0.542	0	0	1
10/09/2014	4	47.1776	-63.2437	3189	36	-0.2	6	3.249	2	0.831	1
10/09/2014	5	47.0637	-63.2106	1938	32	-0.1	1	0.97	0	0	1
10/09/2014	6	46.9595	-63.1994	2441	32	-0.1	38	20.212	1	0.502	1
10/09/2014	7	46.9126	-63.3175	2741	31	1	4	1.834	2	0.77	1
10/09/2014	8	46.7869	-63.4962	2117	23	1.8	1	0.604	0	0	1
10/09/2014	9	46.7863	-63.4196	2344	24	1.6	3	2.021	0	0	2
10/09/2014	10	46.8406	-63.2443	2081	27	1.2	0	0	0	0	1
11/09/2014	1	47.3278	-63.0354	2555	34	-0.4	15	8.555	6	3.004	1
11/09/2014	2	47.3838	-62.899	2266	27	-0.4	0	0	0	0	1
11/09/2014	3	47.301	-62.8967	2899	32	-0.4	1	0.509	1	0.509	1
15/09/2014	2	47.0813	-62.9902	2875	30	-0.2	0	0	0	0	3
15/09/2014	3	46.9419	-62.9164	3057	33	-0.4	28	13.011	9	4.206	1
15/09/2014	4	46.9249	-63.0177	3076	34	-0.1	9	4.004	7	2.877	1
15/09/2014	5	46.8815	-63.0223	3380	33	0.4	4	1.933	0	0	1
15/09/2014	6	46.8322	-62.9003	3141	33	-0.1	5	2.244	0	0	1
15/09/2014	9	46.7185	-63.1938	2528	26	1.8	4	1.903	1	0.384	4
15/09/2014	10	46.6202	-63.17	2261	23	2.7	6	3.27	0	0	1
16/09/2014	2	46.6763	-63.1199	2262	25	1.8	5	2.73	0	0	3
16/09/2014	3	46.6055	-62.9641	2613	24	1.8	2	1.119	0	0	2
16/09/2014	4	46.6789	-62.84	2646	27	1	1	0.512	0	0	1
16/09/2014	5	46.6939	-62.7837	2832	28	0.9	1	0.382	0	0	1
16/09/2014	7	46.625	-62.8891	1785	27	1.5	3	1.702	1	0.519	3
16/09/2014	8	46.6095	-62.6309	3175	26	1.8	0	0	0	0	1
16/09/2014	9	46.625	-62.5932	2283	26	1.6	0	0	0	0	1
16/09/2014	10	46.7111	-62.5596	3119	30	0.4	3	1.573	0	0	1
16/09/2014	11	46.8071	-62.6737	2369	33	0.1	22	10.613	0	0	1
17/09/2014	1	46.7968	-62.4974	2503	33	-0.1	24	12.753	0	0	1
17/09/2014	2	46.8689	-62.4416	2426	35	-0.4	31	16.097	1	0.418	3
17/09/2014	4	46.968	-62.1911	2274	29	-0.4	0	0	0	0	1
30/09/2014	1	47.3018	-62.5665	2642	36	-0.6	8	3.863	3	1.416	1

Date (dd/mm/yyyy)	Tow number	Latitude	Longitude	AS (m²)	Depth (Fthm)	T (ºC)	rC/tow (number)	rW/tow (kg)	RC/tow (number)	RW/tow (kg)	TQ*
30/09/2014	2	47.257	-62.6315	2546	35	-0.4	5	2.309	5	2.309	1
30/09/2014	3	47.2089	-62.6102	2445	36	-0.4	4	2.189	3	1.81	1
30/09/2014	4	47.279	-62.3925	1998	30	-0.4	3	1.261	0	0	3
30/09/2014	6	47.1005	-62.4048	1987	31	-0.2	5	2.679	0	0	3
30/09/2014	7	47.1365	-62.2968	1908	28	-0.1	0	0	0	0	1
30/09/2014	8	47.146	-62.1833	1858	20	2	0	0	0	0	1
30/09/2014	9	47.0582	-62.2473	1965	29	-0.1	2	0.965	0	0	1
01/10/2014	1	47.0373	-61.9204	2681	22	0.6	0	0	0	0	1
01/10/2014	2	47.008	-62.0059	1873	27	-0.1	1	1.035	0	0	1
01/10/2014	3	46.9841	-61.9389	2407	26	-0.1	0	0	0	0	1
01/10/2014	5	46.9837	-61.9899	2200	26	-0.1	1	0.52	0	0	3
01/10/2014	7	46.9267	-61.6227	1981	26	-0.2	14	8.829	1	0.878	3
01/10/2014	8	46.8745	-61.719	2766	30	-0.4	8	4.385	5	2.491	1
01/10/2014	9	46.7745	-61.8688	3464	37	-0.4	1	0.95	0	0	1
01/10/2014	10	46.7336	-61.9704	3113	45	-0.4	6	3.637	3	1.3	1
02/10/2014	1	46.612	-61.5481	2983	33	-0.1	6	4.201	5	3.412	1
02/10/2014	2	46.532	-61.4488	3555	34	0.1	8	4.624	2	1.365	1
02/10/2014	3	46.4597	-61.362	2994	34	0.9	4	2.941	4	2.941	1
02/10/2014	4	46.6326	-61.2436	3471	43	0.4	9	6.247	7	5.16	1
02/10/2014	5	46.6921	-61.2384	3055	62	1	18	11.553	14	9.872	2
02/10/2014	7	46.678	-61.0271	2061	22	2.9	1	0.515	1	0.515	3
03/10/2014	1	46.8302	-60.9012	3631	49	1.2	8	4.866	8	4.866	1
03/10/2014	2	46.8477	-61.0455	2474	56	1.2	16	12.05	7	5.029	1
03/10/2014	3	46.9119	-61.1491	3137	34	-0.1	3	1.799	1	0.402	1
03/10/2014	4	46.9372	-61.0066	3615	54	1.6	11	7.773	4	2.827	1
03/10/2014	5	46.8146	-61.2896	3264	34	0.2	3	2.026	3	2.026	1
03/10/2014	6	46.7979	-61.2551	3463	36	0.6	4	2.861	4	2.861	1
04/10/2014	1	46.6818	-61.8884	2756	32	-0.1	1	0.694	0	0	3
04/10/2014	2	46.6791	-61.7778	3357	36	0.1	1	0.664	0	0	1
04/10/2014	3	46.5955	-61.822	2077	30	0.2	0	0	0	0	1
04/10/2014	5	46.4799	-61.7405	1756	22	1.6	0	0	0	0	3
04/10/2014	6	46.6	-61.7224	2621	32	0.1	0	0	0	0	1
04/10/2014	7	46.7378	-61.6043	3416	40	-0.4	9	6.214	4	2.687	1
04/10/2014	8	46.7966	-61.5072	3100	35	-0.4	5	3.283	2	1.319	1
04/10/2014	9	46.7343	-61.3576	3041	37	-0.4	11	7.893	7	4.985	1
06/10/2014	1	46.9804	-60.8114	1800	75	4.1	8	5.726	3	2.363	1
06/10/2014	2	47.051	-60.7493	1979	80	2.1	4	2.566	0	0	1
06/10/2014	3	47.079	-60.499	2316	74	0.1	7	4.825	7	4.825	1
06/10/2014	4	47.1995	-60.5502	1865	90	5.9	0	0	0	0	1
06/10/2014	5	47.2839	-60.3437	1908	90	5.8	0	0	0	0	1
06/10/2014	6	47.3816	-60.3966	3378	44	0.4	0	0	0	0	1
06/10/2014	7	47.4313	-60.465	2490	52	2.9	9	5.894	1	0.458	2

Date (dd/mm/yyyy)	Tow number	Latitude	Longitude	AS (m²)	Depth (Fthm)	T (ºC)	rC/tow (number)	rW/tow (kg)	RC/tow (number)	RW/tow (kg)	TQ*
06/10/2014	8	47.5235	-60.4026	1195	165	6.2	0	0	0	0	1
07/10/2014	1	47.6285	-61.0053	2530	21	2	0	0	0	0	2
07/10/2014	2	47.5622	-60.8654	2656	27	0.4	0	0	0	0	1
07/10/2014	3	47.5723	-60.69	2772	31	0.2	0	0	0	0	1
07/10/2014	4	47.5566	-60.443	2031	126	6.1	0	0	0	0	1
07/10/2014	5	47.5124	-60.4852	2167	77	5	0	0	0	0	1
07/10/2014	6	47.4804	-60.6078	2948	32	1	6	3.527	3	1.734	1
07/10/2014	7	47.4917	-60.7554	2724	30	0.7	13	7.24	5	3.119	1
07/10/2014	8	47.4471	-60.9369	2370	26	0.4	2	0.956	1	0.455	1
07/10/2014	9	47.37	-60.8035	2800	34	1	6	4.357	5	3.287	1
07/10/2014	10	47.3659	-60.6498	2907	35	0.7	2	1.514	1	0.764	1
11/10/2014	1	47.0076	-60.9534	2725	56	1.3	19	14.152	8	5.206	1
11/10/2014	2	47.0061	-60.8923	2881	62	3.2	4	2.104	1	0.368	1
11/10/2014	3	47.1695	-60.9164	3012	45	1.3	6	3.412	5	2.738	1
11/10/2014	4	47.1499	-60.7592	2261	82	5.3	7	5.014	6	4.397	1
11/10/2014	5	47.2223	-60.6809	2823	52	1.5	0	0	0	0	1
11/10/2014	6	47.3097	-60.5882	2874	38	2.1	0	0	0	0	1
11/10/2014	7	47.2697	-60.8717	3483	46	1.2	12	8.57	11	7.918	1
11/10/2014	8	47.3603	-61.0114	2737	29	0.6	6	4.058	6	4.058	1
11/10/2014	9	47.3298	-61.097	2529	28	0.4	1	0.556	1	0.556	1
11/10/2014	10	47.3259	-61.1554	2489	26	0.4	0	0	0	0	1
12/10/2014	1	47.3789	-61.1397	2533	24	0.9	0	0	0	0	1
12/10/2014	2	47.1675	-61.1153	3650	32	0.7	2	1.281	2	1.281	1
12/10/2014	3	47.109	-61.0536	3843	42	1.2	7	3.957	5	2.935	1
12/10/2014	4	47.0434	-61.1572	3088	32	0.4	5	2.658	4	2.162	2
12/10/2014	5	47.0084	-61.3761	2362	25	0.6	8	5.247	2	0.998	1
12/10/2014	6	47.0171	-61.5583	1593	18	4	0	0	0	0	1
12/10/2014	7	46.9628	-61.3972	3183	28	-0.1	0	0	0	0	1
12/10/2014	8	46.9016	-61.4574	3677	32	0.2	1	0.661	0	0	1