



**GEOLOGICAL SURVEY OF CANADA  
OPEN FILE 6473**

**Cruise Report Matthew 2009053 Bay of Fundy  
9 October to 4 November 2009**



**D.R. Parrott, P. Fraser, S. Hayward, E. Patton and J. Griffin**

**2010**



Natural Resources  
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Canada

**Canada**



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## Background

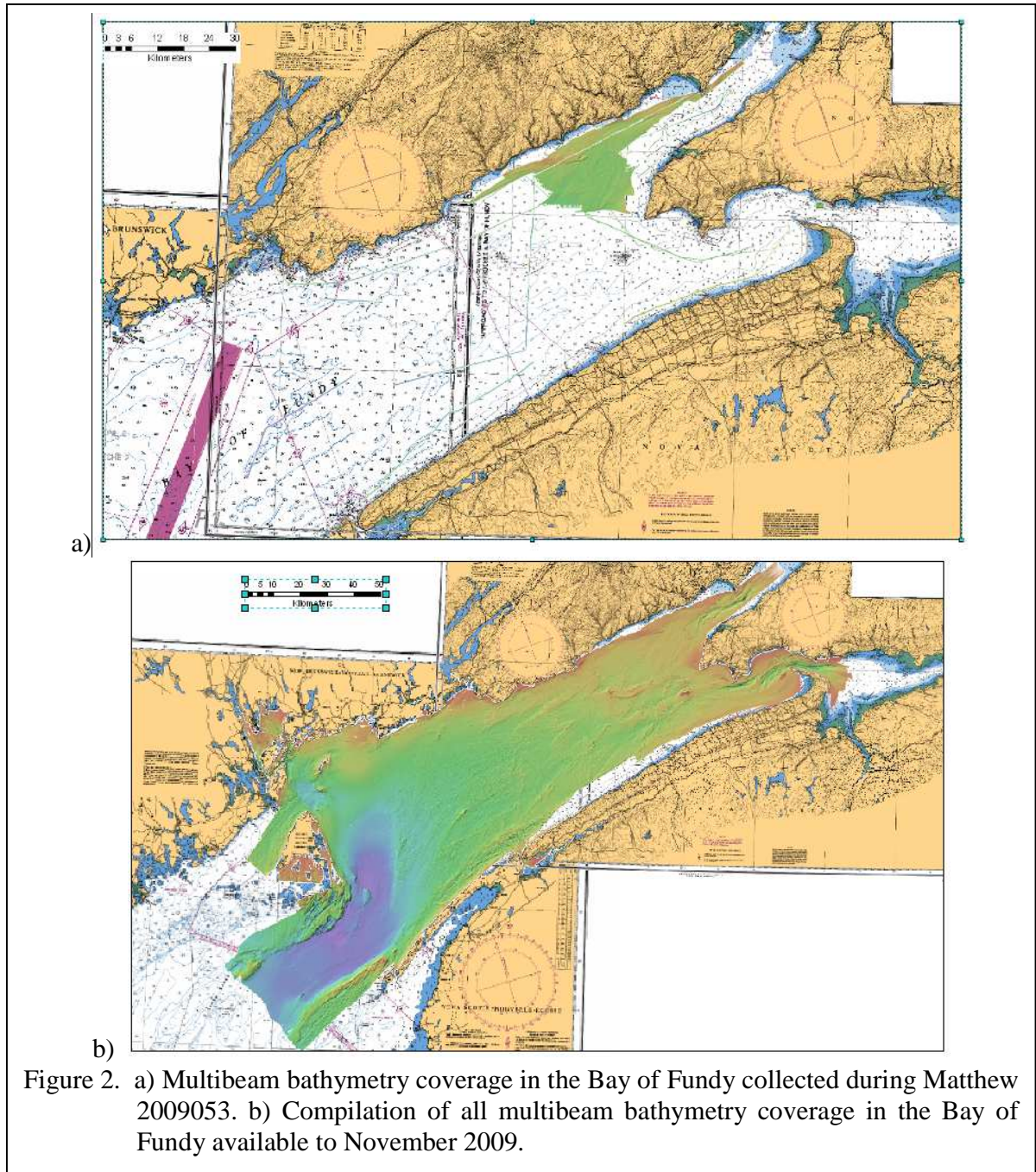
The Geological Survey of Canada (GSC), a division of Natural Resources Canada (NRCan), has initiated a project to produce a series of maps showing the bathymetry, seafloor backscatter, and surficial geology throughout the Bay of Fundy. Survey Matthew 2009053 was conducted as a joint project between the Geological Survey of Canada and the Canadian Hydrographic Service of the Department of Fisheries and Oceans, Canada.

Matthew 2009053 was conducted from 9 to 31 October 2009 using the *CCGS Matthew* (Figure 1). The vessel, equipped with a Kongsberg EM710 multibeam bathymetry system and a Knudsen 3.5 kHz sounder, collected multibeam bathymetry, multibeam backscatter and sub-bottom profiler data. The *Matthew* carried one hydrographic launch, equipped with a Kongsberg EM3002 multibeam bathymetry system, which was deployed for daytime operation. The vessel operated out of Saint John, NB and expanded on previous data collected throughout the Bay of Fundy, as shown in Figure 2. The surveys were designed to take advantage of previously collected data in the area. Selected areas were re-surveyed to determine if changes had occurred in the seafloor.

Previous surveys in the Bay of Fundy (Fader et al., 1977; Amos et al., 1992; Parrott et al., 2000, Parrott et al., 2010a, b, c, d, e,) have collected a variety of geophysical and multibeam bathymetry data, samples, and photographs. These data will be integrated with the multibeam bathymetry coverage from this survey to generate new surficial geology maps for the bay.



Figure 1. Multibeam bathymetry and sub-bottom profiler data were collected using the CCGS *Matthew* equipped with a Kongsberg EM710 multibeam bathymetry system and one hydrographic launch equipped with a Kongsberg EM3002 multibeam bathymetry system. Photo courtesy of J. Shaw.



## Vessel Characteristics

CCGS *Matthew* is an inshore hydrographic survey vessel with the following particulars:

Length overall	51.25 m
Draft	4.3 m
Breadth	10.50 m
Displacement (light)	745 tonnes
Displacement (loaded)	950 tonnes
Speed	12 knots
Range	4000 nautical miles
Crew	14 persons
Scientific staff	9 persons

The P-class hydrographic launch *Plover*, can be deployed from the CCGS *Matthew* for operations away from a home port or can operate independently from a shore base. *Plover* was equipped with a Kongsberg Simrad EM3002 multibeam bathymetry system.

Length overall	10 m
Breadth	3 m
Speed	12 knots
Crew	1 person
Scientific staff	1 person

## Survey procedures

During this survey, the CCGS *Matthew* was used for multibeam bathymetry and sub-bottom profiler surveys. The systems consoles for the multibeam bathymetry and sub-bottom profiler were located on the bridge level, in the hydrographic control room. A data processing facility of work stations equipped with five Caris HIPS licenses was established in the hydrographic plotting room. A central disk stored a backup copy of the raw multibeam bathymetry data, as well as the processed data. All computers and storage drives were connected by a high speed network. Staff generally divided their time between data acquisition and processing. The surveys were designed to take advantage of previously collected data in the area. Selected areas were re-surveyed to determine if changes had occurred in the seafloor.

The launch, *Plover* was carried aboard the *Matthew*, and deployed for daytime operations. Georeferenced images of existing coverage and areas to be surveyed were provided to the launches each morning. Areas to be surveyed were generally divided equally between the launches. When necessary the launches would exchange coverage plots at midday to ensure that the survey block was completely surveyed, with no unnecessary duplication.

Often, at the start of a survey block, the survey vessels would run a baseline along a preplanned course, along a contour line, or along the edge of existing coverage. The coverage plots, provided by the multibeam bathymetry logging systems, were then used to run a series of offset lines from the baseline, to ensure that all the seafloor was surveyed.

Variations in velocity of sound in the water column were determined at the start of each survey using a CTD (conductivity/temperature/depth) probe or SVP (sound velocity probe). The velocity casts were repeated as required throughout the survey to reduce the effects of artifacts observed changes on the multibeam bathymetry data.

## Data Acquisition and Processing

The following equipment and software was used during surveys Matthew 2009053:

- Kongsberg EM710 and EM3002 multibeam bathymetry systems
- Knudsen 320M echo sounder
- ODIM Brooke Ocean MVP-200 (Moving Vessel Profiler )
- CARIS HIPS multibeam bathymetry data cleaning software running on Windows XP

### Multibeam Bathymetry

The Kongsberg EM710 system on the CCGS *Matthew*, uses a 70 to 100 kHz transducer with 200 or 400 beams typically set to a beam footprint of  $1^\circ \times 1^\circ$ . The system is capable of sounding to depths in excess of 2000 metres, and across-track coverage of up to 5.5 times water depth. Information on the multibeam bathymetry systems can currently be found on the company website at <http://www.kongsberg.com>.

Multibeam bathymetric data were also collected using a Kongsberg EM3002 multibeam bathymetry system mounted in the hydrographic survey launch *Plover* (Figure 1b). The EM3002 system uses a 300kHz transducer with 254 beams with a maximum angular coverage of 130 degrees. The system provides a depth resolution of 1 cm with an accuracy of 5 cm RMS in shallow water.

Survey lines were run to provide overlapping swaths with the previous line with 120% to 200% percent coverage of the seafloor. The multibeam swath width was set at the maximum allowable angle by the conditions at the time of the survey. Generally beam angles of 60-70 degrees either side of nadir were used. The multibeam bathymetry coverage is shown in Figure 2.

During the survey, data were processed using version 6.1 of the CARIS HIPS data cleaning program (by CARIS, Fredericton, NB) on Windows XP workstations to remove spurious soundings and navigation data and to apply the OmniStar HP (High Precision) which yields difference in elevation of GPS antenna from the ellipsoid. These values (different file for each platform/each day), when processed with a known separation from chart datum derives the tidal corrections for each platform's sounding data. Short term changes in height, due to waves, are logged separately from the POS-MV motion compensation system (the TrueHeave signal). These were not applied during the survey but are available for application in post-processing. CARIS HIPS was also used to grid survey lines after they were completed to check data quality especially for motion and refraction artifacts. 5-metre and 10-metre grids were constructed using the "swath-angle" option for weighting soundings in the gridding process. The colour coding of depths generally set for a 0-225 metre range, illuminated from an azimuth of 315 degrees and at an angle of 45 degrees. A vertical exaggeration of 10 was applied to the data.

### Navigation and Attitude

Each vessel used an Applied Analytics Corporation POS-MV 320 attitude sensing system with integrated differential GPS navigation system to determine the position and attitude. The systems integrate data from an inertial measurement unit and differential GPS signals. A positional accuracy of 0.5 to 4 metres can be obtained using the phase differential of the GPS carrier frequency when using DGPS, and of 0.02-0.10 metres when using an RTK source. This survey was performed using DGPS data for an accuracy of 0.5 to 4 metres. A heading, with an accuracy of 0.5 degrees is obtained from the GAMS (GPS phase comparison) module of the POS-MV.

More information on this system can be found at [www.applanix.com](http://www.applanix.com).

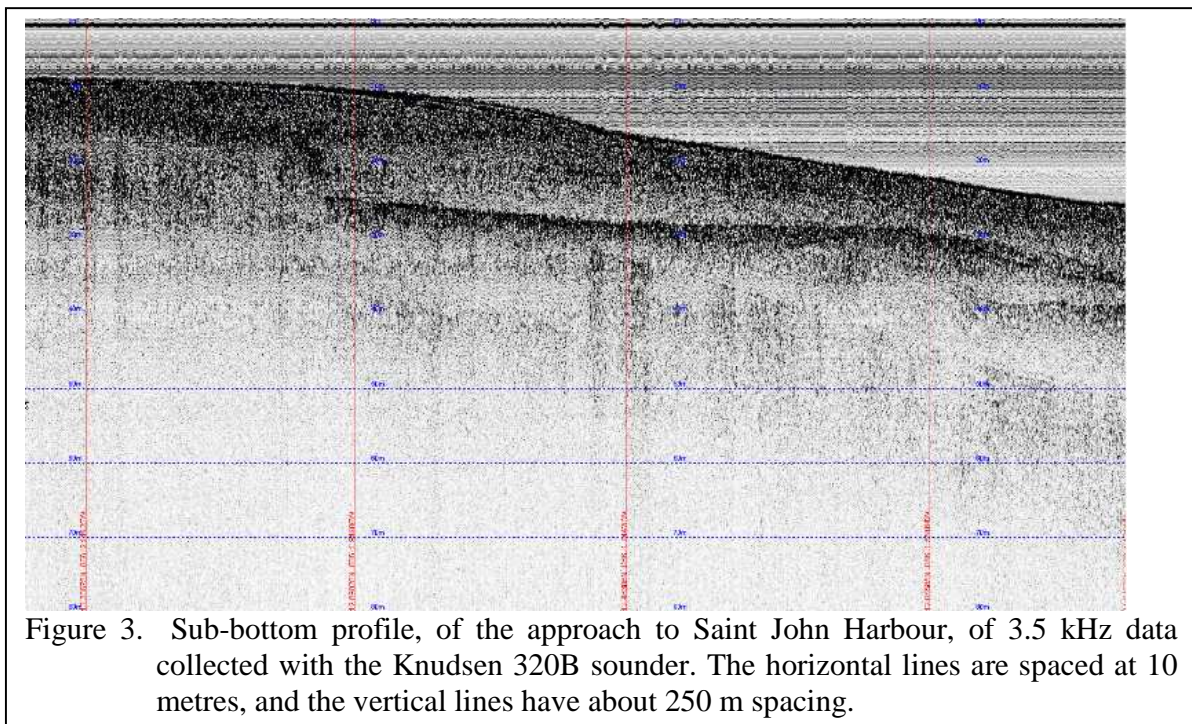
## **OmniSTAR**

With recent advancements in GPS positioning precision, a vessel's height above mean sea level can be determined for any point during transit. The multibeam bathymetry data collected during this survey were corrected for tidal heights using OmniSTAR HP (High Precision), a wide-area differential GPS service provided by the Fugro group of companies. More information is available at [www.omnistar.com](http://www.omnistar.com).

## **Knudsen 320M echo sounder**

Sub-bottom profiler data were collected with a Knudsen 320M sounder operating a four element 3.5 kHz transducer array installed on a ram near the keel, on the starboard side of the Matthew. The system was synchronized with the Kongsberg EM710 to avoid cross talk between the signals resulting from conflicting acoustic pulses in the water.

More information on the sounder is available on the company website at <http://www.knudsenengineering.com/ASP/Products/Products.asp>. Data were stored in KEB (Knudsen Extended Binary) and SEG-Y formats and viewed using the Knudsen PostSurvey program available. Information of the format and the program are available at <http://www.knudsenengineering.com/ASP/Support/Download.asp>.



The timestamp in the headers of the data recorded by the Knudsen echo sounder was synchronized to UTC using the NMEA ZDA string output from the POS-MV. The PC clock on the recording computer was manually synchronized to GPS time.

## **ODIM Brooke Ocean Moving Vessel Profiler MVP-200**

Measurements of the velocity of sound in the water column were made with an ODIM Brooke Ocean Moving Vessel Profiler MVP-200 equipped with Applied Microsystems Limited CTD & SVP probes (Smart Probes). The data are used to correct the Kongsberg EM710 multibeam bathymetry data for variations in sound velocity in the water column. More information on the MVP is available at <http://www.brooke-ocean.com> and for the Smart Probes at <http://www.appliedmicrosystems.com>.



## **Tides and Currents**

Bathymetry surveys in the Bay of Fundy must accommodate the largest recorded tides in the world. Prior to the survey, tides and currents for the survey area were calculated using the program Tides and Currents Pro by Nautical Software Inc. As shown in Appendix III, a tidal range of about 10 metres was predicted for Saint John, NB, during the period of the 2008 survey. Times are shown in Atlantic Daylight Time and tide heights are shown in centimetres. Tides were also calculated using the program WebTides, developed by the federal Department of Fisheries and Oceans (DFO), and used in post-processing to provide comparison for the real time GPS corrections. The program is available from the DFO website at

[http://www.mar.dfo-mpo.gc.ca/science/ocean/coastal\\_hydrodynamics/WebTide/webtide.html](http://www.mar.dfo-mpo.gc.ca/science/ocean/coastal_hydrodynamics/WebTide/webtide.html).

For the duration of the survey, tide gauges were installed at various locations in the upper Bay of Fundy, in addition to the permanent gauge located in Saint John, NB. Data were also downloaded from the tidal gauge in Eastport, Maine, USA, operated by the US Coast and Geodetic Survey.

For the Minas Passage survey, tide gauges were previously installed at Cape Sharp, Cape Split and Blomidon to provide a 1-2 month record of tidal elevations in the restricted waters of the passage. The gauge at Cape Sharp was left in place to provide a long term record.

## **Access to Data and Samples**

The multibeam bathymetry and sub-bottom profiler data collected during this survey are archived by both the Canadian Hydrographic Service and the Geological Survey of Canada, Atlantic, in Dartmouth Nova Scotia. For access to the data and samples contact the senior scientist for the survey, Russell Parrott (902-426-7059) or Susan Merchant of the GSCA Curation group (902-426-3410). Data can be accessed by logging on to the Geological Survey of Canada Atlantic site at <http://gsc.nrcan.gc.ca> and the Canadian Geoscience Knowledge Network <http://cgkn.net/>.

## **Acknowledgements**

The captains and crews of the CCGS *Matthew* provided valuable assistance with data collection. This project was jointly funded by Natural Resources Canada through the Offshore Geoscience Program of the Earth Sciences Sector, and the Canadian Hydrographic Service –Atlantic Region, of the Department of Fisheries and Oceans Canada. Vladimir Kostylev reviewed the manuscript.

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## Appendices

### Appendix I - Survey Particulars

Name of Vessel:	CCGS <i>Matthew</i>
Dates:	9 October 2009 – 4 November 2009
Vessel captains:	Fergus Fancey
Area of Operation:	Bay of Fundy
Senior Scientist:	Russell Parrott
Senior Hydrographer:	Jon Griffin

#### **List of Participants – Matthew 2009052 – 9 October to 4 November 2009**

##### Geological Survey of Canada Atlantic

Russell Parrott	Senior Scientist
Scott Hayward	GIS, navigation, multibeam bathymetry
Eric Patton	GIS, navigation, multibeam bathymetry
Paul Fraser	GIS, navigation, multibeam bathymetry

##### Canadian Hydrographic Service

Jon Griffin	Senior Hydrographer
Michael Collins	Hydrographer
Glenn Rodger	Hydrographer
Heather Joyce	Hydrographer
Julie LeClerc	Electronics

##### Department of National Defence

Gerard Arsenault	Multibeam bathymetry
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## Appendix II - Activities

All times are shown in UTC Universal Coordinate Time (Atlantic Daylight Savings Time + 3 hr).

### 8 October 2009 Thursday – Day 281

CCGS *Matthew* at Bedford Institute of Oceanography (BIO) facilities in Halifax. Problems are reported with the propeller shaft and main bearing on the port engine on the *Matthew* and with the bearing on the launch *Pipit*. The launch *Pipit* was removed from the vessel for repairs at BIO.

The Knudsen 320B sounder and the Kongsberg EM710 are tested at the dock and are operational. The Knudsen is keyed to fire from the multibeam sounder, and will not operate without the sounder working.

S. Parsons (CHS) arrives on *Matthew* and assist J. LeClerc with the OmniStar initialization. Calls are made to the service provider and OmniStar licenses are activated for the CCGS *Matthew*, and launch *Plover*.

### 9 October 2009 Friday – Day 282

S. Parsons and J. Griffin confirm that the OmniStar is operational and check offsets in the SIS, POS-MV and HIPS.

14:30 Train wheels loaded to compensate the vessel trim for the weight of launch *Pipit*.

16:00 CCGS *Matthew* departs BIO and starts the transit to the Bay of Fundy. Vessel speed will be limited to 10 kn to prevent further damage to the shaft and bearing. R. Parrott and E. Patton from GSC-A; J. Griffin, H. Joyce, M. Collins, G. Rodger, J. LeClerc from CHS; and G. Arsenault from DND are on board.

### 10 October 2009 Saturday – Day 283

00:00 In transit.

04:30 Drop anchor in Shelburne, NS. Strong winds predicted.

12:00 Familiarization with vessel for anyone who had not been on board in the past 6 months.

14:00 Depart Shelburne for Bay of Fundy.

21:00 In transit to Bay of Fundy. Prepare ArcView projects and images for the Regulus system.

### 11 October 2009 Sunday – Day 284

00:00 In transit to Bay of Fundy. Alter course into St. Mary's Bay to allow a brief respite from the waves.

11:00 In transit near Brier Island. Clear and sunny with 15-20 kn winds. Winds predicted to decrease during the day and increase to 30 kn during the evening.

14:30 Began logging Knudsen on survey line through old multibeam coverage from survey Creed 99004.

14:52 MVP cast after a few failed attempts. The cable out would stop at about 125 metres on each attempt and report a profile rate error. The parameter for the Profile Rate was changed to 0.0 m/s to disable the error check and the system then functioned properly. An email will be sent to Odium Brooke Ocean to determine if there are any serious consequences to disabling the error check. Started logging new Kongsberg EM710 after applying MVP profile.

The Kongsberg EM710 has been configured with a 60 degree beam angle, with High Density Equidistant pinging – resulting in 400 beams per ping. The system is in Shallow mode. The system is using SIS software version 3.6 Build 173 compiled on 4 November 2008.

The Knudsen 320B system is configured to operate at 3.5 kHz using a 1.5 msec chirp with a processing gain of 1. Automatic Gain Control (AGC) was enabled for display. Data was recorded in KEB and SEG-Y formats.

- 16:46 Stopped logging EM710. We are breaking the line at the northeast corner of the Creed 99004 coverage bounding box, while the Matthew transits to the next Creed 99004 survey boundary. The *Matthew* will survey from the southwest to northeast corner.
- 17:46 Began logging a diagonal transect through the bounds of a second Creed 99004 survey grid.
- 18:00 Sand waves, star dunes and mussel reefs present on data.
- 18:30 Fire and boat drill!
- 18:40 End of section through 1999 survey. Continue surveying to start of new coverage. Vessel crabbing 15 degrees to course.
- 20:00 MVP deployed.
- 21:15 Start line parallel to 2008 line. New coverage.
- 21:27 MVP cast.
- 22:11 MVP recovered.
- 22:20 Olex screen moved to helmsman's display in night mode with intensity reduced to 65%.

### **12 October 2009 Monday – Day 285**

- 00:00 Continue survey line near Alma, NB.
- 00:34 End line. Start reciprocal line back.
- 07:20 Heading southwest on new line; winds about 30 knots, 1-2m swell. Daybreak today is partly cloudy, good visibility.
- 08:49 The Omnistar system was not logging a data file from last night. We realized that no data strings were configured to log to the listening COM port on the Omnistar computer. Began logging the following strings to the JD285 Omnistar data file: GPGGA, GPGGALONG, GPGGARTK, GPGLL, GPVTG, GPZDA, OMNHPPOSA.
- 13:27 Noted that the “Nav/GAMS Heading Rejected” light on the POS/MV machine occasionally is blinking red, about once every 5-6 seconds.
- 13:30 Ship is now making water using evaporators. The system has been shut down overnight due to turbid water. The Reverse Osmosis system will be kept offline until water clarity improves.
- 13:47 Changed beam width from 60/60 to 65/65 degrees on Line 50.
- 16:28 MVP cast, and new SVP applied in SIS.
- 17:28 MVP cast, and new SVP applied in SIS.
- 18:21 SOL 0061. Survey being run in Lobster Fishing Area 35. The season starts here on 15 October. Lines will be run here before the traps are set in the area.
- 19:25 Long linear positive relief features (1-2 m above seafloor) seen on multibeam in a depth of 30 metres. Could these be mussel reefs ?
- 20:00 The MVP is still deployed. The tow depth has decreased from 10 to 6 metres as the speed has increased from 4-6 knots. The fish is still too deep for a proper deployment. Either we have to increase speed or shorten the length of the cable to bring the tow fish to 2.5 metres depth.
- 20:20 Alter course to rub back to NE.
- 20:30 New SVP cast. Speed 10.5 kn resulting in a towfish depth of 2.5 metres.
- 21:45 MVP retrieved and on board.

### **13 October 2009 Tuesday – Day 286**

- 00:00 Added the LBANDSTAT string to the set of Novatel GPS strings being logged. Winds continue to blow from the north.
- 00:25 Alter course to run NE towards Cape Enrage. The plan is to continue with these NW-SW lines through the night and to run more lines on the western end of the area if these are completed.
- 11:35 Launch Plover deployed to begin coastal multibeam survey near Cape Enrage.
- 12:08 End of NE-SW lines. Running a cross line orthogonal to the current survey area to begin a new SW-NE line on the western, shoreward edge of current coverage.
- 13:04 MVP cast; new SVP applied in SIS.

- 14:19 MVP cast; new SVP applied in SIS. Recover MVP.
- 14:30 Alter course to survey NE back to Cape Enrage.
- 20:00 Continue with survey near Alma NB. The winds has dropped to less than 10 knots and fog and rain have moved in.  
Note that 14 October is 'Dump Day' when the lobster traps are set in LFA 35, east of 65°W. The intent is to survey here until early morning and then move to LFA 36 (west of 65°W) where there should not be any traps.
- 21:26 Alter course to continue lines SW of Cape Enrage.
- 22:07 Launch Plover recovered and aboard. Continue survey. Fisheries patrol vessel Cape Mariner IV nearby, waiting for start of lobster fishing season.
- 23:10 Large sandwaves near Matthews Head.
- 23:30 All the stored multibeam images disappeared from the SIS display screen.

#### **14 October 2009 Wednesday – Day 287**

- 00:00 Winds continue to blow from the north. Continue with survey near Alma, NB.
- 00:05 Alter Course to survey SW from Cape Enrage.
- 00:15 All the stored multibeam images just re-appeared on the SIS display screen. Must be magic.
- 00:42 Noted that the SIS display grids reappeared on the screen after panning and zooming to a different scale.
- 01:05 Alter course to survey NE to Cape Enrage.
- 02:05 Alter course to survey SW from Cape Enrage.
- 11:44 Finished surveying parallel to N.B. coast; transiting southeast to survey northeast-to-southwest lines parallel to Fishing Area 35 boundary.
- 11:56 Deployed launch Plover to continue work in Chignecto Bay.
- 12:16 Many lobster pots are present in the area, in a zone that is not identified as available for fishing on the image showing the various LFAs provided by DFO and downloaded from the NS government website. A similar plot was generated from data provided by Fundy Traffic. The *Matthew* is taking evasive maneuvers while trying to come into SOL.
- 14:00 Enquiries have been made to Coast Guard in Halifax and co-ordinates for LFA 35 were received. When these co-ordinates were plotted, they did not align with the data from the website or from Fundy Traffic. Both of those data sets were out of date. The traps appear to have been deployed within the designated area. As a side note – the co-ordinates were provided in the NAD27 reference datum. The chart for the area (4010 Bay of Fundy – Inner Portion) use NAD83. NAD83 has replaced NAD27 as the default datum for many North American applications.
- 18:14 *Matthew* maneuvering around lobster pots.
- 19:04 MVP deployed, cast and recovered.
- 20:00 Alter course to survey NE towards Cape Enrage.
- 20:40 Alter course to fill in dip in line.
- 20:50 Terrace on sub-bottom profiler. Stratified sediments in deeper areas (> 30 metres). 10 metre high terrace with 1-2 metres of sediments over other material.
- 21:30 End of line. Stop logging to recover launch *Plover*.
- 22:00 Start of line SW from pickup area. Lines will be run west of LFA 35 during the night to avoid lobster traps.
- 23:55 End of line SW from Alma area.

#### **15 October 2009 Thursday – Day 288**

- 00:00 Winds continue to blow from the north. Continue with survey west of LFA 35 near Alma, NB. 20-30 metres of penetration in some places on the sub-bottom profiler.
- 01:30 Large sand waves (about 5 metres high) on the records.

- 01:55 End of line. Start line on reciprocal course.
- 11:04 Deploy launch *Plover* to continue survey operations near Cape Enrage. Stopped logging Simrad 710 and Knudsen 3.5kHz while the *Plover* is deployed.
- 11:25 *Plover* is free and clear of the ship. Turning to the north and logging a line against the northeast edge of current coverage, en route to infill a section that was skipped yesterday on account of fishing buoys in the area.  
*Plover* will in-fill another area that was left yesterday due to the presence of buoys.
- 13:04 The *Matthew* is veering a bit off line to avoid fishing buoys. There are several strings of buoys in the area. The survey in this area will be run in daylight hours only to minimize the risk of snagging any gear.
- 13:25 Snagged a lobster buoy. Logging stopped. Appears to have cleared the buoy after drifting. The buoy appears to be still attached to the trap.
- 16:12 MVP cast. New SVP applied in SIS.
- 18:25 Alter course to survey back along a SW line. 20 metres of stratified sediments seen on sub-bottom profiler.
- 19:23 Alter course to survey back along a NE line. 'Bright spots' on sub-bottom profiler.
- 20:00 30 metres of stratified sediments are visible on the sub-bottom profiler records.
- 22:25 Stop logging to recover launch.
- 22:32 Launch *Plover* is aboard the *Matthew*. Resume survey.
- 23:16 Regulus either closed remotely or crashed; it was successfully restarted with no problems.
- 23:59 Continue with survey.

#### **16 October 2009 Friday – Day 289**

- 00:00 Winds continue to blow from the north and are predicted to increase to NE 35 overnight. With all the lobster gear now present in LFA 35 near Alma, it is not prudent to try to steam there for cover from the wind. The *Matthew* will survey until 07:00 GMT and then transit to Saint John, NB.
- 00:43 Start reciprocal line SW.
- 01:15 30 metres of stratified sediment on the sub-bottom profiler.
- 01:43 Start reciprocal line NE.
- 06:35 Break line to transit to Saint John. Continue with sounders on.
- 11:00 Raise ram. Continue to collect sub-bottom profiler data.
- 13:30 *Matthew* secured at Coast Guard Base in Saint John.
- 16:00 Paul Fraser arrives from BIO.
- 17:00 R. Parrott departs.

#### **17 October 2009 Saturday – Day 290**

- 14:15 *Matthew* departs Coast Guard base en route to survey area.
- 17:40 Ram lowered and SVT pump switched on.
- 21:05 Start logging sub bottom profiler.
- 21:16 Start Logging multibeam using sound velocity profile from previous day.
- 21:29 New sound velocity profile.

#### **18 October 2009 Sunday – Day 291**

- 00:00 At some point through the night the POS-MV stopped using the Omnistar GPS. Web tide will be used to correct these lines.
- 02:00 POS-MV restarted. After the restart the POS was correctly accepting the Omnistar GPS positions again.

- 10:00 Cutting northwest across survey region to drop off the launch Plover near shore.
- 11:00 Stopped logging Knudsen and Simrad 710 while the launch is deployed.
- 11:10 Launch *Plover* deployed; resuming logging on Knudsen and Simrad 710.
- 17:14 Winds have picked up to about 25 knots; ship has slowed to about 250 rpm, which given the wind, has slowed the ship down to 5 knots.
- 18:01 Begin transit to pick up launch as wind has increased to 30 kts. Continue logging multibeam and sub-bottom during transit.
- 20:09 Stop logging multibeam and sub bottom to pick up launch.
- 21:03 Launch on board. Start transit to work area on northern edge of the coverage for the night. Log sub-bottom during transit.
- 21:27 Start logging multibeam again on transit to work area.
- 21:52 Back online on northern edge of data coverage.
- 22:23 New SVP as we are out of the fishing area. Continue survey for the night.

### **19 October 2009 Monday – Day 292**

- 03:19 The wind picked up to 35 knots, and as a result the outer beams are becoming noisy and frayed. Reduce beam width from 65 degrees port/starboard to 60 degrees.
- 10:00 Launch to remain on board for the day due to the winds.
- 12:00 MVP cast and new SVP applied in SIS.
- 21:13 MVP cast and new SVP applied in SIS.
- 22:01 Beams back out to 65 degrees.
- 23:38 Wind is down to 12 kts. Break off survey line to transit to southern edge of the data coverage.

### **20 October 2009 Tuesday – Day 293**

- 00:00 Continue transit. Logging multibeam as a check line.
- 00:14 Arrived at survey area.
- 09:00 End survey in Chignecto Bay. The *Matthew* will transit to Scots Bay to pick up Julian Goodyear from CHS, who will be on board for the day. Continue logging Simrad EM710 and Knudsen on the way.
- 12:31 *Plover* deployed near Cape D'Or to re-survey the Minas Basin turbine sites and Scots Bay. Stopped logging Simrad EM710 and Knudsen while the launch is deployed.
- 13:50 FRC back on board. Starting transit to work area on the Nova Scotia side of the data coverage.
- 15:03 SOL along Nova Scotia coastline.
- 15:47 MVP deployed and new SVP applied.
- 19:45 Break off survey line near Halls Harbour to start transit to Scots Bay. Julian Goodyear will be dropped off and we will anchor in Scots Bay for the night.
- 20:07 Stop logging multibeam and sub-bottom to pick up launch.
- 20:21 Launch secure on board. Continue transit. Logging sub bottom only.
- 20:41 Stop to anchor for the night in Scots Bay.

### **21 October 2009 Wednesday – Day 294**

- 01:09 Pulled up anchor for a search and rescue call. Logging multibeam and sub-bottom on the transit for possible change detection.
- 02:06 Detached from SAR tasking, transiting to Chignecto Bay to resume survey.
- 05:20 Arrive in survey area, commence lines in the southeast corner of the triangle.
- 05:25 Break line due to fishing gear, ship altering to the west to avoid floats, will pick up lines in the southwest corner of the triangle.
- 05:52 Commence lines SW corner of triangle.
- 11:27 MVP deployed, and new SVP applied in SIS.



- 11:39 The *Matthew* is pulling off of line and into existing coverage to deploy the launch. Stopped logging Knudsen and Simrad EM 710 while the launch *Plover* is deployed.
- 11:53 Launch *Plover* deployed. *Matthew* coming around back on to the survey line. Resume logging of Simrad EM 710 and Knudsen.
- 13:30 *Plover* coming alongside with electrical problems. Stopped logging multibeam and sub-bottom while ship's tech and engineers work on the problem.
- 13:55 *Plover* secured on board while they work on the problem. Start logging multibeam and sub-bottom.
- 15:27 Stop logging multibeam and sub-bottom to launch the *Plover*.
- 15:58 Finish surveying triangular section. Begin new survey area in fishing zone, running east-west lines.
- 21:24 Stop logging multibeam and sub-bottom data to pick up launch.
- 21:38 Launch on board. Begin transit to work area along the NB coast. Logging multibeam and sub-bottom.
- 21:43 New SVP
- 22:29 Online at survey location.

#### **22 October 2009 Thursday – Day 295**

- 00:00 Continue surveying on the NB side of the coverage.
- 11:47 EOL in survey area along N.B. coast; weather is forecast to become rough Friday, with 30 knot winds, and the *Matthew* must take on fuel, so the ship will begin transit to Saint John.
- 13:54 Start of diagonal check line through Creed 99004 multibeam bathymetry coverage.
- 14:58 Finish check line through 99004 Creed data. Stop logging multibeam and sub-bottom. Continue transit to Saint John.
- 16:40 *Matthew* secured in Saint John.

#### **23 October 2009 Friday – Day 296 Saint John, NB**

- 00:00 *Matthew* secured in Saint John
- 11:00 *Plover* departs for survey in and above the Reversing Falls, Saint John.
- 15:30 S. Hayward arrives from BIO. E. Patton departs vessel to return to BIO.
- 18:30 Taking on fuel.

#### **24 October 2009 Saturday – Day 297 Saint John, NB**

- 00:00 *Matthew* secured in Saint John. *Matthew* to remain alongside due to a gale warning.
- 11:00 *Plover* departs for survey in harbour and rapids.
- 12:00 J. Griffin departs to download data from Saint John Tide Gauge.
- 15:00 Logging Omnistar to compare with the tide gauge.
- 21:20 *Plover* back on board the *Matthew*.

#### **25 October 2009 Sunday – Day 298 Saint John, NB**

- 00:00 *Matthew* secured in Saint John. Vessel to remain in Saint John while waiting for the seas to calm down. Winds have died down and wave forecast is to be down to 1 – 2 m by noon ADT. Also, waiting on the arrival of a new deckhand to replace one that injured his wrist on Thursday night.
- 15:00 *Plover* departs for Saint John River survey.
- 21:30 J. Griffin and company depart to check the Saint John tide gauge.
- 22:00 *Plover* on-board.

#### **26 October 2009 Monday – Day 299**

- 11:00 *Matthew* departs Saint John enroute to Survey area off Alma, NB

- 11:03 Logging survey line out of harbour to note changes in the shipping channel due to infilling or dredging.
- 15:37 Start logging data off Black Point, NB.
- 17:12 Stop logging to drop launch.
- 18:00 Surveying along fishing zone.
- 21:11 Stop logging to pick up launch.

**27 October 2009 Tuesday – Day 300**

- 00:00 Surveying off of Martins Point, adjacent to fishing zone
- 11:04 *Plover* away.
- 15:35 Leaving holes in coverage due to the presence of lobster traps
- 21:30 Pick up *Plover*.

**28 October 2009 Wednesday – Day 301**

- 00:00 Surveying off of Martins Point, adjacent to fishing zone weather overcast, sea state < 1m
- 10:45 *Plover* away.
- 18:30 Continue survey off Cape Chignecto in the fishing zone.
- 20:11 *Matthew* ends survey for the day, heading to anchor in Advocate Bay. The water was too shoal for night *Matthew* operations nearshore, and there is too much fishing gear offshore.
- 21:00 Deploy the anchor.
- 21:30 *Plover* on board.

**29 October 2009 Thursday – Day 302**

- 00:00 *Matthew* anchored in Advocate Bay
- 10:45 *Plover* away.
- 11:00 Retrieve the anchor and transit to the survey area.
- 12:08 SOL for the day.
- 16:00 The Knudsen 320 sub-bottom profiler system crashed.
- 16:20 Knudsen 320 operational again..
- 19:03 Stopped logging as the ship has hooked on some fishing gear.
- 19:15 Back online and logging has resumed.
- 21:00 Stop logging data to recover the launch.
- 23:00 Deploy anchor off Quaco ledge.

**30 October 2009 Friday – Day 303**

- 00:00 At anchor off Quaco Ledge.
- 10:15 Recover anchor and get underway for Cape Chignecto area.
- 11:00 *Plover* away.
- 11:41 Survey underway to infill gaps in the coverage.
- 12:40 Survey of Cape Chignecto area complete.
- 13:02 Launch on board. Starting transit back to BIO. The *Matthew* will survey along the NS edge of the data coverage on the transit.
- 15:01 Acquiring coverage between Harbourville and Digby (data may be questionable it was not feasible to perform MVP cast due to the presence of lobster traps)
- 17:01 Survey Program ends (3 days early due to possible weather concerns). The FRC is deployed to deliver the chief cook to Digby.
- 18:00 *Matthew* begins transit back to Halifax at 13 knots. (Apparently it was decided that there would be less damage to the shaft/bearings by travelling at full speed in relatively calm seas, than at a slower speed in the rough weather forecast for later in the day.)

**31 October 2009 Saturday – Day 304**

00:00 Transit back to Halifax (seas <1m).

10:00 Data backup underway (seas 1-2m).

13:45 Enter Halifax traffic zone.

17:00 Arrive BIO and commence demobilization of equipment.

### Appendix III - Predicted Tides for SaintJohn, NB

Hourly values in metres above chart datum – generated by the program Tides and Currents version 4.2 by Nautical Software Inc. Times are shown in Atlantic Daylight Time. Heights are in centimeters above chart datum, with 12 hourly predictions per line.

Date	Time	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
9-Oct-09	12:00a	328	480	620	709	719	656	548	418	282	179	149	204
9-Oct-09	12:00p	320	465	610	721	760	718	618	486	338	203	126	136
10-Oct-09	12:00a	221	349	493	621	697	699	636	533	409	283	190	169
10-Oct-09	12:00p	225	335	472	609	710	744	703	608	482	340	213	142
11-Oct-09	12:00a	151	231	352	488	611	684	689	632	536	417	295	204
11-Oct-09	12:00p	180	228	331	462	594	695	732	700	613	493	355	227
12-Oct-09	12:00a	153	154	225	340	474	598	678	692	644	553	436	311
12-Oct-09	12:00p	213	177	215	311	439	574	683	731	709	631	513	372
13-Oct-09	12:00a	238	153	144	207	320	458	592	685	709	668	579	457
13-Oct-09	12:00p	322	209	160	189	282	413	558	679	741	728	653	533
14-Oct-09	12:00a	385	239	142	124	185	303	451	598	704	737	697	603
14-Oct-09	12:00p	471	320	192	132	158	253	393	551	686	758	749	672
15-Oct-09	12:00a	546	386	228	122	102	169	296	458	619	733	767	721
15-Oct-09	12:00p	618	472	304	163	99	129	233	386	557	703	777	765
16-Oct-09	12:00a	681	545	374	206	98	87	165	306	480	651	767	792
16-Oct-09	12:00p	734	618	456	274	128	69	111	229	394	576	725	793
17-Oct-09	12:00a	769	675	529	349	179	79	84	179	333	517	691	796
17-Oct-09	12:00p	805	731	599	423	234	94	51	110	243	419	605	746
18-Oct-09	12:00a	798	759	653	498	314	151	72	98	210	375	563	729
18-Oct-09	12:00p	814	801	709	564	380	193	69	50	129	274	456	637
19-Oct-09	12:00a	760	790	734	618	457	276	132	79	129	255	426	611
19-Oct-09	12:00p	758	817	780	673	518	331	158	60	68	165	318	499
20-Oct-09	12:00a	665	763	769	697	573	411	243	125	101	172	308	479
20-Oct-09	12:00p	651	772	802	745	627	467	286	136	70	103	213	369
21-Oct-09	12:00a	540	684	754	737	653	524	368	220	132	136	222	363
21-Oct-09	12:00p	527	679	770	774	702	577	418	253	131	95	148	265
22-Oct-09	12:00a	417	573	690	733	698	607	479	334	211	152	178	273
22-Oct-09	12:00p	411	563	691	755	739	657	530	379	235	142	130	195
23-Oct-09	12:00a	314	457	593	684	706	660	566	443	314	215	180	219
23-Oct-09	12:00p	317	449	584	688	731	703	617	493	353	232	163	167
24-Oct-09	12:00a	238	353	485	601	671	679	627	534	419	307	228	208
24-Oct-09	12:00p	254	350	472	591	677	705	671	586	468	341	238	186
25-Oct-09	12:00a	270	380	499	600	657	657	605	515	408	308	242	231
25-Oct-09	12:00p	277	369	482	589	663	685	649	566	454	338	247	204
26-Oct-09	12:00a	220	290	394	506	597	648	647	594	507	404	311	251
26-Oct-09	12:00p	242	287	376	484	585	654	674	638	556	448	337	250
27-Oct-09	12:00a	211	229	299	402	511	601	651	648	594	505	401	308
27-Oct-09	12:00p	247	239	286	376	485	586	655	673	636	552	442	330
28-Oct-09	12:00a	243	206	228	303	411	525	617	666	658	597	501	391
28-Oct-09	12:00p	292	230	225	279	376	491	597	667	682	638	547	429

29-Oct-09	12:00a	312	225	192	224	311	429	551	646	689	671	598	489
29-Oct-09	12:00p	367	261	201	205	272	383	509	620	688	694	638	534
30-Oct-09	12:00a	405	282	197	176	225	329	461	591	684	716	680	589
30-Oct-09	12:00p	463	328	217	166	188	275	402	539	654	713	702	628
31-Oct-09	12:00a	509	369	242	166	165	237	361	508	642	726	737	677
31-Oct-09	12:00p	565	421	275	168	135	182	291	436	582	692	734	700
1-Nov-09	12:00a	605	471	322	198	140	166	265	409	565	696	762	746
1-Nov-09	12:00p	660	526	367	216	122	115	191	323	481	630	727	744
2-Nov-09	12:00a	684	571	424	271	158	126	183	307	466	627	746	786
2-Nov-09	12:00p	739	628	477	307	160	88	112	215	366	533	676	752
3-Nov-09	12:00a	740	657	528	372	222	128	127	214	358	526	684	784
3-Nov-09	12:00p	793	718	587	423	249	116	71	126	252	415	583	713
4-Nov-09	12:00a	762	724	622	482	323	183	114	143	254	410	581	728
4-Nov-09	12:00p	804	784	687	543	372	203	89	73	152	293	462	624

## Appendix IV - Canadian Hydrographic Service weekly reports

These reports are enclosed in the format received for CHS. Times are shown in Atlantic Daylight Time.

### Weekly Report: Matthew 2009-053

Dates: 7 Oct to 11 Oct

Projects: NRCAN GOM Survey Bay of Fundy

Geographic Area: Bay of Fundy

Charts affected 4010, 4011, 4377

### Hydrographic Staff

J. Griffin (HIC), R. Parrott, G. Rodger, M. Collins, H. Joyce, E. Patton, G. Arsenault, J. Leclerc

### Statistics

		%	
		Days	Use
3301	Survey operations	0.5	3.3
3306	CHS Calibration	0.4	2.7
3352	Alongside/On Deck; not active	6.6	44.0
3353	Mobe - deMobe	0.0	0.0
3356	Crew Change	0.5	3.3
3359	Crew Delays	0.0	0.0
3367	Lost; CHS/Science Equipment	5.0	33.3
3371	Lost; Weather/Tide	0.5	3.3
3376	Lost; ship equipment	0.0	0.0
3392	Transit to/from work area	1.5	10.0
3394	Training	0.0	0.0
5101	Lost; SAR	0.0	0.0
8107	Lost; ISM/Training/Audits	0.0	0.0
9111	Lost; Refit Delay	0.0	0.0
9151	Lost; Stores/Fueling	0.0	0.0
		0.0	0.0
Total		<b>15.0</b>	100.0

Distance Surveyed (km) 

145.0	
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280 Wed 07-Oct	1030 Report received significant - play observed in Pipits cutlass bearing 1100 Confirmed by boat shop – recommend not using Pipit until repaired 1200 Crew Change at BIO 1330 CHS/AGC crew assembled and briefed 1500 Decision to offload Pipit and load ballast 1600 News from C/O and Ch/E that the port M/E coupling bearing is approximately 25% worn. Caterpillar reps recommend reduced load on engine – resulting in lower ship speeds (8-10 knots) versus 10-12 knots
281 Thu 08-Oct	1300 Unload Pipit 1400 Omnistar installed on Plover and Matthew 1500 Commence calibration of Omnistar
282 Fri 09-Oct	0900 Continue Omnistar calibration – waiting for high tide for installation of train wheels 1130 train wheels installed aboard Matthew 1245 Away from dock 1300 Run two lines in basin to further verify Omnistar underway 1400 Depart Halifax Hbr
283 Sat 10-Oct	0015 anchored at Shelburne waiting weather 1100 Weigh anchor – transit toward program area
284 Sun 11-Oct	0000 Transit to work area – weather delays 1145 SOL, Start of Survey 2359 Underway in Chignecto Bay

### **Problems**

Note that this report only covers 4 days.

Pipit: Significant play has been reported and observed in the cutlass bearing on the Pipit. Recommendations from the small boat shop were to cease using the launch and get it repaired to prevent further substantial damage further up the shaft. The Pipit was off loaded onto the wharf. Train wheels were then loaded onto the Matthew to replace the weight of the Pipit. A work order will be submitted to get repairs completed as soon as possible.

Matthew: Reports from the C/E during crew change layover were that the Matthew's Port Main Engine coupling bearing is worn to the point where the Caterpillar representative cautioned against working the ship more than 75% of its rated speed. The C/O and C/E have established that this is an acceptable arrangement. This reduced power will limit the program in that we will only be able to enter the Minas Channel at slack tide.

Plover: Nothing to report at this time.

### **Recommendations**

None at this time.

## **Future Plans**

Continue surveying sea and weather conditions. There are plans to host Geomatics staff aboard the Matthew for training throughout the cruise as port stopovers present themselves.

## **Distribution List**

Director, CHS (Atlantic)  
Sheila Acheson, A/Planning Officer, CHS (Ottawa)  
CHS Division Managers, Maritime Region  
CHS Supervisors, Maritime Region  
Planning Officer, CHS Maritimes Region  
Manager, CHS, Newfoundland  
Regional Director, Science Branch  
D. Belliveau, Oceans Physics  
Anne Miller, Director, Operational Services, CCG  
Mark Chin-ye, Director, ITS, CCG  
Nigel Hawksworth, Superintendent, Marine Engineering, CCG  
Gary Walsh, Superintendent of Operational Business, CCG  
Dave Morse, Supervisor, Resource Deployment, CCG  
C. Myers, Communications  
John Shaw, A/Program Manager, GOM  
Russ Parrott, Bay of Fundy Project  
Rob MacGregor, Equipment and Systems Maintenance  
Central Registry, BIO



**Weekly Report: Matthew 2009-053**

Dates: 19 Oct to 25 Oct

Projects: NRCAN GOM Survey Bay of Fundy

Geographic Area: Bay of Fundy

Charts affected 4010, 4011, 4377

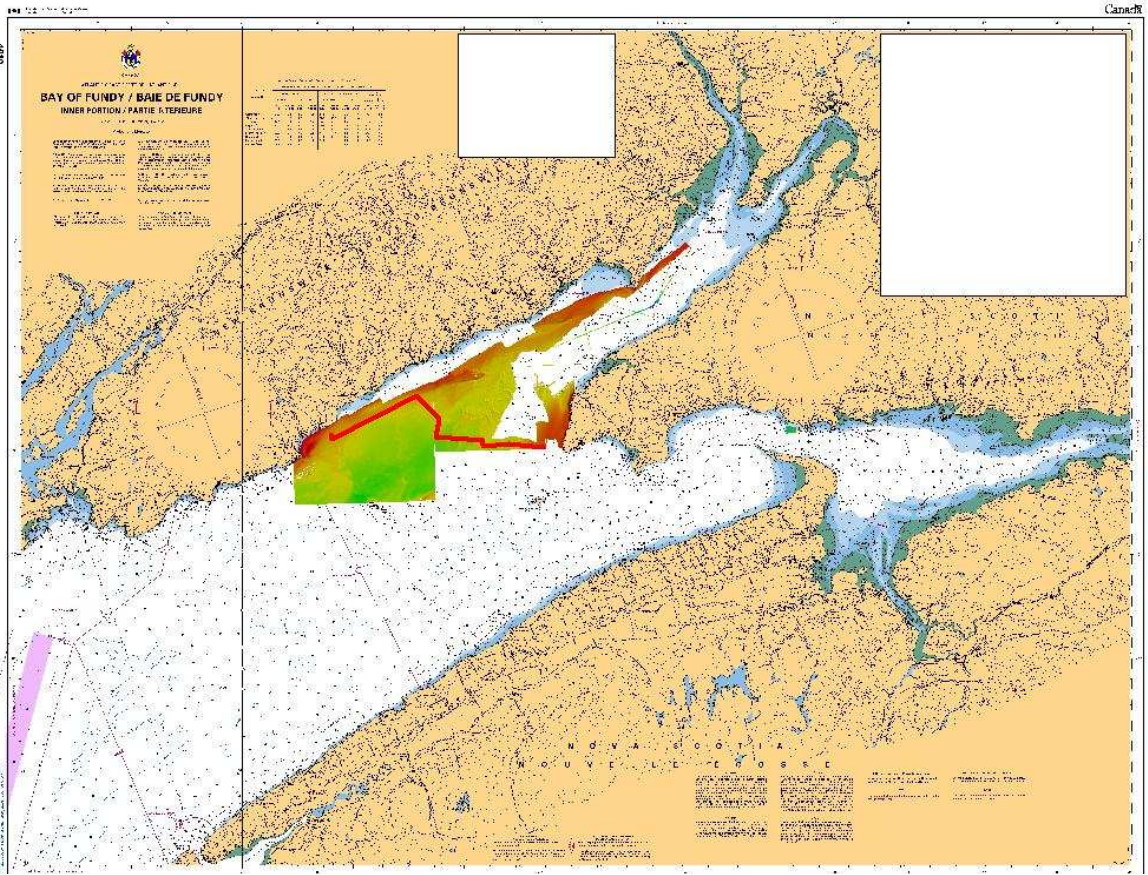
**Hydrographic Staff**

J. Griffin (HIC), G. Rodger, M. Collins, H. Joyce, S. Hayward, G. Arsenault, J. Leclerc, R. Woodward, P. Fraser

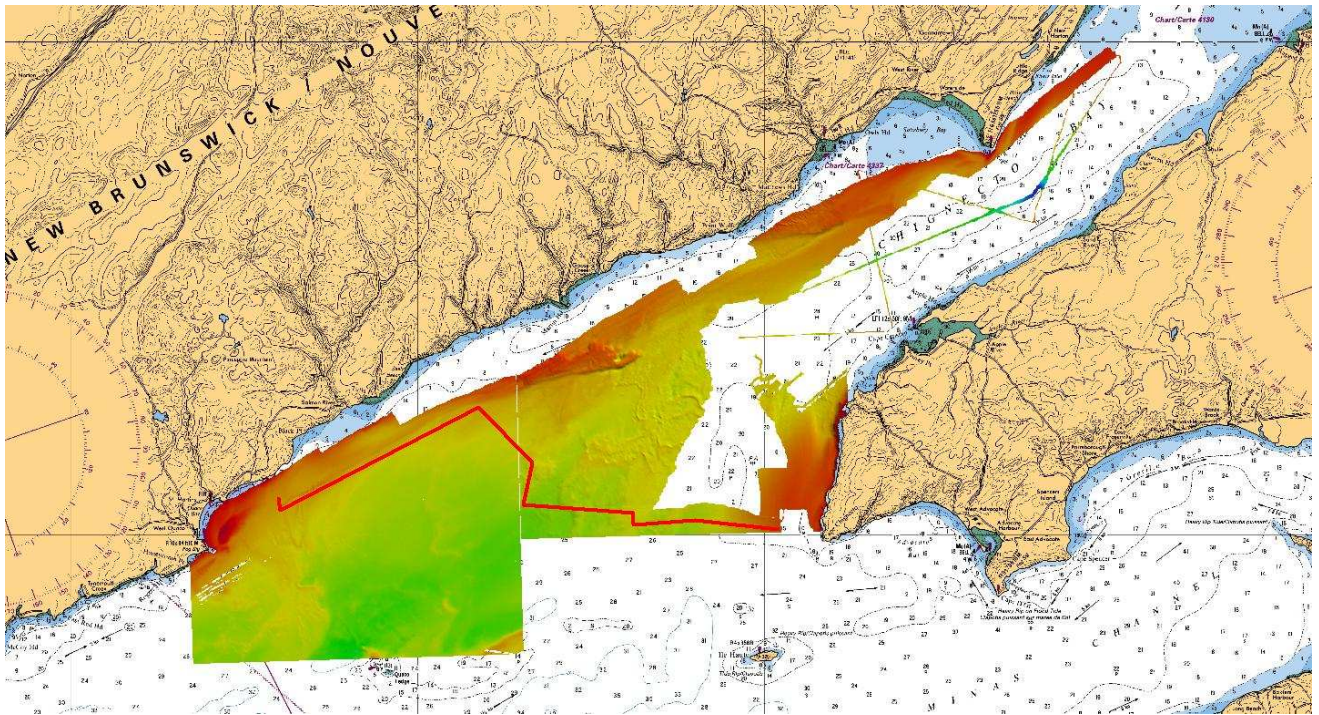
**Statistics**

		Totals				%
		Matt	Plover	Pipit	Days	Use
3301	Survey operations	2.7	2.5	0.0	5.2	24.8
3306	CHS Calibration	0.0	0.0	0.0	0.0	0.0
3352	Alongside/On Deck; not active	0.2	4.5	7.0	11.7	55.7
3353	Mobe - deMobe	0.0	0.0	0.0	0.0	0.0
3356	Crew Change	0.1	0.0	0.0	0.1	0.5
3359	Crew Delays	0.0	0.0	0.0	0.0	0.0
3367	Lost; CHS/Science Equipment	0.0	0.0	0.0	0.0	0.0
3371	Lost; Weather/Tide	3.0	0.0	0.0	3.0	14.3
3376	Lost; ship equipment	0.0	0.0	0.0	0.0	0.0
3392	Transit to/from work area	0.6	0.0	0.0	0.6	2.9
3394	Training	0.0	0.0	0.0	0.0	0.0
5101	Lost; SAR	0.2	0.0	0.0	0.2	1.0
8107	Lost; ISM/Training/Audits	0.0	0.0	0.0	0.0	0.0
9111	Lost; Refit Delay	0.0	0.0	0.0	0.0	0.0
9151	Lost; Stores/Fueling	0.2	0.0	0.0	0.2	1.0
		0.0	0.0	0.0	0.0	0.0
Total		7.0	7.0	7.0	21.0	100.0
	Distance Surveyed (km)	1097.0	470.0	0.0	1567.0	

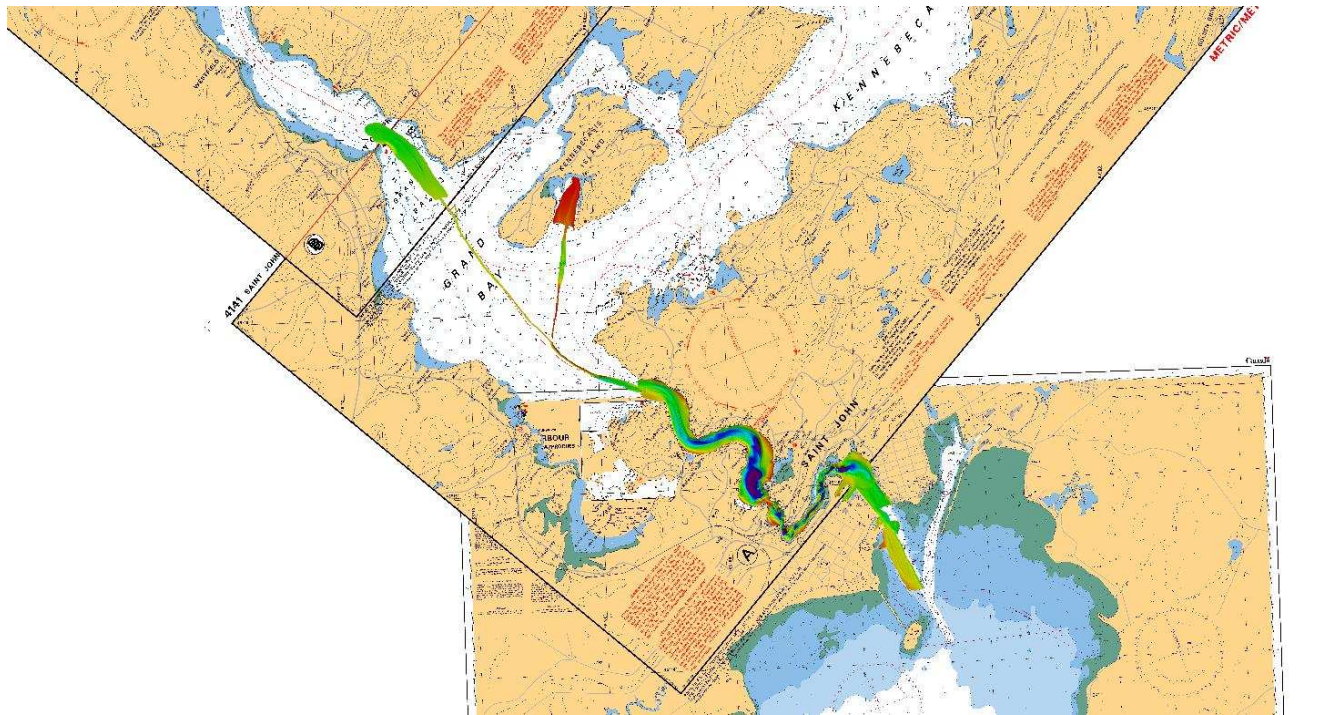
292 Mon 19 Oct	0000 Underway surveying Chignecto Bay
293 Tues 20 Oct	0000 Underway surveying Chignecto Bay 0400 Transit to Scots Bay to pick up J. Goodyear, check line logged over areas of interest for change detection 1000 RHIB away 1100 RHIB aboard with J. Goodyear 1115 Resume survey lines on West coat of NS 1730 Anchored in Scots Bay 1830 RHIB away with J. Goodyear 2000 Vessel tasked to SAR Case #2068 2315 Vessel stood down from SAR Case by RCC – resume transit to work area
294 Wed 21 Oct	0000 Underway surveying Chignecto Bay 0815 Plover away 1600 Plover a/s – power problems – breaker tripped 1900 Plover aboard
295 Thu 22 Oct	0000 Underway surveying Chignecto Bay 0830 Break off survey transit to Saint Johns 1300 Tied up Saint Johns CG Wharf 1400 Plover away 1730 Plover aboard
296 Friday 23 Oct	0000 A/S Saint John – waiting for fuel, AGC/CG/Technician crew change 0900 Plover away 1630 Plover aboard
297 Saturday 24 Oct	0000 Matthew a/s Saint John waiting for good weather 0800 Plover away 1015 CHS Staff way on shore program to check on Tide Station 0065 (Saint John) reported offline. 1815 Plover alongside 1930 CHS Staff away to check on repairs made to station.
298 Sunday 25 Oct	1200 Plover away surveying areas in the Saint John River, and approaches to Saint John Harbour 1830 Shore crew check on Saint John tide gauge. 1930 Plover aboard



**Overview of Week3 (Area south of red line is prior years data on CHS Chart 4010)**



**Detail of Week3 Coverage**



### Overview of Saint John River Coverage (week 3) on CHS Charts 4141 (A&B) and 4117

#### Problems

Pipit: Not aboard

Matthew: No problems to report. Officers and crew are working hard to accommodate our program.

Plover: Nothing to report at this time.

#### Recommendations

None at this time.

#### Discussion

On Friday, an additional ships technician joined the vessel to take advantage of training opportunities. AGC and Coast Guard each changed a staff member.

At the beginning of the week, the officers, crew and scientific staff welcomed Julian Goodyear aboard for a day trip to observe operations as the Matthew surveyed the approaches to the Minas Channel.

The Matthew hosted three Master students and their professor Dr. John Hughes Clarks from the Ocean Mapping Group at the University of New Brunswick.

#### Future Plans

The Matthew is returning to the survey area Monday morning to take advantage of the window of good weather. The Matthew is considering a departure from the area over the coming weekend. Upon

the arrival at BIO, the Matthew will conduct end of season patch tests in Bedford Basin. She will then enter a winter lay up 2 weeks later.

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CHS Supervisors, Maritime Region  
Planning Officer, CHS Maritimes Region  
Manager, CHS, Newfoundland  
Regional Director, Science Branch  
D. Belliveau, Oceans Physics  
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