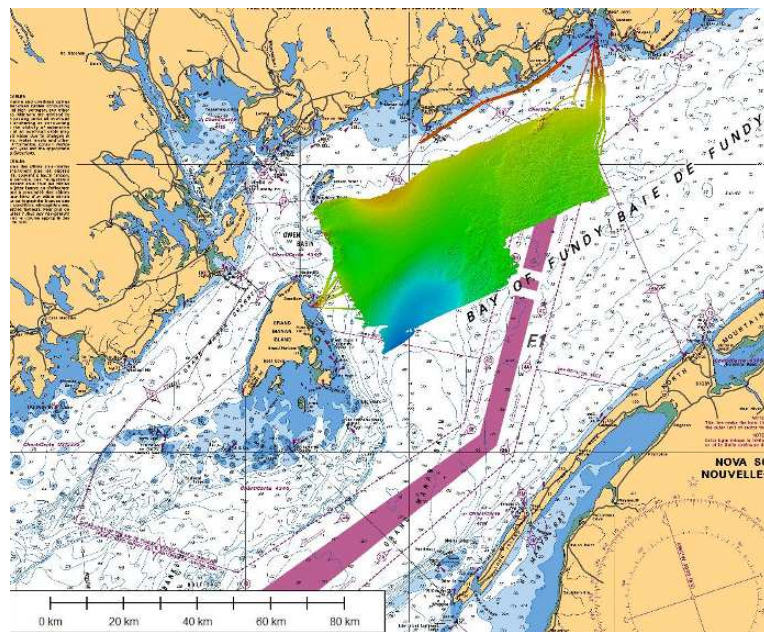




**GEOLOGICAL SURVEY OF CANADA
OPEN FILE 6475**

**Cruise Report Creed IML 2007-022 and IML2007-023
Bay of Fundy 12 July - 30 August 2007**



D.R. Parrott, E. Patton, S. Hayward, G. Duffy, B. MacGowan and G. Rodger

2010



Natural Resources
Canada

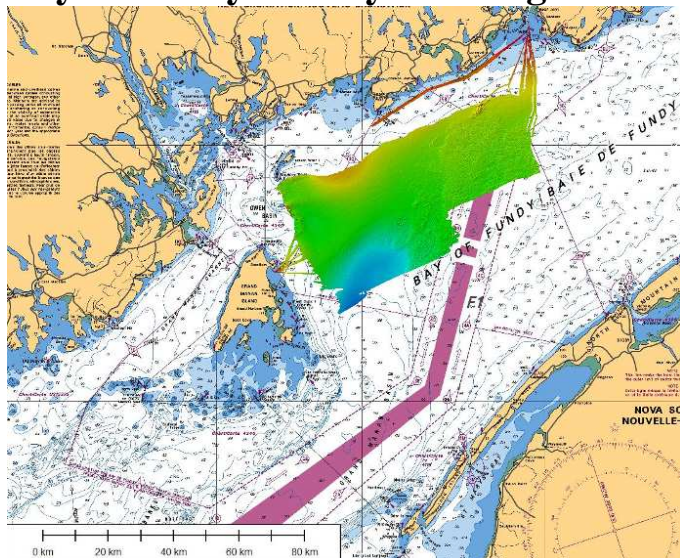
Ressources naturelles
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Open files are products that have not gone through the GSC formal publication process.

Background	4
Data Acquisition and Processing	5
Multibeam Bathymetry	5
Navigation and Attitude	6
OmniSTAR	6
Knudsen 320M echo sounder	6
SeaSpy Magnetometer	7
Brooke Ocean Technology Moving Vessel Profiler MVP200	8
Tides and Currents	8
Access to Data and Samples	8
Acknowledgements	8
References	8
Appendices	10
Appendix I - Survey Particulars	10
List of Participants	10
Department of Fisheries and Oceans	10
Appendix II - Activities	11
Appendix III - Predicted Tides for Digby	29
Appendix IV - SeaSpy Magnetometer	32

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. Surveys *Creed IML2007022* and *IML2007023* were conducted from 12 July to 30 August, 2007, and collected multibeam bathymetry, multibeam backscatter, sub-bottom profiler and geomagnetic data in the Bay of Fundy. This was the third in a series of cruises planned for the area. The surveys were conducted as a joint project between the Geological Survey of Canada and the Canadian Hydrographic Service of the Department of Fisheries and Oceans Canada.

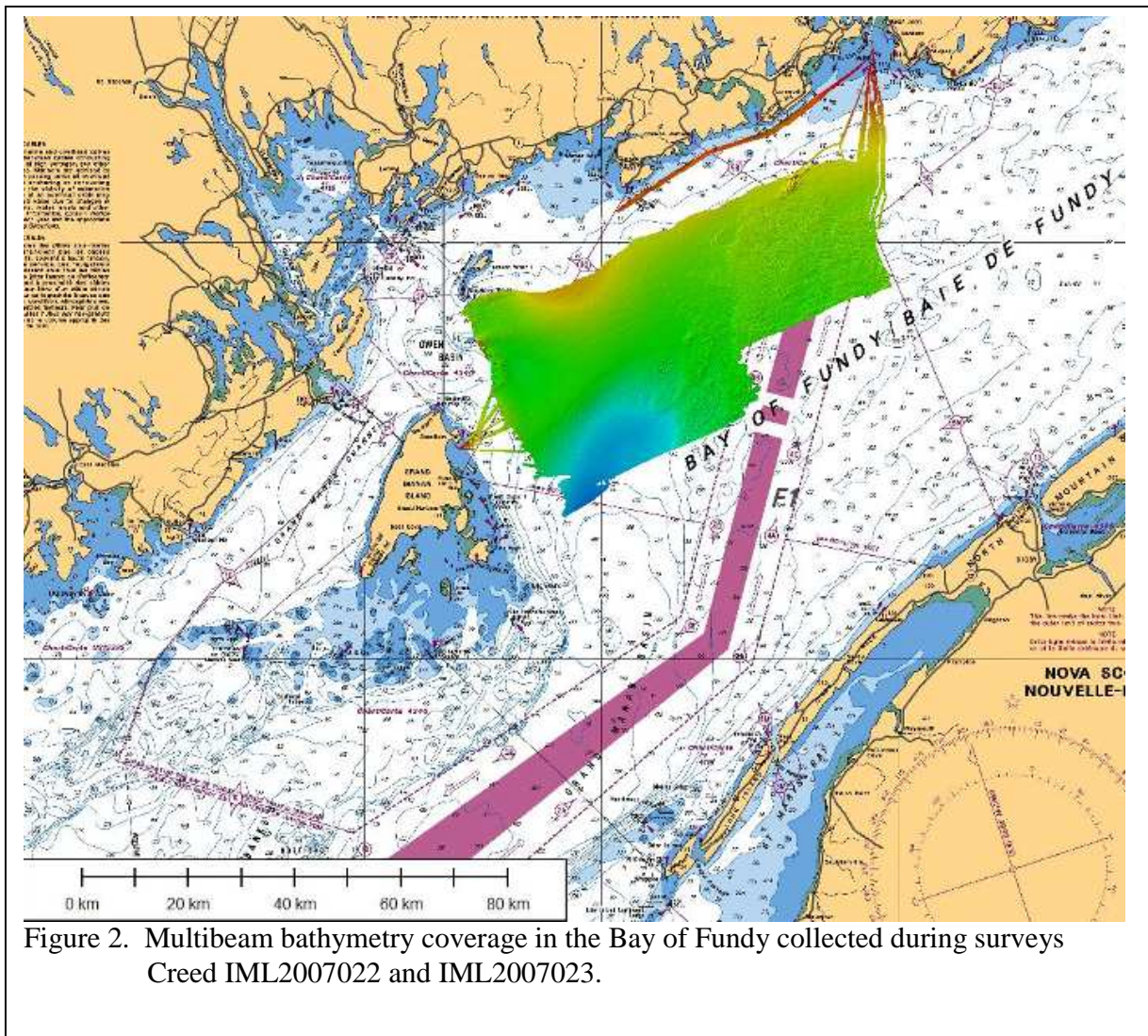
The project will provide geoscience information to resolve user conflicts and balance competing demands for seafloor use with conservation. The primary outcome of this project will be that ocean-management decisions made by stakeholders will be based on sound scientific information provided by NRCan.

Surveys *Creed IML2007022* and *Creed IML2007023* were conducted using the CCGS *Frederick G. Creed* (Figure 1) operated out of the Institute Maurice Lamontagne (IML) in Mont-Joli (Québec). The cruise numbers IML2007022 and IML2007023 were assigned by IML. The vessel was equipped with a Kongsberg EM1002 multibeam bathymetry system, Knudsen 3.5 kHz sounder and a SeaSpy marine magnetometer. Data were collected in the Bay of Fundy, as shown in Figure 2. The vessel operated out of Digby, NS, Saint John, NB and Grand Manan, NB.

Previous surveys in the Bay of Fundy (Fader et al., 1977; Amos et al., 1992; Parrott et al., 2000; Parrott et al., 2007a; Parrott et al., 2007b) 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, sub-bottom profiler and magnetic data were collected using the CCGS *Frederick G. Creed* equipped with a Kongsberg EM1002 multibeam bathymetry system.



Data Acquisition and Processing

The following equipment was used during survey Creed IML 2007022 and IML 2007023:

- Kongsberg EM1002 multibeam bathymetry system
- Knudsen 320M echo sounder
- Brooke Ocean Technology Moving Vessel Profiler MVP100
- Sea-Spy Magnetometer
- Caris HIPS multibeam bathymetry data cleaning software running on Windows XP

Multibeam Bathymetry

Multibeam bathymetric data were collected using a Kongsberg EM1002 multibeam bathymetry system mounted in the CCGS *Frederick G. Creed* (Figure 1). The EM1002 system uses a 95 kHz transducer with 111 beams with a beamwidth of $2.0^\circ \times 2.3^\circ$. The system provides a depth resolution of 1 cm with an accuracy of 5 cm RMS. A nadir beam ensonifies an area of approximately 2.25 m^2 at 50 metres water depth.

Survey lines were run to provide overlapping swaths with the previous line with 120% to 150% percent coverage of the seafloor in water depths greater than about 100 metres. The multibeam swath

width was set as the lesser of either 250 m port and starboard or the swath width corresponding to 120° angular sector (in other words swath width corresponding to 3.46 times the water depth). In water depths greater than 145 m, the swath width was held steady at 500 m. The multibeam bathymetry coverage is shown in Figure 2.

During the survey, data were processed using version 6.11 of the CARIS HIPS data cleaning program (by CARIS Limited, Fredericton, NB) on Windows XP workstations to remove spurious soundings and navigation data and to apply the OmniStar tidal corrections and TrueHeave (logged separately on the POS-MV computer). CARIS HIPS was also used to grid survey lines immediately after they were completed to check data quality especially for motion and refraction artifacts. Both 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 was generally set for a 0–225 metre range, illuminated from an azimuth of 315 degrees and at an angle of 45 degrees above the horizon. A vertical exaggeration of 10 was applied to the data.

Navigation and Attitude

The 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. Real Time Kinematic corrections were received from the OmniStar system using a NovAtel receiver which provided a navigational accuracy of 0.03 metres and a height resolution of 0.07 metres. The POS-MV uses a Kalman filter to improve the heading estimate to 0.05° – 0.1°. Vessel attitude is measured using an inertial measurement unit to provide an accuracy of 0.0003° for pitch, roll and heading. More information on this system can be found at www.applanix.com.

In regions where no previous multibeam coverage existed, survey lines were run with the Regulus navigation package by ICAN Limited, Mount Pearl, NF. Otherwise, survey lines were run in the Geographic display module of the Kongsberg Seafloor Information System (SIS) in the manner described in the previous section.

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, a wide-area differential GPS service provided by the Fugro group of companies. More information is available at 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 in a ram near the keel, on the starboard side of the Matthew. 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. Information of the format and the program are available at <http://www.knudsenengineering.com/ASP/Support/Download.asp>.

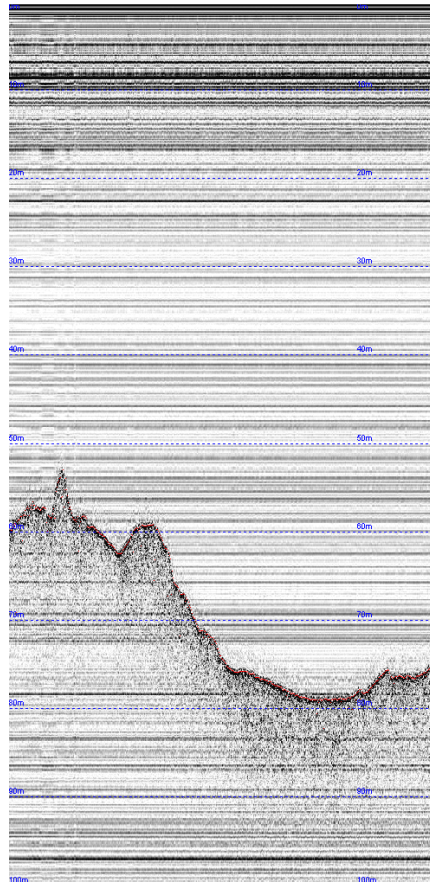


Figure 3. Example of 3.5 kHz data collected with the Knudsen 320B sounder with a power level of 2, 1.5 msec chirp, and a processing gain of 2. Note the coherent noise on the record.

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.

The sub-bottom profiler data were corrected for vessel heave using a digital signal from the POS-MV system. The Knudsen 320B echosounder was configured with a pulse length of 1.5 ms used for the chirp signal, with the power level set at 2, processing gain at 2 with Automatic Gain Control enabled, TVG at “20logR” (20 times Logarithm Range).

SeaSpy Magnetometer

This survey used the SeaSpy Magnetometer. The fish was towed at an average depth of 1 metre below the sea surface at a speed of 10–12 knots in varying sea states. The system uses Overhauser sensors and measures ambient magnetic field regardless of survey direction or orientation with the field. For more information on the magnetometer refer to the manufactures website at <http://www.marinemagnetics.com/>. Operational procedures are outlined in Appendix IV.

The Magnetometer base station was placed at the Coast Guard base in Westport, Brier Island. The magnetometer sensor was about 15 m from the building in a patch of tall grass, well out of the traffic area. Flagging tape was placed on the cable where it was visible next to the building. The CPU, GPS, and other electronics were setup inside the base in the office.

Brooke Ocean Technology Moving Vessel Profiler MVP200

Measurements of the velocity of sound in the water column were made with a Brooke Ocean Technology Moving Vessel Profiler MVP200 equipped with an Applied Microsystems Limited Smart Probe SVP velocimeter. The system was used to provide data for correction of calculated water depths from the Kongsberg EM1002 multibeam bathymetry data. More information on the MVP is available at <http://www.brookeocean.com> and for the velocimeter at <http://www.appliedmicrosystems.com>.

Tides and Currents

Bathymetry surveys in the Bay of Fundy must accommodate the largest 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 Digby, NS, during the period of the 2007 survey. Times are shown in Atlantic Daylight Time and tide heights are shown in centimetres.

For the duration of the survey, tide gauges were installed at the Lighthouse Cove lighthouse on Brier Island, in North Head on Grand Manan Island, and at the privately owned public wharf in Digby, NS to supplement the permanent gauge in Saint John, NB. Data were also downloaded from the tidal gauge in Eastport, Maine, USA, operated by the US Coast and Geodetic Survey.

Tide height was applied in real time from the altitude signal available from the NovAtel OmniStar RTK GPS signal, and supplied to the POS-MV system.

Access to Data and Samples

The multibeam bathymetry data collected during this survey are archived by the Geological Survey of Canada, Atlantic, and the Canadian Hydrographic Service in Dartmouth Nova Scotia. For access to the sub-bottom profiler and magnetic data, 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://gsca.nrcan.gc.ca> and the Canadian Geoscience Knowledge Network <http://cgkn.net/>.

Acknowledgements

The captains and crews of the CCGS *Frederick G. Creed* provided valuable assistance with data collection. This project was jointly funded by Natural Resources Canada through the Geoscience for Ocean Management program of the Earth Sciences Sector, and the Canadian Hydrographic Service of the Department of Fisheries and Oceans Canada. R.O. Miller and B.J. Todd reviewed the manuscript.

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Appendices

Appendix I - Survey Particulars

Name of Vessel:	CCGS <i>Frederick G. Creed</i>
Dates	12 July – 30 August 2007
Vessel captains:	Mario Bernard and Stephan Tessier
Area of Operation	Bay of Fundy
Senior Scientist:	Russell Parrott
Senior Hydrographers	Bruce MacGowan and Glenn Rodger

List of Participants

Geological Survey of Canada Atlantic

Russell Parrott	Senior Scientist
Garret Duffy	Postdoctoral Fellow - multibeam bathymetry
Eric Patton	GIS, navigation, multibeam bathymetry
Scott Hayward	GIS, navigation, multibeam bathymetry

Department of Fisheries and Oceans

Bruce MacGowan	Senior Hydrographer
Glenn Rodger	Senior Hydrographer
Mike Collins	Hydrographer/Processing
Christine Delbridge	Hydrographer/Processing

Christine Delbridge CCGS *Frederick G. Creed* Crews - 2 week rotation

July 25 to August 8, August 22 to August 30

M. Bernard	Master, CCGS Fredrick G. Creed
R. Boisvert	Chief Engineer
C. Campagne	Chief Officer
M. Jean	Cook/Deckhand

July 11 to July 25, August 8 to August 22

S. Tessier	Master, CCGS Fredrick G. Creed
C. Russell	Chief Engineer
M. Poulin	Chief Officer
E. Sioch	Cook/Deckhand

Appendix II - Activities

All times are shown in UTC Universal Time Code = Atlantic Daylight Savings Time + 3 hr.

16 July 2007 Monday - Day 197

20:00 CCGS *Frederick G. Creed* arrives at BIO.

17 July 2007 Tuesday - Day 198

11:00 B. MacGowan, G. Rodger join CCGS *Frederick G. Creed* at BIO. Also on board are Larry Norton, and Morely Wright from BIO. During the previous survey in the Gulf of St. Lawrence, the survey system electronics had been configured to use a shore-based RTK GPS system to provide tidal corrections. CHS Atlantic had recently purchased NovAtel OmniStar receivers that allow height calculations via satellite transmission of RTK signals. The receivers have to be installed and the POS-MV reconfigured to use the signals.

The wireless network used on the previous survey was disabled and a 1 gigabit hardwired network installed.

Personnel from Brooke Ocean Technology were on board to determine the cause of problems encountered with the MVP system.

Two computers are loaded to run the Caris HIPS data cleaning program. One is configured to operate in the lab. The other appears to be a spare. A 1.7 terabyte RAID is installed to store the multibeam bathymetry data.

18 July 2007 Wednesday - Day 199

11:00 Continue with mobilization. Upgrade POS-MV. Problems encountered with many of the system components.

The station magnetometer components are checked to ensure that they are all in the storage cases.

19 July 2007 Thursday - Day 200

11:00 Continue with mobilization. Depart BIO for trials in Bedford Basin.

Personnel from Brooke Ocean Technology on board to determine the cause of problems encountered with the MVP probe.

Problems encountered with the telegraph used to control the speed of the port engine.

15:00 Vessel returns to dock, where more problems are encountered with the starboard engine during the docking procedure.

18:00 The chief engineer has diagnosed the problem and recommends changing the telegraph cable from the control position on the starboard side, used while docking. No further sea trials can be performed until the cable is replaced.

Problems still encountered with many of the multibeam bathymetry system components.

20 July 2007 Friday - Day 201

11:00 Continue with mobilization. Depart BIO for trials in Bedford Basin.

R. Parrott travels to Brier Island and installs the magnetometer base station at the Coast Guard base in Westport.

MVP cast performed successfully. Start patch test to determine offsets in multibeam bathymetry system. Problems encountered with the OmniStar system for tidal corrections. S. Parsons and G. Roger troubleshoot the system.

15:00 Return to BIO.

All keyboards are replaced with English versions.

21 July 2007 Saturday - Day 202

- 11:00 Continue with mobilization. L. Norton on board in addition to B. MacGowan, G. Rodger, G. Duffy, E. Patton and R. Parrott. New version of SIS software is downloaded to cure problems encountered with naming of height data records.
- 15:30 Creed departs BIO en route for the Bay of Fundy. MacGowan, Rodger, Duffy and Patton depart BIO in a van en route to Yarmouth to meet the Creed.
- 20:00 Van arrives Yarmouth.
- 22:00 Creed arrives Shelburne and ties up for the night.

22 July 2007 Sunday - Day 203

- 09:30 Creed departs Shelburne and transits to West Head, Cape Sable Island.
- 14:00 Van arrives West Head. G. Rodger, G. Duffy and E. Patton join the vessel and start the transit to Grand Manan. B. MacGowan departs to travel to Grand Manan
R. Parrott departs Halifax to travel to Grand Manan.
- 15:00 Creed departs West Head.
- 15:30 Problems encountered with the MVP. The configuration file was corrupted and values had to be re-entered. POS-MV and OmniStar RTK configuration files were corrupt. The GPS feed to the Brooke MVP computer appears to have been interpreted as a mouse feed, causing the mouse pointer to jump erratically all over the screen. The problem cleared itself after a while. Severe problems were encountered with the MVP system. Communication with the towfish sensors was quite erratic making it impossible to perform a velocity cast.
- 17:00 Because of all the equipment problems, it was decided to head to Digby, rather than Grand Manan, to make arranging for technical help from BIO easier. B. MacGowan informs R. Parrott of the change in plans.
- 20:00 Most of the equipment problems have been fixed. A successful MVP cast has been completed and the equipment appears to be functioning. It is decided to revert to the original plan and transit to Grand Manan and start the survey in the morning. Attempts to contact B. MacGowan and R. Parrott are not successful.
- 23:00 Creed arrives in North Head, Grand Manan.
- 23:30 Able to contact R. Parrott and inform him of the change in location. Since it is too late for him to catch a ferry to Grand Manan, he continues to Halifax.

23 July 2007 Monday - Day 204

- 01:30 R. Parrott contacts B. MacGowan and informs him of the change in plans.
- 10 :00 G. Rodger feels that the day has started well as R. Parrott and B. MacGowan have not arrived yet. Parrott will remain in Halifax. MacGowan will take the ferry from Digby to Saint John.
- 10 :30 Departed North Head Jetty on route to survey area to the east of Grand Manan. Began logging multibeam bathymetry and sub-bottom profiler data. Problems were encountered with the detected fish depth on the MVP. The magnetometer was not deployed.
- 10:49 Completed MVP cast; incremented file number is SIS. Weather today is sunny, seas calm.
- 11:22 Beginning another MVP cast. Fish in the water.
- 11:30 Slowing vessel down to 6 knots to get the fish deeper in the water column (depth approx.150m).
- 11:36 Successful MVP cast.
- 11:48 Fixed an error in a more recent MVP cast; switching to use that one; new line.
- 12:01 Started logging NovAtel OmniStar data on the laptop computer.
- 12:59 MVP cast.
- 13:43 Seas are flat calm.
- 13:45 Strong ebb tide pushing the vessel to the SSW. Ship is correcting against it.

- 13:55 G. Duffy taking over from E. Patton
- 14:16 SIS crash when trying to make Geographical Display colours easier for Helmsman to see. When trying to ``Save settings as...``, had system crash. Restart SIS. SIS automatically opened new raw file with same filename 0018 but different start time. Will try and see if SIS stopped logging when it was being restarted, if so, there will be a 20 second hole!!
- 14:20 Noted degraded vertical accuracy of height measurement (>30 cms) and correlation with few satellites (8), also poor constellation configuration led to VDOP value of 2.4
- 14:30 Improved accuracy correlates with an extra satellite in constellation.
- 14:42 E. Patton taking over from G. Duffy.
- 15:00 Noted that heading light on the POS-MV View turned red indicating that the data was outside the specified parameters. The heading accuracy had degraded to 0.235 degrees.
- 15:08 Heading accuracy on MV-POSView improved; green light now; accuracy is at 0.016 degrees.
- 16:19 New MVP cast in the deepest portion of this line.
- 18:33 A problem was encountered with the MVP crane; when the brake on the crane is released, the fish will not descend. The ship's engineer is on the scene. It seems the MVP can't freewheel on its own when the brake is released.
- 19:13 HIC notified. B. MacGowan will arrange for Brooke Ocean to call the Creed to troubleshoot the MVP crane issue.
- 19:36 MVP is working again. Successfully obtained new MVP.
- 21:40 Performing another MVP cast just to make sure it is working. MVP deploys correctly.
- 21:54 End of survey. Returning to North Head, Grand Manan. Continuing to log data on the transit back on line #0036.
- 22:00 EOL 0036.

24 July 2007 Tuesday - Day 205

- 09:15 Depart North Head wharf en route to survey area east of Grand Manan. Weather is foggy, overcast, seas calm. NovAtel OmniStar is up and running, showing HDOP 1.006, PDOP 1.937. POS-MV shows all fields within prescribed limits.
- 09:59 More problems encountered with the MVP. We are consistently losing contact with the fish on multiple casts The towfish is recovered to check for debris, seaweed, etc.
- 10:08 It was noted that the MVP towfish seems to lose the depth signal on a cast right at the point where it reaches bottom and is cabled in.
- 11:00 Another failed attempt to obtain a fresh SVP. Using SVP from yesterday from this area.
- 11:48 End of survey. Unable to communicate with MVP fish. Brooke Ocean Technology thinks it could be an intermittent/degraded cable connection at a stress point 1-2m from contact with the fish. The Creed will steam to Digby for repairs on the MVP by technicians from BOT.
- 14:49 Creed arrives in Digby; tied up for the remainder of the day. Crew change will be tomorrow.

25 July 2007 Wednesday - Day 206

- Crew change day.
- Called Brooke Ocean Technologies and had two repair technicians drive to Digby to work on the MVP cable. Several kinks were discovered in the MVP cable causing a loss of conductivity and intermittent communication with the fish. About 18.86 metres of the cable was removed, and a fresh splice and reconnect done. The cable should be fine to use after 24 hours.
- 18:00 R. Parrott arrives from Halifax.
- 21:00 BOT technicians complete the re-termination of the cable. They provide instructions for replacing the indicators for the auto-start locators for the cable sensors. BOT technicians depart Digby.
- 23:45 B. MacGowan arrives from Saint John.

26 July 2007 Thursday - Day 207

- 9:29 Creed departs Digby en route to run a new survey line east of Digby, parallel to existing multibeam coverage, along the North Mountain coastline. The magnetometer seems to be working and the program Sealink was successfully synching with it. POSMV is green across the board.
- 9:36 Steaming to an area just outside of Digby Gut to configure new tow points for the MVP fish. This area is full of fishing buoys, so we are unable to deploy the fish for a cast until the Creed is clear of it.
- 9:53 Started logging multibeam bathymetry data despite not having a fresh MVP cast, just to get some coverage.
- 11:20 MVP cast. Deployed magnetometer; Creed coming around to start of line, surveying to the northeast, parallel to the Nova Scotia coast.
- 11:47 Doing another MVP cast. Slowing to 8 knots.

27 July 2007 Friday - Day 208

- 9:29 Creed departs wharf in Digby. Steaming to survey area east of Grand Manan Island. Weather is sunny, light winds, no swell. NovAtel is up and logging, Regulus up and logging. Kongsberg, Magnetometer, and Knudsen CPU's all booted and initialized with no problems. B. MacGowan is driving the truck to Grand Manan and will meet us there tonight.
- 11:34 Nearly on survey line. Completed MVP cast. Deployed magnetometer. The SIS computer seems to be cooperating today. Real-time swaths are displaying with no interruptions in coverage.
- 11:39 SOL 0075. Surveying from NE to SW.
- 12:01 MVP cast.
- 12:54 Changed POSMV heave filter from 5 seconds to 12 seconds.
- 12:56 MVP cast. It was decided to recover the MVP after every deployment, as it gets covered with seaweed after every cast and requires cleaning.
- 18:21 MVP cast. The MVP software wasn't receiving the ship's log, latitude and longitude. Sound velocity profile looked ok, despite this, however.
- 18:49 Water temperature at the end of line 101 to the beginning of line 102 went through a rapid change, decreasing from a maximum of 14.3 Celsius to 13.3 Celsius within the span of 2 minutes; sound velocity accordingly decreased from a maximum of 1500.4 ms⁻¹ to 1497.3 m/s and is still dropping.
- 18:54 Water temperature stabilized, and then started climbing back to 14.1 Celsius, and velocity of 1500 ms⁻¹. Checked with captain and tide is on the early flood in North Head, Grand Manan.
- 19:45 The Creed received a Search and Rescue (SAR) request from the Coast Guard to investigate a weak distress signal from an airplane. Doubling back on current line and steaming to the southwest. Still logging all instruments. It is unlikely we will have the time to slow for any more velocity casts today.
- 19:52 End of survey. Creed needs to deviate from the survey grid to investigate possible distress signal. Stopped logging Kongsberg. Recovering magnetometer.
- 20:15 The vessel is released from SAR search.
- 21:01 Logged another small section of multibeam bathy during the transit to the SAR response area, line 0108 and 0109.
- 22:26 Steaming back to North Head, Grand Manan. Will log selectively if doing so will add to existing multibeam coverage.
- 00:00 UTC (Julian Day 209) Creed secured at jetty in North Head.

28 July 2007 Saturday - Day 209

- 9:15 Creed departs jetty in North Head, to resume survey grid to the east of Grand Manan. Booted Omnistar, and began logging. Omnistar positional accuracy looks good; 12 SVs, lat/long positioning is +/- 0.03m, height is +/- 0.06m.
- 9:52 Started pinging on Knudsen.
- 10:06 SOL 0113. Logging on Knudsen, Kongsberg.
- 10:50 MVP cast. Magnetometer deployed; starting logging magnetometer.
- 11:35 MVP cast.
- 13:23 MVP cast.
- 15:00 The water in this area is very consistent in sound velocity, changing only by 3-4 m/s over several hours.
- 21:45 End of survey. With the exception of a small area in the extreme southwest corner, completed the survey grid to the east of Grand Manan. Stopped logging Kongsberg, magnetometer. Retrieving magnetometer.
- 21:50 Magnetometer on board. Stopped logging Knudsen. Creed is steaming to North Head, Grand Manan.

29 July 2007 Sunday –Day 210

- 9:21 Departed North Head for survey. Today the Creed will be running long 3-hour lines to the northeast, parallel to existing multibeam coverage. NovAtel is up and running, and logging. Began logging Knudsen. POSMV is green across the board.
- 9:55 Deployed magnetometer, and conducted an MVP cast.
- 10:13 Began logging magnetometer.
- 10:34 MVP Cast.
- 12:10 End of line, temporarily. Stopping to reboot the Sis computer as the display coverages are not drawing in.
- 12:20 Rebooted SIS computer and deleted temporary files. Coverages seem to be drawing again.
- 14:10 MVP cast.
- 15:55 Retrieved magnetometer as the cable was twisting. Brought it on board, and re-deployed. Completed a new MVP cast as well.
- 17:10 SIS has lost bottom again, in the same location as earlier today. Rebooting the computer hasn't made any difference. CPU usage of SIS seems to be unrelated to the problem, as SIS uses only 7-43% of CPU and never maxes out.
- 17:21 SIS real-time coverages have returned, only intermittently. Not noting any change on the CPU usage history that would correlate with the gaps being observed.
- 19:43 End of survey. Retrieved magnetometer, stopped logging Kongsberg and Knudsen.
- 20:07 Creed secured at jetty in North Head.

30 July 2007 Monday - Day 211

- 9:12 Booted NovAtel, SIS, Knudsen, Regulus and Magnetometer CPUs.
- 9:30 Departed the jetty in North Head. Started logging NovAtel. POSMV is good, no problems. SIS computer is rendering real-time coverages. We will be filling a hole left in the survey grid to the east of Grand Manan before resuming running 3-hour west-to-east lines up the Bay of Fundy, paralleling existing multibeam coverage.
- 9:59 Deployed magnetometer. Cast MVP. Began logging Kongsberg EM1002 and Knudsen.
- 10:52 Finished filling hole. Steaming to start of line for next survey area.
- 11:16 SOL in next survey area.
- 12:25 Weather today is foggy, winds light. Seas are flat calm.

- 13:12 Heave compensation enabled on Knudsen 3.5kHz. Signal is out of POSMV on channel 4 as Kongsberg EM1000 (TATE Bryant). Input on channel 2 of Knudsen, using an “EM1000 TATE Bryant” format.
- 13:33 A rope is caught on the starboard pontoon. Stopped logging magnetometer; retrieved magnetometer and stop vessel.
- 13:34 Stopped logging Kongsberg until the rope is removed.
- 13:40 Rope removed from water for later disposal on shore. Redeployed magnetometer.
- 13:50 MVP cast. Resumed logging Kongsberg.
- 14:10 Logging resumed on magnetometer.
- 15:58 MVP cast.
- 17:50 SIS coverage markers intermittent, then lost. SIS program taking 20-65 % of CPU.
- 18:45 End of regular survey. Creed is steaming to Digby. Continuing to log all instruments on the way along a north-southbound cross-line.
- 20:15 End of line. Stopped logging magnetometer. Retrieving magnetometer.
- 20:20 Magnetometer on board. Stopped logging Kongsberg.
- 20:30 Stopped logging NovAtel.
- 20:34 Stopped logging Knudsen.
- 20:40 Creed secured at jetty in Digby.
- 21:30 R. Parrott departs for Halifax.

31 July 2007 Tuesday –Day 212

- 09:30 Creed departs jetty in Digby. The refrigerator aboard the Creed has broken down, and despite repairs from a local repairman in Digby, still does not refrigerate cooler than 10 degrees Celsius. Steaming to Saint John to either repair it or purchase a new one.

1 August 2007 Wednesday –Day 213

- 02:00 M. Ruxton arrives from Halifax and replaces a hard drive in the RAID.
 - 04:00 M. Ruxton departs vessel.
- Creed remains secured at Coast Guard wharf in Saint John all day. Parts for refrigerator arrive at 17:00, to be installed either this evening or first thing tomorrow morning.

2 August 2007 Thursday –Day 214

- Creed remains secured at the Coast Guard wharf in Saint John while repairs are made to the refrigerator.
- 16:15 Refrigerator now repaired after new parts were installed by repair crew. Creed is preparing to depart Saint John bound for North Head, Grand Manan.
 - 16:30 Creed departs wharf at Coast Guard station. Started logging NovAtel. POSMV is showing all green. Weather today is sunny, light to moderate winds, 20 knots, out of the southwest, with light swell.
 - 16:34 Started logging Knudsen.
 - 16:40 Started logging magnetometer, Kongsberg 1002.
 - 16:51 MVP cast.
 - 17:20 MVP cast. Rapidly changing sound velocity outside of the Saint John delta.
 - 18:09 Finished running transit line from Saint John to existing multibeam coverage. Making the turn on to survey line that will take us to North Head.
 - 19:31 Noticed that the outer beams of the swath are starting to become jagged and truncated at the edges, as though the echosounder is losing bottom at the edges of the swath.
 - 19:49 MVP cast.
 - 20:58 End of survey. Stopped logging Kongsberg, NovAtel, magnetometer, and Knudsen. Magnetometer retrieved and on board.

21:03 Creed secured at jetty in North Head.

3 August 2007 Friday –Day 215

- 9:05 Booted NovAtel, began logging. Configured daily settings for all other computers. The magnetometer CPU is not receiving GPS strings. Will try to trouble shoot the problem as we go.
- 9:13 Creed departs North Head jetty en route to main survey area east of Grand Manan. Weather today is foggy, overcast, winds 7 knots out of the ENE.
- 9:39 Magnetometer still isn't receiving NMEA strings, although all other computers normally receiving a feed are functioning properly. Mag computer also is having difficulty communicating to the magnetometer.
- 9:51 HIC Bruce MacGowan loses consciousness in the lab and drops to the deck. The incident is reported to the Master by the Chief engineer. The Master makes the decision to head for port to seek medical attention for Bruce, Vessel arrives at the wharf in Digby where OSH personnel, paramedics and firefighters are waiting to assist in removing Bruce and transfer him to Annapolis Royal hospital.
- 17:30 R. Parrott and C. O'Reilly arrive from Halifax.
- 17:45 After discussions with the captain, R. Parrott and C. O'Reilly depart for Annapolis Royal hospital to visit B. MacGowan and collect G. Rodger.
- 19:00 G. Rodger arrives with R. Parrott and C. O'Reilly to collect B. MacGowan's personal effects.
- 19:30 C. O'Reilly departs to transport B. MacGowan back to Halifax.

4 August 2007 Saturday –Day 216

- 8:30 Creed departs wharf in Digby with R. Parrott on board to replace B. MacGowan to resume survey operations in the central Bay of Fundy. Today's weather is foggy and overcast, 22 knots out of the south.
- 8:36 Began logging NovAtel.
- 7:09 Started logging Knudsen, Kongsberg 1002.
- 7:27 End of survey; the captain has determined the winds are too high for sailing (33 knots). Stopped logging Knudsen. The Creed will steam to Saint John and tie up for the day. We will continue to log Kongsberg 1002 on the way. No velocity casts will be available, however.
- 11:46 Stopped logging Kongsberg. Entering main channel of Saint John Harbour.
- 12:04 Creed secured at Coast Guard jetty.

5 August 2007 Sunday –Day 217

- 8:29 Booted OmniStar. POSMV is up and running, showing green attitude, position, velocity and heave. Weather today is clear, winds calm. Sea swell is moderate from the strong winds we had yesterday.
- 8:31 Creed departs Coast Guard wharf in Saint John en route for survey area in the central Bay of Fundy. Today's plan for line running will be to run NE to SW lines parallel to existing coverage
- 9:00 Started logging Knudsen, magnetometer. Completed an MVP cast.
- 9:01 Started logging Kongsberg.
- 9:13 Started logging OmniStar.
- 9:30 MVP cast.
- 10:17 Finished transit line from Saint John to central Bay of Fundy; now altering course to run a survey line to Grand Manan.
- 11:41 Omnistar is showing a relatively degraded accuracy of +/- 0.65m in x, y, and z. PDOP is 1.814, VDOP 1.523 and 9 SV's are in the constellation.

- 12:00 NovAtel accuracy has improved. Latitude, longitude, and height are accurate to +/-0.1m; PDOP is 1.659, VDOP 1.346.
- 12:19 MVP Cast.
- 13:40 Outer beams on port side quite irregular.
- 15:47 MVP Cast.
- 16:46 Outer beams on port side quite irregular again, overlapping with previous line with irregular outer beams.
- 17:54 Port beams have settled down, and are no longer irregular.
- 18:59 Partial blackout on the Creed; SIS navigation screen has gone offline.
- 19:01 Power is back on; Creed is doubling back on the line to redo the missed portion of the line.
- 19:02 SOL.
- 19:31 Passing through lots of “hot spots” in the water; places where the water temperature at the sound velocity sensor are fluctuating very quickly by about 0.5 degrees Celsius. These patches are quite localized, and not persistent. The Creed passes through them too quickly to change and document the sound velocity profile used. The temperatures range from 12.5 to 13.6 degrees C
- 19:50 The temperature in the processing lab has increased to 30.0 degrees C. The doors have been opened and fans repositioned to lower the temperature in the lab and in the equipment rack.
- 20:29 Port beams are acting up again, in the exact location they did in a previous line running parallel to this one but in the opposite direction.
- 20:54 Kongsberg is only pinging with about half the regular number of beams (every other beam is pinging). Stopping logging and pinging, and restarting again. Creed is going to come around and redo the portion of the line incompletely sounded.
- 20:58 Back on the line again, and Kongsberg seems to be pinging with all 111 beams again.
- 22:38 Temperature of water at end of survey line (immediately east of North Head) has dropped to 10.6 Celsius. We don't have an SVP to cover this velocity. End of regular survey. Continuing to log data on all instruments on the way to the dock. Speed has increased to 15 knots, so data quality will likely suffer.
- 22:49 Stopped logging magnetometer, Kongsberg, Knudsen, and NovAtel. Retrieved magnetometer.
- 22:52 Creed secured at jetty in North Head.

6 August 2007 Monday –Day 218

- 08:22 Creed departs North Head wharf en route to survey area just to the east of Grand Manan Island. NovAtel is booted and showing 1-2 dm accuracy. POSMV booted with no problems. Weather today is clear, winds calm, seas like a mirror. Large number of small fish breaching as vessel approaches. Small whale present.
- 08:24 Started pinging and logging Kongsberg on the way out of Long Island Bay; started logging Knudsen.
- 08:52 MVP cast.
- 09:00 Port beams on Kongsberg are jagged again on the southwestern portion of line 0300.
- 09:18 MVP cast.
- 11:38 MVP cast.
- 11:50 Possibly passed over a fishing vessels' net, as a fishing boat was nearby. The echosounder lost about 75% of its beams. Turning around to resurvey the missing data. Stopping logging and pinging, and will restart pinging once we are back on line.
- 11:56 Back on the line again. The echosounder is firing with 100% of its beams again. The hole left in the data has been filled.
- 13:29 MVP cast.
- 14:00 Noted a few distinct water bands crisscrossing the survey track. These water bodies corresponded to water temperature changes of 0.5 degrees C.

- 14:19 MVP cast.
- 16:10 Start of new line back towards Grand Manan. Cross track coverage markers have not plotted for the past 10 minutes.
- 16:40 Still no cross track coverage lines.
- 16:43 Coverage lines have returned.
- 18:04 MVP cast.
- 22:06 End of survey for the day. Stopping logging on Kongsberg and magnetometer.
- 22:13 Retrieved magnetometer. Stopped logging Knudsen.
- 22:15 Stopped logging NovAtel.
- 22:30 Creed secured at wharf in North Head.

7 August 2007 Tuesday –Day 219

- 8:15 Creed departs jetty in North Head. NovAtel is showing good ($\pm 0.03\text{m x/y}$, $\pm 0.07\text{ z}$) accuracy. POSMV is showing no errors.
- 8:17 Started pinging with Kongsberg 1002.
- 8:28 Streaming towards survey area to the northeast of Grand Manan. The magnetometer cable was twisted upon retrieval yesterday, so it will have to be untwisted prior to deployment today.
- 8:39 Started logging Kongsberg and Knudsen.
- 8:46 MVP cast.
- 9:07 MVP cast attempted, but the winch would not respond to the computer.
- 9:15 After repeated attempts at getting a successful sound velocity profile, the MVP computer had to be rebooted, the MVP controller switched on and off, and the MVP controller program restarted. The next attempt at a cast was successful.
- 10:00 Several targets observed in an area designated ‘Wrecks’ on the chart.
- 10:40 Disconnect the magnetometer and stream the cable and connector to get the kinks out. Note that the cable termination (a threaded connection) appeared to be a bit loose between the cable and the towfish.
- 10:54 Recovered magnetometer cable, attached towfish, and redeploy. The nose cone was installed to a hand-tight fit only. No wrench was used. Start logging magnetometer again.
- 10:56 MVP cast.
- 11:11 EOL from Grand Manan. SOL back to end of partial lines run late yesterday.
- 12:20 It’s foggy.
- 15:25 MVP cast.
- 16:18 Water temperature = 14.1 degrees, velocity at the transducer = 1502.2 ms^{-1}
- 16:27 MVP cast. Water temperature has returned to normal for this area; 13.3°C , velocity 1499.1ms^{-1} .
- 18:23 Stopped logging magnetometer and retrieved it; fishing vessels ahead of the Creed on its transit line to Saint John.
- 18:25 Creed has accelerated (13.5 kts) for the final entrance into Saint John Harbour. Continuing to log on the way.
- 18:33 Stopped logging Kongsberg.
- 19:06 Stopped logging Knudsen.
- 19:13 Creed is secured at Coast Guard base jetty in Saint John. R. Parrott departs for Halifax.

9 August 2007 Thursday –Day 221

- 9:12 Booted NovAtel CPU, began logging. POSMV is showing all green. Mike Collins joined the ship overnight and will be replacing B. MacGowan.
- 9:30 Creed departs Coast Guard jetty to begin survey operations outside Saint John. Weather today is partly cloudy, winds 20-25 inside the harbour. Gale force warnings for Grand Manan today.

- 09:46 SOL. Running some parallel lines close to the New Brunswick coast because of the strong NW winds. Lines will be run from the entrance of Saint John Harbour to Point Lepreau and back. Winds at 30 knots.
- 09:51 Began logging Knudsen.
- 10:20 Deployed magnetometer, began logging. Conducted a velocity cast.
- 13:53 Sound velocity cast.
- 16:20 Sound velocity cast.
- 22:00 End of line; retrieving magnetometer; stopped logging Kongsberg, mag, and Knudsen.
- 22:09 Stopped logging NovAtel.
- 22:24 Creed secured at Coast Guard base in Saint John.

10 August 2007 Friday –Day 222

- 9:43 Creed departs Coast Guard jetty in Saint John to survey in the central Bay of Fundy. Lines today will be run from NE to SW, parallel to existing multibeam coverage. Began logging NovAtel. POSMV is working well, no problems.
- 10:07 Began logging Kongsberg.
- 10:15 Began logging Knudsen.
- 10:26 Deployed magnetometer and began logging. Conducted an MVP cast.
- 11:04 MVP cast.
- 12:04 Weather today is partly cloudy, light winds, no swell, and calm seas.
- 12:08 MVP cast.
- 13:51 MVP cast.
- 14:47 Noticed a persistent, systematic error in the echosounder; the outer port beams are consistently 1-1.5m shallower than the outer starboard beams, even after taking a velocity cast. Additionally, the outer starboard beam displays an artifact where the outer 15% of the beams are elevated slightly compared to the rest of the starboard beam, forming a distinct plateau in the waterfall swath display in SIS.
- 15:55 MVP cast.
- 17:10 The vessel may have hit something in the water; stopped logging Kongsberg temporarily.
- 17:17 No evidence of debris or objects in the water. Resumed logging Kongsberg.
- 17:41 MVP cast.
- 18:44 Received a message from the SIS computer that “a network cable was disconnected”. After a moment or two the computer reported that the network connection was re-established. I checked the connections on the back of the SIS CPU, all were tight; there was one loose connection between a network cable connecting the SIS CPU and the Linksys black box, which was tightened.
- 20:11 MVP cast.
- 21:55 Finished survey lines for the day; continuing to log a transit line to North Head.
- 22:20 Stopped logging mag; retrieved mag; the mag cable was twisted; will try to sort this mess out on deck after we tie up; stopped logging Knudsen and Kongsberg.
- 22:30 Creed secured at jetty in North Head.

11 August 2007 Saturday –Day 223

- 9:05 Creed departs wharf in North Head, Grand Manan.
- 9:14 Started logging NovAtel, Knudsen, and Kongsberg. We are steaming to the main survey area in the central Bay of Fundy, northeast of Grand Manan. All systems operational, with the exception of the magnetometer. The cable needs to be untangled. We will stream it out, recover it, attach the mag, and redeploy once the ship is on line.
- 9:18 Weather is clear, calm.
- 9:25 MVP cast.

- 10:00 Streamed out mag cable to try to untangle it. After about 5 minutes of streaming, reeled the cable back in around the bollards, reattached the magnetometer, and redeployed. Started logging mag.
- 11:48 Began a ship's draft log on the NovAtel CPU in a spreadsheet. Values of draft are obtained from the master ship log, and have been obtained for all past dates of this survey as well.
- 12:28 MVP cast.
- 13:46 Reduced speed to 8.9 knots to allow a cargo ship to pass.
- 16:29 MVP cast.
- 16:30 Noticed the magnetometer was surfing on the surface; stopped logging, retrieved the towfish and found that the rear fins had somehow come off; no problems were noticed with the fins on deployment this morning. End of operations for the magnetometer until we can get replacement fins. Position: 44°59.3' N, 066°08.9' W
- 21:47 Reached end of line of main survey area. We will continue logging a transit line into North Head.
- 22:10 Stopped logging Kongsberg, Knudsen.

12 August 2007 Sunday –Day 224

- 9:08 Creed departs jetty in North Head en route to survey area to the northeast of Grand Manan. Began logging NovAtel. POSMV is working properly.
- 9:16 Began logging Kongsberg and Knudsen. Logging a transit line on the way out to the main survey area. Not logging magnetometer.
- 9:20 Weather today is clear and calm. Winds light.
- 9:46 MVP cast.
- 10:17 MVP cast.
- 11:44 MVP cast.
- 13:58 MVP cast.
- 14:35 MVP cast.
- 15:06 MVP cast.
- 15:41 MVP cast.
- 16:12 MVP cast.
- 16:43 MVP cast.
- 17:30 MVP cast.
- 18:00 MVP cast.
- 18:48 MVP cast.
- 19:21 MVP cast.
- 19:53 MVP cast.
- 20:37 End of line for regular survey area. Running a transit line back to Saint John.
- 21:27 End of transit line. Stopped logging Kongsberg.
- 21:46 Stopped logging Knudsen.

13 August 2007 Monday –Day 225

- 9:26 Began logging NovAtel.
- 9:40 Creed departs Coast Guard base in Saint John. Weather today is overcast, raining, 17 knot winds.
- 9:57 Began logging Kongsberg on a transit line on the way out of Saint John Harbour.
- 10:13 Began logging Knudsen.
- 11:09 On main survey line, running northeast to southwest in the central Bay of Fundy. MVP cast.
- 11:45 MVP cast.
- 12:24 MVP cast.
- 13:01 MVP cast.

13:39 MVP cast.
14:09 MVP cast.
14:49 MVP cast.
15:26 MVP cast.
16:15 MVP cast.
16:50 MVP cast.
17:38 MVP cast.
18:16 MVP cast.
18:55 MVP cast.
19:15 End of survey for the day. Stopped logging Knudsen, and Nel.
21:30 Creed secured at jetty in Digby.

14 August 2007 Tuesday –Day 226

09:30 Leave wharf in Digby, weather foggy in basin, light wind. Scott Hayward has joined the vessel to overlap with E. Patton for one day. Christine Delbridge also joined the vessel last night as well. Mike Collins departed for BIO.
10:00 Sub-bottom logging
10:10 MVP cast
10:12 Begin logging SIS on line NE of Digby parallel to North Mountain
10:47 MVP cast
11:31 MVP cast
12:15 MVP cast
13:07 MVP cast
13:55 MVP cast
14:41 MVP cast
15:10 Survey midday turn around, heading back to Digby
15:44 MVP cast
16:39 MVP cast
18:16 MVP cast
19:30 MVP cast
20:05 Pull off line for calibration test
21:10 Finished calibration, resuming line running back to Digby.
21:50 MVP back on board for night
22:00 Creed secure at wharf in Digby, Eric Patton departs for Halifax

15 August 2007 Wednesday –Day 227

09:00 Leave wharf in Digby, skies clear, winds light, sea state calm, transiting to traffic area 5A to continue Grand Manan survey block.
10:50 MVP cast near traffic call in point 5A.
11:56 MVP cast.
12:38 MVP cast.
13:26 MVP cast.
14:57 Restart SIS system bogged down Helmsman display not updating, (really slow), still slow, rebooting system, pulling off line.
15:13 System back up, heading back towards line.
15:17 Back online.
15:56 MVP cast.
16:32 MVP cast.
17:11 MVP cast.
17:30 Weather picking up, 20knts out of the NW, sea state 2-3m Increase of heave in the data.

18:37 Lost bottom tracking for a few seconds.
17:56 MVP cast.
18:44 MVP cast.
21:45 Tied up in North Head Grand Manan.

16 August 2007 Thursday –Day 228

09:33 Depart North Head, weather clear, visibility 10nm, seas calm, winds light out of the north, running survey lines between Grand Manan and Saint John.
10:11 MVP cast.
10:25 The SIS computer locked up due to a memory issue.
11:00 Heavy Fog.
11:07 MVP cast.
11:49 MVP cast.
12:36 MVP cast.
13:15 MVP cast. No velocity value was obtained on deployment. The fish is retrieved and it is noticed that the plastic vibration guard on the sensor has come loose. The engineer refits and tightens.
13:30 MVP cast, looks good, survey continues.
14:20 MVP cast.
15:16 MVP cast.
16:00 Overheard on radio that the NOAA ship Henry Bigelow is performing transects in the Bay NW of Grand Manan (Passamaquoddy Bay?) stopping to do CTD casts.
16:11 MVP cast.
16:40 The vessel may have hit something soft. The vessel circled to look for any debris and then continued with survey after it was determined that nothing was visible in the water.
16:57 MVP cast.
17:38 MVP cast.
18:19 MVP cast.
19:05 MVP cast.
19:45 Turn around and head for Saint John, fishing boat in the way, slight delay.
19:47 En route to Saint John.
19:53 MVP cast.
22:15 Tied up in Saint John.

17 August 2007 Friday –Day 229

10:30: Depart Saint John for survey area, foggy, calm seas light breeze. Fuel did not show up last night until 12:00 AM local, late start to day.
12:00 MVP cast.
12:46 MVP cast.
13:27 MVP cast.
14:22 MVP cast.
15:40 MVP cast.
16:27 MVP cast.
17:15 MVP cast.
17:59 MVP cast.
18:56 MVP cast.
19:40 Offline 0733 due to CPA for vessel heading south.
19:45 MVP cast.
19:54 Turning around headed for North Head, Grand Manan.
20:05 Off line due to a fishing vessel on the line.

21:00 Tied up in North Head.

18 August 2007 Saturday –Day 230

09:00 Depart North Head en route to survey area between Saint John and Grand Manan. Weather slightly overcast wind 5 knts out of the NW.

09:41 MVP cast.

10:46 MVP cast.

11:35 MVP cast.

13:10 MVP cast.

13:41 Error “Connection to sounder lost” encountered. The SIS and PC were re-booted. The system now seems to be working fine, and the vessel is circling to resume coverage.

13:48 Back on line.

13:57 MVP cast.

15:34 MVP cast.

16:25 MVP cast.

17:15 MVP cast.

18:20 MVP cast.

18:52 Gale warning for Grand Manan issued, swell’s increasing.

19:10 MVP gets stuck. Magnetometer towfish wrapped in seaweed. The rain is increasing with winds 25-30 knts NW.

19:15 Winds strong out of the SW. Coming offline, heading back to Saint John.

19:20 Running a straight line for Saint John.

21:15 Tied up in Saint John.

19 August 2007 Sunday - Day 231

09:40 Depart Saint John, skies clear, wind 10 knots out of the NE sea state 1.5 m. Heading south to pick up NE-SW line to Grand Manan.

09:45 Online and recording.

11:30 Communications problems encountered with the MVP, probably due to a break in the cable. Brooke Ocean were contacted.
No more MVPs until problem is resolved.

11:35 Staying online and will re-use MVP data collected yesterday until we can arrange for repair of the system.

12:00 R. Parrott, G. Costello and Brooke Ocean have all been informed of problem.

18:45 The engineer has discovered a spare MVP cable onboard. Steam to North Head to change the cable.

19:00 Ceased operations for the day, headed to North Head to swap out cable on the MVP

19:45 Tied up in North Head Grand Manan.

23:00 Repair complete on the MVP cable. 400 m of cable were put on the winch to give a 30m lead-in on the spool for the emergency stop, leaving 370 m of usable cable. The cable will be tested tomorrow.

20 August 2007 Monday – Day 232

09:30 Depart North Head to survey area. The MVP is tested and we begin acquiring data. Skies clear, winds 5 to 10 kts, seas < 1 m.

09:59 MVP cast, data looks fine (can’t use profile due to directory search problem). Continue survey using old profile.

11:24 MVP cast, data is fine.

12:28 MVP cast.

- 13:48 MVP cast. The marks on MVP cable used for the automatic sensors were repositioned from 20 m to 18 m. The system is working excellent.
- 14:59 MVP cast.
- 16:02 MVP cast.
- 16:32 MVP cast.
- 17:00 MVP cast.
- 17:42 MVP cast.
- 18:29 MVP cast.
- 20:00 MVP cast.
- 21:19 Received a couple of notifications today from the SIS PC that the EM1002 is now connected. This may be the results of a hiccup in communication.
- 22:00 Tied up in Saint John at Coast Guard slip as per usual. Talk with R. Parrott and G. Costello about the MVP cable and will courier the broken MVP cable to BOT for repair, today or tomorrow morning

21 August 2007 Tuesday – Day 233

- 09:30 Depart Saint John for survey area. Skies clear, winds 5 to 10 knots, seas < 1 m.
- 10:43 MVP cast.
- 12:07 MVP cast.
- 13:05 MVP cast.
- 13:50 The vessel hit something in the water. Several days ago there were several sunfish at the surface in this area when the air temperature was warmer. The vessel stays on station for 5 minutes to observe the area. There were no sightings of any large fish or mammals. Note that there have been no sightings of any whales in the survey area for the past week.
- 14:04 Back online.
- 14:10 Take the Creed off the line to retrieve some flotsam.
- 14:18 Back online.
- 15:46 MVP cast.
- 17:07 MVP cast.
- 17:41 MVP cast.
- 17:54 Offline due to a fishing vessel.
- 18:15 End of line, Turn around and head back to Saint John.
- 18:28 Offline due to a fishing vessel.
- 19:16 MVP cast.
- 21 :20 Tied up in Saint John.

22 August 2007 Wednesday – Day 234

Crew change day. Remain tied up in Saint John.

23 August 2007 Thursday – Day 235

- 09:00 Leave wharf in Saint John headed for survey area to south. Skies clear, weather fair, visibility 10 nm plus, sea state <1m. G. Rodger notices that there are unusual data gaps in the coverage which didn't show up in real time acquisition on SIS. The cause for the gaps is unknown.
- 09:11 Begin logging.
- 10:01 MVP cast.
- 11:47 MVP cast.
- 12:39 MVP cast.
- 15:26 MVP cast.
- 17:46 MVP cast.

- 17:48 The Ellipsoid Height is flagged red again on the OmniStar system even though the POS-MV looks fine on Line 885 (this may be related to the weird data gaps we had a couple of days ago).
- 21:15 End logging.
- 21:30 Tied up at Coast Guard Base Saint John.
- 23:30 R. Parrott arrives from Halifax.

24 August 2007 Friday – Day 236

- 08:45 Depart wharf in Saint John with R. Parrott on board. Dark.
- 09:02 Logging underway.
- 09:30 Seas 1m out of the harbour, wind from the SE 5–10knts, overcast, light drizzle
- 09:52 MVP cast.
- 12:11 MVP cast.
- 13:06 The SIS computer lost bottom tracking. The tracking algorithm was forced to the seafloor by inputting a correct depth. The system then tracked properly.
- 15:38 MVP cast.
- 16:43 MVP cast.
- 17:00 Heavy fog in the Bay, visibility under 1 cable.
- 18:41 MVP cast.
- 19:41 MVP cast.
- 21:30 Tied at wharf, Saint John Coast Guard Base.
- 22:00 Taking on fuel

25 August 2007 Saturday – Day 237

- 08:48 Depart wharf in Saint John. Winds 10-15 knots, heavy Fog in harbour. Problems were encountered synching ZDA and PU time in SIS. The system was restarted and is in sync.
- 09:05 Logging started for Kongsberg EM1002.
- 09:10 Knudsen logging started.
- 09:53 MVP cast.
- 11:09 MVP cast.
- 11:49 Starting infill to straighten coverage on the western sector of the line.
- 12:21 MVP cast.
- 12:45 Fog lifting, visibility 3 miles.
- 13:46 MVP cast.
- 15:34 MVP cast.
- 15:50 Right Whale spotted. Vessel maneuvers to ensure no contact.
- 17:13 MVP cast.
- 18:23 MVP cast.
- 19:23 MVP cast.
- 20:00 Heavy fog as we approach Saint John.
- 21:00 Tied up Coast Guard Base Saint John.

26 August 2007 Sunday – Day 238

- 08:45 Depart Coast Guard Wharf in Saint John. Heavy fog for the third day.
- 09:02 Logging of Multibeam and Knudsen underway. Wind 5-10 knots, sea state below 1m, foggy in the bay. Start transit line out of Saint John.
- 09:43 Start running NE-SW lines between Saint John Traffic Zone and the “Wolves” near Grand Manan.
- 09:57 MVP cast

11:53 MVP cast.
12:21 End of SW line. Start reciprocal line.
13:11 MVP cast.
14:10 MVP cast.
17:25 MVP cast
17:30 Right Whale spotted 2 miles South of South Wolf Island
18:37 Positioning flagged red in SIS for about 45 s PU ZDA time sync problem
19:05 Right Whale spotted 3.5 miles South of Point Lepreau.
19:49 MVP cast
21:00 Logging stopped heading in to Saint John
21:30 Tied up in Saint John, R. Parrott departs for Halifax

27 August 2007 Monday – Day 239

08:50 Leave Coast Guard Station in Saint John, enroute to survey area between Saint John and Digby, winds light out of the SW, sea state below 1m, skies clear.
10:00 MVP cast.
11:36 MVP cast.
12:15 Right Whale spotted 2 miles Southeast of “Southern Wolf Island”.
12:42 MVP cast.
13:51 MVP cast.
15:43 MVP cast.
16:48 MVP cast.
18:15 MVP cast.
19:00 It has been sunny and clear all day, but we are still getting unknown positioning errors in SIS “ellipsoid height” and the “sync of PDA and Zulu time”, even though the POS-MV shows acceptable values.
19:16 MVP cast.
21:00 Tied at wharf in Saint John.
22:00 Taking on fuel.

28 August 2007 Tuesday – Day 240

08:45 Depart Wharf in Saint John for survey area. Winds light, seas flat calm, skies clear.
09:00 Four pods of porpoise were spotted throughout our first line. Problems have been encountered with the positioning through the day shown by the gated red on and off. Working between Grand Manan and Saint John and running infill lines near Grand Manan.
09:44 MVP cast.
11:34 MVP cast.
13:17 MVP cast.
14:21 MVP cast.
15:40 MVP cast.
18:50 End of Survey.
19:15 Tied in North Head, Grand Manan.

28 August 2007 Wednesday – Day 241

08:45 Depart North Head for transit to Shelburne. Heavy Fog throughout the day.
19:00 Arrive Shelburne. Meet Brooke Ocean technicians and DRDC technician
19:30 Secure Free Fall Cone Penetrometer (FFCPT), grab and other equipment on board.
C. Delbridge departs for Halifax.

29 August 2007 Thursday – Day 242

08:30 Depart Shelburne for Halifax. Heavy fog

17:00 Arrive Halifax Harbour. On station at Purcells Cove and McNabs Island. Perform a total of 6 FFCPT penetrometer drops and 2 grabs from MVP rigging.

19:00 Tied along wharf BIO. Survey complete

30 August 2007 Friday – Day 243

Patch test in Bedford Basin.

Demobilization of Creed for transit back to Quebec

Appendix III - Predicted Tides for Digby

Hourly values in centimetres above chart datum – generated by the program Tides and Currents version 4.2 by Nautical Software Inc. Times are shown in Atlantic Daylight Time.

Year	Month	Day	Time	Height	Height	Height	Height	Height	Height
2007	July	21	0:00	223	320	445	576	677	715
2007	July	21	6:00	680	591	471	343	234	182
2007	July	21	12:00	204	288	407	539	655	720
2007	July	21	18:00	714	646	538	411	291	211
2007	July	22	0:00	198	250	347	467	585	667
2007	July	22	6:00	689	647	559	445	329	240
2007	July	22	12:00	206	239	324	439	562	663
2007	July	22	18:00	710	694	623	516	394	286
2007	July	23	0:00	219	216	270	365	478	585
2007	July	23	6:00	654	666	623	539	432	327
2007	July	23	12:00	251	229	266	349	459	574
2007	July	23	18:00	663	701	680	608	502	385
2007	July	24	0:00	284	225	226	280	372	482
2007	July	24	6:00	582	644	653	611	530	428
2007	July	24	12:00	329	260	243	281	362	470
2007	July	24	18:00	581	665	697	674	602	495
2007	July	25	0:00	378	279	224	226	281	373
2007	July	25	6:00	484	583	643	651	610	528
2007	July	25	12:00	426	328	261	245	285	368
2007	July	25	18:00	478	590	673	704	678	600
2007	July	26	0:00	489	368	265	211	216	276
2007	July	26	6:00	375	491	593	654	660	614
2007	July	26	12:00	527	419	317	248	236	282
2007	July	26	18:00	372	490	608	693	720	686
2007	July	27	0:00	598	477	347	240	187	201
2007	July	27	6:00	273	383	509	617	676	674
2007	July	27	12:00	616	519	402	292	224	220
2007	July	27	18:00	279	383	513	639	723	741
2007	July	28	0:00	691	588	454	313	203	159
2007	July	28	6:00	190	278	403	540	652	704
2007	July	28	12:00	686	611	499	370	254	192
2007	July	28	18:00	206	284	405	548	680	758
2007	July	29	0:00	758	687	566	418	268	161
2007	July	29	6:00	134	188	296	437	585	695
2007	July	29	12:00	730	689	595	467	327	209
2007	July	29	18:00	162	200	300	438	593	726
2007	July	30	0:00	790	765	670	532	370	215
2007	July	30	6:00	120	120	201	329	485	638
2007	July	30	12:00	738	749	682	567	425	275
2007	July	30	18:00	164	140	205	327	480	643
2007	July	31	0:00	771	811	757	640	487	315
2007	July	31	6:00	162	90	121	227	373	541
2007	July	31	12:00	693	774	756	664	532	377
2007	July	31	18:00	223	125	129	222	361	525
2007	August	1	0:00	692	805	817	736	601	436
2007	August	1	6:00	259	118	74	136	264	424
2007	August	1	12:00	599	744	800	753	640	494
2007	August	1	18:00	328	176	99	131	244	396
2007	August	2	0:00	569	732	824	808	706	559
2007	August	2	6:00	387	211	89	76	164	307
2007	August	2	12:00	477	653	783	813	742	613
2007	August	2	18:00	456	285	141	87	142	269
2007	August	3	0:00	428	603	757	826	787	672
2007	August	3	6:00	518	344	177	79	92	197
2007	August	3	12:00	349	524	695	807	813	726
2007	August	3	18:00	588	425	253	122	88	158
2007	August	4	0:00	291	452	625	765	814	760
2007	August	4	6:00	639	485	315	162	85	117
2007	August	4	12:00	231	386	559	721	815	804
2007	August	4	18:00	709	568	403	236	118	98
2007	August	5	0:00	174	306	465	631	756	792
2007	August	5	6:00	732	614	465	303	165	104
2007	August	5	12:00	145	260	411	579	730	809
2007	August	5	18:00	791	695	555	394	234	126
2007	August	6	0:00	112	186	312	465	622	737
2007	August	6	6:00	766	710	599	459	307	181
2007	August	6	12:00	129	170	279	422	582	723

2007	August	6	18:00	796	777	687	553	397	244
2007	August	7	0:00	140	125	191	308	453	603
2007	August	7	6:00	712	744	696	596	465	323
2007	August	7	12:00	203	152	186	285	420	573
2007	August	7	18:00	708	781	769	686	560	410
2007	August	8	0:00	260	154	131	188	296	435
2007	August	8	6:00	580	691	730	693	602	480
2007	August	8	12:00	343	223	166	191	281	409
2007	August	8	18:00	557	693	771	768	693	572
2007	August	9	0:00	424	272	161	129	178	281
2007	August	9	6:00	417	563	680	728	699	614
2007	August	9	12:00	495	357	232	167	185	270
2007	August	9	18:00	396	545	686	772	774	702
2007	August	10	0:00	582	432	275	156	119	166
2007	August	10	6:00	269	407	559	683	736	708
2007	August	10	12:00	623	502	360	227	157	175
2007	August	10	18:00	261	390	544	691	781	782
2007	August	11	0:00	706	582	428	264	141	107
2007	August	11	6:00	160	268	412	572	700	749
2007	August	11	12:00	714	622	496	345	208	141
2007	August	11	18:00	167	261	396	557	708	794
2007	August	12	0:00	784	699	569	407	238	120
2007	August	12	6:00	99	165	283	436	601	724
2007	August	12	12:00	760	710	609	474	315	179
2007	August	12	18:00	127	169	274	418	585	733
2007	August	13	0:00	803	775	676	538	370	202
2007	August	13	6:00	101	104	187	317	478	641
2007	August	13	12:00	750	762	694	580	436	274
2007	August	13	18:00	151	122	185	303	454	623
2007	August	14	0:00	757	801	750	639	492	321
2007	August	14	6:00	167	94	125	227	367	532
2007	August	14	12:00	686	767	751	663	538	386
2007	August	14	18:00	230	131	132	216	344	501
2007	August	15	0:00	662	771	784	711	588	436
2007	August	15	6:00	270	140	104	163	281	429
2007	August	15	12:00	592	724	772	726	622	486
2007	August	15	18:00	332	192	125	157	258	395
2007	August	16	0:00	552	695	772	753	660	529
2007	August	16	6:00	376	225	130	131	214	343
2007	August	16	12:00	496	647	748	761	691	573
2007	August	16	18:00	431	282	167	136	194	307
2007	August	17	0:00	448	597	715	756	710	605
2007	August	17	6:00	469	323	196	138	172	273
2007	August	17	12:00	408	558	689	756	737	648
2007	August	17	18:00	522	379	244	160	161	237
2007	August	18	0:00	357	497	631	719	728	663
2007	August	18	6:00	551	417	284	186	163	220
2007	August	18	12:00	331	467	606	712	747	704
2007	August	18	18:00	605	475	338	223	169	194
2007	August	19	0:00	281	401	534	649	708	693
2007	August	19	6:00	618	505	379	264	195	198
2007	August	19	12:00	269	381	512	636	716	726
2007	August	19	18:00	669	566	439	313	219	189
2007	August	20	0:00	228	317	434	556	651	687
2007	August	20	6:00	659	581	474	358	262	215
2007	August	20	12:00	235	310	418	540	648	707
2007	August	20	18:00	702	640	539	418	304	227
2007	August	21	0:00	211	255	342	452	563	641
2007	August	21	6:00	665	633	559	459	353	271
2007	August	21	12:00	239	264	336	438	551	646
2007	August	21	18:00	693	682	622	525	411	305
2007	August	22	0:00	238	227	270	352	457	559
2007	August	22	6:00	630	649	619	551	456	358
2007	August	22	12:00	284	255	279	347	444	552
2007	August	22	18:00	641	685	675	618	524	411
2007	August	23	0:00	309	243	230	270	350	453
2007	August	23	6:00	554	625	647	620	554	461
2007	August	23	12:00	363	287	256	278	345	443
2007	August	23	18:00	552	643	690	683	625	527
2007	August	24	0:00	412	304	233	218	259	342
2007	August	24	6:00	450	558	634	660	632	561
2007	August	24	12:00	462	358	275	240	264	337
2007	August	24	18:00	442	560	660	711	701	635
2007	August	25	0:00	528	402	284	206	193	243
2007	August	25	6:00	338	459	577	661	685	648

2007	August	25	12:00	564	453	336	244	210	244
2007	August	25	18:00	331	452	584	693	745	723
2007	August	26	0:00	640	517	376	245	165	164
2007	August	26	6:00	232	346	484	616	703	716
2007	August	26	12:00	659	556	427	295	197	172
2007	August	26	18:00	227	336	476	624	740	781
2007	August	27	0:00	739	633	491	332	192	120
2007	August	27	6:00	141	235	371	528	671	751
2007	August	27	12:00	742	659	534	386	239	143
2007	August	27	18:00	139	221	354	514	676	790
2007	August	28	0:00	811	740	610	449	275	134
2007	August	28	6:00	82	134	255	413	586	733
2007	August	28	12:00	796	757	646	500	333	178
2007	August	28	18:00	94	119	229	384	560	730
2007	August	29	0:00	832	824	725	575	397	215
2007	August	29	6:00	83	60	145	291	467	651
2007	August	29	12:00	791	827	757	623	458	277
2007	August	29	18:00	122	59	115	249	419	608
2007	August	30	0:00	776	856	819	696	532	344
2007	August	30	6:00	161	49	60	172	336	524
2007	August	30	12:00	711	834	841	743	592	414
2007	August	30	18:00	226	80	45	126	276	456
2007	August	31	0:00	648	805	860	796	659	488
2007	August	31	6:00	297	124	39	79	211	383
2007	August	31	12:00	576	757	857	836	721	560
2007	August	31	18:00	375	188	60	50	148	304

Appendix IV - SeaSpy Magnetometer

This section has been modified from the Geological Survey of Canada Open File Report F.G. CREED EXPEDITION 2005-038 Multibeam and magnetometer survey of the St. Lawrence Estuary north of Rimouski (June 5th to 17th 2005), (Campbell et al., 2005) which provided a description of the operational procedure used for the SeaSpy Marine Magnetometer.

This survey used the SeaSpy Magnetometer. The fish was towed at an average depth of 1 metre below the sea surface at a speed of 10-12 knots in varying sea states. The system uses Overhauser sensors and measures ambient magnetic field regardless of survey direction or orientation with the field.

Procedures for Sea-Spy Magnetometer deployment during this survey

1. Tow point on Fish - 60m of cable were measured on wharf (3 times vessel length) – A tow point was created using rope.
2. Tow point on Vessel - small shackle on port side rail (Figure 1).
3. Spool - 60 m cable wrapped loosely around port cleats (Figure 2), wooden spool on aft quarter/bridge-deck, deck lead to lab through conduit. Deck lead to adapter to small black input box. Black input box output splits to COM port input and power supply. (See manual for more details).

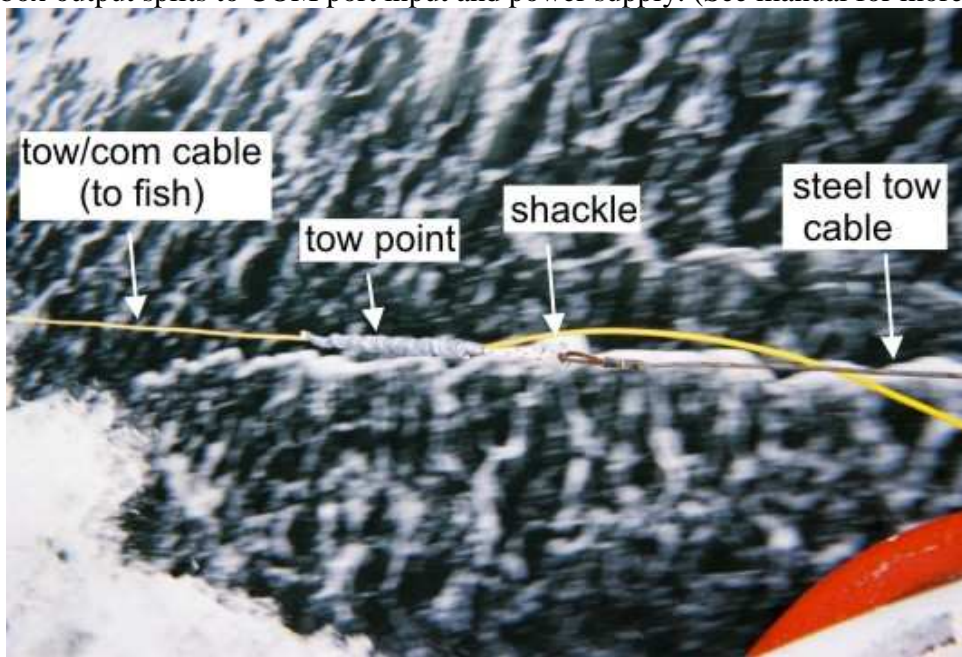


Figure 1- Magnetometer tow point in action.

4. Setup GPS input. Software accepts standard NMEA navigation input from a COM port. Software requires baud rate, parity, etc. to be set. In this case it was a baud rate of 9600 and no parity. Nav was updated at 10 Hz.

5. Determine layback. In this case approximately $3 \times \text{Vessel Length (60m)} + \text{Vessel DGPS/RTK offset (7.5m)} + \text{Towpoint (1m)} = 68.5\text{m}$

6. Deployment Procedures- The system requires two people to deploy the fish which weighs about 20 kg. Slowed to deployment speed of 2–4 knots. Before deploying, startup SeaLINK software. Check that GPS data is streaming in the GPS window. Press the “sync GPS” button to sync the computers clock to the GPS. In the command window, enter “p” to zero pressure the depth sensor on the tow fish. Set the cycle rate (usually 1 or 2 Hz). Press the “append GPS values button” to attach position information to the file. Enter the calculated layback. Fish lowered over top of railing on the side of vessel with person 1 holding tension on fish. Wraps were taken off cleats by person 2 as to not tangle cable or transfer tension to deck. Note two additional wraps were left on deck cleats as safety back up. Once fish is deployed, press the logging button on the acquisition computer to begin logging. Bring ship to survey speed (10-12 kts) (Figure 3).

7. Retrieval Procedures- Slowed to recovery speed of 2 to 4 kts. Person 1 hand recovers fish while person 2 neatly wraps the tow cable on deck (not tight around cleats). When tow fish is along side, bring fish on board carefully, ensuring that the fish does not impact the hull. Removed composite nose piece and using potable water (starboard side of the Creed) thoroughly rinsed the brass connector and body of the fish, replaced nose piece and secured fish to railing. Note, corrosion takes place fairly quickly when the saltwater, fresh air and brass are all in contact, it is important to rinse the fittings after each retrieval, however it is not necessary to break the brass seal during this process, the o-rings provide the true seal.



Figure 2- Setup of magnetometer while on deck.

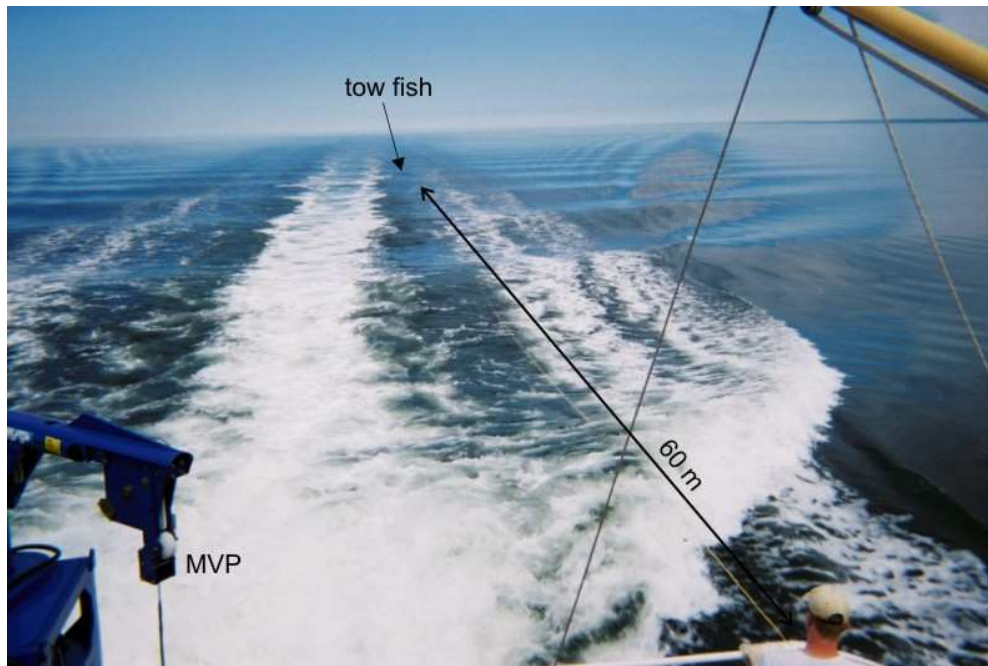


Figure 3- Setup of magnetometer while acquiring data.

SeaLink setup and magnetometer software configuration

System Requirements Windows 95 or higher with two available com ports.

- The Magnetometer requires both a Serial connection to the towfish and a real-time NMEA nav string from DGPS.
- A cycle rate of 1 to 2 hz is desirable on the magnetometer at 12 kts, 1 Hz gives reading ~ every 20 metres, 2 Hz every 10 m.
- Mag Baud 9600 string com1.
- GPS Baud 9600 10hz NMEA string com2.

Problems encountered in the Gulf of St. Lawrence.

- No valid navigation string found, program restarted/rebooted until com port found.
- No valid magnetometer com link, Windows OS interpreted the magnetometer communications port as a plug and play mouse. The power was disconnected from magnetometer until windows completed reboot, power reconnected and program initiated.
- The pressure sensor provided erroneous calculations of depth throughout the cruise, sometimes showing fish above surface of the water. Fish could be observed under most conditions riding 60m aft and .5m or greater, below the surface.