CSL HERON MAPPING OPERATIONS, MAY 23RD-JUNE 4TH

BLUE HILL BAY, MAINE, USA

OCEAN MAPPING GROUP CRUISE REPORT

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OCEAN MAPPING GROUP

UNIVERSITY OF NEW BRUNSWICK

2009 Seabed Mapping Cruise Report – Maine, USA

Personnel:

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- Travis Hamilton, BScEng, *University of New Brunswick*
- Dr. John E. Hughes Clarke, Professor, *University of New Brunswick*
- Laura Brothers, PhD student, *University of Maine*
- Dr. Joseph Kelly, Professor, *University of Maine*
- James Leslie, *Skipper of the CSL Heron*

Introduction

The Ocean Mapping Group from the University of New Brunswick and the Department of Earth Sciences from the University of Maine both share a common interest in mapping coastal and inner continental shelf sediments in the Gulf of Maine and Bay of Fundy region. The two universities used their specialities in marine quaternary geology and seabed mapping, to survey Blue Hill Bay and Somes Sound areas in the Gulf of Maine. Using multibeam sonar and sub-bottom profiling, these surveys delineated the extent, morphology and shallow stratigraphy of post-glacial sedimentation. The aim of the surveys was to better understand the sea level history and sedimentation that occurred at the time of, and after the retreat of the glaciers in the Maine - New Brunswick region. A particular focus was on pockmarks and their evolution.

The Ocean Mapping Group operated their seabed mapping vessel, the CSL Heron, which is on loan to the University from the Canadian Government. The vessel was run by Captain James Leslie, while the survey equipment was run by personnel from the University of New Brunswick.

Equipment

Systems used on board the CSL Heron:

1. Kongsberg EM3002 Multibeam echosounder, 300 kHz.
2. Two Knudsen 320B Single beam echosounders, 3.5/28 kHz and 200/200 kHz.
3. Brooke-Ocean Technologies Moving Vessel Profiler: MVP 30.
4. CODA F185 motion sensor
5. C&C Technologies CNav 2050 GPS
6. Trimble 5700 base station.

Planning

The planned survey area is shown in figure 1. The time it took to complete the survey was estimated using the dimensions of the surveyed area and running 200 percent coverage (see figure 2). The survey time was estimated assuming an 8 hour survey day, a survey speed of 8 knots, using the mid-depth per polygon area, adding 10 percent for turns and multiplying the whole survey time by 2 to allow for any hardware/software issues, CTD casts and any unplanned events. The total time estimated to complete the Blue Hill Bay area was 18 days. The total time estimated to complete the Somes Sound area was 1.5 days giving a total time estimation of 19.5 days on site.

On average, a survey day lasted 9 hours and the Blue Hill Bay / Somes Sound survey required 12 days to complete.

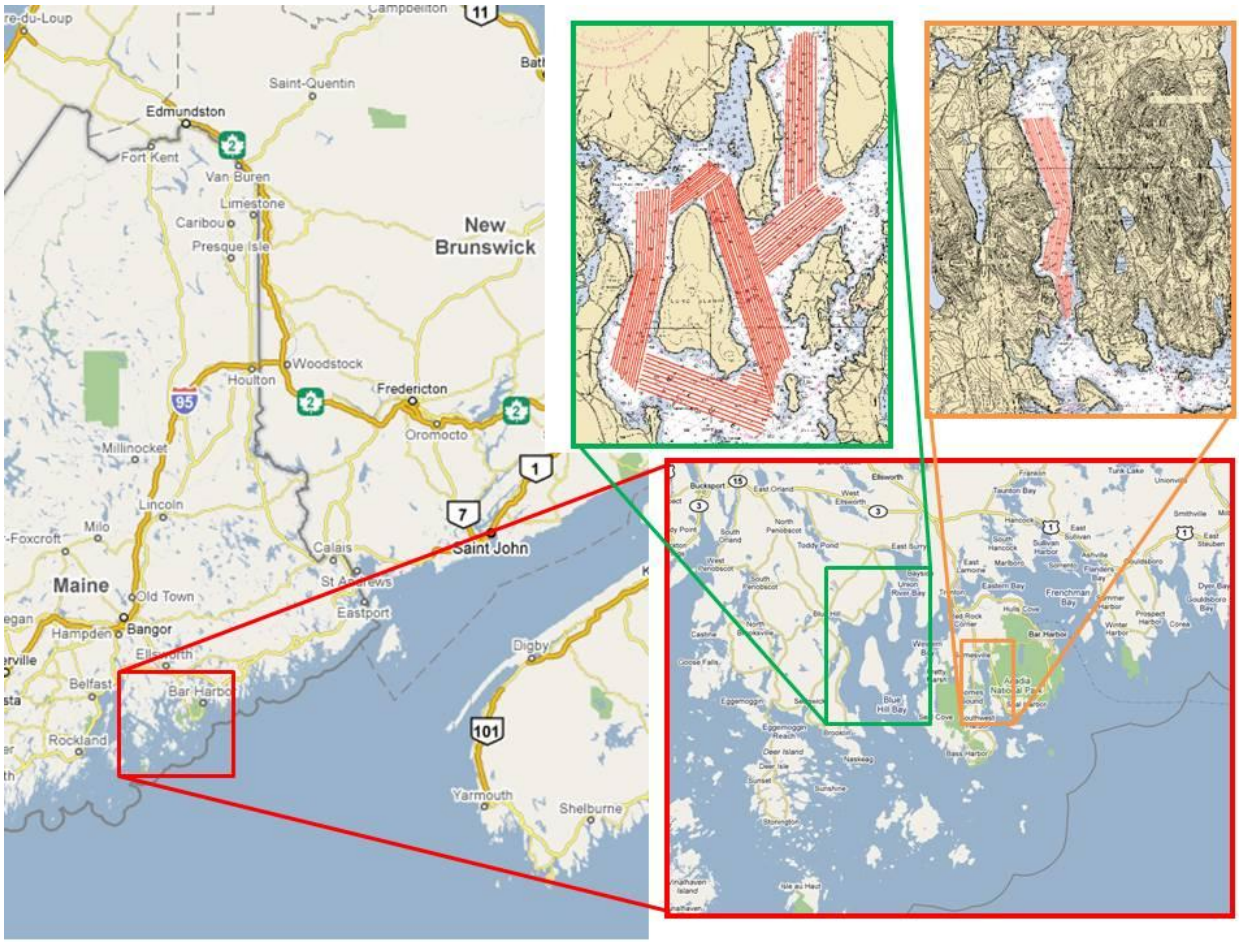


Figure 1. The Maine survey area of Blue Hill Bay (shown in Green in top, centre of image) and Somes Sound (shown in Orange in top, right of image). Preliminary survey lines are shown in red.

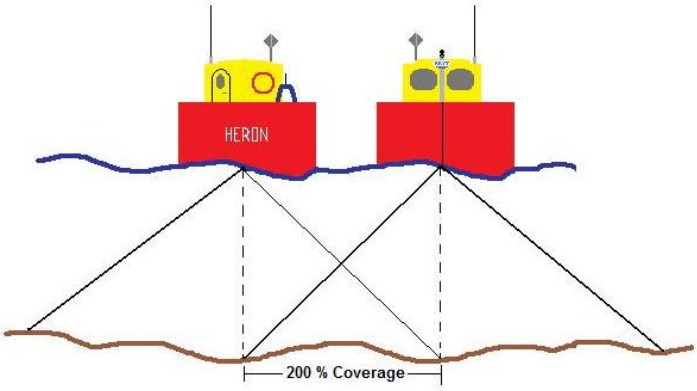


Figure 2. Survey with 200% coverage of the seafloor, meaning the seafloor is covered twice with each new line.

Patch Test

A patch test was performed on May 24th to calibrate the multibeam echosounder. The offsets were entered into the F180.

Survey Procedures

While in the field, planned survey lines were run in most locations, The line spacing was repeatedly adapted in order to maintain approximately 200% coverage in the varying water depth. Also there were several locations, due to aquaculture sites and the varying coastline, that deviation from planned lines was necessary. In these areas the approach of getting the skipper to build on previous coverage was taken.

Each day, coverage was built up along the transit from Bass Harbour to Blue Hill Bay. This was outside the survey area but was taken as an opportunity to further enhance the seabed information in the area. Following an ahead of schedule completion of the Somes Sound survey on June 3rd, the crew took advantage of an opportunity to run several lines over an area at the mouth of Bass Harbour in which there had been sub-bottom profiles run in the past.

Logging Procedures

Onboard the CSL Heron, the 300 kHz multibeam and multibeam water column, 3.5 kHz sub-bottom profiler, 28 kHz single beam and 200 kHz single beam echosounder data were logged at all times while the vessel was in motion (see Appendix A for ship track and Appendix B for coverage). Additionally, CNAV GPS (pseudo-ranges and NMEA strings) and attitude information from the CODA F-180 were logged continuously from when the Heron departed to when it returned at the end of the day.

The MVP 30 was used to sample the water-column, collecting CTD casts as frequently as possible while the vessel was in motion (see Appendix D). Due to lobster season in the Blue Hill Bay / Somes Sound area, the collection of MVP casts was limited to areas with low densities of lobster traps. The MVP 30 software used depths provided by the 28kHz single beam sounder since it is traditionally the most reliable nadir depth solution. After using the svp tool to look at the amount of sounding error that could occur between each dip (see Appendix E), it was determined that MVP dips only needed to be at the beginning and end of each line (see figure 4 for plot of all MVP casts). The first MVP cast of each day was converted to an .asvp format, extended to 12000 metres and input into SIS to provide an accurate sound velocity profile. The multibeam was re-raytraced in post-processing, to correct for refraction in the outer beams, using a nearest in time/distance method.

At the end of each day all logged data was transferred to processing machines at the office using an external hard drive.

In addition to the onboard data logging, a Trimble GPS base station was set-up at the Bass Harbor Inn (See figure 3 for location). The Trimble was logged continuously for the duration of the survey (May 23rd, 2009 – June 4th, 2009), downloading and swapping the data cards every two days. The location of the GPS was 44.23952 N -68.35033 W at an elevation of -20.047 metres below the WGS84 Ellipsoid.

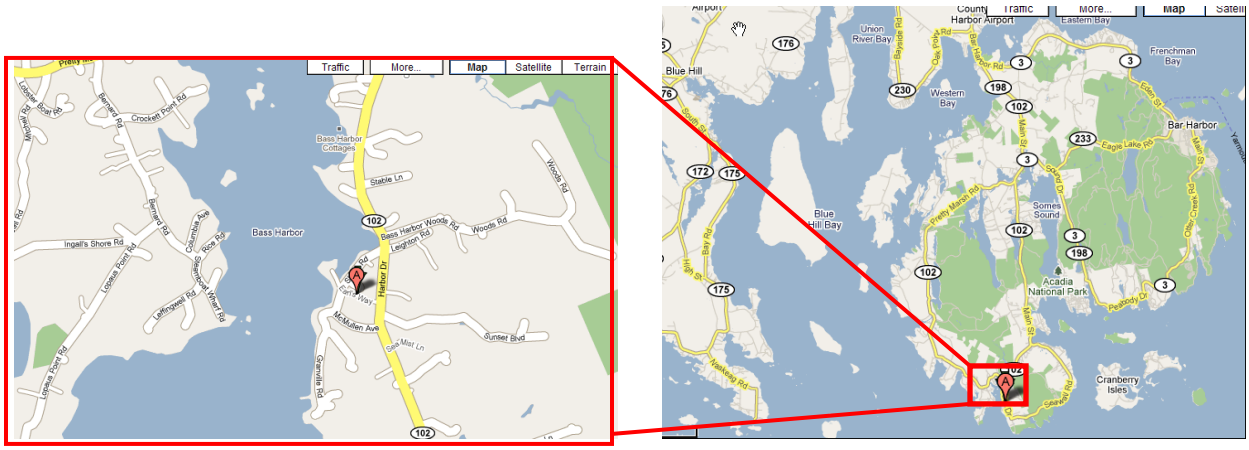


Figure 3. The location of the Trimble GPS Base station (44.238589,-68.345336)

Processing

The data was all post-processed in the days following the survey. Raw data from the multibeam, multibeam water column, sub-bottom profiler, 28 and 200 kHz single beam echosounders were converted to the OMG format. The soundings were visually inspected and noise was filtered out on the processing machines.

Multibeam soundings were corrected for refraction using the MVP casts collected on the same day. The nearest in time or distance or an interpolation between each cast was used to re-raytrace the multibeam soundings.

Multibeam soundings were corrected for tide using the WebTide Scotian Shelf tidal model in post-processing. The location of the survey was just outside the tidecor grid, therefore the nearest point or node was used for tidal corrections instead of a weighted average (used for positions inside the grid). WebTide uses tidal harmonic constituents to create predicted tides. Raw CNAV data and base station data were logged continuously for the duration of the survey, allowing for post processed kinematic solutions with base lines reaching ~25km. This made it possible to reference the entire survey to the ellipsoid and then using a geoid-ellipsoid separation model, reduce soundings to the geoid and then to chart datum, effectively removing the tidal aspect of the survey.

Sub-bottom raw data was converted to the OMG format. The soundings used the multibeam nadir bottom tracking to remove any noise in the sub-bottom bottom detection or in the water column.

Images were made from the multibeam bathymetry and backscatter data, as well as from the sub-bottom data. Multibeam bathymetry and backscatter data was overlaid on a NOAA background chart with 30 metre SRTM topography of terrestrial areas superimposed (see appendix B for bathymetry example).

A fence diagram system was set-up for the sub-bottom data. This fence diagram displayed the properly referenced sub-bottom data, in regional stacks. The properly referenced multibeam

bathymetry and backscatter, of the same area as the fence diagrams, with track-lines overlaid were also created (see appendix C).

A website was set-up with images showing the area of multibeam coverage in both bathymetry and backscatter forms. Images were also created with sub-bottom fence diagrams and the correspondingly, properly referenced, multibeam bathymetry and backscatter images. For more information visit the website: http://www.omg.unb.ca/Maine/ . A composite of the data in Google Maps can be found at http://www.omg.unb.ca/Maine/GoogleBathy.html.

Hardware Issues

The surface sound speed probe pump stopped working on JD150 (May 30, 2009) at ~ 1800 UTC. The pump was replaced at the end of the day; no issues with the new pump for the remainder of the survey.

The MVP snagged a lobster trap on JD147 (May 27, 2009). Skipper James Leslie was quick to stop and un-tangle the fish. There did not appear to be any damage to the MVP winch, cable or fish upon a test cast, nor for the rest of the survey.

On several occasions the hinges connecting the swing arm to the free fall fish of the MVP began to seize. Foreseeing that this would cause problems in the trajectory of the fish, the hinges were disassembled and lubricated each time the problem was detected.

The Trimble base station lost power one day during a survey. The receiver and backup battery were located in a pelican case (water tight) however there was a hole where the receiver plugs into the extension cord. During a rainy day and night, some water leaked into the connection causing the outside power plug to trip and shut off power. The backup battery ran out of power and the Trimble shut off for an unspecified amount of time.

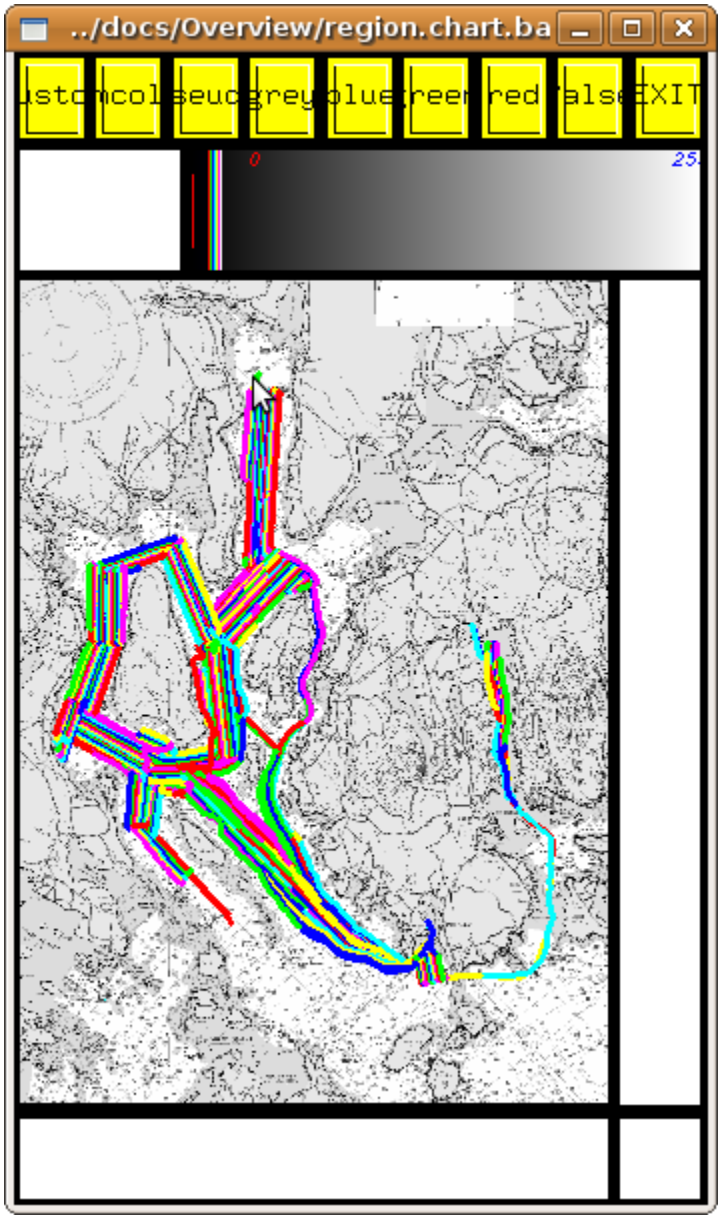
Software Issues

SIS had wrong version of Java making some features not work (ie. SVP editor). Re-installed SIS and Java to fix the problem.

The 200kHz K320 software shutdown JD148 (May 28, 2009) on line 97, problem seemed to be from a loose SCSI cable.

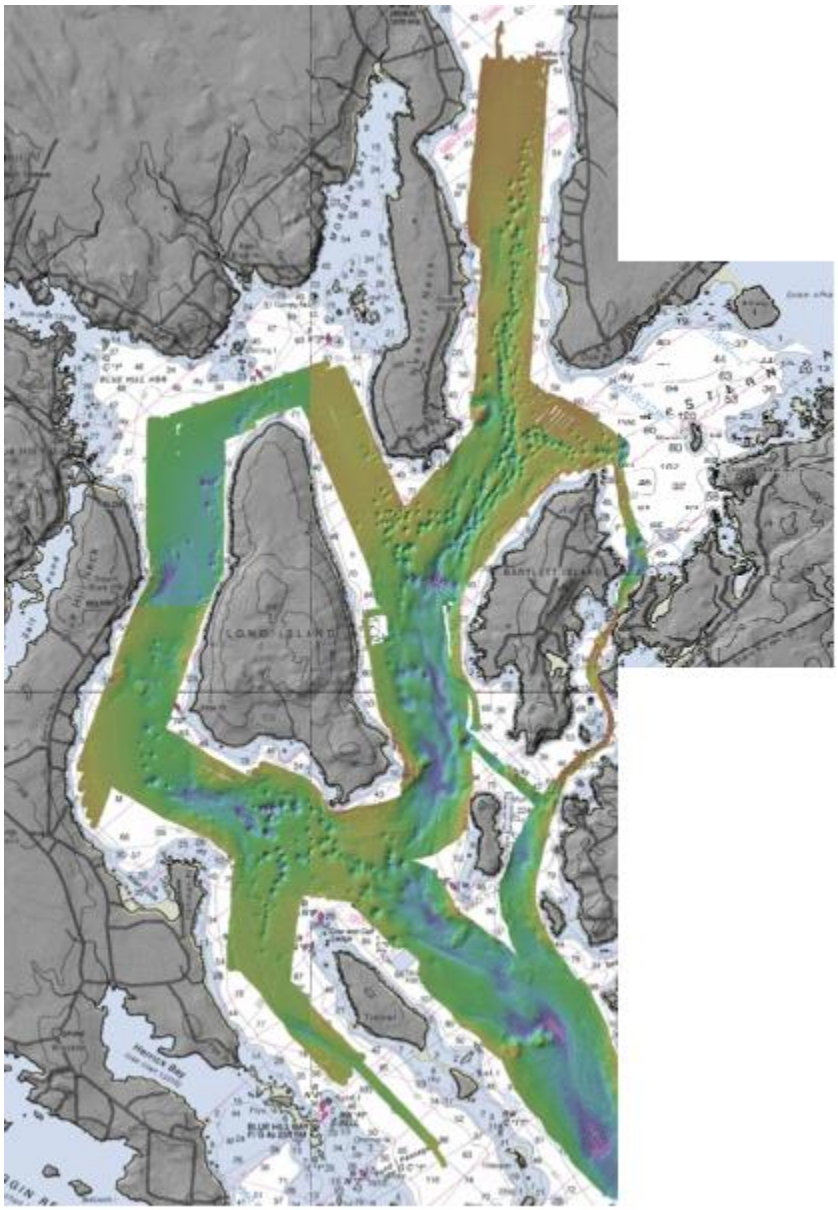
Appendices

Appendix A

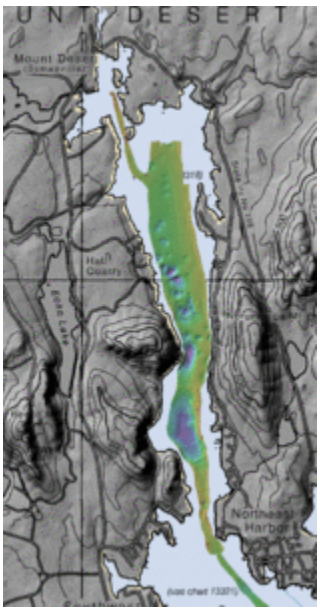


The Heron ship-track throughout the Maine survey.

Appendix B

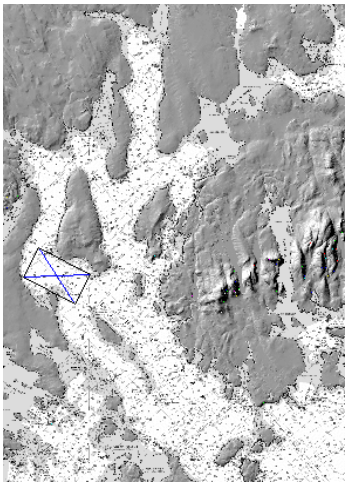


Blue Hill Bay Multibeam Coverage (above)

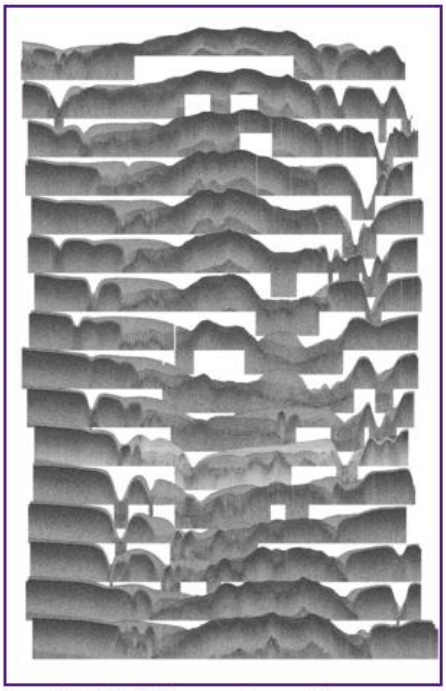


Somes Sound Multibeam Coverage (above)

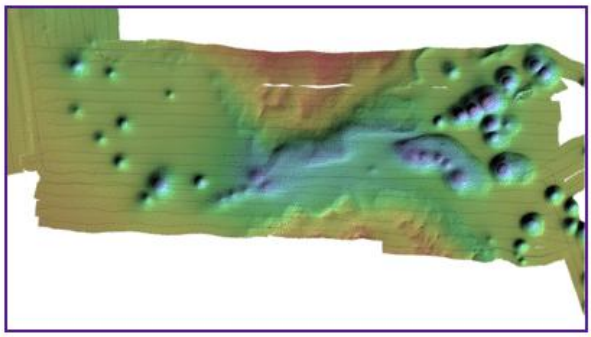
Appendix C



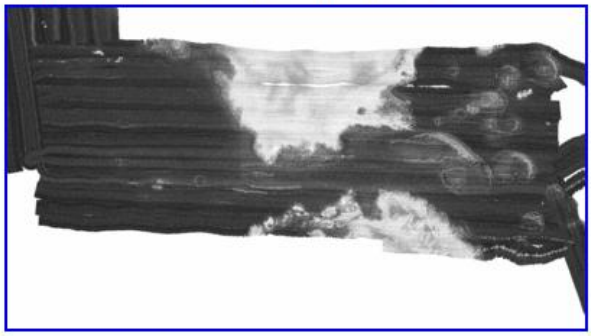
Overview of Fence Diagram, area outlined with blue box.



3.5 kHz Subbottom Fence Diagram
Looking from bottom of adjacent mapsheet.

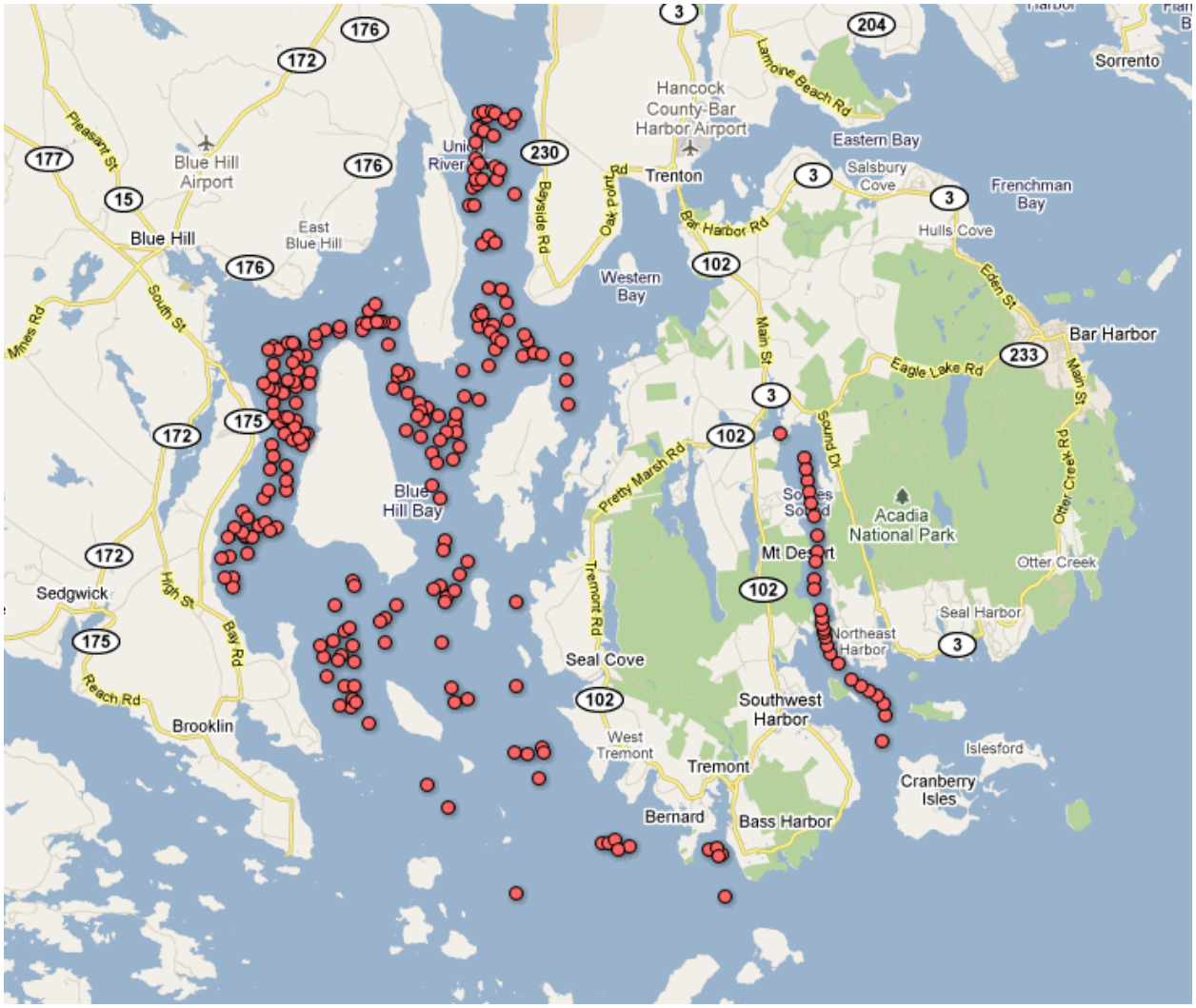


Multibeam Bathymetry - *tracklines superimposed*



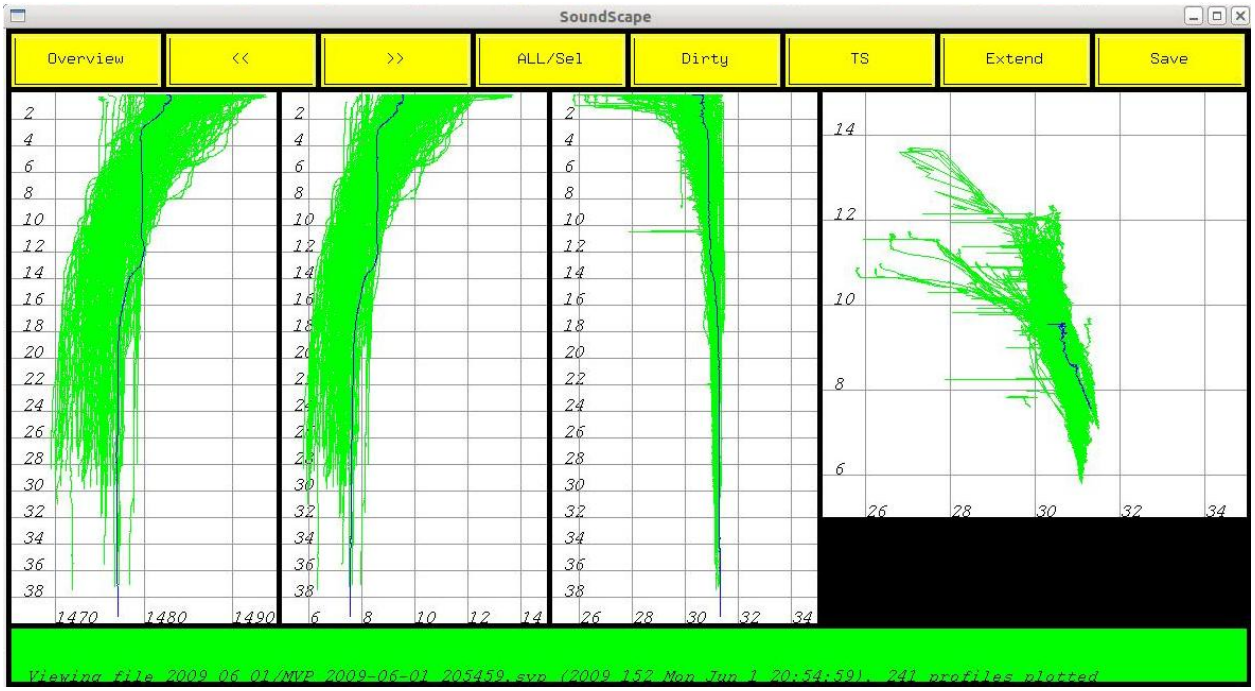
Multibeam Backscatter

Appendix D



The location of all MVP dips is shown in red.

Appendix E



Sound speed, found in the left box, from 241 profiles in the area, varies from ~1468m/s to ~1495m/s and is mostly controlled by temperature.

Temperature, found in the middle box (left), from 241 profiles in the area, varies between ~5.7^{o}C and ~13.7 ^{o}C.

Salinity, found in the middle box (right), from 241 profiles in the area, varies from ~25.7 ppt to ~31.2 ppt.

A temperature vs. Salinity plot is found on the far right.