



## *Chair in Ocean Mapping*

Current and Future Research Activities Y2002-Y2003



*"home of the Heron"*

January 2003

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## Introduction

### Overview

This report outlines the status and current and future research directions of the Chair in Ocean Mapping (COM) at the University of New Brunswick (UNB) at the end of the 2002 calendar year. The Chair works within the Ocean Mapping Group which is a part of the Dept. of Geodesy and Geomatics Engineering (GGE) at UNB.

The Ocean Mapping Group is a loose association of researchers at UNB with a common interest in Ocean Mapping. The Chair provides research direction, support staff and infrastructure to support research within the Group.

2002 marked a significant advance in the research capabilities of the Ocean Mapping Group. For the past 10 years the Group's research has been based on working with survey platforms owned and operated by others. This has allowed us to be directly involved in state-of-the-art operational ocean mapping activities worldwide. The fact, however, that these platforms were almost always involved in operational surveys restricted our freedom to undertake experimentation.

### Recent Progress

Over the winter 2001-2002, in partnership with the Canadian Hydrographic Service we mobilized the CSL Heron. The Heron is equipped with multibeam, keel mounted sidescan, subbottom profiler, ADCP and underway CTD (MVP-30). She was first mobilized in mid April and was involved in over 100 days of operations in 2002 until being frozen in in December. The Heron now is the primary platform for three major thrusts of research that will be investigated using this dedicated suite of instruments.



## Improved Oceanographic Imaging for Better Sound Speed Information

As an extension of our interest in the sound speed field in the ocean, we have been developing techniques to monitor water mass boundaries and their migration. Four interests have driven this research:

1. better sound speed field monitoring
2. offshore boundary delineation
3. Estuarine Circulation studies
4. Sediment Transport Studies

Using the under way MVP-30 CTD profiling equipment together with a pole mounted ADCP we have undertaken detailed investigations of coastal circulation in both estuarine and inshore areas. These serve the dual purpose of investigating the local oceanography and sedimentology as well as quantifying the degree of local sound speed variability that can be expected.

## Precise Repetitive Surveying.

This research direction aims at establishing the practical limits of monitoring of small scale (decimeter level) seabed change (erosion and deposition). To achieve this level of accuracy requires not only high precision in instrumentation, but also excellent integration. The suite of instruments on board the Heron, each in isolation have sufficient range, angle or positional resolution, but the total propagated error of the integrated solution ultimately depends on how well each of these components are linked together.

We have conducted research into both sensor performance studies and automated integration procedures. To test out the integrated results, an ongoing sediment transport project is used to test predicted total achievable accuracy and resolution. In addition repeated reference surface experiments have been conducted through the year to better understand the dynamic (during periods of high sustained acceleration) response of the motion sensors used.

## Use of Calibrated Backscatter Measurements to Investigate Coastal Habitat.

In 2001 we started a research thrust in the field of aquaculture site monitoring. This represented a small but industrially relevant application of the use of seabed backscatter data in aid of coastal environmental research. In 2002, this program has continued and been expanded to include the more general field of coastal seabed habitat definition.

Whilst our initial work was primarily involved with the use of Simrad sonar systems (as they are used by the majority of our sponsors), in 2002 we have developed the means to derived measures of the seabed backscatter strength from the RESON family of sonars. This work, driven by the interests of the USGS and NOAA allows us the freedom to work with a much larger variety of sonar systems.

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## Personnel

### Faculty

John E. Hughes Clarke	Associate Professor, Chair in Ocean Mapping, GGE <i>Swath Sonar Software Development, Sediment Transport</i>
David Wells	Professor Emeritus, GGE <i>Hydrography, Geodesy, Uncertainty management</i>
Y.C. Lee	Professor, GGE <i>Geographic Information Systems, Spatial Data Infrastructure</i>
Sue Nichols	Associate Professor, GGE <i>Coastal and Marine Cadastral</i>
Marcelo Santos	Associate Professor, GGE <i>Kinematic Positioning, Geodesy</i>
Karl Butler	Assistant Professor, Dept. Geology <i>Exploration Geophysics</i>
Dave Monahan	Director of Ocean Mapping, CHS <i>Law of the Sea</i>

### Research Associates and PostDoctoral Fellows

Dr. Susan Haigh	Contract Researcher <i>Numerical Modeling of Coastal Circulation</i>
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### Support Staff

Shawn Woo	System Manager
Anya Duxfield	Research Assistant
Capt. Loren Fleet	Skipper, CSL Heron
Joan Henry	Accounting (until June 2002)
Tracey Hawco	Accounting (after Sept. 2002)

### Graduate Students

Graham Nickerson	LAM	M.Sc.Eng 1997-2002
Doug Cartwright	JHC	MEng 2000-
Enrique Silva	DEW	MEng 2000-2002
Ted Byrne	JHC	MEng 2000-
Sam Ng'ang'a	SN	PhD 2000-
Sarah Cochrane	SN	MEng 2000-
Michael Sutherland	SN	PhD 2000-
Garret Duffy	JHC	PhD 2001-
Jonathan Beaudoin	JHC	M.Sc.Eng 2001-
Jennifer Coppola	JHC	M.Sc.Eng 2002 -

Karen Cove	MS	M.Sc.Eng 2002 -
Jim Bradford	JHC	MEng 2002 -
Andy Muir	JHC	MEng 2002 -
Lionel Manteigas	DEW	MEng 2002 -
John Fleming	DEW	MEng 2002 -

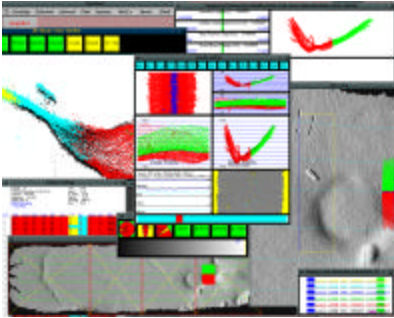
### ***Adjunct Faculty and Active Collaborators in 2002***

Dr. Christian deMoustier	Honorary Research Associate, Scripps Institute of Oceanography
Dr. Larry Mayer	Adjunct Professor, University of New Hampshire
Dr. Gary Melvin	Adjunct Professor, DFO, St. Andrews Biological Station
Russell Parrot	Research Scientist GSC – Atlantic, BIO
Dr. David Wildish	Senior Research Scientist DFO St. Andrews Biological Station
Dr. Peter Lawton	Senior Research Scientist DFO St. Andrews Biological Station



## Active Research Directions

The following short overviews explain the researchers, sources of funding and describe the type of research currently active under the umbrella of the Chair in Ocean Mapping:



### **Swath Sonar Analysis Software**

*Hughes Clarke*

*Chair Funding*

In order to support the core swath sonar research that is active within the Ocean Mapping Group, a UNIX based processing and analysis package (SwathEd) is constantly maintained and enhanced.

Software developments have continued, the most noticeable advancements in the 2002 year include.

- ?? Seismic section project software (fence diagrams)
- ?? MVP 30 profile manipulation software (cross-sections etc..).
- ?? Upgrading of patch test tools to handle dual head sensors independently.
- ?? Automated motion correlated residual analysis (wobbles)
- ?? Reson snippet support
- ?? Combining multi-phase ADCP tidal current observations

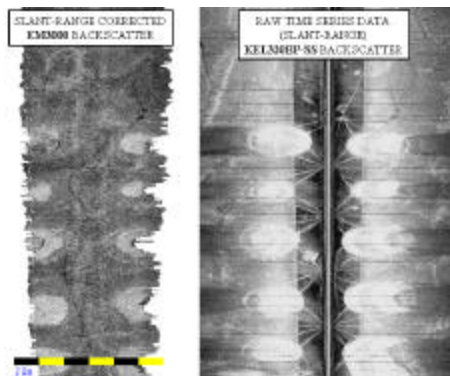
### **Acoustic Imaging of Aquaculture Sites**

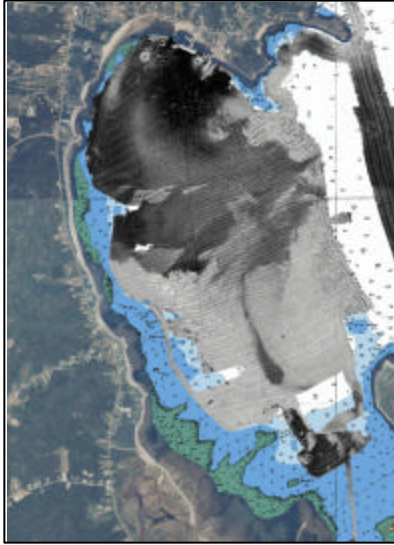
*Hughes Clarke, and Wildish (DFO-SABS)*

*DFO Subvention Grant funding*

Continuing our studies in the Letang estuary, the progress of organic enrichment at the Limekiln salmon farm site was investigated in May and September.

We have been comparing the relative value of EM3000 backscatter strength measurements derived from narrow beams with 200 kHz backscatter derived from a conventional sidescan stave. Whilst initial results with the sidescan staves in 2001 seemed promising, it is clear from the 2002 data that, as the acoustic signature of the fish swim bladders grows with age, it masks the signature of the organically enriched sediments beneath the cages, rendering the results unusable.





### **Coastal Habitat Definition –Scallops and Lobsters**

*Coppola, Lawton (DFO-SABS) and Hughes Clarke DFO and NBAF funding*

Building on our work in coastal habitat surveys in the vicinity of aquaculture sites, two research projects were undertaken off Grand Manan. The first in Long Island Sound examines the interaction between lobster habitat and aquaculture. The second in Duck Island Sound examines the potential interaction between an existing inshore scallop fishery and proposed new aquaculture site developments.

The surveys were conducted using the C.S.L. Heron EM3000 system allow us to map 300 kHz acoustic

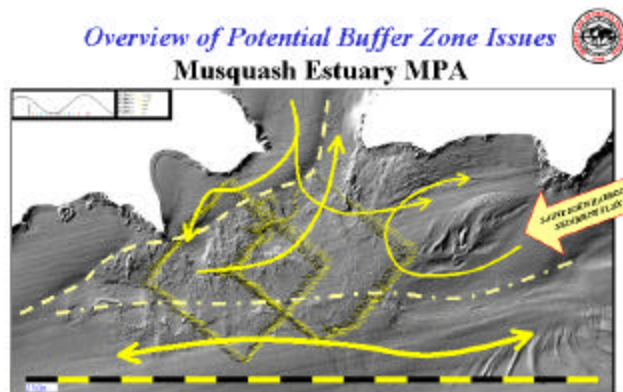
backscatter as a tool for delineation of surficial sediments.

### **Coastal Boundary Delineation using current patterns– the Musquash Proposed Marine Protected Area**

*Byrne, Nichols, Ng'ang'a, Sutherland and Cockburn  
GEIODE HSS # 55*

In order to better understand the technological implication of modern submarine survey methods to boundaries, a case study was implemented as part of the proposed Marine Protected Area (MPA) in the Musquash Estuary. The Musquash Estuary MPA, has conflicting jurisdictional control from Federal, Provincial Municipal and Private stakeholders.

At the end of 2001, ADCP diamonds surveys were conducted over the Musquash outer boundary. This data, analyzed in 2002, was able for the first time to examine the reason for the presence of a sharp sediment boundary off the MPA mouth, allowing a greater understanding of the physical oceanographic processes at work



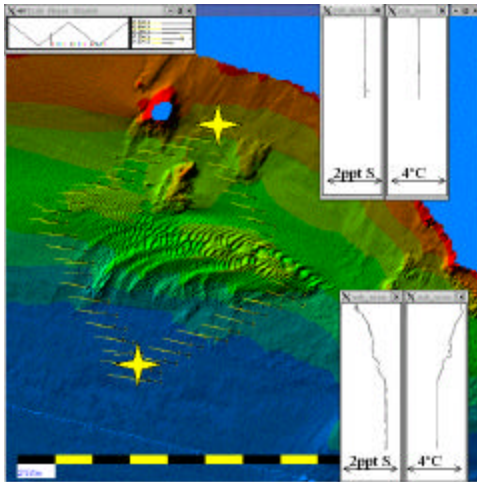
As part of this study, an offshore buffer zone was recognized, outside of which water did not exchange significantly with the estuary over a single tidal cycle. The seabed sediment boundary directly corresponds to a shear zone developed on the end of the ebb tide.

### **Precise Monitoring of Bedform Migration**

*Duffy, Parrott (GSC) and Hughes Clarke*

*GSC and NSERC funding.*

As part of the increased focus on precise resurvey capability, a test bed has been established over a highly dynamic sand wave field off Mispec Bay.



Building on the 2 years of GSC operations on the Mispec Bay sands wave field, an experiment was initiated over these mobile bedform fields where different motion sensors and RTK integrations would be tested at monthly intervals for the summer period of 2002. In all, 6 surveys were conducted at monthly intervals over the summer period.

In addition 3.5 kHz subbottom was deployed to examine the internal structure of the dune field and 2 ADCP tidal cycle diamonds were implemented to isolate the eddy development centred over the tear shaped body. Simultaneously

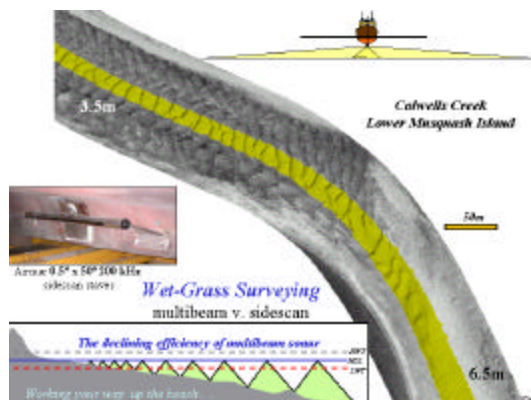
MVP-30 CTD profiles were conducted to examine the evolution of the oceanography over the tidal cycle allowing us to monitor the location of the Saint John River plume.

### **Software Development and Field Trials in Support of Keel-Mounted Sidescans.**

*Hughes Clarke, Crutchlow (CHS) CHS funding*

In 2002, sidescan staves were purchased by the CHS for all regions in preparation for implementation in shallow water single beam operations. Remaining barriers that needed to be solved included:

- ?? proper export of the Knudsen sidescan telegrams as XTF format.
- ?? Integration with Hypack logging.



Trials for the CHS were conducted in September 2002 in Grand Bay. OMG has developed new processing software for proper radiometric and geometric reduction of the

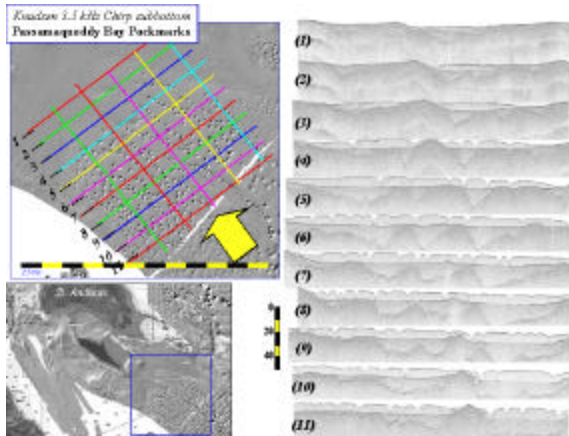
Knudsen binary format sidescan trace data.

The KSS was used for the first time in the upper Saint John river estuary in depths between 15 and 1m under the keel. It was found that 100m single side ranges are viable for depths > 5 m but shallower than this, thermocline effects in the lower estuary, and Lloyds mirror artifacts prevented operational use at range over 50m.

### ***Passamaquoddy Pock Mark Project.***

*Duxfield, Hughes Clarke, Wildish (DFO-SABS) and Parrot (GSC-A)  
Chair Funding*

In 1992, the first EM1000 survey performed in Canada took place in Passamaquoddy Bay. The dataset at the time was compromised by a number of sensor integration problems. Using newly developed analysis software, the data is being reprocessed as part of a project to better understand the evolution of these enigmatic seabed features.



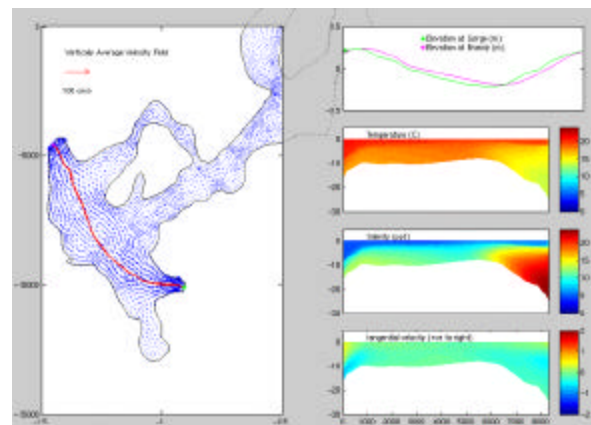
Beginning in may of 2002, the St. Andrews harbour and approaches survey was completed as an instrument test trial (see Hydrocamp results below). This repeated transit sections run by the Creed 10 years earlier providing higher resolution data on the linear trains of smaller pockmarks developed SE of Navy Island. This is a region where the highest density of pockmarks has been developed.

By extending the 1992 surveys into shallow water, for the first time the outcrops of the buried horizon that appears to nucleate the pockmarks was mapped. Clear sub-glacial landforms (eskers) were identified both exposed at the seabed and identified in the subsurface from dense 3.5 kHz profiling.

### ***Kennebecasis Project – Numerical Modeling of Sound Speed Variability***

*Haigh and Hughes Clarke  
CHS and Chair funding*

As a continuation of our study of the dynamics of the lower Saint John river estuary in support of sound speed variability, in 2002, the QUODDY 3-D numerical model was implemented using full baroclinic extensions. This allows us to realistically predict the estuarine circulation, and most particularly the





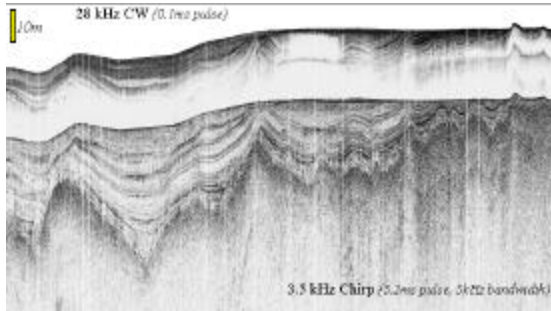
saline intrusions that are so critical to sound speed prediction.

Further multibeam mapping of the ebb flow erosion scar and sections of the upper Kennebecasis was completed. This allows us to improve the bathymetric model used as a framework for the numerical model.

### ***Seismic Stratigraphy of the Lower Saint John River Lakes***

*Hughes Clarke, Chair Funding*

As part of developing software for and testing out the performance of small hull-mounted chirped subbottom profilers, we have initiated a seismic stratigraphic program investigating the sedimentary history of the sediments in the lakes associated with the Lower Saint John River.



We use a standard 28 kHz source together with a single 3.5 kHz element. For lacustrine sediments we can achieve up to 15m penetration at 28 kHz and over 60m at 3.5 kHz.

The systems serve as a training tool for undergraduates exposing them to the planning and processing of a single-channel

seismic project.

Software tools to perform basic enhancement (first arrival detection, filtering, stacking) and to project sections into plane and make fence diagrams have been developed as an extension to the SwathEd package.

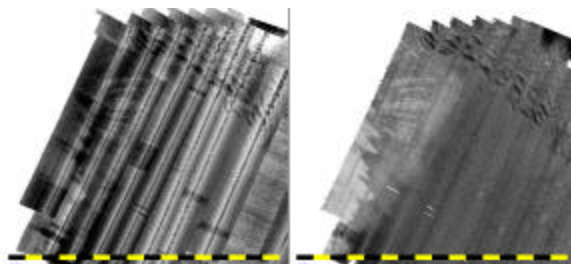
### ***Backscatter Processing and Registration from RESON 8101 Sonars from NOAA Rainier Launches***

*Beaudoin, Hughes Clarke and Gardner (USGS)*

*USGS Funding*

USGS continental shelf mapping programs over the past 7 years have employed multibeam sonars for both bathymetry and surficial backscatter measurements

In 2002, the RESON 8101 data reduction algorithms were implemented for Alaskan and New Hampshire survey data. The project has now been extended to include the 8125 sonars and the new snippet data formats. Adaptation of existing

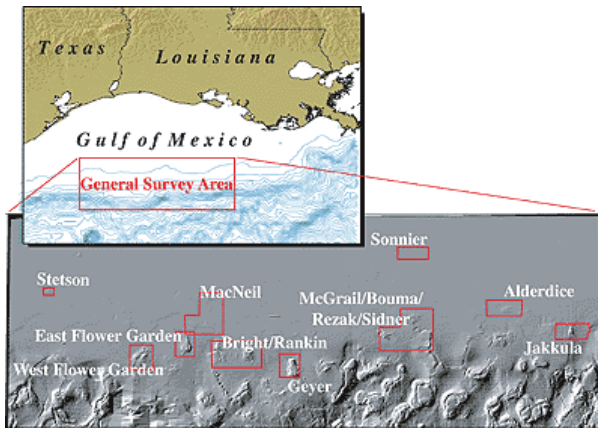


algorithms designed originally for Simrad beam trace data (a snippet concept) has been completed.

### ***Offshore mapping of West Florida Shelf – Support for EM1002 surveys***

*Hughes Clarke, Beaudoin, Cartwright, Duxfield, Coppola*  
*USGS Funding*

As part of a long standing collaborative research arrangement between the US Geological Survey and the OMG, the OMG provides planning advice, field calibration, processing tools and data analysis support for USGS continental shelf mapping programs.



In 2002, as part of MMS investigations in the Gulf of Mexico, the OMG provided field calibration and software support for two simultaneous surveys in the eastern and western gulf.

The Eastern Gulf surveys involved integration of an EM3000D and an EM1000 (RV Moana Wave). In the Western Gulf, EM1000 surveys were conducted from RV Ocean Surveyor under the direction of OMG graduate

students.

### ***Evaluation of the International Hydrographic Organization's Standards for***

#### ***Hydrographic Surveys***

*Monahan, Wells*

Standards for hydrographic surveys are issued by the International Hydrographic Organization to its Member States. These were primarily created for inshore, safety-of-navigation surveys, but do have some application to deeper water. The UN Guidelines for states claiming a Continental Shelf under the United Nations Convention on Law of the Sea (UNCLOS) require that claims include "a priori or a posteriori estimates of random and systematic errors" using the IHO standard.

We are investigating the magnitude of horizontal uncertainty in the location of boundary elements using data that meet the standard, comparing them to other standards, devising ways in which users of the data can be apprised of its uncertainty, and recommending additions to the IHO standard for use in deep water.

***Investigation of the role of Hydrography in Marine Boundary Delimitation****Monahan, Nichols, Hughes Clarke, Sutherland*

UNCLOS gives jurisdiction over portions of the sea floor to a Coastal State; it does not, and cannot, regulate how the area is further subdivided within the territory of the Coastal State. How marine boundaries are recorded and shown within a Coastal State's new oceanic regions is of rising concern to hydrography.

We have investigated the role of standard navigation charts in portraying boundaries and designed a data base of marine boundaries. Applied research has included investigating the relationship between boundaries as defined by regulation and natural boundaries on the seafloor and in the water column for the Musquash Marine Protected Area.

***Open Access Learning at Sea.****Wells, Richer (College of Extended Learning), Dare, Santos, Monahan*

New communications technologies allow formal education to be delivered to students remotely. Few are as remote today as hydrographers on extended offshore surveys are, with very limited access to telephone and Internet. They require self-contained, comprehensive, course material that has most of the benefits of an on-line course without the need for connectivity.

Subject Matter Experts from GGE have teamed with technical specialists from the UNB College of Extended Learning, to produce design standards and a macro-design. A module "Horizontal and Vertical Datums and their Transformations" is at an advanced stage of completion.

***Hydrographic elements of delineating a juridical Continental Shelf under Article 76 of the United Nations Convention on the Law of the Sea****Monahan, Wells*

This project has analyzed UNCLOS Article 76 and the Guidelines produced by the Commission on the Limits of the Continental Shelf (CLCS) and determined which elements of the formula can be deemed hydrographic. It has described the hydrographic measurements necessary and determined the uncertainty achievable and desirable.

***Morphology of the sea floor at depths critical to defining a juridical Continental Shelf****Monahan, van de Poll*

The Outer Limit to a Juridical Continental Shelf is measured from a feature called the Foot of the Slope and may be constrained by measurements based on the 2500m isobath.

Both lie on the Continental Slope, a geomorphic province characterized by very low gradients. Small uncertainties in measuring to a surface of low gradient can translate into large horizontal uncertainty in the location of the feature and the boundary based on it. By studying the gross morphology of Continental Slopes we hope to establish some uncertainty estimates for the Outer Limit.

Measurements of seafloor gradient at 2500m for the entire ocean have shown that half the world's 2500 m contour lies on sea floor with gradients less than 2.09 degrees. Contours which meet IHO specifications over this gradient could have a horizontal uncertainty of almost 3500m.

### ***Capacity Development in Coastal Communities to link Science and Local Knowledge***

*Nichols, Sutherland, Cockburn, and Ng'ang'a, Fisheries and Oceans Canada/SSHRC:*

This project is part of "Linking Science and Local Knowledge", one of three funded nodes of the Ocean Management Research Network (OMRN). Based out of the Coastal Studies Group at Simon Fraser University, the project has three areas of focus: community capacity building, marine conservation, and economic diversification. OMG's involvement includes: capacity building in mapping, positioning, and coastal boundary determination; governance models for coastal management and marine protected areas; and development of a model marine property rights information system. <http://www.sfu.ca/coastalstudies/linking/about.htm>



## Education and Training Options

### **Multibeam Courses**

The international training course organized by the Ocean Mapping Group gave 4 more courses in the 2002 year in:

Burlington Ontario, Canada	in May
Sydney, NSW, Australia	in August
Lafayette, LA, USA,	in October and
Gillileje, Denmark	in November.

The course student body is typically 40 to 50 students per course in order to meet the continued growth in demand for this course. Latest result of research within the Ocean Mapping Group are used to update the course material to ensure that it keeps up with the latest trends in swath sonar surveying. We rely heavily on the benevolence of agencies for whom we conduct trials of their operational systems. As long as no restrictions are placed on these data, they are used as type examples in the course material.

### **GGE Marine Survey courses :**

In order to ensure that the student body within the GGE dept. benefits from the research activities of the Ocean Mapping Group, a series of courses are provided that pass on both first principles and latest research results to the undergraduate and graduate student body.

These courses include:

#### **UNDERGRADUATE:**

##### **GGE3353 Imaging and Mapping II, Acoustic Imaging Systems**

**Hughes Clarke**

Theory of, and operational issues in acoustic marine surveying.

[http://www.omg.unb.ca/GGE/SE\\_3353.html](http://www.omg.unb.ca/GGE/SE_3353.html)

##### **GGE4042 Kinematic Positioning**

**Santos and Wells**

Marine, Terrestrial and Airborne dynamic navigational theory and methods.

##### **GGE5072 Hydrographic Data Management**

**Wells**

Principles and issues of data management in marine applications

### GGE5013 Tides and Water Levels

#### Wells

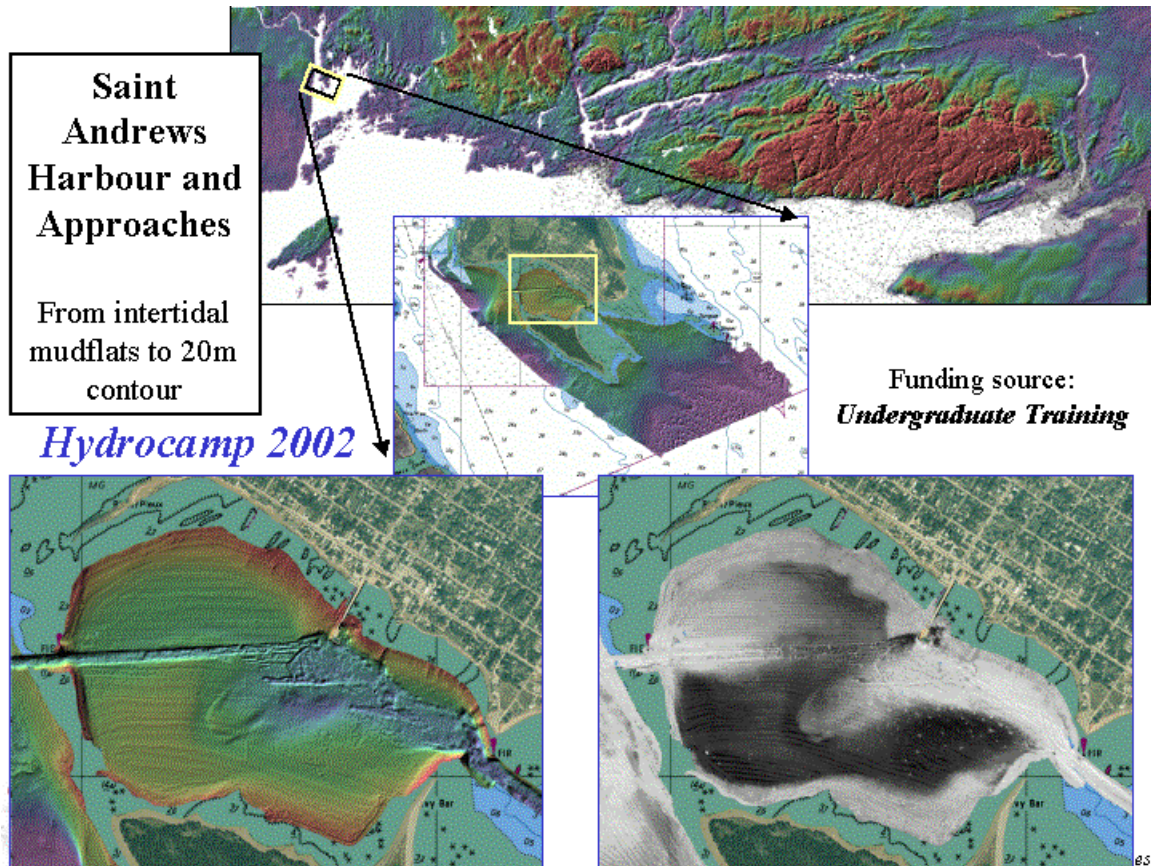
Theory of tides and the reduction of sounding data to a stable vertical datum.

### GGE5083 Hydrographic Field Operations

#### Hughes Clarke

Planning, execution and data processing for a coastal marine field program

[http://www.omg.unb.ca/GGE/SE\\_5083.html](http://www.omg.unb.ca/GGE/SE_5083.html)



### GRADUATE:

### GGE6023 Multibeam Sonar

#### Hughes Clarke

Research Topics on Swath Sonar Systems.

[http://www.omg.unb.ca/GGE/SE\\_6023.html](http://www.omg.unb.ca/GGE/SE_6023.html)

### GGE6022 Special Topics in Ocean Mapping

#### Hughes Clarke

Research Topics in Ocean Mapping (Sediment Characterisation, Coastal Physical Oceanographic Phenomena, Marine Sedimentation, Environmental Monitoring).

GGE6021 Special Studies in Hydrography

**Wells**

Research Topics in Aspects of Hydrography

GGE5543-6543 Marine Policy, Law and Administration

Nichols

## Funding and Financial Commitments

Funding for the Chair in Ocean Mapping comes from two sources:

- ?? Sponsorship funds
- ?? Other research organisations

To maintain the Chair technical and administrative staffing at the current levels and to support the necessary computing facilities and travel to international meetings, an annual budget of ~C\$165k is required. To date, this level of support continues to be met or exceeded. The continuation of this level of support, however, will require ongoing commitment from the sponsors of the Chair. That in turn requires that the Chair can show continued relevance and usefulness toward the marine survey community.

## Sponsors

The Chair in Ocean Mapping at UNB can only survive as long as there is external funding. The Chair, originally set up as an NSERC Industrial Research Chair, originally survived by the combination of Industrial Sponsorship together with matching funds from NSERC. In 1996, on the renewal of the Chair the matching funds were withdrawn as planned. From that point on the Chair has been fully dependent on external funding (from Canadian or International, Commercial or Government organisations). At this point there are 8 sponsors.

### Current Sponsoring organisations

- |                                    |        |
|------------------------------------|--------|
| 1. Canadian Hydrographic Service   | 1991 - |
| 2. CARIS                           | 1991 - |
| 3. Simrad Mesotech                 | 1995 - |
| 4. U.S. Geological Survey          | 1996 - |
| 5. U.S. Naval Research Laboratory  | 1996 - |
| 6. U.S. Naval Oceanographic Office | 1997 - |
| 7. State University of New York    | 1998 - |
| 8. University of New Hampshire     | 2000 - |

Active sponsors have access to all current research results developed with Chair funding (at a source code level) and are free to call upon the chair personnel to provide informal advice on operational survey issues. In addition, the chair actively seeks advice on new relevant research directions. Graduate student research topics are driven by Chair needs and access to operational survey data for research purposes is routinely derived from sponsor-owned or chartered vessels and equipment. The continued success of the chair is thus clearly critically reliant on the continued relevance and leadership of Chair research. As this document outlines, new focused research directions are actively being pursued based on current sponsorship suggestions.

## **Other Sources of Funding (Current)**

Whilst the sponsorship funding is the prime source of support for the core Chair research program, all the researchers working with the Chair have been successful in attracting funding from other research agencies. This funding allows us to complement Chair research, which is by design very focused on immediately relevant problems, with research into more long term and esoteric problems.

Projects names (details of which are included in the list of current research) and level of funding include:

### ***Acoustic imaging in support of salmonid mariculture site assessment and nautical charting surveys***

DFO Subvention Grant Program  
Hughes Clarke, C\$15,000

### ***Development and testing of improved field techniques and software for fine-scale monitoring of the seabed***

Geological Survey of Canada, Atlantic -23420-02-M308  
Hughes Clarke, C\$15,000

### ***EM1000 surveys in the Western Gulf of Mexico***

U.S. Geological Survey  
Hughes Clarke, US\$280,000

### ***Habitat Mapping of Grand Manan Coastal Waters***

DFO- St. Andrews  
Hughes Clarke, C\$12,000

### ***Swath Sonar Training and Field Instruction***

Kongsberg Simrad  
Hughes Clarke US\$8,000

### ***SynSwath – Educational Software for Swath Sonar Systems***

Royal Danish Administration of Navigation and Hydrography  
Hughes Clarke C\$7,500

***Extraction of backscatter information from US Government Contract Surveys***

**U.S. Geological Survey**

Hughes Clarke, C\$45,000 pa

***COSTA-CANADA , continental slope stability***

**NSERC Collaborative Research Grant,**

Hughes Clarke, sub contract - C\$31,000 pa .

***Precise Mapping and Monitoring of Seabed Change.***

**NSERC Research Grant**

Hughes Clarke C\$28,000 pa

***Optimal Integration of Geodetic Techniques for Positioning and Navigation.***

**NSERC Research Grant**

Santos C\$16,000 pa.

## Hardware Capabilities

### *Equipment to Support Field Research Programs*

**Trimble 5700** suite: base station, radio link and two rovers capable of 10Hz RTK

**Ashtech Z12** suite: base station, radio link and one rover capable of 1Hz RTK

**Trimble AG-132** combined GPS and Racal Landstar or Coastguard beacon receiver.

**Knudsen 320B/P** 2 x 200 kHz **keel-mounted sidescan** staves.

**Knudsen 320M 28 kHz and 3.5 kHz** (320M on loan from Knudsen Engineering and 3.5 kHz transducer on loan from GSC-A)

**Datasonics CAP6000** Chirp subbottom profiler (on loan from the GSC)

**RDI 600 kHz Monitor ADCP** with Winriver software.

**Sutron Model 8200 data logger** (on loan from CHS)

for tidal measurements interfaced to:

- pressure gauge and
- AMASS encoder

**Simrad EM3000S** 300 kHz multibeam sonar system

**Seatex MRU-6** Orientation and heading sensor

**Ocean Sensors OS500-APV** – autonomous winching CTD.

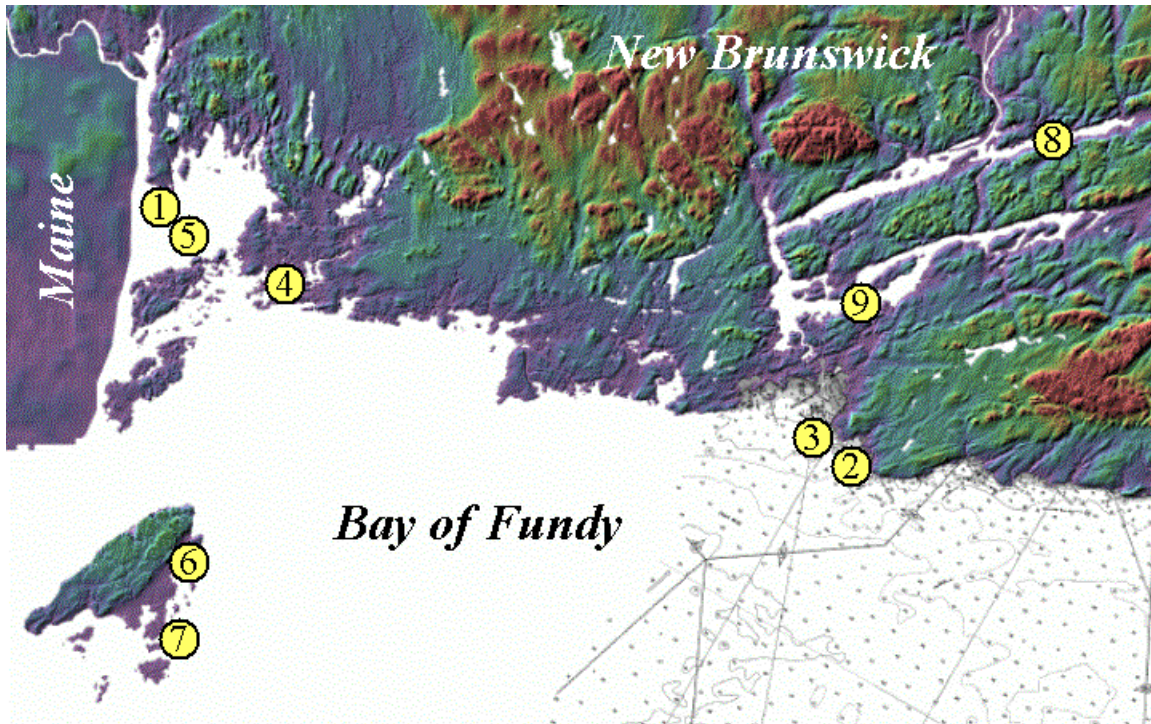
**Applied Microsystems Limited SVP16** Temp., sound speed and depth logger.

**Brooke MVP-30** towbody, overboarding Sheave with AML Smart CTD (25 Hz) integrated with a Valeport SK172 winch.

### *Heron Field Operations*

In April 2002, the CSL Heron became fully operational. She was trucked to Saint John Coastguard base for launching. For the 2002 field season she was based at the Saint John Marina in Grand Bay, just above the Reversing Falls.





The following field programs were undertaken in 2002 using the Heron:

<b>Location</b>	<b>Funding</b>
1. Saint Andrews Harbour Survey	Undergraduate Training
2. Mispic Bay Dunefield Investigations	NSERC
3. Blacks Point Offshore Disposal Site Monitoring	GSC-Atlantic
4. Limekiln Bay Aquaculture site imaging	DFO Subvention
5. Passamaquoddy Bay, Pock Marks	Chair
6. Long Island Sound, Grand Manan	DFO
7. Duck Island Sound, Grand Manan	DFO
8. Seismic Stratigraphy, Lower Saint John Lakes	NSERC
9. Kennebecasis Bay, Estuarine Oceanography	Chair

### ***Computing Hardware***

In order to conduct OMG research, a mixture of Unix and Windows platforms are maintained. For the core swath sonar data processing applications (SwathEd), the UNIX platforms are the prime tool. SwathEd is currently supported on SGI, DEC, Solaris or Linux. For historical reasons SGI is the most used hardware platform. SUN operability is maintained to support sponsors who use that hardware (SUNY, C&C) and DEC is supported for CHS operations.



To take advantage of the cheap PC hardware, Linux support was introduced in 2000. It is intended that Linux be the main operating system for SwathEd in the future. Recent purchases have been Linux hardware only.

**SGI-Irix 6.5**

3 – SGI Extremes	(clownfish, stereo and southern)
4 - SGI 02's	(solomon, cyclops, bliss and blacks)
1 – SGI Indy	(indian)

**Compaq/DEC**

1 DEC Alpha	(alpha)
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**Solaris**

1 – SUN Sparc20	(coral – EM3000)
1 – SUN Sparc 2	(atlantic)
1 –SUN Sparc 2	(hudson)

**Linux**

2 Dell Optiplex 400 MHz	(baffin, dipper)
4 Dell Optiplex 800 MHz	(heron1, heron2, stcroix, letang)
1 Dell Dimension 1 GHz	(bocabec)
1 Dell Dimension 1.6 GHz	(chamcook)
1 IBM laptop (A30)	(oakbay)

**Windows**

2 Dell Optiplex 300 MHz	(erie, huron)
2 Dell Optiplex 450 MHz	(gee, louise)
1 Dell Optiplex 600 MHz	(hydro1)
2 IBM laptops (A20, A21)	(chance, kennet)
1 IBM workstation (1.8 GHz)	(for fledermaus)

**Plotters**

HP 650  
HP 2500  
Lexmark 1200dpi  
Lexmark II 1200 dpi

**SCSI Disks (on SGI's and DEC's)**

1x 50 Gb, 3 x 36 Gb, 4 x 18 Gb, various 9's, 4's, and 2's.....  
(and now innumerable 20-100Gb IDE disks on the various PC's).

**Tapes Drives**

DLT  
Exabyte  
DAT

## Publications:

**2002**

### Journal Articles

1. Lastras, G., Canals, M., Hughes Clarke, J.E., Moreno, A., De Batist, M., Masson, D.G. and Cochonat, P., 2002, Seafloor imagery from the BIG'95 debris flow, western Mediterranean: **Geology**, v.30, no10., p.871-874.
2. Monahan, Dave and Rob van de Poll, 2002 Measured gradients of the seafloor at depths of 2500m and their possible influence on the outer limit of juridical Continental Shelves. **International Hydrographic Review**, V 3, no 3 (new series) , pp 72- 76.
3. Monahan, Dave and Dave E Wells, 2002. The use of the International Hydrographic Organization's "Standards for Hydrographic Surveys" as a measure of depth accuracy in Continental Shelf determinations. **International Hydrographic Review**, v3, no 1 (new series), pp 59-67.
4. Monahan, Dave , 2002. Variable errors and fixed boundaries: the role of deep echo-sounding in the United Nations Convention on Law of the Sea (UNCLOS). **The Hydrographic Journal**, no 105, July 2002, pp 11-16.
5. Urgules, R., Locat, J., Schmitt, T. and Hughes Clarke, J., 2002, The July 1996 flood deposit in the Saguenay Fjord, Quebec, Canada: Implications for sources of spatial and temporal backscatter variations: **Marine Geology**, v.184, p.41-60.
6. Wells, DE and Dave Monahan, 2002. IHO S44 Standards for Hydrographic Surveys and the variety of requirements for bathymetric data. **The Hydrographic Journal**, No 104, April 2002, pp 9-16.

### Conference Proceedings

1. Beaudoin, J., Hughes Clarke, J.E., van den Aamele, E. and Gardner, J., 2002: Geometric and radiometric correction of multibeam backscatter derived from Reson 8101 systems: **Canadian Hydrographic Conference Proceedings CDROM**.
2. Byrne, T., Hughes Clarke, J.E., Nichols, S. and M-I, Buzeta, 2002, The delineation of the seaward limits of a Marine Protected Area using non-terrestrial (submarine) boundaries – The Musquash MPA : **Canadian Hydrographic Conference Proceedings CDROM**.
3. Cartwright, D. and Hughes Clarke, J.E., 2002, Multibeam surveys of the Fraser River Delta, coping with an extreme refraction environment: **Canadian Hydrographic Conference Proceedings CDROM**.
4. Hughes Clarke, J.E., Wildish, D. and Duxfield, A., 2002, Acoustic Imaging of Salmonid Mariculture Sites: **Canadian Hydrographic Conference Proceedings CDROM**.
5. Monahan, Dave and Sue Nichols, 2002. Hydrography's Role in Marine Boundary Delimitation. **Proceedings Canadian Hydrographic Conference 2002, Toronto Un-paginated CD-ROM**
6. Monahan, Dave , Dave E Wells and Rob Hare, 2002. Providing Clients with Usable Uncertainty Indices. **Proceedings Canadian Hydrographic Conference 2002, Toronto Un-paginated CD-ROM**.
7. McLaughlin, F, C Gobeil, D Monahan and M Chadwick, eds, 2002. Proceedings of the First Annual National Science Workshop, Department of Fisheries and Oceans. **Canadian Technical Report of Fisheries and Aquatic Sciences #2403, 191pp**.
8. Monahan, Dave 2002. Altimetry and the Law of the Sea. Workshop on Global Bathymetry for Oceanography, Geophysics, and Climatology, Scripps Institution of Oceanography, October, 2002

9. Monahan, Dave and Sue Nichols, 2002. Hydrography's Role in Marine Boundary Delimitation. **Hydro International** v6, n9, p7-9.
10. Wells, Dave , Joss Richer, Kyle Purves, Ian Allen, Peter Dare, Denis Wiesenburg, Dave Dodd, Stephan Howden, Semme Dijkstra, Lee Alexander, Dave Monahan, Andre Godin, Jimmy Chance, 2002. Open Access Learning at Sea. **Proceedings Canadian Hydrographic Conference 2002**, Toronto Un-paginated CD-ROM.

## Technical Reports

1. Beaudoin J.D., Gardner J.V., Hughes Clarke J.E., 2002, RV Ocean Surveyor Cruise O1-02-Gm, Bathymetry and Acoustic Backscatter of Selected Areas of the Outer Continental Shelf, Northwestern Gulf of Mexico, June 8, through June 28, 2002, Iberia, LA to Iberia, LA: **USGS Open-File Report** OF02-410.
2. Monahan, D, 2002. Claiming a juridical Continental Shelf under Article 76 of the United Nations Convention on the Law of the Sea (UNCLOS). Department of Geodesy and Geomatics Engineering **GGE Technical Report no 217**, University of New Brunswick, Fredericton, New Brunswick, Canada, 132pp.
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