



FINAL FIELD REPORT
CCGS VECTOR
North Coast Surveys
23 June – 14 July, 2008



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HIC: G. Schlagintweit, CLS
Department of Fisheries and Oceans, Science Branch
Canadian Hydrographic Service, Pacific Region
Institute of Ocean Sciences, Sidney, BC
9860 West Saanich Road V8L 4B2



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TABLE OF CONTENTS

INTRODUCTION	4
LIST OF CHS STAFF (SURVEY OPERATIONS).....	5
PLANNING AND PREPARATIONS.....	6
LIST OF EQUIPMENT	7
CHRONOLOGY OF NOTEWORTHY EVENTS.....	8
PROJECTS	11
PROJECT SUMMARY AND STATISTICS	14
VERTICAL CONTROL UPGRADING	15
HORIZONTAL CONTROL UPGRADING	15
VECTOR TIME UTILIZATION RECORD	16
RECOMMENDATIONS.....	17
CONCLUSIONS.....	17



Photo courtesy David Thornhill

Bosun Henderson (Captain Canada) wins 'Best Dressed' contest on Canada Day

INTRODUCTION

The main objective for the bathymetric multibeam surveys described in this report was to support new charting initiatives. Areas of particular interest included; 1) the chosen navigation routes for the eventual bulk shipment of crude oil and aggregate out of Kitimat (Gateway Project), and 2) both sides of the Canada – US boundary in Pearse and Portland Canals, areas last surveyed in 1888. A large aggregate mine near the head of Portland Canal¹ is in the final construction stages, with plans to transport the aggregate to California via bulk carriers as early as November, 2008.

This mission had the following secondary objectives, to be accomplished on an opportunity basis:

1. To collect a continuous water level record at a secondary tidal reference port in support of the Gateway charting initiative. Although there are numerous secondary tidal reference stations in the general ‘Gateway’ vicinity², most of these stations were established approximately 80 – 100 years ago, and often water level records were restricted to less than 30 days – which were subsequently used to compute a limited suite of tidal constituents for the station. A continuous record of 60+ days would provide for the ability to resolve considerably more tidal constituents for the station, thereby enhancing the CHS’ ability to predict the tides for the station’s immediate vicinity.
2. To collect precise GPS observations at vertical reference benchmarks in order to establish the geoid – ellipsoid separation. A better understanding of the area undulation will support the eventual migration towards an ellipsoid–based reference datum for nautical charts.
3. To collect precise GPS observations at pre-determined horizontal control monuments. Stations chosen are found to have high positional standard deviations when multiple survey control networks were consolidated by least-squares adjustment.

¹ Aggregate mine located at Maple Bay (Canada), latitude: 55-25-20, longitude: 130-00-46.

² Gateway vicinity: Northern BC coast, between Prince Rupert and Bella Bella.

LIST OF CHS STAFF (SURVEY OPERATIONS)

Staff	Dates
Tracey Prentice	June 23 – July 14
George Schlagintweit	June 23 – July 14
Rosanna Sheppard	June 23 – July 14
Alan Thomson	June 23 – July 7
David Thornhill	June 23 – July 14
Ron Woolley	June 23 – July 14
Gordon Worthing	July 7 – July 14
<i>And of course, the Officers and Crew of CCGS Vector (White Crew)</i>	



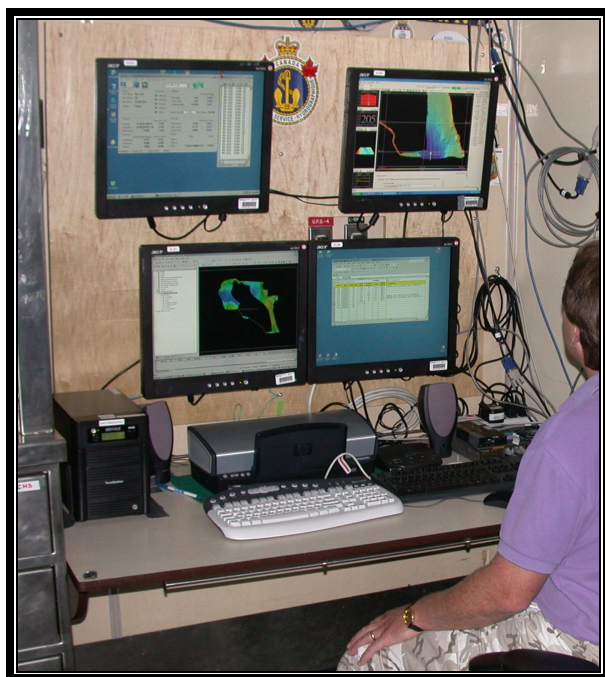
Photo courtesy Mike Ludwig

Left to Right: G. Schlagintweit, D. Thornhill, A. Thomson, R. Woolley, T. Prentice, G. Worthing, and R. Sheppard.

PLANNING AND PREPARATIONS

During an early meeting with staff from Navigational Products and Services Division, it was noted that it would be desirable if MBES data could be collected in Pearse and Portland Canals. This work would support CHS ENC production commitments made to the US-Canada Hydrographic Commission. A US Clearance Request was submitted to the CCG Regional Operations Centre, along with a Cruise Plan. Four days prior to the departure date, the Manager of Data Acquisition and Technical Support received formal notification from the CCG Regional Operations Centre that the US Clearance Request had been approved.

With some exceptions including the field survey described in this report, the 2008 MBES survey program with *Vector* involved numerous joint initiatives with disparate science groups. The premise was for a hydrographer to accompany an alternate DFO Science mission, and collect MBES data on an opportunity basis. Because past MBES surveys with *Vector* involved time and space consuming installations of the acquisition / processing stations in *Vector*'s lab, an alternate approach was sought to accommodate the new, 'piggy-back' modus operandum of conducting these surveys. To the credit of CHS staff Ernest Sargent and Gordon Worthing, a dedicated MBES control panel was designed and constructed for a small area in the lab.



Dedicated MBES control panel

This panel is designed to remain in the lab on a semi-permanent basis. It will enable hydrographers to mobilize for surveys with minimal extra equipment and effort. As the north coast surveys described in this report were fully funded by the CHS, two additional data processing stations were added to the lab to accommodate the CHS contingent.

Once the scheduling for the field program was finalized and Field Project Instructions were issued, preparations for the survey were relatively straightforward. New staff were equipped

with safety equipment, and those that were due were re-certified with basic first-aid. An external hard-drive was loaded with;

- Pacific Region’s BASE-surface inventory,
- an updated shape file that contained a snapshot of CHSDIR’s G-Ring inventory with associated metadata,
- a shape file containing the proposed chart limits for the Gateway charting initiative,
- a copy of all relevant QMS³ documentation (from ISOShare), and
- a copy of all relevant survey software, including *TCWL Tools* for creating tide predictions.

The above files represented 30 gigabytes of memory.

Although the general area to survey was well defined, by having a complete inventory of BASE-surfaces on board, site planning could remain flexible in order to accommodate unforeseen circumstances.

LIST OF EQUIPMENT

Equipment	Details
Multibeam	Kongsberg EM1002A
	Frequency: 95 kHz
	Swath angle: 120° (111 beams)
	Fore / aft beam width: 2.4°
MBES Processing software	HIPS/SIPS CARIS (Ver.6.1) SP1
Surface Sound Speed Sensor	AML Smart SV&T
Sound Speed Profiler	1 AML SVP Plus
	1 Brooke Ocean MVP30
Motion Sensor / MBES GPS	Applanix POSMV (Ver.4)
	Trimble GPS
Auxiliary GPS	NovAtel RT-20
Differential GPS Corrections	Primary: CDGPS service
	Secondary: CCG radio beacons

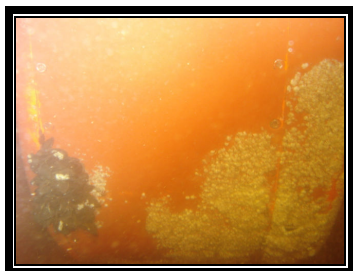
³ QMS: Quality Management System

CHRONOLOGY OF NOTEWORTHY EVENTS

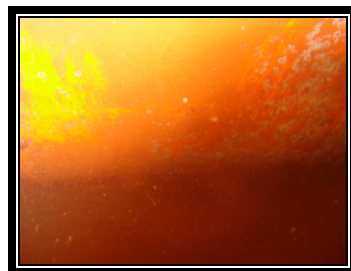
- June 23** *Vector* was away from IOS jetty at 15:30. At 16:00, *Vector* was dispatched on a SAR call. Back underway at 17:30.
- June 24** After picking up our 2nd cook in Port McNeill, we continued north. Queen Charlotte Strait was relatively calm and a considerable amount of time and fuel were saved by taking the unsheltered route directly to Laredo Sound.
- June 25** Sounding of the Caamaño Sound (2008Caamano_Sound) area commenced at 07:00. With the assistance of Al Thomson, Tracey Sheppard and Mike Petrie (*Vector* crew), Ron Woolley installed a CF Bubbler gauge in Barnard Harbour in the afternoon.
- June 26** Sounding operations continued in Caamaño Sound, despite the following hindrances that compromised productivity:
1. The outer beams (35 – 60) of the MBES became ‘flakey’, and beam outages became more frequent over time. Floating bunches of bull kelp were abundant in the area, and it was suspected that the transducer’s protective ‘cow catcher’ could be fouled with kelp, thus causing MBES transmit / receive interference. In an attempt to resolve the problem, *Vector* was put hard astern with the hope that any entangled kelp might be dislodged. Although no kelp was seen surfacing as a result, the problem did appear to be temporarily resolved.
 2. The AUTO option within SIS’ *Angular Coverage Mode* was found to be unreliable, with the EM1002’s outer beams disappearing for no apparent reason. This problem manifested itself suddenly, unlike the gradual degradation of beam coverage as described previously. This problem appeared to resolve itself when MANUAL mode was selected, and having the operator toggle from SHALLOW to MEDIUM when depths exceeded approximately 150m.
 3. The helmsman’s display froze-up due to a suspected glitch in the computer network and this problem could only be resolved by shutting down the entire MBES in the lab and re-booting all systems from scratch.
- June 28** Sounding in Caamaño Sound continued. For the first time since we arrived in the survey area we saw the coastal mountains and even experienced a brief hint of sunshine.
- June 29** The survey of Caamaño Sound was completed at 15:00 and Beauchemin Channel commenced shortly thereafter. The plan was to expand on this project – weather permitting – until July 6th.
- June 30** *Vector* was surveying the northerly portion of Beauchemin Channel all day. Fortunately, the Caamaño Sound project was an excellent MBES training ground for the hydrographers and crew - many of whom had no past

experience with MBES surveying. Although it is well known that the west coast of Aristazabal Island is one of the most poorly charted areas on the BC coast, this fact is only truly appreciated when collecting MBES data in such an area. Many features on charts 3724, 3726, and 3737 were found to be out of position by as much as 150 metres and it was not uncommon to observe depths to be half (or twice) that of what is charted.

- July 1** Canada Day could never be overlooked thanks to a complete *Vector* makeover courtesy of David Thornhill. MBES operations continued in Beauchemin Channel. Nine potential Notices to Mariners (NTM) were emailed to the CHS Navigational Information Officer (NIO) as a result of work done thus far in the area.
- July 2** Work in Beauchemin Channel continued on an uncharacteristically flat ocean. Twelve more potential NTMs were emailed to the NIO.
- July 3** The west coast of Aristazabal Island continued to experience calm seas. Four more uncharted shoals were found overnight and emailed to the NIO in the morning.
- July 4** The survey of Beauchemin Channel was terminated at 08:00 in order to retire to more sheltered waters due to an approaching gale. Five more uncharted shoals were emailed to the office. *Vector* commenced surveying the sheltered waters of Ursula Channel at noon.
- July 5** Controlling the P/S beam angles and vessel speed were measures taken to ensure the channel's thalweg (as much as 570m) and steep slopes were adequately ensonified. Off-duty personnel enjoyed a dip in the Bishop Bay hot springs while *Vector* collected MBES data in the general vicinity.
- July 6** The Ursula Channel project was completed at 08:30. *Vector* then steamed to Prince Rupert and was tied up at the Seal Cove Coast Guard Base at 16:30.
- July 7** In the morning, Al Thompson flew out of Prince Rupert on the plane Gordon Worthing arrived on. Per arrangements, professional divers (Adam's Diving) inspected the cow-catcher for entangled kelp. Only a few strands of kelp were found, however, they did observe barnacles and muscles growing on the face of the EM1002 transducer, which were subsequently scrubbed off.



Transducer before



Transducer after

Vector then steamed over to the Cow Bay Fuel dock to take on fuel and change the oil of the main engine. Away from the dock en route the survey grounds at 17:00.

July 8 The survey of Portland Canal (2008Portland_Canal) commenced at 00:00. The backscatter information confirmed the existence of sponge colonies near the south-westerly limits of this project. Three uncharted shoals – ranging in depths from 18.2 to 23.3m - were found in what is charted to be in approximately 40 fathoms (73m) of water.

July 11 The Portland Canal survey was regrettably terminated at 15:00, in order to initiate the long journey south. One uncharted shoal with a least depth of 26.3m was located in what is charted to be 80 fathoms (146m) of water, approximately 450m from the shore. To celebrate the end of another outstanding project, *Vector's* galley staff out-did themselves once again, by putting on an incredible BBQ (as only the Coast Guard know how) on the aft deck.

July 12 A brief stop was made by Barnard Harbour to download tidal records and make water level observations. With a few hours to spare due to the slack tide required for transiting through Seymour Narrows, the rumour of a historic First Nations meeting site along the shore of Laredo Sound was investigated and confirmed.



Photo courtesy David Thornhill

Overgrown Traditional Meeting Place of the First Nations

July 13 Once again, Queen Charlotte Sound was flat calm and *Vector* was able to take the more direct route from Laredo Sound to Queen Charlotte Strait. After dinner, a brief detour was made to recover an oceanographic buoy that was found on the shore of Cortes Island.



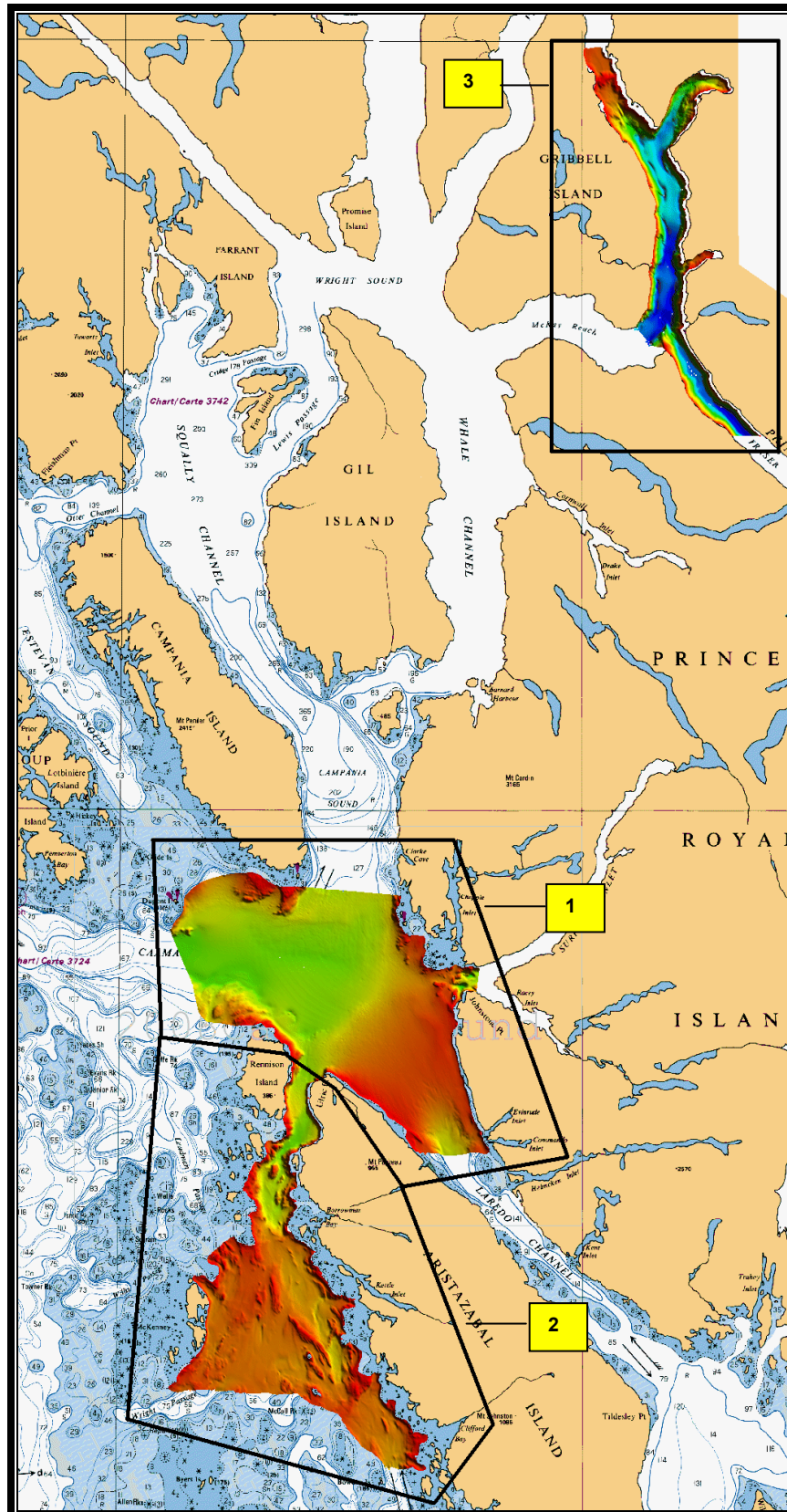
Photo courtesy David Thornhill

Zodiac 640 being deployed to recover an oceanographic buoy

July 14 *Vector* was alongside the Pacific Biological Station wharf in Nanaimo at 07:00.

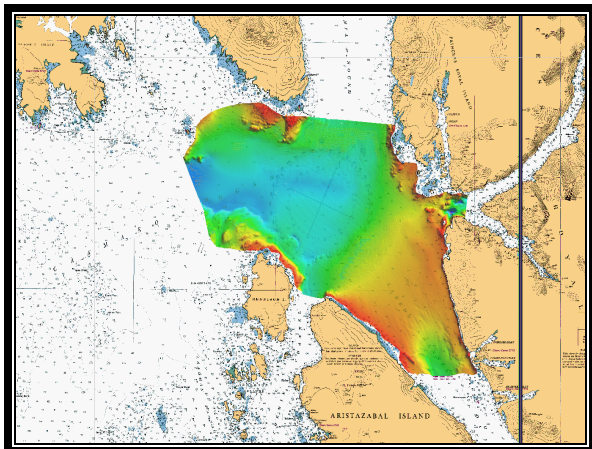
PROJECTS

#	Project	Primary Purpose of Survey
1	2008Caamano_Sound	Multibeam coverage extension for nautical charting (Gateway Project)
2	2008Beauchemin_Channel	Modernizing hydrographic coverage for nautical charting
3	2008Ursula_Channel	Multibeam coverage extension for nautical charting (Gateway Project)
4	2008Portland_Canal	Modernizing hydrographic coverage for transboundary ENC production



General Area Sketch – 1st Three Projects

Project #1 – 2008Caamano_Sound



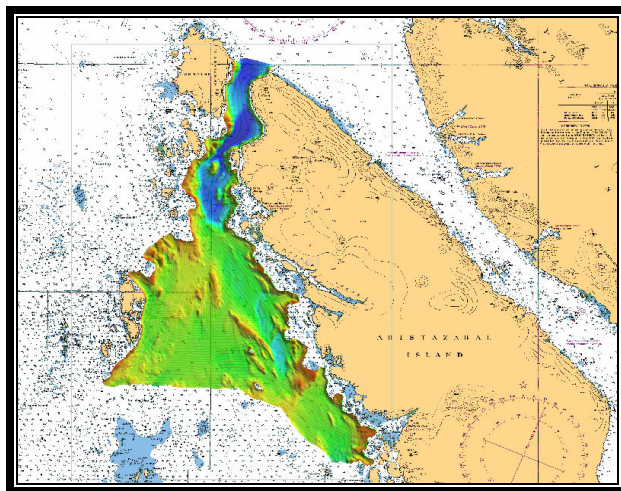
Caamaño Sound is in the south-west portion of the new charting initiative for the Gateway Project. This survey connected the following five MBES projects together;

1. 2006CaamanoTankerRoute from the west,
2. 2007GillenHarbour from the northwest,
3. 2006EstevanSouth from the northwest,
4. 2007SquallyChannel from the north, and
5. 2005SurfInlet to the east.

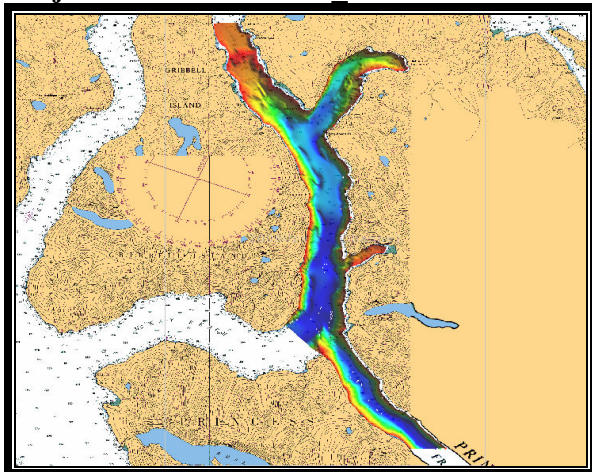
This survey extends the continuous multibeam coverage from Prince Rupert an additional 27Km to the south. The southerly limits of New Chart 3982 (in production) determined the southerly boundary of this project.

Project #2 – 2008Beauchemin_Channel

The west coast of Aristazabal Island is presently one of the most poorly charted areas on the BC Coast. This area was last surveyed between 1922 and 1927, with no horizontal datum. Horizontal discrepancies of as much as 200m were observed, however the shift did not appear to be consistent, and some areas were actually found to be in the right place. Thirty (30) charting discrepancies – many of which were uncharted shoals – were reported as a result of this survey.



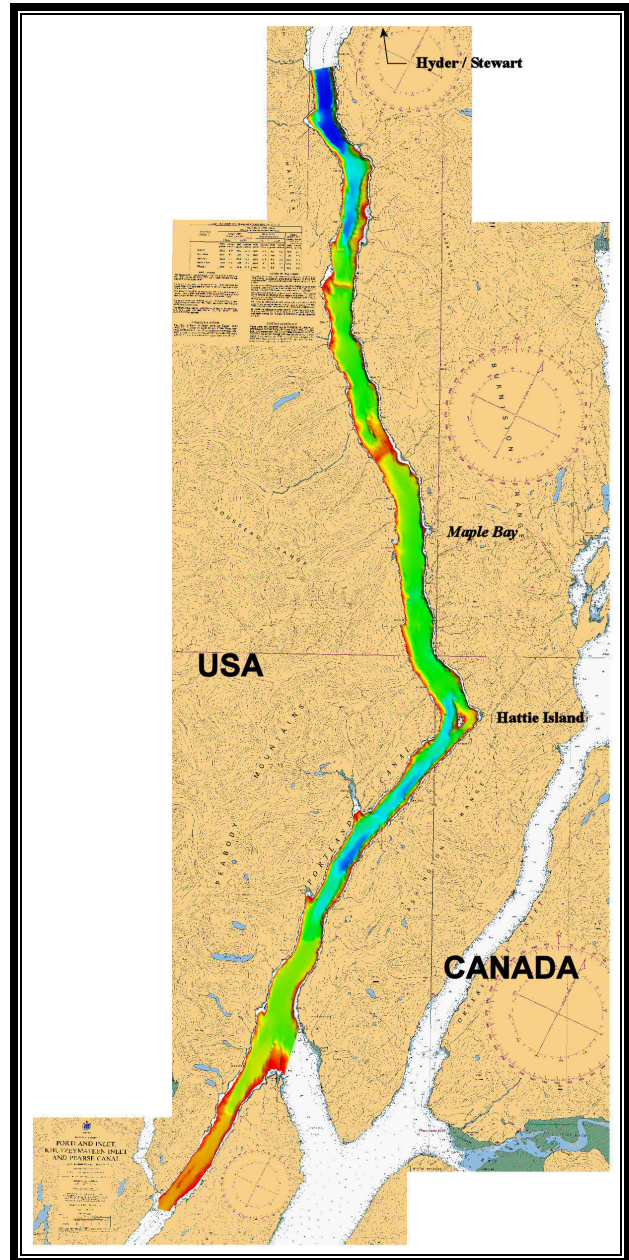
Project #3 – 2008Ursula_Channel



This area was surveyed in support of new charting for the Gateway initiative. It was also an ideal back-up area for when a gale was approaching the unsheltered waters of the previous project area. The southerly limits of New Chart 3977 (in production) determined the southerly boundary of this project. A prominent terminal moraine is located near the northerly limits of this survey.

Project #4 – 2008Portland_Canal

Split down the middle by the Canada-US boundary, Portland Canal was last surveyed in 1888. Backscatter information for this area suggests the existence of sponges in the south-westerly portion of the canal. Three uncharted shoals were found off the northerly tip of Pearse Island, and an additional one was found near the north-easterly limits of the project. Three moraines are easily identifiable within the canal, spanning from shore to shore. Much of the coastline was found to be adequately positioned, however there were a few areas where discrepancies existed; Hattie Island for one. Eighty-five percent of the canal (80Km) was surveyed as a result of this project. Only 14Km of the canal's bathymetry south of Stewart and Hyder remain to be surveyed with multibeam.



PROJECT SUMMARY AND STATISTICS

#	Project Name	CHSDir #	Sdg. Days	Area (km ²)
1	2008Caamano_Sound	5026853	4.3	266.0
2	2008Beauchemin_Channel	5026854	4.6	173.9
3	2008Ursula_Channel	5026855	1.9	78.8
4	2008Portland_Canal	5026856	3.6	201.3
Totals:			14.4	720.0

VERTICAL CONTROL UPGRADING

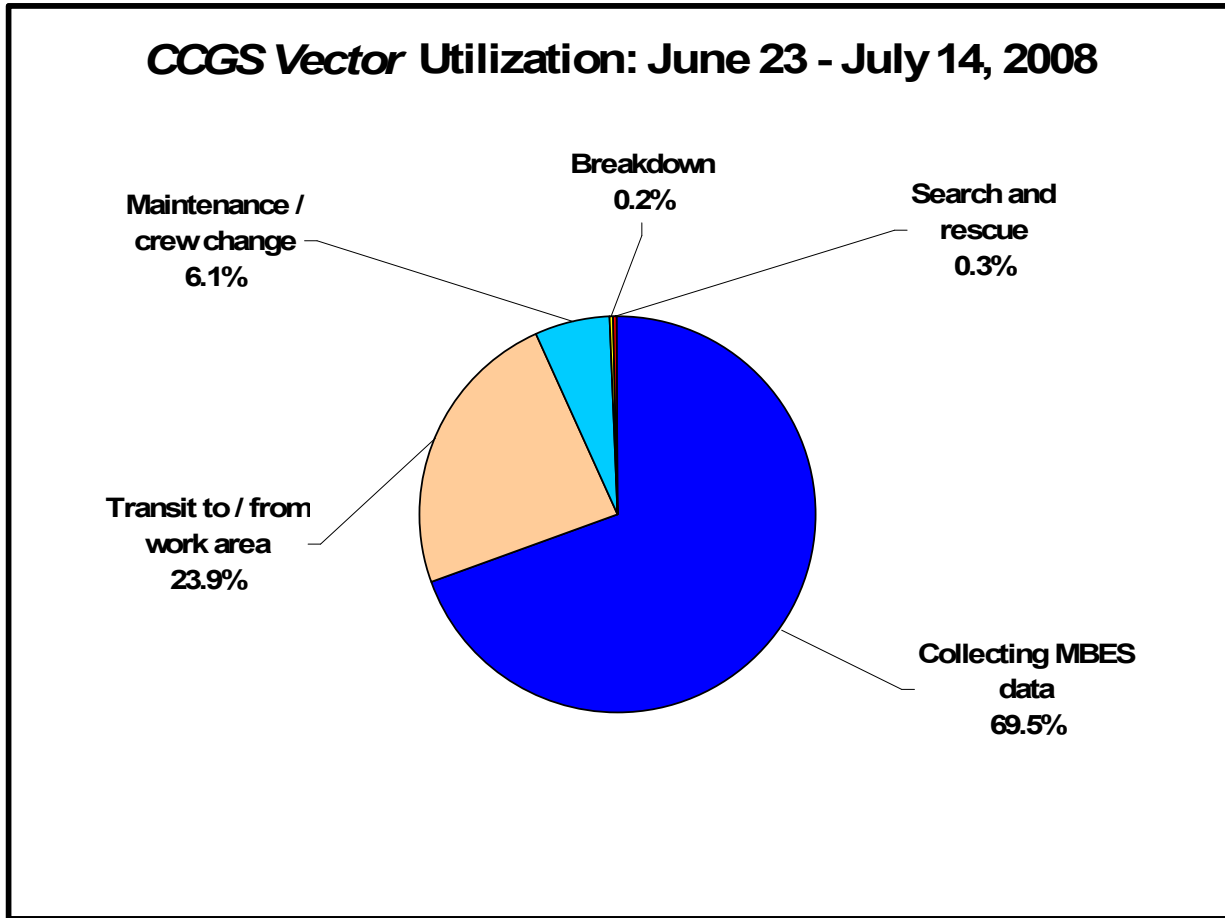
During the first three multibeam projects, the Zodiac 640 rigid hull inflatable was deployed almost every day. The goal was to find, describe and, conditions permitting, collect GPS data on the benchmarks. When possible, GPS data were logged on-site for two hours at a 1 second sample rate. These data were subsequently post-processed with NRCAN's online Precise Point Positioning utility back in the office.

Benchmark Location	Station #	BMs Recovered	Described	Observed with GPS	# of water level comparisons	Temp. Gauge Installed
Barnard Harbour	9115	1 of 1	✓	✓	8	✓
Smithers Island	9067	3 of 3	✓	✓	1	x
Hartley Bay	9130	3 of 3	✓	x	n/a	x
McKenney Island	9077	0 of 3	x	x	n/a	x
Whitmore Island	9075	3 of 3	✓	x	n/a	x
Moore Island	9078	3 of 3	✓	✓	1	x
Borrowman Bay	9080	1 of 1	✓	x	n/a	x
Gillen Harbour	9105	3 of 3	✓	x	n/a	x
Beauchemin Ch.	9082	0 of ?	x	x	n/a	x
Home Bay	9125	2 of 2	✓	✓	1	x

HORIZONTAL CONTROL UPGRADING

Horizontal control stations in the immediate vicinity of the first three projects did not require positional refinement. In Portland Canal, however, two International Boundary Commission stations (KEEN and LAW) at the head of the canal were flagged as 'weak stations' and therefore occupied with GPS.

VECTOR TIME UTILIZATION RECORD



RECOMMENDATIONS

1. **Project Administration:** The CCG US Clearance Request Form would be enhanced if it contained instructions for the recipient to contact the requestor directly regarding whether clearance is granted or not.
2. **MBES Installation:** Extend the Toshiba 1400 UPS to the Helmsman display PC. This PC would benefit from a single power source so network lines are free of voltage differences between equipment. This UPS operates at only 25% load and has proven itself to be very reliable.
3. **MBES Installation:** Install a network switch off of the second network port of the SIS PC such that the switch output would feed the helmsman's display PC directly. The objective here is to reduce the Helmsman display PC from freezing, an occurrence which is suspected due to '*traffic jams*' on the network.
4. **Chart Compilation:** When preparing for the compilation of source data for 1) the west coast of Aristazabal Island and 2) Pearse and Portland Canals, modern geo-referenced imagery of the coastline should be acquired.

CONCLUSIONS

The hydrographic surveys conducted during this *Vector* patrol were highly productive, thanks to the dedication and commitment of all involved. The following factors contributed towards the overall success of this mission:

1. **Relevance:** 34 potential Notices to Mariners were submitted as a result of the MBES data collected in remote areas that desperately require modern hydrographic data prior to any chart production activity.
2. **Productivity:** 720 square kilometres of seabed were surveyed, despite considerable shallow depth areas (25 – 50m) – much of which was in poorly charted areas that kept the officers on the bridge in an enhanced state of alert. In order to accomplish this coverage, *Vector* steamed a total of 3,320 nautical miles.
3. **Efficiency:** 70% of the duration of this mission was spent collecting multibeam data. This percentage takes into consideration the time it took to travel the entire length of the BC coast ... twice.
4. **Capacity Development:** Prior to this mission, the captain, the second mate, two quartermasters and two hydrographers had never been exposed to multibeam operations. By the end of the mission, everyone knew what was expected of them and they had stepped-up to the task at hand. Dave Thornhill and Ron Woolley are to be commended for their patience when providing hands-on training; data quality was never compromised in the process.



Photo courtesy Tracey Prentice

Ron Woolley collecting precise GPS data on benchmark in Barnard Harbour



Photo courtesy Tracey Prentice

Sunset in Beauchemin Channel

(1st Place entry in annual North Coast Vector Photo Contest - Winner: Tracey Prentice)