CRC for Coastal Zone Estuary and Waterway Management

In cooperation with

Centre for Marine Science and Technology
Curtin University of Technology

FIELD REPORT:
Toolkit Version

Report on the field survey in Bowling Green Bay, Townsville, Queensland, Aug 17 – 26, 2004
(Milestone Report CA5.01)

By:

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PROJECT CMST 369

REPORT 2005-21 (Toolkit Version)

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Introduction

This report summarises aspects of a field program undertaken by the Coastal CRC in 2004 off the Queensland coast in the central section of the Great Barrier Reef Marine Park, in the vicinity of the town of Townsville. It is the only CRC field program to include coverage of coral reef structures. The study area involved, in the Bowling Green Bay spans a section of the north-eastern coast of Queensland, between longitude 147°05'E and 147°40'E, around latitude 19° south. The following provides a brief overview of the objectives of the August 2004 survey, the work undertaken and field data that were collected. The study area is situated

Fieldwork was undertaken by six CRC Coastal Water Habitat Mapping project personnel from James Cook, and Curtin Universities The survey work was undertaken on the James Cook Uinversity research vessel *RV James Kirby*.

The field equipment used in the survey included the Reson 8125 swath system, DATASONIC sub-bottom profiler (SBP), SIMRAD EQ60 singlebeam system and an underwater video system (described in detail below).

Itinerary Summary

6 Aug	Consign freight, deliver to Marine Geophysical Laboratory, School of Mathematical & Physical Sciences, James Cook University, Townsville QLD 4811
6 Aug	Pick up SonarData sounder, freighted to Townsville.
17 Aug	Curtin team departed from Perth to Townsville.
17 Aug	Arrive in Townsville, mobilise all field gear onto vessel *RV James Kirby*, check in and stay overnight at Seagulls Motel in Townsville.
18-23 Aug	Survey in Bowling Green Bay.
24 Aug	Demobilise all field gear, consign freight to Brisbane, check in and stay at Seagulls Motel.
25/26 Aug	Curtin team returned to Perth.

Vessel

JCU research vessel *RV James Kirby* was used in the survey (Figure 1).

Figure 1. The *RV James Kirby* used in the survey.

Trip Objectives

1. To provide a multibeam dataset for comparison of utility and performance of RESON 8125 & 8101 in tropical waters.
2. To demonstrate the scale of operation of different tools to assess the coastal tropical seabed (multibeam, CHIRP, sediment samples, video, subject to availability).

Methods

Gear

All field gear deployed in the survey are listed in Table 1.

Table 1. List of field gear deployed in the survey.

Equipment
RESON 8125 multibeam sonar
SIMRAD EQ60 singlebeam sonar
DATASONIC CHIRP-660 sub-bottom profiler
FUGRO Starfix DGPS
UWA underwater video camera
Tide gauge
CTD/SVP

Mounting

Sonar heads

The head of the RESON 8125 multibeam sonar was mounted on the existing RESON 8101 side mounted pole in the starboard of *RV James Kirby*. The head of the SIMRAD EQ60 singlebeam sonar was also in the starboard of the vessel, 1 meter behind the head of the multibeam sonar (see Figure 2).

DMS05 motion sensor and Meridian Surveyor gyrocompass

As recommended, the DMS05 motion sensor was installed in the centre of gravity of the boat and the Meridian Surveyor gyrocompass parallel to the centre line of the vessel. The DMS05 motion sensor was fitted right in the centre of gravity of the boat *RV James Kirby*. Prior to the survey, the motion sensor was calibrated using the software provided while the vessel was anchored at the jetty.

FUGRO Starfix GPS

The GPS antenna was fitted in a selected location with a full 360 field of view at the roof of the wheelhouse.

RESON 8125 multibeam sonar

The connection for the multibeam system is shown in Figure 3. The normal multibeam mode was partly operated when the snapshot mode was in operation. In this case, the normal multibeam mode was used only for navigation purposes.

Patch Test

The patch test is an independent measurement required to allow for "data alignment". The objective is to derive four other offsets i.e. latency, roll, pitch and yaw. For the latency, data were collected with the vessel traveling in the same direction, but at two significantly different speeds over a well-defined feature on the same line. It is required that one speed be at least double the other. Two independent sets of data for the roll offset were collected on reciprocal headings from one to another on the same line over a flat seafloor. Using the same line as was used for the latency, two sets of data for the pitch offset were collected with the vessel traveling at same speed, but in opposite directions on the same line. For the yaw offset, data were collected over a well-defined feature on two different parallel lines. The line spacing was set to allow the outer beams of one line to overlap the track for the other line (approximately 2 times water depth). The patch test data were collected prior to the actual survey.

Figure 2. The mounting poles used to mount the sonarheads of the multibeam and the singlebeam systems, respectively. Both were side mounted on the starboard side of the *RV James Kirby*.

Survey planning

The following discussion includes comments on a variety of survey planning, data acquisition and processing software packages. These include Navisoft Survey and Navisoft Planning and Presentation, descriptions of which appear in the previous report[1].

As far as bathymetry is concerned, a common practice in a single beam survey is to run survey lines normal to the contour in order to obtain the best definition of the slope. This is however not the case for a multibeam survey. A rule of thumb in a multibeam survey is to run survey lines parallel to the contour. The idea is to get the maximum swath coverage in a short time. The objectives of the survey, navigational requirements and weather conditions may however rule out this multibeam survey

[1] Siwabessy, P.J.W. 2003. "RESON Training and Data Collection using SeaBat 8125 Multibeam System in Sydney Harbour." CMST Report 2003-24 prepared for Coastal Habitat Water Mapping Program, CA, Curtin University of Technology, Perth, Western Australia. 17pp.

requirement. For instance, the objective is to look at changes in seabed habitat type along the track and if it happens that the changes are depth dependent, it is more appropriate to run survey lines normal to the contour.

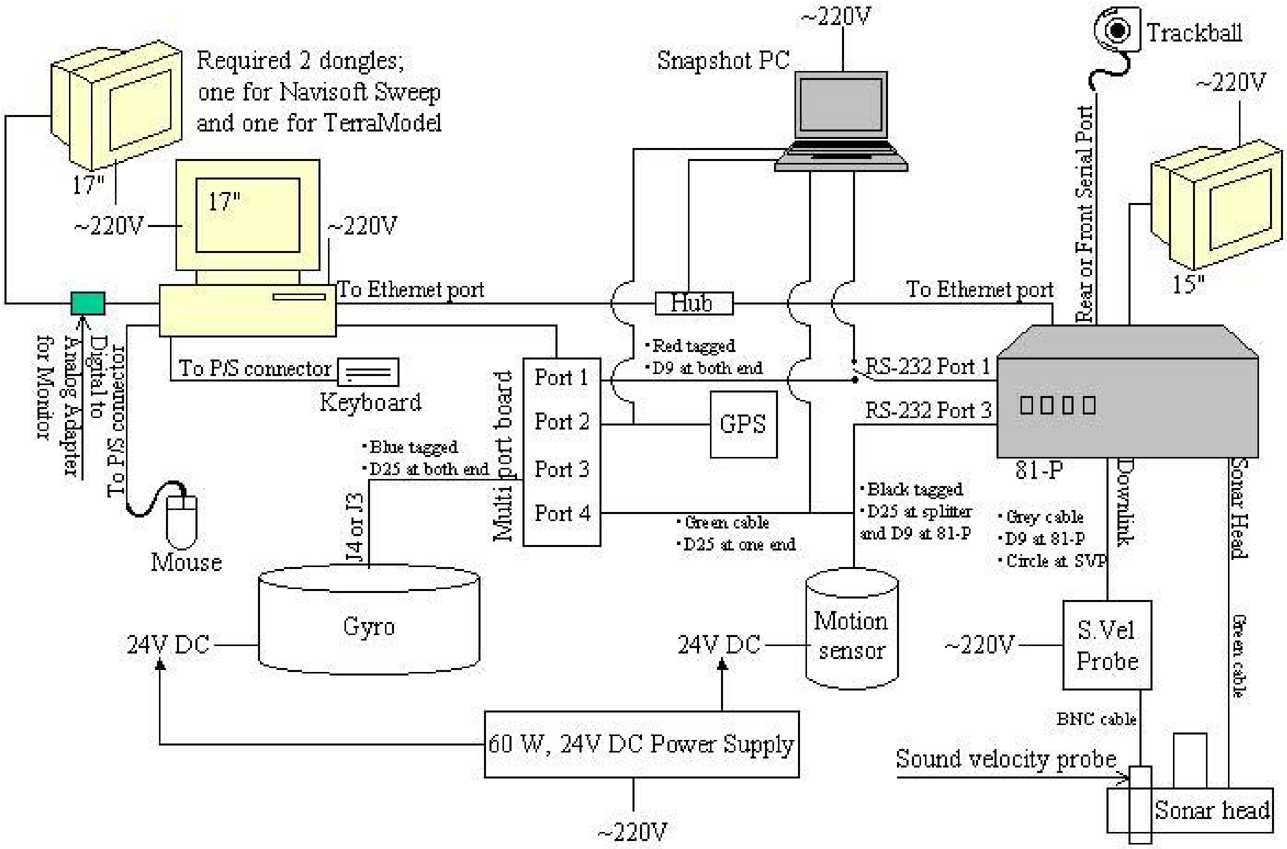

Figure 3. Wiring diagram of the multibeam system for normal and snapshot operations.

Irrespectively however, a 100% overlap between adjacent lines is required to avoid gap between lines due to, among others, roll.

In this survey, lines were created in consultation with the skipper on the arrival at the particular area to be surveyed. In this survey, mainly only the line in the middle of the area of interest was drawn using Navisoft Planning and Presentation software. Since the skipper was experienced in multibeam survey techniques, consecutive survey lines were not drawn because he was able to accurately steam along the edge of the previous swath track. It should be noted that this simplification will not always be available; a less competent skipper might require that guidelines for all tracks be entered on the vessel cruise track display.

In the Morinda Shoal area, a middle line along the longest track of seabed habitat changes was drawn as a first, reference survey line. The edge of the previous swath tracks in either side of the reference line were then used as a guide for subsequent survey lines.

Similar to the Morinda Shoal example, a middle line was drawn along the longest length of the wreck of Yongala at the site of this wreck. As before, consecutive tracks were guided by the previous swath track in either side of the reference line.

The objective of the survey in Cape Bowling Green was to look at sediment changes from shallow to deeper water. Hence, in this case the direction of the survey tracks was normal to the depth contours. Again, only a middle line was drawn as a reference for the swath track and consecutive tracks were based on the edge of the previous swath track.

In all other areas, the direction of the survey tracks did not matter since the seabed of those areas was quite flat. Like those other areas however, only a reference line was drawn and all other survey tracks were based on the edge of previous swath track.

Grid setup

The objective here was to divide the survey area into grids/bins. This is a requirement when using the Navisoft package for data acquisition, but is not necessarily the case for other processing packages including FUGRO's Starfix and Caris.

Initial setup and data collection

The software used for data collection was Navisoft Survey. Using this software, the project file created using the Navisoft Planning and Presentation software was loaded and all available offsets were entered. Communication lines between PC and all sensors were checked. Data logging configuration was also checked, making sure that the folder and the filename were correctly specified and the GRD file (grid file) was selected.

Mainly, data were recorded in survey lines and in travelling tracks as necessary. Some additional tracks allowing for filling the gap and setting the boundary close to the shore were required. Each file was created to store the data for each line or track.

RESON 8125 Snapshot

Snapshot data were collected using the RESON SnapSaver software. Unfortunately, the software only acquired the acoustic data coming from the RESON 8125 multibeam sonar. Attitude and position data were collected separately using hyperterminal.

SIMRAD EQ60 singlebeam sonar

The SIMRAD EQ60 singlebeam sonar was deployed in the survey. The singlebeam sonar and the UWA underwater video camera were deployed simultaneously in selected areas. While these two systems were in operation, the RESON 8125 multibeam sonar was switched off.

DATASONIC CHIRP-660 sub-bottom profiler

The DATASONIC CHIRP-660 sub-bottom profiler was deployed only in selected areas. The head was installed on a towed fish suspended from above the wing of the stabilisation system of the boat. While the system was in operation, other sonar systems were switched off.

UWA underwater video camera

The connection for the UWA underwater video camera system is shown in Figure 4. The system was operated by at least 2 persons; one holding the umbilical and the other watching the screen. The person holding the umbilical operated the camera from the stern of the boat (see Figure 5). This person was guided to bring the camera up/down by the person watching the screen. The speed of the vessel was maintained, typically at 1 knot.

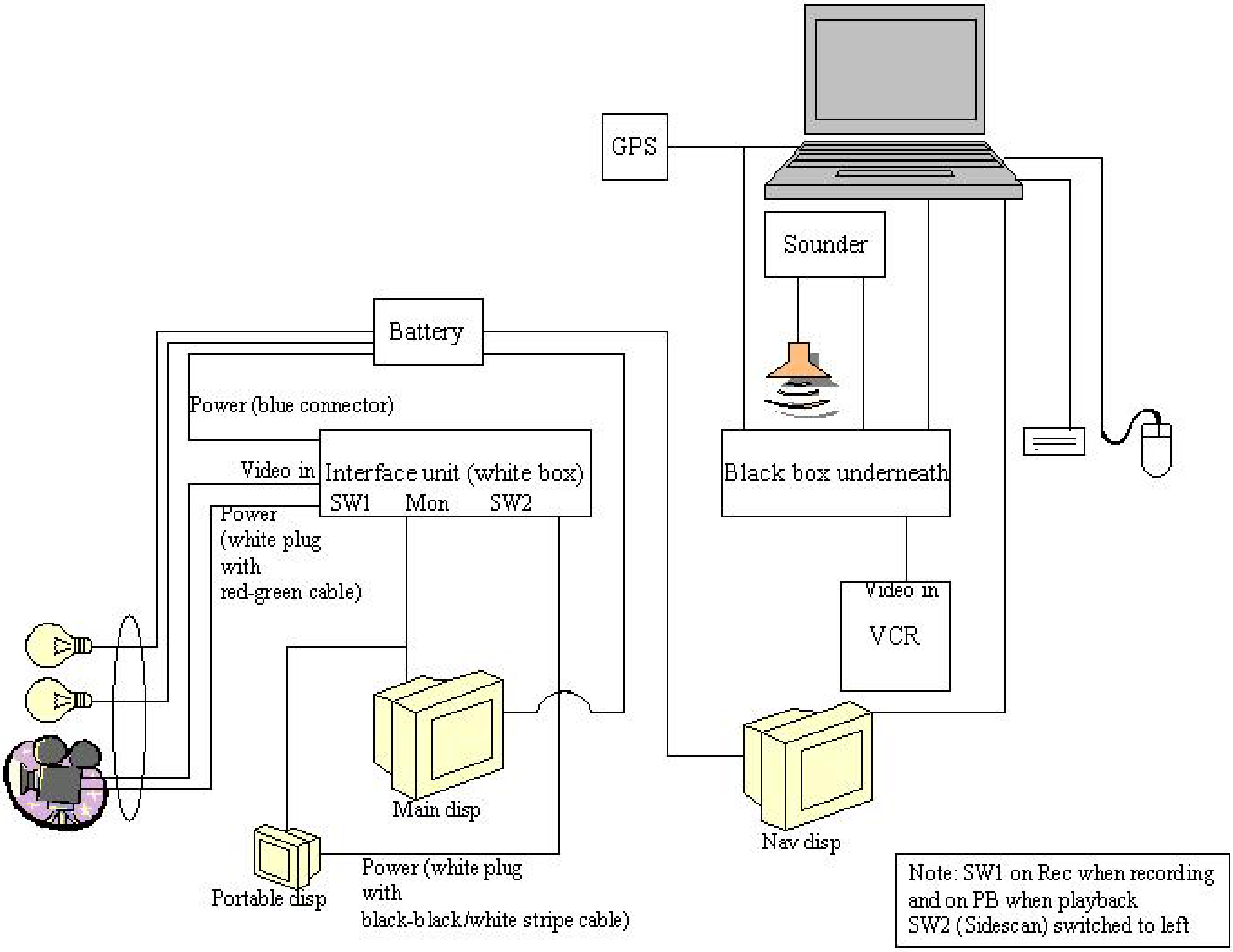

Figure 4. Wiring diagram of the UWA underwater video camera system.

Tide gauge
Using the A-frame at the stern of *RV James Kirby* and the winch, the tide gauge was put in the seabed of specified areas before collecting multibeam data in those areas. Close to the A-frame in the photo shown in Figure 5 is the tide gauge.

CTD/SVP
The CTD and SVP were deployed at the stern of *RV James Kirby* using the A frame and the winch. At least one CTD cast was collected in each area where the multibeam data were collected. Normally two casts were collected before and after collecting the multibeam data in an area of interest. Left to the coil of the umbilical in the photo shown in Figure 5 is the metal frame together with the CTD and SVP used in the survey.

Sensor offsets
All the measurements were made using a metal tape. A spirit level and a plumb bob were used to allow for accurate measurements. An example of how the measurement was done is shown in the photo presented in Figure 6.

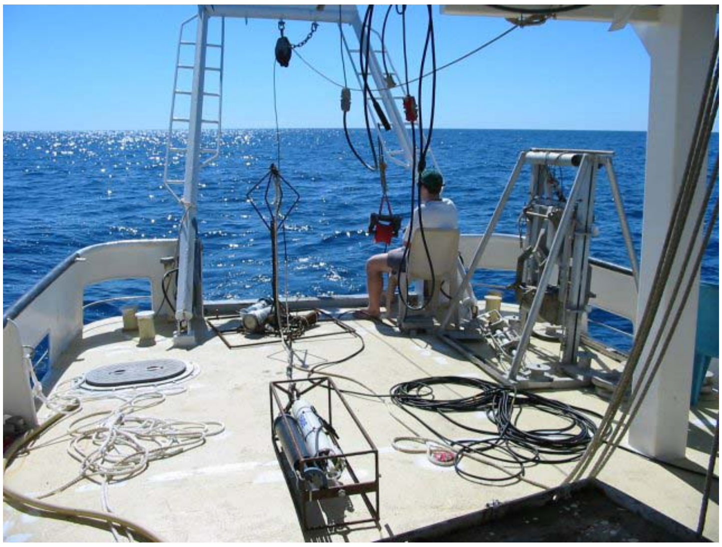

Figure 5. Iain Parnum enjoying the scene while holding the umbilical of the UWA underwater video camera. Also seen in the photograph are the CTD/SVP and the tide gauge deployed in Bowling Green Bay.

Figure 6. Thomas Stieglitz measuring the offset of the head of DATASONIC CHIRP-660 sub-bottom profiler relative to the GPS antenna.

Results

Offsets

The offset of all sensors deployed in the survey was measured. Table 2, however, provides only the summary of all offsets required for the multibeam survey.

Table 2. Summary of sensor offsets measured for the multibeam system.

Study Area	Sensor	Offset [m]		
		dX	dY	dZ
Bowling Green Bay, Townsville	DGPS	0	-2.08	6.22
	Sonar head	2.66	0.21	-2.75
	Motion sensor	0	0	0

Table 3 provides the summary of the patch test offsets required for further multibeam analysis. The offsets were derived on the field using the Navisoft Patch Test software. Further analysis is required as the variability of the latency is considerable.

Table 3. Summary of the patch test offsets.

Study Area	Parameter			
	Latency [ms]	Roll [ ]	Pitch [ ]	Yaw [ ]
Bowling Green Bay, Townsville	27	-0.44	-2.48	-4.03

Data collection

Tables 4 to 10 provide the summary of all data available from the survey. CMST holds all data except the CHIRP data.

Table 4. Summary of RESON 8125 multibeam data from normal mode operation. *including segmented traveling tracks.

Study Area	Date	Survey Area	Data		
			Number of lines*	Size [Gb]	Location (Format)
Bowling Green Bay	18/08/04	Morinda Shoal	6	0.39	CMST (RAW, XTF), JCU (XTF)
	19/08/04	Morinda Shoal	50	5.10	
	20/08/04	Morinda Shoal, Yongala Wreck	13	0.43	
	21/08/04	Mystery site	15	4.79	
	22/08/04	Paddock 1, Morinda Shoal	26	4.89	
	23/08/04	Paddock 2, Cp Bowling Green Bay	20	5.15	

Table 5. Summary of RESON 8125 snapshot data. *segmented line.

Study Area	Date	Survey Area	Data		
			Number of lines*	Size [Gb]	Location (Format)
Bowling Green Bay	20/08/04	Morinda Shoal	3	1.55	CMST (RAW)
	21/08/04	Mystery site	1	0.81	
	22/08/04	Paddock 1	1	0.45	
	23/08/04	Paddock 2, Cp Bowling Green Bay	1	0.94	

Table 6. Summary of CHIRP data. CHIRP= DATASONIC CHIRP-660 sub-bottom profiler. *segmented line.

Study Area	Date	Divice	Survey Area	Data		
				Number of lines*	Size [Gb]	Location (Format)
Bowling Green Bay	19/08/04	CHIRP	Morinda Shoal	n/a	n/a	JCU (n/a)
	21/08/04	CHIRP	Mystery site	n/a	n/a	

Table 7. Summary of singlebeam data. *including segmented line.

Study Area	Date	Survey Area	Data		
			Number of lines*	Size [Gb]	Location (Format)
Bowling Green Bay	20/08/04	Morinda Shoal	3	0.85	CMST (RAW)
	21/08/04	Mystery site	1	0.49	
	22/08/04	Paddock 1	3	0.26	

Table 8. Summary of video data.

Study Area	Date	Survey Area	Data		
			Number of lines	Size [Hr]	Location (Format)
Bowling Green Bay	20/08/04	Morinda Shoal	2	2.00	CMST (DV), JCU (DV)
	21/08/04	Mystery site	1	2.00	
	22/08/04	Paddock 1	1	1.25	
	23/08/04	Paddock 2, Cape Bowling Green Bay	2	1.75	

Table 9. Summary of tide data collected in the survey.

Study Area	Date	Survey Area	Data	
			Number of deployment	Location (Format)
Bowling Green Bay	19/08/04	Morinda Shoal	1	JCU (ASCII), CMST (ASCII)
	20/08/04	Morinda Shoal, Yongala Wreck	2	
	21/08/04	Mystery site	1	
	22/08/04	Paddock 1	1	
	23/08/04	Paddock 2, Cp Bowling Green Bay	2	

Table 10. Summary of CTD/SVP data.

Study Area	Date	Survey Area	Data	
			Number of deployment	Location (Format)
Bowling Green Bay	19/08/04	Morinda Shoal	2	JCU (ASCII), CMST (ASCII)
	20/08/04	Yongala Wreck	1	
	21/08/04	Mystery site	2	
	22/08/04	Anchorage, Paddock 1, Morinda Shoal	5	
	23/08/04	Paddock 2, Cp Bowling Green Bay	4	

Survey Narrative

The survey area in Bowling Green Bay is shown in Figure 7. Figure 7 also provides the multibeam swath, singlebeam, video and snapshot tracks, study areas, and positions where other data such as tide, CTD/SVP etc were collected.

The survey in Bowling Green Bay, Townsville started on 18 August 2004 after calibrating the DMS05 motion sensor and re-testing the multibeam sonar. Because of safety reasons due to the travelling speed of the boat, the pole holding the head of the multibeam sonar was folded up above the sea surface before steaming to the area for the patch test. The patch test data were collected in 6 lines.

The survey continued on 19 August 2004 in the Morinda Shoal. The tide gauge was first deployed around the survey area. The RESON 8125 multibeam sonar was in operation right after the deployment of the CTD/SVP cast. Multibeam data from 50 lines were collected. The second CTD/SVP cast was made right after the survey in this area.

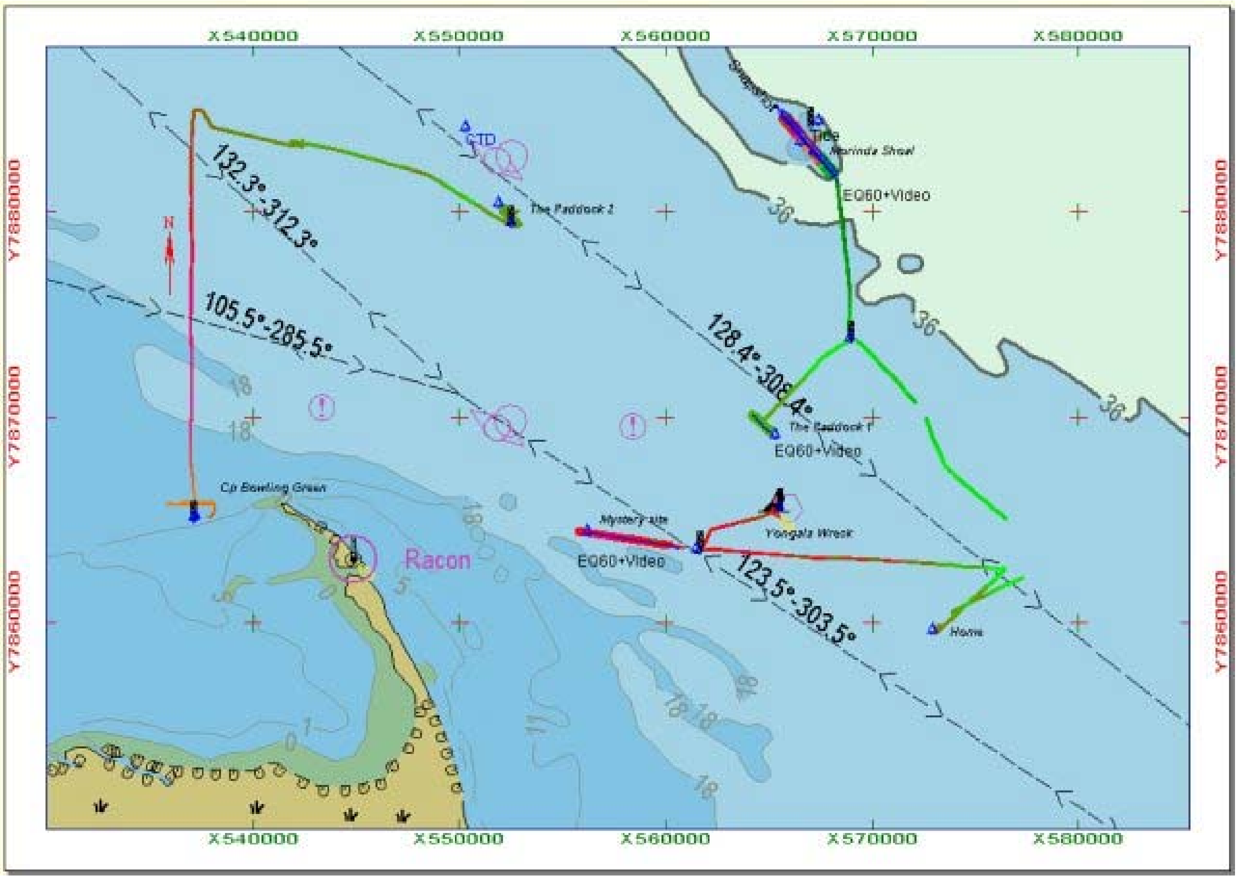

Figure 7. C-MAP chart of the survey area in Bowling Green Bay, Townsville.

On 20 August 2004 in the Morinda Shoal, two snapshot data sets were collected along the swath track in the middle of the survey area. Along this track, three different sets of singlebeam data were collected using the SIMRAD EQ60 echosounder. Of these three sets, two were gathered simultaneously when the underwater footage was recorded using the UWA underwater video camera system. A 2.5-hour underwater footage was produced from the Morinda Shoal. The DATASONIC CHIRP-660 sonar was also operated to produce sub-bottom profile. Before steaming off to the Yongala Wreck, the tide gauge was recovered from the seabed. The survey resumed in the Yongala Wreck right after the deployment of the tide gauge and the CTD/SVP cast. Multibeam data were collected along 13 survey lines. The tide gauge was again recovered from the seabed before the survey ended. The bathymetry image of these two sites is presented in Figure 8.

The survey resumed on 21 August 2004 in a so-called Mystery site. Before the survey started, the tide gauge was deployed and the first CTD/SVP cast was made. The second cast was made right after the survey. Multibeam data from total of 15 survey lines were collected in the Mystery site. Snapshot data were collected along a single line only. The same line was also used to gather the singlebeam data and the underwater footage simultaneously. The sub-bottom profile was also collected in this area.

On 22 August 2004, the survey went on in two different areas namely the Paddock 1 and the Morinda Shoal. As usual, the tide gauge and the CTD/SVP were deployed nearby before collecting any other data in the Paddock 1. Multibeam data were acquired along 24 lines in the Paddock 1 and along 2 lines in the Morinda Shoal. In the Paddock 1, the sub-bottom profile, the snapshot and the singlebeam data, and the underwater footage were also collected. The same line was used for the operation of the snapshot, the singlebeam and the video. Again, the singlebeam and the video were operated simultaneously. The second CTD/SVP cast was made in the Paddock 1. Before heading off to the Morinda Shoal, the tide gauge was recovered from the seabed. Only one CTD/SVP cast was made in the Morinda Shoal.

Morinda Shoal

Yongala Wreck

Figure 8. Image of the Morinda Shoal and the Yongala Wreck derived from RESON 8125 multibeam data.

23 August 2004 was the last day of the survey in Bowling Green Bay. Data were collected in two different areas namely the Paddock 2 and the Cape Bowling Green Bay. Multibeam data were collected along 20 lines in those two areas. The snapshot data were also collected along a single line in

each survey area. The underwater footage was recorded along a single line in the Paddock 2. Two CTD/SVP casts, before and after the survey were made in each survey area. Tide gauge was also deployed before collecting any other data and was recovered right after the survey in each survey area. The underwater video was deployed in the Cape Bowling Green Bay to record underwater footage along a single line.