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Geoscience Australia

COASTAL CRC

# Coastal CRC Coastal Water Habitat Mapping Project
# Coastal Geomorphology Subproject (CG)

# Report on the field survey in Esperance Bay, Recherché Archipelago, Western Australia, May 2 – 16, 2005

# Milestone Report CG5.02

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**Background and Field Personnel**

The Recherché Archipelago spans a section of the south-western coast of Western Australia, between longitude 121°30'E and 124°15'E, around latitude 34° south. This report provides a brief overview of the scientific objectives of the May 2005 survey, the work undertaken and field data for the surface sediments and vibracore samples that were collected. The study area, Esperance Bay, is situated in the western portion of the Recherché Archipelago, in the vicinity of the town of Esperance (Figure 1). The Archipelago was first charted in detail by Matthew Flinders in 1802, and comprises 105 dome-shaped granite islands, and more than 1500 islets and exposed shoals.

The objectives of the May 2005 survey was to provide a more reliable and comprehensive understanding of the present-day distribution and dynamics of sediments in Esperance Bay, better define the links between distinct biological communities and sedimentary environments, and to gain a better understanding of the geomorphic evolution of the bay. Fieldwork was undertaken by CWHM project personnel from Geoscience Australia (GA; David Ryan, Brendan Brooke and David Holdway), Curtin University (Justy Siwabessy) and University of Western Australia (UWA; Nisse Goldberg), with the assistance of Neil Lazarow (Coastal CRC). The survey ran from May 2 – 16, 2005. The survey work was undertaken on vessels owned and operated by SE Fisheries Pty Ltd of Esperance (Mr Marcus Grey), with the *Firebird* and *Jumbo* fishing vessels skippered by Marcus Grey, Kevin MacNeall and Paul Murch (Ginger).

**Scientific Aims**

A major aim of this study was to build on the first Recherche survey by obtaining complete multibeam coverage for the Woody Island Group by 'filling in' between the existing small areas of multibeam coverage around the islands (Fig. 1). This is a key study area for the CWHM project because of the high diversity of habitats and bottom morphologies within a relatively small area. A more complete swath coverage of a key area of diversity like the Woody Island Group will provide a better understanding of the finer-scale ecological and sedimentary processes that operate in this benthic environment. Additional aims were to determine the thickness and rate of sediment accumulation in Esperance Bay in relation to rhodoliths; and examine soft-substrate and hard-substrate habitat distribution and stability.

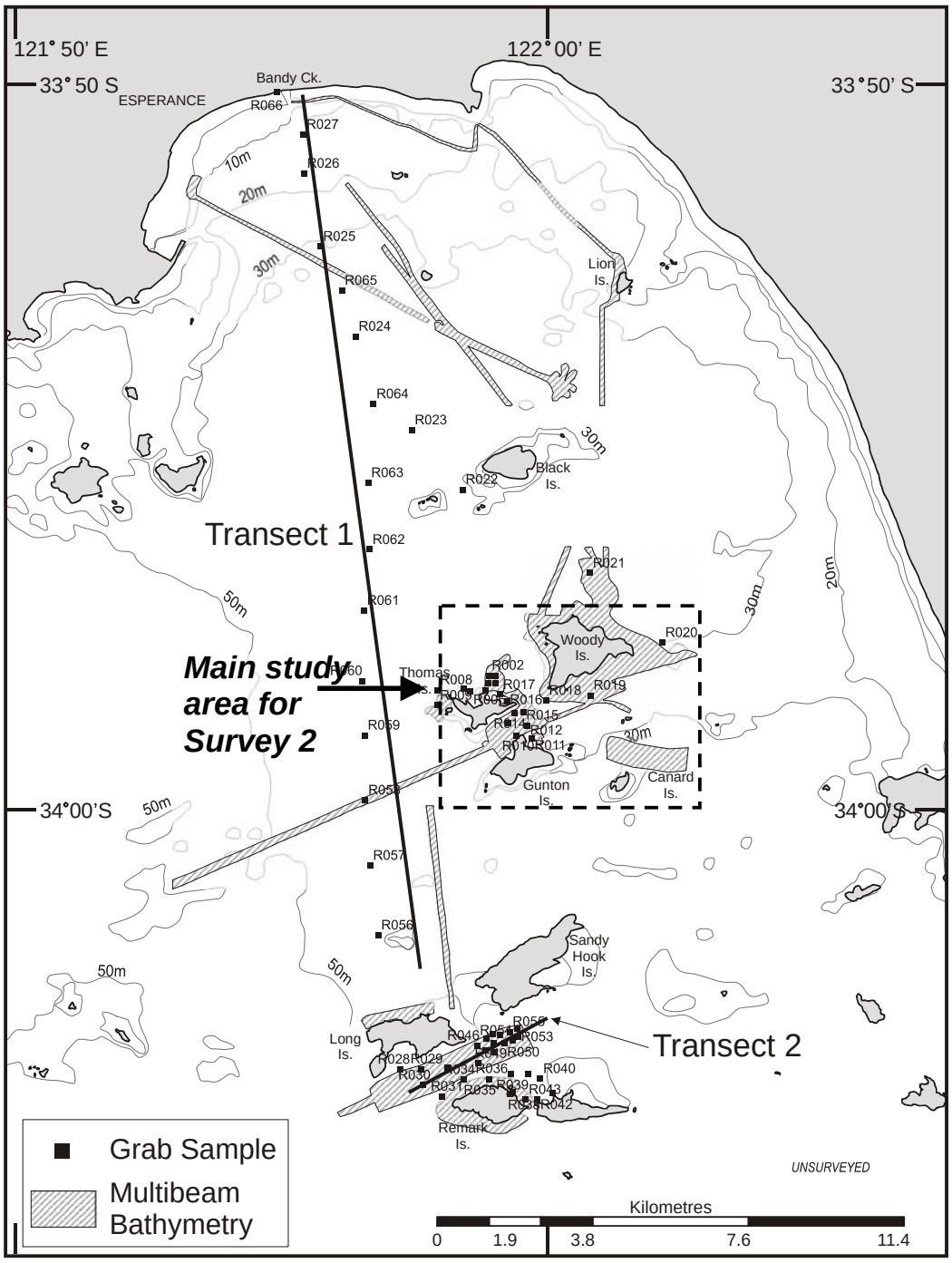


Figure 1: Map of Esperance Bay showing areas of multibeam swath coverage (grey hatched areas) mapped in November 2003 and the focus area mapped in the 2nd survey around the Woody Island Group. The location of sediment samples collected in the first survey are also indicated (Transect 1 and 2).

Key research questions addressed by the field survey were:

1) What is the relationship between rhodolith growth forms/species, bed morphology and wave exposure (collect samples to determine the age structure of rhodoliths from different parts of the bay, and how this varies downcore).
2) Can some rhodolith beds be identified in the Reson 8125 bathymetry data?
3) What role do the granitic islands of Esperance Bay play in enhancing local sedimentation rates, and what is the volume and rate of accumulation of sediment in the leeward sediment aprons?
4) What is the subsurface structure and thickness of sediment and rock units in Esperance Bay, especially the low-profile reefs?
5) What is the morphology, mobility and origin of large sand waves in the bay?

**Field Equipment**

*Vessels*

The multibeam mapping was undertaken on the *Firebird*, which has a moon pool that enabled the transducer to be hull mounted. This was the same mounting that was used in the 2003 survey. A larger vessel, the *Jumbo*, was used for sub-bottom profiling, grab sampling and vibracoring. The vibracoring required significant modifications to the *Jumbo* winch equipment to enable this relatively heavy gear to be safely operated. This work was expertly handled by Mr Marcus Gray.


Figure 2: The *Firebird* (14 m) and *Jumbo* (17.2 m) vessels used in the survey. The *Jumbo* has the vibracorer set ready for deployment.

*Sub-Bottom Profiling Equipment*

The thickness and structures within granite, limestone and unconsolidated sediments were mapped using GA's *Chirper* and *Sparker* acoustic sub-bottom profiling systems. The new *Chirp* system comprises transmit and receive transducers mounted in a towfish, and a topside data acquisition and processing unit. This system employs a swept 2-12 kHz frequency. This signal generally penetrates sediments to a depth of 10's of metres and can resolve sub-bottom reflectors with a relatively very high vertical resolution of approximately 0.05 m. The *Sparker* system generates an acoustic pulse using a high-voltage spark that produces a sound frequency of 0.5-3.5 kHz. This signal can penetrate the seabed to 100's of metres and can resolve sub-bottom reflectors at a vertical resolution of around 2 m.

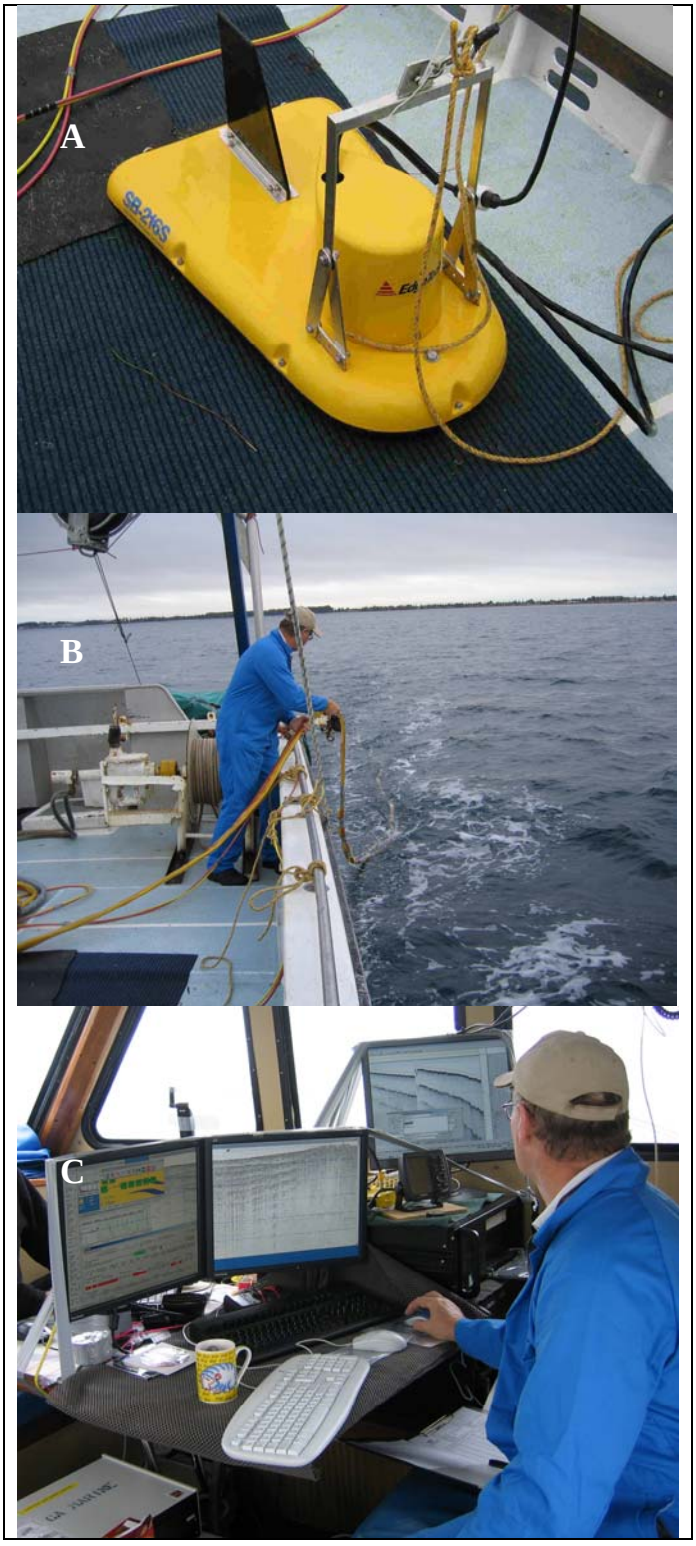


Figure 3: A) Tow fish unit of the Edgetech SB-216S 'Chirper' sub-bottom profiling system. B) Deploying the high voltage signal cable of the 'Sparker' system. C) Screen displays and integrated data acquisition unit for the three sub-bottom profiling systems, set up in the wheel house of the *Jumbo*.

*Multibeam Sonar Equipment*

The Coastal CRC's Reson 8125 multibeam system was installed on the *Firebird* using the same mounting pole and setup developed for the first Recherche Survey in November 2003: the transducer head was mounted amidships through a moon-pool. The system emits acoustic energy at a frequency of 455 KHz, and resolves signals returning from the seabed into 240 beams in an arc of 120° under the ship, allowing a swath approximately 3.5 times the water depth to be mapped. The system was installed and operated by Dr Justy Siwabessy, CMST, during the May 2005 survey.

*Video*

A small underwater video system (developed by Andy Bickers, UWA) was provided by UWA and deployed from the *Firebird*.

Figure 4: Installing the Reson 8125 sonar head on the *Jumbo*. The mounting pole was inserted into a moon pool within the hull of the boat.

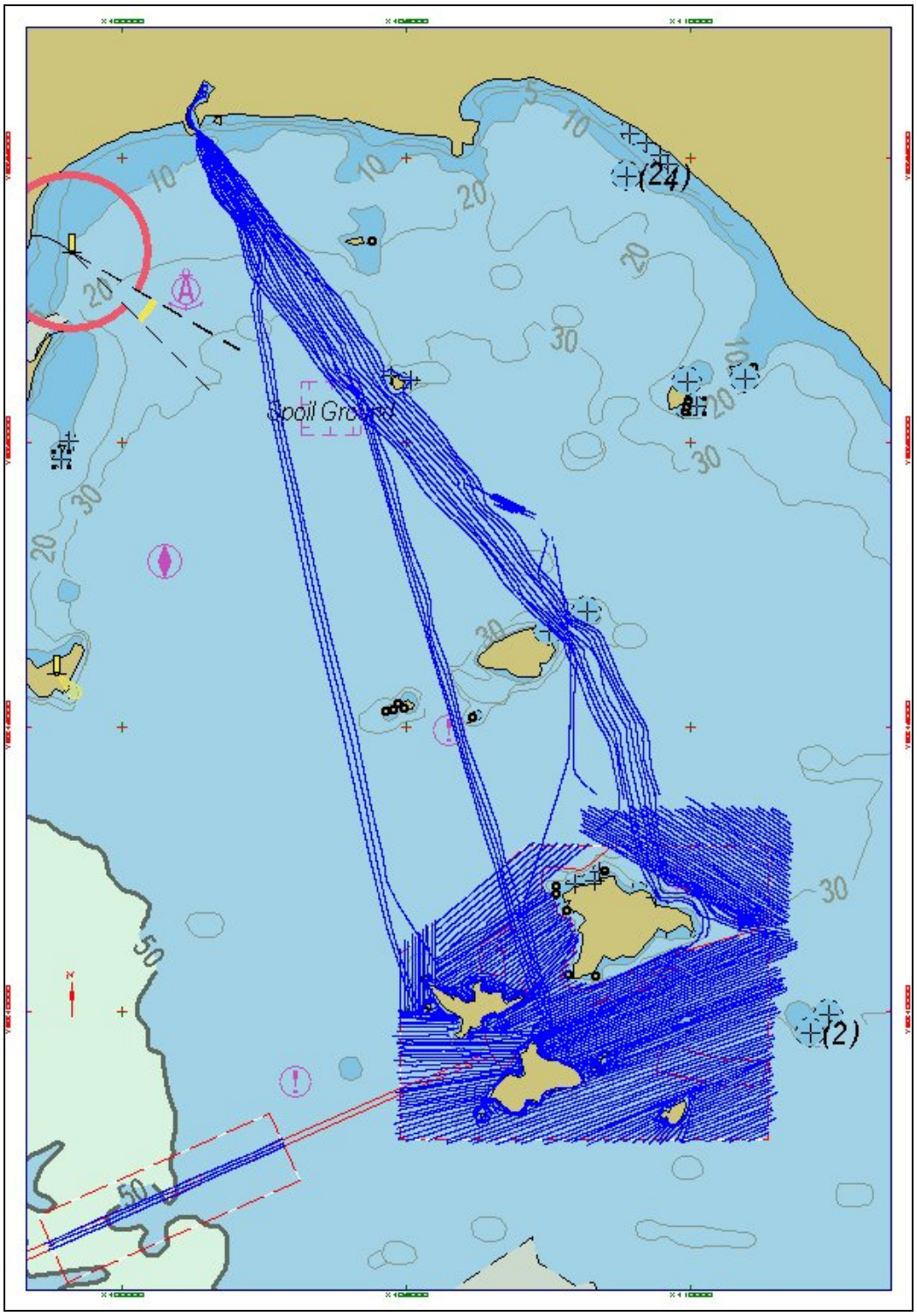


Figure 5: A map of Esperance Bay showing the Reson 8125 track lines run in the survey. There is a dense coverage of lines around the Woody Island group.

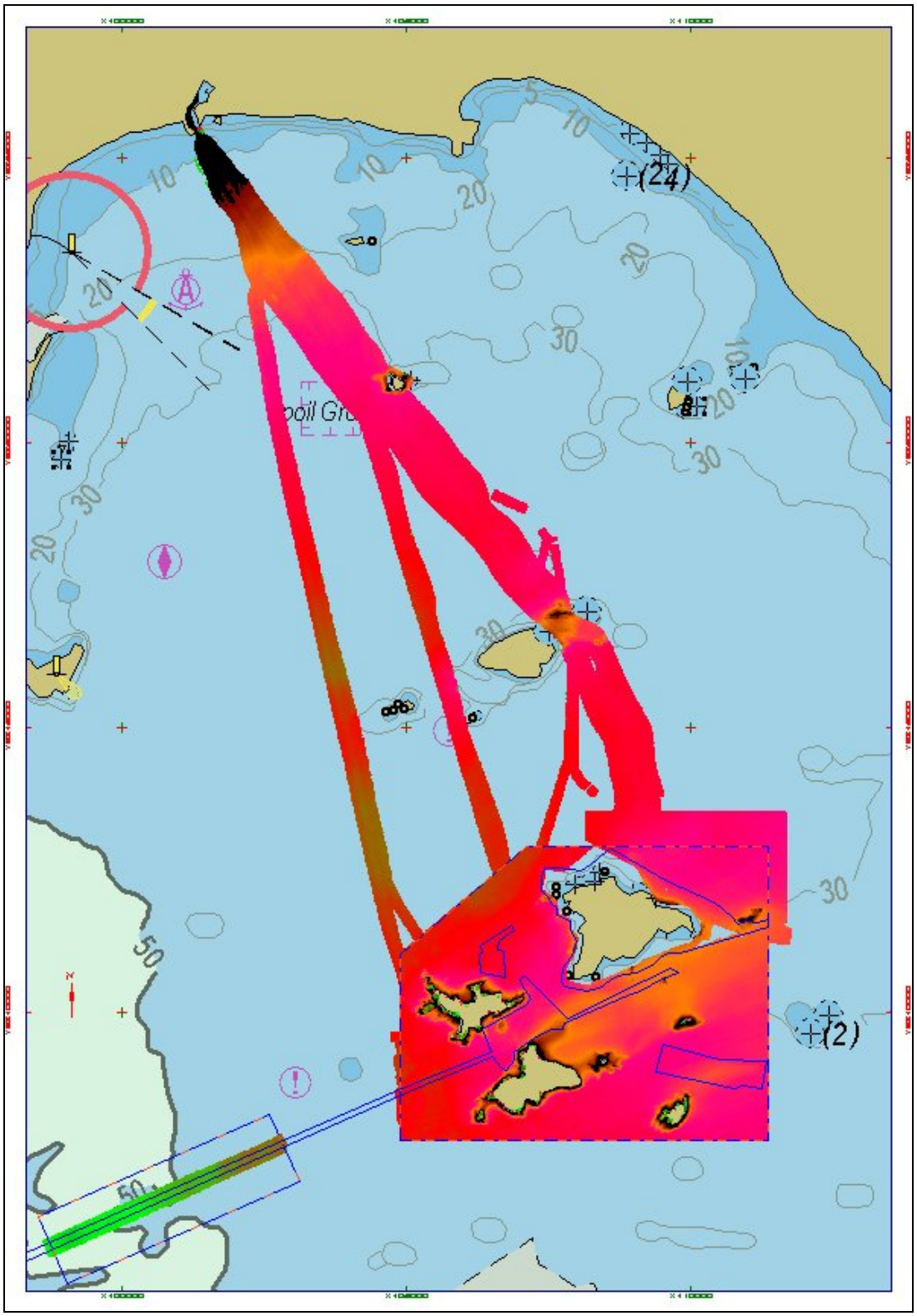


Figure 6: Bathymetry of the survey areas based on the unprocessed 8125 swath data.

*Vibracoring Equipment*
GA's small shallow-water (<200m), electrically powered (415 volts) vibracorer, with 3 m aluminium barrels and 4.2 m core mast, was used in this survey (Figure 7). The system was deployed over the side of the *Jumbo* using a dual-winch system developed by the skipper, Mr Marcus Gray.

Figure 7: Deploying the vibracorer over the side of the *Jumbo* using the very effective two winch setup.

*Grab Sampling Equipment*
The GA 1 litre Shipeck grab sampler was deployed using the *Jumbo's* capstan winch to haul the grab back up to the side of the vessel and then retrieved onto deck by hand (Fig. 8). A mini-Van Veen 0.5 L grab sampler was also used but was found to be unsuitable in the relatively deep water around the Woody Island Group (>30m) – the grab and rope tended to drift too much away from the boat.

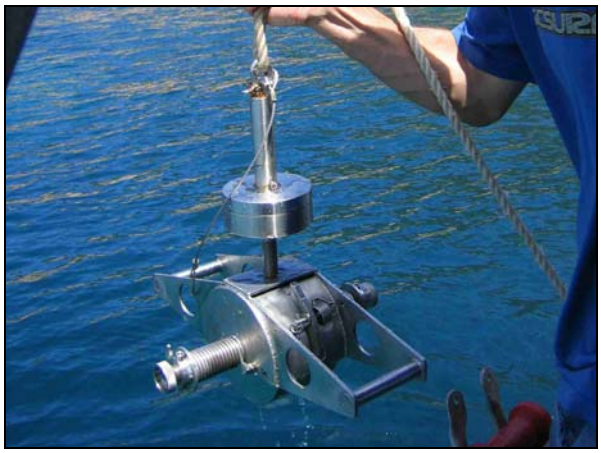

Figure 8: The mini-Shipeck grab sampler used in the survey to collect samples of surface sediment.

**Sample Locations**

Sample locations in Esperance Bay, including grab sample sites, vibracore sites, multibeam survey areas and sub-bottom profiling lines are indicated in Figure 2.

*Multibeam Sonar*

The key survey site for Reson 8125 system was in the Woody Island Group (Figs 5, 6) to provide an almost complete multibeam coverage of the previously partially mapped area – we joined up the existing 'tiles' of MB coverage around Woody, Thomas, Gunton, and Canard Islands (marked as blue polygons in Fig. 6). This area includes all major benthic habitat types identified in Esperance Bay and a wide range of depths. This area also provided the opportunity to map the extent of leeward sediment accumulations to the NE of Woody Island and Canard Island.

*Video*

Several video drops and tows were made within the MB survey area in the Woody Island Group, in order to ground-truth future backscatter images and record biological features of the seabed.

*SBP Lines*

The Chirper and Sparker sub-bottom profilers were deployed at the same time with no significant signal interference between the systems. They were used to map the subsurface stratigraphy along widely spaced lines throughout Esperance Bay and closely spaced lines in the Woody Island and Remark Island Groups (Fig. 9).

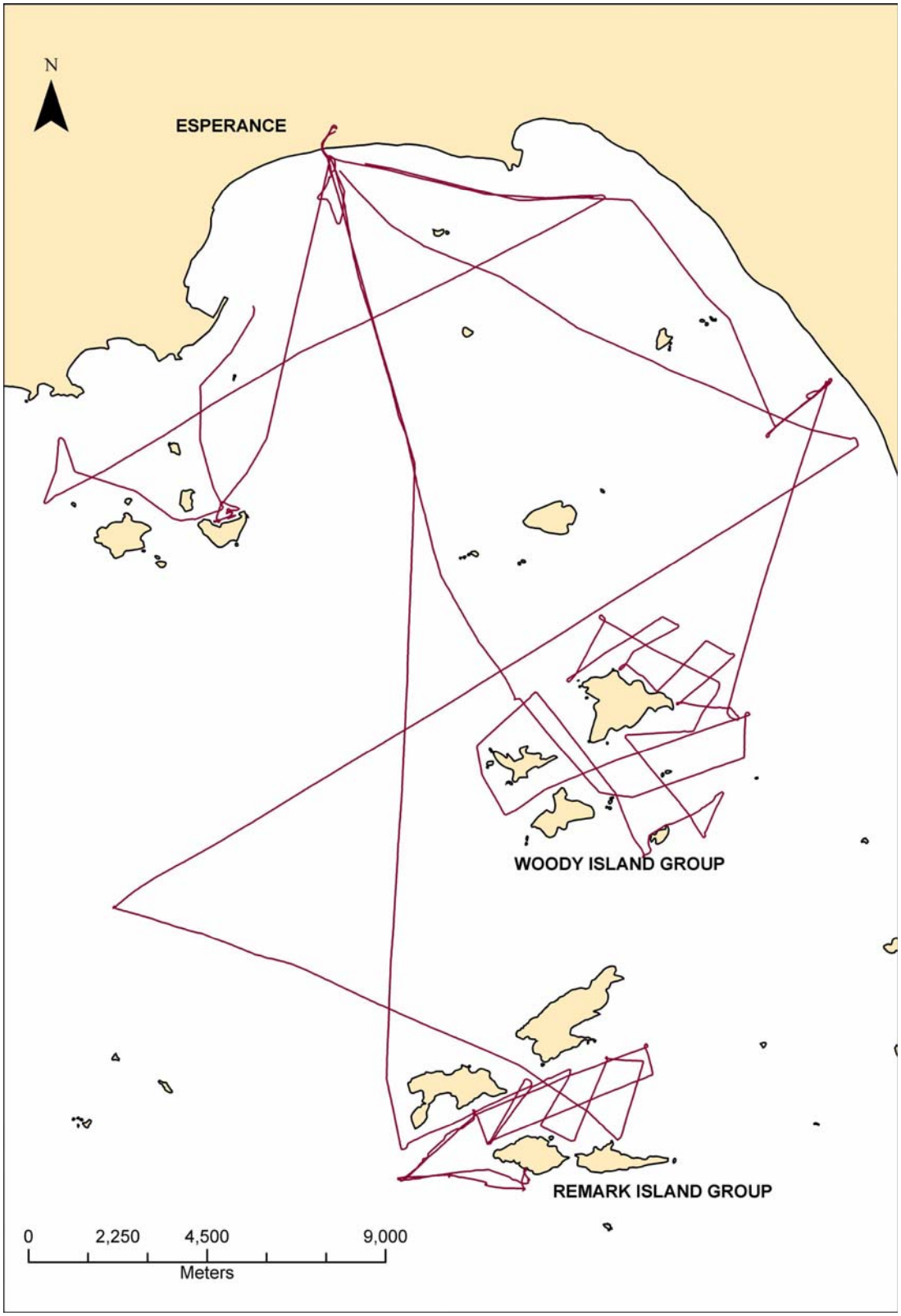


Figure 9: Track lines for the *Chirper* and *Sparker* sub-bottom profiles collected in Esperance Bay.

*Vibracore Sites*

Twelve vibracores were collected around Woody Island and in rhodolith beds, low profile reef and sandy habitats to the north of Woody Island (Fig. 10; Table 1).

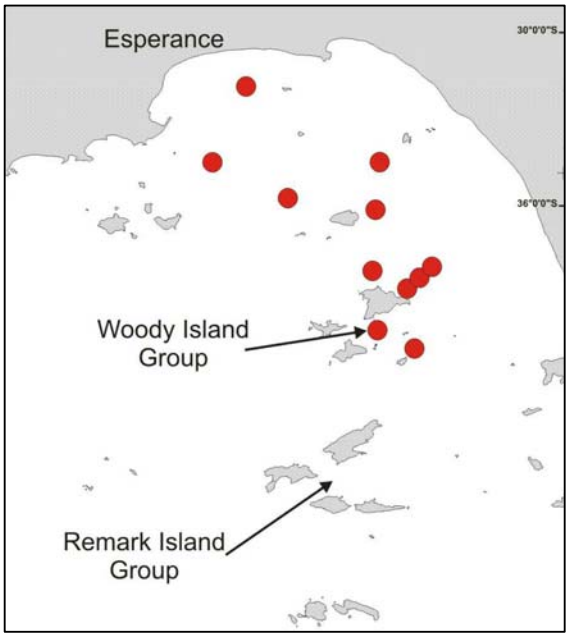


Figure 10: Locations of the vibracores collected in Esperance Bay.

*Grab Sampling Sites*

Grab samples were collected from outer Esperance Bay to determine the nature of large sand waves; near Cull Island to indicate the nature and provenance of sediments moving along the coast into the Bay; in transects adjacent to Remark Island, and in a cluster around Woody Island (Figs 2, 11; Table 2).

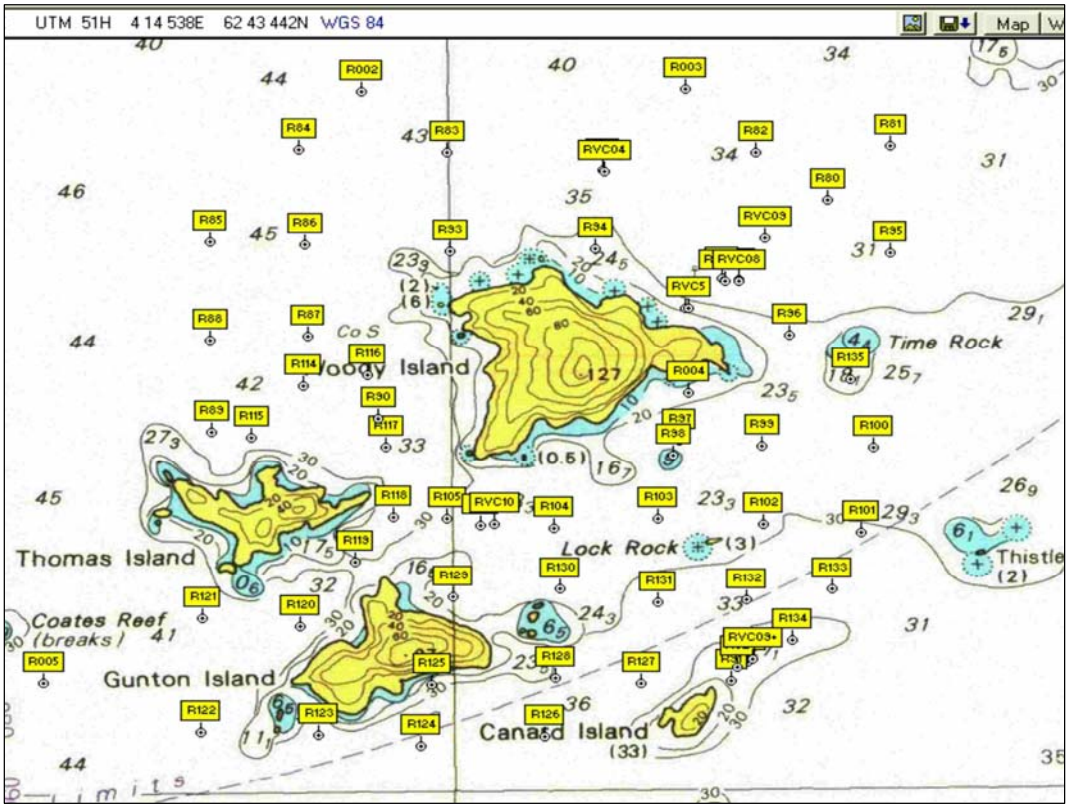


Figure 11: Locations of the samples of surface sediment collected around the Woody Island Group in Esperance Bay.

## Field Data

Table 1: Field data for the vibracores collected in Esperance Bay.

| Site ID | Lat_dd | Long_dd | Northing_UTM51 | Easting_UTM51 | Broad Habitat Class |
|---|---|---|---|---|---|
| RVC01 | -33.95246 | 122.02962 | 6242691.051 | 410335.9943 | Sand |
| RVC02 | -33.85443 | 121.9379 | 6253476.997 | 401748.2225 | Seagrass |
| RVC03 | -33.89568 | 121.94176 | 6248906.756 | 402152.4082 | Rhodolith |
| RVC04 | -33.94668 | 122.01541 | 6243319.444 | 409016.7773 | Rhodolith |
| RVC05 | -33.95816 | 122.0227 | 6242052.946 | 409702.5786 | Offshore seagrass/Sand |
| RVC06 | -33.95592 | 122.02619 | 6242304.392 | 410022.6899 | Sand |
| RVC07 | -33.90466 | 121.99331 | 6247958.936 | 406928.8043 | Rhodolith |
| RVC08 | -33.95602 | 122.02729 | 6242294.268 | 410124.4357 | Sand |
| RVC09 | -33.98782 | 122.0281 | 6238768.88 | 410232.7058 | Offshore seagrass |
| RVC10 | -33.97622 | 122.00525 | 6240034.884 | 408109.6561 | Offshore seagrass |
| RVC11 | -33.87359 | 121.94484 | 6251359.093 | 402412.0534 | Sand/Low-profile reef |
| RVC12 | -33.91 | 122.01217 | 6247383.8 | 408677.9 | Sand/Rhodoliths |
| RVC13 | -33.888953 | 121.99244 | 6249699.781 | 406831.2848 | Low-profile reef |

Table 2: Field data for the surface sediment samples collected in Esperance Bay

| Site ID | Lat_dd | Long_dd | Northing_UTM51 | Easting_UTM51 | Habitat Value | Habitat |
|---|---|---|---|---|---|---|
| R067 | -34.05438 | 121.97074 | 6231336.638 | 405008.7609 | 13 | Sand Dunes |
| R068 | -34.0593 | 121.96358 | 6230784.408 | 404353.4588 | 13 | Sand Dunes |
| R069 | -34.06491 | 121.95699 | 6230156.155 | 403751.6155 | 3 | Rhodolith |
| R070 | -34.06927 | 121.95006 | 6229666.148 | 403117.0554 | 3 | Rhodolith |
| R071 | -34.06881 | 121.96445 | 6229730.695 | 404444.4271 | 3 | Rhodolith |
| R072 | -34.0714 | 121.97527 | 6229453.558 | 405445.7627 | 3 | Rhodolith |
| R073 | -34.07203 | 121.98419 | 6229391.912 | 406269.5584 | 3 | Rhodolith |
| R074 | -34.06995 | 121.98533 | 6229623.599 | 406372.4637 | 3 | Rhodolith |
| R075 | -33.8957 | 121.94193 | 6248904.7 | 402168.1503 | 3 | Rhodolith |
| R076 | -33.94667 | 122.01532 | 6243320.473 | 409008.4497 | 3 | Rhodolith |
| R077 | -33.95821 | 122.02252 | 6242047.243 | 409685.9997 | 7 | Sparse seagrass |
| R078 | -33.91336 | 121.95488 | 6246958.758 | 403385.518 | 3 | Rhodolith |
| R079 | -33.95577 | 122.02585 | 6242320.726 | 409991.1158 | 7 | Sparse seagrass |
| R080 | -33.94923 | 122.03527 | 6243054.128 | 410854.71 | 11 | Sand |
| R081 | -33.94483 | 122.04091 | 6243546.9 | 411371.3283 | 11 | Sand |
| R082 | -33.9452 | 122.02891 | 6243495.442 | 410262.767 | 11 | Sand |
| R083 | -33.94503 | 122.00136 | 6243489.853 | 407716.6254 | 3 | Rhodolith |
| R084 | -33.94467 | 121.98816 | 6243517.819 | 406496.3845 | 3 | Rhodolith |
| R085 | -33.95232 | 121.98018 | 6242662.256 | 405767.3599 | 11 | Sand |
| R086 | -33.95265 | 121.98862 | 6242633.386 | 406547.618 | 3 | Rhodolith |
| R087 | -33.96034 | 121.98882 | 6241780.872 | 406574.5055 | 3 | Rhodolith |
| R088 | -33.96066 | 121.98005 | 6241737.365 | 405764.5435 | 11 | Sand |
| R089 | -33.96827 | 121.98002 | 6240893.51 | 405770.1648 | 3 | Rhodolith |
| R090 | -33.96736 | 121.99497 | 6241008.053 | 407150.3707 | 3 | Rhodolith |
| R091 | -33.98961 | 122.02635 | 6238568.864 | 410072.951 | 11 | Sand |
| R092 | -33.98845 | 122.02677 | 6238697.858 | 410110.5224 | 6 | Medium seagrass |
| R093 | -33.95326 | 122.00166 | 6242577.551 | 407753.2301 | 11 | Sand |
| R094 | -33.95322 | 122.01456 | 6242593.513 | 408945.1944 | 4 | Low-profile reef |
| R095 | -33.95374 | 122.04093 | 6242558.95 | 411382.413 | 11 | Sand |
| R096 | -33.96056 | 122.03179 | 6241794.792 | 410544.9899 | 3 | Rhodolith |
| R097 | -33.96944 | 122.02188 | 6240801.458 | 409638.7421 | 6 | Medium seagrass |
| R098 | -33.97065 | 122.02138 | 6240666.848 | 409593.8297 | 6 | Medium seagrass |
| R099 | -33.96988 | 122.02917 | 6240759.07 | 410312.6977 | 4 | Low-profile reef |
| R100 | -33.97009 | 122.03917 | 6240744.487 | 411236.7697 | 4 | Low-profile reef |
| R101 | -33.97728 | 122.03799 | 6239946.213 | 411135.2363 | 4 | Low-profile reef |
| R102 | -33.97651 | 122.02925 | 6240023.982 | 410327.0494 | 4 | Low-profile reef |
| R103 | -33.97595 | 122.01976 | 6240077.735 | 409449.7855 | 6 | Medium seagrass |
| R104 | -33.9767 | 122.01055 | 6239986.398 | 408599.7774 | 6 | Medium seagrass |
| R105 | -33.97579 | 122.0011 | 6240078.836 | 407725.8193 | 6 | Medium seagrass |
| R106 | -33.91181 | 121.99974 | 6247171.932 | 407531.0202 | 11 | Sand |
| R107 | -33.90853 | 121.99647 | 6247532.679 | 407225.1593 | 3 | Rhodolith |
| R108 | -33.90646 | 121.99459 | 6247760.506 | 407049.1022 | 3 | Rhodolith |
| R109 | -33.90474 | 121.99258 | 6247949.403 | 406861.3982 | 3 | Rhodolith |
| R110 | -33.90497 | 121.99293 | 6247924.218 | 406894.0079 | 3 | Rhodolith |
| R111 | -33.95587 | 122.02729 | 6242310.9 | 410124.278 | 7 | Sparse seagrass |
| R112 | -33.98811 | 122.02779 | 6238736.452 | 410204.3774 | 6 | Medium seagrass |
| R113 | -33.9764 | 122.00411 | 6240013.903 | 408004.5381 | 6 | Medium seagrass |
| R114 | -33.96449 | 121.98835 | 6241320.276 | 406535.6188 | 3 | Rhodolith |

| | | | | | | |
|---|---|---|---|---|---|---|
| R115 | -33.96888 | 121.98361 | 6240829.164 | 406102.5071 | 11 | Sand |
| R116 | -33.96363 | 121.994 | 6241420.771 | 407056.6962 | 3 | Rhodolith |
| R117 | -33.96975 | 121.99558 | 6240743.593 | 407209.3237 | 11 | Sand |
| R118 | -33.97564 | 121.99629 | 6240091.129 | 407281.3117 | 6 | Medium seagrass |
| R119 | -33.9794 | 121.9929 | 6239671.133 | 406972.241 | 11 | Sand |
| R120 | -33.98471 | 121.98788 | 6239077.771 | 406514.3298 | 11 | Sand |
| R121 | -33.98403 | 121.97901 | 6239145.046 | 405694.2579 | 2 | High-profile reef |
| R122 | -33.99351 | 121.97884 | 6238093.704 | 405689.0293 | 4 | Low-profile reef |
| R123 | -33.99384 | 121.98933 | 6238066.718 | 406658.2503 | 4 | Low-profile reef |
| R124 | -33.99486 | 121.99852 | 6237961.95 | 407508.143 | 4 | Low-profile reef |
| R125 | -33.98977 | 121.9995 | 6238527.235 | 407593.1439 | 4 | Low-profile reef |
| R126 | -33.99415 | 122.00947 | 6238050.508 | 408518.7093 | 4 | Low-profile reef |
| R127 | -33.98984 | 122.01817 | 6238536.152 | 409317.6565 | 7 | Sparse seagrass |
| R128 | -33.98929 | 122.01053 | 6238590.351 | 408611.4067 | 7 | Sparse seagrass |
| R129 | -33.98233 | 122.00145 | 6239353.97 | 407765.2163 | 6 | Medium seagrass |
| R130 | -33.98176 | 122.01109 | 6239425.807 | 408655.0745 | 4 | Low-profile reef |
| R131 | -33.98301 | 122.01973 | 6239294.869 | 409454.5005 | 4 | Low-profile reef |
| R132 | -33.98291 | 122.02772 | 6239312.987 | 410192.4419 | 4 | Low-profile reef |
| R133 | -33.98197 | 122.03542 | 6239423.938 | 410902.7201 | 4 | Low-profile reef |
| R134 | -33.98626 | 122.03181 | 6238945.103 | 410573.7496 | 6 | Medium seagrass |
| R135 | -33.96437 | 122.0372 | 6241377.032 | 411048.8156 | 4 | Low-profile reef |
| R136 | -33.97375 | 121.96889 | 6240275.579 | 404748.0001 | 11 | Sand |
| R137 | -34.00261 | 121.9309 | 6237039.487 | 401271.7885 | 4 | Low-profile reef |
| R138 | -34.00522 | 121.9242 | 6236743.598 | 400656.0754 | 11 | Sand |
| R139 | -34.00824 | 121.91482 | 6236399.586 | 399793.3953 | 11 | Sand |
| R140 | -34.01071 | 121.90793 | 6236118.936 | 399160.0571 | 11 | Sand |
| R141 | -34.01366 | 121.90005 | 6235784.036 | 398435.9105 | 11 | Sand |
| R142 | -33.9968 | 121.98241 | 6237732.175 | 406022.3789 | 4 | Low-profile reef |
| R143 | -33.99795 | 121.98972 | 6237611.338 | 406698.7642 | 4 | Low-profile reef |
| R144 | -33.99779 | 121.99859 | 6237637.122 | 407517.7834 | 11 | Sand |
| R145 | -33.9981 | 122.0097 | 6237612.721 | 408544.1852 | 4 | Low-profile reef |
| R146 | -33.99849 | 122.02095 | 6237579.462 | 409583.5927 | 4 | Low-profile reef |
| R147 | -33.9948 | 122.0305 | 6237997.011 | 410461.7067 | 6 | Medium seagrass |
| R148 | -33.98927 | 122.03613 | 6238615.104 | 410975.9169 | 4 | Low-profile reef |
| R149 | -33.94815 | 121.99431 | 6243137.532 | 407068.5076 | 3 | Rhodolith |

Table 2 continued

**Acoustic data and sediment analysis – the work ahead**

A very large multibeam data set was collected in Esperance Bay during the survey, approximately 60 Gb of soundings. This data will be processed at Curtin University, which will be a significant task for the CWHM project staff. When the data is processed, GA will integrate the MB data into a GIS of Esperance Bay. We will also incorporate the MB bathymetry into a 3D visualisation of the Woody Island Group.

Sub-bottom profile data will be processed at GA and then be compared to lithological logs of the vibracores collected along the sub-bottom tracklines. Stratigraphic sections identified in the sub-bottom profiles will also be integrated with multibeam seabed coverages of the same area.

Vibracores and grab samples collected in the survey have been delivered to Geoscience Australia in Canberra. The cores will be processed and logged at GA. Cores that were collected in rhodolith beds will be analysed in collaboration with Drs Nisse Goldberg and Gary Kendrick (UWA) and individual rhodoliths will be selected for radiocarbon dating. The grab samples will be analysed in laboratories at Geoscience Australia for grain size, mineralogy, trace and major elements, and granular composition/biogenic content.

**Acknowledgements**

We would like to thank Mr Marcus Gray and his staff for their major efforts in planning and undertaking the boat work and solving numerous field equipment problems during the survey. Their efforts played a major role in the great success of the survey. This field study was funded by the Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management and supplementary funds were provided by the Petroleum and Marine Division of Geoscience Australia.