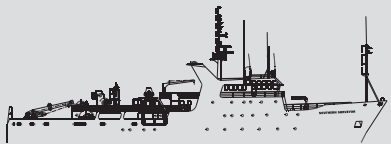

MARINE
NATIONAL FACILITY

RV *Southern Surveyor*

2005
program

CSIRO

voyage summary SS03/2005

SS03/2005

Biogophysical characterisation of northern Australia marine ecosystems: Assessing biophysical relations, ecosystem biodiversity, and surrogacy.

Itinerary

Departed Cairns, Queensland 1330 hrs Wednesday 23 February 2005
Arrived Weipa, Queensland 1000 hrs Monday 21 March 2005

Principal Investigator(s)

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Scientific Objectives

The survey provided quantitative data for the development of knowledge and tools for managing the effects of prawn trawling on the benthic ecosystems and communities of the Northern Prawn Fishery. It characterised the impacts of trawling on benthic communities and key ecosystem processes in the Gulf of Carpentaria using the wide array of sampling equipment simultaneously on the RV Southern Surveyor.

Voyage Objectives

The survey design was done around a natural experiment (i.e. the existing human "manipulation" of different levels disturbance on the benthos) to test the effects of trawling on benthic biota and ecosystem processes. There were a total of 127 sampling stations. At each location we sampled in the day and night. The stations were distributed among three trawling intensity strata and day/night within three key habitat types (Regions). At each sampling station we: (1) sampled biota with a prawn sampling net and epibenthic sled; (2) collected surface sediments with a box core; (3) collected water samples with the CTD; and (4) measured currents with an underway ADCP. In addition we will also deployed moored instruments to measure currents and sediment flux at two sites.

Voyage Track

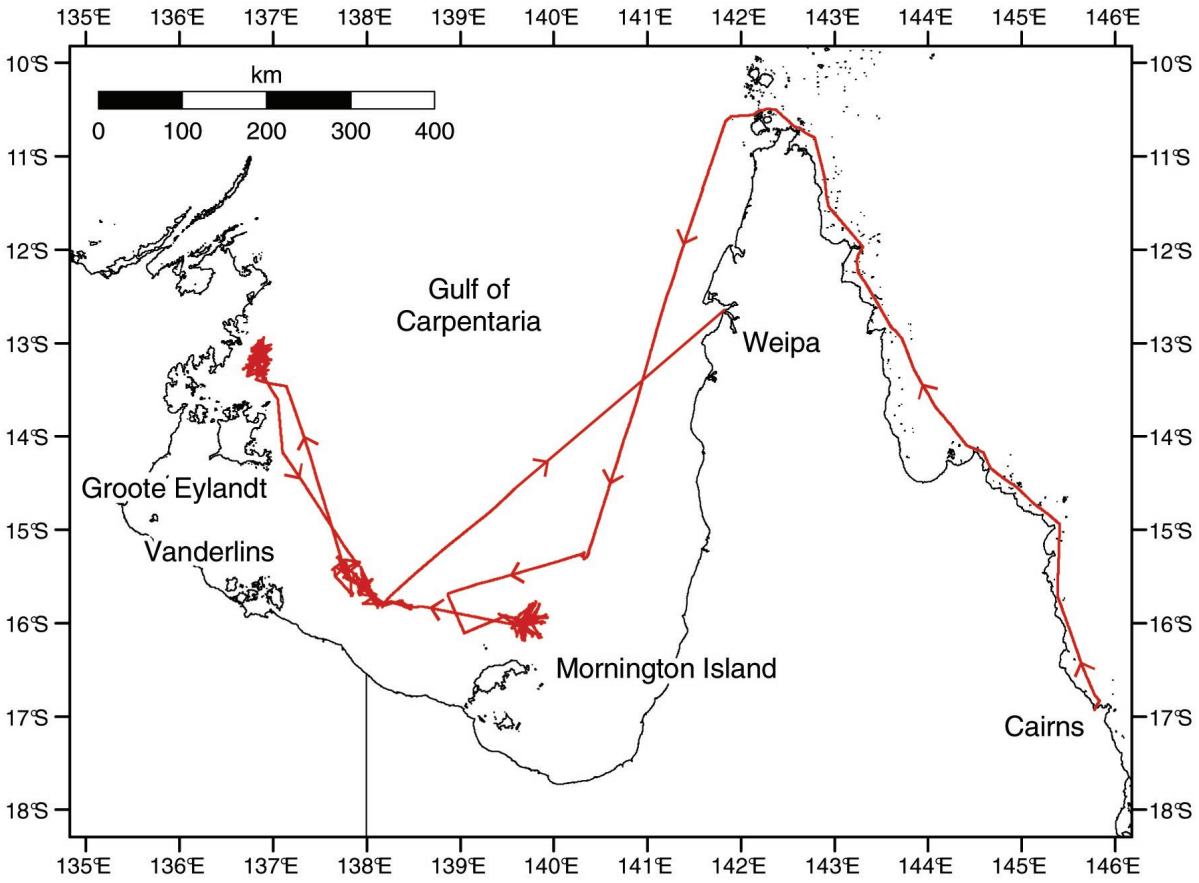

Figure 1: Voyage track for SS03/2005 departing Cairns on 23 February 2005 and arriving Weipa 21 March 2005. The voyage track is approximately 7000 km long.

Results

This voyage was a collaborative effort between CSIRO Marine Research (CMR), Geosciences Australia (GA) and the Department of Environment and Heritage – National Oceans Office (DEH/NOO). The voyage objectives were designed to satisfy a shared set of objectives. Further SS03/2005 would be followed by a complementary voyage (SS04/2005) manned by GA and CMR scientists and funded by GA and DEH/NOO.

Geological Sampling

The geological sampling program overall was highly successful, with 127 sites sampled, including the three target regions, reef areas, and current meter and BRUCE mooring sites. A total of 125 box cores were sub sampled using a 90 mm diameter minicore. An additional 23 bulk samples were taken from selected box cores to provide duplicate samples or where the sediments were unsuitable for coring.

Samples to measure suspended sediment concentrations were taken from 125 CTD samples. These will be analysed to provide information on sediment concentration and composition in the water column.

Nine (9) rock samples were also collected from benthic sled hauls, mainly in the region of the Vanderlins where there is much hard ground. Some of these samples appear to be reefal limestones, but require further analysis.

The box corer yielded excellent results with typical recoveries of 20 to 22 cm depth. Surface sediments were particularly well preserved in the bulk of samples. The sample sites encompass a range of habitat types, so will provide a good data set for investigating surrogates for benthic habitats.

The minicores collected will be analysed using a multi-sensor core logger which provides data on density and other sediment changes downcore. These data together with analysis of sediments and microfossil content will be used to interpret changes in sea floor conditions and biota through the last sea level rise. Surface minicore and bulk samples will be analysed for grain size, using sieve and laser techniques, to provide information on modern environments.

The diverse range of habitats sampled will provide an excellent dataset for testing relationships between geological and biological distributions, with sampling prior to and following Cyclone Ingrid allowing an unexpected opportunity to study the effects of these events on the sea floor environments.

The Geoscience Australia instrument frame, BRUCE (Benthic Research frame for Underwater sediment Concentration Experiments) was deployed on the top of the reef at the north-western end of the reef at location 15° 42.024′ S, 138° 52.029′ E in 26.0 m water depth. The Acoustic Doppler Current Profiler (Angus, son of BRUCE) mooring was deployed in the narrow tidal channel located mid-way between the BRUCE mooring site and Mornington Island at location 16° 5.706′ S, 139° 2.418′ E in 40.8 m water depth. Both deployments were left for recovery on the following leg of the voyage. These arrays are designed to measure currents, temperature, salinity, and turbidity.

Swath mapping was carried out during sampling activity within regions. Due to a problem with the sound velocity probe, sound velocity data was manually fed into the system. With this solution we obtained reasonable swath coverage, although it is relatively noisy.

Biological sampling

CMR in collaboration with DEH/NOO had three principal objectives: (1) to characterise the benthic communities in the Gulf of Carpentaria; (2) measure key benthic ecosystem processes; and (3) measure the effects of trawling on the benthic communities and these ecosystem processes. These objectives satisfy long-term needs to: measure the biodiversity of the Gulf; understand the nutrient dynamics that underpin it and the prawn fishery it supports; and be able to assess the impacts of trawling. All these objectives contribute to both ensuring sustainability of the prawn fishery and also designing Marine Protected Areas (MPAs) in shallow tropical waters of northern Australia.

1. Characterise benthic communities

The benthic community was characterised by a combination of geological and biological sampling using a box corer, benthic sled and a modified prawn trawl at 127 stations in three Regions (Mornington Island, Vanderlins Islands, and Groote Eylandt) (Appendix 1 has a full listing of the gear deployments (Operation Numbers) for all stations). The Regions were chosen to maximise the degree of environmental variation present in the Gulf of Carpentaria. The selection and delineation of the regions was done by analysing previous environmental and fisheries data. For the benthic characterisation objective the benthic sled was deployed 124 times. Live animals were sorted from the catches on-board and preserved by either freezing or storing in ethanol or formalin. These samples await further analysis by taxonomic experts from the Queensland and Northern Territory Museums. The trawl was deployed 155 times. Most catches were sorted at sea as time permitted. Of the sorted samples fish and invertebrates were identified and enumerated to lowest taxonomic classification possible. Over 75,000 fish from 258 species were identified and over 20,000 of those were weighed and measured. All invertebrates and unidentified fish await taxonomic investigation before further processing. The box corer was deployed 368 times for benthic community analysis as well as geological and biogeochemical analysis (see next sections). Benthic invertebrates were sieved from the sediment samples and preserved for further analysis.

2. Characterise key ecosystem processes

The principal ecosystem processes that were examined on this voyage were nitrogen cycling (nitrogen fixation and denitrification) and measurements of sediment oxygen demand. For nitrogen cycle studies a total of 166 samples were incubated on board (Table 1) and await further gas chromatograph and mass spectrometer analysis.

Sediment oxygen demand was measured during 12 h incubations on board. Preliminary analysis show high variability within and between regions. The Mornington Island Region appears to have both the coarsest sediments and the lowest sediment oxygen demand (Figure2). Both the Vanderlins and Groote Eylandt regions had finer sediments and higher oxygen demands indicating higher biological activity.

3. Quantify the effects of commercial trawling

To examine the effects of commercial trawling the 42 sample locations within each geographic region were allocated randomly across three levels of trawl intensity (Table 3). Locations were adjusted where necessary to eliminate extreme clumping or avoid untrawlable ground. The trawl intensity was determined by analysing AFMA's Vessel Monitoring System (VMS) data for the past 4 years (Figure 2 is an example of sample allocation for the Vanderlins Region). Sampling was also divided equally between daytime (0700 to 1700 hrs) and nighttime (1900 to 0500 hrs) to both capture day/night variability and avoid animals that were active during dawn and dusk. Dawn and dusk periods were also used for additional trawl samples to examine feeding behaviour of the trawled fishes. The same samples collected for the benthic characterisation objective will be used to address this objective with the added refinement of incorporating the trawl intensity classification on the data.

Voyage Narrative

The R/V Southern Surveyor left Cairns at approximately1330 hrs and off-loaded the pilot an hour later. We steamed north, inside the Great Barrier reef with 17 knot south-easterly winds and a gentle following sea. The first 3 d were spent steaming to our first sampling station in the south-eastern Gulf of Carpentaria. During the steam sampling equipment, instrument arrays and laboratories were set up. This was accompanied by a safety induction and vessel tour, a fire drill, an induction by the Voyage Manager, and a series of Job Hazard Analysis (JHA) meetings and Tool Box meetings for new crew members.

We arrived at our first sampling station around 0630 on 26/2/05 (Table 3). Here, adjacent to the reef GA had found on its last voyage to the Gulf (SS04/2003, May 2003), we deployed our soft sediment sampling gear for the first time. Hydraulic pump failures prevented us from completing all the planned sampling so we departed around 1900 hrs to the "Bruce" and ADCP mooring stations west of Mornington Island.

"Bruce" was deployed 0700 hrs 27/2/05 and the ADCP ("Angus", son of Bruce) around 1140 hrs. Intermittent hydraulic problems prevented the full suite of samples being taken near these two mooring sites. At 1820 hrs we started our first series of samples in our Regional surveys (Station 7, Mornington Region; Table 3). By day 6 (28/2/05) the hydraulic problems had been resolved and the ship was getting into a rhythm of CTD profiling, box corer sampling, dredging, trawling and sample handling. We were starting to achieve seven stations per day which was our target. With the exception of two small intense squalls the weather up until now was incredibly calm. And the Chief Scientist had a surprise Birthday Party!

Day 7, Tuesday 1 March 2005 will be remembered as the attack of the heart urchins (*Maretia planulata*). Approximately 3 to 5 t were caught in the trawl, which couldn't be brought on board; the cod-end was torn and it took ca. 3 h to replace the net. Their abundance, based on numbers in the box corer samples, was estimated at ca. 100 m^2. These high abundances were a feature of a whole suite of stations north-west of Mornington Island where trawl durations and station locations had to be modified. Wayne Rochester's adaptive sampling protocol was coming into its own. We also started sending the web-based "Ship to shore" articles about activities on board to be mounted on the CMR and National Facility web pages. We completed sampling in Region 1 by 1800 hrs on Day 12 (6/3/05) and started sampling in Region 2 at ca. 2000 hrs. Weather was still incredibly kind – you couldn't see the horizon except for the point of the sea-sky reflection – and the Captain was predicting we'd pay for it later (How prescient he was).

The Vanderlins Region is characterised by a lot of untrawlable hard bottom (Fig. 3). The adaptive sampling protocol associated with depth sounder interpretation was used extensively to find suitable sampling sites within each of the three trawl intensities. At 0300 hrs on Day 17 (11/3/05) the Captain decided to take evasive action as Cyclone Ingrid had crossed Cape York and moved into the Gulf and was predicted to move south-west. We suspended sampling and steamed for our third sampling region, north of Groote Eylandt.

Sampling re-commenced at 1600 hrs. Winds were increasing (25 to 30 kts) and Ingrid was tracking north-westerly across the Gulf. We ceased sampling about 0200 when winds reached 40 to 50 kts as gear could not longer be safely deployed. Winds eased by dawn and sampling resumed by 0700 hrs. Seas were mixed, and there was a lot of sediment in the water column. It was too rough to weigh animals on the electronic balances, so we started boxing and freezing the fish catches for later analysis. We continued to defer sample processing for the next 2 d to make up for lost time and were able to make up all the time lost from steaming and suspending sampling by completing 10 to 11 stations per day.

Sampling in the Groote Region finished on Day 21 (15/3/05) and after a 15 h steam re-commenced at 1200 hrs Day 22 at the unfinished stations near the Vanderlins. The weather continued to be rainy and squally but sampling went on routinely. "Kenny the Kingfisher" landed exhausted on deck and immediately became the ship's mascot. He/she lived in a box in the Wet lab and was hand-fed round the clock. Kenny was released 3 d later off Weipa. Sampling was completed ca 0100 on Day 26 (20/3/05) and we commenced the 30 h steam to Weipa. A farewell barbeque and a Customs flyover were the highlights, while we broke down the sampling equipment and cleaned up the laboratories and accommodation.

The pilot came on board at the Weipa fairway buoy at 0830 on Day 27 (21/3/05) and we were docked at Evans Landing Weipa at 1000 hrs. Offloading was hampered by fueling operations at Evans Landing and another ship on the Humbug Wharf. The ship was moved to Humbug at 1700 hrs and offloading completed ca. 1100 hrs on day 28 (22/3/05).

Summary

Scientific achievements

All the objectives of the voyage were achieved – see earlier Results Section for more detail. The adaptive sampling protocol allowed us to sample all the planned sites in three Regions at three trawl intensities evenly distributed over day and night samples. Additional dawn/dusk trawl samples were taken for gut-content analysis. The combined sampling between GA and CMR centred around the CTD and box corer was also very successful. Samples await further laboratory analysis.

Personnel

Scientific crew

Name	Organisation	Role
Pamela Brodie	Southern Surveyor	Computer/data manager, Voyage Manager
Neale Johnston	Southern Surveyor	Hydrochemist
Lindsay McDonald	Southern Surveyor	Electronics Technician
Rodrigo Bustamante	CMR	Principal Investigator, benthic infauna
Peter Rothlisberg	CMR	Chief Scientist, benthic biogeochemistry
Michele Burford	Griffith University	Primary productivity, benthic biogeochemistry
Vicki Passlow	Geoscience Australia	Sediment sampling
Alix Post	Geoscience Australia	Sediment sampling
John Salini	CMR	Fish biology & taxonomy
Ted Wassenberg	CMR	Invertebrate biology & taxonomy
Tom Okey	CMR	Benthic infauna
Wayne Rochester	CMR	Sampling design & data analysis
Gary Fry	CMR	Fish biology & taxonomy
Mark Tonks	CMR	Invertebrate biology & taxonomy

Ship's crew

Ian Taylor	Master
Samantha Durnian	Chief Officer
Robert Ferries	Second Officer, Fishing Master
John Morton	Chief Engineer
Jim Hickie	First Engineer
Chris Heap	Second Engineer
Malcolm McDougall	Bosun
Graham McDougall	Day work Integrated Rating (IR)
Mark McRae	IR
Patrick Chamberlain	IR
Tony van Rooy	IR
Phillip French	Greaser
Charmaine Aylett	Chief Stewart
Andy Goss	Chief Cook
Adam Edwards	Second Cook

Acknowledgements

- Ian Taylor (Master) and crew, especially John Morton (Chief Engineer) and staff for battling and beating the early hydraulic problems
- Doug Chetwynd (CMR) for early data base development under limited time frames and Wayne Rochester (CMR) for keeping it alive and modifying it underway
- Ship Support crew (Pamela Brodie, Lindsay MacDonald and Neale Johnston) were extremely professional and unflappable, all needs were met and problems solved often on the run
- Ted Wassenberg and John Salini for logistical planning and watch leading. Their experience and professionalism ensured a successful outcome.
- Vicki Passlow and Alix Post (GA) would also like to acknowledge the assistance of the crew in setting up and deploying BRUCE and the ADCP, as well as in the sampling program.

Peter C Rothlisberg
Chief Scientist

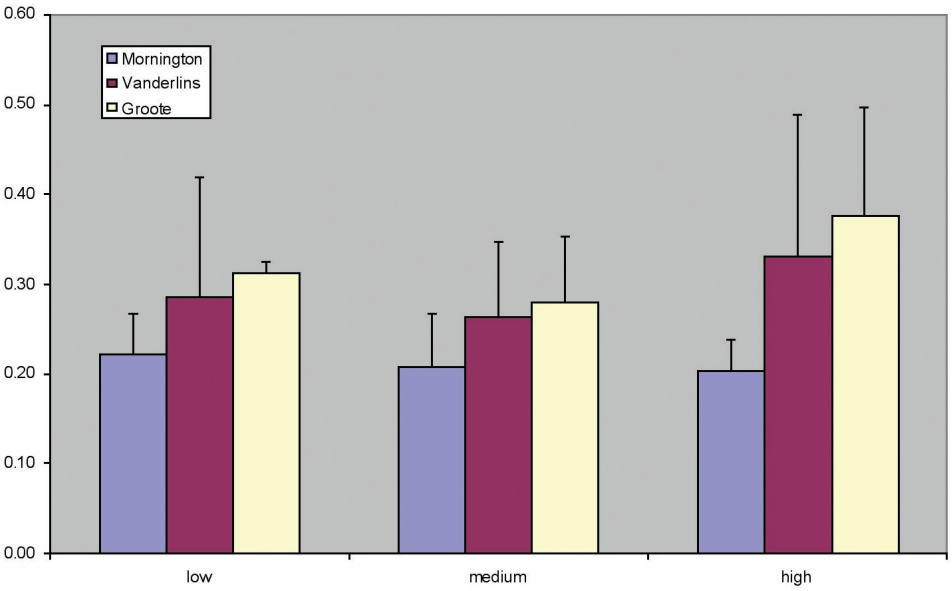

Figure 2: Measurements of sediment oxygen demand at three Regions and three Levels of trawl intensity.

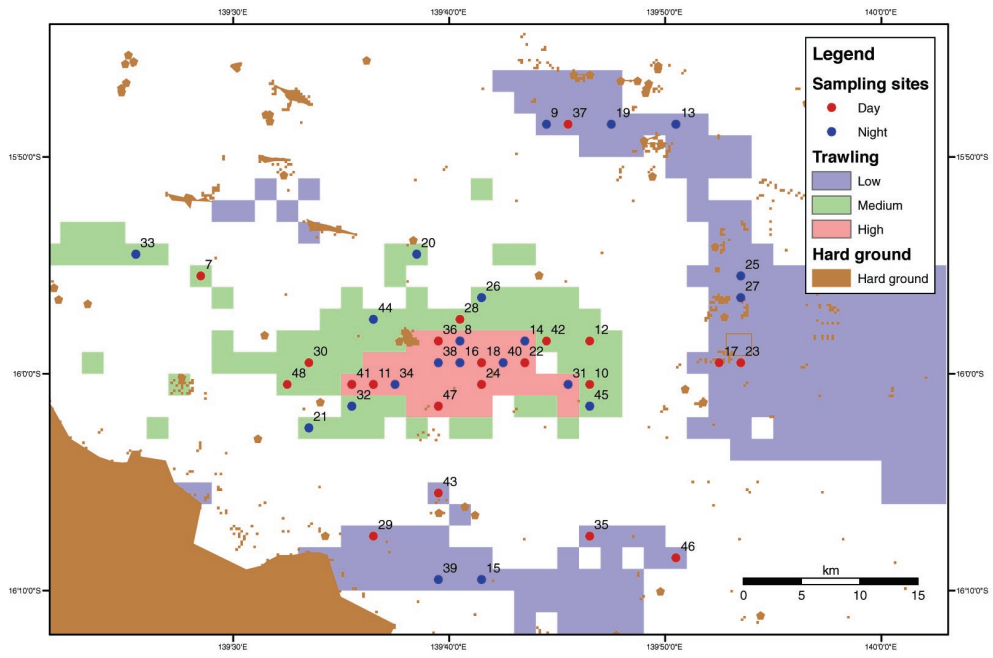

Figure 3: Map of sampling locations in Mornington Region showing random allocation of day and night stations with respect to high, medium, and low trawling intensity.

Table 1: The number of nitrogen fixation, denitrification and sediment oxygen samples that were incubated on board.

Parameter	Region	High	Medium	Low	Total
N fixation – water column	Mornington	0	0	12	12
	Vanderlins	12	0	0	12
	Groote	0	0	0	0
Total					**24**
N fixation – sediment	Mornington	5	0	5	10
	Vanderlins	4	4	0	8
	Groote	2	2	4	8
Total					**26**
15N denitrification	Mornington	12	12	20	44
	Vanderlins	12	12	12	36
	Groote	12	12	12	36
Total					**116**
Sediment oxygen demand	Mornington	8	8	6	22
	Vanderlins	8	8	8	24
	Groote	8	8	8	24
Total					**70**

Table 2: The number of benthic sampling stations stratified by Region and Trawl Intensity. Equal numbers of daytime (7) and nighttime (7) samples were undertaken in each strata*.

Region	Trawl intensity	Number of stations
Mornington	High	14
	Medium	14
	Low	14
Vanderlins	High	14
	Medium	12*
	Low	14
Groote	High	14
	Medium	14
	Low	14

*two daylight samples were selectively dropped from the design (medium intensity stratum at the Vanderlin Islands) in order to complete the voyage on schedule

Table 3: SS03/2005 Station location, date and Region.

Site	Date	Latitude	Longitude	Region	Site	Date	Latitude	Longitude	Region
1	2005 02 26	–15.26	140.36	GA	66	2005 03 09	–15.34	137.89	Vanderlins
2	2005 02 26	–15.26	140.29	GA	67	2005 03 09	–15.51	137.76	Vanderlins
3	2005 02 26	–15.28	140.30	GA	68	2005 03 10	–15.59	137.96	Vanderlins
4	2005 02 26	–15.31	140.30	GA	69	2005 03 10	–15.77	138.14	Vanderlins
5	2005 02 27	–15.70	138.87	GA	70	2005 03 10	–15.77	138.33	Vanderlins
6	2005 02 27	–16.10	139.04	GA	71	2005 03 10	–15.81	138.14	Vanderlins
7	2005 02 27	–15.92	139.48	Mornington	72	2005 03 10	–15.67	138.06	Vanderlins
8	2005 02 27	–15.97	139.68	Mornington	73	2005 03 10	–15.52	137.79	Vanderlins
9	2005 02 28	–15.81	139.74	Mornington	74	2005 03 11	–13.39	136.83	Groote
10	2005 02 28	–16.01	139.78	Mornington	75	2005 03 11	–13.17	136.83	Groote
11	2005 02 28	–16.01	139.61	Mornington	76	2005 03 11	–13.34	136.84	Groote
12	2005 02 28	–15.97	139.78	Mornington	77	2005 03 12	–13.19	136.93	Groote
13	2005 02 28	–15.81	139.84	Mornington	78	2005 03 12	–13.22	136.79	Groote
14	2005 02 28	–15.97	139.73	Mornington	79	2005 03 12	–13.29	136.78	Groote
15	2005 03 01	–16.16	139.69	Mornington	80	2005 03 12	–13.27	136.86	Groote
16	2005 03 01	–15.99	139.68	Mornington	81	2005 03 12	–13.21	136.84	Groote
17	2005 03 01	–15.99	139.88	Mornington	82	2005 03 12	–13.29	136.93	Groote
18	2005 03 01	–15.99	139.69	Mornington	83	2005 03 13	–13.37	136.91	Groote
19	2005 03 01	–15.81	139.79	Mornington	84	2005 03 13	–13.31	136.89	Groote
20	2005 03 02	–15.91	139.64	Mornington	85	2005 03 13	–13.36	136.89	Groote
21	2005 03 02	–16.04	139.56	Mornington	86	2005 03 13	–13.27	136.91	Groote
22	2005 03 02	–15.99	139.73	Mornington	87	2005 03 13	–13.32	136.83	Groote
23	2005 03 02	–15.99	139.89	Mornington	88	2005 03 13	–13.34	136.91	Groote
24	2005 03 02	–16.01	139.69	Mornington	89	2005 03 13	–13.31	136.84	Groote
25	2005 03 02	–15.92	139.89	Mornington	90	2005 03 13	–13.34	136.76	Groote
26	2005 03 02	–15.94	139.69	Mornington	91	2005 03 13	–13.16	136.76	Groote
27	2005 03 03	–15.94	139.89	Mornington	92	2005 03 14	–13.06	136.86	Groote
28	2005 03 03	–15.96	139.68	Mornington	93	2005 03 14	–13.26	136.86	Groote
29	2005 03 03	–16.12	139.61	Mornington	94	2005 03 14	–13.07	136.86	Groote
30	2005 03 03	–15.99	139.56	Mornington	95	2005 03 14	–13.24	136.93	Groote
31	2005 03 03	–16.01	139.76	Mornington	96	2005 03 14	–13.04	136.84	Groote
32	2005 03 03	–16.02	139.59	Mornington	97	2005 03 14	–13.17	136.94	Groote
33	2005 03 04	–15.91	139.43	Mornington	98	2005 03 14	–13.07	136.81	Groote
34	2005 03 04	–16.01	139.63	Mornington	99	2005 03 15	–13.02	136.96	Groote
35	2005 03 04	–16.12	139.78	Mornington	100	2005 03 15	–13.19	136.83	Groote
36	2005 03 04	–15.97	139.66	Mornington	101	2005 03 15	–13.07	136.96	Groote
37	2005 03 04	–15.81	139.76	Mornington	102	2005 03 15	–13.07	136.78	Groote
38	2005 03 04	–15.99	139.66	Mornington	103	2005 03 15	–12.96	136.89	Groote
39	2005 03 05	–16.16	139.66	Mornington	104	2005 03 15	–13.12	136.91	Groote
40	2005 03 05	–15.99	139.71	Mornington	105	2005 03 15	–13.24	136.76	Groote
41	2005 03 05	–16.01	139.59	Mornington	106	2005 03 15	–13.14	136.79	Groote
42	2005 03 05	–15.97	139.74	Mornington	107	2005 03 16	–12.99	136.84	Groote
43	2005 03 05	–16.09	139.66	Mornington	108	2005 03 16	–13.16	136.94	Groote
44	2005 03 05	–15.96	139.61	Mornington	109	2005 03 16	–13.17	136.76	Groote
45	2005 03 05	–16.02	139.78	Mornington	110	2005 03 16	–13.16	136.91	Groote
46	2005 03 06	–16.14	139.84	Mornington	111	2005 03 16	–12.99	136.88	Groote
47	2005 03 06	–16.02	139.66	Mornington	112	2005 03 16	–13.14	136.86	Groote
48	2005 03 06	–16.01	139.54	Mornington	113	2005 03 16	–13.31	136.76	Groote
49	2005 03 06	–15.84	138.46	Vanderlins	114	2005 03 17	–13.11	136.84	Groote
50	2005 03 07	–15.77	138.28	Vanderlins	115	2005 03 17	–13.27	136.84	Groote
51	2005 03 07	–15.79	138.09	Vanderlins	116	2005 03 17	–15.36	137.89	Vanderlins
52	2005 03 07	–15.66	138.01	Vanderlins	117	2005 03 17	–15.42	137.73	Vanderlins
53	2005 03 07	–15.79	138.19	Vanderlins	118	2005 03 18	–15.29	137.71	Vanderlins
54	2005 03 07	–15.72	138.06	Vanderlins	119	2005 03 18	–15.36	137.78	Vanderlins
55	2005 03 07	–15.61	137.94	Vanderlins	120	2005 03 18	–15.41	137.66	Vanderlins
56	2005 03 08	–15.54	138.04	Vanderlins	121	2005 03 18	–15.52	137.84	Vanderlins
57	2005 03 08	–15.71	138.06	Vanderlins	122	2005 03 18	–15.69	137.84	Vanderlins
58	2005 03 08	–15.57	137.96	Vanderlins	123	2005 03 18	–15.49	137.66	Vanderlins
59	2005 03 08	–15.44	137.94	Vanderlins	124	2005 03 18	–15.39	137.78	Vanderlins
60	2005 03 08	–15.52	137.99	Vanderlins	125	2005 03 19	–15.62	138.03	Vanderlins
61	2005 03 08	–15.69	137.93	Vanderlins	126	2005 03 19	–15.81	138.11	Vanderlins
62	2005 03 09	–15.54	137.84	Vanderlins	127	2005 03 19	–15.77	138.24	Vanderlins
63	2005 03 09	–15.41	137.78	Vanderlins	128	2005 03 19	–15.82	138.48	Vanderlins
64	2005 03 09	–15.29	137.69	Vanderlins	129	2005 03 19	–15.77	138.38	Vanderlins
65	2005 03 09	–15.44	137.76	Vanderlins	130	2005 03 19	–15.81	138.18	Vanderlins

Appendix 1: Table of operation numbers for all gear deployments

Deployments

Site	Sled	Trawl	Dawn	Dusk	CTD	Grabs	Not for analysis (e.g. failed)
1							3 (sled), 4 (trawl), 5 (trawl), 6 (CTD)
5							10 (CTD), 11 (grab), 16 (other)
6							12 (grab), 13 (grab), 17 (other), 19 (grab), 20 (grab)
7	21	22			23	24, 25, 28	26 (grab), 27 (grab)
8	29	30			31	32, 33, 35, 36	34 (grab)
9	37	38			39	40, 42, 43	41 (grab)
10	47	48	46		49	50, 51, 52	44 (sled), 45 (sled)
11	53	54			55	56, 57, 58	
12	59	60			61	62, 63	
13	64	70		69	65	66, 67, 68	
14	71	72			73	74, 75, 77	76 (grab)
15	78	79			80	82, 83, 84	81 (grab)
16	85	86	87		88	89, 90	
17	91	92			93	95, 96, 97	94 (grab)
18	98	99			100	101, 102	
19	104	108			105	106, 107	103 (trawl)
20	109	110			111	112, 113	
21	114	115	116		117	118, 119, 120, 121, 123	122 (grab)
22	124	125			126	128, 129, 131, 132	127 (grab), 130 (grab)
23	133	134			135	136, 141, 142	137 (grab), 138 (grab), 139 (grab), 140 (grab)
24	143	144		150	145	146, 148	147 (grab), 149 (grab)
25	151	152			153	155, 156, 157	154 (grab)
26	158	159			160	161, 164	162 (grab), 163 (grab)
27	165	166	171		167	169, 170	168 (grab)
28	174	173			175	176, 177, 179	172 (sled), 178 (grab)
29	180	181			182	183, 184	
30	185	186			187	188, 189	
31	190	193		191	192	194, 195, 196	
32	197	198			199	200, 201, 202	
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