



**MARINE**  
**NATIONAL FACILITY**

# 2005

*RV Southern Surveyor*  
program



CSIRO

**voyagesummary**SS10/2005

## SS10/2005

Mapping benthic ecosystems on the deep continental shelf and slope in Australia's "South West Region" to understand evolution and biogeography and support implementation of the SW Regional Marine Plan and Commonwealth Marine Protected Areas.

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### Itinerary

#### Leg 1

Departed Fremantle 0600 hrs, Friday 18th November 2005

Arrived Fremantle 1400 hrs, Wednesday 30th November 2005

#### Leg 2

Departed Fremantle 0800 hrs, Thursday 1st December 2005

Arrived Dampier 1200 hrs, Wednesday 14th December 2005

### Principal Investigator

Dr Alan Williams (Chief Scientist, Leg 1)

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### Scientific Objectives

The aims of the project were: 1) to apply targeted field-based observation to develop, test, refine and validate multiple use management frameworks developed for the SW Region as part of Regional Marine Planning under Australia's Oceans Policy, and 2) explore and characterise marine ecosystems of the SW Region.

Ecosystem-based, integrated regional marine planning for the Australian marine environment depends on the identification of natural regions as planning units. Therefore, there are near-term requirements for regionalisation and mapping at a range of relatively fine scales throughout the Australian Marine Jurisdiction (AMJ). Given the vast size of the AMJ and the cost of marine surveys, Australia needs to develop the most efficient and cost-effective suite of methods for surveys, and to establish a national mapping program using an optimal methodology. It has been argued for some time that the most cost-efficient way to conduct such surveys will be by using multibeam acoustics (swath mapping) together with an optimally-designed, targeted program of geological and biological 'ground-truth' sampling. However, despite the already-demonstrated benefits of multibeam acoustics for mapping the physical seabed at fine resolution (10s m) over intermediate scales (10s to 100s of sq km), there are still technical and methodological issues to investigate before a multibeam-based, optimised method for predictive and reliable habitat assessment is fully developed.

The data for this project are being collected during two surveys. Survey 1 was completed in July/ August (SS07/2005) when all the survey sites were mapped using multibeam acoustics, surveyed with the towed, high-resolution video system and sampled with sediment grabs. This second survey ran a reciprocal course and collected the complementary benthic invertebrate epifauna and infauna using benthic sleds. Two sled designs were used: a robust, heavy design for rocky terrains and a light beam-sled for sediment terrains. There was an emphasis of taxonomic effort on taxa that can be worked up to named species within 12 months (enabling comparison to pre-existing data); taxa that will be highly informative to biogeographic analysis (e.g. with limited dispersal mechanisms); taxa amenable to CO1 gene analysis "Bar-coding"; and commercial species. Surrogate-based metrics of biodiversity will be investigated based on morphotypes, and there will be a focus on those taxa amenable to monitoring (e.g. by non-destructive photographic sampling for MPA performance assessment).

Sampling was targeted at nested spatial scales of habitat – terrains of sediment and rocky substrata comprising features (mostly canyons and sediments terraces of the continental slope), within depth zones, across latitudes – to determine how biodiversity is distributed at particular scales. At the highest level, samples are allocated to enable comparison of the benthic bioregions off the west and southwest coasts of Western Australia: the Northwest Province, Central Western Transition Zone, Central Western Province, South-western Transition Zone and Southern Province. To the extent possible, sampling targeted sites that may become candidate sites for MPAs, or suited to the establishment of scientific reference sites, and that would demonstrate the different outcomes from alternative conservations strategies.

The survey program (two voyages) will address four primary objectives:

- 1) test hypotheses on the evolution and biogeography of Australia's biodiversity, in particular relating to species composition, distribution patterns and taxonomic surrogacy
- 2) validate and refine CSIRO's optimised methodology for mapping deep water benthic ecosystems on the western continental margin and in sub-tropical locations to enhance its application to natural resource management at a national scale
- 3) document the benthic biodiversity and identify areas of high conservation values in the context of Commonwealth MPA declaration
- 4) validate, and permit refinement of, a marine bioregionalisation during the development of the SW Regional Marine Plan by the National Oceans Office

### **Voyage Objectives**

At depths of 100 m, 200 m, 400 m, 700 m and ~1000 m, and possibly a deeper site, in each survey area:

1. Collect benthic invertebrate epifauna and infauna using benthic sleds
2. Fill gaps in the sediment sampling program from SS07/2005
3. Fill gaps in the swath mapping program from SS07/2005

### Secondary objectives:

4. Collect water column acoustic backscatter at multiple frequencies

### Voyage Track

Outer shelf and upper slope (~100 and 400 m isobaths) between transects and focus survey areas, Fremantle to Fremantle via Albany, and Fremantle to Dampier.



A map showing the voyage track for SS10/22205. The *Southern Surveyor* departed from Fremantle at the start of leg 1 and travelled south to a position east of Albany before returning to Fremantle. Leg 2 departed from Fremantle and travelled north ending in Dampier.

## Results

### *1. Collect benthic invertebrate epifauna and infauna using benthic sleds*

A total of 132 benthic sled samples covered virtually all planned stations at depths of 100 m, 200 m, 400 m, 700 m and 1000 m, and additional stations in focus areas. Separate targeting of hard and soft seabed terrain types was undertaken successfully in most areas. Macrofauna were sorted to the lowest possible taxonomic resolution on board by a team of specialist taxonomists. In total, approximately 1,750 taxa were photographed, catalogued and preserved. These included large collections of the priority taxa for the project: sponges (~550 putative species), cnidarians (e.g. anemones, corals) (~127), molluscs (~322), echinoderms (~261, including 110 brittlestar species), and crustaceans (378). Diversity was exceptionally high in some taxa, e.g. the brachyurans (true crabs) in which the ~180 taxa collected represented all the subtidal families except Atelecyclidaea and included a number of very rare deep-water groups, with several genera not recorded from Australia, and species that are either new records or new species. All material has been freighted to the relevant museum specialists in Australia and detailed taxonomic work is already underway on the priority groups.

### *2. Fill gaps in the sediment sampling program from SS07/2005*

Few sediment sample gaps existed in the program from the first voyage, but some additional samples were collected.

### *3. Fill gaps in the swath mapping program from SS07/2005*

Gap-filling data were collected successfully at target locations, including unsampled sections of the 100 and 400 m isobaths; map data were processed and products made on board to assist with the targeted sled sampling.

### *4. Collect water column acoustic backscatter at multiple frequencies*

Samples were collected successfully from the entire voyage.

## Voyage Narrative

### Leg 1

#### **Friday 18th November**

Following a very busy period of preparations alongside in Fremantle, Southern Surveyor departed for the beginning of a month-long survey off the coast of Western Australia at 0600 hours.

Calibrating the Sonardyne system was the first task (Op 1), and this took until about 1400 hours when Jeff Cordell departed the vessel by launch close to Fremantle. From there we headed out to begin sampling at the Two Rocks transect on the 100 m station. Safety induction, Muster Drill and a science briefing were completed on the way. Operation 2 was a benthic faunal sample using the new 'French beam trawl' at T4 100. A large catch was taken including large bryozoans and sponges.

Operation 3 was an unsuccessful beam trawl shot.

#### **Saturday 19th November**

Operation 4 was a successful beam trawl sample from soft bottom in 400 m; 91 taxa were identified. Operation 5 used the Sherman sled for the first time to target hard bottom in 400 m but it overshot and took no catch. Operation 6 was a successful repeat

shot on hard bottom at T4 400. Operation 7 was a successful Sherman sample on hard bottom at T4 700; interestingly a lot of Solomosmila coral matrix was collected, although it didn't contain many animals. Operation 8 was targeted at soft bottom in 700 m with the beam trawl, but overshot. A short tow resulted in major damage to the net framework and no catch, but no components were lost. Operation 9 was a Sherman tow on soft bottom at T4 1000; catch was small but representative. Operation 10 was a Sherman tow on rubbly bottom in 1000 m; again a small but representative catch. From here we moved in to complete the Transect 4 sampling with a sample at 200 m. Images showed a proliferation of large epifauna, so the Sherman sled was used. A large catch dominated by sponges and bryozoans resulted. We steamed south from here to the Perth Canyon where a target shot with the Sherman was completed at the outermost photo transect in about 480 m. A small representative catch resulted.

#### **Sunday 20th November**

Steamed to Latitude site 13 off Bunbury and completed a beam trawl sample at 400 m (Op 13) and a Sherman sample at 100 m (Op 14). Both produced good samples: the beam trawl a small but diverse catch including many crustaceans and echinoids; the Sherman tow a large catch dominated by sponges. Steamed south towards the Mentelle Latitude site 14.

#### **Monday 21st November**

Took the first sample in 100 m with the Sherman and collected another large catch dominated by sponges and bryozoan rubble (Op 15, L14 100S). The beam trawl sample at 400 m was small due to insufficient wire out and poor bottom contact (Op 16); adequate but to repeat if possible. Steamed to D'Entrecasteaux Latitude site 15 and completed successful sampling at 400 m with the beam trawl (Op 17) 100 m with Sherman (Op 18). Commenced the long steam to the next site: L13 off Point Hillier.

#### **Tuesday 22nd November**

Commenced sampling on the 400 m contour during the late morning with the beam trawl. Operation 19 was on L16 400 soft: the beam trawl was put down too early and pinned up fairly quickly. A small but diverse catch was taken; all components of the gear were recovered. A repeat with the Sherman at the same site (Op 20) provided a similar, complementary sample. After this the 100 m site, L16 100S was sampled with the Sherman (Op 21). This resulted in a small but adequate sample. Steamed to next survey area: Transect 6 off Albany. Commenced with a Sherman shot on T6 100 – a relatively hard ground, but just sand and rubble with moderately dense communities of erect epifauna. A six-minute tow (Op 22) produced a large sample that took until the end of the shift to process.

#### **Wednesday 23rd November**

Operation 23 was at the T6 700 H site where the camera pinned up. We shot this at a down slope angle to avoid a pin up; a small catch yielded several rocks and 22 species. Operation 24 was a failed beam trawl at T6 400 S, and Operation 25 a repeat that yielded 40 species. The next sample at T6 200 S (Op 26) was a beam trawl that took a small catch of sponges and rubble with 43 species. Operation 27 was a beam trawl at T6 700 S that produced only a small catch. This was repeated in Operation 29 when a good catch was taken. In between, a shot on the Peanut (Op 28, T6 1000 H) yielded a large bag of dead coral. Operation 30 was an unsuccessful attempt to take a small sample from rich habitat at T7 100 S/H. This was repeated in Operation 31 which yielded a modest but sufficient sample. A small but representative sample from T7 700

S taken by beam trawl during Operation 32 yielded 44 species. Operation 33 was an attempt to get the Sherman into the canyon adjacent to the transect line for a T7 400 H sample. Poor bottom contact resulted in a small sample containing only 12 species.

#### **Thursday 24th November**

Operation 34 took a good sample by beam trawl from T7 400 S. A very large bag of coral and sponges yielding ~90 species was taken during Operation 35 from T7 200 S.

Operation 36 was a beam trawl at T7 1000 S which pinned up shortly after hitting the bottom but still took a catch containing 25 species. Operation 37 was aborted. The next shot, Operation 38 at T7 200 H, was an attempt to take a sample right at the shelf edge on harder bottom with a lot of sponges. Appears to have been slightly too shallow and is effectively a duplicate of Operation 35. Operation 39 was a surgical shot at hard looking bottom in 100 m – no photo data. Operation 40 used Sherman to have another attempt at sampling T7 400 H – over the canyon rim onto hard bottom.

#### **Friday 25th November**

Operation 41 T7 1000 S was a repeat beam trawl shot on the deep station for another modest but valuable catch. A repeat of this using Sherman during Operation 42 (T7 1000 S) took a very small catch, but containing 17 species. That shot concluded work on Transect 7. We steamed to the Albany Transect 6 and sampled soft bottom in 1000 m (T6 1000 S) with the Sherman (Op 43) and beam trawl (Op 48). Two repeat shots were also done on the Peanut (T6 1000 H) (Ops 44 and 49). In between we did LADCP drops over the Peanut and the adjacent soft ground (Ops 45 and 46 respectively), and sampled hard ground at 200 m with the Sherman (Op 47).

#### **Saturday 26th November**

Work was concluded at the Albany transect in the early hours with a sample from soft bottom in 100 m (T6 100 S), after which an overnight steam took us back to Point Hillier, Latitude site L16, where we started work with a deep Sherman at L16 1000 S (Op 51). Some additional transects were run over the offshore platform feature before sampling recommenced with a beam trawl over the L16 1000 S site (Op 52). Neither gear took a good sample. Due to the lack of photo data on this feature we did a camera drift (Op 53) that provided a few average quality images, but interesting insights into the substratum.

#### **Sunday 27th November**

Operation 54 was another unsuccessful attempt to get a sample from the top of the platform with the beam trawl. From here we moved into 100 m and needed two shots with the Sherman (Ops 55, 56) to get an adequate sample from L16 100 S. Operation 57 was a good Sherman sample from L16 200 S – which included the giant sponge. From here we steamed to on to site L15 D'Entrecasteaux.

#### **Monday 28th November**

At L15 we moved into 50 m depth to get sediment samples comparable with those taken in Eastern Bass Strait. Attempted five (Ops 58-62) but it was all hard bottom and only small rocky samples were taken. We continued steaming back towards L14 Mentelle where we stopped to back fill a beam trawl sample in 400 m depth. Operation 63 at L14 400 S provided a small sample, while a further repeat (Op 64) was unsuccessful. We also attempted to take 50 m grab samples (Ops 65, 66) but again encountered only rocky ground and no good samples were taken. Continued steaming north towards Bunbury.

### **Tuesday 29th November**

At Bunbury we took the opportunity to get a replicate beam trawl sample in 400 m on the way through. Operation 67 at L13 400 S took a large catch containing many brittle stars. From here we steamed north to complete Leg 1 of the survey at the Perth Canyon. Operation 68 was a beam trawl in 400 m along a camera transect, and Operation 69 a Sherman along a camera transect in 200 m. These were followed by a series of deep tows: Operation 70, a Sherman in 1000 m at a site in the base of the canyon, and Operation 71 a beam trawl at the same site.

### **Wednesday 30th November**

Operation 72 was a Sherman tow targeted at a deeper part of the canyon floor in 1600 m, but this returned few animals in a large sample of mud. The final biological sample was Operation 73, a repeat beam trawl sample from the 1000 m site. The remaining time before leaving was spent doing an LADCP drop at the 1600 m site (Op 74). Commenced steaming to meet the pilot at 1015 hours, and were alongside in Fremantle at 1400 hours.

## **Leg 2**

### **Thursday 1st December**

Departed 0800 hours from Fremantle and steamed north in good weather to the first sampling site at Lancelin L11. A beam trawl (Op 75) was targeted at soft ground in 400 m and yielded a good catch dominated by crustaceans (bugs) and a high number of fishes. The next Sherman (Op 76) was targeted at 100 m depth and yielded 4 bins of coarse shell/bryozoan hash. Swath mapped the 100 m contour to the Jurien L10 and T3 site and deployed a plankton tow (Op 77) for no phylosoma.

### **Friday 2nd December**

The 400 m low backscatter L9 site beam trawl (Op 78) yielded a good diverse catch (3.5 kg) with 60 specimens retained. Operation 80, a Sherman sled targeted on high backscatter at 400 m with 29 specimens retained. Operation 82 targeted a Sherman sled on the reef at the 90 m site retaining a large catch dominated by sponges (49 kg) with 106 specimens retained. Off the reef in 100 m a Sherman sled (Op 83) retained a large catch of coarse shell and bryozoan material (52 kg) with 64 specimens retained. Of note was the need to deviate the operation due to a fishing vessel.

Steamed to the Abrolhos transect site with a back log of material to process underway. At the Abrolhos 1000 m soft site a beam trawl (Op 84) retained a large catch of fish and some very large spicules (300 – 500 mm long) as well as numerous chrinoids (54 invertebrate specimens retained). Operation 85 at the 700 m soft beam trawl site retained a smaller but diverse catch (2.7 kg) dominated by fish and crustaceans.

### **Saturday 3rd December**

At the Abrolhos L9 site a 700 m hard (Op 87) and 400 m hard (Op 88) Sherman tow yielded good catches. These were followed by soft beam trawls at 400 m (Op 90) and 200 m (Op 91) targeted at corresponding video tows. These tows retained a large number of large crustaceans (bugs) and eels respectively. During the evening a problem with the winches delayed progress. A targeted Sherman sled (Op 92) at the 85 m hard reef site yielded 2-3 tonnes of large biogenic rocks and shell fragments. This catch took a long time to sort and at this point we



steamed to Geraldton to drop off Julia Phillips and pick up John Keesing. On returning we targeted a 100 m soft Sherman site (Op 93) that retained a small bin of biogenic rocks and two bins of fines. Of note was a large basket starfish.

#### **Sunday 4th December**

Operation 95 targeted a Sherman sled on high backscatter terrain at 400 m on route to the Kalbarri site (L8). At the Kalbarri 100 m site the Sherman was shot away (Op 96) on low backscatter after a delay with the hydraulics. The sled in 110 m of water produced a good catch of two bins coarse whole dead shells with numerous urchins, crabs and live shells (83 specimens were retained). The shot indicated a lower energy environment compared to the Abrolhos 100 m tows. A beam trawl on 400 m soft (Op 98) retained a high proportion of fishes and seapens which were observed on the video of the site (Voyage1, Op 95), 17 invertebrate species and 15 fish species were retained.

#### **Monday 5th December**

Operation 99 was a beam trawl at Kalbarri on 200 m soft terrain at the top of a shelf edge slump and resulted in a catch dominated by sponges (166 kg) with 93 specimens retained. Operation 100 was a plankton tow followed by a Sherman sled tow at L8 400 and another (Op 102) at L8 100.

On route to Zuytdorp a large algal bloom was observed on the surface with extensive brown slicks covering many nautical miles. A representative sample was collected to be filtered. At Zuytdorp 100 m a shallow Sherman sled tow L7 (Op 104) yielded a large bag (500 kg) of sponges and limestone rubble. The steam out to the 400 m site confirmed the unusual dark circular seabed backscatter marks in 190 m. A small (5kg) catch of fish and crustaceans were obtained from the 400 m soft beam trawl (Op 105). On the steam back to the 100 m site the pock marks at 190 m were investigated with the swath, CTD and sediment samplers. A delay in sampling occurred due to excess wire run off the sediment winch.

#### **Tuesday 6th December**

The beam trawl at 100 m soft yielded a high catch of sponge and limestone rubble. A large fan sponge was a notable addition to the collection. There was a long steam (8 hrs) to the Shark Bay site (L6). The swath showed that the reef edge which had characterized the 100 m swath from Jurien was decreased and a more sand wave dominated terrain was evident at the L6 site. A shallow tow yielded a familiar limestone rubble and shell hash with a few sponges. Steamed out to the 400 m site and a few marks appeared on the echo sounder and TOPAS characteristic (?) of gas seeps.

#### **Wednesday 7th December**

A Sherman tow targeted on the features (Op 115) yielded a small catch (<5kg) of gorgonians, sponges and shell hash. At the L6 100 m soft site two beam trawls (Op 115 and Operation 118) retained a small catch (<5kg) of a diverse range of fishes, sponges and crustaceans. After a 6 hr steam the Carnarvon L5 100 hard site was chosen based on the swath mapper backscatter. The Sherman retained a small (5 kg) but diverse catch of animals dominated by sponges. Two beam trawls (Op121 and 122) in deeper water (400 m) yielded small catches (<5 kg) dominated by fish and crustaceans. Strong winds continued from the south at 20 to 30 knots. The combination of running TOPAZ (sub bottom profiler) and the swath mapper proved useful in detecting emerging subcrop.

#### **Thursday 8th December**

The last station at Carnarvon L5 was a beam trawl (Op 124) targeted on soft terrain in 100 m that produced a small and diverse catch with a high number of fish. After a short steam to Red Bluff (L4) the Sherman (Op 126) was targeted on hard 100 m terrain that retained a number of biogenic rocks. At 400 m two beam trawls (Ops 128 and 130) yielded small catches (<2 kg) dominated by bugs, fish and crustaceans. The fines bag proved to contain a high diversity of organisms. The 100 m soft site was characterized by a small macrofauna catch dominated by crustaceans and fish and 240 kg of fines to be sieved.

#### **Friday 9th December**

The beam trawl (Op 135) on sand waves at Point Cloates (L3) yielded a large catch of sponges (165 kg) and rubble with very high species diversity. At the 400 m soft beam trawl site (Op 137) a small catch (2.4 kg) was retained from a soft seafloor. On returning to the 100 m site the Sherman (Op 139) was targeted on high backscatter and retained 30 kg. On route to Ningaloo, hard ground at 400 m was targeted yielding 14 kg of mainly rocks and crayfish. Arrived at the southern T1 Ningaloo site at 2100 hrs where a beam trawl (Op 141) at 100 m retained 4 kg of diverse fauna and 136 kg of fines (mud). This contrasted with the 1000 m beam trawl (Op 142) that hooked up and only retained a small catch and 3 bins of mud.

#### **Saturday 10th December**

At the Ningaloo south site (T1) we continued to sample the 100 m and 150 m high backscatter sites (Ops 143 & 144) for large catches of sponge dominated fauna. The beam trawl was targeted at the 200 (Op 146), 400 (Op 148, 151), 700 (Op 149) and 1000 m (Op 150) soft sites. All these sites were dominated by fine mud that was retained in the fines bag and was difficult to remove and sieve. At 200 m the fauna retained was 21 kg and diverse; the first 400 m site was repeated and the second beam trawl retained 13 kg dominated by bugs and holothurians. At the 700 m site 3 kg of fauna were retained dominated by fish with only 0.5 bins of fine mud. The 1000 m site retained a good catch (11 kg) dominated by holothurians with 2 bins of fine mud.

#### **Sunday 11th December**

A swath transect to the south was run through the morning to allow processing of the catch. The 200 m hard beam tow was targeted on the camera tow of voyage 1 (155 m to 165 m) and retained 73 kg sponges, 26 kg rubble and 8 kg fauna. At the 700 m soft site two beam trawls (Op 154 and 159) were targeted as the first pinned up with 10 bins of mud whilst the second retained a good catch of 4 kg of fish and crustacean dominated catch. Two beam trawls targeted at the 100 m hard site running north to south retained small catches. The 400 m beam trawl (Op 157) retained a good catch of a fish and crustacean dominated catch whilst two 1000 m beam trawls (Op 158 and 160) suffered net damage and retained poor catches.

#### **Monday 13th December**

Operation 161 was targeted at the 1000 m site with the Sherman and retained no catch and as this was the third tow on this site it was abandoned. Operation 162 was a targeted beam trawl at 100 m soft and retained a small but diverse catch. In contrast the third attempt at the 100 m site beam trawl (Op 162) targeted more to the west retained a large catch >100 kg of sponge dominated fauna. Operation 163 beam trawl on high backscatter at 150 m retained a 1.5 tonne catch of limestone

rubble. Two beam trawls targeted at 400 m soft (Op 165 and 166) with the second retaining a good fauna catch with 1 bin of mud in the fines and a broken beam. The last operation (Op 168) at Ningaloo was targeted on soft terrain in 1250 m depth and only retained a small catch and 500 kg of mud and a broken beam.

#### **Tuesday 14th December**

We steamed to Barrow Island site 21 S for 9 hours collecting acoustic data along the 100 m contour. Good examples of seabed backscatter were collected from the Simrad EK500, EM300 and TOPAZ systems. Operation 169, a Sherman sled tow, was targeted on 100 m high backscatter at the Barrow Island site retained 1.5 tonnes of mud, rubble and boulders with little fauna. Operation 170 was a beam trawl targeted on low backscatter and retained 54 kg of fauna dominated by sponges and crustaceans. Two beam trawls (Ops 171 and 172) were targeted at the 400 m site as the first trawl appeared to have fished upside down. The second catch retained 4 kg dominated by fish, crustaceans and echinoderms. We steamed back to the 100 m contour collecting acoustic data on route to Dampier whilst processing the remaining catches.

#### **Wednesday 15th December**

Cleaning, packing and data back ups occurred on the steam to Dampier with some concerns raised over the effect that temperature may have on the DNA of collected samples. The biological samples preserved in ethanol were organized to be kept cool on the steaming leg to Darwin with a wet canvas. The vessel docked at Dampier at 1200 hours.

### **Summary**

Voyage SS102005 was a technical and scientific success with all objectives met. Its greatest achievements were the successful collection of an extensive range of benthic epifauna, in good condition, from a variety of seabed types that were often challenging to sample effectively, and the thorough initial taxonomic processing (including photographic inventory) while on board. This level of processing will accelerate the subsequent museum-based taxonomic work, and was possible only with the broad range of specialist knowledge provided at sea by teams from Australia's major museums. Seabed maps and imagery collected on Voyage 1 (SS0705) were used to precisely target the benthic sled sampling, with acoustic tracking of the sleds enabling collections to be accurately georeferenced in relation to seabed types and features.

Collectively, these data and the multiscale mapping data taken during Voyage 1 will provide the first view of the structure of the deep ocean seascape off Western Australia, and knowledge of the composition, distribution and evolution of many components of its benthic invertebrate biodiversity. Together with a high quality data set on fishes collected in 1991, these data will make a large contribution to developing, testing, refining and validating multiple use management frameworks developed for the SW Region as part of Regional Marine Planning and inform the design of a representative system of marine protected areas. In addition, the data will provide information on species distributions in relation to habitats – fine scale features of geomorphology and substratum – to assist in determining whether reliable physical surrogates for invertebrate biodiversity distributions exist at the scales of Province, depth and feature type.

## Personnel

### Scientific Contingent Leg 1

Alan Williams	CMAR	Chief Scientist
Mark Lewis	CMAR	Gear operations
Don McKenzie	CMAR	Voyage manager/ Gear operations/ SST
Bernadette Heaney	CMAR	NF computing support/ SST
Andrea Cortese	GA	Swath mapping
Peter Dunn	CMAR	NF electronics support
Karen Gowlett-Holmes	CMAR	Invertebrate taxonomy coordination
Penny Berents	AM	Invertebrate taxonomy coordination
Corey Whisson	WAM	Invertebrate taxonomy
Jane Fromont	WAM	Sponges
Jerome Mallefet	MV	Echinoderms
Tim O'Hara	MV	Echinoderms
Robin Wilson	MV	Polychaetes
Anna Syme	MV	Invertebrate taxonomy

### Scientific Contingent Leg 2

Rudy Kloser	CMAR	Chief Scientist
Mark Lewis	CMAR	Gear operations
Don McKenzie	CMAR	Voyage manager/ Gear operations/ SST
Hiski Kippo	CMAR	NF computing support/ SST
Andrea Cortese	GA	Swath mapping
Lindsay MacDonald	CMAR	NF electronics support/ SST
Gary Poore	MV	Decapods
Karen Gowlett-Holmes	CMAR	Invertebrate taxonomy coordination
Steve Keable	AM	Invertebrate taxonomy
Mark Salotti	WAM	Sponges
Julia Phillips	CMAR	Invertebrate taxonomy
John Keesing	CMAR	Echinoderms
Shirley Slack-Smith	WAM	Molluscs
Anna McCallum	MV	Invertebrate taxonomy
David Staples	MV	Invertebrate taxonomy

(GA – Geoscience Australia; WAM – Western Australian Museum; MV – Museum Victoria; AM – Australian Museum; SST – System Support Technician)

## **Marine Crew**

Ian Taylor	Master
Samantha Durnian	Chief Officer
Drew Meinke	2nd Officer
John Morton	Chief Engineer
Dave Jonker	1st Engineer
Seamus Elder	2nd Engineer
Graham McDougall	Bosun
Pat Chamberlain	I.R.
Karl Cooke	I.R.
Peter Dallas May	I.R.
George Cook	Greaser
Richard Smith	Chief Steward
Peter Williams	Chief Cook
Alan Sessions	2nd Cook
Martin De Bavay	Extra I.R.

## **Acknowledgments**

Thanks are due to all members of the large team that planned, implemented and supported this voyage. In particular we would like to acknowledge the high level of professional support provided by all the science team throughout the month at sea. We enjoyed the cooperation of the ship officers, engineers, and crew who were extremely professional in all aspects of their work; we also acknowledge the cooperation and high level of support from the ships group, particularly Don McKenzie in his role as voyage manager and for hands-on assistance with many aspects of the logistics. We would also like to extend thanks to our collaborators, particularly Andrea Cortese from Geoscience Australia, and the many staff from Australia's museums, and to our communications staff for assistance with post-survey reporting. Our survey time was provided by the Marine National Facility and the Department of Environment and Heritage (via the National Oceans Office) and funding support was provided by the CSIRO Wealth from Oceans Flagship.

### **Alan Williams and Rudy Kloser**

*Chief Scientists*

**Table 1:** A summary of the number of operations at “areas” conducted during SS10/2005. Site coding for “latitude sites”, “transects” and “focus study” areas are also included.

Area	Latitude site	Transect	Focus area	Beam trawl	Bucket	Camera drop	CTD	Plankton Net	Sediment Grab	Sled-Sherman	Sonardyne	Area total operations
Barrow Island	L1			3			1			1		5
Ningaloo North	L2	T2	F	11			1			5		17
Ningaloo South	L2	T1	F	7			1	1		2		11
Point Cloates	L3			2			1	1	1	2		7
Red Bluff	L4			4			1	1	1	1		8
Carnarvon	L5			3			1	1	1	1		7
Shark Bay	L6			3			1	1	1	2		8
Zuytdorp	L7			2	1		1	1	2	1		8
Kalbarri	L8			2			1	1		3		7
Abrolhos	L9	T3		4			1	2		5		12
Jurien Bay	L10			1			1	1		3		6
Lancelin	L11			1				1		1		3
Two Rocks	L12	T4		4						6		10
Perth Canyon			F	3			1			4		8
Perth											1	1
Mentelle	L14			3					2	1		6
Bunbury	L13			2						1		3
D'Entrecasteaux	L15			1					5	1		7
Pt Hillier	L16	T5		3		1				6		10
Albany	L17	T6	F	6			2			8		16
Bald Island	L18	T7		4						9		13
<b>Total number ops/gear</b>				<b>69</b>	<b>1</b>	<b>1</b>	<b>14</b>	<b>11</b>	<b>13</b>	<b>63</b>	<b>1</b>	<b>173</b>

**Table 2:** A list of all sampling operations from SS10/2005 with layback positions and depths (including unsuccessful deployments).

Op	Date (local)	Time (24 hr local)	Gear	Site	Soft / Hard (1)	Area	Start tow position			End tow position			Finish
							Longitude (E)	Latitude (S)	Depth (m)	Longitude (E)	Latitude (S)	Depth (m)	
1	18/11/2005	11:14	Sonardyne	Calibration	-	Perth	115.3298	-31.9951	100	-	-	-	-
2	18/11/2005	17:56	Beam trawl	T4 100	Soft	Two Rocks	115.2440	-31.7243	102	115.2411	-31.7184	-	-
3	18/11/2005	18:26	Beam Trawl	T4 400	Soft	Two Rocks	114.9660	-31.6231	404	114.9660	-31.6231	404	404
4	19/11/2005	0:21	Beam trawl	T4 400	Soft	Two Rocks	114.9720	-31.6180	364	114.9660	-31.6231	404	404
5	19/11/2005	3:42	Sled - Sherman	T4 400	Hard	Two Rocks	114.9850	-31.6036	275	114.9790	-31.6103	327	327
6	19/11/2005	5:20	Sled - Sherman	T4 400	Hard	Two Rocks	114.9810	-31.6088	329	114.9710	-31.6173	370	370
7	19/11/2005	7:43	Sled - Sherman	T4 700	Hard	Two Rocks	114.8440	-31.6800	685	114.8460	-31.6851	688	688
8	19/11/2005	11:20	Beam trawl	T4 700	Hard	Two Rocks	114.8460	-31.6808	669	114.8490	-31.6825	683	683
9	19/11/2005	14:18	Sled - Sherman	T4 1000	Soft	Two Rocks	114.7450	-31.7229	1012	114.7560	-31.7261	989	989
10	19/11/2005	16:03	Sled - Sherman	T4 1000	Hard	Two Rocks	114.7600	-31.7270	986	114.7930	-31.7357	988	988
11	19/11/2005	18:46	Sled - Sherman	T4 200	Soft	Two Rocks	115.0040	-31.6242	205	115.0030	-31.6285	210	210
12	19/11/2005	23:58	Sled - Sherman	target 1	Hard	Perth Canyon	115.0250	-31.9200	479	115.0130	-31.9230	484	484
13	20/11/2005	9:03	Beam Trawl	L13 400	Soft	Bunbury	114.5710	-33.0084	421	114.5750	-33.0020	414	414
14	20/11/2005	12:06	Sled - Sherman	L13 100	Soft	Bunbury	114.8200	-33.0364	95	114.8130	-33.0378	99	99
15	21/11/2005	1:02	Sled - Sherman	L14 100	Soft	Mentelle	114.7340	-33.9800	97	114.7350	-33.9837	96	96
16	21/11/2005	4:35	Beam Trawl	L14 400	Soft	Mentelle	114.4430	-34.0109	467	114.4410	-34.0158	490	490
17	21/11/2005	15:08	Beam Trawl	L15 400	Soft	D'Entrecasteaux	115.3360	-35.0696	378	115.3480	-35.0707	379	379
18	21/11/2005	18:05	Sled - Sherman	L15 100	Soft	D'Entrecasteaux	115.5070	-34.8860	100	115.4990	-34.8839	95	95
19	22/11/2005	8:21	Beam Trawl	L16 400	Soft	Pt Hillier	117.2070	-35.3817	539	117.2070	-35.3817	539	539
20	22/11/2005	10:07	Sled - Sherman	L16 400	Soft	Pt Hillier	117.2030	-35.3818	419	117.1920	-35.3822	460	460
21	22/11/2005	11:56	Sled - Sherman	L16 100	Soft	Pt Hillier	117.2170	-35.3566	96	117.2200	-35.3526	89	89
22	22/11/2005	19:24	Sled - Sherman	T6 100	Soft/ Hard	Albany	118.2940	-35.3350	99	118.2900	-35.3366	100	100
23	23/11/2005	1:41	Sled - Sherman	T6 700	Hard	Albany	118.3090	-35.3925	748	118.3060	-35.4012	776	776
24	23/11/2005	3:44	Beam Trawl	T6 400	Soft	Albany	118.3090	-35.3639	399	118.2950	-35.3698	404	404
25	23/11/2005	5:31	Beam Trawl	T6 400	Soft	Albany	118.3070	-35.3647	398	118.2930	-35.3708	407	407
26	23/11/2005	7:01	Beam Trawl	T6 200	Soft	Albany	118.3410	-35.3397	212	118.3290	-35.3447	213	213
27	23/11/2005	8:18	Beam Trawl	T6 700	Soft	Albany	118.3330	-35.3715	685	118.3210	-35.3774	695	695
28	23/11/2005	10:08	Sled - Sherman	T6 1000	Hard	Albany	118.3510	-35.4341	912	118.3440	-35.4365	922	922
29	23/11/2005	14:05	Beam Trawl	T6 700	Soft	Albany	118.3350	-35.3690	676	118.3220	-35.3753	680	680
30	23/11/2005	19:31	Sled - Sherman	T7 100	Soft/ Hard	Bald Island	118.6310	-35.1790	107	118.6320	-35.1787	107	107
31	23/11/2005	20:00	Sled - Sherman	T7 100	Soft/ Hard	Bald Island	118.6320	-35.1784	106	118.6330	-35.1778	105	105
32	23/11/2005	21:40	Beam Trawl	T7 700	Soft	Bald Island	118.6640	-35.2337	728	118.6750	-35.2279	710	710
33	23/11/2005	23:44	Sled - Sherman	T7 400	Hard	Bald Island	118.5950	-35.2269	386	118.5890	-35.2292	494	494
34	24/11/2005	1:34	Beam Trawl	T7 400	Soft	Bald Island	118.6510	-35.2135	431	118.6690	-35.2040	408	408
35	24/11/2005	3:10	Sled - Sherman	T7 200	Soft	Bald Island	118.6450	-35.1907	157	118.6500	-35.1875	147	147
36	24/11/2005	7:52	Beam Trawl	T7 1000	Soft	Bald Island	118.7090	-35.2815	980	118.7090	-35.2810	976	976
37	24/11/2005	12:32	Sled - Sherman	T7 200	Hard	Bald Island	-	-	-	-	-	-	-
38	24/11/2005	13:24	Sled - Sherman	T7 200	Hard	Bald Island	118.6490	-35.1901	161	118.6460	-35.1919	169	169

Op	Date (local)	Time (24 hr local)	Gear	Site	Soft / Hard (1)	Area	Start tow position			End tow position			Finish Depth (m)
							Longitude (E)	Latitude (S)	Depth (m)	Longitude (E)	Latitude (S)	Depth (m)	
39	24/11/2005	21:36	Sled - Sherman	T7 100	Hard	Bald Island	118.6230	-35.1791	99	118.6210	-35.1799	97	
40	24/11/2005	23:09	Sled - Sherman	T7 400	Hard	Bald Island	118.5940	-35.2273	398	118.5870	-35.2301	554	
41	25/11/2005	1:31	Beam Trawl	T7 1000	Soft	Bald Island	118.7230	-35.2713	978	118.7190	-35.2829	980	
42	25/11/2005	4:08	Sled - Sherman	T7 1000	Soft	Bald Island	118.7200	-35.2698	973	118.7190	-35.2881	999	
43	25/11/2005	11:50	Sled - Sherman	T6 1000	Soft	Albany	118.3740	-35.4176	1019	118.3660	-35.4327	1031	
44	25/11/2005	10:01	Sled - Sherman	T6 1000	Hard	Albany	118.3500	-35.4341	900	118.3510	-35.4374	915	
45	25/11/2005	13:33	CTD - LADCP	T6 1000	-	Albany	118.3500	-35.4365	910	-	-	-	
46	25/11/2005	15:03	CTD - LADCP	T6 1000	-	Albany	118.3660	-35.4314	1024	-	-	-	
47	25/11/2005	16:58	Sled - Sherman	T6 200	Hard	Albany	118.2990	-35.3546	179	118.2960	-35.3558	179	
48	25/11/2005	19:10	Beam trawl	T6 1000	Soft	Albany	118.3730	-35.4183	1011	118.3680	-35.4260	1021	
49	25/11/2005	21:01	Sled - Sherman	T6 1000	Hard	Albany	118.3480	-35.4310	925	118.3510	-35.4368	913	
50	26/11/2005	0:42	Sled - Sherman	T6 100	Soft	Albany	118.3770	-35.3061	95	118.3720	-35.3079	95	
51	26/11/2005	13:06	Sled - Sherman	L16 1000	Soft	Pt Hillier	117.2130	-35.5238	1074	117.2380	-35.5337	1080	
52	26/11/2005	21:07	Beam trawl	L16 1000	Soft	Pt Hillier	117.2030	-35.5194	1073	117.2170	-35.5252	1076	
53	26/11/2005	23:43	Camera drop	L16 1000	Soft	Pt Hillier	117.2270	-35.5262	1133	117.2180	-35.5248	1079	
54	27/11/2005	3:27	Beam trawl	L16 1000	Soft	Pt Hillier	117.2110	-35.5227	1075	117.2300	-35.5261	1110	
55	27/11/2005	10:05	Sled - Sherman	L16 100	Soft	Pt Hillier	117.2150	-35.3552	91	117.2170	-35.3559	94	
56	27/11/2005	10:43	Sled - Sherman	L16 100	Soft	Pt Hillier	117.2160	-35.3553	92	117.2200	-35.3547	91	
57	27/11/2005	11:28	Sled - Sherman	L16 200	Soft	Pt Hillier	117.1970	-35.3735	195	117.2040	-35.3734	196	
58	28/11/2005	-	Sediment Grab	L15 50	-	D'Entrecasteaux	115.5400	-34.8258	50	-	-	-	
59	28/11/2005	-	Sediment Grab	L15 50	-	D'Entrecasteaux	115.5520	-34.8188	50	-	-	-	
60	28/11/2005	2:47	Sediment Grab	L15 50	-	D'Entrecasteaux	115.5530	-34.8179	50	-	-	-	
61	28/11/2005	2:58	Sediment Grab	L15 50	-	D'Entrecasteaux	115.5520	-34.8188	50	-	-	-	
62	28/11/2005	3:05	Sediment Grab	L15 50	-	D'Entrecasteaux	115.5520	-34.8188	50	-	-	-	
63	28/11/2005	11:49	Beam Trawl	L14 400	Soft	Mentelle	114.4400	-34.0177	514	114.4390	-34.0197	528	
64	28/11/2005	13:02	Beam Trawl	L14 400	Soft	Mentelle	114.4390	-34.0213	529	114.4430	-34.0113	467	
65	28/11/2005	16:42	Sediment Grab	L15 50	-	Mentelle	114.8480	-34.0464	50	-	-	-	
66	28/11/2005	16:51	Sediment Grab	L15 50	-	Mentelle	114.8490	-34.0461	50	-	-	-	
67	29/11/2005	1:19	Beam Trawl	L13 400	Soft	Bunbury	114.5700	-33.0097	423	114.5820	-32.9937	397	
68	29/11/2005	9:36	Beam Trawl	PC 400	Soft	Perth Canyon	115.1830	-31.9924	508	115.1780	-32.0020	478	
69	29/11/2005	11:31	Sled - Sherman	PC 200	Soft	Perth Canyon	115.2020	-31.9210	194	115.1960	-31.9241	232	
70	29/11/2005	12:54	Sled - Sherman	PC 1000	Soft	Perth Canyon	115.1050	-31.9658	920	115.1290	-31.9431	1135	
71	29/11/2005	22:35	Beam Trawl	PC 1000	Soft	Perth Canyon	115.1000	-31.9715	848	115.1140	-31.9552	1050	
72	30/11/2005	2:31	Sled - Sherman	PC 1500	Soft	Perth Canyon	115.0390	-31.9872	1577	115.0370	-32.0038	1584	
73	30/11/2005	6:14	Beam Trawl	PC 1000	Soft	Perth Canyon	115.1050	-31.9650	928	115.1180	-31.9497	1170	
74	30/11/2005	8:46	CTD - LADCP	PC 1500	-	Perth Canyon	115.0390	-31.9944	1591	-	-	-	
75	1/12/2005	17:16	Beam Trawl	L11 400	Soft	Lancelin	114.8250	-31.0125	394	114.8230	-31.0046	393	
76	1/12/2005	19:36	Sled - Sherman	L11 100	Soft	Lancelin	114.9330	-30.9913	100	114.9310	-30.9860	100	
77	1/12/2005	21:08	Plankton Net	L11	-	Lancelin	114.8740	-30.8302	100	114.8760	-30.8204	100	



Op	Date (local)	Time (24 hr local)	Gear	Site	Soft / Hard (1)	Area	Start tow position			End tow position			Finish Depth (m)
							Longitude (E)	Latitude (S)	Depth (m)	Longitude (E)	Latitude (S)	Depth (m)	
78	2/12/2005	4:29	Beam Trawl	L10 400	Soft	Jurien Bay	114.3870	-29.8677	414	114.3980	-29.8739	401	
79	2/12/2005	5:38	Plankton Net	L10 400	-	Jurien Bay	114.4060	-29.8758	370	114.4010	-29.8697	316	
80	2/12/2005	6:31	Sled - Sherman	L10 400	Hard	Jurien Bay	114.3620	-29.8419	408	114.3670	-29.8502	427	
81	2/12/2005	8:11	CTD - Pigments	L10 400	-	Jurien Bay	114.3710	-29.8519	408	-	-	-	
82	2/12/2005	9:48	Sled - Sherman	L10 100	Hard	Jurien Bay	114.4390	-29.8029	85	114.4360	-29.8038	92	
83	2/12/2005	10:50	Sled - Sherman	L10 100	Soft	Jurien Bay	114.4310	-29.8070	113	114.4320	-29.8091	114	
84	2/12/2005	19:27	Beam Trawl	L9 1000	Soft	Abrolhos	113.6360	-29.0609	1000	113.6300	-29.0781	1037	
85	2/12/2005	22:13	Beam Trawl	L9 700	Soft	Abrolhos	113.7130	-29.0099	704	113.7220	-29.0252	700	
86	3/12/2005	0:00	Plankton Net	L9 700	-	Abrolhos	113.7210	-29.0406	737	113.7220	-29.0367	728	
87	3/12/2005	1:19	Sled - Sherman	L9 700	Hard	Abrolhos	113.6790	-28.9534	678	113.6920	-28.9718	686	
88	3/12/2005	6:16	Sled - Sherman	L9 400	Hard	Abrolhos	113.7790	-29.0127	419	113.7850	-29.0230	439	
89	3/12/2005	8:09	CTD - Pigments	L9 400	-	Abrolhos	113.7730	-29.0031	420	-	-	-	
90	3/12/2005	9:51	Beam Trawl	L9 400	Soft	Abrolhos	113.7650	-28.9900	389	113.7690	-28.9967	407	
91	3/12/2005	11:11	Beam Trawl	L9 200	Soft	Abrolhos	113.7840	-28.9888	180	113.7880	-28.9964	183	
92	3/12/2005	12:58	Sled - Sherman	L9 100	Hard	Abrolhos	113.8320	-28.9714	86	113.8350	-28.9744	85	
93	3/12/2005	23:17	Sled - Sherman	L9 100	Soft	Abrolhos	113.8470	-28.9997	112	113.8440	-28.9964	114	
94	4/12/2005	0:18	Plankton Net	L9 100	-	Abrolhos	113.8070	-28.9551	107	113.8020	-28.9486	107	
95	4/12/2005	4:46	Sled - Sherman	Tran 400	Hard	Abrolhos	113.4190	-28.4895	431	113.4250	-28.5010	416	
96	4/12/2005	12:54	Sled - Sherman	L8 100	Soft	Kalbarri	113.2970	-27.8080	123	113.2990	-27.8126	112	
97	4/12/2005	14:51	CTD	L8 400	-	Kalbarri	113.0370	-27.8053	435	-	-	-	
98	4/12/2005	16:35	Beam Trawl	L8 400	Soft	Kalbarri	113.0810	-27.9351	417	113.0880	-27.9441	428	
99	4/12/2005	20:44	Beam Trawl	L8 250	Soft	Kalbarri	113.1380	-27.9286	252	113.1440	-27.9337	253	
100	5/12/2005	0:19	Plankton Net	L8 400	-	Kalbarri	113.0640	-27.9340	455	-	-	-	
101	5/12/2005	3:22	Sled - Sherman	L8 400	Hard	Kalbarri	113.0500	-27.9399	480	113.0420	-27.9278	469	
102	5/12/2005	7:47	Sled - Sherman	L8 100	Hard	Kalbarri	113.3110	-27.8134	96	113.3120	-27.8183	98	
103	5/12/2005	13:15	Bucket	L7-L8	-	Zuytdorp	113.2220	-27.3625	100	-	-	-	
104	5/12/2005	15:30	Sled - Sherman	L7 100	Hard	Zuytdorp	113.1010	-27.0517	97	113.1000	-27.0490	97	
105	5/12/2005	18:56	Beam Trawl	L7 400	Soft	Zuytdorp	112.7510	-27.1335	414	112.7620	-27.1466	405	
106	5/12/2005	20:12	Plankton Net	L7 400	-	Zuytdorp	112.7650	-27.1568	409	-	-	-	
107	6/12/2005	0:11	CTD	L7 200	-	Zuytdorp	112.9320	-27.0822	193	-	-	-	
108	6/12/2005	0:39	Sediment Grab	L7 200	-	Zuytdorp	112.9300	-27.0833	194	-	-	-	
109	6/12/2005	2:31	Sediment Grab	L7 200	-	Zuytdorp	112.9300	-27.0833	194	-	-	-	
110	6/12/2005	4:01	Beam Trawl	L7 100	Soft	Zuytdorp	113.0810	-27.0520	106	113.0800	-27.0480	106	
111	6/12/2005	13:51	CTD	L6 100	-	Shark Bay	112.8050	-25.8682	100	-	-	-	
112	6/12/2005	15:25	Sled - Sherman	L6 100	Soft/ Hard	Shark Bay	112.8230	-25.9076	100	112.8290	-25.9073	100	
113	6/12/2005	19:53	Beam Trawl	L6 400	Soft	Shark Bay	112.2430	-25.9277	404	112.2460	-25.9381	407	
114	6/12/2005	21:11	Plankton Net	L6 400	-	Shark Bay	112.2480	-25.9511	419	-	-	-	
115	7/12/2005	2:32	Sled - Sherman	L6 120	Hard	Shark Bay	112.6800	-25.9297	120	112.6810	-25.9330	120	
116	7/12/2005	4:49	Beam Trawl	L6 100	Soft	Shark Bay	112.8290	-25.9022	100	112.8270	-25.9064	95	

Op	Date (local)	Time (24 hr local)	Gear	Site	Soft / Hard (1)	Area	Start tow position			End tow position			Finish Depth (m)
							Longitude (E)	Latitude (S)	Depth (m)	Longitude (E)	Latitude (S)	Depth (m)	
117	7/12/2005	6:16	Sediment Grab	L6 100	-	Shark Bay	112.8310	-25.8955	100	-	-	-	-
118	7/12/2005	5:25	Beam Trawl	L6 100	Soft	Shark Bay	112.8280	-25.9058	100	112.8300	-25.8996	100	100
119	7/12/2005	14:12	CTD	L5 100	-	Carnarvon	112.6260	-24.8029	100	-	-	-	-
120	7/12/2005	16:42	Sled - Sherman	L5 100	Hard	Carnarvon	112.6660	-24.6194	100	112.6660	-24.6228	100	100
121	7/12/2005	19:43	Beam Trawl	L5 400	Soft	Carnarvon	112.2580	-24.5591	388	112.2650	-24.5689	368	368
122	7/12/2005	21:35	Beam Trawl	L5 400	Soft	Carnarvon	112.2520	-24.5520	404	112.2530	-24.5634	396	396
123	7/12/2005	22:43	Plankton Net	L5 400	-	Carnarvon	112.2590	-24.5652	383	-	-	-	-
124	8/12/2005	1:45	Beam Trawl	L5 100	Soft	Carnarvon	112.6710	-24.6245	100	112.6690	-24.6288	100	100
125	8/12/2005	2:38	Sediment Grab	L5 100	-	Carnarvon	112.6710	-24.6411	100	-	-	-	-
126	8/12/2005	8:13	Sled - Sherman	L4 100	Hard	Red Bluff	113.0270	-24.0437	100	113.0290	-24.0473	100	100
127	8/12/2005	9:24	Sediment Grab	L4 100	-	Red Bluff	113.0380	-24.0406	100	-	-	-	-
128	8/12/2005	12:49	Beam Trawl	L4 400	Soft	Red Bluff	112.5450	-23.9851	398	112.5370	-23.9933	402	402
129	8/12/2005	14:11	CTD - Pigments	L4 400	-	Red Bluff	112.5340	-24.0065	395	-	-	-	-
130	8/12/2005	15:13	Beam Trawl	L4 400	Soft	Red Bluff	112.5340	-23.9866	411	112.5290	-23.9954	411	411
131	8/12/2005	16:21	Plankton Net	L4 400	-	Red Bluff	112.5250	-24.0066	408	-	-	-	-
132	8/12/2005	20:17	Beam Trawl	L4 100	Soft	Red Bluff	113.0310	-24.0315	100	113.0270	-24.0345	100	100
133	8/12/2005	21:00	Beam Trawl	L4 100	Soft	Red Bluff	113.0340	-24.0286	101	113.0300	-24.0314	100	100
134	9/12/2005	5:04	Plankton Net	L3 100	-	Point Cloates	113.5170	-22.8308	100	-	-	-	-
135	9/12/2005	6:14	Beam Trawl	L3 100	Soft	Point Cloates	113.5110	-22.8487	100	113.5140	-22.8583	100	100
136	9/12/2005	7:11	Sediment Grab	L3 100	-	Point Cloates	113.5130	-22.8513	100	-	-	-	-
137	9/12/2005	8:43	Beam Trawl	L3 400	Soft	Point Cloates	113.3380	-22.8468	420	113.3330	-22.8538	430	430
138	9/12/2005	10:07	CTD - Pigments	L3 400	-	Point Cloates	113.3360	-22.8460	429	-	-	-	-
139	9/12/2005	11:46	Sled - Sherman	L3 100	Hard	Point Cloates	113.5110	-22.8504	100	113.5130	-22.8554	100	100
140	9/12/2005	15:12	Sled - Sherman	L3 400	Soft	Point Cloates	113.4840	-22.6177	355	113.4760	-22.6200	382	382
141	9/12/2005	21:14	Beam Trawl	T1 100	Soft	Ningaloo South	113.8140	-22.0743	101	113.8130	-22.0784	102	102
142	9/12/2005	22:54	Beam Trawl	T1 1000	Soft	Ningaloo South	113.6510	-22.0151	1085	113.6570	-22.0235	1077	1077
143	10/12/2005	2:55	Sled - Sherman	T1 100	Hard	Ningaloo South	113.8220	-22.0365	105	113.8220	-22.0389	106	106
144	10/12/2005	4:22	Sled - Sherman	T1 150	Hard	Ningaloo South	113.8110	-22.0667	106	113.8150	-22.0708	101	101
145	10/12/2005	5:09	Plankton Net	T1 100	-	Ningaloo South	113.8160	-22.0830	101	-	-	-	-
146	10/12/2005	5:42	Beam Trawl	T1 200	Soft	Ningaloo South	113.7960	-22.0795	206	113.7940	-22.0873	201	201
147	10/12/2005	14:29	CTD	T1 400	-	Ningaloo South	113.7550	-22.0936	571	-	-	-	-
148	10/12/2005	15:43	Beam trawl	T1 400	Soft	Ningaloo South	113.7560	-22.0729	396	113.7560	-22.0828	391	391
149	10/12/2005	16:50	Beam Trawl	T1 700	Soft	Ningaloo South	113.7290	-22.0595	658	113.7210	-22.0671	754	754
150	10/12/2005	18:54	Beam Trawl	T1 1000	Soft	Ningaloo South	113.6790	-22.0038	983	113.6760	-22.0209	1010	1010
151	10/12/2005	21:35	Beam Trawl	T1 400	Soft	Ningaloo South	113.7560	-22.0719	399	113.7560	-22.0809	387	387
152	10/12/2005	23:41	Beam Trawl	T2 200	Soft	Ningaloo North	113.8200	-21.9784	177	113.8200	-21.9842	170	170
153	11/12/2005	4:15	Beam Trawl	T2 200	Hard	Ningaloo North	113.8200	-21.9862	165	113.8190	-21.9965	166	166
154	11/12/2005	5:45	Beam Trawl	T2 700	Soft	Ningaloo North	113.7640	-21.9641	690	113.7630	-21.9684	702	702
155	11/12/2005	13:27	Sled - Sherman	T2 100	Hard	Ningaloo North	113.8450	-21.9584	105	113.8430	-21.9623	106	106

Op	Date (local)	Time (24 hr local)	Gear	Site	Soft / Hard (1)	Area	Start tow position			End tow position			Finish Depth (m)
							Longitude (E)	Latitude (S)	Depth (m)	Longitude (E)	Latitude (S)	Depth (m)	
156	11/12/2005	14:10	Sled - Sherman	T2 100	Hard	Ningaloo North	113.8430	-21.9627	105	113.8420	-21.9662	105	
157	11/12/2005	16:18	Beam Trawl	T2 400	Soft	Ningaloo North	113.7930	-21.9702	356	113.7910	-21.9792	324	
158	11/12/2005	17:40	Beam Trawl	T2 1000	Soft	Ningaloo North	113.7230	-21.9374	1051	113.7140	-21.9459	1056	
159	11/12/2005	20:52	Beam Trawl	T2 700	Soft	Ningaloo North	113.7610	-21.9690	726	113.7540	-21.9784	732	
160	11/12/2005	23:06	Beam Trawl	T2 1000	Soft	Ningaloo North	113.7260	-21.9375	1050	113.7190	-21.9501	1036	
161	12/12/2005	1:54	Sled - Sherman	T2 1000	Hard	Ningaloo North	113.7250	-21.9448	1029	113.7150	-21.9573	1014	
162	12/12/2005	4:56	Beam Trawl	T2 100	Soft	Ningaloo North	113.8370	-21.9781	106	113.8350	-21.9838	107	
163	12/12/2005	6:06	Sled - Sherman	T2 150	Hard	Ningaloo North	113.8410	-21.9438	134	113.8380	-21.9515	132	
164	12/12/2005	8:16	Sled - Sherman	T2 100	Hard	Ningaloo North	113.8450	-21.9615	104	113.8370	-21.9679	114	
165	12/12/2005	9:50	Beam Trawl	T2 400	Soft	Ningaloo North	113.7910	-21.9702	373	113.7850	-21.9801	382	
166	12/12/2005	11:08	Beam Trawl	T2 400	Soft	Ningaloo North	113.7920	-21.9689	373	113.7860	-21.9787	366	
167	12/12/2005	12:43	CTD - LADCP	T2 400	-	Ningaloo North	113.7960	-21.9563	526	-	-	-	
168	12/12/2005	17:33	Beam Trawl	T2 1200	Soft	Ningaloo North	113.6050	-21.9178	1260	113.5830	-21.9197	1295	
169	13/12/2005	8:24	Sled - Sherman	L1 100	Hard	Barrow Island	114.8920	-21.0316	93	114.8880	-21.0344	93	
170	13/12/2005	10:10	Beam Trawl	L1 100	Soft	Barrow Island	114.9070	-20.9847	101	114.9090	-20.9945	100	
171	13/12/2005	14:08	Beam Trawl	L1 400	Soft	Barrow Island	114.3810	-21.0063	399	114.3700	-20.9957	411	
172	13/12/2005	15:54	Beam Trawl	L1 400	Soft	Barrow Island	114.3810	-21.0067	399	114.3750	-21.0007	408	
173	13/12/2005	16:37	CTD		-	Barrow Island	114.3653	-20.9913	400	-	-	-	

(1) provisional assessment of seabed type