SHARK BAY MARINE RESERVES MONITORING PROGRAMME

A collaborative project between CALM Marine Conservation Branch, Geraldton Regional Office and Gascoyne District Office

Project No. 151/95 - National Ecotourism Programme
Commonwealth Department of Tourism

INITIALISATION AND RESAMPLING OF LONG-TERM MONITORING SITES AND FURTHER GROUNDTRUTHING OF HABITAT MAP: APRIL 1997

Field Programme Report MMSP/MW/SBMP-2/1997

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CONTENTS

FIGURES

TABLES

APPENDICES

SUMMARY

This field programme report presents details of the planning and proposed field work for the initialisation of further long-term monitoring sites, the resampling of a sub-set of the long-term monitoring sites established in August 1996 in the Shark Bay Marine Park and further groundtruthing of the Shark Bay habitat map. Long-term monitoring sites will be established at approximately 15 sites during this survey, including Bernier and Dorre Islands and the Wooramel Seagrass Bank. The proposed survey follows on from the field survey of the Shark Bay Marine Reserves Monitoring Programme (SBMRMP), conducted in August 1996, during which 41 long-term monitoring sites were established (Cary and Pobar 1997).

The SBMRMP is being coordinated by the Marine Conservation Branch (MCB) of the Department of Conservation and Land Management (CALM) and conducted in collaboration with CALM's Midwest Region and Gascoyne District offices. Funding for the establishment of the long-term monitoring sites was obtained from the Commonwealth Department of Tourism, under a National Ecotourism Programme grant (Project No. 151/95).

One of the primary objectives of the survey is to initialise a long-term monitoring programme and provide baseline quantitative data along re-locatable transects to enable any changes to the key conservation attributes of the Marine Park to be detected before unacceptable or irreversible impacts occur. The main field technique to be employed will be the acquisition of high quality video footage along accurately positioned transects of 50 m length (3 replicates per site). Position-fixing, to better than 3 m accuracy, will be achieved by differential GPS.

Another primary objective is to improve the accuracy of the existing habitat map of the Shark Bay Marine Park. The opportunistic collection of physical data (salinity-temperature profiles) will be undertaken as a contribution to current oceanographic studies of Shark Bay. The opportunistic collection of information on Crustacea will also be undertaken as a contribution to the baseline data of fauna in the Shark Bay Marine Park.

ACKNOWLEDGEMENTS

Direction

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Manager, Marine Conservation Branch (MCB), Nature Conservation Division, CALM - Dr Chris Simpson
Manager, Midwest Region, CALM - Greg Leaman

CALM Regional/District collaboration

Geraldton Region - Ron Shepherd, Programme Leader, Nature Conservation.
Gascoyne District - Paul Brown, District Manager; Brad Barton, Operations Officer.
Field Team Leader - Jennie Cary, MCB.

Funding

Funding for the Shark Bay Marine Reserves Monitoring Programme is from the following sources:

$50 000 through Commonwealth Department of Tourism - National Ecotourism Programme (Category - Baseline Studies and Monitoring, Infrastructure Projects, Regional Ecotourism Planning; Project reference number - 151/95).
$20 000 from the World Heritage Trust Fund.
$ 3 500 from CALM.

Funding for the April 1996 field survey;

Budget:	$22 500 (from above sources)
'In kind' CALM resources	
CALM people:	55 person days
CALM volunteers:	20 days

CALM equipment: trailers, diving gear, cameras, underwater videos etc

GIS Habitat Maps

Eleanor Bruce, PhD Student, Department of Geography, University of Western Australia.

1 INTRODUCTION

1.1 General

This field program report presents details relating to the third survey of the Department of Conservation and Land Management's ***Shark Bay Marine Reserves Monitoring Programme (SBMRMP)***. The survey will be conducted during April 1997 and will involve the establishment of approximately 15 long-term monitoring sites within the Shark Bay Marine Park. These sites will complement the sites established in August 1996 (Cary and Pobar, 1997) and data gathered in April 1996 (D'Adamo, Colman and Pobar, 1996). The locality and boundaries of Shark Bay Marine Park, Hamelin Pool Marine Nature Reserve and Shark Bay World Heritage Area and surrounds are shown in Figure 1.

The field survey will be coordinated by the Marine Conservation Branch of CALM (Principle contact: Dr Chris Simpson, Manager, Marine Conservation Branch) and conducted in collaboration with the Geraldton Regional Office (Contact: Ron Shephard) and the Gascoyne District Office (Contact: Paul Brown).

Jennie Cary (Marine Conservation Branch) is the Field Team Leader and will coordinate all activities in the field.

Other CALM field staff will include Tim Daly and Lea McQuillan (volunteer) from the Marine Conservation Branch, Ron Shephard from the Geraldton Regional Office, Brad Barton from the Gascoyne District Office. Matz Berggren a shrimp ecologist from Kristineberg Marine Research Station, Sweden currently of the Marine Biology Laboratory of the University of Western Australia and Eva Boogard, a professional underwater photographer will also take part in the survey.

1.2 Background

The SBMRMP is an integration of two projects: (i) ***Baseline Studies and Monitoring of Visitor Sites in the Shark Bay Marine Park*** (Project No. 151/95, granted under the *National Ecotourism Programme* by the Commonwealth Department of Tourism in 1995) and (ii) ***Habitat Mapping for Shark Bay Marine Reserves Programme*** funded by CALM's World Heritage funds. Although technically separate, there is considerable overlap in these two projects. As a result, some of the objectives of the 'Baseline Studies' project directly service the requirements of the 'Habitat Mapping' project.

The SBMRMP is being undertaken in three phases. Phase I, which has been completed, comprised a review of the current state of knowledge, in relation to monitoring information requirements, and the preliminary exploratory field survey of April 1996. Phase II involved designing the monitoring program found in the field program report SBMRMP-03/96. Phase III establishes the long-term monitoring locations and initialises the monitoring programme. The data report MMSP/MW/SBMP-1/1997 presents the results of the August 1996 field programme of Phase III. This field survey will complete Phase III.

The objective of the *Baseline Studies and Monitoring of Visitor Sites in the Shark Bay Marine Park* project is to establish and initialise a monitoring programme to ensure that recreation and tourism activities are ecologically sustainable. Quantitative and qualitative biological information will be obtained using video and still photography from relocatable transects throughout the Shark Bay Marine Park. The location of sites will be fixed to better than 3 m accuracy with a differential GPS. Video footage and photographs will be archived for future reference and held with the Marine Conservation Branch. These data will complement data collected during the preliminary survey of the SBMRMP conducted in April 1996 (see D'Adamo, Colman and Pobar, 1996; D'Adamo and Pobar, 1996).

The key objectives of the *Habitat Mapping for Shark Bay Marine Reserves Programme* are to validate, spatially and biologically, CALM's existing GIS habitat maps of the Shark Bay area. The habitat information gathered during this April survey will contribute to the 'Habitat Mapping' project by providing data on habitat type at accurately fixed positions. These data will complement data collected during the preliminary survey of the SBMRMP conducted in April 1996 (D'Adamo, Colman and Pobar, 1996) and August 1996 (Cary and Pobar, 1997).

The SBMRMP is linked to the recommendations of the *Shark Bay Marine Reserves Management Plan 1996-2006* relating to the research and monitoring required to ensure that activity in the Bay is consistent with its World Heritage, Marine Park and Marine Nature Reserve status (see Figure 1).

Figure 1 Location map of Shark Bay

1.3 Aims

The aims of the April 1997 survey are separated into primary and secondary objectives, as follows.

Primary aims

- The initialisation of re-locatable long-term monitoring sites to provide baseline ecological data from which the potential impacts of recreational usage can be monitored and managed.
- The establishment of scientific control sites having ecological attributes that are representative of the major habitats in the Marine Park and which will be used to provide information on the natural variation of key attributes of the ecosystem.
- To resample long-term monitoring sites which showed signs of impact from recreational usage.
- To improve the biological accuracy of the existing GIS habitat map.

Secondary aims

- The opportunistic collection of salinity and temperature profile data as a contribution to studies of the circulation of Shark Bay.
- The opportunistic collection of still photographs and video footage of major habitat types and visually dominant flora and fauna of the Shark Bay region.
- The opportunistic collection of qualitative information on the Crustacea of the Shark Bay area.

2 SURVEY GRID, METHODS AND EQUIPMENT

2.1 Survey grid

2.1.1 Site selection

Site observations during the April 1996 preliminary survey (D'Adamo, Colman and Pobar, 1996) enabled direct impacts from common activities such as fishing and diving to be determined. The results of a 1993 visitor survey (Appendix V) and the zones as shown in the Management Plan (1996-2006) were also used to guide the selection of the sites, and are therefore important to the selection of permanent long-term monitoring sites.

In site selection, highest priority has been assigned to sites subjected to tourism/recreational pressures and additional sites have also been selected on the basis of commercial usage, in cognisance of the fact that proper management of the Marine Park must account for the inter-connectivity of regions and the overall suite of pressures, both current and predicted.

In the Shark Bay Marine Park there are large expanses of mono-specific floral habitats such as seagrass meadows. Although there may be mono-specificity in the flora of these regions their faunal populations can show significant diversity and these regions have therefore been considered in the long-term monitoring programme.

2.1.2 Control sites

A number of sites are required as scientific control. These sites have ecological attributes that are representative of particular habitats in the Marine Park. They need to be set aside to exclude activities that could compromise their role in providing information on natural variation of key attributes of the ecosystem that they are representing. The results of long-term monitoring at sites subjected to recreational and/or commercial pressures will be assessed in the context of natural variation at the control sites. This is a fundamental requirement for effective management.

Much of the Shark Bay Marine Park is largely free of human activity or impact and hence the determination of control sites is not difficult, particularly in view of the large areas of similar habitat types around the Park. The exception is that of coral reef habitat, which is only recorded at relatively few locations, and there is variability of species composition at each location.

2.1.3 Sites of scientific or historic interest

Certain sites have been selected on the basis of their intrinsic value in either a scientific or historical sense.

2.1.4 Survey grid details

Approximately 15 long-term monitoring sites are planned to be established during the survey, and their locations are shown in Figure 2. A listing of the sites and their locations (latitude and longitude coordinates) is given in Table 1. Table 1 also contains a brief description of the major habitat type and the dominant factor considered in the selection of the sites. Five long-term monitoring sites established in the August 1996 field survey will be resampled using the video sampling method (Figure 2 and Table 1).

2.1.5 Contingency for adverse conditions

In the event of adverse weather or sea conditions relating to winds, rain, currents or visibility the Field Team Leader may choose to re-evaluate the day's field programme and change the schedule if necessary. This would primarily involve the abandonment of a site at which conditions are unsuitable and the replacement of the site with a site that is sheltered from the wind and/or offers better sea conditions for underwater work..

2.2 Methods

At each long-term monitoring site, the dominant benthic habitat types will be surveyed and three permanent 50 m transects will be established to monitor spatial and temporal changes in benthic composition. The transects will be set parallel to each other at approximately equal distances. The distance between the transects and the consequent size of the transect grid will be determined by the spatial scales, topographical characteristics, current regime, and benthic habitat types present at each sampling site. The transect grid will be placed so as to ensure that the positioning of the separate transects is random, giving three replicate samples for each site. The transects are to be permanently set using star pickets at the start and end points, with a 50 m fibreglass tape or a scaled and weighted rope marking the transect line across the seabed. The position of the start of each transect is recorded using differential GPS, providing an accuracy of better than 3 m. The sessile benthic composition along each transect is then recorded at a set height and speed, using a high quality video camera in an underwater housing, resulting in a strip transect 50 m long and 1 m in width being sampled.

The video sampling method was developed by the Australian Institute of Marine Science (AIMS) to monitor the status of coral dominated benthic communities by detecting and quantifying major spatial and temporal changes in the percentage cover of sessile benthos (Christie *et al.* 1996). This survey technique is more suitable than the time-consuming line intercept transect method as it is faster to carry out in the field and requires no extensive field identification and taxonomic knowledge. It also provides a permanent record of benthic habitats which can be later analysed in a variety of different ways. A visual record is a very compelling method for identifying change and for highlighting impacts that may result from recreational and commercial usage.

At new sites (ie not previously visited during the preliminary survey of April 1996) recordings of benthic composition using the video transect technique will be complemented with general information on the major benthic community types (eg seagrass meadows, coral etc) the visually dominant species and the nature and extent of impacts (if present) will be recorded either by direct observation from the boat (ie by viewfinder and /or remote video), or by divers taking general video footage and still photographs.

All habitat data and related observations will be recorded electronically onto standard data files which have been pre-formatted and stored on a laptop computer. Data sheets for written data recordings will be also be made available. All written data is to be transferred to the computer files during the field survey, and preferably on the day of collection. Examples of data recording sheets are presented in Appendix II.

Vertical profiles of salinity and temperature will be collected opportunistically through the water column at each site to provide insight into broad-scale circulation patterns and determine the degree of stratification of the water column as an aid to interpretations of satellite imagery (NOAA-AVHRR and Landsat Thematic Mapper) of sea-surface temperature (SST) and water colour signals which can be used as a proxy for broadscale surface water circulation patterns. This information will be useful as calibration and validation data for numerical hydrodynamic models of the circulation of Shark Bay. A better understanding of the circulation and mixing patterns in Shark Bay will enable the movement of water borne substances (such as pollutants, larvae and phytoplankton) to be better understood and predicted, and this information assists in management. Further studies of the hydrodynamics of Shark Bay forms an important recommendation of the Shark Bay Marine Reserves Draft Management Plan 1994 (Department of Conservation and Land Management, 1994).

Figure 2 Approximate locations of sites for the April 1997 field survey

Table 1 Sites to be visisted. Week 1 (7-12April) and week 2 (14-19): scheduled sites with exact coordinates for the permanent transects to be resampled and indicative coordinates to aid in navigation to the general area at which transects are to be established or qualitatively assessed. Week 3 (21-25 April) and week 4 (28 April-2May) will be for groundtruthing the habitat map.

Site number	Site name	Dominant factor in site selection	latitude and longitude	Habitat	Location of transects
WEEK 1					
'Permanent transect' sites to resample			*Exact coordinates*		
SB 20	Heirisson flats	Recreation site	25° 58.599' S 113° 19.451' E	Seagrass	see August 1997 data report
SB 31	Slope Is-Nth platform	Recreation site	26° 04.592' S 113° 24.515' E	Limestone platform	see August 1997 data report
SB 57	Pearl beds	Scientific interest	26° 15.914' S 113° 29.579' E	Seagrass	see August 1997 data report
SB 128	Pearl farm control	Control site	25° 47.035' S 113° 41.862' E	Seagrass	see August 1997 data report
SB 105	Broadhurst reef	Recreation site	25° 38.091' S 113° 22.330' E	Coral reef	see August 1997 data report
SB 120	80 Acres	Recreation site	25° 32.741' S 113° 31.708' E	Limestone platform	see August 1997 data report
Wooramel Bank			*Indicative coordinates*		
'Permanent transect' sites to be initialised					
SB 149	Dugong research site	Dugong feeding ground-control	to be determined-see management plan	Seagrass/ Halodule sp	Survey to confirm location
SB 150	Disappointment Reach sanctuary zone	Dugong feeding ground-control	25° 41' S 113° 57 E	Seagrass	Survey to confirm location
SB 151	Disappointment Reach-north	Representative of Wooramel Bank	25° 35' S 113° 50' E	Seagrass - ?m	Survey to confirm location
SB 152	Grey Point - west	Representative of Wooramel Bank	25° 09' S 113° 39' E	Seagrass -12m	Survey to confirm location
SB 153	Carnarvon - south	Representative of Wooramel Bank	24° 59' S 113° 33' E	Seagrass -9 m	Survey to confirm location
Non-transect sites to be initialised					
SB 154	Grey Point bommie	Recreation site	25° 04.5' S 113° 30' E	Limestone/coral	
SB 155	Pearl bed	Scientific interest			
WEEK 2					
'Permanent transect' sites to be initialised			*Indicative coordinates*		
SB 5	Monkey Rock	Recreation site	26° 08.608' S 113° 09.949' E	Coral reef	Reef slopes up from north west
SB 90	Turtle Bay	Recreation site	25° 29.793' S 112° 59.185' E	Limestone/coral	Survey to confirm location
SB 70	Louisa Bay	Recreation site	25° 45.83'S 113° 04.84'E	Limestone/coral	Survey to confirm location
SB 21	Bar Flats	Recreation site	25° 51.05'S 113° 21.06'E	Limestone/coral	Survey to confirm location
Bernier & Dorre Islands -East			*Indicative*		

'Permanent transect' sites to be initialised			*coordinates*		
SB 200	Museum site 15*-Uranie Bank*	Control site	25° 11.02'S 113° 10.2'E	Seagrass	Survey to confirm location

Table 1 cont.

Site number	Site name	Dominant factor in site selection	latitude and longitude	Habitat	Location of transects
SB 201	Museum site 14 *-Cape St Cricq	Control site	25° 16.38'S 113° 04.65'E	Limestone reef/coral	Survey to confirm location
SB 202	Museum site 8 *-Castle Point	Recreation site	25° 07.54'S 113° 06.96'E	Seagrass	Survey to confirm location
SB 203	Museum site 16 *-Middle rock	Recreation site	24° 59.02'S 113° 07.17'E	Limestone reef/coral	Survey to confirm location
SB 204	Museum site 29* Cleft rock	Recreation site	24° 48.54'S 113° 09.95'E	Limestone reef/coral	Survey to confirm location
SB 205	Museum site 25*- East Koks Island	Recreation site	24° 45.15'S 113° 09.81'E	Coral/seagrass	Survey to confirm location
Bernier & Dorre Islands -West *'Non-transect' sites to be initialised*					
SB 206	Museum site 9/10*-North Cliff Pt	Control	25° 11.71'S 113° 05.14'E and south	Intertidal/ nearshore limestone reefs	
SB 207	Museum site-19*-West Cape Couture	Control	24° 59.02'S 113° 07.17'E	Intertidal/ nearshore limestone reefs	
SB 208	Museum site 24*-West Cape Ronsard	Control	24° 45.34'S 113° 09.45'E	nearshore limestone reefs	
Naturaliste Channel *'Non transect' sites to be initialised*					
SB 210	Dampier Reef	Control	25 21.6'S 113° 04.5'E	reef	
SB 211 +	Other reefs	Control	?	reef	

WEEK 3 and WEEK 4

Further grountruthing of habitat map. Sites to be determined.

* Museum site refers to: '*Bernier and Dorre Islands, Shark Bay- Marine Biological Survey' by the* WA Museum (1995*).*

The times (Western Standard Time) at which NOAA-AVHRR satellites begin their passes over Western Australia have been obtained from the Department of Land Administration (Remote Sensing Applications Centre, contact Mr Mike Steber) and this information has been reproduced in Appendix III (see column 6). The last column (i.e., Column 11) of the data sheets in Appendix III shows the time that will be taken by the satellite to cover the entire

area of Western Australia. Sea-surface temperature data should be collected during the period that the satellite passes over Western Australia.

The physical data set will be forwarded to Mr Alan Pearce (CSIRO, Division of Oceanography) for use in the calibration of selected NOAA-AVHRR SST images and also Mr Murray Burling (Department of Environmental Engineering, University of Western Australia) for use in his research on the circulation of Shark Bay. Mr Burling is engaged in a Master of Engineering Science study of the hydrodynamics of Shark Bay, supervised by Drs Charitha Pattiaratchi and Greg Ivey, and involving both process studies and numerical modelling.

2.2.1 Establishment of permanent transects

The following sequence describes the basic field procedure that is to be followed to establish three permanent transects at each site. The entire procedure should take between 2 and 4 hours, depending on *in situ* conditions, enabling at least two sites to be visited per day. Changes to this procedure may be made by the Field Team Leader, Jennie Cary, and advised to the field crew in the field.

- The boatman and two divers will conduct a general survey of the site from the tender (a Zodiac inflatable). Observations of the benthic habitats will be made either by using the viewfinder from the vessel or by in-water observations on snorkel, using the manta-tow technique or underwater scooter. The boatman and divers will then proceed back to the main vessel to decide on the size, location and alignment of the transect grid.

- The tender will then be equipped with three transect kits, with this activity coordinated by the field officer onboard the main vessel. Each kit will comprise a porous plastic crate attached to a rope (with a buoy attached to the end) of length chosen to suit the approximate depth of the respective transects, and with each crate containing two star pickets, a scaled 50 m line, a mallet, a picket driver and an underwater writing slate, all fastened to the inside of the crate. The specifications for the respective kits (rope length and contents) are to be tailored to suit each of the three respective transects (nominally called Transects T1, T2 and T3).

- The boatman will transport the three transect kits and the two divers to the start point of Transect T1.

- The two divers provide the boatman with confirmation of the path that they will traverse to establish the three transects including where they wish to be retrieved after establishing the three transects.

- The kit for Transect T1 is lowered over the side of the tender to the seabed.

- The two divers then enter the water at this site and descend to the seabed. In the event that the two divers perceive a problem at this stage of the exercise they are to ascend to the surface and inform the boatman of the problem. An appropriate course of action to rectify the problem is to be decided upon either by agreement between the boatman and two divers or, in the event of a failure to reach agreement, by the Field Program Leader. If there are no problems then the divers are to proceed with the establishment of Transect T1, followed by Transects T2 and T3.

- After the two divers have descended to the bottom at the start point of Transect T1, the boatman will leave Transect T1 and progressively drop the two remaining transect kits at the start points of Transects T2 and T3, respectively.

- From this time onwards the boatman is to keep a watch on the transect zone in which the divers are operating in order to be able to respond to requests for assistance, such as the delivery of equipment, towing of divers or retrieval of divers.

- While the two divers are establishing the transects the boatman returns to the main vessel and takes delivery of the cameras. The boatman then awaits for a signal from the divers.

- After establishing the transects the divers will signal to the boatman. The boatman then retrieves the two divers and returns them to the start point of Transect T1, where the divers are given the video recorder and

stills camera. The divers descend to the bottom and then proceed to acquire video footage and selected still photography along the three respective transect alignments. The sampling methodology for the collection of benthic habitat video imagery is detailed in Section 2.2.2.

- While the divers are filming the boatman will return to the main vessel where the fourth field officer will board the tender with the differential GPS and then proceed to fix the positions of the start points of transects T1, T2 and T3 but only approaching these points if they are sure that the divers are not in the vicinity. After the positions have been fixed the boatman returns the differential GPS and the field officer to the main vessel.

- After the divers have completed filming they can either place the photographic equipment in a crate or signal to the boatman to approach them and take delivery of the equipment.

- The divers then decommission each transect by fastening the scaled lines, mallets and drawing sheets into their respective crates.

- Upon receiving a signal from the divers the boatman then retrieves the two divers and proceeds to retrieve the three transect kits.

- The boatman and divers then return to the main vessel.

- Data recording and field notes are to be processed onboard the main vessel. Field notes are to be written into pre-formatted data file sheets and stored electronically in the hard drive of a laptop computer and backed up to floppy disc.

2.2.2 Sampling methodology for the collection of benthic habitat video imagery

This sampling technique is adapted from the AIMS Standard Operating Procedure No. 2 (Christie *et al.*, 1996). The steps required for preparation of the underwater housing and video camcorder are included in Appendix IV. The recording of data for each transect should be carried out according to the following steps:

1) Fill out the details on the in-water data sheet (located on the top of the housing) identifying the transect. Record the site number, date, transect number, and recorder's name.

2) Set the camcorder to **autofocus**, press REC and video a panoramic shot of the start of the transect. Start at the star picket, hold the camera in a horizontal position and turn slowly clockwise, videoing the immediate surroundings and ending at the initial view. Move in on the top of the star picket to record the site number and transect number written on the white plastic cap. Press STBY.

3) Record the start time code on the data sheet. Press REC and video the base of the star picket for a few seconds and then move along the tape or scaled rope, keeping it approximately 10 cm in from the right hand side of the field of view. Keep the housing lens parallel to the substrate at a distance of 1 m.

4) Follow the transect line keeping the housing at the set height of 1 m, ensuring that the screen image is in focus. Adjust your swimming speed so that it is constant and you cover approximately 10 m every minute, and not faster. This is important to ensure a high quality of image. The entire transect should take between 5 and 6 minutes in total. At the end of the transect video the base of the star picket for a few seconds and then press STBY.

5) Record the finish time code on the data sheet.

6) If video recording along a transect has to be aborted for any reason, or if there is considerable variation in the height or speed of the recorder, then the entire transect should be re-sampled, beginning again from the start point of the transect. It is important that the new start and finish time codes for any repeated transects are clearly recorded on the data sheets.

7) Proceed to the next transect. Once all three transects at a site have been completed and the tape has been viewed and checked back on the vessel, full details must be recorded on the main video transect data sheet (Appendix II). Any repeated or incomplete transects, or situations where transects were recorded out of order or with false starts should be noted on the data sheets.

8) A total of three sites should be recorded on each 90 min Hi8 tape. The tape and tape cover should be clearly labelled (using a permanent marker) with the designated tape number (Appendix IV), the site number and date of recording. The red copy protect switch on the tape should be switched on to prevent accidental recording over any data, and the tapes should be stored in a waterproof case at all times.

9) At the end of the field trip and before data analysis the tapes must be duplicated, either in Hi8 or VHS format, and the originals archived and stored separately from the duplicates.

2.2.3 Resampling ofpermanent transects

Previously established transects will be relocated and a 50m weighted rope will be laid out between the two star pickets. The transect will then be video taped.

2.2.4 Groundtruthing of habitat map

Landsat images combined with vector coverage of habitat classification will be used to select sites to assist in the groundtruthing of the habitat map. Sites to be determined when the images are available.

2.2.5 Physical data

Vertical salinity and temperature profile data will be collected from the main vessel using a Yeokal Salinity-Temperature Bridge (Hamon Model 602). Salinity and temperature are to measured at 1 m intervals through the water column, beginning just below the surface. The data are to be recorded to the field data sheets and then transferred to the electronic data files on the laptop computer. Salinity and temperature calibration adjustments will be determined after the field survey on the basis of laboratory analyses of salinity samples collected in clean glass bottles in the field and by checks of the meter against a scientific thermometer. Salinity samples are required to be collected and temperature checks with the scientific thermometer should be made at the beginning and end of each day. At each site a bucket of surface water should be collected and quickly (within 1 min) measured for temperature using the scientific thermometer. This should also be performed if possible, at times of NOAA-AVHRR or Landsat TM satellite overpasses (see Appendix 111 for overpass times). Sea-surface temperature imagery (from NOAA-AVHRR) will be acquired from the Department of Land Administration (Remote Sensing Applications Centre) and the temperature data collected during April 1997 will be used to calibrate the images.

2.3 Equipment

2.3.1 Video system

- Blaupunkt CC894 Hi 8 video camcorder, with battery pack (2), battery charger (1), battery discharger (1), yellow and orange filters
- StingRay SR-700 underwater video housing with colour monitor back, super wide-angle and zoom-macro lenses, and built-in red filter
- SunRay underwater lighting system with battery pack (3), battery charger (1), and spare lamps (2).
- Insruction manuals
- Video transect data sheets
- Sony professional 90 min Hi 8 video tapes (15)
- Housing O-ring kit and silicone grease
- Cleaning kit
- Back-up underwater video system (Sony VHS system)

2.3.2 Still photography

- Camera 1: Nikonos V, 35mm lens and close up kit
- Camera 2: Nikonos V, 15mm lens and SB102 strobe unit
- 5 rolls of 36 exposure print film
- 15 rolls of 36 exposure slide film
- Log books for cameras 1 and 2
- Kit of camera spares

2.3.3 Safety

- Comprehensive diving first aid kit
- Emergency response flowsheet
- Emergency contact flow chart
- Patient information log
- Log sheets for accidents
- Oxygen therapy equipment
- Spare oxygen D cylinder
- 4 wet weather jackets
- Sunscreen
- Spare sunglasses
- Spare caps

2.3.4 Information

- Marine Charts: AUS 747, AUS 748, AUS 749, DMH 661
- Reference books for the identification of corals, fish, birds, marine mammals and marine fauna
- Scientific reference file
- Landsat imagery of Shark Bay
- CALM GIS habitat maps
- Available aerial photographs of selected regions of Shark Bay
- Habitat data sheets
- Long-term monitoring site data sheets
- Transect data sheets
- Video data sheets
- 1 laptop computer plus 20 floppy discs

2.3.5 Diving

SCUBA

- 10 scuba tanks
- 6 BCD's
- 6 regulators with alternate airsource and gauges
- 2 masks and snorkel
- 2 dive computers
- 7 weight belts, each with 24 lb of weight
- 4 underwater torches
- 4 compasses

Accessories

- 2 dive flags
- 1 large spare parts and repair kit
- 1 manta board and line
- 4 pocket size underwater slates, grips and pencils

- 20 sheets underwater paper
- printed underwater paper for recording video codes
- 4 field notebooks
- 1 box of rubber bands
- 1 box of pencils
- 4 catch bags
- 1 underwater scooter
- 1 viewfinder

Administration

- 1 scuba log book
- 1 equipment log book

Vessel (inflatable)

- Bags, repair kit, ropes, oars and lines, outboard motor and fuel tank

Compressor

- Tool and repair kit
- Fuel

2.3.6 Position fixing, communications and habitat data recording

Position fixing

- 2 hand held GPS units and accessories
- 1 Omni star differential GPS unit, antennae and accessories

Communictions

- 2 calm hand-held radios and chargers
- 2 waterproof bags for radios

Habitat data recording

- 1 drop down camera and B/W monitor
- 1 drop down camera and cable
- 1 video receiver unit, aerial and cables
- 1 video recorder unit

Mechanical and electrical repair kits

- Comprehensive mechanical tool kit
- Comprehensive electrical repair kit

Transect establishment

- 6 pimple buoys
- 9 pre-cut station marker ropes, (3 x 5 m length, 3 x 10 m length, 3 x 15 m length)
- 3 x 50m tape
- 3 x 50m line
- 100 full size pickets
- Large bolt cutters

- 2 x 100 m rope
- 4 weighted crates
- 3 mallets
- 3 peg drivers

Other items

- 100 AAA batteries
- 50 D batteries
- 50 C batteries
- 6 VHS 3 hr tapes
- 2 motorbike batteries and chargers

2.3.7 Physical data

- Yeokal Salinity-Temperature Bridge (Hamon Model 602). Serial No. ST384
- Scientific thermometer (model TOT 1MM E-MIL GOLD LINE)
- Glass numbered salinity sample bottles

3 FIELD PROGRAMME

3.1 Field itinerary

The field itinerary for the field survey period of 3 to 27 April 1997, including travel details, is given in Table 2.

3.2 Equipment suppliers and relevant contacts

The following list gives contact details of the suppliers of major items of equipment.

Aerial photos: DOLA, Gary Caporn, ph. 2737209
Ansett: Flights, Ph. 131644
Calm, Denham: Ph.099 481 208
Car: Budget, Todd Maskiell, Ph. 4791919
Compresser: Malibu Diving, Steve Sturgeon, Ph. 5279211
Drop-down camera: Cunard Technologies, Mark Harris (014 884 006/458 4022
James Sheerer: Craig and Jessie Shankland, Ph. 099 481 616 hm ; 481 617 (fax)
Landsat satellite images: UWA, Eleanor Bruce, ph. 3803838
NOAA-AVHRR satellite images: DOLA, RSAC, Mike Steber, Ph. 3409330
Omnistar differential GPS: Fugro, Gary Allen, Ph. 3225295
Picketts and drivers: DBS Fencing, Ph. 4099711
Scoutmaster GPS: Benchmark, Rob Fergusen, Ph. 08 2325405
Shark Bay Marine: Barry Edwards; Ph. 099 481 001
Transport: Boss Transport, Ph 099 642880
Underwater scooter: Dolphin Dive, 3532488
Underwater video system: Sea Optics, David Hull, Ph. 08 3626161
Zodiac inflatable vessel: Wiltrading, Geoff Jordan, Ph. 3359155

3.3 Emergency contacts

General
CALM, Denham: Ph. 099 481 208, Fax 099 481024
CALM, Marine Conservation Branch, Fremantle: Ph 09 432 5100
Department of Fisheries, Denham: Ph. 099 481 210
Denham Police: Ph. 099 481 201
Carnarvon Police: Ph. 099 411 444

Shark Bay Nursing Post:, 099 481 213
Fremantle Hyperbaric/Diving Service: 09 431 2233 or 09 431 3333

Radio
James Sheerer - sea phone 399580; callsign VHW 4584
CALM VHF - channel 20.
Marine HF - channel 2182, 4620. These channels will establish contact with:
Denham Police
Shark Bay Marine Centre
Carnavon Radio
Marine VHF - channel 16 (any station)

4 SAFETY

Safety issues relating to navigation are the responsibility of the vessel owner (Craig Shankland). Safety issues relating to the field work and diving are the responsibility of the Field Team Leader and Diving Supervisor, Jennie Cary, and have taken into account CALM's departmental safety procedures and protocols.

5 BUDGET

A budget of $22 500 has been allocated for this survey.	$
Boat (16 days at sea & 3 days at port)	10 200
Freight	200
Fuel	350
Travel	250
Compressor	500
Equipment	
-star pickets	400
-sundry consumables	700
Accommodation on land	240
Food costs on land	600
Report preparation	600
GIS costs	400
Contingency (approx 7%)	1 510
Wages	
Contract Technical staff (39 days @ $168 per day)	6 550
Total cost	$ 22 500

Extra costs not included of Marine Conservation Branch
GIS officers time (level 5); 6 days
Project leaders time (level 6); 35 days

Table 2 Field itinerary for the period 3 to 27 April 1997.

Date	day	Activity
3 April 97	T	Bulk equipment leaves Perth on Boss Transport via truck
4	F	Boss Transport truck met by Barton at Denham Barton to check equipment
5	S	Rest day
6	S	Cary, Daly, Berggren, Boogard and Mc Quillan depart Perth by vehicle at approx. 0800 hrs and

		arrive in Denham at approx 1800 hrs.
7	M	Vessel (the “James Sheerer”) is loaded and departs from Denham to field site at approx 1500 hrs. Field crew: Cary, Daly, Barton, Berggren, Boogard and Mc Quillan
8	T	Field work
9	W	Field work
10	T	Field work
11	F	Field work
12	S	Field work Vessel and field crew return to Denham/Monkey Mia/Carnarvon at approx 1800 hrs
13	S	Rest day Shepherd arrives from Geraldton
14	M	Vessel departs from Denham to field site at approx 0700 hrs Field work (field crew: Cary, Daly, Shepherd Berggren, Boogard and Mc Quillan,)
15	T	Field work
16	W	Field work
17	T	Field work
18	F	Field work
19	S	Field work Vessel and field crew return to Denham at approx 1800 hrs
20	S	Rest day (Boogard and Mc Quillan take bus to Perth; Berggren meets family in Denham)
21	M	Vessel departs from Denham to field site at approx 0700 hrs Field crew: Cary, Daly, Shepherd
22	T	Field work
23	W	Field work
24	T	Field work Vessel and field crew return to Denham at approx 1800 hrs
25	F	Unload boat. Shepherd leaves for Denham
26	S	Jennie Cary and Tim Daly drive to Perth via Jurien Bay and drop off equipment for Jurien Bay field trip. Brad Barton remains in Denham.

6 REFERENCES

Cary J L and Pobar G J (1997). Shark Bay Marine Reserves Monitoring Programme- Initialisation of long-term monitoring sites: August 1996. Data Report MMSP/MW/SBMP-1/1997. (Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry St, Fremantle, 6160). Unpublished report.

Christie C A, Bass D K, Neale S J, Osborne K and Oxley W G (1996). Surveys of sessile benthic communities using the video technique. Long-term monitoring of the Great Barrier Reef. Standard Operational Procedure Number 2. Australian Institute of Marine Science, Townsville, Queensland.

D'Adamo N, Colman J G and Pobar G J (1996). Shark Bay Marine Reserves Monitoring Programme. Data Report SBMRMP-02/96. Preliminary Field Survey: 15-22 April 1996. (Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry St, Fremantle, 6160). Unpublished report.

D'Adamo N and Pobar G J (1996). Shark Bay Marine Reserves Monitoring Programme. Field Programme Report SBMRMP-01/96. Preliminary Field Survey: 15-22 April 1996. (Marine Conservation Branch, Department of Conservation and Land Management, 47 Henry St, Fremantle, 6160). Unpublished report.

Department of Conservation and Land Management (1996). Shark Bay Marine Reserves Management Plan 1996-2006. Department of Conservation and Land Management for the National Parks and Nature Conservation Authority, Perth, Western Australia, 6000.

APPENDIX I

CALM GIS HABITAT MAP

APPENDIX II

DATA RECORDING SHEETS

APPENDIX III

NOAA-AVHRR SATELLITE OVERPASS DETAILS FOR WESTERN AUSTRALIA - APRIL 1997

APPENDIX IV

UNDERWATER VIDEO SYSTEM

Preparation of underwater housing and video camcorder

Step-by-step instructions on preparing the StingRay SR-700 housing and Blaupunkt CC894 camcorder are given below. This procedure is adapted from the AIMS Standard Operational Procedure Number 2: "Surveys of sessile benthic communities using the video technique" (Christie *et al.*, 1996).

Where possible, store and prepare the equipment at room temperature to prevent condensation on the lenses of the camcorder and housing. Carry out these preparations in a dry, dust and spray-free environment. For more details refer to the relevant instruction manual.

Housing

1) Open the housing by simultaneously releasing and rotating the two black plastic catches at the rear of the housing. Carefully remove the monitor back and place to one side. Remove the camera tray by depressing the small black plastic catch on the left hand side and simultaneously sliding out the tray. Check the inside of the housing for any dust or other particulate matter, and clean out using a lens cloth and blower brush if necessary. Check the inside of the lens and the red filter and clean using blower brush, lens tissues and lens cleaning fluid if necessary. Check which lens is attached to the housing - super wide-angle (the shorter of the two available optics) or zoom-macro. **For transect work the super wide-angle lens is required.**

2) If using the SunRay lighting system, install a fully charged battery in each of the battery pods mounted on both sides of the housing (see StingRay instruction manual).

3) Remove the two O-rings from the monitor back, clean them with lens tissues and check for any cracks or scratches. If there is any damage to the O-rings, discard and replace with new ones. Apply a small amount of silicone grease (2-3 mm) between thumb and index finger and run the O-ring through several times to spread this evenly. Repeat with the second O-ring. **Ensure that you do not use too much grease as this could cause the seal to leak!** Remember that the grease is there to keep the O-rings supple and not to actually form a seal.

4) Clean out each O-ring groove with a cotton bud, and carefully replace the clean and greased O-rings back into the grooves without twisting them. Ensure that there is no particulate matter sticking to the O-rings. The housing is now ready for the camcorder to be inserted.

Camcorder

5) Place the camcorder on a clean, dry, flat surface and attach the StingRay battery adapter to the rear. Attach a fully charged Sony NP-78 battery pack to the battery adapter. Remove the lens cap, check the lens and clean if necessary. Attach a yellow or orange filter if required (see point No. 24).

6) If the housing zoom-macro lens system is being used, attach the zoom-macro adaptor to the front of the camcorder. This accessory lens pushes on in front of the camcorder lens, so that it lies flush with the manual focusing ring.

7) Press the eject switch (small switch with blue button on top of camcorder) and insert a blank Hi 8 video tape into the cassette holder, ensuring that the red copy protection switch is switched off. Close the cassette holder by gently pressing the 'PUSH' mark on the right side - the top section of the cassette holder will then close down automatically. **Do not push it down manually.**

8) Switch the camcorder on by sliding the OPERATE switch (front left side with green button) to CAMERA. Turn the REC switch (rear left side with red button) to STANDBY.

9) Select the camcorder settings. Turn the IMAGE STABILIZER switch (below the AUTO MODE cover on left side) to ON. Open the AUTO MODE cover and set the functions as follows:

FOCUS- the focus mode can be selected when the camcorder is inside the housing.

EXPOSURE - leave the exposure mode in automatic setting (no exposure indicator on the left side of the LCD display).

PROGRAM - select the desired shutter speed by pressing the PROGRAM button. The SPORTS setting (indicated by a running figure on the LCD display) gives a shutter speed of 1/50 to 1/500 of a second. **This will be suitable for most video transect work**. On occasions when camcorder shake may be excessive, or when trying to video fast-moving subjects such as marine mammals or fish it would probably be better to select the HIGH SPEED setting (indicated by a golfing figure on the LCD display), giving a shutter speed of 1/4000 sec.

WHITE- the white balance setting can be selected when the camcorder is inside the housing (see point No. 18).

10) Ensure the viewfinder lens is removed, and the viewfinder is locked in the down position (see camcorder instruction manual for details).

11) Ensure that the timecode function is switched on (TC displayed on the top right side of the LCD display). If it is off, press the COUNTER/TIMECODE button below the LCD display so that TC is displayed.

12) Mount the camcorder on the StingRay camera tray, ensuring that the camcorder is correctly aligned and that the screw on the bottom of the tray is tightened firmly. Attach the cables from the tray to the camcorder, in the following order:

    i) attach the video cable (yellow label) to the VIDEO OUT plug (front right side), ensuring that it is routed snugly under the base of the battery and inside the camcorder grip strap (otherwise it will not reach the plug);

    ii) attach the power-out cable (green label) from the battery adapter to the DC power jack on the camera tray;

    iii) attach the remote cable (blue label) to the blue REMOTE plug (back right side);

    iv) attach the microphone cable (red label) to the red MIC plug (front right side),ensuring that it is routed under the lens and clear of the camera tray.

13) Slide the camera tray assembly into the grooves in the housing and push forward gently until it will not go in any further. Check that the assembly is locked in place and cannot be withdrawn without depressing the small black plastic locking button at the rear left hand side of the camera tray.

14) Ensure that the two black plastic catches on the outside of the housing are in the vertical position with the slots facing towards you. Place the monitor back onto the rear of the housing, ensuring that the two black plastic guide pins go into the guide holes on the camera tray. Simultaneously rotate the locking catches towards you, ensuring that the stainless steel guide pins on the monitor back enter the slots on the catches. Continue to rotate the catches until they lock in the horizontal position. Inspect around the circumference of the monitor back to ensure that it is properly seated.

15) Assemble the monitor back screen shade and place it in the tracks of the monitor back. Slide it down until it locks in place.

Pre-filming checks

16) Power up the camcorder by sliding the PWR switch (right side rear) towards you and holding it in place for 2 seconds. A green LED comes on at the bottom centre of the monitor back, and the screen display will come on. Check the screen display to ensure that all the camcorder functions are set correctly. At the top right side of the display there should be Hi8 and SP (indicating that the tape is Hi8 format and record mode is set for short play), and STBY (indicating that the camcorder is in standby mode). Underneath these symbols the time code indicator and the remaining tape indicator, will be displayed. At the bottom right side the battery indicator will be displayed. At the top left side there will be a hand symbol (indicating that the image stabilization system is on), and a running figure symbol (indicating that the shutter speed is set to SPORTS mode), and a hand symbol with the letter F inside (indicating that the manual focus mode is on). Check the manual focus by holding the focus switch (left side front) to both N (near) and F (far) positions.

17) To switch to autofocus mode, toggle (push and immediately release) the PWR switch towards you. Do not hold the switch in place or the camcorder will turn off. To return to manual focus mode, toggle the AF switch away from you. Use automatic focus for panoramic shots and manual focus for filming the transects.

18) Toggle the WB switch (left side) towards you repeatedly to change the white balance mode (as indicated by symbols in the top left side of display). The settings available are:

AUTO MODE- (no symbol): automatic white balance setting.

HOLD MODE - (HOLD): the last automatic white balance setting is locked and maintained, even if lighting conditions change.

OUTDOOR MODE - (sun symbol).

INDOOR MODE - (light bulb symbol).

For video transect work the most suitable settings are AUTO or OUTDOOR. Use the OUTDOOR mode in shallow (<3 m) water, on bright sunny days when the water visibility exceeds 8 m. Otherwise, leave the white balance in AUTO mode.

19) If there are any other symbols displayed on the screen check the camcorder instruction manual to determine what they represent.

20) Ensure that the zoom function is set to full wide-angle. Move the zoom switch (right side front) to the W position and hold it there. Check the zoom indicator on the left side of the screen display. (*Note: When using the super wide-angle lens and the auto focus mode, the camcorder will only zoom in and stay in focus for about 50 % of the full range before going out of focus. To zoom in closer than 50 % the zoom-macro lens system should be fitted).*

21) Turn the power off by moving the power/record switch to PWR and holding it there for 5 seconds. the screen display and the green LED will turn off.

22) Check that there is no condensation on the camcorder lens or housing lens. If condensation is present, delay filming until it disappears (approximately 10 minutes). The housing should be kept out of the sun during transport.

23) Once in the water, if visibility is good (>8 m) and transects are in water >3 m deep, slide the red filter down over the lens by turning the knob on the front plate of the housing. If transect is in water <3 m deep, or if the visibility is poor it will probably be necessary to use a yellow or orange filter that screws on to the camcorder, directly in front of the lens.

24) Check the housing for leaks. This may be indicated by a moisture condensation symbol on the screen display (refer to camcorder instruction manual), bubbles coming from the housing, or water droplets visible inside the housing when you look through the housing lens.

25) Before starting to film, check the front of the housing lens for small air bubbles. Gently wipe away any that are present with your hand. Check for air bubbles regularly.

26) If lighting conditions are poor, switch on both SunRay lamps.

27) Turn the power on (move the power/record switch to PWR position and hold it there for 2 seconds) and commence recording (toggle the switch to the REC/STBY position. A red LED will come on at the bottom centre of the monitor back, and the REC symbol will appear at the top left side of the screen display.

Post-dive procedure

28) After every dive immerse the housing in fresh water. Leave it there for 10-15 minutes and wash the controls and monitor back with running water. Remove the monitor back screen shade.

29) Wipe the housing with a clean, dry towel and leave in a clean, dry, airy and salt-free environment to dry completely.

30) Wipe carefully around the rear seal of the housing before opening so that no water gets onto the camcorder. Open the housing by simultaneously rotating the black plastic catches at the rear of the housing. Remove the camera tray assembly by depressing the small black plastic locking button at the rear left side and sliding the tray out. Detach the cables and remove the camcorder from the tray. Attach caps to both housing and camcorder lens. **Do not open the housing where salt spray is present.**

31) Switch the camcorder to video by sliding the OPERATE button to VTR. Rewind the tape using the either the controls on the top of the camcorder or the remote commander. Connect the camcorder to the TV monitor (refer to camcorder instruction manual) and view the footage. Transcribe the system settings and time code information onto the main Video Transect Data Sheet (Appendix II). Label the tape clearly (using a permanent marker pen) with the designated tape number, the site number and the date of recording.

Tape numbering

The video tapes should be consecutively numbered according to the following coding system:

Project acronym (SBMRMP)/Sampling method (bvt - benthic video transect)/Date (07.04.97)/Tape number (#1 onwards).

Thus, the first tape would be labelled as: **SBMRMP/bvt/07.04.97/#1**

If the tape contains footage spanning more than one day the tape number should indicate this (eg. **SBMRMP/bvt/07-08.04.97/#1).**

32) A total of three sites should be recorded on each 90 minute Hi8 tape. Before commencing filming at another site, ensure that the tape is wound forward to the end of the footage recorded at the previous site. This will ensure that no data is recorded over accidentally. Once a tape is complete the red copy protect switch on the tape should be switched on to prevent any loss of site data. The tapes should be stored in a waterproof container and duplicated at the end of the field trip.

33) Clean the video heads with the head cleaning cassette after approximately 10 hours of use. Follow the instructions carefully to avoid damage to the video heads. Refer to the camcorder instruction manual for more details.

Recharging the battery packs

34) New batteries should be fully charged and discharged several times before use to prolong their life. The Sony NP-78 batteries should last between 75 and 90 mins, when using the monitor back. Before recharging a used battery, make sure it is fully discharged first (use the REFRESH function on the battery charger or a battery discharger). Once the battery is totally discharged, slide the indicator switch on the top of the battery so that a red dot is visible. This serves as a reminder that the battery is totally discharged. Connect it to a battery charger and charge it completely. This will take approximately 2 hours and 20 minutes for a Sony NP-78 battery. Once it is charged, slide the indicator switch to hide the red dot, indicating that the battery is fully charged and ready to be used. At the end of the field trip, leave all batteries discharged.

APPENDIX V

USER DATA

DISTRIBUTION LIST

SHARK BAY MARINE RESERVES MONITORING PROGRAMME. INITIALISATION AND RESAMPLING OF LONG-TERM MONITORING SITES AND FURTHER GROUNDTRUTHING OF HABITAT MAP: APRIL 1997. Field Programme Report mmsp/mw/sbmp-2/1997

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