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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

Data Report SBMRMP-02/96

Preliminary field survey: 15-22 April 1996

Prepared by N D'Adamo, J G Colman and G J Pobar
Marine Conservation Branch

July 1996

Marine Conservation Branch
Department of Conservation and Land Management
47 Henry St.
Fremantle, Western Australia, 6160

DISTRIBUTION LIST

SHARK BAY MARINE RESERVES MONITORING PROGRAMME. PRELIMINARY FIELD SURVEY: 15 22 APRIL 1996. Data Report SBMRMP-02/96.

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Field notes and general documentation relating to the Shark Bay Marine Reserves Monitoring Programme (SBMRMP) are archived in the following Marine Conservation Branch files:

MW/SB/MRMP0496/BIO
MW/SB/MRMP0496/OCN
MW/SB/MRMP0496/SOC
MW/SB/MRMP0496/GEN

Access to these files and copies of this report are available at:

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SUMMARY

This data report presents the results of the preliminary field survey of the Shark Bay Marine Reserves Monitoring Programme (SBMRMP), conducted between 15 and 20 April 1996. Benthic habitats were observed at 54 sites. The survey was 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 was obtained from a National Ecotourism Programme grant (Commonwealth Department of Tourism). The primary objective of the survey was to provide information to serve as a foundation for the planning and implementation of proceeding phases of the SBMRMP, beginning with a major survey planned for August 1996. The objective of the August survey is to initialise a long-term monitoring programme to provide baseline quantitative data along re-locatable transects so that any changes to key conservation attributes of the Marine Park are detected before unacceptable or irreversible impacts occur. To that end, the logistics of conducting the August survey have been assessed and various monitoring techniques were trialed during this preliminary field survey. Other objectives of the survey were to provide a more comprehensive understanding of the types and distribution of key habitats, to understand the patterns of recreational and commercial usage and to undertake a preliminary evaluation of existing and potential impacts of usage on the key attributes of the ecosystems of the Shark Bay Marine Park.

Habitat assemblages in the Shark Bay Marine Park are expansive with the key habitat areas dominated by seagrass meadows, shallow sand banks, coral reef or limestone pavement. As a result of this survey a number of key habitat areas, that were not previously represented on CALM's GIS habitat map, have been added to the map. These areas included coral reef at eight sites, seagrass at four sites and limestone pavement at five sites. Accurate position-fixing of selected habitat features (such as habitat boundaries) indicated that in general the true spatial boundaries of habitats can be up to approximately 200 m west of the coordinates assigned to them on the existing CALM GIS habitat map.

Baseline salinity-temperature profiles were also collected opportunistically at 36 sites to contribute to oceanographic studies of Shark Bay being conducted by the University of Western Australia and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). As part of the public consultation process members of the project team outlined the objectives of the programme to local community representatives, recreational and commercial users and the media.

This report contains brief reviews of the oceanography and usage patterns of Shark Bay and the results of an extensive literature search relating to the ecology and management of Shark Bay.

There was little evidence of widespread impacts on benthic habitats due to recreational or commercial activities. Evidence of localised detrimental human activity was noted at six of the 54 sites at which benthic habitats were observed. In particular, the Monkey Rock and Turtle Bay sites had significant amounts of rubbish such as beer cans, car tyres, rope, old chairs and fishing line and overturned corals that have presumably been damaged as a result of line fishing and/or anchoring.

The results of the preliminary survey have indicated that the level of human impact on the benthic habitats of the Shark Bay Marine Park is low with localised signs of detrimental human activity only evident at sites where usage is particularly high. The initiation of appropriate monitoring early in the management of a conservation reserve, before the onset of significant pressures from usage, provides for management emphasis to be directed where it is most required both in a spatial and temporal sense. The identification of initial signs of localised impacts at six sites during this survey underlines this point.

ACKNOWLEDGEMENTS

Direction

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

CALM Regional/District collaboration

Geraldton Region - Ron Shephard, Programme Leader, Nature Conservation.
Gascoyne District - Paul Brown, District Manager; Brad Barton, Operations Officer.
Field Team Leader - Greg Pobar, 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).
$30,000 through MCB cooperative funding and $10,000 through CALM assistance in kind.

GIS Habitat Maps/Usage database

Rod Properjohn, Information Management Branch, CALM.
Eleanor Bruce, PhD Student, Department of Geography, University of Western Australia.

Satellite imagery

Mike Steber, Department of Land Administration, Remote Sensing Applications Centre.
Alan Pearce, Commonwealth Scientific and Industrial Research Organisation, Division of Oceanography.

1 INTRODUCTION

1.1 General

This data report presents the results of the ***Preliminary Field Survey of Shark Bay 15-22 April 1996*** which was conducted as the first survey of the Department of Conservation and Land Management's ***Shark Bay Marine Reserves Monitoring Programme (SBMRMP)***. The field programme and background information relating to the SBMRMP is detailed in a field programme booklet (D'Adamo and Pobar, 1996). 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 was conducted by the Marine Conservation Branch of CALM (Principle contact: Dr Chris Simpson, Manager, Marine Conservation Branch) in collaboration with the Geraldton Regional Office (Contact: Ron Shephard) and the Gascoyne District Office (Contact: Paul Brown). Greg Pobar (Marine Conservation Branch) was the Field Team Leader and coordinated all activities in the field. The field staff included Jeremy Colman and Nick D'Adamo from the CALM Marine Conservation Branch, Kevin Crane from CALM's Swan Region (Marine Operations Group - Swan), Ron Shephard from the CALM Geraldton Regional Office and Paul Brown and Brad Barton from the Gascoyne District Office.

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 includes a review of the current state of knowledge, in relation to monitoring information requirements, and the preliminary exploratory field survey. Phase II will involve designing the monitoring programme and Phase III will establish the long-term monitoring locations and initialise the monitoring programme. Phases II and III will make use of the results presented in this data report.

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 was obtained using video and still photography from relocatable sites throughout the Shark Bay Marine Park. Video footage and photographs have been archived for future reference and held with the Marine Conservation Branch. These data will be used to choose sites and monitoring techniques for the 'Baseline Studies' project. The key objectives of the *Habitat Mapping for Shark Bay Marine Reserves Programme* are to ground-truth CALM's existing habitat maps of the Shark Bay area, particularly in relation to the classification of the major habitat types, and provide better spatial detail in areas where habitat boundaries and marine reserve boundaries approximately coincide. At most of the sites that were visited observations and recordings of habitat type were made. The habitat information will contribute to the 'Habitat Mapping' project by providing data on habitat type at accurately fixed positions.

The SBMRMP is linked to the recommendations of the *Shark Bay Marine Reserves Draft Managment Plan 1994* 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). The *Shark Bay Marine Reserves Management Plan 1996-2006* is currently being finalised by CALM for the National Parks and Nature Conservation Authority.

1.3 Reviews

1.3.1 Oceanography

Shark Bay is a semi-enclosed hypersaline basin that is subjected to large rates of evaporative salinity increases and restricted exchange with the adjacent ocean. Salinities have been found to range from oceanic (approximately 35 pss) in the northern areas of the Bay to hypersaline (up to approximately 72 pss) in the southernmost areas, such as Hamelin Basin and Lharidon Bight. The approximate north-south

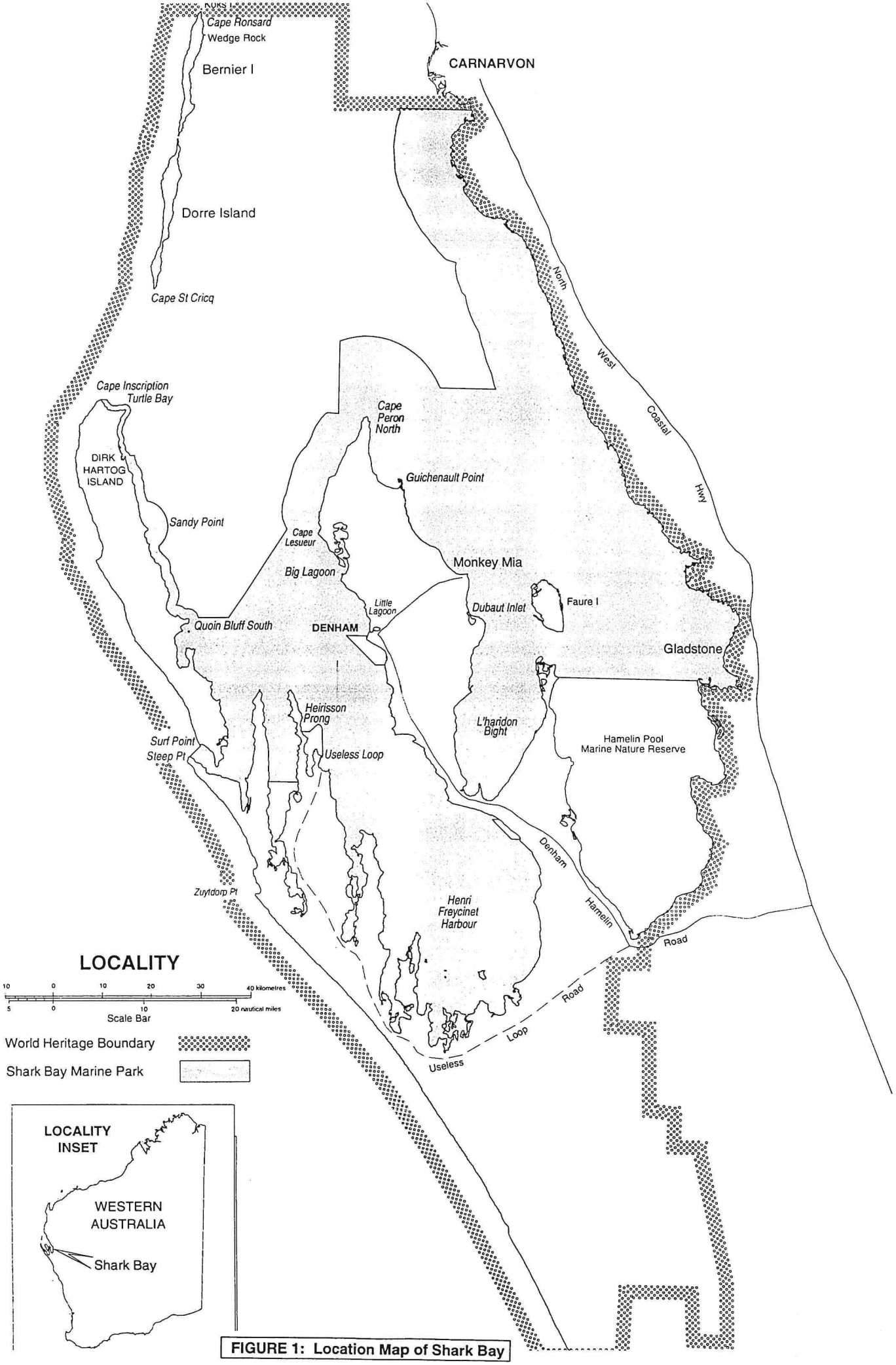

FIGURE 1: Location Map of Shark Bay

direction in the salinity gradient is present throughout the year. Water temperatures range from about 16 °C in winter to about 26 °C in summer, with the greatest seasonal fluctuations occurring in the southern areas of the Bay. The main factor that restricts exchange is the blocking effect of sills between the central portions of the Bay and the lower southern reaches. In addition, the presence of Bernier and Dorre Islands to the north of Dirk Hartog presents a further physical barrier to exchange with the ocean. These and other general physical characteristics of Shark Bay have been comprehensively described in Logan and Brown (1986) which contains information on the climate, bathymetry, sea level history, geomorphology, geology, benthic habitats, salinity, temperature, broadscale flow patterns and exchange of the Bay. Logan and Brown (1986) analysed long-term records of salinity, temperature and currents, and considered the data in conjunction with the evaporative, bathymetric, tidal and wind effects, to calculate a salt budget and estimate a residence time of order 8 months for water in the Hamelin Pool/Faure Sill. Dr Brian Logan of the Geology Department, University of WA has assisted CALM in the literature survey of early work on the salinity regimes and circulation patterns of Shark Bay.

More detailed studies of the hydrodynamics of Shark Bay are currently being conducted by Mr Murray Burling, a M. Eng. Sc. student at the Department of Environmental Engineering of the University of Western Australia (supervised by Drs Charitha Pattiaratchi and Greg Ivey). Mr Burling is analysing oceanographic data and applying a three-dimensional barotropic numerical model to the Bay. Mr Burling has provided CALM with copies of summer and winter data reports containing three-dimensional salinity-temperature-density structure data and associated preliminary hydrodynamic interpretations for Shark Bay. These data highlight the vertically and horizontally stratified salinity and temperature (and therefore density) structure of the Bay and are generally consistent with the results of past investigations of the water structure (see Logan and Brown, 1986). Circulation in the Bay is strongly influenced by wind and tidal effects, however Burling and Pattiaratchi's (1995a, b) preliminary data analyses suggest that the density stratification and Coriolis force (due to the Earth's rotation) provide important influences on the nature of wind and tidal driven flows. Burling and Pattiaratchi (1995a, b) also suggest that characteristic horizontal density gradients in the Bay are sufficiently strong to drive density currents of significance to the overall circulation.

Mr Alan Pearce of the CSIRO Division of Oceanography is undertaking analyses of NOAA-AVHRR sea-surface temperature imagery for Shark Bay and adjacent oceanic waters to determine the seasonal characteristics of basin-wide SST structures and the influence of the Leeuwin Current (Cresswell and Golding, 1980; Cresswell, 1990; Pearce, 1990). These analyses are being used to investigate broad-scale oceanographic patterns and will be of use in subsequent field and analytical studies of Shark Bay. A series of characteristic monthly SST images has been provided to CALM by Mr Pearce and these are reproduced in Appendix IX. As is evident, relatively warm water from the Leeuwin Current enters Shark Bay through its major openings in the north from autumn to spring, however the SST distributions indicate that the southward intrusion of the warm water may be restricted. The spatial and temporal characteristics of the influence of the Leeuwin Curent on the hydrodynamics of Shark Bay requires further investigation and the ongoing studies of Mr Burling and Mr Pearce form important contributions to this objective.

1.3.2 Bibliography

Literature on the ecology of Shark Bay includes the work of the 1970's and 1980's conducted by Dr Brian Logan and colleagues and the more recent work on the seagrasses of Shark Bay by Dr Di Walker. Smith and Atkinson (1983) investigated the mass balance of carbon and phosphorus in Shark Bay and also used these parameters to estimate residence times of Bay waters. The Western Australian Museum has also conducted biological surveys of the marine and terrestrial flora and fauna of the region including the main waters around Bernier and Dorre Islands (Western Australian Museum, 1990) and is currently conducting research on the small cockle *Fragum erugatum* which forms Shell Beach.

There is much literature available on the ecology of Shark Bay and the literature search of the SBMRMP has resulted in an extensive listing of titles for future reference. These lists have been reproduced as a bibliography in Appendix VIII.

1.3.3 Usage patterns

The most up to date information on usage patterns for the Shark Bay Marine Park is contained in CALM's GIS usage maps, compiled by the Information Management Branch on the basis of the Shark

Bay visitor survey data from 1993 (Department of Conservation and Land Management & Fisheries Department, 1994). Since then no further broadscale surveys have been conducted of the Shark Bay Marine Reserves area. However, daily visitor numbers have been recorded for the Monkey Mia Dolphin Visitor Centre since 1987 and these data indicate that total yearly visitor numbers steadily decreased from 114335 in 1989 to 83220 in 1993, thereafter remaining relatively constant.

There is no evidence to suggest that visitor numbers or visitation patterns relating to recreational activities have changed significantly since 1993. Furthermore, on the basis that the most recent broadscale visitor survey data is still relatively current and that annual visitation numbers for Monkey Mia are relatively constant (suggesting, by inferrence, that the same is likely to be the case for the Bay) it is considered that the contribution of another broadscale visitor survey to management objectives would, at this stage, be minimal. It is recommended that the need for further visitor usage data be reviewed in 3-5 years time.

1.4 Aims

The aims of the April 1996 field survey (see D'Adamo and Pobar, 1996) were:

(1) Familiarisation with the Shark Bay area and preliminary selection of long-term monitoring sites

(2) Preliminary selection of control sites

(3) Determination of the accuracy of existing GIS habitat boundaries at representative sites throughout Shark Bay

(4) Trialing and evaluation of the logistics of proposed monitoring techniques

(5) Determination of the accuracy of a differential GPS system in a remote location

(6) Evaluation of the logistical requirements for the mid-year survey (eg. vessel requirements etc.)

(7) Public consultation with the local community, including local government, on the objectives of the Shark Bay Marine Reserves Monitoring Programme via meetings and media contact

(8) The opportunistic collection of still photographs and video footage of major habitat types and visually dominant flora and fauna of the Shark Bay region

(9) The opportunistic collection of salinity and temperature profile data as a contribution to studies of the circulation of Shark Bay.

2 SURVEY GRID, METHODS AND EQUIPMENT

2.1 Survey grid

Direct observations of habitat and/or salinity-temperature measurements were made at 61 sites with the accuracy of a differential GPS ascertained at 5 additional sites. Other forms of observational and anecdotal information were obtained from a further 12 sites. A listing of all sites at which information was obtained is given in Table 1 along with the site coordinates and the nature of the information or activity pertaining to each site. Figure 2 presents a map of the sites visited. Scaled up segments (at 1:50000) from the overall habitat map of the Shark Bay region (part of the GIS habitat map set from the Information Management Branch, CALM) were used by the field crews to assist in site investigation and GIS habitat map verification. GIS habitat data are presented in Appendix III.

2.2 Methods

At each site, the major benthic community types (eg. seagrass meadows, coral reef etc.), the visually dominant species and the nature and extent of impacts (if present) were recorded either by direct observation from the boat (ie. by viewfinder and/or remote video), or by divers taking underwater video and still photographs. A differential GPS was used for position fixing on the vessel Hartog Explorer, and a standard GPS was used on the CALM vessel Sirenia. All habitat data and related observations have been written to standard data sheets and reproduced in Appendix I.

Table 1: Latitude and longitude of sites visited in Shark Bay during 16-20 April 1996 and field activities carried out at each site

SITE	DIFF GPS LAT	DIFF GPS LONG	STD GPS LAT	STD GPS LONG	ST DATA	HABITAT DATA	OTHER ACTIVITY
SB10			26° 07.385'	113° 10.995'	*	*	
SB100			25° 46.557'	113° 28.436'	*	*	
SB101			25° 46.850'	113° 28.475'	*	*	
SB103			25° 33.336'	113° 28.404'	*	*	
SB105			25° 38.048'	113° 22.408'	*	*	
SB116			25° 30.284'	113° 30.050'	*	*	
SB12			26° 10.110'	113° 11.790'		*	
SB120A			25° 35.045'	113° 31.780'		*	
SB120B			25° 34.950'	113° 32.656'			Echo sounding to ascertain bottom relief
SB120C			25° 34.760'	113° 32.697'			Echo sounding to ascertain bottom relief
SB120D			25° 34.800'	113° 31.670'			Echo sounding to ascertain bottom relief
SB120E			25° 34.662'	113° 31.633'		*	
SB120F			25° 34.614'	113° 32.641'			Echo sounding to ascertain bottom relief
SB120G			25° 34.430'	113° 32.640'			Echo sounding to ascertain bottom relief
SB120H			25° 34.397'	113° 31.878'			Echo sounding to ascertain bottom relief
SB120I			25° 34.616'	113° 31.381'		*	
SB120J			25° 36.044'	113° 34.780'			Reference position for a bearing to the "80 Acres" fishing site
SB120K			25° 34.224'	113° 31.960'		*	
SB122			25° 37.429'	113° 35.859'		*	
SB122A			25° 37.447'	113° 35.861'		*	
SB122S			25° 38.227'	113° 35.800'	*	*	
SB123			25° 37.040'	113° 35.492'		*	
SB124			25° 42.259'	113° 36.232'		*	
SB124E			25° 42.410'	113° 36.604'		*	
SB125			25° 46.730'	113° 41.537'	*	*	
SB125S			25° 46.921'	113° 41.571'		*	
SB126	not recorded	not recorded	not recorded	not recorded			Blue lagoon Pearls pontoon
SB129	not recorded	not recorded	not recorded	not recorded			General observation of dolphin feeding
SB130			25° 47.552'	113° 43.129'	*	*	
SB130A			25° 47.733'	113° 43.925'		*	
SB130B			25° 47.549'	113° 43.932'		*	
SB131			25° 47.042'	113° 43.464'	*		
SB133			25° 46.322'	114° 44.024'	*		
SB134			25° 45.658'	113° 44.513'	*	*	
SB134E			25° 45.360'	113° 44.835'	*		
SB145			25° 57.300'	114° 14.700'		*	
SB146			25° 57.155'	114° 14.185'		*	
SB147			25° 56.943'	114° 13.358'	*	*	
SB15	26° 00.822'	113° 13.136'			*	*	
SB155	25° 55.552'	113° 32.306'					Site for differential GPS accuracy check
SB160	25° 55.584'	113° 32.362'					Site for differential GPS accuracy check
SB165	26° 09.817'	113° 40.692'					Site for differential GPS accuracy check
SB170	26° 22.370'	113° 59.220'					Site for differential GPS accuracy check
SB175	not recorded	not recorded	not recorded	not recorded	*		General observation of stromatolite area
SB18	25° 59.599'	113° 16.371'			*		
SB20	25° 58.500'	113° 19.215'			*	*	
SB30	26° 05.321'	113° 25.008'			*	*	
SB33	not recorded	not recorded	not recorded	not recorded			Possible coral monitoring site (anecdotal information)
SB35	26° 09.911'	113° 39.387'			*	*	
SB37	26° 24.443'	113° 45.305'				*	
SB38	26° 26.698'	113° 45.825'			*	*	
SB39	26° 28.831'	113° 46.290'			*	*	
SB40	26° 29.074'	113° 41.070'			*	*	
SB45	26° 33.293'	113° 38.877'			*	*	
SB5	26° 08.608'	113° 09.949'			*	*	
SB50	26° 24.296'	113° 37.067'			*	*	
SB52	26° 27.060'	113° 38.893'					*Dugong dugon* observation
SB55	26° 19.206'	113° 29.676'			*	*	
SB57	26° 15.914'	113° 29.590'				*	
SB6	not recorded	not recorded	not recorded	not recorded			Habitat data from anecdotal information
SB60	26° 13.898'	113° 30.431'			*	*	
SB65	26° 00.110'	113° 11.868'			*	*	
SB7	not recorded	not recorded	not recorded	not recorded		*	
SB70	25° 46.897'	113° 05.357'			*	*	
SB70A	25° 46.778'	113° 05.169'				*	
SB70B	25° 46.785'	113° 05.258'				*	
SB75	25° 43.487'	113° 05.308'			*	*	
SB78	25° 42.785'	113° 05.259'				*	
SB80	25° 35.089'	113° 01.366'			*	*	
SB83	25° 35.071'	113° 06.554'			*		
SB85	25° 30.959'	113° 03.064'			*	*	
SB87	25° 30.222'	113° 01.342'				*	
SB88	25° 29.793'	113° 00.969'				*	
SB90	25° 29.867'	112° 59.185'			*	*	
SB95			25° 58.958'	113° 32.423'		*	
SB95N			25° 54.712'	113° 29.909'		*	
SB96	25° 55.811'	113° 31.941'					Site for differential GPS accuracy check
SB97			25° 56.270'	113° 28.920'	*		

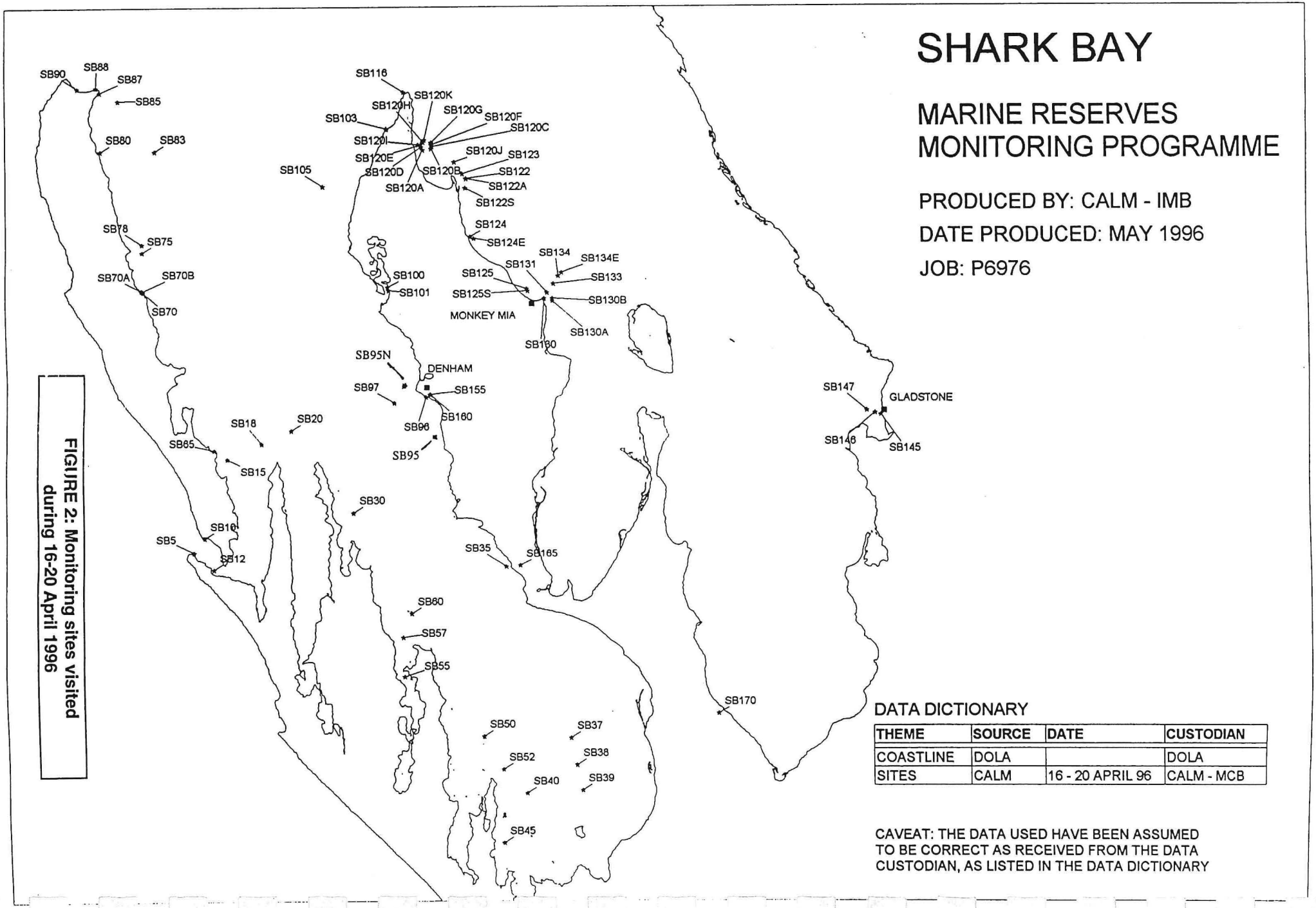

FIGURE 2: Monitoring sites visited during 16-20 April 1996

Salinity and temperature data were collected opportunistically at selected sites using a Yeokal Salinity-Temperature Bridge (Hamon Model 602). At sites where the instrument was not available (due to it being deployed on another vessel) bottled samples of surface water were collected and subsequently analysed for salinity after the survey. The salinity and temperature data have been adjusted after calibration. Calibration adjustments were determined on the basis of laboratory analyses of salinity samples collected in the field and by checks of the meter against a scientific thermometer. The calibrated (adjusted) ST data are presented in Appendix 2.

The physical data were collected 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 of sea-surface temperature signals which can be used as a proxy for broadscale surface water circulation patterns. Mike Steber (Remote Sensing Applications Centre, Department of Land Administration) provided sea surface temperature (SST) images taken by the NOAA-AVHRR satellite at 0620 hrs WST Tuesday 16 April 1996 (image number N12 25561). A better understanding of the circulation of Shark Bay forms an important recommendation of the Shark Bay Marine Reserves Draft Management Plan 1994 (Department of Conservation and Land Managment, 1994).

The SST data has been forwarded to Alan Pearce (CSIRO, Division of Oceanography) for ground-truthing of NOAA-AVHRR SST imagery.

The salinity-temperature data from this survey will be forwarded to Mr Murray Burling for use in his Master of Engineering Science study of the hydrodynamics of Shark (Department of Environmental Engineering, University of Western Australia.

2.3 Equipment

Two vessels were used throughout the survey:

(i) a 9.5 m chartered catamaran, the "Hartog Explorer" (Explorer Charters, Ph: (099) 481 054, contact - Alan Dyson),

(ii) the CALM vessel "Sirenia" (CALM, Gascoyne District, contact - Paul Brown, Manager).

Direct observations of benthic habitats and fauna were made either by SCUBA diving or free diving. Specialised photographic equipment, including still cameras, remote video and hand-held video were used to provide a visual reference of habitat type and location details at all sites.

Either a standard or differential GPS was used for position fixing.

A manually deployed salinity-temperature metre was used to collect vertical profile data.

Prepared field data logs, dive logs, and a reference library were used to record information, observations and data.

Hydrographic charts, Landsat images, and GIS habitat and usage maps were also used to assist in the field survey.

3 RESULTS

3.1 Site and habitat data

Appendix I contains habitat data sheets which provide a brief description of the sites visited during this preliminary survey. Explanations of the terminology used in the data sheets and techniques employed during the survey are now given to allow for a consistent approach to data recordings and survey methodologies in future programs.

Site No: All sites visited were designated a site number. Each site number begins with SB (denoting Shark Bay) and ends in a number or number/letter combination. It is anticipated that these site numbers

will remain with these locations in all future CALM studies and are therefore key designators for any other information or records kept relating to each site.

Site: Most sites have been given a name, chosen either as one that is formally recognised (such as a chart location) or a name introduced by the study team to enable quick identification.

Date and Time: This is the date and time at which the data at the site were collected.

Vessel: Two vessels were used for this program. The 'Hartog Explorer' is a 9 metre inboard fibreglass catamaran capable of good speed (15-20 knots in fair to moderate conditions), carrying equipment and up to 12 passengers. The CALM Vessel 'Sirenia' is a 6 m aluminium shallow-hulled vessel of centre console design and powered by an outboard motor. It had a working compliment of 4 people and was only suited in calm to slight seas during winds less than about 12-15 knots.

Recorder: This is the name of the person who was primarily responsible for the recording of original notes. Much of the information contained in the data sheets was drawn from the original field logs. Observations were made by: Chris Simpson, Greg Pobar, Nick D'Adamo, Jeremy Colman, Kevin Crane, Ron Shepherd and Brad Barton.

Weather: The weather was classed as 'fine' (mostly sunny) or 'overcast' (mostly cloudy), and wind data were recorded as estimates of speed and direction.

Sea: The sea state was described as calm (no wind, calm sea), slight (breeze was influencing surface water), moderate (wind was generating wind waves up to 1 metre) or rough (windy with wind waves greater than 1 metre).

Water Depth: Depths are approximate and were read off an echo sounder.

Water Visibility: This is an estimation of horizontal in-water visibility at the time of observation.

GPS Lat and GPS Long: The coordinates (latitude and longitude, respectively) of the site as read from a GPS

Differential: If a differential GPS was used then 'yes' is noted. GPS readings utilising a differential system allowed for position fixing described by latitude and longitude to within about 3 m or less.

Location of site with ref. to lat/long: On occasions observations were made after swimming some distance from the position of the anchored vessel. Hence, a note of the actual location of the observations and/or visual recordings that were made is given with respect to the latitude and longitude of the anchored vessel.

Habitat description: This is a general note of the habitat type and its percentage cover. As cover can vary within the general vicinity of a site the described percentage cover can have an error of approximately 20%.

Dominant Species: This is a list of the most common or readily observed species of marine life at the site. It reflects what an observer might expect to see when visiting the site in the future. Marine life are described to generic level.

Other Habitat Notes: Features of interest at or nearby the site are noted.

Activity or Impact Noted: Signs of activity or impacts that were observed at the site are noted.

Video reference: Video image taken of the site is referred to as

160496/sb5/0.00.00-4.24.56/hv, where

160496 is the date
sb5 is the site number
0.00.00-4.24.56 is the time code for the relevant segment of video footage
hv means hand held video (*dv* means drop down video and *av* means acquired video)

Photo reference and Slide reference: A photograph or slide image taken of the site is referred to as

180496/sb60/01/p, where

180496 is the date
sb60 is the site number
01 is the photo or slide number
p refers to 'photo' (alternatively *s* refers to 'slide')

Aerial reference: Aerial photographs of the site are referred to as

11.9.90/2/5124-5136, where

11.9.90 is the date of the photography
2 is the run number, where applicable
5124-5136 are the photograph reference numbers

3.2 Salinity-temperature data

Appendix 2 presents calibrated salinity-temperature data collected during 16-20 April 1996. The data were collected with the Yeokal Salinity-Temperature Bridge (Hamon Model 602) and a scientific thermometer (labelled TOT 1mm E-MIL GOLDLINE).

At some sites surface seawater samples were collected in clean glass sample bottles and subsequently analysed with an inductive salinometer by Mr Bob Griffiths at the CSIRO Marine Laboratory, Marmion, WA, to determine the salinity of the sample accurate to better than 0.001 pss. The water samples were obtained by lowering a bucket over the side of the boat, quickly filling a sample bottle and then reading the salinity of the water in the bucket with the ST meter. Pre-washed bottles, that were also washed with sea-water collected from the site at the time of sampling, were used to collect water samples. The laboratory-measured values were then compared to the field recorded values and the required adjustment to the raw data was determined. It was found that the ST meter gave salinity values that were lower than the true salinity (as measured in the laboratory) by a mean value of 0.21 pss. Hence, 0.21 pss has been added to all raw salinity records and it is these adjusted (calibrated) data that have been written to the data sheets presented in Appendix II. On the basis of the variability in the raw versus laboratory-measured salinities a range of errors were noted, with the ST meter reading lower than the true salinity by 0.116 to 0.28 pss. According to manufacturer's specifications the ST meter has an accuracy of +/- 0.03 pss. Hence, the data written to the data sheets in Appendix II are accepted as accurate to +/- 0.1 pss. The salinity calibration information is detailed in Table 2, below.

Temperature calibration was achieved by comparing the temperature reading from the ST meter with that from a scientific thermometer at various times during the field survey. In the field, a bucket was filled with surface water, the ST meter was used to obtain a raw temperature reading and at the same time the scientific thermometer was used to measure the temperature at the level of the ST meter's thermister in the bucket (the bottom of the thermometer was positioned next to the thermister of the ST meter in the bucket). The respective readings were recorded on the field data sheets. The temperature calibration information is detailed in Table 3. The ST meter has a specified temperature accuracy of +/- 0.1 degrees C.

Table 4 is the field log of sites where temperature and salinity readings were conducted. Appendix 2 presents the data. Figure 3 presents a sea surface temperature (SST) image (NOAA-AVHRR) from 0620 hrs WST Tuesday 16 April 1996 (image number N12 25561).

3.3 Information for the preliminary selection of long-term monitoring sites

Site observations enabled direct impacts from common activities such as fishing and diving to be determined. The results of a 1993 visitor survey (presented in CALM's GIS user survey habitat maps) were used to guide the selection of the sites visited during the preliminary field survey, and are therefore important to the selection of permanent long-term monitoring sites.

Table 2. Salinity calibration data.

Site	Time	Date	Bottle number	Recorded salinity of raw field sample* (pss)	Salinity of sample from laboratory analysis** (pss)	Adustment required to raw data (pss)
SB5	1103	16-4-96	024	35.25	35.366	Add 0.116
SB20	1603	16-4-96	027	35.82	37.032	Add 0.201
SB90	1100	17-4-96	144	35.10	35.38	Add 0.28
SB70	1545	17-4-96	152	35.70	35.943	Add 0.243
SB122S	1152	18-4-96	180	40.30	40.725	Add 0.425***

Comments on salinity calibration data (above):

(1)* ST meter serial number ST384

(2) CSIRO inductive salinometer instrument reference number 313 (contact: Bob Griffiths, Ph: 2468288)**

(3)* Reject SB122S data because it was significantly higher than the other calibration adjustments**

(4) The mean salinity adjustment (based on calibration data from SB5, SB20, SB90, SB70) is 0.21 pss (i.e. add 0.21 pss to raw salinity data)

(5) The range in the adjustments indicated by analyses of individual bottle samples (from SB5, SB20, SB90, SB70) is 0.116 to 0.28 pss. Manufacturers specifications indicate that the ST meter has an accuracy of +/- 0.03 pss. Hence, the calibrated data are accepted as being accurate to +/- 0.1 pss.

Table 3. Temperature calibration data

	Time	Date	Recorded temperature of raw field sample* (°C)	Temperature of sample from thermometer reading** (°C)	Adustment required to raw data (°C)
SB5	1103	16-4-96	24.60	24.1	Subtract 0.5
SB20	1603	16-4-96	25.2	24.7	Subtract 0.5
Denham Villas	1700	19-4-96	29.6	29.1	Subtract 0.5

Comments on temperature calibration data (above):

(1)* ST meter serial number ST384

(2) Scientific thermometer reference TOT 1mm E-MIL Goldline**

(3) The mean temperature adjustment (based on calibration data from SB5, SB20, Denham Villas) is 0.5 °C (i.e. subtract 0.5 °C from raw temperature data)

Table 4. Field log for salinity-temperature measurements

SITE	DATE	TIME	WEATHER	SEA	S*	T**	OTHER
SB5	160496	1103	ESE < 10KN, CLEAR	CALM	ST384	ST384	
SB10	160496	1223	ESE < 10KN, CLEAR	CALM	ST384	ST384	
SB15	160496	1405	ESE < 10KN, CLEAR	CALM	ST384	ST384	
SB65	160496	1435	ESE < 10KN, CLEAR	CALM	ST384	ST384	
SB18	160496	1535	ESE < 10KN, CLEAR	CALM	ST384	ST384	
SB20	160496	1603	ESE < 10KN, CLEAR	CALM	ST384	ST384	
SB97	160496	1735	ESE < 10KN, CLEAR	CALM	ST384	SCI THERM	
SB83	170496	1030	S < 5KN, CLEAR	CALM	ST384	ST384	
SB100	170496	1040	STILL, CLEAR	CALM, STRONG INCOMING CURRENT	ST384	SCI THERM	SALINITY OFF SCALE
SB101	170496	1050	STILL, CLEAR	CALM, STRONG INCOMING CURRENT	ST384	SCI THERM	SALINITY OFF SCALE
SB90	170496	1100	STILL, CLEAR	CALM	ST384	ST384	
SB105	170496	1215	STILL, CLEAR	CALM	ST384	SCI THERM	
SB85	170496	1220	STILL, CLEAR	CALM	ST384	NO DATA	
SB80	170496	1240	STILL, CLEAR	CALM	ST384	ST384	
SB103	170496	1400	STILL, CLEAR	CALM	ST384	SCI THERM	
SB75	170496	1450	STILL, CLEAR	CALM	ST384	ST384	
SB116	170496	1500	STILL, CLEAR	CALM, SOUTHWESTERLY SURFACE CURRENT, STRONGER ON SEA FLOOR	ST384	SCI THERM	
SB70	170496	1545	SLIGHT SOUTHERLY < 10KN	NOT NOTED	ST384	ST384	
SB35	180496	0925	STILL	NOT NOTED	ST384	SCI THERM	
SB38	180496	1055	STILL, OVERCAST	CALM	ST384	SCI THERM	SALINITY OFF SCALE
SB39	180496	1130	STILL, OVERCAST	CALM	ST384	SCI THERM	SALINITY OFF SCALE
SB122S	180496	1152	NOT NOTED	CALM	ST384	ST384	
SB45	180496	1215	FINE	CALM	ST384	SCI THERM	SALINITY OFF SCALE
SB40	180496	1250	FINE	CALM	ST384	SCI THERM	
SB125	180496	1311	NNE ~ 12KN, SUNNY	SLIGHT CHOP	ST384	ST384	SALINITY OFF SCALE
SB50	180496	1430	FINE	CALM	ST384	SCI THERM	SALINITY OFF SCALE
SB130	180496	1523	NNE < 5KN (MODERATING)	CALM	ST384	ST384	SALINITY OFF SCALE
SB60	180496	1525	FINE	CALM	ST384	SCI THERM	SALINITY OFF SCALE
SB131	180496	1540	BREEZE < 5KN, SUNNEY	CALM	ST384	ST384	SALINITY OFF SCALE
SB134	180496	1558	NOT NOTED	CALM	ST384	ST384	
SB134E	180496	1604	NOT NOTED	CALM	ST384	ST384	SALINITY BELOW 3M OFF SCALE
SB133	180496	1615	NOT NOTED	CALM	ST384	ST384	SALINITY BELOW 2 M OFF SCALE
SB55	180496	1630	FINE	CALM	NO DATA	SCI THERM	
SB30	180496	1735	FINE	FLAT	ST384	SCI THERM	
SB147	190496	1250	STORM IMMINENT, BUILDING FROM WSW @ 15KN	CHOP < 0.5 M	ST384	ST384	SALINITY OFF SCALE
SB175	200496	1500	SSW ~ 15KN	NOT NOTED	NO DATA	SCI THERM	

*** ST384** **Refers to the Yeokal Salinity-Temperature Bridge Hamon Model 602 (serial no. ST384)**

**** SCI THERM Refers to the scientific thermometer, labelled TOT 1 mm E-MIL GOLDLINE**

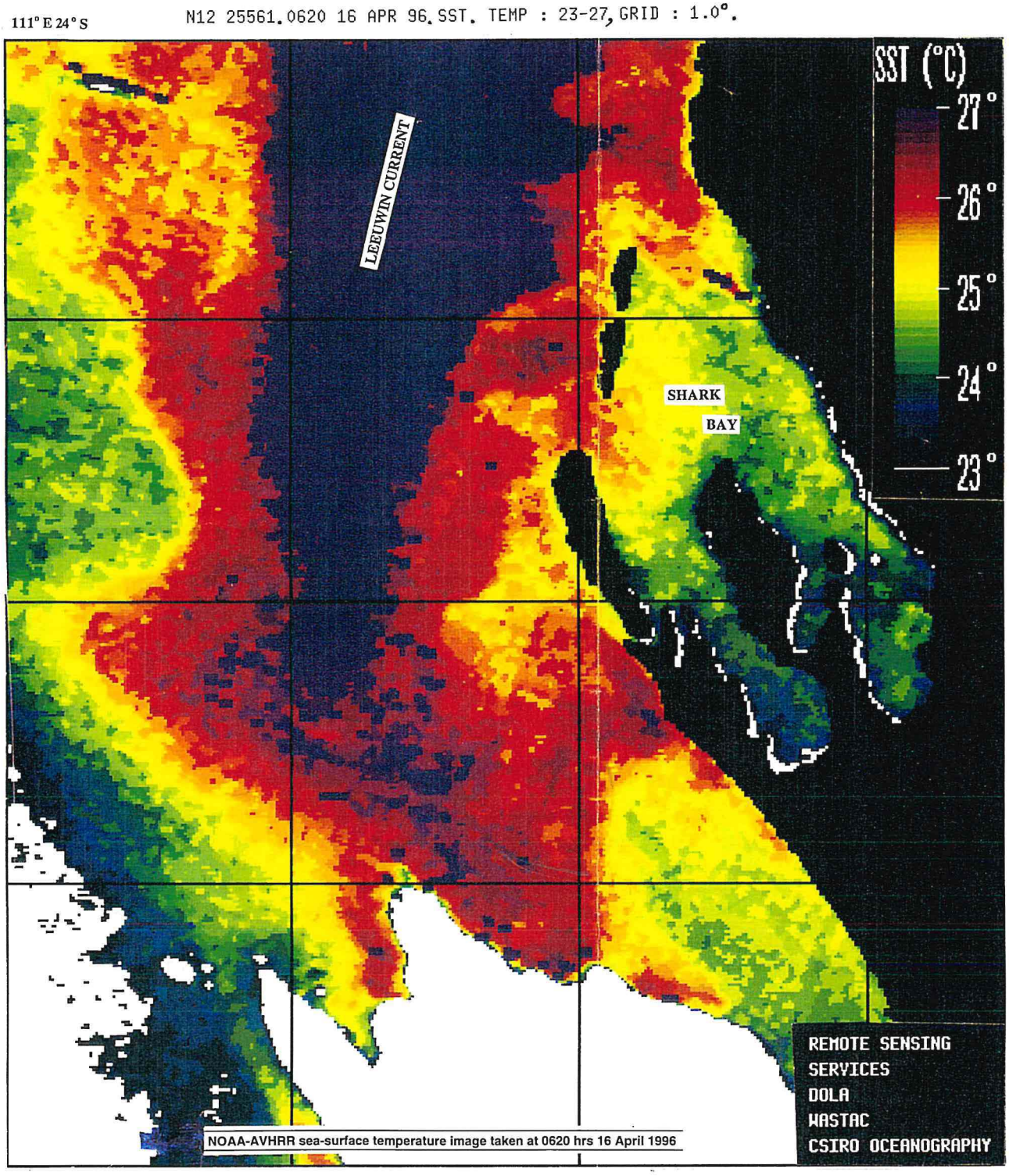

Figure 3 NOAA-AVHRR sea-surface temperature image taken at 0620 hrs 16 April 1996

Areas that are more frequently targeted by users and sites of commercial activity or development will receive priority consideration in the selection of long-term monitoring sites.

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 should therefore be considered in the long-term monitoring programme.

3.4 Information for the preliminary selection of control sites

A number of sites will be required as scientific control sites and will be zoned as 'sanctuary' or 'special protection areas'. These sites will have ecological attributes that are representative of particular habitats in the Marine Park. They will 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 expected to be difficult, particularly in view of the large areas of similar habitat types around the Park. The exception may be that of coral reef habitat, which is only recorded at relatively few locations, and there is variability of species composition at each location.

Of interest is the fringing reef system on the western side of Dirk Hartog Island. While not gazetted as part of the Marine Park and not yet considered within the objectives of the long-term monitoring program, examination and monitoring of the exposed reefs may provide useful background data that could indicate biodiversity trends in the sheltered waters of the bay. This may warrant futher consideration as this program develops. Other control sites will be chosen on the basis of the results of the study and information from existing GIS habitat and usage maps.

3.5 Determination of the accuracy of existing GIS habitat boundaries

A set of GIS-based habitat maps of the Shark Bay area produced by CALM with data input by Eleanor Bruce and Dr Di Walker of the University of Western Australia was used as a habitat reference during the field survey (Appendix III). At various locations, differential GPS or standard GPS readings were plotted over distinct environmental features (such as habitat boundaries). These readings were then transfered electronically to the existing GIS data base and the field descriptions of habitats or features were compared with the information on the GIS at selected locations. Any discrepencies between the field recordings and existing GIS habitat maps have been ascertained in order to arrive at an estimate of the spatial accuracy of the GIS maps. Table 5 presents a general summary of the information that was collated as a result of this comparison.

The observations revealed that significant habitat cover was present at sites not previously shown on the existing GIS habitat maps. Significant habitats were newly identified at 12 sites (8 coral and 4 seagrass).

While it is difficult to make a definitive statement regarding the accuracy of the existing GIS habitat maps, the following conclusions can be drawn:

- The existing GIS habitat maps describe reasonably accurately the general spatial distribution of seagrass beds and the relevant percentage cover of those beds in waters less than 12 metres in depth.

- Coral sites that were indicated on existing GIS habitat maps were either non-existent at those locations or were found to be at some distance away from their indicated positions.

- There are many other areas of habitats that are not presently shown on existing GIS habitat maps (eg. limestone pavement and corals).

Table 5 : Determination of spatial errors in GIS habitat maps.

Sites at which a differential GPS reading of a habitat feature or boundary was made	Sites at which a standard GPS reading of a habitat feature or boundary was made	Comment after comparing field observations with existing GIS habitat map data
SB5, SB10, SB15, SB35, SB37, SB40, SB60, SB65, SB85, SB87, SB88, SB90	SB101, SB103, SB105, SB116, SB130, SB145	The observed habitat or feature is not presently shown on existing GIS habitat maps
SB75, SB78, SB80, SB30, SB39, SB70a, SB70b	SB120a, SB120c, SB120i, SB122, SB122a, SB122s, SB123, SB124, SB125, SB125s, SB130a, SB130b, SB146, SB147	The observed (true) location of a habitat or feature is not consistent with the location as shown on existing GIS habitat maps
SB20, SB38, SB45, SB50, SB55, SB57, SB70	SB100, SB124e, SB134	The observed habitat or feature is accurately described and located on existing GIS habitat maps

CONCLUSION (differential GPS)

On the basis of position fixing with the differential GPS, features on the existing GIS habitat maps are plotted up to approximately 200 m to the east of the observed (true) location

CONCLUSION (standard GPS)

On the basis of position fixing with the standard GPS, features on the existing GIS habitat maps are plotted up to approximately 500 m to the east of the observed (true) location

- By using a differential GPS, errors of up to 200 metres were noted in the positions of prominent features shown on the existing GIS habitat maps. In general, the true positions of selected features, such as habitat boundaries, were up to 200 m west of their positions as shown on the existing GIS habitat maps.

- Position fixing using a standard GPS can have an associated error of up to approximately 100 m. Hence, when considered in conjunction with the error in the postion of features on existing GIS habitat maps (up to 200 m, as discussed above) it is likely that the use of standard GPS to verify information on existing maps will have only limited value. It is recommended that differential GPS be used for this purpose.

3.6 Evaluation of proposed monitoring techniques for future surveys

The preliminary survey resulted in a much improved understanding of the type and distribution of habitats and on the exisitng and potential impacts of usage on the habitats within the Marine Park. Using this improved information an evaluation has been made of possible techniques for long-term monitoring and certain techniques were trialed in the field (eg. video transects).

Appendix III represents the existing GIS habitat map and Appendix 4 contains a summary of usage from the 1993 user survey.

From the observations made in the Marine Park, and considering the existing information in GIS habitat maps, the following classification of habitat features has been made:

- Sand
- Silt
- Mud
- Seagrass (< 20 % cover)
- Seagrass (20-40 % cover)
- Seagrass (40-80 % cover)
- Seagrass (> 80 % cover)

- Limestone platform, algae covered (turf or macroalgae)
- Coral reef (< 30 % cover)
- Coral reef (30-50 % cover
- Coral reef (> 50 % cover

The following possible monitoring techniques have been evaluated and are believed to be worth considering for future monitoring of the Shark Bay Marine Reserves.

Habitats

- Direct benthic surveys for broad area habitat mapping by use of hydro-acoustic soundings, such as the RoxAnn/MICROPLOT system
- Manta tows for area orientation and general identification of habitats and species
- Aerial photography for broad-scale and site-specific habitat mapping in relatively clear shallow waters
- Video transects for detailed measurement of benthic assemblage along 50 m transects (species diversity, abundance and composition)
- Quadrat surveys for seagrass density and epiphytic cover.
- Spot surveys for direct qualitative identification of habitats

Oceanography

- Satellite imagery for broad-scale monitoring of sea-surface temperature distributions and water colour distributions
- Salinity-temperature profiling
- Fixed point current metering
- Drogue-tracking
- Wave-rider buoy deployments
- Sediment trapping

Visitor demographics

- Aerial surveys
- Visitor surveys by questionaire
- Direct observations

Details of some of the techniques that have been investigated have been included in this report. It is planned that the data in this report be considered prior to selecting permanent monitoring sites. Once sites are selected, the appropriate techniques will be determined.

3.7 Determination of the accuracy of a differential and standard GPS in a remote location

Two hand-held GPS systems were used during the survey. A Scoutmaster standard GPS system was linked with an Omnistar differential GPS system so as to record the position of selected locations as accurately as possible. An Ensign XL standard GPS system was also used and its readings were compared with the differential GPS readings in order to establish the errors in the readings from the standard GPS.

It will be important for future surveys that a precise location or marker (such as an underwater monitoring transect peg) can be revisited. Considering the vast areas of habitats within the Bay and the often reduced water visibility, transect markers and sites must be re-locatable with a high degree of accuracy. To test the respective accuracies of both the differential and standard GPS systems a number of sites were specifically marked and re-visited to determine variations in the latitude and longitude readings from the instruments.

Table 6 summarises this information. Maximum errors in the differential GPS readings were 3.6 metres south and 1.8 metres east compared with 40.8 metres south and 48 metres east when using a standard GPS. The errors recorded using standard GPS suggest that the relocation of underwater markers or the determination of habitat boundaries would be very difficult and in certain instances impossible. The

Table 6 Data from accuracy trials of a differential and standard GPS.

Site / Number	Date	Time	Scoutmaster/Omnistar differential GPS		Number of satellites	Ensign XL Standard GPS		Number of satellites
Jetty adjacent to Hartog Explorer berth (site SB96)	17.4.96 18.4.96 19.4.96 20.4.96	1815 1815 1805 1705	25 55.811' S 25 55.810' S 25 55.810' S 25 55.810' S Maximum error 1.8 metres S	113 31.941' E 113 31.941' E 113 31.941' E 113 31.942' E Maximum error 1.8 metres E	4 4 - 6	Not recorded		not available
WAWA sign (site SB160)	20.4.96	1005 1654	25 55.584' S 25 55.586' S Maximum error 3.6 metres S	113 32.362' E 113 32.362' E Maximum error 0 metres E	6 7	25 55.522' S 25 55.488' S Maximum error 40.8 metres S	113 32.434' E 113 32.482' E 48 metres E	5 6
Peron Grid (site SB165)	20.4.96	1300	26 09.817' S 26 09.817' S Maximum error 0 metres S	113 40.692' E 113 40.692' E Maximum error 0 metres E	4 6	26 09.745' S 26 09.747' S Maximum error 3.6 metres S	113 40.766' E 113 40.778' E 39.6 metres E	4 7
Peron Road (site SB170)	20.4.96	1345 1600	26 22.370' S 26 22.369'S Maximum error 1.8 metres S	113 59.220' E 113 59.221'E Maximum error 1.8 metres E	7 6	26 22.304' S 26 22.308' S Maximum error 7.2 metres S	113 59.319' E 113 59.310' E 16.2 metres E	7 6

relatively small error exhibited by differential GPS indicates that it would be possible to relocate markers or features given accurate coordinates. Hence, the use of differential GPS will be employed during the next stage of this program.

3.8 Evaluation of the logistic requirements for the mid-year survey

During the preliminary survey, the opportunity to assess the skills of key field staff, the reliability of equipment, techniques and the confirmation of cost for the long-term monitoring programme was undertaken. During the survey habitat information was acquired at 54 sites and salinity-temperature data were collected at 36 sites. The field crew comprised six personnel operating from two vessels over 5 days.

3.8.1 Budget

A budget of $10,600 was allocated for the survey and approximately $8,500 has been expended to date.

3.8.2 Equipment

There were no equipment failures or concerns with the operation of the equipment during this programme. The value of differential GPS systems and remote drop-down video were assessed and it is concluded that both systems will be suitable for future monitoring surveys of the SBMRMP. The use of manta technique or diver/swimmer propulsion systems would have been of assistance for general reconnaisance at a site. A sensitive full colour echo sounder and GPS plotter linked to the differential system would have also been of value to assist in navigation and position fixing.

3.8.3 Diving

All diving operations were conducted within CALM's Safe Work Practices : Scientific Diving. The Dive Supervisor was Greg Pobar. A total of 24.5 hours of in-water work on SCUBA and snorkel was logged with no incident or equipment problems.

3.8.4 Vessels

Charter vessel operation, navigation and associated safety procedures were the responsibility of the operator. The facilities available on the charter vessel were not fully realised and better use could have been made of sounder and GPS plotter facilities. In some cases the shallow depth of water precluded the vessel from being positioned exactly on site and this increased the time that it took to accurately locate and describe habitat sites.

The local CALM vessel 'Sirenia' was used for shallow coastal sites. The vessel was towed to the area and launched from shore. CALM vessel operations were conducted within CALM's Safe Boating guidelines. This vessel was best suited to relatively calm conditions (winds less than about 12-15 knots) with a maximum crew of 3 (including the navigator) and associated diving gear and monitoring equipment. While suitable conditions prevailed for most of the program, the vessel was unsuitable and unstable in slight to moderate conditions on 19 April 1996 when a 15-25 knot squall struck and the vessel displayed a propensity to take on water in the 0.5-1.0 m seas.

3.8.5 Logistical Considerations

It is possible that 40 to 50 sites will be selected as long-term monitoring sites, and the monitoring techniques will be chosen prior to the August 1996 survey. It is likely that the establishment of transects at one site may take up to half a day so it is anticipated that at least 20 days of field work will be required. There is the provision for a follow-up survey in 1997 if required. A team size of 4 skilled personnel will be required to operate from a stable, well equipped vessel.

Projected administration costs and field costs have not yet been determined but are unlikely to exceed the allocated budget for the program.

3.9 Information dissemmination

Every opportunity was made to ensure the community and other agencies were informed of the preliminary survey, its objectives and the aims of the programme. The preliminary field programme report was widely circulated prior to the commencement of the survey.

3.9.1 Briefings

Discussions or briefings were held with the following:

- Department of Fisheries: Mike O'Dea
- Monkey Mia Dolphin Visitor Centre: Brian Nicholson, Ranger in Charge
- Explorer Charters: Alan Dyson, Proprietor
- Shotover Charters: Harvey Raven, Proprietor
- Monkey Mia Resort: Roger Symes, Naturalist
- Blue Lagoon Pearls: Peter Morgan, Manager
- Hamelin Pool Museum: Dave Taylor
- James Scheerer Charters: Craig and Jessie Shankland

Briefings with representatives of the Shire Council were not held as many of the councillors were away attending other programmes. Calm's Gascoyne District Manager (Paul Brown) is ensuring that the Shire is well-informed on the progress of the programme.

3.9.2 Media

On Thursday 18 April 1996 the Department of Conservation and Land Management released a media statement as attached in Appendix V. This media release resulted in the following media profiles:

- The Sunday Times Newspaper (Regional Edition): 21 April 1996.
- The Northern Guardian Newspaper: 24 April 1996
- The Midwest Times Newspaper: 24 April 1996.
- ABC Regional Radio News, Karratha: 20 April 1996
- ABC Regional Radio Morning Programme, Karratha: 22 April 1996
- 96.5 FM Radio, Geraldton: 19 April 1996

3.10 Opportunistic collection of still photos and video footage

Whenever possible observations of obvious landmarks (for site location) were noted and images of habitat were recorded by photograph, slide and video image. All images have been collated, coded and stored at the Marine Conservation Branch in Henry St., Fremantle. A slide image record of the most common and

obvious species of marine flora and fauna was initiated for future reference, confirmation of species identification and for training purposes. These images are referred to in the habitat data sheets.

4 FUTURE WORK AND RECOMMENDATIONS

4.1 Future field work

The major field survey of the SBMRMP, in which long-term baseline monitoring will be initialised, is planned for August 1996. That survey will make use of the information presented in this report. A planning report will be produced for this stage of the programme.

4.2 Methodologies and equipment for future work

Liaison will continue with the Australian Institute of Marine Science (AIMS) and other agencies to ensure consistency in the techniques of broad-scale and site-specific habitat monitoring.

For broad-scale monitoring, consideration will be given to the use of satellite imagery, combined with ground-truthing technology such as the 'RoxAnn' system, described below. Site monitoring will involve the refinement of the video transect technique, which has application for a range of habitat types and allows for general description as well as detailed qualitative and quantitative descriptions of benthic composition. It also gives a permanent record for future analyses.

Hydro-acoustic signal processors for broad-scale habitat surveys

The RoxAnn habitat surveying technology is one commercially available product that operates as a sophisticated single beam echo-sounder transducer that communicates its signal to an onboard PC for hydro-acoustic signal processing. With ground-truthing, the system can be used to quickly scan large areas (along vessel tracks) with the ability to discern different habitat types and spatial variation of density within a particular habitat type. The returned acoustic signals are processed into a 'roughness' and 'hardness' value. These values are inferred from voltaic strengths of the first and second echo of the hydro-acoustic pulse that is sent out by the echo sounder. For example, up to 4000 signal bins (from 0 to 4 volts) and hence potentially up to 4000 roughness and hardness values can be discerned.

MICROPLOT is one software package that can be used to analyse the data either in the field via a portable PC or at the office. Two basic versions of MICROPLOT are available; a field version which allows the position fixing information (via standard or differential GPS) to be incorporated into the acquired field data files and an office version which is significantly cheaper because it does not allow for position fixing data to be incorporated to the data fields. The office version of MICROPLOT can be used for post-processing of data.

RoxAnn has recently been extensively used by the Victorian Fisheries Department for large-scale habitat surveys (contact: John Barry, Ph. 052-580111 (mob.) 019-955292). Two demonstrations of the MICROPLOT software have been attended by Marine Conservation Branch staff, and the RoxAnn/MICROPLOT facility has shown that this type of technique may be an appropriate tool for broad-scale habitat surveys. The next step in the evaluation of this technique should be a small-scale field trial.

To provide examples for typical specifications for these types of instruments, details of RoxAnn and MICROPLOT are presented in Appendix VI.

Vessels for the August 1996 survey

Past biological field surveys in Shark Bay have made use of a 12 m sailing catamaran (the "James Scheerer"). The vessel was inspected by the field team on 20 April 1996 and it was concluded that this type of vessel would be suitable for the planned mid-year survey. The vessel cruises at about 9 knots, has a 'zodiac' type tender, is fully self-contained and sleeps up to 6 field crew onboard. This type of vessel is suitable for diving operations and the deployment of scientific equipment. Other locally available vessels will also be investigated for their suitability in the mid-year surveys. As an example of the type of vessel

that is believed to be suitable for the work planned in August 1991 details of the James Shearer are presented in Appendix VII.

The Australian Customs Service (ACS) has a 20 m ocean going vessel, the ACV "Charles Kingston", that can be made available for government work. The vessel is fully self-contained and has the capacity to comfortably sleep 8 onboard, with a maximum of 2 of the 8 berths available for non ACS crew. Programming of the vessel is via formal requests to the ACS via a 'tasking' application. Discussions are planned between ACS and MCB to investigate the possibility of future use of the ACS vessel for marine investigations.

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APPENDIX I

HABITAT DATA

SHARK BAY MARINE RESERVES MONITORING PROGRAM
PRELIMINARY FIELD SURVEY OF SHARK BAY 15- 22 APRIL 1996
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SITE AND HABITAT DATA

Site No: SB5

Name: Monkey Rock

Date: 16.4.96 **Time:** 1102 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 12-2 m **Water Visibility:** 6m

Land marks / Site Description : Monkey Rock is NE of Steep Point. Rock is visible above water.

GPS Lat 26° 8.608' S **GPS Long** 113° 9.949' E **Differential** yes

Location of site with ref. to lat/long : Depth at location: 12m. Rock 100m to SSE.

Habitat Description: The site is a slope rising from 20-30 metres up to shallows surrounding the rock. Waters from 12 metres to 2 metres were surveyed. In 12 metres coral lumps with diverse corals and fish appear surrounded by sand. On the slopes at 8-6 metres ledges and gullies show up to 60 - 80% coral cover with the cover in some places being all soft coral species. In less than 6 metres there is approx. 30% coral cover of hard and soft coral. Fish species observed here are very diverse.

Dominant Species: Corals: *Acropora sp.* (tabulate), *Pocillopora sp.* (branching), *Sinularia sp.* (Soft coral forms 80% cover in some areas).
Fish : Western Puller *(Chromis westaustralis),* Western Buff Bream *(Kyphosus cornelii)*, juv. Baldchin Groper *(Choerodon rubescens)*, Key Hole Angelfish *(Centropyge tibicen)* Green and Moon Wrasse *(Thalassoma lutescens and T. lunare)*, Western King Wrasse *(Coris auricularis)*. High diversity of reef, predator and coral fish observed.
Invertebrates: Molluscs very diverse including small clams *(Tridacna maxima and T.crocera).*

Other Habitat Notes: To the west of this site there is a steep drop-off into unprotected oceanic waters. Shallow protected waters lie to the east, connected by deeper channels and fast moving waters. For most of the time this site is inaccessible as a result of oceanic swell.

Activity or Impact Noted: Six recreational fishing boats and one commercial dive boat were observed in this area. There is evidence of anchor damage to coral. Discarded fishing line is readily observed.

Video reference: 160496/sb5/0-4.24.20/hv **Aerial ref**:11.9.90/1/ 5085-5088
Slide reference: 160496/sb5/1s **Photo reference**:

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SITE AND HABITAT DATA

Site No: SB6

Name: Steep Point

Date: 16.4.96 **Time:** 1102 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : N/A **Sea:** N/A **Water Depth:** N/A **Water Visibility:** N/A

Land marks / Site Description : Immediately offshore of Steep Point.

GPS Lat N/A **GPS Long** N/A **Differential**

Location of site with ref. to lat/long:

Habitat Description: Reef

Dominant Species:

Other Habitat Notes:

Activity or Impact Noted: Anecdotal information from Mr Alan Dyson (Explorer Charters) suggests that this popular fishing platform is littered with rubbish such as old chairs, SCUBA tanks, camping gear, fishing rods and lines.

Video reference:
Slide reference:

Aerial reference:
Photo reference:

SHARK BAY MARINE RESERVES MONITORING PROGRAM
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SITE AND HABITAT DATA

Site No: SB7

Name: Mid South Passage

Date: 16.4.96 **Time:** 1200 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 2m **Water Visibility:** 5m

Land marks / Site Description : This shoal extends south from Dirk Hartog Island into South Passage.

GPS Lat N/A **GPS Long** N/A **Differential**

Location of site with ref. to lat/long: N/A

Habitat Description: Reef pavement covered by algal turf and the occasional low relief coral. This site is wave swept and is considered a surf zone.

Dominant Species: None observed.

Other Habitat Notes: This shoal extends south into South Passage from Dirk Hartog Island. It is a site of extreme turbulence and can only be viewed when there is limited swell.

Activity or Impact Noted: None observed.

Video reference:
Slide reference:
Aerial reference: 11.9.90/1/5085-5088
Photo reference:

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SITE AND HABITAT DATA

Site No: SB10

Name: Surf Point Reef

Date: 16.4.96 **Time:** 1223 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 2m **Water Visibility:** 10m

Land marks / Site Description : SW corner of Dirk Hartog Island, inside reef break.

GPS Lat 26° 7.385'S **GPS Long** 113° 10.995'E **Differential** no

Location of site ref. to lat/long : Reef extends from 20 metres west of here to surf break

Habitat Description : A shallow sandy bay with patchy cover of limestone/turf and remnant seagrass *Halophila ovalis*. Site is bordered on its western edge by a shallow reef platform that is comprised of micro-atolls of *Porites sp.* that provides refuge for some reef fish and invertebrate species. Coral species, mainly juvenile, have established themselves on this reef.

Dominant Species: **Corals**: *Porites sp.*, micro atolls cover 60% of the site with associated *Pocillopora* and *Acropora sp.* (branching), and some soft coral.
Algae: Green algae is present on dead coral.
Fish: there were few obvious species of fish and little diversity.
Invertebrates: There were few invertebrate species, only molluscs exhibited some diversity, particularly predatory species including *Trochus sp. Drupella sp.* was observed on a variety of coral species. Clams *(Tridacna maxima, T. crocea* and *T. squamosa)* of varying sizes were very common. The burrowing urchin species *Echinometra* dominates this site.

Other Habitat Notes : On the southern side of the reef platform are deeper holes that have not been surveyed.

Activity or Impact Noted: This is a popular snorkelling site. There are some signs of coral damage. Anecdotal evidence suggests that the abundant egg cowrie normally observed in large numbers at this site, is heavily collected. There were no egg cowries observed during this survey.

Video reference: 160496/sb10/4.24.18 6.53.16/hv **Aerial reference:** 11.9.90/1/5085 5088
Slide reference: 160496/sb10/3-4/s **Photo reference:**

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SITE AND HABITAT DATA

Site No: SB12

Name: Shelter Bay

Date: 16.4.96 **Time:** 1315 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 3m **Water Visibility:** 3m

Land marks / Site Description : Camping/boating site east of Steep Point.

GPS Lat 26° 10.11'S **GPS Long** 113° 11.79 E **Differential** no

Location of site with ref. to lat/long: Vessel stationary on site.

Habitat Description : The bay has a sandy substrate. Seagrass *(Posidonia australis)* was observed in small patches on the slope into the bay. The distinct habitat observed on the aerials at this site is also seagrass *(Amphibolis antarctica)*

Dominant Species: **Seagrass:** *Posidonia australis* observed in water > 4 metres deep. In water less than 3 metres deep the dominant species is *Amphibolis antartica.*

Other Habitat Notes : This site is close to the main channel of South Passage where sandy substrate dominates.

Activity or Impact Noted: Bay has three camping sites and temporary moorings placed in sand. Popular site for campers and launching of small vessels.

Video reference:
Slide reference:

Aerials reference: 11.9.90/1/5085-5088
Photo reference:

SHARK BAY MARINE RESERVES MONITORING PROGRAM
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SITE AND HABITAT DATA

Site No: SB15

Name: Sea Cages

Date: 16.4.96 **Time:** 1405 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth**: 18m **Water Visibility:** 2m

Land marks / Site Description : Single circular cage with small holding cage in channel.

GPS Lat 26° 00.822'S **GPS Long** 113° 13.136'E **Differential** yes

Location of site with ref. to lat/long: South west corner of cage.

Habitat Description: Sand and silt only, with some evidence of small burrows.

Dominant Species: None observed.

Other Habitat Notes: Cage is moored by four points on western slope of main channel.

Activity or Impact Noted: None observed.

Video reference:
Slide reference: 160496/sb15/2-3/8/s

Aerial reference:
Photo reference:

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SITE AND HABITAT DATA

Site No: SB20

Name: Heirisson Prong

Date: 16.4.96 **Time:** 1615 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 8 - 4 m **Water Visibility:** 10m

Land marks / Site Description: 50m north of green channel marker of Heirisson Prong.

GPS Lat 25° 58.500' S **GPS Long** 113° 19.215'E **Differential** yes

Location of site with ref. to lat/long: 50 metres north of channel marker.

Habitat Description: Seagrass beds were observed on the slopes *(Posidonia australis)* and on the flats at 4 metres depth (90% cover of *Amphibolis antarctica* was observed).

Dominant Species: Seagrass: *Posidonia australis* > 4 metres deep.
Amphibolis antarctica < 4 metres deep.
Fish: Juvenile fish species common.
Invertebrates: Little diversity or abundance. The Heart Urchin (species unknown) was common in sandy areas around the site.

Other Habitat Note:

Activity or Impact Noted: None observed.

Video ref: 160496/sb20/8.48.04 -11.41.04/hv **Aerial reference:** 11.9.90/5S/5102-5103
Slide reference: **Photo reference**:

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SITE AND HABITAT DATA

Site No: SB30

Name: Useless Loop Shipping Jetty

Date: 18.4.96 **Time:** 1730 **Vessel:** Hartog Explorer **Recorder:** Pobar

Weather : O/cast **Sea:** Calm **Water Depth:** 10 - 5m **Water Visibility:** 4m

Land marks / Site Description : North, East and West of jetty

GPS Lat 26° 05 321'S **GPS Long** 113° 25.008'E **Differential** Yes

Location of site with ref. to lat/long: Tied to most northern tip of jetty, 10 m from pylon.

Habitat Description:

A. A steep slope drops to 10 metres. Bottom substrate is fine sand.

B. 200 metres due south of Slope Island, the water depth is 4.6m. 100% cover of healthy seagrass cover *(Amphibolis antarctica)* extending to the slope and inshore.

C. 300 metres NE of Slope Island is patchy seagrass in approximately 4 metres of water. Estimated 60% cover of *Amphibolis antarctica.*

Dominant Species: **Seagrass**: *Amphibolis antarctica*

Other Habitat Notes: Information from Mr Craig Shankland of Shark Bay indicates that there are significant areas of coral to the north and south of the end of the jetty. The coral area to the south is approximately 1650 m south of the jetty. In view of their proximity to shipping and commercial activity these coral areas should be considered as long-term monitoring sites.

Activity or Impact Noted: This jetty is used extensively by ships of up to 30,000 tonnes to transport salt from the salt works. Salt is stored on a small island called Slope Island.

Video reference:
Slide reference: 180496/sb30/21-23/s

Aerial reference: 11.9.90/6S/5110
Photo reference:180496/sb30/01-07/p

SHARK BAY MARINE RESERVES MONITORING PROGRAM
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SITE AND HABITAT DATA

Site No: SB35

Name: Wilson Is.

Date: 18.4.96 **Time:** 0925 **Vessel:** Hartog Explorer **Recorder:** Pobar

Weather : O/cast **Sea:** Calm **Water Depth:** 1m **Water Visibility:** 5m

Land marks / Site Description : Shallow water to the NW of Wilson Is.

GPS Lat 26° 09.911'S **GPS Long** 113° 39.387'E **Differential** yes

Location of site with ref. to lat/long: On site.

Habitat Description: Towards the island, a seagrass bed (60 - 80% cover of *Posidonia australis*) was observed over sand. North of here however the bed was almost 90% cover of *Amphibolis antarctica.*

Dominant Species: **Seagrass**: *Posidonia australis* and *Amphibolis antarctica.*

Other Habitat Notes: Surrounding waters shallow with up to 80% seagrass cover.

Activity or Impact Noted: None observed although some line fishing takes place in this area.

Video reference:
Slide reference:

Aerial ref: 21.3.95 5087-5089
Photo reference:

SHARK BAY MARINE RESERVES MONITORING PROGRAM
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SITE AND HABITAT DATA

Site No: SB37

Name: Freycinet Sound

Date: 18.4.96 **Time:** 1020 **Vessel:** Hartog Explorer **Recorder:** Pobar

Weather : O/cast **Sea:** Calm **Water Depth:** 10 m **Water Visibility:** 5 m

Land marks / Site Description : Site is in open water at deepest point in sound.

GPS Lat 26° 24.443'S **GPS Long** 113° 45.305'E **Differential** yes

Location of site with ref. to lat/long: On site.

Habitat Description: Fine sandy substrate with sparse seagrass plants (<5% cover).

Dominant Species: **Seagrass:** *Posidonia australis*.

Other Habitat Notes:

Activity or Impact Noted: Occasional recreational fishing vessel observed in this area.

Video reference:
Slide reference:
Aerial reference:
Photo reference:

SHARK BAY MARINE RESERVES MONITORING PROGRAM
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SITE AND HABITAT DATA

Site No: SB38

Name: White Is.

Date: 18.4.96 **Time:** 1055 **Vessel:** Hartog Explorer **Recorder:** Pobar

Weather : O/cast **Sea:** Calm **Water Depth:** 2m **Water Visibility:** 5m

Land marks / Site Description : Site is 200 metres east of the centre of White Is.

GPS Lat 26° 26.698'S **GPS Long** 113° 45.825'E **Differential** yes

Location of site with ref. to lat/long: On site

Habitat Description: 100% cover of seagrass surrounding the island.

Dominant Species: **Seagrass:** *Amphibolis antarctica* is the only species observed.

Other Habitat Notes: There appears to be no reef platform associated with this island.

Activity or Impact Noted: None observed.

Video reference:
Slide reference: 180496/sb38/24-27/s

Aerial reference:
Photo reference:

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SITE AND HABITAT DATA

Site No: SB39

Name White Island Flats

Date: 18.4.96 **Time:** 1130 **Vessel:** Hartog Explorer **Recorder:** Pobar

Weather : Fine **Sea:** Calm **Water Depth:** 2m **Water Visibility:** 5m

Land marks / Site Description : These flats are the shallowest point of a shoal that extends SSE from White Is.

GPS Lat 26° 28.831'S **GPS Long** 113° 46.290'E **Differential** yes

Location of site with ref. to lat/long: On site

Habitat Description: A flat limestone area of approximately 100 x 100 metres surrounded by seagrass beds. There is no obvious life on this platform. Numerous burrows of the Blue Spot Tuskfish were observed in this area.

Dominant Species: **Seagrass:** *Amphibolis antarctica* surrounding the area.
Fish: Blue Spot Tuskfish *(Choerodon cauteroma).*

Other Habitat Notes

Activity or Impact Noted: Two vessels were observed fishing directly on the reef.

Video reference:
Slide reference:

Aerial reference:
Photo reference:

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Is.
SITE AND HABITAT DATA

Site No: SB40

Name: Mary Anne

Date: 18.4.96 **Time:** 1430 **Vessel:** Hartog Explorer **Recorder:** Pobar

Weather : Fine **Sea:** Calm **Water Depth:** 3m **Water Visibility:** 5m

Land marks / Site Description : Site is the immediate surrounds of island

GPS Lat 26° 29.074'S **GPS Long** 113° 41.070'E **Differential** yes

Location of site with ref. to lat/long: Island is 100 metres SW of this location

Habitat Description : The island is surrounded by limestone platform covered in turf algae. The tuskfish is common, sheltering under ledges. There is very little marine life or diversity on the platform, and except for the tuskfish, it is devoid of any other obvious or dominant species.

Dominant Species: **Fish:** Blue Spot Tuskfish *(Choerodon cauteroma).*

Other Habitat Notes : This island is a major sea bird nesting site.
Nesting: Gull Billed Terns (1000), Silver Gulls (150), Caspian Terns (8 juv.), Crested Terns (150).
Resting: Pied Cormorants (50), Ruddy Turnstones (50), Roseate Terns (20), Sea Eagle (1)

Activity or Impact Noted: One vessel was observed fishing in this area. This area is a proposed Sanctuary Zone.

Video reference: 180496/sb40/00.00.00-05.32.06/hv **Aerial reference:**
Slide reference: 180496/sb40/15/s **Photo reference**: 180496/01-08/p

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SITE AND HABITAT DATA

Site No: SB45

Name: Three Bay Is.

Date: 18.4.96 **Time:** 1215 **Vessel:** Hartog Explorer **Recorder:** Pobar

Weather : Fine **Sea:** Calm **Water Depth:** 3m **Water Visibility:** 5m

Land marks / Site Description : 70 metres from beach of eastern bay

GPS Lat 26° 33.293'S **GPS Long** 113° 38.877'E **Differential** yes

Location of site with ref. to lat/long: On site

Habitat Description : There is 80% seagrass cover in this vicinity right up to beach. Seagrass shows some epiphytic cover.

Dominant Species: **Seagrass:** *Amphibolis antarctica.*

Other Habitat Notes :

Activity or Impact Noted: There were three recreational fishing vessels observed within 500 metres of this island.

Video reference: **Aerial ref:** 11.9.90/7/5139
Slide reference: 180496/sb45/13-14/ 31-36/36a/s
Photo reference: 180496/sb45/01-02/p

SHARK BAY MARINE RESERVES MONITORING PROGRAM
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SITE AND HABITAT DATA

Site No: SB50

Name: Freycinet Is.

Date: 18.4.96 **Time:** 1430 **Vessel:** Hartog Explorer **Recorder:** Pobar

Weather : Fine **Sea:** Calm **Water Depth:** 2m **Water Visibility:** 8m

Land marks / Site Description : Habitat described is 100m E of northern peninsula

GPS Lat 26° 24.296'S **GPS Long** 113° 37.067'E **Differential** yes

Location of site with ref. to lat/long: In shallow waters over a series of distinct seagrass circles.

Habitat Description : Four distinct circles of seagrass are obvious off the northern tip of the island and are surrounded by sand. These circles, obvious on aerial photographs, are approximately 20 metres in diameter and consist of 100% cover of *Posidonia australis*. To date only *Amphibolus antartica* has been observed in very shallow water.

Dominant Species: **Seagrass:** *Posidonia australis*.

Other Habitat Notes : There is no sign of limestone platform surrounding the island.

Activity or Impact Noted: A recreational boat was observed fishing south of the island.

Video reference:
Slide reference: 180496/sb50/17-18/s

Aerial ref: 11.9.90/7/5140 -5145
Photo reference: 180496/sb50/01-05/p

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SITE AND HABITAT DATA

Site No: SB52

Name: Dugong City

Date: 18.4.96 **Time:** 1400 **Vessel:** Hartog Explorer **Recorder:** Pobar

Weather : Fine **Sea:** Calm **Water Depth:** 8m **Water Visibility:** 5m

Land marks / Site Description : Open water between Mary Anne Is. and Freycinet Is.

GPS Lat 26° 27.060'S **GPS Long** 113° 38.893'E **Differential** yes

Location of site with ref. to lat/long:

Habitat Description: This site was notable for the presence of 6-8 dugong..

Dominant Species: *Dugong dugon*
Sea grass: *Posidonia australis* and *Amphibolis antarctica.*

Other Habitat Notes:

Activity or Impact Noted:

Video reference:
Slide reference:

Aerial reference: 11.9.90/7/5140-5143
Photo reference:

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SITE AND HABITAT DATA

Site No: SB55

Name: Kangaroo Is.

Date: 18.4.96 **Time:** 1630 **Vessel:** Hartog Explorer **Recorder:** Pobar

Weather : Fine **Sea:** Calm **Water Depth:** 5m - 1m **Water Visibility:** 5m

Land marks / Site Description : Site is due west of Kangaroo Is. 100 m offshore.

GPS Lat 26° 19.206'S **GPS Long** 113° 29.676'E **Differential** yes

Location of site with ref. to lat/long: On site.

Habitat Description: The shallows in the vicinity of the island are 1 metre deep and covered in fine sand with approximately 80 % seagrass cover of *Amphibolis antarctica.* Down the slope, to a depth of 5 metres, a 20% cover of the seagrass *Posidonia australis* was observed.

Dominant Species: **Seagrass:** *Amphibolis antarctica* on the shallow flat.
Posidonia australis on the slope and in deeper water.

Other Habitat Notes: Kangaroo Is. is at the end of a channel that heads south through the Briggs Rocks Boat Haven Loop. The channel is approx. 6 metres deep with some seagrass coverage on the slopes and on the flats.

Activity or Impact Noted: A commercial net fishing vessel was observed working the channel to the north.

Video reference:

Slide reference

Aerial ref: 11.9.90/5S/5077-5082
11.9.90/5S/5122-5127

Photo reference:180496/sb55/01-3/p

SHARK BAY MARINE RESERVES MONITORING PROGRAM
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SITE AND HABITAT DATA

Site No: SB57

Name: Pearl Beds

Date: 18.4.96 **Time:** 1600 **Vessel:** Hartog Explorer **Recorder:** Pobar

Weather : Fine **Sea:** Calm **Water Depth:** 1-2m **Water Visibility:** 8m

Land marks / Site Description: Seagrass flat on the NE side of entrance to Boat Haven Loop.

GPS Lat 26° 15.914'S **GPS Long** 113° 29.590'E **Differential** yes

Location of site with ref. to lat/long: On site

Habitat Description : A large seagrass bed of *Posidonia australis* was observed. An area of over 500 x 500m was covered in the natural pearl shell (sp. unknown).

Approximately 20 or more shells per square metre were observed.

Dominant Species: **Seagrass:** *Posidonia australis*.
Invertebrates: Pearl shell (sp. unknown).

Other Habitat Notes: This area is at the northern entrance to the channel into Briggs Rocks Boat Haven Loop.

Activity or Impact Noted:

Video reference:
Slide reference:

Aerial ref: 11.9.90/6S/5120-5123
Photo reference:

SHARK BAY MARINE RESERVES MONITORING PROGRAM
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SITE AND HABITAT DATA

Site No: SB60

Name: Lefebre Is.

Date: 18.4.96 **Time:** 1525 **Vessel:** Hartog Explorer **Recorder:** Pobar

Weather : Fine **Sea:** Calm **Water Depth:** 3m **Water Visibility:** 8m

Land marks / Site Description : Site extends 50 m SW of island in shallow lagoon

GPS Lat 26° 13.898'S **GPS Long** 113° 30.431'E **Differential** yes

Location of site with ref. to lat/long: On site

Habitat Description: A small lagoon is surrounded by *Amphibolis antarctica* seagrass. The bottom of the lagoon is covered in 'rhodoliths' of calcareous red algae. In the lagoon there are approximately 10 coral bombies of the species *Turbinaria reniformis*, that extend to the surface. There are also some soft corals on the southern side. There is little else in the way of dominant or common fish species, or invertebrate marine life.

Dominant Species: **Seagrass**: *Amphibolus antarctica.*
Algae: Calcareous red 'rhodolith' algae (sp. unknown).
Corals: *Turbinaria reniformis* and undescribed soft corals.

Other Habitat Notes:

Activity or Impact Noted: Rope, broken coral, bottles and cans.

Video reference: 180496 5.32.04 - 12.37.20 **Aerial ref:** 11.9.90/7/5153
Slide reference: 180496/sb60/13/15/17-20/s **Photo reference**: 180496/sb60/01/p

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SITE AND HABITAT DATA

Site No: SB65

Name: Homestead Bay

Date: 16.4.96 **Time:** 1435 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 3m **Water Visibility:** 2m

Land marks / Site Description : Vessel on mooring 200m NW of small Mead island

GPS Lat 26° 00.11'S **GPS Long** 113° 11.868'E **Differential** yes

Location of site with ref. to lat/long: 200 metre SW swim to island

Habitat Description: Substrate is very fine silt and sand with some seagrass cover *(Posidonia sp.)* with forams attached to the leaf. A few isolated corals were observed, and some razor clams in the silt. Limestone platform is covered in turf algae and some macro-algae, particularly *Sargassum sp.*

Dominant Species: **Seagrass:** *Posidonia australis.*
Macro-algae: *Sargassum sp.* and *Padina sp.*
Corals: *Turbinaria reniformis, Montastrea sp.*(massive).
Molluscs: *Trochus sp.* and Razor shell, *Pinna bicolor.*
There was very little diversity or obvious dominance of other marine invertebrates or fish.

Habitat Notes:This bay is subject to tidal movements and sedimentation. The island was a resting site for a number of seabirds including pelicans, pied cormorants and silver gulls.

Activity or Impact Noted: Up to six moorings and two small boats were observed in the bay. A homestead is 50 metres from shore. A landing barge frequents this site.

Video reference: 160496/sb65/ 6.53.12 - 8.48.06 **Aerial ref:** 11.9.90/3/5185-5187
Slide reference: 160496/sb65/12-13/s **Photo reference**:

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SITE AND HABITAT DATA

Site No: SB70

Name: Louisa Bay

Date: 17.4.96 **Time:** 1545 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Slight **Water Depth:** 3m **Water Visibility:** 5m

Land marks / Site Description :In bay, 500m east of broken windmill.

GPS Lat 25° 46.897'S **GPS Long** 113° 5.357'E **Differential** yes

Location of site with ref. to lat/long: Inshore of this location.

Habitat Description: Fine sand and sediment substrate. Less than 30% cover of seagrass.

Dominant Species: **Seagrass**: *Posidonia australis* and *Amphibolis antarctica*. Beds of seagrass detritus observed in the bay.

Other Habitat Notes: Anecdotal evidence of coral in the area. However, none was observed.

Activity or Impact Noted: None.

Video reference:170496 19.23.12 - 20.17.02 **Aerial ref:**11.9.90/3/5196-5200
Slide reference: **Photo reference**:

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SITE AND HABITAT DATA

Site No: SB70a

Name: Louis Seagrass Bed West

Date: 17.4.96 **Time:** 1630 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 3m **Water Visibility:** 5m

Land marks / Site Description : Site is just south of Louisa Bay .

GPS Lat 25° 46.778'S **GPS Long** 113° 5.169'E **Differential** yes

Location of site with ref. to lat/long: Directly over western edge of seagrass bed.

Habitat Description: Edge of 100% seagrass bed where bed meets sand.

Dominant Species: **Seagrass:** *Amphibolis antarctica.*

Other Habitat Notes :

Activity or Impact Noted:

Video reference:
Slide reference:

Aerial ref: 11.9.90/4/5018-5022
Photo reference:

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Site No: SB70b

Name: Louisa Seagrass Bed East

SITE AND HABITAT DATA

Date: 10.4.96 **Time:** 1630 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 3m **Water Visibility:** 5m

Land marks / Site Description : South of Louisa Bay.

GPS Lat 25° 46.785'S **GPS Long** 113° 5.258'E **Differential** yes

Location of site with ref. to lat/long: Directly over eastern edge of seagrass bed.

Habitat Description: Edge of 100% seagrass bed where segrass meets sand.

Dominant Species: **Seagrass:** *Amphibolis antarctica.*

Other Habitat Notes: Site is just south of Louisa Bay.

Activity or Impact Noted:

Video reference:
Slide reference:

Aerial ref: 11.9.90/4/5018-5022
Photo reference:

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SITE AND HABITAT DATA

Site No: SB75

Name: Sandy Point Reef

Date: 17.4.96 **Time:** 1450 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 4 m **Water Visibility:** 10m

Land marks / Site Description : This coral reef is approximately 1NM offshore.

GPS Lat 25° 43.487'S **GPS Long** 113° 5.308'E **Differential** Yes

Location of site with ref. to lat/long: Coral reef is 100 metres south of this location.

Habitat Description: A coral reef with an area of approximately 1 hectare amongst a sandy area with patchy seagrass. The coral reef shows great diversity of coral species with up to 80% cover (50% soft corals and 50% hard corals). Coral 'bombies' extend up to 2 - 3 metres off the bottom. During this site investigation, there were few reef fish or invertebrate life observed. Coral species were the dominant marine life observed.

Dominant Species: **Corals**: Soft corals included *Sinularia sp.* and *Sarcophyton sp.* Hard corals: *Acropora sp.* (tabulate), *Porites sp.* (massive), *Pocillopora sp.* (branching), *Turbinaria reniformis* and *Favid sp.* (massive) were common in a variety of forms.

Other Habitat Notes: This reef is isolated offshore and is surrounded by sand.

Activity or Impact Noted: Commercial dive charter boat was observed at this site. The site is popular for snorkelling. It is a proposed Sanctuary Zone.

Video reference: 170496 13.17.06 - 19.23.14 **Aerial ref:** 11.9.90/4/5016 -5018
Slide reference: 170496/sb75/3/5-8/10-12/s (species)
Photo reference: 170496/sb75/01/p

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Sandy
SITE AND HABITAT DATA

Site No: SB78

Name: Offshore

Point

Date: 17.4.96 **Time:** 1430 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 4m **Water Visibility:** 10m

Land marks / Site Description : Investigation of edge of seagrass meadow offshore from Sandy Pt. GIS check.

GPS Lat 25° 42.785'S **GPS Long** 113° 5.259'E **Differential** yes

Location of site with ref. to lat/long: Lat/long on site.

Habitat Description: Sandy substrate with less than 2% cover of seagrass species.

Dominant Species: **Seagrass**: *Amphibolis antarctica* and *Posidonia australis*.

Other Habitat Notes:

Activity or Impact Noted:

Video reference:
Slide reference:

Aerial ref: 11.9.90/5N/5135-5137
Photo reference:

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SITE AND HABITAT DATA

Site No: SB85

Name: Levillian Shoals

Date: 17.4.96 **Time:** 1220 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 5 -18m **Water Visibility:** 4m

Land marks / Site Description: Shoal runs north to south for 2 NM.

GPS Lat 25° 30.959'S **GPS Long** 113° 03.064'E **Differential** Yes

Location of site with ref. to lat/long: Lat and Long is location of 18 metre contour on the NE side of shoal.

Habitat Description: The shoal consists of sand. Vessel track was north along the shallowest part of the shoal and then down the eastern side from 5 to 18 metres depth. Sounder indicated almost 100% sand with occasional indication of rock or reef.

Dominant Species: None observed.

Other Habitat Notes:

Activity or Impact Noted: None Observed.

Video reference:
Slide reference:

Aerial ref: 11.9.90/6N/5118-5122
Photo reference:

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SITE AND HABITAT DATA

Site No: SB87

Name: Cape Levillian

Date: 17.4.96 **Time:** 1200 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 3m **Water Visibility:** 10m

Land marks / Site Description: Site is approximately 500 m south of Cape Levillian

GPS Lat 25° 30.222'S **GPS Long** 113° 01.342'E **Differential** yes

Location of site with ref. to lat/long: Positioned over beginning of seagrass bed.

Habitat Description: Beginning of seagrass bed (approximately 20 % cover), sand substrate.

Dominant Species: **Seagrass:** *Amphibolis antarctica.*

Other Habitat Notes: This site is the commencement of seagrass beds south from Cape Levillian.

Activity or Impact Noted: None observed.

Video reference:
Slide reference:

Aerial ref: 13.9.90/6N/5120-5124
Photo reference:170496/sb87/01/p

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SITE AND HABITAT DATA

Site No: SB88

Name: Levillian Point Reef

Date: 17.4.96 **Time:** 1140 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 4m **Water Visibility:** 10m

Land marks / Site Description: This reef platform is located just offshore NW of the north eastern tip of Cape Levillian.

GPS Lat 25° 29.793'S **GPS Long** 113° 00.969'E **Differential** yes

Location of site with ref. to lat/long: Vessel over reef.

Habitat Description: This is a limestone platform up to 2 metres high off the bottom. Area appears to be approx 1000 x 50m and is approximately 50% sand and 50% reef. Reef has up to 30% coral cover in some areas.

Dominant Species: **Corals**: Composition similar to nearby Turtle Bay. *Turbinaria sp.*, *Acropora sp* (branching and tabulate), *Pocillopora sp* (branching), and some soft corals noted.
Invertebrate and fish species were not observed.

Other Habitat Notes: North of this location the water depth increases to 18 metres and the habitat is unknown. This site is a fringing platform similar to that observed in Turtle Bay.

Activity or Impact Noted: None observed. However, the area has potential for snorkelling, spearing and fishing activities and it is probable that these activities do occur.

Video reference:
Slide reference:

Aerial ref: 13.9.90/6N/5125-5128
Photo reference:

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SITE AND HABITAT DATA

Site No: SB90

Name: Turtle Bay

Date: 17.4.96 **Time:** 1100 **Vessel:** Hartog Explorer **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 6m **Water Visibility:** 6m

Land marks / Site Description : On mooring, 150 metres offshore, Turtle Bay

GPS Lat 25° 29.867'S **GPS Long** 112° 59.185'E **Differential** Yes

Location of site with ref. to lat/long: Site is 50 metres SW of this location

Habitat Description: Turtle Bay has a sandy bottom with small limestone reef platforms extending from its east and west sides. The western part of the bay is dominated by an an area of turf covered limestone flat 2 metres off the bottom. Coral cover is approximately 10% inshore and up to 30% offshore. The area is approximately 200 x 50 m in size. There is some diversity of coral type, fish life and invertebrates.

Dominant Species: **Corals**: *Turbinaria reniformis*, large *Acropora sp.* (tabulates) and *Pocillopora sp.* (branching) common, with some small *Porites sp* .(massive).
Fish: Schools of Tarwhine *(Rhabdosargus sarba)* and juvenile Snapper *(Chrysophrys auratus)* were most common. Of note was some diversity in reef fish with Queensland Groper *(Promicrops lancelatos)*, Baldchin Groper *(Choerodon rubescens)* and Scribbled Angelfish *(Cheatodontoplus duboulayi)* readily observed. Bull rays *(Dasyatis thetidis)* were observed buried in the sand.
Invertebrates: Some diversity with the feather star *(Tropiometra sp.)* obvious and holothurians *(Holothuria sp.)* common. The clam *Tridacna maxima* was also observed.

Other Habitat Notes :Water depth increases to 30 metres two miles north of the site. The location is a major nesting beach for loggerhead and green turtles.

Activity or Impact Noted: The bay is used for camping and fishing. Rubbish on sea bed included fishing lines, beer cans, car tyres, plastic chair and rope.

Video reference: 170496/sb90/00.00.00-04.57.22/hv **Aerials ref:** 13.9.90/5N/5125-5120

Slide reference: 170496/sb90/01-08/15-17/s **Photo reference**: 170496/01-02/p

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SITE AND HABITAT DATA

Site No: SB95

Name: Town Bluff Offshore

Date: 18.4.96 **Time:** 0830 **Vessel:** Sirenia **Recorder:** Shepherd

Weather : Fine **Sea:** Calm **Water Depth:** **Water Visibility:**

Land marks / Site Description : Proposed pearl aquaculture sites south of Denham, souhthwest of Town Bluff, comprising two individual 1 nm X 1 nm blocks.

GPS Lat 25° 58.958' S **GPS Long** 113 ° 32.423' E **Differential**

Location of site with ref. to lat/long The GPS coords define the SW corner of Block 1 and the NW corner of Block 2.

Habitat Description : Patchy areas of seagrass among sand.

Dominant Species: **Seagrass:** *Posidonia australis* and *Amphibolis antarctica.*

Other Habitat Notes :

Activity or Impact Noted: These blocks define proposed lease area for pearl aquaculture. Discussions with the proponent (Mr Errol Francis) indicated that the pontoon (work platform) would be moored over shallow sand at the closest margins to the shore (east of a block). Issues identified were: possible shading of nearby seagrasses by the pontoon and direct damage to seagrass beds by anchor-related scouring. The panels would be cleaned from a work boat. Panels would be spaced one meter apart and most probablybe aligned perpendicular to the coast. Another important issue identified was that of Visual Resource Management: the likely visual impacts due to the visibility of the pontoon from Denham. On the basis of an initial assessment the investigators concluded that Block 2 would be preferred over Block 1 because it was the furthest offshore.

Video reference:
Slide reference:
Photo reference:

Aerial ref : 11.9.90/1/5137 -5140
21.3.95 5430-5435

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SITE AND HABITAT DATA

Site No: SB95N

Name: Nicholson Point Offshore

Date: 18.4.96 **Time:** 0900 **Vessel:** Sirenia **Recorder:** Shepherd

Weather : Fine **Sea:** Calm **Water Depth:** Approx. 2.2m **Water Visibility:**

Land marks / Site Description: Proposed pearl aquaculture sites NW of Denham.

GPS Lat 25° 54.712' S **GPS Long** 113 ° 29.909' E **Differential**

Location of site with ref. to lat/long: The GPS coords define the approximate centre of a general area surveyed. The area was about 1 nm in radius.

Habitat Description: A large sand patch surrounded by seagrass.

Dominant Species: **Seagrass:** *Halophila ovalis* and *Amphibolis antarctica.*

Other Habitat Notes :

Activity or Impact Noted: The main issue raised at this site was that of Visual Resource Management. In particular, the aquaculture infrastructure at this site would be visible from Nicholson Point where a World Heritage Visitor Centre and other developments could potentially be sited.

Video reference:
Slide reference:
Photo reference:

Aerial ref : 11.9.90/1/5137 -5140
21.3.95 5430-5435

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SITE AND HABITAT DATA

Site No: SB100

Name: Big Lagoon

Date: 17.4.96 **Time:** 1030 **Vessel:** Sirenia **Recorder:** Crane

Weather : Fine **Sea:** Calm **Water Depth:** **Water Visibility:**

Land marks / Site Description : Offshore of small boat launching site in Big Lagoon.

GPS Lat 25° 46.557'S **GPS Long** 113° 28.436'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: Sandy bottom with some limestone rock platform off the point. A narrow seagrass bed runs offshore, parallel to the coast.

Dominant Species: **Seagrass:** *Posidonia australis*.

Other Habitat Notes: This site is in a narrow channel that leads into Big Lagoon. Strong currents were recorded here.

Activity or Impact Noted: Vessel launching and anchoring (on sand).

Video reference:
Slide reference:
Aerial ref: 11.9.90/1/5126-5131
Photo reference:

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SITE AND HABITAT DATA

Site No: SB101

Name: Outer Big Lagoon

Date: 17.4.96 **Time:** 1050 **Vessel:** Sirenia **Recorder:** K. Crane

Weather : Fine **Sea:** Calm **Water Depth:** **Water Visibility:**

Land marks / Site Description : Approx. 500m seaward from campsite, in channel.

GPS Lat 25° 46.85'S **GPS Long** 113° 28.475'E **Differential** No

Location of site with ref. to lat/long: At site.

Habitat Description: Limestone outcrop with silt and turf covering. Some invertebrates here and good diversity of fish species in moderate numbers.

Dominant Species: **Fish:** Green Parrotfish *(Scarus sordidus)*, Tarwhine *(Rhabdosargus sarba)*, Western Scaly Fin *(Parma occidentalis)* ; Sergeant Major *(Abudefduf vaigiensis)*. **Invertebrates:** Black sponge *(Spirastrella sp.)*.

Other Habitat Notes: Site is in channel towards lagoon delta, strong current observed.

Activity or Impact Noted: Site does not seem to be targeted by fishers.

Video reference:
Slide reference:
Aerial ref; 11.9.90/1/5127-5133
Photo reference:

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SITE AND HABITAT DATA

Site No: SB103

Name: Gregory's

Date: 17.4.96 **Time:** 1400 **Vessel:** Sirenia **Recorder:** Crane

Weather : Fine **Sea:** Calm **Water Depth:** **Water Visibility:**

Land marks / Site Description : Site is on outside of shallows approx. 200 m offshore.

GPS Lat 25° 33.336'S **GPS Long** 113° 28.404'E **Differential** no

Location of site with ref. to lat/long: Lat/long is at boat channel.

Habitat Description : Typical limestone platform with turf cover and bare areas. Less than 5% coral cover, some black sponge cover. Invertebrate diversity not obvious with no dominant species type.

Dominant Species: **Corals:** types unknown.
Fish: Moon Wrasse *(Thalassoma lunare)*
Invertebrates: Black sponge *(Spirastrella sp.)*.

Other Habitat Notes : An oyster-covered rock is situated at the southern entrance to the bay.

Activity or Impact Noted: The bay is an anchorage and campsite. Some fishing line and hooks were observed at the oyster stack.

Video reference:
Slide reference:

Aerial ref: 11.9.90/4/5203 - 5202
Photo reference:

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SITE AND HABITAT DATA

Site No: SB105

Name: Broadhurst Reef

Date: 17.4.96 **Time:** 17.4.96 **Vessel:** Sirenia **Recorder:** Crane

Weather : Fine **Sea:** Calm **Water Depth:** 3-5m **Water Visibility:** 9m

Land marks / Site Description: This reef is approximately 400 x 200 m in area and is a shoal offshore of Peron Peninsula.

GPS Lat 25° 38.048'S **GPS Long** 113° 22.408'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: A large shallow shoal in water 3-5 metres deep, approximately 5 NM offshore of Peron Peninsula. In shallow areas, the coral cover is 30-40% whilst in deeper water it is 60-80%. The deeper water is on the northern edge of the flat. Fish life is diverse, however there is little invertebrate diversity or dominance.

Dominant Species: **Corals:** *Acropora sp.* (tabulate), *Montipora sp.* (massive).
Fish: Sergeant Major *(Abudefduf vaigiensis)*, Western Puller *(Chromis westaustralis)*, Moon Wrasse *(Thalassoma lunare)*,Bi-colour Angelfish *(Centropyge bicolor)*, Coral Trout *(Plectropomus leopardus)*.

Other Habitat Notes : Broadhurst Reef slopes down on all sides to a sandy bottom at approximately 8 metres depth.

Activity or Impact Noted: Evidence of some anchor damage to coral on the northern (deeper) side where fishing is most common.

Video reference:
Slide reference:

Aerial ref: 11.9.90/1/5122-5123; 2/5160
Photo reference:

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SITE AND HABITAT DATA

Site No: SB116

Name: Cape Peron Drop-off

Date: 17.4.96 **Time:** 1500 **Vessel:** Sirenia **Recorder:** K. Crane

Weather : Fine **Sea:** Calm **Water Depth:** 6-12m **Water Visibility:** 6m

Land marks / Site Description :Water drops from 6m to 12 m, 400 m N of Cape Peron.

GPS Lat 25° 30.284'S **GPS Long** 113° 30.050'E **Differential** no

Location of site with ref. to lat/long: On site

Habitat Description : This site is a sandy drop-off with no limestone or coral reef evident. The slope was steep with only scattered seagrass *(Amphibolis antarctica)* and possibly algae (*Sargassum sp.* indicating some possible limestone structures present).

Dominant Species: N/A

Other Habitat Notes :

Activity or Impact Noted: Hooks and lines observed near oyster stacks.

Video reference:
Slide reference:

Aerial ref: 11.9.90/5/5204-5205
Photo reference:

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SITE AND HABITAT DATA

SiteNo: SB120a

Name: Inshore Meadow

Date: 18.4.96 **Time:** 1025 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** **Water Visibility:**

Land marks / Site Description : Offshore; beginning of search transect to the north.

GPS Lat 25° 35.045'S **GPS Long** 113° 31.78'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: Edge of seagrass meadow.

Dominant Species: **Seagrass:** *Amphibolis antarctica.*

Other Habitat Notes : An offshore-onshore 'zig-zag' transect commenced at this site with the aim of locating the '80 Acres' fishing area. Typically, the vessel headed E for about 5 minutes then N for about 1 minute then W for about 5 minutes then N for about 1 minute and so on.

Activity or Impact Noted:

Video reference: **Aerial ref:** 11.9.90/5/5207-5211
Slide reference: **Photo reference:**

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SITE AND HABITAT DATA

SiteNo: SB120e

Name: Seagrass Bank

Date: 18.4.96 **Time:** 1039 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** 5m **Water Visibility:**

Land marks / Site Description: Detected seagrass bank.

GPS Lat 25° 34.800'S **GPS Long** 113° 31.633'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: Approximately 10 -20% seagrass cover on sand substrate, sparse coverage.

Dominant Species: **Seagrass:** *Posidonia australis.*

Other Habitat Notes :

Activity or Impact Noted: Site is part of 'zig-zag' transect used to search for fishing site '80 Acres'.

Video reference:
Slide reference:

Aerial ref: 11.9.90/5/5207-5211
Photo reference:

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SITE AND HABITAT DATA

SiteNo: SB120i

Name: Seagrass Bank

Date: 18.4.96 **Time:** 1104 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** **Water Visibility:**

Land marks / Site Description : Onshore eastern edge of seagrass meadow.

GPS Lat 25° 34.616'S **GPS Long** 113° 31.381'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: Inshore edge of distinct seagrass bed.

Dominant Species: **Seagrass:** *Posidonia australis.*

Other Habitat Notes :

Activity or Impact Noted: Last site investigated on 'U' search pattern looking for site known as '80 Acres'.

Video reference:
Slide reference:

Aerial ref: 11.9.90/5/5207-5211
Photo reference:

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SITE AND HABITAT DATA

SiteNo: SB120k

Name: Seagrass Bank

Date: 18.4.96 **Time:** 1110 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : Fine **Sea:** Calm **Water Depth:** **Water Visibility:**

Land marks / Site Description :.

GPS Lat 25° 34.224'S **GPS Long** 113° 31.960'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: Seagrass meadow (30-40% cover).

Dominant Species:.

Other Habitat Notes :

Activity or Impact Noted:

Video reference: **Aerial ref:** 11.9.90/5/5207-5211
Slide reference: **Photo reference:**

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SITE AND HABITAT DATA

Site No: SB122

Name: Guichenault Pt Seagrass East

Date: 18.4.96 **Time:** 0945 **Vessel:** Sirenia **Recorder:** Barton

Weather : O/cast **Sea:** Calm **Water Depth:** 4m **Water Visibility:** 5m

Land marks / Site Description : Beginning of sand spit

GPS Lat 25° 37.429'S **GPS Long** 113° 35.859'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: Beginning of uneven edge of sea grass bed of 100% cover of *Amphibolis antarctica.*

Dominant Species: **Seagrass:** *Amphibolis antarctica.*

Other Habitat Notes :

Activity or Impact Noted: None observed.

Video reference:
Slide reference:

Aerial ref: 11.9.90/6/5238-5242
Photo reference:

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SITE AND HABITAT DATA

Site No: SB122a

Name: Guichenault Seagrass bed

Date: 18.4.96 **Time:** 0950 **Vessel:** Sirenia **Recorder:** Barton

Weather : O/cast **Sea:** Calm **Water Depth:** 4m **Water Visibility:** 5m

Land marks / Site Description : 100 metres South of SB122

GPS Lat 25° 37.040'S **GPS Long** 113° 35.492'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description : 100% cover of *Amphibolis antarctica* seagrass.

Dominant Species: **Seagrass:** *Amphibolis antarctica.*

Other Habitat Notes: Large seagrass bed in shallow water.

Activity or Impact Noted:

Video reference:
Slide reference:

Aerial ref: 11.9.90/6/5238-5242
Photo reference:

SHARK BAY MARINE RESERVES MONITORING PROGRAM
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Department of Conservation and Land Management

SITE AND HABITAT DATA

Site No: SB122s

Name: Herald Bluff

Date: 18.4.96 **Time:** 1215 **Vessel:** Sirenia **Recorder:** Crane

Weather : Fine **Sea:** Calm **Water Depth:** **Water Visibility:**

Land marks / Site Description : Site is east of Herald Bluff

GPS Lat 25° 38.227'S **GPS Long** 113° 35.800'E **Differential** no

Location of site with ref. to lat/long: On site on edge of seagrass bed

Habitat Description: Site is on edge of 100% seagrass cover of *Amphibolis antarctica.*

Dominant Species: **Seagrass:** *Amphibolis antarctica.*

Other Habitat Notes :

Activity or Impact Noted:

Video reference:
Slide reference:

Aerial ref: 11.9.90/5/5210-5215
Photo reference:

SHARK BAY MARINE RESERVES MONITORING PROGRAM
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SITE AND HABITAT DATA

Site No: SB123

Name: Seagrass Patch

Date: 18.4.96 **Time:** 1000 **Vessel:** Sirenia **Recorder:** Barton

Weather : Fine **Sea:** Calm **Water Depth:** 2m **Water Visibility:** 5m

Land marks / Site Description : Patchy seagrass bed.

GPS Lat 25° 37.040's **GPS Long** 113° 35.492'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: Patchy seagrass in shallow water. Approximately 20% cover on 80% sand.

Dominant Species: **Seagrass:** *Amphibolis antarctica* and *Posidonia australis.* *Foraminefera sp.* observed on seagrass leaves.

Other Habitat Notes :

Activity or Impact Noted:

Video reference:
Slide reference:

Aerial ref: 11.9.90/5/5211-5215
Photo reference:

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SITE AND HABITAT DATA

Site No: SB124

Name: Hades Hollow

Date: 18.4.96 **Time:** 1215 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : Fine **Sea:** Slight **Water Depth:** 2m **Water Visibility:** 5m

Land marks / Site Description: Close to shore/ steep rocky coast, about 20 m offshore.

GPS Lat 25° 42.259'S **GPS Long** 113° 36.232'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: Turf-covered limestone pavement and bare sand.

Dominant Species: N/A

Other Habitat Notes: Shallow bay, with sandy substrate.

Activity or Impact Noted:

Video reference:
Slide reference:

Aerial ref : 11.9.90/5/5214-5216
Photo reference:

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SITE AND HABITAT DATA

SiteNo: SB124e

Name: East Hades Hollow

Date: 18.4.96 **Time:** 1230 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : fine **Sea:** Slight **Water Depth:** 4m **Water Visibility:** 5m

Land marks / Site Description: Edge of seagrass meadow as tracking offshore.

GPS Lat 25 42.410's **GPS Long** 113 36.604'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: This is the edge of a 100% cover seagrass bed bordered by sand.

Dominant Species: **Seagrass:** *Amphibolis sp.*

Other Habitat Notes:

Activity or Impact Noted:

Video reference:
Slide reference:

Aerial ref: 11.9.90/5/5214-5216
Photo reference:

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SITE AND HABITAT DATA

Site No: SB125

Name: Blue Lagoon Pearl Farm

Date: 18.4.96 **Time:** 1311 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : Fine **Sea:** Slight **Water Depth:** 5m **Water Visibility:** 5m

Land marks / Site Description : Pearl lease

GPS Lat 25° 46.730'S **GPS Long** 113° 41.537'E **Differential** no

Location of site with ref. to lat/long: Southern most edge of pearl lease.

Habitat Description: This seagrass bed was of almost 100% cover of *Amphibolis antarctica*, with some *Posidonia australis* present. There was approx. 40% cover of epiphytes on the seagrass, including macro-algae and foraminefera.

Dominant Species: **Seagrass:** *Amphibolis antarctica.*

Other Habitat Notes: Pearl farm is placed over extensive seagrass meadow.

Activity or Impact Noted: Blue Lagoon Pearl farm consists of over 20 strung lines approximately 5 km offshore, covering an area of 300 x 100 metres in 5 metres of water. Cleaning of structures takes place on site.

Video reference:
Slide reference:

Aerial ref: 11.9.90/6/5230-5234
Photo reference:

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SITE AND HABITAT DATA

SiteNo: SB125s

Name: South Pearl Lease

Date: 18.4.96 **Time:** 1330 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : Fine **Sea:** Slight **Water Depth:** 3m **Water Visibility:** 5m

Land marks / Site Description: Seagrass bed 100 m S of Pearl lease

GPS Lat 25° 46.921'S **GPS Long** 113° 41.571'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: A seagrass bed of 100% cover with *Amphibolus antartica* dominant with some scattered *Posidonia australis* present.

Dominant Species: **Seagrass**: *Amphibolis antarctica.*

Other Habitat Notes:

Activity or Impact Noted: See notes re: Blue Lagoon Pearl Farm SB125

Video reference:
Slide reference:

Aerial ref: 11.9.90/6/5230-5234
Photo reference:

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SITE AND HABITAT DATA

Site No: SB130

Name: Monkey Mia

Date: 18.4.96 **Time:** 1523 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : Fine **Sea:** Slight **Water Depth:** 3m **Water Visibility:** 8m

Land marks / Site Description: In front of dolphin feeding area and no swimming zone boundary.

GPS Lat 25° 47.552'S **GPS Long** 113° 43.129'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: Less than 5% cover of a thin bladed seagrass on a sandy substrate. These plants were sparse. Little else obvious or identified.

Dominant Species: **Seagrass:** Resembles juvenile *Posidonia australis*.

Other Habitat Notes: Lagoon is surrounded on three sides by shallow banks. Dynamics of this lagoon will be subject to further work.

Activity or Impact Noted: Directly offshore of major resort and dolphin feeding area of Monkey Mia. High recreational use, vessel use and possible impact from resort development is part of the history of this area.

Video reference: **Aerial ref:** 11.9.90/6/5227-5230
Slide reference: 180496/sb130/28/29/31/33/s **Photo reference:** 180496/sb130/1/2/p

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SITE AND HABITAT DATA

SiteNo SB130a

Name: Shallow Bank Monkey Mia

Date: 18.4.96 **Time:** 1500 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : Fine **Sea:** Slight **Water Depth:** <3m **Water Visibility:**

Land marks / Site Description : This is the next shallow bank east of Monkey Mia

GPS Lat 25° 47.733'S **GPS Long** 113° 43.925'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: Site is described as a seagrass bed. Of note was the 60 -80% epiphytic cover on seagrass.

Dominant Species: **Seagrass:** *Posidonia australis*.

Other Habitat Notes: Shallow banks and channels are common in this area.

Activity or Impact Noted: Many small boats travel through or fish in this area.

Video reference:
Slide reference:

Aerial ref: 11.9.90/6/5228-5230
Photo reference:

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SITE AND HABITAT DATA

SiteNo: SB130b

Name: Offshore Monkey Mia

Date: 18.4.96 **Time:** 1510 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : Fine **Sea:** Slight **Water Depth:** 4m **Water Visibility:**

Land marks / Site Description : In deep channel offshore Monkey Mia.

GPS Lat 25° 47.549'S **GPS Long** 113° 43.932'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: Seagrass beds continue into deeper water however there is less obvious epiphytic cover.

Dominant Species: **Seagrass:** *Posidonia australis.*

Other Habitat Notes: Shallow banks, deeper channels and fast currents are common in this area.

Activity or Impact Noted: Offshore from Monkey Mia. Occasional boating activity in this area noted.

Video reference:
Slide reference:

Aerial ref: 11.9.90/6/5228-5230
Photo reference:

SHARK BAY MARINE RESERVES MONITORING PROGRAM
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SITE AND HABITAT DATA

Site No: SB134

Name: Herald Bank

Date: 18.4.96 **Time:** 1555 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : Fine **Sea:** slight **Water Depth:** **Water Visibility:**

Land marks / Site Description : Shallow bank offshore of Monkey Mia in mid-channel

GPS Lat 25 45.658'S **GPS Long** 113 44.513'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: A combined seagrass bed with 100% cover. Both species of seagrass observed here.

Dominant Species: **Seagrass:** *Posidonia australis* and *Amphibolis antarctica.*

Other Habitat Notes: Site is on the shallow banks mid way between Monkey Mia and Faure Is. Shallow banks, deep channels and currents are common in this area.

Activity or Impact Noted:

Video reference: **Aerial ref:**
Slide reference: **Photo reference:**

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SITE AND HABITAT DATA

Site No. SB145

Name: Gladstone Jetty

Date: 19.4.96 **Time:** 1250 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : O/cast **Sea:** Moderate **Water Depth:** 2m **Water Visibility:** 3m

Land marks / Site Description : Site is just off SW side of end of jetty on small limestone outcrops.

GPS Lat 114° 14.9'S **GPS Long** 25° 57.3'E **Differential** no

Location of site with ref. to lat/long: On outcrop in shallows.

Habitat Description: Small shallow limestone outcrops covered in turf are present at the end of the jetty, surrounded by fine sand.

Dominant Species: There were no dominant species observed, although some unidentifiable small fish were present.

Other Habitat Notes : This site is on the eastern edge of the Faure Sill abutting the mainland.

Activity or Impact Noted: A camping site and launching area is almost 300 metres from this site. Fishing occurs off the end of the jetty, 100 metres from this site.

Video reference:
Slide reference:

Aerial ref:
Photo reference:

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SITE AND HABITAT DATA

Site No. SB146

Name: Inshore Gladstone

Date: 19.4.96 **Time:** 1310 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : O/cast **Sea:** Moderate **Water Depth:** 3.5m **Water Visibility:** 3.5m

Land marks / Site Description: First line of habitat observed in sand inshore Gladstone, due west of jetty

GPS Lat 25° 57.155'S **GPS Long** 114° 14.185'E **Differential** no

Location of site with ref. to lat/long: On site.

Habitat Description: This site is the beginning of obvious habitat type west of Gladstone jetty. On sand substrate there is 60-80 % cover of fine filamentous species of algae (not seagrass sp.).

Dominant Species: **Algae:** Green alga *(Cladophora sp.)* observed growing in an anaerobic substrate, with the green alga species *Polyphysa sp.* semi-attached.

Other Habitat Notes : These beds appear very extensive to the north and south in water of similar depth.

Activity or Impact Noted: None observed.

Video reference: 190496/sb146/00.00.00-00.30.00/hv **Aerial ref:**
Slide reference: **Photo reference**:

SHARK BAY MARINE RESERVES MONITORING PROGRAM
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SITE AND HABITAT DATA

Site No. SB147

Name: Offshore Gladstone

Date: 19.4.96 **Time:** 1330 **Vessel:** Sirenia **Recorder:** D'Adamo

Weather : O/cast **Sea:** Moderate **Water Depth:** 3.7m **Water Visibility:** 3m

Land marks / Site Description : Site is approx. 3NM due west of jetty; beginning of true seagrass bed.

GPS Lat 25 56.943'S **GPS Long** 114 13.358'E **Differential** No

Location of site with ref. to lat/long: On site.

Habitat Description: This is the beginning of the true seagrass bed of 60-80% cover. East of this site substrate has a cover of a green alga as described at SB146. However, at this site there is a monospecific seagrass bed.

Dominant Species: **Seagrass:** *Amphibolis antarctica sp.*(leaf cover was not as dense as observed in Freycinet Inlet).

Other Habitat Notes: Beds appear to be extensive. This site is the eastern flat of the Faure Sill.

Activity or Impact Noted:

Video reference:
Slide reference:

Aerial ref:
Photo reference:

APPENDIX II

SALINITY/TEMPERATURE DATA

SITE	SB5	DATE	16-4-96	TIME	1103
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	35.46	24.05			
4	35.46	24.05			
8	35.46	24.05			
10	35.46	24.05			

SITE	SB18	DATE	16-4-96	TIME	~1535
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	36.53	25.20			
1	36.70	23.90			

SITE	SB10	DATE	16-4-96	TIME	1223
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	35.41	24.45			
1	35.41	24.45			

SITE	SB20	DATE	16-4-96	TIME	1603
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	37.07	24.50			
1	37.09	24.40			
2	37.02	24.25			
3	37.07	24.20			
4	37.07	24.20			
5	37.07	24.20			
5.5	37.07	24.10			

SITE	SB15	DATE	16-4-96	TIME	1405
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	36.08	24.35			
3	36.05	23.55			
6	37.01	23.50			
9	37.31	23.50			
12	37.63	23.50			

SITE	SB97	DATE	16-4-96	TIME	1735
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	39.24	23.81			

SITE	SB65	DATE	16-4-96	TIME	1435
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	35.89	25.00			
1	35.91	24.30			
2	35.91	24.10			

SITE	SB83	DATE	17-4-96	TIME	1030
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	35.46	24.85			
5	35.46	24.65			
10	35.42	24.65			

SITE	SB100	DATE	17-4-96	TIME	1040
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	23.40			

SITE	SB85	DATE	17-4-96	TIME	1220
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	35.41	No Data			
19	35.31	No Data			

SITE	SB101	DATE	17-4-96	TIME	1050
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	24.10			

SITE	SB80	DATE	17-4-96	TIME	1240
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	35.43	25.60			
1	35.43	25.55			
2	35.51	25.35			
3	35.51	25.25			

SITE	SB90	DATE	17-4-96	TIME	1100
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	35.53	25.00			
3	35.33	25.00			
5	35.33	24.80			

SITE	SB103	DATE	17-4-96	TIME	1400
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	36.70	25.10			

SITE	SB105	DATE	17-4-96	TIME	1215
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	36.07	24.50			

SITE	SB75	DATE	17-4-96	TIME	1450
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	35.68	25.00			
1	35.68	25.00			
2	35.68	24.85			

SITE	SB116	DATE	17-4-96	TIME	1500
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	38.82	24.60			

SITE	SB39	DATE	18-4-96	TIME	1130
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	23.90			

SITE	SB70	DATE	17-4-96	TIME	1545
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	35.91	25.60			
1	35.91	25.60			
2	35.89	24.50			

SITE	SB122S	DATE	18-4-96	TIME	1152
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	40.51	24.70			
1	40.91	24.10			
2	41.01	24.00			
3	41.01	24.00			
4	41.01	24.00			

SITE	SB35	DATE	18-4-96	TIME	0925
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	24.50			

SITE	SB45	DATE	18-4-96	TIME	1215
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	23.90			

SITE	SB38	DATE	18-4-96	TIME	1055
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	23.70			

SITE	SB40	DATE	18-4-96	TIME	1250
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	23.60			

SITE	SB125	DATE	18-4-96	TIME	1311
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	24.60			
1	>42	24.60			
2	>42	24.50			
3	>42	24.20			
4	>42	24.05			
4.5	>42	24.05			

SITE	SB131	DATE	18-4-96	TIME	1540
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	24.75			
1	>42	24.70			
2	>42	24.65			
3	>42	24.65			
4	>42	24.65			

SITE	SB50	DATE	18-4-96	TIME	1430
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	24.40			

SITE	SB134	DATE	18-4-96	TIME	1558
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	39.66	25.00			
1	39.81	24.90			
2	40.79	24.70			

SITE	SB130	DATE	18-4-96	TIME	1523
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	25.30			
1	>42	24.70			
2	>42	24.70			
3	>42	24.70			
3.5	>42	24.70			

SITE	SB134E	DATE	18-4-96	TIME	1604
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	39.91	25.00			
1	40.11	24.95			
2	41.71	24.40			
3	41.95	24.20			
4	>42	24.15			
5	>42	24.15			
7	>42	24.15			
9.5	>42	24.05			

SITE	SB60	DATE	18-4-96	TIME	1525
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	24.60			

SITE	SB133	DATE	18-4-96	TIME	1615
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	39.33	25.00			
1	40.61	24.75			
2	41.71	24.70			
3	>42	24.50			
4	>42	24.30			
5	>42	24.30			
6	>42	24.10			
7	>42	24.10			
8	>42	24.10			
9	>42	24.10			
10.5	>42	24.10			

SITE	SB55	DATE	18-4-96	TIME	1630
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
	No Data	24.90			

SITE	SB175	DATE	20-4-96	TIME	1500
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	No Data	25.20			

SITE	SB30	DATE	18-4-96	TIME	1735
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	40.54	23.90			

SITE		DATE		TIME	
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			

SITE	SB147	DATE	19-4-96	TIME	1250
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			
0	>42	25.75			
3	>42	25.75			

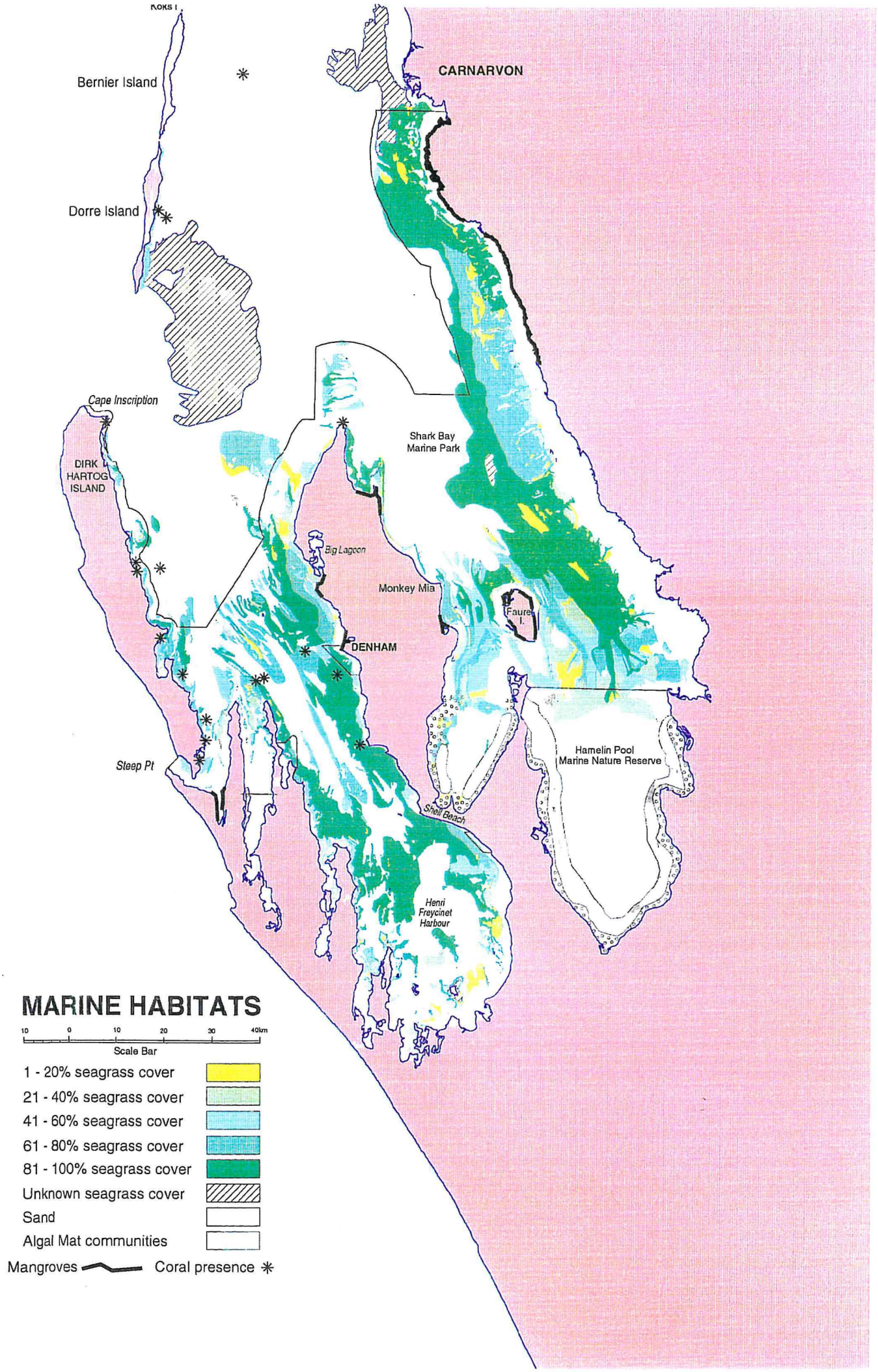
SITE		DATE		TIME	
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			

SITE	Denham Villas	DATE	19-4-96	TIME	1700
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			

SITE		DATE		TIME	
DEPTH (m)	SALINITY (pss)	TEMPERATURE (°C)			

APPENDIX III

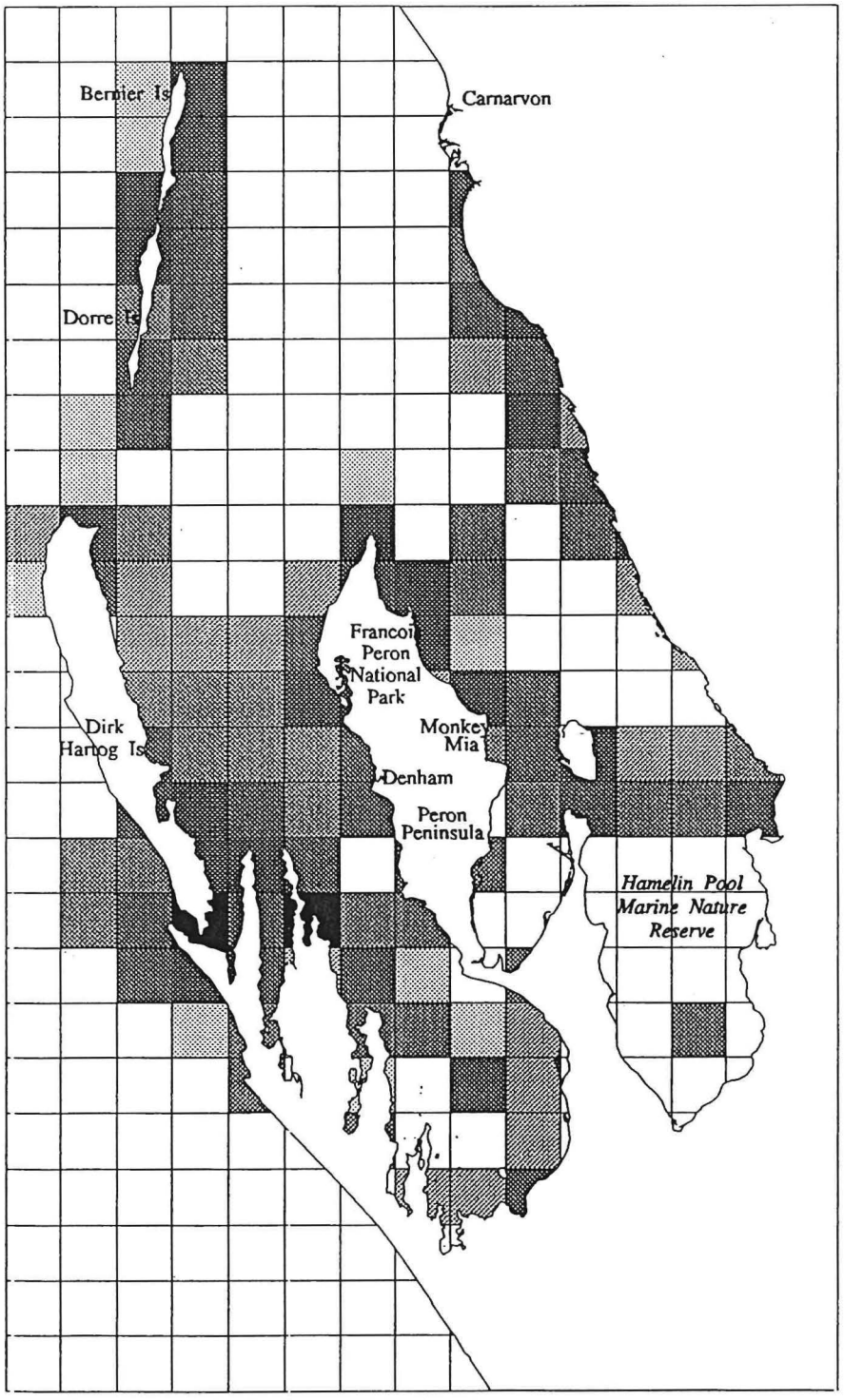
GIS HABITAT MAP


Bernier Island
Dorre Island
CARNARVON
Cape Inscription
DIRK HARTOG ISLAND
Shark Bay Marine Park
Big Lagoon
Monkey Mia
Faure I.
DENHAM
Steep Pt
Hamelin Pool Marine Nature Reserve
Shell Beach
Henri Freycinet Harbour
MARINE HABITATS
10 0 10 20 30 40km
Scale Bar
1 - 20% seagrass cover
21 - 40% seagrass cover
41 - 60% seagrass cover
61 - 80% seagrass cover
81 - 100% seagrass cover
Unknown seagrass cover
Sand
Algal Mat communities
Mangroves
Coral presence

APPENDIX IV

USER/ACTIVITY DATA

Total Activities* in the Shark Bay World Heritage Area



Number of Visits

- 1
- 1 - 5
- 5 - 15
- 15 - 40
- 40 - 91
- 91 - 205

Scale

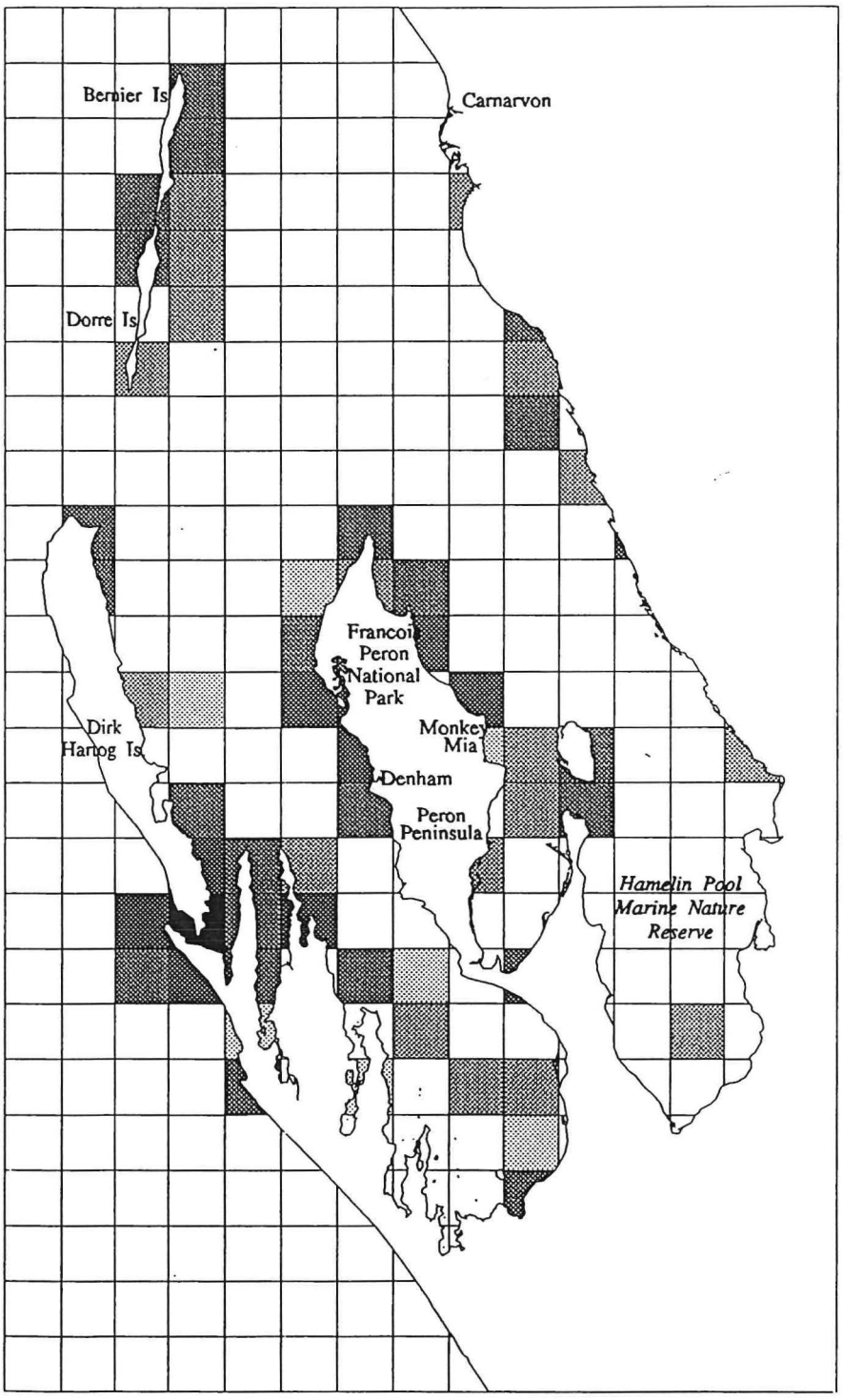
0 10 20 30 Km

1: 1300000

Data Source: CALM Shark Bay Visitor Survey, 1993

* Includes line fishing, spearfishing, diving and sightseeing.

Sightseeing in the Shark Bay World Heritage Area



Number of Visits

- 1
- 1 - 5
- 5 - 15
- 15 - 40
- 40 - 91

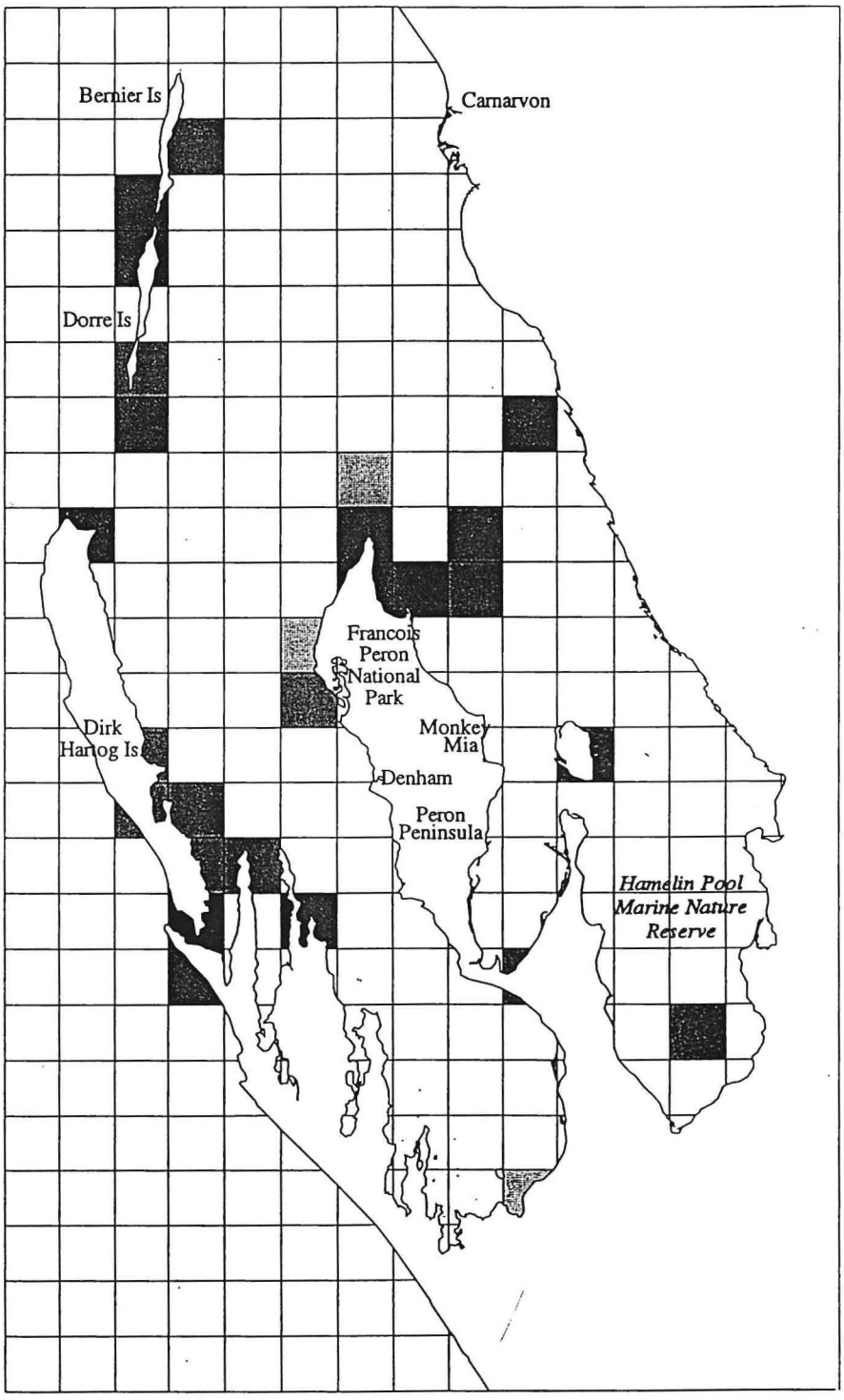
Scale

0 10 20 30 Km

1: 1300000

Data Source: CALM Shark Bay Visitor Survey, 1993

Diving in the Shark Bay World Heritage Area



Number of Visits

- 1
- 1 –5
- 5 –15
- 15 –40
- 40 –91

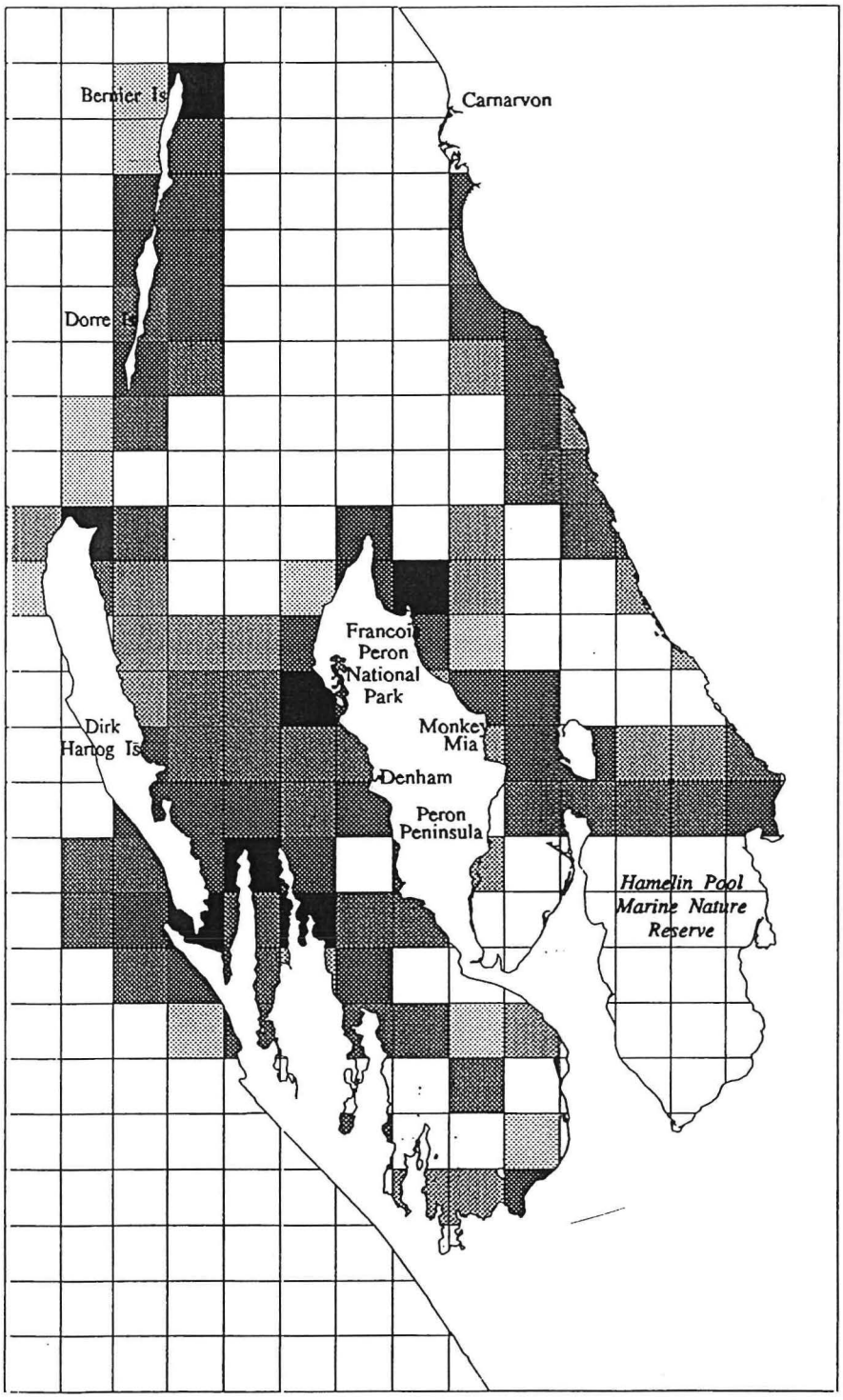
Scale

0 10 20 30 Km

1: 1300000

Data Source: CALM Shark Bay Visitor Survey, 1993

Line Fishing in the Shark Bay World Heritage Area



Number of Visits

- 1
- 1 - 5
- 5 - 15
- 15 - 40
- 40 - 91

N

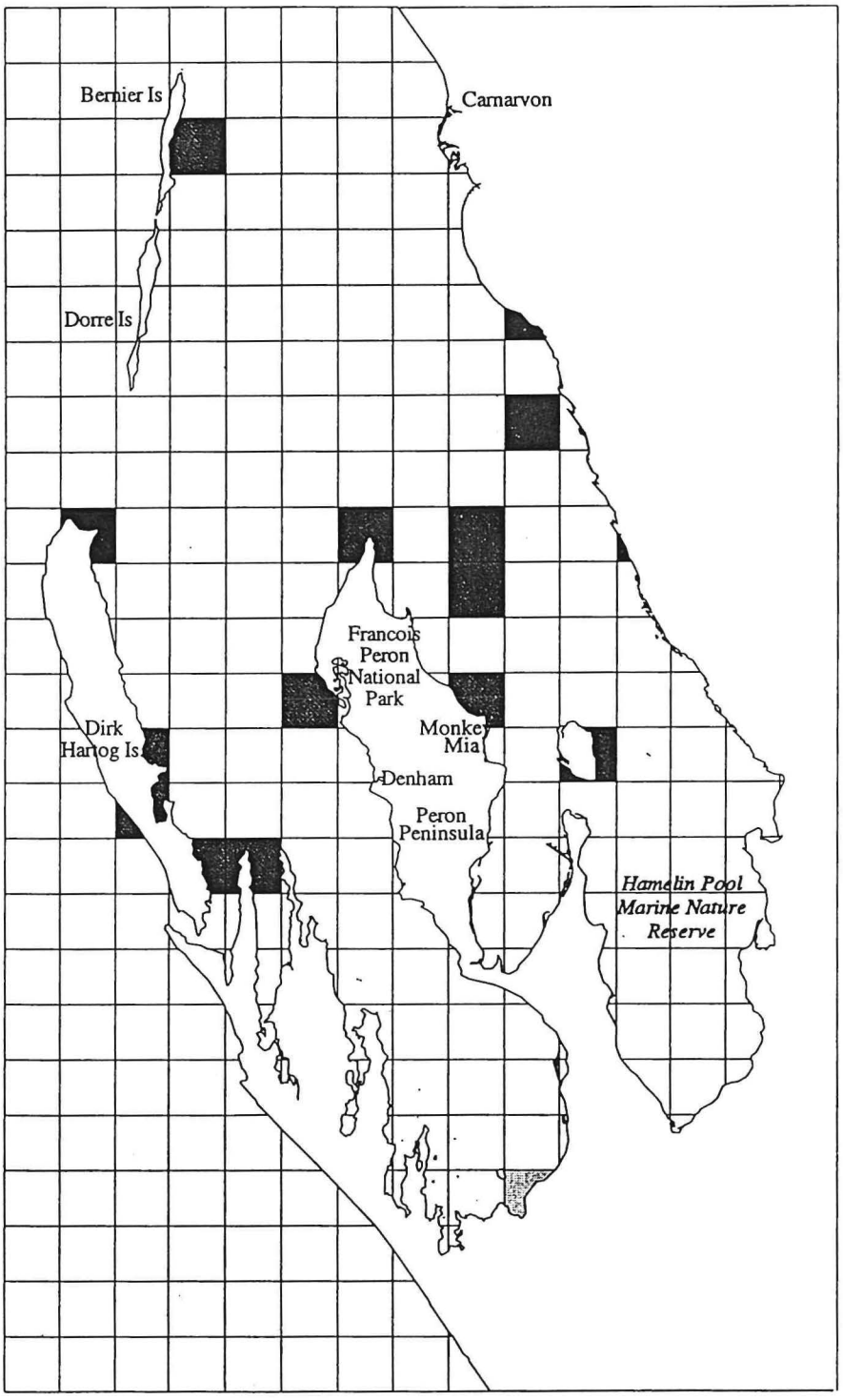
Scale

0 10 20 30 Km

1: 1300000

Data Source: CALM Shark Bay Visitor Survey, 1993

Spearfishing in the Shark Bay World Heritage Area



Number of Visits

- 1
- 1 –5
- 5 –15

Scale

0 10 20 30 Km

1: 1300000

Data Source: CALM Shark Bay Visitor Survey, 1993

APPENDIX V

MEDIA RELEASE

News

R E L E A S E

Department of Conservation and Land Management

18 April 1996

Shark Bay Marine Reserves to be Monitored

A Department of Conservation and Land Management team is carrying out preliminary work within the Shark Bay Marine Reserve to identify the impact of human activities in the area.

The survey this week marks the beginning of a comprehensive monitoring program that will examine long term changes to the area's Marine Reserves.

"To manage Shark Bay's Marine Reserves successfully, we need to establish a monitoring program that will give us information on long term changes to the key biological communities within the reserves and any undesirable trends resulting from human activities," team leader Greg Pobar said.

"We will also look at the natural attributes of the reserves and the impact of periodic events such as cyclones, invasion of predators, and natural variability."

The work will be carried out by CALM's Marine Branch, in collaboration with its Geraldton regional office and Gascoyne district office.

During the initial field survey, staff will select long term monitoring and control sites, determine the accuracy of existing habitat boundaries, and trial monitoring techniques. They will also look at the requirements for a larger scale survey planned for mid-year.

The CALM team will call on considerable local staff knowledge in relation to habitats, visitor usage patterns, contaminants, existing and proposed developments, recreational and commercial fishing activities and sea conditions in the area.

"Our observations will be made using remote video from the boat, divers and still photography at selected sites. A progress report will be produced, and a major field survey will follow in July or August of 1996," Mr Pobar said.

Media contact in the field: Greg Pobar ph (099) 481 208
Media contact in Perth: Dr Chris Simpson (09) 334 0105

APPENDIX VI

HYDRO-ACOUSTIC SIGNAL PROCESSORS

RoxAnn Report

News from MARINE MICRO SYSTEMS LTD — Autumn 1994

It really does that?

"Identify sea-bed material — *from an echo-sounder*? Pull the other one!"

That is typical of the healthy initial scepticism which we generally encounter when we start to tell customers about RoxAnn, our innovative and unique hydro-acoustic processor

So, after six years of operation, we felt it was time to set down the proof in print.

Just for the record, yes — RoxAnn really **does** identify sea-bed material types from your existing echo-sounder!

Probably the most remarkable thing about the system, though, is that it can be absolutely as accurate, or as discriminating, as you want it to be.

In theory, it can recognise over 16 million different combinations of ground types. In practice, naming the ground types tends to be the limiting factor, and RoxAnn is rarely required to discriminate between more than 10/15 types.

RoxAnn is also capable of differing user classifications in very specialised survey work — for example, looking exclusively for the presence of sea-grass or spillages of drilling mud.

On the other hand, as you can read elsewhere in *RoxAnn Report*, RoxAnn is also capable of unparalleled survey sensitivity — between healthy and dying sea-grass, for example, or mud, sand and silt.

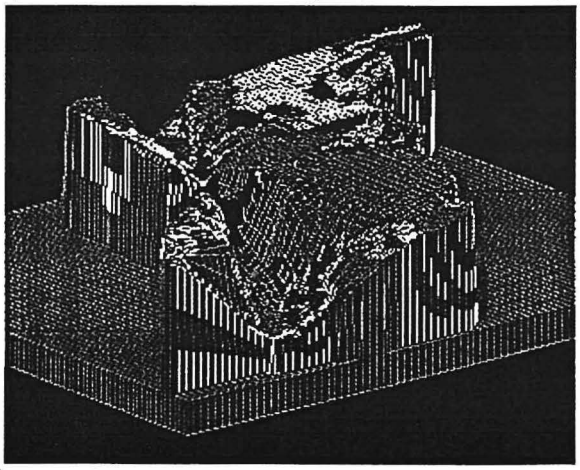
As you will see for yourself on these pages, RoxAnn has many practical applications in almost all the subsea industries, is practical and easy-to-use, and is now available on a world-wide basis.

If you are in the UK, you can now get further information on RoxAnn by contacting us in our new Scottish HQ — see below for details. Enquiries from overseas customers will be re-directed to one of our international agents.

We look forward to introducing you to what we at MMS believe to be one of the most significant new developments in hydrography for a very long time!

Andrew Williamson, B.Sc. B.Eng.
Managing Director

RoxAnn is an innovative and unique hydro-acoustic processor which, when connected to a standard echo-sounder, will discriminate between sea-bed material types and output the data acquired in a quantitative format ready for computer analysis. RoxAnn data can be acquired at an average speed of 15 knots.



This data can be logged and processed by a number of different types of user software to identify particular sea-bed types over a large area.

3D colour graphic image showing sea-bed material types by colour and depth by profile

At-A-Glance Specs

RoxAnn represents a genuinely significant advance in echo-sounding technology.

- ✔ ***Ease of fitting***
  It can be fitted to your existing echo-sounder without affecting its operation, and requires no additional work through the hull
- ✔ ***Remote sensing***
  So no post-disturbance distortion of data
- ✔ ***Unambiguous numerical classification***
  RoxAnn's data is directly processable, rather than readings from subjective descriptions
- ✔ ***Objective***
  Unlike divers' reports!
- ✔ ***Portable for post-processing***
  Data can be saved on disk so ground truth results can be assimilated, batched and colour coded
- ✔ ***Different user classifications***
  RoxAnn simply gives you as much — or as little — information as you want.
- ✔ ***Real-time performance***
  Results are displayed as they happen
- ✔ ***Tried and tested***
  Over 300 users worldwide
- ✔ ***Fully patented throughout the world***
- ✔ ***Low cost***
- ✔ ***Not dependent upon depth, vessel speed or sea state***
  See page three for heroic and living proof!

Marine Micro Systems Ltd ❖ The Innovation Centre ❖ Offshore Technology Park ❖ Aberdeen
AB23 8GX ❖ Scotland ❖ United Kingdom ❖ Tel +44 224 707737 ❖ Fax +44 224 827290

US Navy comes on board

This summer saw MMS introduce a revised version of an intensive, two-day RoxAnn appreciation seminar for system users. The most recent of these was presented to NAVOCEANO personnel at the Stennis Space Center in Mississippi by MMS managing director Andrew Williamson and RoxAnn inventor David Burns, following NAVOCEANO's RoxAnn system purchase earlier this year.

Ten crew members from the US Navy hydrographic vessel *USNS Littlehales* attended the seminar, and the group included electronics engineers, technicians, data analysts, geologists, physicists and hydrographers.

"The delegates had heard the theory of RoxAnn, and, as often happens with such an innovative product, were initially fairly sceptical." recalls Andrew.

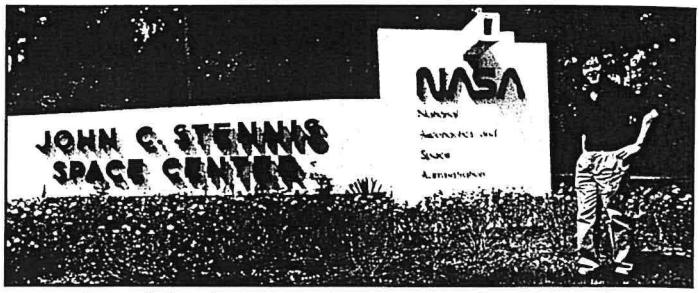
"To ensure that we provided the delegates with sufficient information to get the most out of RoxAnn, the Aberdeen team created a fairly intensive seminar which included both classroom work and a practical field trip.

"The subjects which we covered ranged from the basic principles of sea-bed classification through to data interpretation, installation, maintenance and general operation."

The superb facilities provided by NAVOCEANO included personal computers for each delegate and the use of a hydrographic survey launch for the field trip. Once RoxAnn was fitted to the Odom Echotrac on board this vessel, the field trip around the Gulfport, Mississippi area was under way.

The outward test runs produced some impressive discrimination of the sea-bed in the mud basin, and the data acquired clearly distinguished between different mud bottoms, living growth and sandy gravel, with accurate, identical discrimination over the same area on the return runs.

Such seminars can be delivered by MMS anywhere in the world wherever operations personnel need to evaluate or familiarise themselves with RoxAnn's capabilities.



A sign of the times? MMS managing director Andrew Williamson reports for duty at a recent RoxAnn training seminar for NAVOCEANO in Mississippi

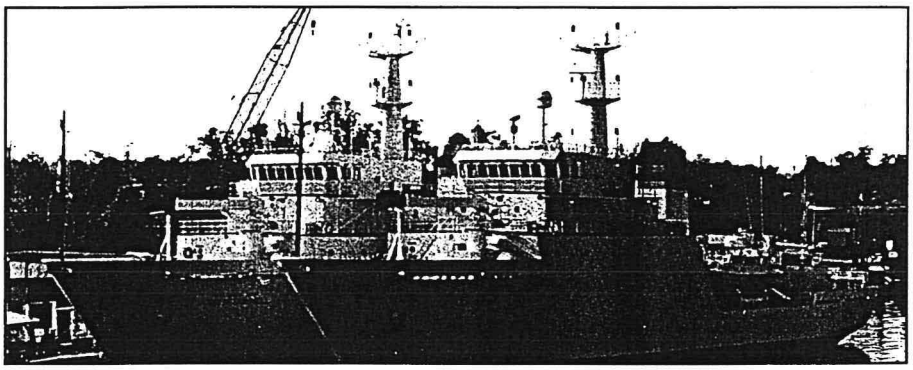
"The exercises have the benefit of giving both potential and existing customers an appreciation of the range, practicality and sophistication of RoxAnn's capabilities." comments Fiona Ogilvie of MMS.

"In addition, they offer an opportunity to negate the potential for down-time caused by lack of either operational experience or familiarity with the system."

MMS would like to record its grateful thanks to Jim Glydewell of NAVOCEANO for hosting the seminar, and also to Richard Byrd and Brian Apsey of Odom Hydrographic Systems Inc (US agents for RoxAnn) for their invaluable assistance.

The final word must surely rest with Jim. "I feel that our people now have the skills and capabilities for collecting quality bottom classification data." he reports.

NAVOCEANO is in the process of taking delivery of a further 10 RoxAnn systems.



The USNS Littlehales — now fitted with the RoxAnn system

STOP PRESS

As well as delivering company-specific RoxAnn training seminars, MMS is running an open-access RoxAnn appreciation seminar in Aberdeen on 14-15 December 1994.

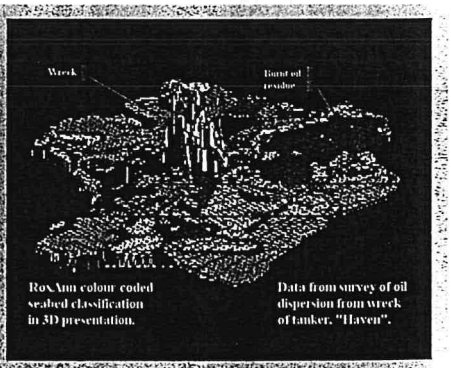
Readers can contact Fiona Ogilvie of MMS in Scotland for details.

RoxAnn in action

When the oil tanker *Haven* went down in 1991 in relatively shallow water off Genoa, it was decided to track the dispersion of the burnt oil residue which had gone down with the vessel.

The state of the local currents led the Italian authorities heading the clean-up to believe that the residue would lie to starboard of the wreck, but a RoxAnn survey soon after the event clearly revealed that the substantial deposits in fact lay unsuspectedly on the other side of the remains of the *Haven*.

The entire area was surveyed and the results confirmed by sampling, and RoxAnn therefore ended up playing a lead role in what turned out to be a very efficient clean-up operation following such a potentially disastrous incident.



Survey of wrecked tanker 'Haven'

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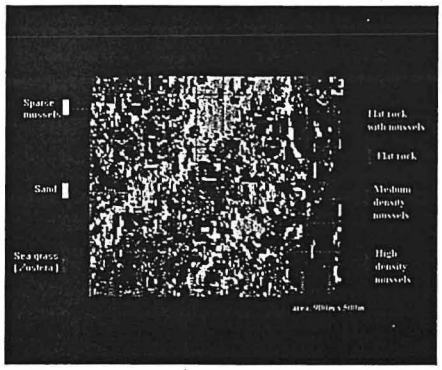
Quote — "In combination with bathymetry and other acoustic investigation, the RoxAnn system provides qualitative and detailed sea-bed texture and environmental sea-bed mapping."
Ola Oskarsson



Oresound environment impact study

'Strait' To The Point

The proposed construction of a bridge across the Oresound Strait to link Denmark and Sweden has aroused great controversy in both countries because of the environmental considerations.

An essential part of the influx of ocean water in the Baltic passes through the strait, and the environmental lobby has succeeded in convincing both governments that the hydrography, biology and geology of the strait must not be affected by the proposed bridge.

As a result, hydrographic surveyors working on the project had to source new tools for monitoring changes in ecology and biomass in the area, and RoxAnn was chosen for intensive trials by Marin Matteknik AB.

The test survey was successful, and a contract for enduring environmental sea-bed studies using RoxAnn has since been awarded to the company.

"It was concluded that the RoxAnn data had high precision since the repeatability of data was consistently high and video line inspection visualised the results." concluded Marin Matteknik President Ola Oskarsson.

"To our judgement, the correct use of the RoxAnn system in combination with conventional survey methods has the potential to make a significant improvement of the possibility to map the Oresound Bridge corridor."

Taking it to the limit

1994 has seen at least two RoxAnn performance records tumble in spectacular style, thanks to the dedication (*or should that read "recklessness"?*) **of Marine Micro Systems directors Andrew Williamson and David Burns.**

Until August, conventional wisdom held that RoxAnn would deliver accurate results up to a respectable vessel speed of around 15 knots.

MMS speed-freak Andrew, however, drove a metaphorical horse and cart through that impressive statistic on a recent test run in the Biscayne National Park, Florida.

"We were operating from a cabin cruiser — *sadly not mine* — in shallow water which never exceeded five or six metres" reports Andrew "and we decided gradually to push up the speed beyond 15 knots.

"To everyone's astonishment and delight, even at 25 knots we were still getting good data!"

As Andrew points out, this remarkable speed performance has more than mere academic interest. For a pre-site survey, for example, a lot of ground could profitably be covered in a very short space of time.

MMS would like to record its thanks to Larry Murphy and Timothy Smith of the National Park Service's Submerged Cultural Resources Unit for their assistance on this record-breaking trip.

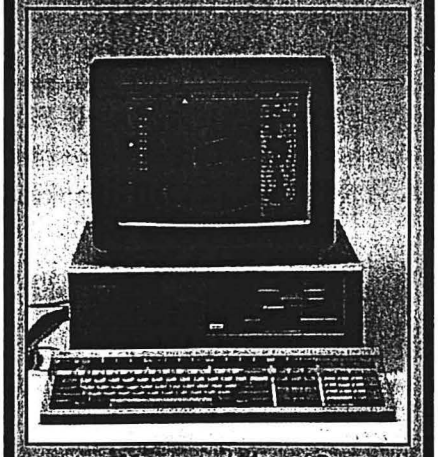
Equally dramatic (although perhaps marginally less enjoyable) was David Burns' selfless heroism in a hurricane west of Shetland in January.

We have eye-popping video evidence of a white-knuckled David on the fishing vessel *Amadeus*, being tossed around in 50ft waves, but with RoxAnn impervious to the conditions and still recording good data.

Vessel speed and sea state no problem — well done our intrepid testers!

PS. RoxAnn is equally impressive in its depth parameters. Dependent upon the power of the echo-sounder, it can typically operate from between one and over one thousand metres. A dual frequency system is also available.

Simple, pc based real-time data...


courtesy Marimatech Aps of Denmark

It is spectacular enough when RoxAnn discriminates between sea-bed materials, but a recent survey on Mediterranean sea-grass revealed data of truly remarkable sensitivity.

RoxAnn *in action*

The survey was concerned with identifying the spread of sea-grass over a large area of sea-bed. Sea-grass is commonly referred to as 'the lungs of the sea', and environmentalists wanted to survey the area to record whether it was standing up to pollution and human impact, or was in a state of decline.

In essence, they simply wanted to know — "is the sea-grass alive or dead?" but, in the event, RoxAnn gave them much more than that.

By looking at different returns during ideal tide conditions, RoxAnn was able to discriminate between no less than four different states of sea-grass — new growth, mature, dead and dying.

As a result, the environmentalists could chart the relative health of the sea-grass with unparalleled accuracy and sensitivity.

The twentieth century has already seen cartographers chart the world's landmass types in unprecedented detail and with great accuracy, with RoxAnn's unique sensitivity, hydrographers can now look forward to being able to build up equally precise records of the world's sea-floor.

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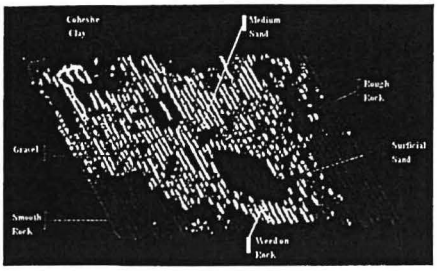

Colour coded track presentation; data taken from a survey of an offshore installation site (Courtesy Sea Information Systems Ltd)

"RoxAnn is exactly the kind of innovative product which will enhance Scotland's already considerable reputation as an international centre of excellence in subsea technology.

Scottish Enterprise is pleased to welcome Marine Micro Systems Ltd to one of Europe's most advanced research and development locations, the Aberdeen Offshore Technology Park."

Kourosh Bassiti, Head of Energy, Scottish Enterprise National

RoxAnn *in action*

MMS was recently invited to put RoxAnn through its paces for the Canadian Hydrographic Society. The test venue was a major Canadian harbour, and the exercise was expected to be pretty much a routine look at mud, sand and silt, with the results to be published in a paper later this year.

To the immense surprise of the port authorities, however, a high-speed, one-day RoxAnn survey identified no less than six different ground types including pebble beds, some rock and, most spectacularly of all, one-metre boulders whose existence nobody had suspected until then!

The RoxAnn survey also, of course, identified areas which we now know to be clear of these boulders.

Another classic example of the value of RoxAnn's sophistication even on high-speed surveys.

About Marine Micro Systems Ltd

1994 saw RoxAnn's operational base move to Aberdeen, Scotland, one of the world's leading centres of excellence in sub-sea technology.

Fast-growing sub-sea specialists Marine Micro Systems Ltd markets, services and distributes the system, and other products, from its high-tech Aberdeen base on a worldwide basis.

Fiona Ogilvie, who has responsibility for sales and marketing at MMS, is aiming to concentrate heavily upon further internationalising the company's services.

"We are currently actively opening up new export markets in defence, dredging and environmental surveys, and expect a number of additional overseas agents to be appointed in the near future." she says.

At the same time, MMS has embarked upon an extensive research and development programme — "Just watch this space." she promises.

RoxAnn Report will keep readers informed on the ambitious programme of commercial and technical developments as they unfold over the next few months, but prospective customers or agents can contact Fiona at any time for an update on progress.

MMS services

- ✔ *Manufacture, servicing, distribution and marketing of RoxAnn*
- ✔ *Delivery of RoxAnn familiarisation seminars*
- ✔ *Product rental*
- ✔ *Engineering field support*

RoxAnn applications

- ✔ *Coastal engineering*
- ✔ *Defence*
- ✔ *Dredging*
- ✔ *Environmental monitoring*
- ✔ *Fisheries habitat research*
- ✔ *Oil and gas hydrographic surveying*
- ✔ *Sea-bed engineering*

Diary

An extensive programme of RoxAnn demonstrations is planned at international exhibitions, conferences and workshops in coming months. Some of the more prominent events include —

13-15 September 1994	**HYDRO '94, Aberdeen**
4-6 October 1994	**IOCE, Aberdeen**
26-29 October 1994	**Techno-Ocean 94, Kobe City, Japan**
22-24 November 1994	**AUSMARINE 94, Freemantle WA**
14-15 Dec 1994	**Open-access RoxAnn appreciation seminar, Aberdeen**
27-29 March 1995	**RoxAnn workshop/seminar for Benthic ecologists, sponsored by the Estuarine Coastal and Shelf Sciences Association, to be held at The University of Wales, Bangor**
28-31 March	**International Maritime Defence Exhibition and Conference, Greenwich**

Details of these, and other events are available from Fiona Ogilvie of MMS in Aberdeen.

Patents

RoxAnn enjoys worldwide patent protection.

Your RoxAnn agent is :

Marine Micro Systems Ltd
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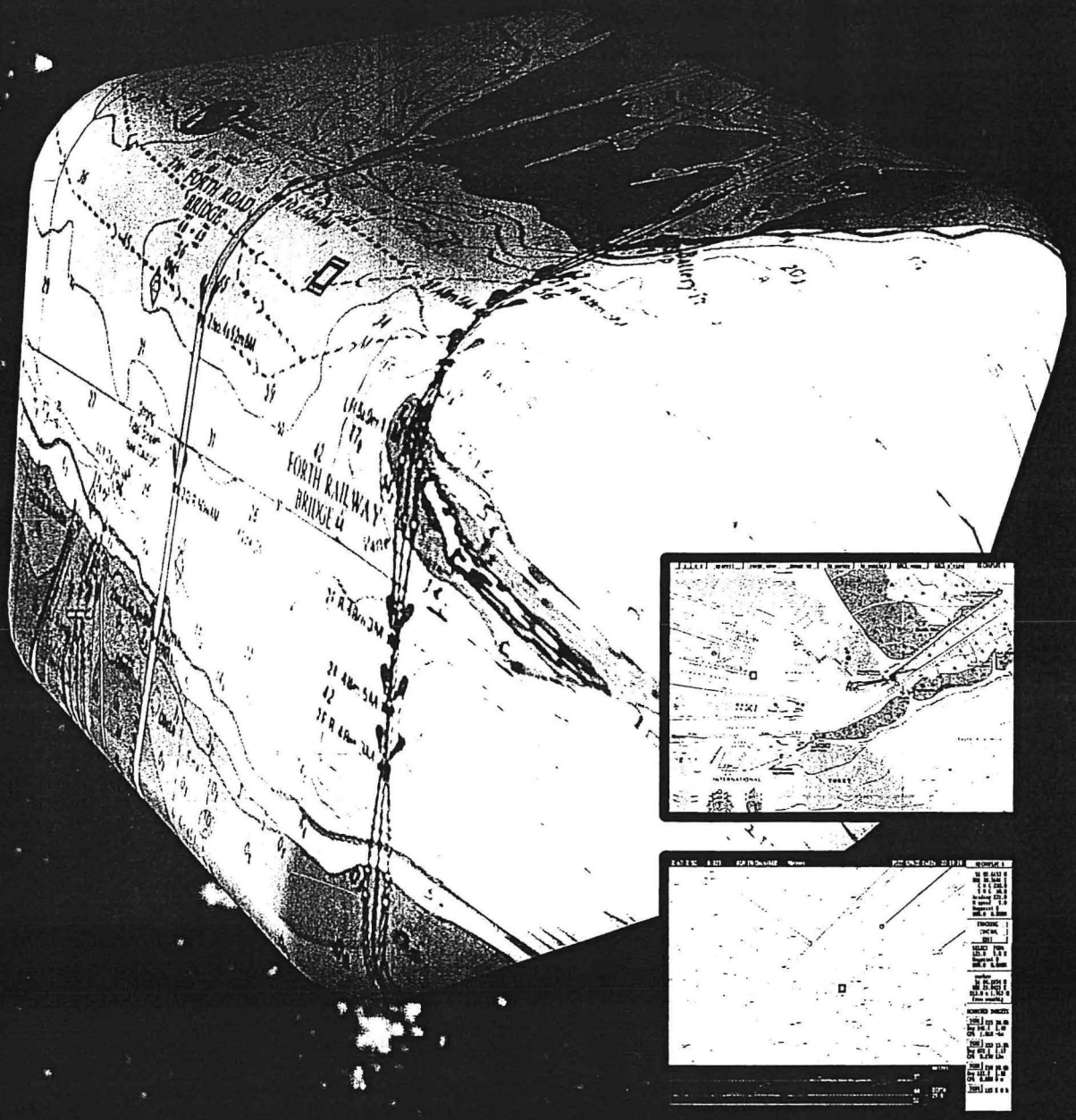
RoxAnn Report is produced by the marketing department of Marine Micro Systems Ltd, a member of the Stenmar Ltd group of companies

Microplot 6

Electronic Charting and Plotting

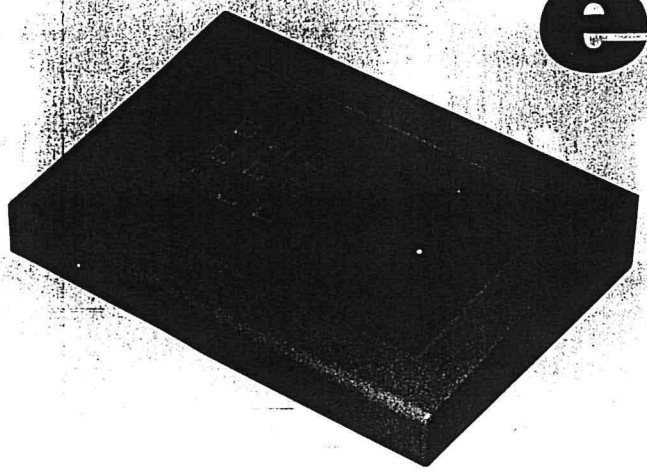


Safety Through Precision

SIS

Sea Information Systems

Sea Information Systems Ltd (SIS), *is a company specialising in marine software system design & development. Founded in 1984, the Company quickly built up a reputation for providing effective software solutions in the demanding proving grounds of the fishing, dredging and offshore oil markets. Today, SIS is a leading innovator in designing software systems for application in a wide variety of marine operations.*



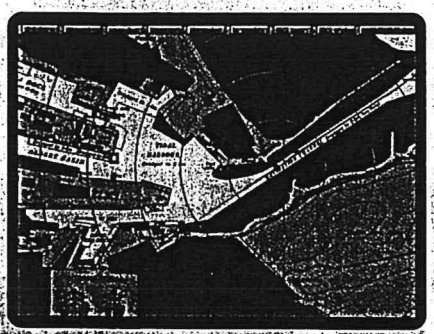
easy to use

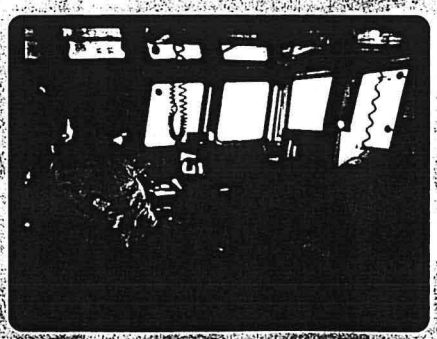
The new back lit splashproof Keypad and combined trackerball has been designed to make Microplot simple to use. All Microplot's functions can be accessed by the menu windows. As there are many of these and only a few keys on the keypad, Microplot allows you to program the keys to carry out functions that you may use frequently.

programmable buttons

The latest Version 6 of Microplot allows "Point and click" operation of the program with on screen 3D buttons, programmable tool bars and other features you may expect to see in this kind of graphical environment. These user friendly methods of operation are enhanced by the professional hot keys which allows an operator to drive the system with unrivalled speed and flexibility.

dual screen capability





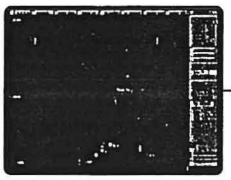
Allows control to be interchanged between two separate work stations using the same PC giving a significant reduction in hardware costs and space requirement to a multi-user system.

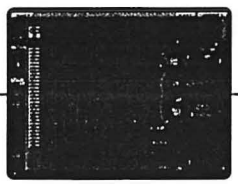
electronic chart data bases

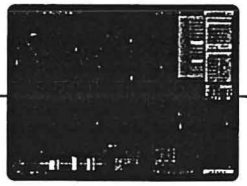
Microplot handles both raster and vector chart formats. Presently these formats include ARCS and NOAA. Once the IHO has standardised its vector format Microplot will be compatible with this as well. All charts can be displayed at varying ranges with palette and brightness controls available.

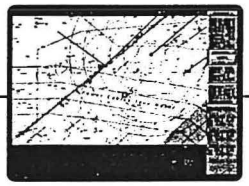
corrections and services

Sea Information Systems is an approved ARCS licensee. The Hydrographic office supplies ARCS corrections on CD ROM on a weekly basis, and with a few key presses, these corrections may be loaded onto the computer. When a chart loads it does so in its original form, and the corrections are overlaid on top. Within Microplot functions are available which allow you to highlight the corrections and view the chart with or without them being displayed. Corrections are logged and can be inspected in the traditional manner.









interfacing

With the correct hardware Microplot will interface with up to 10 different input/output devices simultaneously. The system can be set to automatically switch devices in the event of failure and give an audio and visual alarm. Offsets may be applied to account for sensor positioning and all geodesy shifts are carried out automatically. To comply with ECDIS standards these interfaces must be made through an optical isolator box. Sea Information Systems design and manufacture such a unit.

general applications

The Microplot system has been developed for many years now and has been supplied to hundreds of separate and permanent installations world-wide, including dredgers, survey ships, oil rigs, merchant ships, SBM's and fishing vessels. In addition the navies of France, Sweden, Singapore, as well as the UK, all use SIS software systems.

Workboat - The new Microplot system suitable for smaller working vessels.

Standard - Continuing to provide and improve video plotting systems for the fishing industry.

Survey - A software package designed for marine survey, bathymetry, and hydro-acoustic & dredging operations.

Mariner - A navigation system integrating and displaying information from ARPA radars, echo sounders, auto pilot, positional receivers and electronic charts (Vector and ARCS).

Rigmove - Navigation software for rigmove and telemetred tug management applications used by a number of different offshore companies.

Mooring - A specialised version, approved by DNV, for the control and monitoring of floating storage tankers moored to production buoys.

Office - Chart plotting software used for planning and replaying operations, for all versions.

system requirements

The minimum requirement is a 486 DX2 66, with 8 Mb of Ram, SVGA screen, CD ROM (for ARCS) 500mb hard disc, with an Expanded Memory Management system and Dos 5.0 or above operating system. The more RAM you have the more vector information you can display on screen. With 4 mb RAM available for Microplot you could show 200,000 vector co-ordinates.

Sea Information Systems

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Tel: +44 1224 621326
Fax: +44 1224 621393
URL: http://www.microplot.co.uk
e-mail: seainfo@sextant1.demon.co.uk
Compuserve 100 726.3110

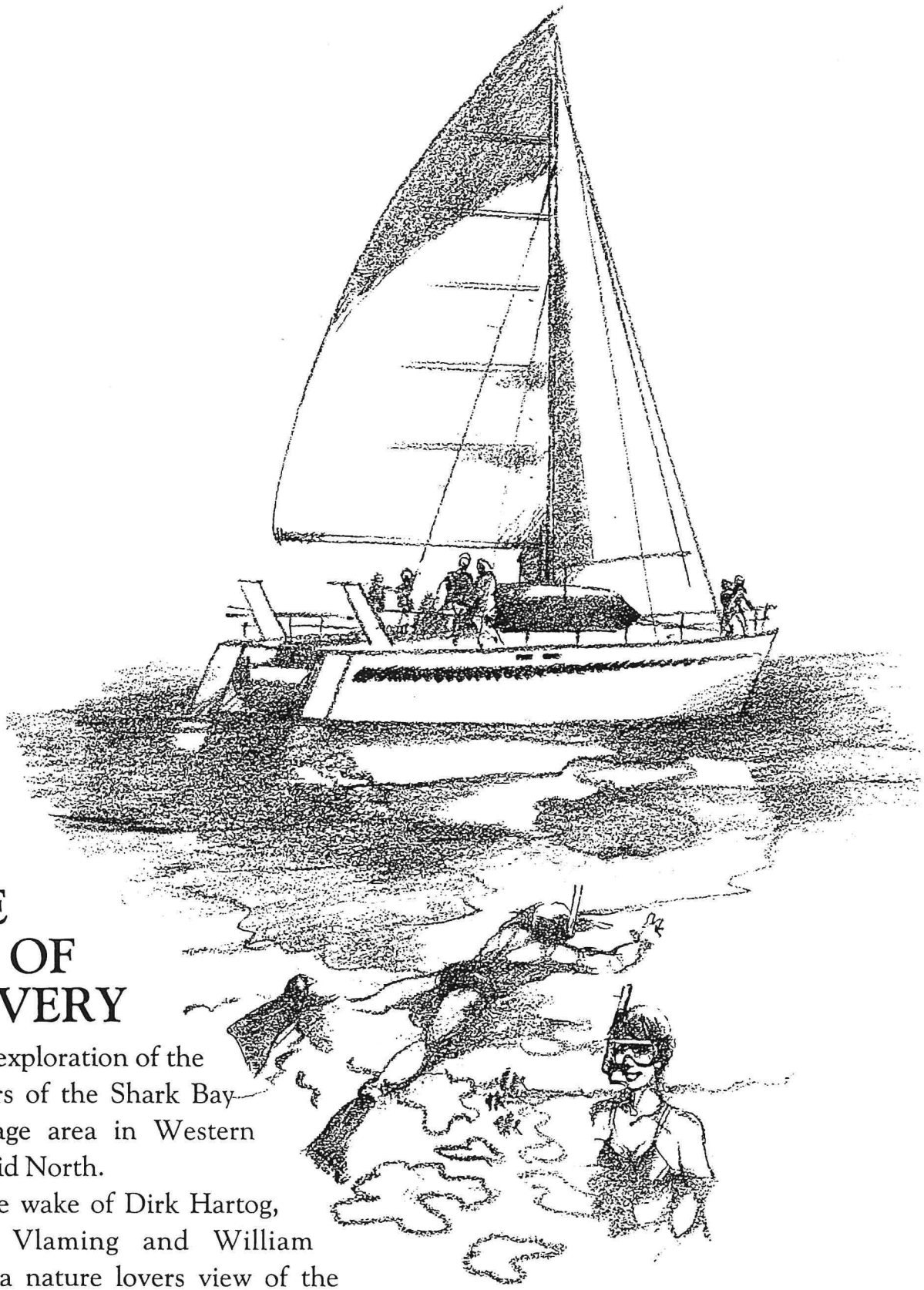
AGENT:

APPENDIX VII

NOTES ON THE VESSEL "JAMES SCHEERER"

SHARK BAY UNDER SAIL

The ultimate sailing expedition

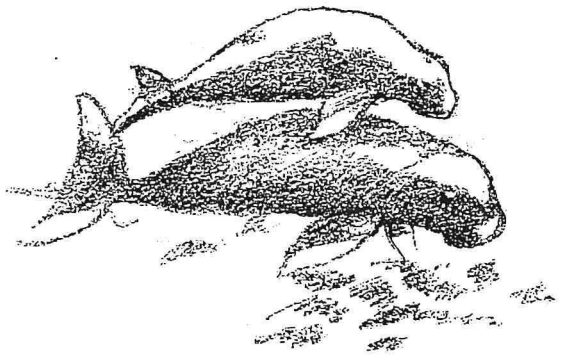


IN THE SPIRIT OF DISCOVERY

A sailing exploration of the pristine waters of the Shark Bay World Heritage area in Western Australia's Mid North.

Sail in the wake of Dirk Hartog, Willem De Vlaming and William Dampier for a nature lovers view of the unique marine and bird life that abounds in this very special place on earth.

SHARK BAY UNDER SAIL



IN THE SPIRIT OF DISCOVERY

Join us aboard the sailing catamaran *James Scheerer* and discover why Shark Bay captivates those fortunate enough to visit the region.

The voyage combines the thrill of sailing with exploration of this World Heritage Area.

The environmental focus of your cruise will introduce you to Shark Bay's bio-diversity as well as offering the chance to contribute in a practical way to conservation research as you encounter a bewildering array of marine life.

James Scheerer is a 12.5m motorsailing catamaran with an airy "tropical modern" accommodation layout, providing for both twin and double bunking in separate cabins.

The clear waters of Shark Bay offer excellent sailing conditions for experienced sailors and non-sailors alike, enhanced by the stable sailing platform of a catamaran.

All voyages will involve a degree of marine monitoring, a feature that will not only add to the appreciation of the region by those aboard but will assist in establishing baseline studies of the long-term ecological sustainability of Shark Bay.

On board is a substantial library of reference books featuring information on both terrestrial and marine flora and fauna, combined with the crew's local knowledge, a thorough interpretation of Shark Bay's marine bio-diversity is assured.

Embarking from Denham – the main town of the Shark Bay World Heritage area, each voyage is flexible allowing for individual interests and weather conditions.

A TYPICAL EXPEDITION:

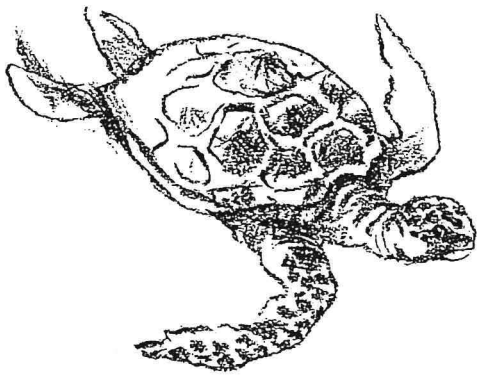
DAY 1: Sailing due west for Dirk Hartog Island we visit Egg Island – as the name suggests a rookery for numerous gulls and terns, also the site mined for Guano in the mid 1800s. Then protected by a garrison of soldiers at Quoin Bluff. A stroll through the remains of their camp will enthuse those with a love of history. Green turtles can be seen feeding below the tip of the bluff.

After lunch, we sail up the east coast of Dirk Hartog Island recording the movement of dugong. Late afternoon finds us at anchor at Sandy Point, a Sanctuary Zone of spectacular shallow corals. Snorkel or drift over the coral in our glass bottom dinghy. The evening presents an opportunity to get to know your fellow passengers and crew, peruse the charts, plan tomorrow's events and discuss the discoveries of the day.

DAY 2: As dawn breaks take a morning swim or a beach walk along the windrows of coral washed up on shore which tinkle like broken china underfoot.

After breakfast we weigh anchor, cruise south along the inside of Dirk Hartog Island past the homestead and into Useless Inlet between Bellefin and Heirisson Prong. Identify the sea grasses that are fundamental to the geology of Shark Bay. Explore the rolling sand dunes of Bellefin that sheer away at 75° angles or sit quietly in a stand of tamala rose and watch the prolific bird life.

As we leave the peaceful inlet, relax on the bow nets of *James Scheerer* to watch the bottlenose dolphins riding the bow pressure wave.

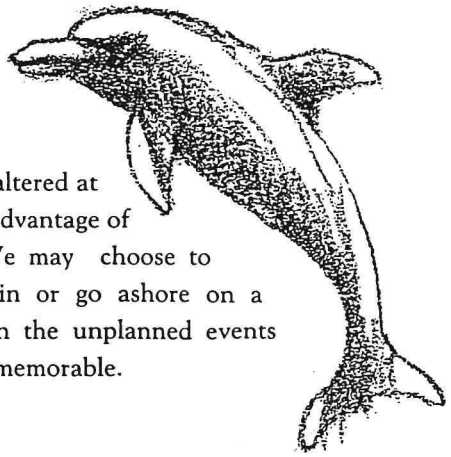


Evening will bring us past the sheltered shoreline of Heirisson prong, south of Friday Island with the lights of Useless Loop off to the west.

DAY 3. Discover the deep reaches of Henry Freycinet Harbour, a myriad of tiny islands, many encircled in limestone reefs – a secure haven for mari birdlife.

Enjoy an on-shore excursion, beachcombing along the intertidal flats or spotting marine life from the mast mounted crowsnest. Plenty to talk over during our evening de-brief.

DAY 4. The return journey, we sail north along the pristine coastline past Nanga, Goulet Bluff and spectacular Eagle Bluff to disembark at Denham mid afrernoon.



ALTERNATIVE ITINERARIES:

Our itinerary can be altered at very short notice to take advantage of a special opportunity. We may choose to follow a party of dolphin or go ashore on a deserted beach. It's often the unplanned events that prove to be the most memorable.

ALTERNATIVE ITINERARIES Cont.

Subject to weather our voyage may take us through South Passage where we can snorkel over clam shells and egg cowries. To Steep Point and the Zuytdorp Cliffs, up the western side of Dirk Hartog Island to watch hump back whales in their migration south. A landing at Cape Inscription – the site of Dirk Hartog's landing in 1616.

Or sail north from Denham along the remote and beautiful red cliffs of Peron Peninsula, past Cape Leseur, through schooling manta rays to visit derelict pearling camps and for the diving enthusiasts – the wreck of the Gudrun.

Summer may find us at the Gladstone seagrass beds surveying dugongs, exploring Lharidon Bight and Hamelin Pool accompanied by the Monkey Mia dolphins as we glide past Cape Rose and Herald Bluff.

COST 4 DAY EXPEDITION – PER PERSON $685

INCLUDES:–

- 4 day (3 night) sailing expedition of Shark Bay in shared twin or double bunk accommodation.
- All meals – from lunch, on day one.
- Services of a fully experienced crew.

REFRESHMENTS: Tea, coffee and soft drinks available at all times. Guests are invited to bring a supply of their favourite alcoholic beverage if they wish.

James Scheerer is available for private charter or scientific expeditions.

SHARK BAY – WESTERN AUSTRALIA

The Shark Bay World Heritage Region is often described as one of the World's very special places.

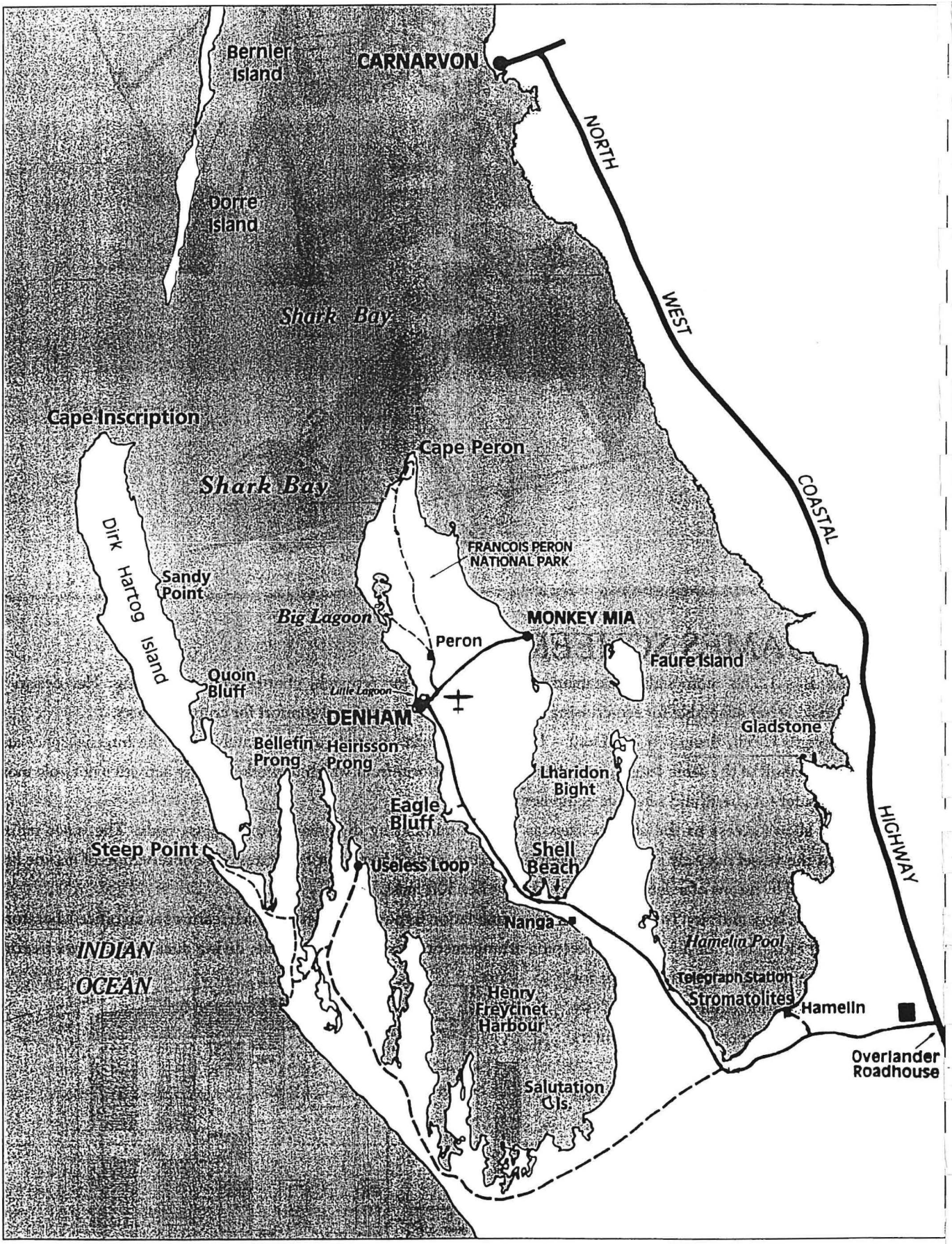
Covering an area of about 22,000 square kilometres of which half is covered by a huge W shape bay with a coastline of approximately 1,500 kilometres. It's this bay with its bountiful marine life that we will explore.

The first known landing of European man on Australian soil took place in October 1616 when Dutch sea captain Dirk Hartog dropped anchor in the shelter of a large island which now bears his name, leaving behind a pewter plate recording his visit.

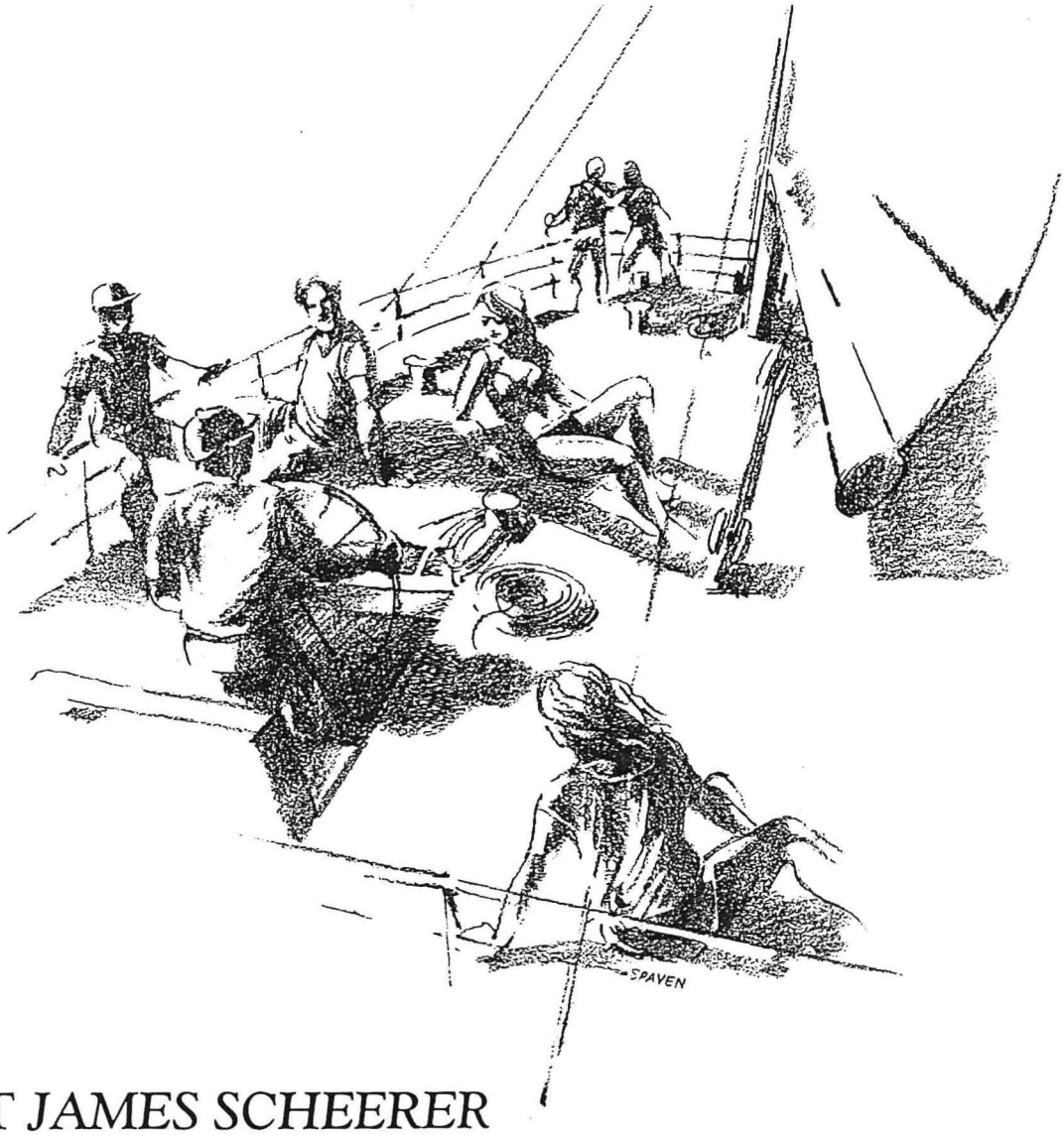
Hartog was followed by many navigators synonymous with the Western Australian coast, several French and English scientific expeditions followed – most notable – that of Francois Peron who visited in 1801 and again in 1803.

Join us as we follow in the wake of these great explorers. You will find Shark Bay very much as they left it.

MAP OF THE BAY



The town of Denham is 831km from Perth by good sealed road. The Shark Bay Airport (8km) is served three times each week by propjet flights from Perth (Skywest). Special fares available on application.



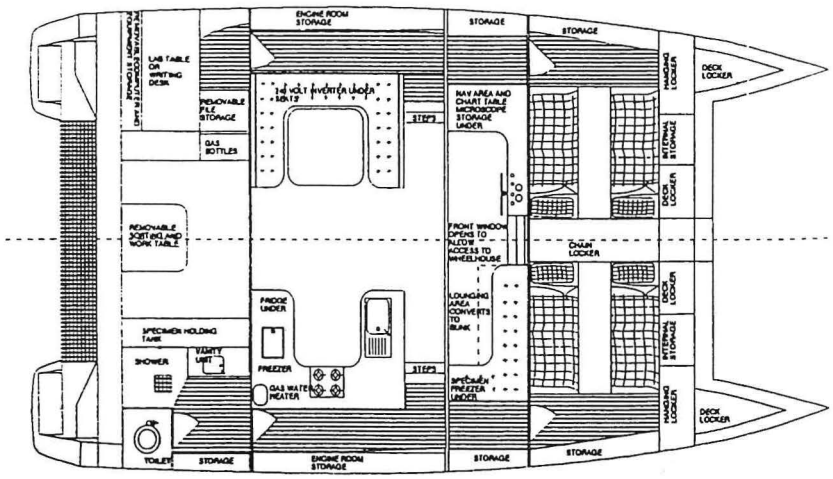
ABOUT *JAMES SCHEERER*

James Scheerer is a 12.5m motorsailing catamaran, purpose built for research, charter and sightseeing. Her design is multi-faceted, making her adaptable for eco-cruising and research with exceptional comfort for cruising guests.

Dimensions – length 12.5m, Beam – 6.7m, Draft – 1.02m. Twin hulls equate to approximately twice the internal space and deck area of a monohull of the same length, and offers a stable platform from which to work, making activities not only more comfortable, but safer for guests and sensitive equipment.

A shallow draft allows access to the shallow bays as well as minimising disturbance to seagrass beds. The quiet sailing characteristics of the vessel not only eliminates disruption to the environment, but facilitates close observation of marine life. Elevation is achieved by means of a detachable crowsnest on her 50ft mast.

James Scheerer has a large and airy 'tropical modern' accommodation layout, incorporating such features as an office/laboratory, specimen holding tanks, twin or double bunk sleeping arrangements, cockpit sorting table, diving duck board, extra freezing capacity for marine specimens, special storage for microscopes and scientific equipment, and 240v power allowing for the operation of computers and other data processing.



The vessel is equally adapted to motoring and sailing. Cruising speed is approximately 10 knots. Her specifications are in compliance with the 2BUSL code and she is surveyed to carry 6 overnight passengers plus 2 crew, or 10 day passengers plus 2 crew.

James Scheerer is available for private charter or for scientific exploration.

DISCLAIMER

Customers of Shark Bay Under Sail and James Scheerer Research Charter accept the services and ancillary services offered by the operator entirely at their own risk and the operator shall not be held liable and does not accept any liability or responsibility for any injury to customer, damage to or loss of property of customer or death of customer arriving out of or incidental to the use by the customer of the services of the operator or any activity associated with or ancillary to the service notwithstanding whether or not such injury or damage be due to the negligence breach of contract or otherwise of the operator AND all warranties guarantees and conditions implied into this contract by the Trade Practises Act 1974 Commonwealth or any other legislation State or Federal expressly excluded.

LIMITATION OF LIABILITY

The operator provides its services on the express condition that neither it nor any of its agents directors guides or employees shall be liable to any person for any loss damage injury illness accident delays or any irregularity which may be caused either by reason of defect in the vessel or by virtue of any act or default of the operator its agents or servants in respect of any tours/voyages of the operator associated with the operator and the customer accepts the services of the operator for the entire duration of the tour/voyage inclusive of any ancillary services of all embarkation and disembarkation entirely at his own risk notwithstanding such injury or damage be due to the negligence, breach of contract default or otherwise of the operator.

BOOKINGS

May be confirmed by payment (and acceptance) of a $100 deposit per person or payment in full if departure is inside 3C days. Bookings and payments may be made by phone by authorised credit card charge. Final payment must be paid 30 days prior to departure.

Cancellations: Reservations cancelled 30 days prior to departure will be refunded in full. Reservations cancelled within 30 days prior to departure will incur a $25 per person process cancellation fee. There will be no refund for services offered and not utilised.

Book to sail the pristine waters of Shark Bay with –

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The Tours Desk
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Monkey Mia (099) 48 1320

Or your travel agent

When reservations are processed through a travel agent the agent is deemed to be the agent for the traveller.

APPENDIX VIII

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Shark Bay

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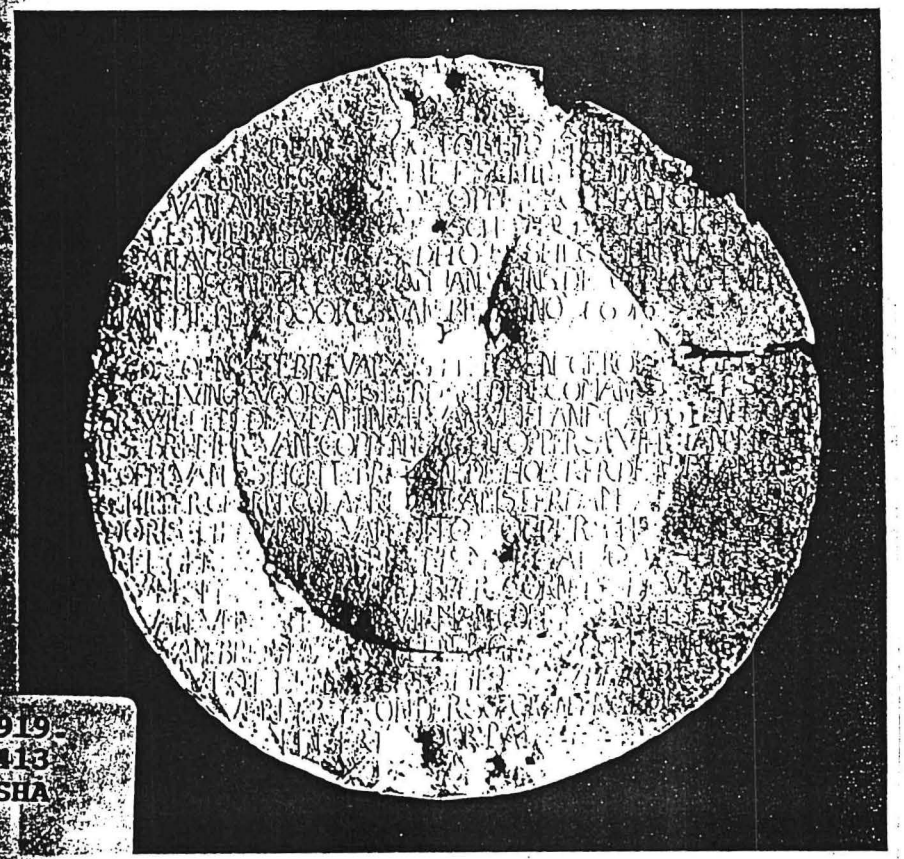

A BIBLIOGRAPHY

Shark Bay

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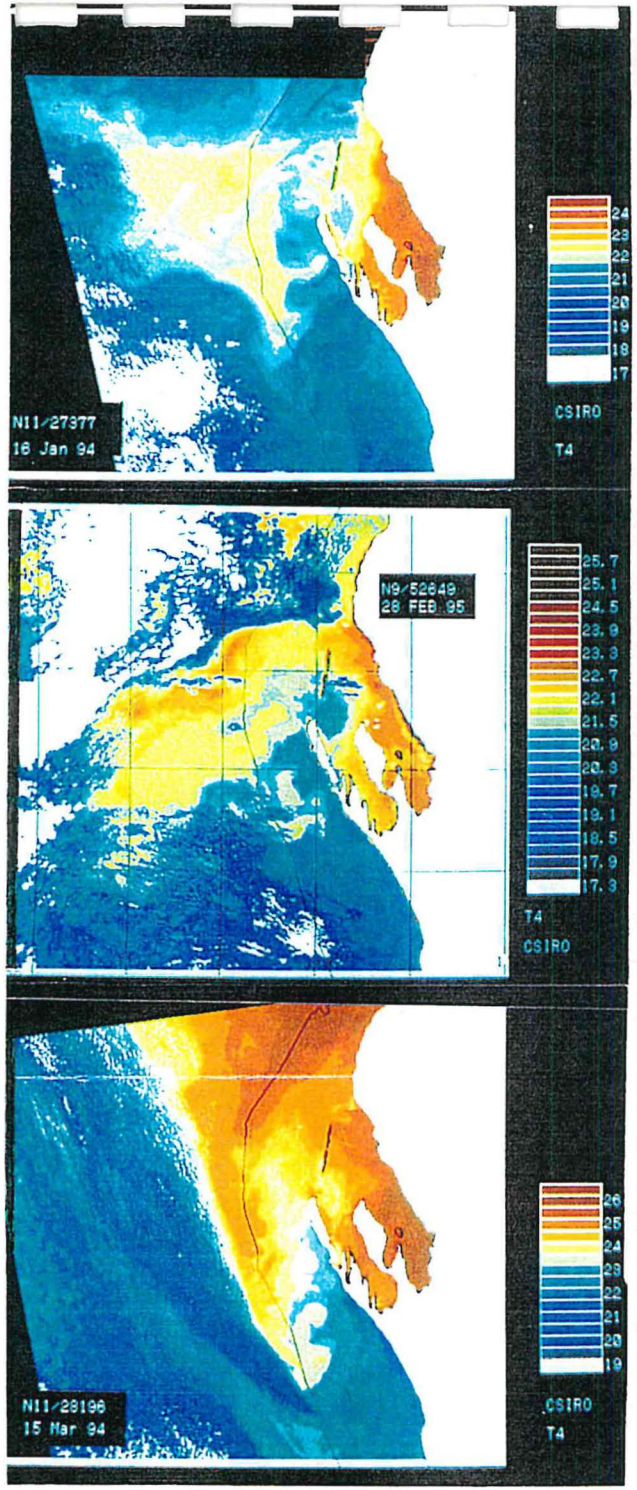
APPENDIX IX

CHARACTERISTIC MONTHLY SEA-SURFACE TEMPERATURE IMAGES FROM NOAA-AVHRR
(source: CSIRO, Division of Oceanography)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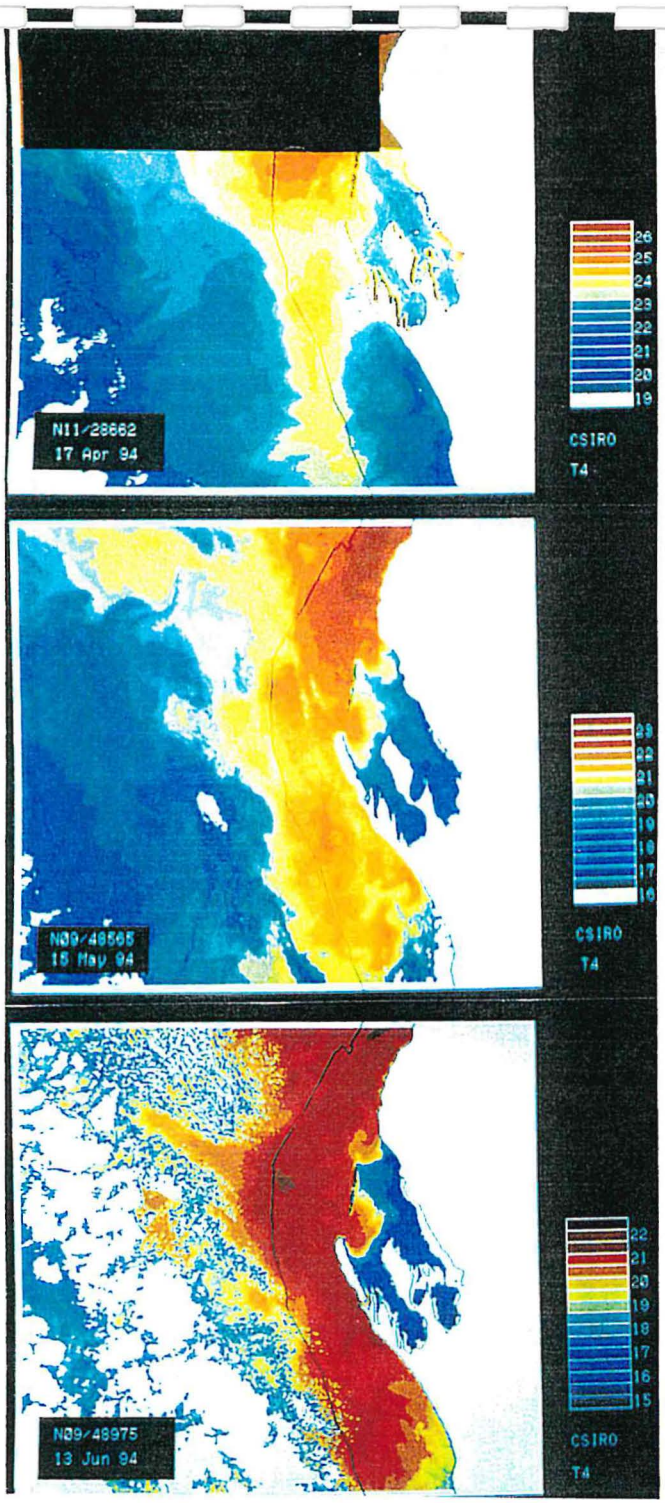
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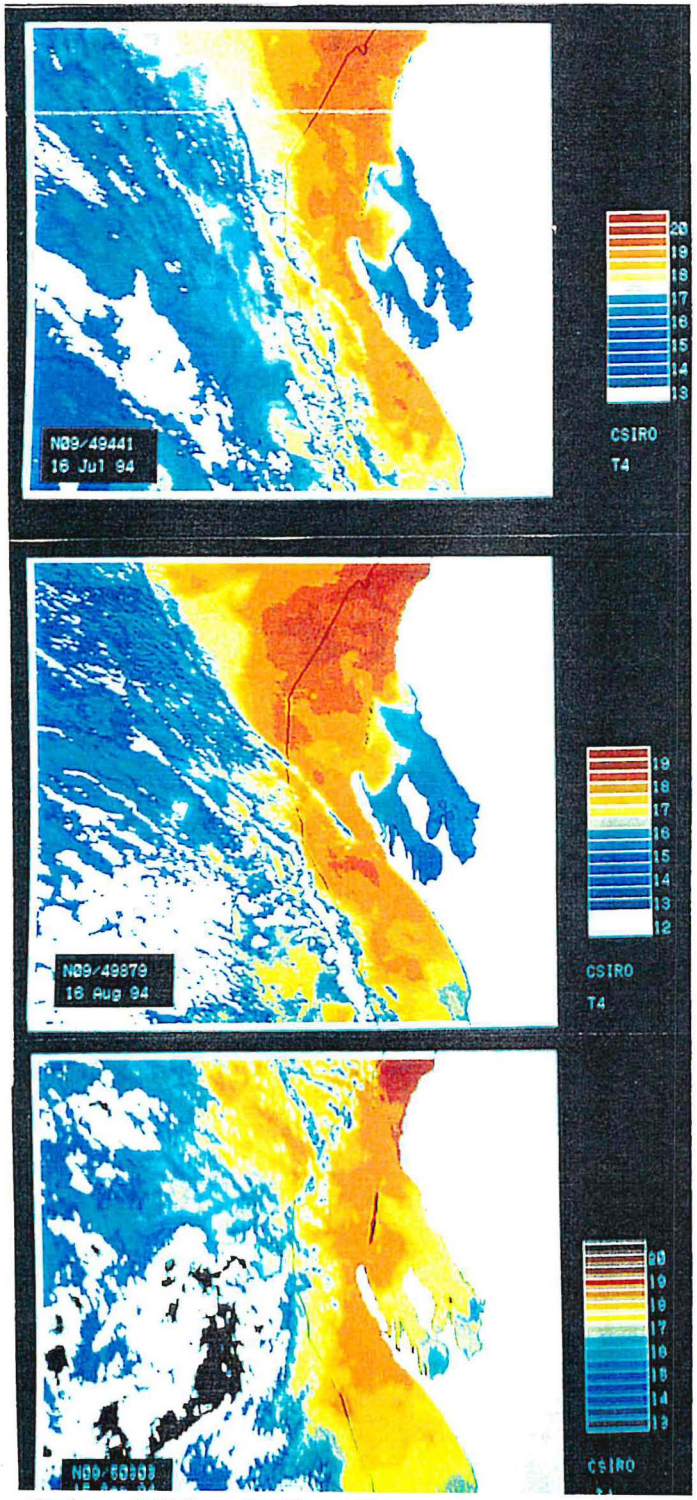
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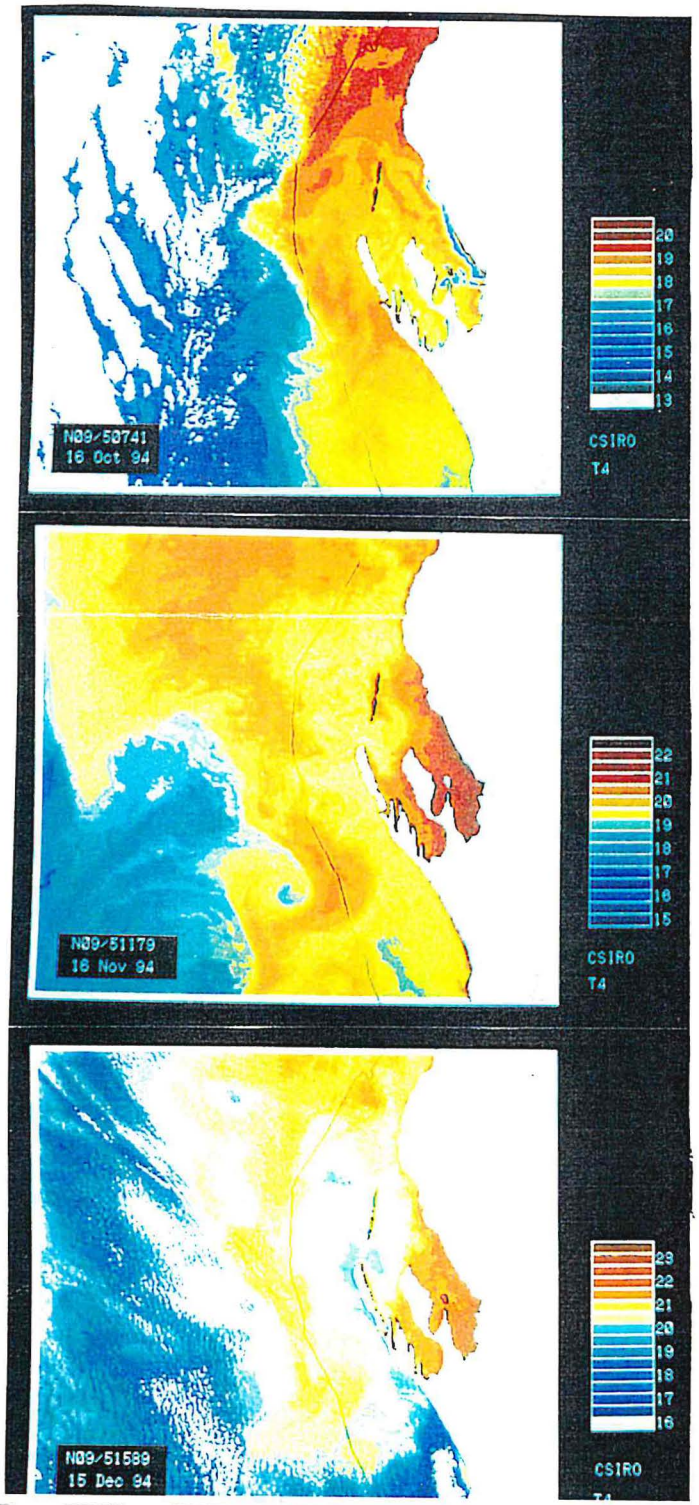
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