MARINE MANAGEMENT SUPPORT:
NINGALOO & OCEANIC SHOALS

TEMPERATURE MONITORING IN NINGALOO MARINE PARK, ROWLEY SHOALS MARINE PARK AND MERMAID REEF MARINE NATIONAL NATURE RESERVE: RETRIEVAL AND DEPLOYMENT DETAILS OF TEMPERATURE LOGGERS (September – October 2001)

Field Programme Report: MMS/NIN,OSS/NIN,RSH - 51/2001

A collaborative project between the Marine Conservation Branch and the Exmouth District and West Kimberley District of the Department of Conservation and Land Management.

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November 2001

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ACKNOWLEDGEMENTS

Direction

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- Dr Chris Simpson - Manager, Marine Conservation Branch (MCB), Nature Conservation Division.

CALM Collaboration

- Chris Muller – Manager, Pilbara Region.
- Jennie Cary – Manager, Exmouth District.
- John Hanel – Acting Manager, Exmouth District.
- Roland Mau – Conservation Officer (Marine), Exmouth District.
- Adam Meyer – Reserves Officer (Marine), Exmouth District.

- Chris Done – Manager, Kimberley Region.
- Allen Grosse – Manager, West Kimberley District.
- Mike Lapwood – Marine Operations Officer, West Kimberley District.

Funding and resources

- Resources provided by the MCB and the Exmouth District and West Kimberley District of the Department of Conservation and Land Management.

This report may be cited as:
Davidson, J. A. and D'Adamo, N. (2001). Temperature monitoring in Ningaloo Marine Park, Rowley Shoals Marine Park and Mermaid Reef Marine National Nature Reserve: Retrieval and deployment details of temperature loggers (September – October 2001). Field Program Report: MMS/NIN,OSS/NIN,RSH – 51/2001. Marine Conservation Branch, Department of Conservation and Land Management. Perth, Western Australia (Unpublished report).

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SUMMARY

This report presents the details of field work that was carried out in Ningaloo Marine Park, Rowley Shoals Marine Park and Mermaid Reef Marine National Nature Reserve during the months of September and October 2001. The field work comprised the retrieval of temperature loggers that were deployed in Ningaloo Marine Park on 28th December 2000 and 3rd January 2001, Rowley Shoals Marine Park on 2nd December 2000 and Mermaid Reef Marine National Nature Reserve on 4th December 2000. The field work also comprised of the deployment of temperature loggers in Rowley Shoals Marine Park on 10th September 2001 and 20th October 2001, and Mermaid Reef Marine National Nature Reserve on 17th October 2001.

This project is being coordinated by the Marine Conservation Branch (MCB) of the Department of Conservation and Land Management and conducted in collaboration with the Department's Exmouth District and West Kimberley District offices.

The objective of this project is to collect water temperature data over long time scales, as relevant to the management of Ningaloo Marine Park and Rowley Shoals Marine Park. The temperature monitoring program for Mermaid Reef Marine National Nature Reserve was originally established as an opportunistic initiative and is being maintained to provide the Commonwealth with information relevant to the management of the area and to provide a data set complementary to those being collected in the Rowley Shoals Marine Park. The extra data set will strengthen the correlation analysis that will be conducted between water temperature collected in-situ during this project and those derived by satellite-based sensors of the area adjacent to the three atolls of the Rowley Shoals.

This comprises part of the development of a statewide ocean temperature monitoring capacity in Western Australia's tropical marine conservation reserves, required by the Department for the characterisation and modelling of key ecological processes and for the on-going management of these areas.

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1 INTRODUCTION

1.1 GENERAL BACKGROUND

This report presents the details of field work that was carried out in Ningaloo Marine Park, Rowley Shoals Marine Park and Mermaid Reef Marine National Nature Reserve during the months of September and October 2001. The field work, which included the retrieval and deployment of temperature monitoring equipment in these marine conservation reserves, was coordinated by the Marine Conservation Branch (MCB) of the Department of Conservation and Land Management and conducted in collaboration with the Department's Exmouth District and West Kimberley District offices. This forms part of the 2001/2002 MCB project titled: *Development of an ocean temperature monitoring capability in existing tropical marine reserves – Stage 2.*

The field work detailed in this report comprised the retrieval of temperature loggers that were deployed in Ningaloo Marine Park on 28th December 2000 and 3rd January 2001, Rowley Shoals Marine Park on 2nd December 2000 and Mermaid Reef Marine National Nature Reserve on 4th December 2000. Deployment and calibration details for these temperature loggers can be found in the field programme reports by D'Adamo & Davidson (2001a and 2001b). The field work detailed in this report also comprised the deployment of temperature loggers in Rowley Shoals Marine Park on 10th September 2001 and 20th October 2001 and Mermaid Reef Marine National Nature Reserve on 17th October 2001.

This project was undertaken as a contribution to the statewide monitoring network for physical oceanographic management-related data in tropical marine conservation reserves, required by the Department for the characterisation and modelling of key ecological processes and for the on-going management of these nationally significant areas.

1.2 STUDY AREA

The study area for this project is Ningaloo Marine Park (Figure 1) and the Rowley Shoals (Figure 2), which includes the Rowley Shoals Marine Park and the Mermaid Reef Marine National Nature Reserve.

1.3 OBJECTIVES

The objectives of the field work were to:

- Retrieve temperature loggers from Bills Bay and Tantabiddi, Ningaloo Marine Park.
- Retrieve temperature loggers from Clerke Reef and Mermaid Reef, Rowley Shoals.
- Establish new monitoring sites at Clerke Reef and Mermaid Reef to replace the previous sites, with the aim of making them more inconspicuous to other boats in the area (to minimise accidental or intentional damage) and to ensure they are easily retrievable in the future.
- Deploy temperature loggers at these two new sites.

2 METHODS

StowAway Tidbit temperature loggers (Onset Computer Corporation; www.onset.com) were used to collect time-series data of water temperature variation at pre-specified time intervals. The loggers were set to record instantaneous temperature data at 30 minute intervals. For these initial deployments, the Marine Conservation Branch (MCB) assumed responsibility for pre-deployment activities, which included logger calibration (Section 2.3) and initialisation. The MCB will also

coordinate initial downloading and data processing of retrieved data. Operational aspects in relation to deployments and retrievals were conducted by the Department's Exmouth District and West Kimberley District offices with assistance provided by the MCB.

Note that advice from the manufacturer indicates that *StowAway Tidbit* temperature loggers immersed in water for a continuous period of 8 weeks or more at temperatures above 30^{o}C have a susceptibility to temperature drift. The only way to avoid this would be to waterproof the loggers by, for example, deploying them within waterproof containers. However, the absence of suitable containers (in respect of thermal lag response times between the outside water and inner air of the container) resulted in deployment without the protection of waterproof containers in this instance. The data will be appropriately scrutinised for the possibility of excessive temperature effects during data evaluation and processing.

2.1 NINGALOO MARINE PARK

The field work conducted in Ningaloo Marine Park involved the retrieval of two temperature loggers that were deployed at Tantabiddi (Figure 3) on 28th December 2000 and one that was deployed in Bills Bay (Figure 4) on 3rd January 2001. The details pertaining to the deployment of these loggers are presented in the field programme report by D'Adamo and Davidson (2001a) and are briefly presented below in Table 1.

After approximately 8 months submersion, the two loggers from Tantabiddi (serial numbers 304276/0699 and 299266/2199) were retrieved on 8th October 2001. Retrieval details for the loggers are presented below in Table 2. Unfortunately one of the loggers (serial number 304276/0699) was damaged and the data was not retrievable using the standard software used by the MCB (BoxCar Pro Version 3.0+ for Windows, Onset Computer Corporation: www.onset.com). The damaged logger has been sent to Onset Computer Corporation, who advised that they may be able to retrieve the data by interrogating the electronics of the logger.

In early September an attempt was made to retrieve the temperature logger from Bills Bay (serial number 304285/0699), unfortunately the logger was not found on this attempt. Another attempt to retrieve this logger will be made after the date of this report.

Table 1: Deployment details for StowAway Tidbit temperature loggers in Ningaloo Marine Park (amended from D'Adamo and Davidson, 2001a)

Serial number	304276/0699	299266/2199	304285/6099
Activity	Deployment	Deployment	Deployment
Site name	NO1 (Tantabiddi)*	NO1 (Tantabiddi)*	N48 (Bills Bay)**
Date	28/12/00	28/12/00	03/01/01
Time	1255 hrs	1255 hrs	Not recorded
Latitude* **	21.91181	21.91181	23.14127
Longitude* **	113.97354	113.97354	113.76938
Water depth (m) at time of deployment	Approx. 3 m	Approx. 3 m	Approx. 3 m
Position of logger in water column	Approx. 0.3m above bottom	Approx. 0.3m above bottom	Approx. 1 m from bottom (logger was positioned among coral)

* Site NO1 is the Department of Conservation and Land Management's mooring, which is located near the Tantabiddi boat ramp.

** Site N48 is an existing Department of Conservation and Land Management habitat monitoring site (see Cary *et al.*, 2000).

*** Latitude and longitude are presented in decimal degrees. They were recorded using a Garmin 12 GPS and the datum was WGS 84. The accuracy of these readings is ± 10 m.

Table 2: Retrieval details for StowAway Tidbit temperature loggers in Ningaloo Marine Park

Serial number	304276/0699	299266/2199	304285/6099
Activity	Retrieval	Retrieval	Attempted retrieval (logger was not found)
Site name	NO1 (Tantabiddi)*	NO1 (Tantabiddi)*	N48 (Bills Bay)**
Date	08/10/01	08/10/01	Early September***
Time	1505 hrs	1505 hrs	Not recorded
Latitude**	21.91181	21.91181	23.14127
Longitude**	113.97354	113.97354	113.76938
Water depth (m) at time of retrieval	Not recorded	Not recorded	Logger not found
Position of logger in water column	Approx. 0.3m above bottom	Approx. 0.3m above bottom	Logger not found

* Site NO1 is the Department of Conservation and Land Management's mooring, which is located near the Tantabiddi boat ramp.

** Site N48 is an existing Department of Conservation and Land Management habitat monitoring site (see Cary *et al.*, 2000).

*** Actual inspection date was not recorded, however advice from Roland Mau (Conservation Officer – Marine from Exmouth District) indicates that it occurred around early September.

**** Latitude and longitude are presented in decimal degrees. They were recorded using a Garmin 12 GPS and the datum was WGS 84. The accuracy of these readings is ± 10 m.

2.2 ROWLEY SHOALS

The field work conducted in the Rowley Shoals involved the retrieval of two temperature loggers that were deployed at Clerke Reef on 2nd December 2000 and two that were deployed at Mermaid Reef on 4th December 2000. The details pertaining to the deployment of these loggers are presented in the field programme report by D'Adamo and Davidson (2001b) and are briefly presented below in Table 3.

After approximately 10 months submersion, an opportunity arose on 10th September 2001 for the loggers to be retrieved by Mr Ron Kitcher from the charter vessel 'Jodi Anne'. Unfortunately the 'True North' mooring in Clerke Reef, to which the loggers (serial numbers 299261/2199 and 304273/0699) were originally attached, had lost its float and both loggers were found on the seabed still attached to the mooring chain. Retrieval details are presented below in Table 4. At this time, one logger (serial number 439414/1200) was deployed on the chain of the broken mooring (details are presented below in Table 5). Ron Kitcher attempted to retrieve the two loggers from Mermaid Reef, but unfortunately could not find them.

Another opportunity arose in October 2001, for the retrieval of the Mermaid Reef loggers and the deployment of three loggers (two at Mermaid Reef and one at Clerke Reef) by Judy Davidson (Marine Conservation Officer from MCB) and Mike Lapwood (Marine Operations Officer from West Kimberley District), who took part in an MCB monitoring field survey on board the Department of Fisheries Patrol Vessel 'Walcott'. Details for this monitoring field survey are presented in the field programme report by Cary *et al*. (2001). On 17th October 2001, the Mermaid Reef loggers were retrieved and it was found that the mooring they were attached to had lost its sub-surface float and both loggers were buried in the sand. Retrieval details are presented below in Table 4.

Due to the damage that occurred at both sites during the operation of the previous loggers, it was decided that two new sites would be selected to make them more inconspicuous to other boats in the area and to ensure they are easily retrievable in the future. As such, the logger that was deployed by Ron Kitcher at Clerke Reef on 10th September 2001 (serial number 439414/1200) was retrieved and re-deployed on 20th October 2001 at a new site (Figure 5) with another logger (serial number 298878/2199). The loggers were attached to a mooring constructed using approximately 15 m of rope, which was buoyed by two small floats (sitting one on top of the other) and anchored by a danforth anchor and 2 m of 8 mm chain. The loggers were attached to the rope using wire thread and gaffa tape. One logger was attached at the end of the rope (where the chain meets the rope) and the other was attached 1 m below the surface float immediately above a weight. This weight will ensure that this logger stays consistently at a depth of 1 m below the surface regardless of tides. Two loggers (serial number 299272/2199 and 439439/12-00) were deployed at Mermaid Reef (Figure 6) on 17th October 2001 using the same method. Details for the deployment of the loggers are presented in Table 5.

Table 3: Deployment details for StowAway Tidbit temperature loggers in the Rowley Shoals (amended from D'Adamo and Davidson, 2001b)

Serial number	299261/2199	304273/2199	298514/2199	304286/0699
Activity	Deployment	Deployment	Deployment	Deployment
Site name	Clerke Reef*	Clerke Reef*	Mermaid Reef**	Mermaid Reef **
Date	02/12/00	02/12/00	04/12/00	04/12/00
Time	0830 hrs	0830 hrs	0830 hrs	0830 hrs
Latitude* **	17.27916	17.27916	17.06562	17.06562
Longitude* **	119.36395	119.36395	119.6239	119.6239
Water depth (m) at time of deployment	11 m	11 m	12 m	12 m
Position of logger in water column	1 m from seabed	1 m beneath surface float	1 m from seabed	1m beneath sub-surface float

* Clerke Reef loggers were attached to the 'True North' mooring line (see D'Adamo and Davidson, 2001b).

** Mermaid Reef loggers were attached to a mooring constructed by Mike Lapwood from the West Kimberley District office specifically for the deployment of loggers (see D'Adamo and Davidson, 2001b).

*** Latitude and longitude are presented in decimal degrees. They were recorded using a Garmin 12 GPS and the datum was WGS 84. The accuracy of these readings is ± 10 m.

Table 4: Retrieval details for StowAway Tidbit temperature loggers in the Rowley Shoals

Serial number	299261/2199	304273/2199	298514/2199	304286/0699
Activity	Retrieval	Retrieval	Retrieval	Retrieval
Site name	Clerke Reef*	Clerke Reef*	Mermaid Reef**	Mermaid Reef **
Date	10/09/01	10/09/01	17/10/01	17/10/01
Time	1115 hrs	1115 hrs	1745 hrs	1745 hrs
Latitude* **	17.27916	17.27916	17.06562	17.06562
Longitude* **	119.36395	119.36395	119.6239	119.6239
Water depth (m) at time of retrieval	12.4 m	12.4 m	10.7 m	10.7 m
Position of logger in water column	Logger retrieved from seabed	Logger retrieved from seabed	Logger retrieved from seabed	Logger retrieved from seabed

* Clerke Reef loggers were attached to the 'True North' mooring line (see D'Adamo and Davidson, 2001b) and this was found to be damaged on retrieval of the loggers.

** Mermaid Reef loggers were attached to a mooring constructed by Mike Lapwood from the West Kimberley District office specifically for the deployment of loggers (see D'Adamo and Davidson, 2001b) and this was found to be damaged on retrieval of the loggers.

*** Latitude and longitude are presented in decimal degrees. They were recorded using a Garmin 12 GPS and the datum was WGS 84. The accuracy of these readings is ± 10 m.

Table 5: Deployment details for StowAway Tidbit temperature loggers in the Rowley Shoals

Serial number	439414/1200*	29887821/2199	299272/2199	439439/12-00
Activity	Deployment	Deployment	Deployment	Deployment
Site name	Clerke Reef**	Clerke Reef**	Mermaid Reef**	Mermaid Reef**
Date	20/10/01	20/10/01	17/10/01	17/10/01
Time	1440	1455	1706	1706
Latitude* **	E 751385.53	E 751385.53	E 779226.30	E 779226.30
Longitude* **	N 8087828.65	N 8087828.65	N 8111367.77	N 8111367.77
Water depth (m) at time of deployment	11 m	11 m	8 m	8 m
Position of logger in water column	0 m (on the seabed)	1 m from surface	1 m from surface	0 m (on the seabed)

* Logger 439414/2100 was originally deployed on the damaged 'True North' mooring on 10th September 2001 at 1125 hrs and was then retrieved on 19th October 2001 at approximately 1000 hrs. It was re-deployed at the new site according to the details in the above table.

** Clerke Reef and Mermaid Reef loggers were attached to moorings constructed by Mike Lapwood (Operations Officer) from the West Kimberley District office specifically for the deployment of loggers.

*** Latitudes and longitudes are expressed as Eastings and Northings and were recorded using a DGPS with the datum UTM.

2.3 CALIBRATION

Although in field programme reports which pre-date the present report, the *StowAway Tidbit* temperature loggers were said to have a specified accuracy of ± 0.2 ^{o}C, based on Onset Computer Corporation brochures, more precise information from Onset Computer Corporation indicates the actual accuracy to be ± 0.23^{o}C. Loggers must be checked against a thermometer or any other temperature recorder with an accuracy much better than ± 0.23^{o}C, prior to all field deployments. For this deployment, calibration was performed using a scientific mercury thermometer (accuracy of ± 0.05^{o}C). The procedure for calibration was as follows:

i. Temperature loggers were initialised to record instantaneous temperature data at 1 minute intervals;
ii. The air temperature was recorded using a mercury thermometer, and the time of each recording was taken down;
iii. The loggers were placed in an insulated container of water for approximately 30 minutes and the water temperature was recorded with the mercury thermometer every 4 minutes, time of each recording was also taken down;
iv. The loggers were taken out of the water and dried;
v. The air temperature was recorded every 1 minute for approximately 5 minutes, the time of each reading was also recorded;
vi. The information was downloaded from the loggers to ensure that the difference between the logger and thermometer readings was not greater than ± 0.23^{o}C.

This calibration information has been recorded in the appropriate Marine Conservation Branch file and will be included in a data report. Post-retrieval calibration information will also be presented in the relevant data report.

3 PROJECT MANAGEMENT

3.1 SURVEY VESSEL AND TEAM

Responsibility of the Exmouth District and West Kimberley District office.

3.2 FIELD ITINERARY

Responsibility of the Exmouth District and West Kimberley District office.

3.3 SAFETY

Since all field operations for these surveys have and will be conducted by the Exmouth District and West Kimberley District office staff, all safety aspects have and will be coordinated by the relevant office under the supervision of the relevant District Manager.

3.4 BUDGET

This project was jointly resourced through core budgets of MCB, Exmouth District and West Kimberley District. The budget breakdown for the MCB's expenditure for this project is described in Table 6.

Table 6: Approximate budget breakdown of MCB expenses for the Ningaloo Marine Park and Rowley Shoals Marine Park temperature monitoring field work.

Budget Item	Description		CALM ($)	Total ($)
Travel				
Vehicles/airfares	N/a			
		Sub-total	0	0
Staff				
Judy Davidson	Preparation for deployments: 4 days		650	650
Nick D'Adamo	Supervision, project management: 3 days		1000	1000
		Sub-total	1650	1650
Vessel & other equipment				
Purchase Tidbit loggers and	Existing loggers were used (no purchase cost).		0	0
associated equipment	Mooring equipment was budgeted by West Kimberley District		0	0
		Sub-total	0	0
Consumables				
Postage/ printing, discs etc			200	200
		Sub-total	200	200
Contingency				
General			650	650
		Sub-total	650	650
		TOTAL	**2500**	**2500**

4 DATA MANAGEMENT

4.1 FIELD PROGRAMME REPORT

Hard copies of this Field Programme Report will be held at three locations:

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

2. Woodvale Library, Science and Information Division, Ocean Reef Rd., Woodvale, Western Australia, 6026.

3. Archives, Woodvale Library, Science and Information Division, Ocean Reef Rd., Woodvale, Western Australia, 6026.

The Marine Conservation Branch will hold digital copies of this Field Programme Report at three locations:

1. The Marine Conservation Branch Server:
   Shareddat on 'Calm-frem-1'
   [T:\144-Marine Conservation Branch\Shared Data\Current_MCB_reports\MMS\mms_5101]

2. MCB Server full backup DAT tape
   [T:\144-Marine Conservation Branch\Shared Data\Current_MCB_reports\MMS\mms_5101]

3. CD-ROM [MMS_5101]

4.2 DATA REPORT

Collected raw data will be presented in a data report(s) (to be prepared by the MCB) and held at the same locations as for this Field Program Report. A database of the oceanographic data will be stored digitally at three locations:

1. On MCB server:
   144-mcb gis data on 'Calm-frem-1'
   [L:\MIS\Data\Development\Oceanography\Temperature\Calm]

2. MCB Server full backup DAT tape:
   [L:\MIS\Data\Development\Oceanography\Temperature\Calm]

3. On 3.5" floppy disk stored in the back of the relevant data report.

5 REPORT DISTRIBUTION LIST

Copies of this report will be distributed to:

- Chris Simpson Manger, Marine Conservation Branch.
- Jennie Cary, Manager, Exmouth District.
- Allen Grosse, Manager, West Kimberley District.
- Other relevant marine research organisations.

6 REFERENCES

D'Adamo, N. and Davidson, J. A. (2001a). Establishment of an oceanographic monitoring network in marine reserves: Stage 1. Temperature monitoring in Ningaloo Marine Park (July 2000 – January 2001). Field Programme Report: MMS/NIN/NIN – 32/2001. Marine Conservation Branch, Department of Conservation and Land Management. (Unpublished report).

D'Adamo, N. and Davidson, J. A. (2001b). Establishment of an oceanographic monitoring network in marine reserves: Stage 1. Temperature monitoring in Rowley Shoals Marine Park (December 2000). Field Programme Report: MMS/OSS/RSMP – 34/2001. Marine Conservation Branch, Department of Conservation and Land Management. (Unpublished report).

Cary, J., Grubba, T. and Lapwood, M. (2001). Rowley Shoals Marine Park Monitoring Program: Establishment of long term monitoring sites in benthic communities in Rowley Shoals Marine Park and Mermaid Reef Marine National Nature Reserve in October 2001. Field Program Report: MMS/RSH/RSMP – 46/2001. Marine Conservation Branch, Department of Conservation and Land Management. (Unpublished report).

Cary, J. L., Grubba, T. L., Mahendran, M. and Radford, B. J. (2000). Ningaloo Marine Park Monitoring Program: Benthic monitoring sites established in 1999. Data Report: MMS/PI/NMP – 21/2000. Marine Conservation Branch, Department of Conservation and Land Management. (Unpublished Report).

FIGURES

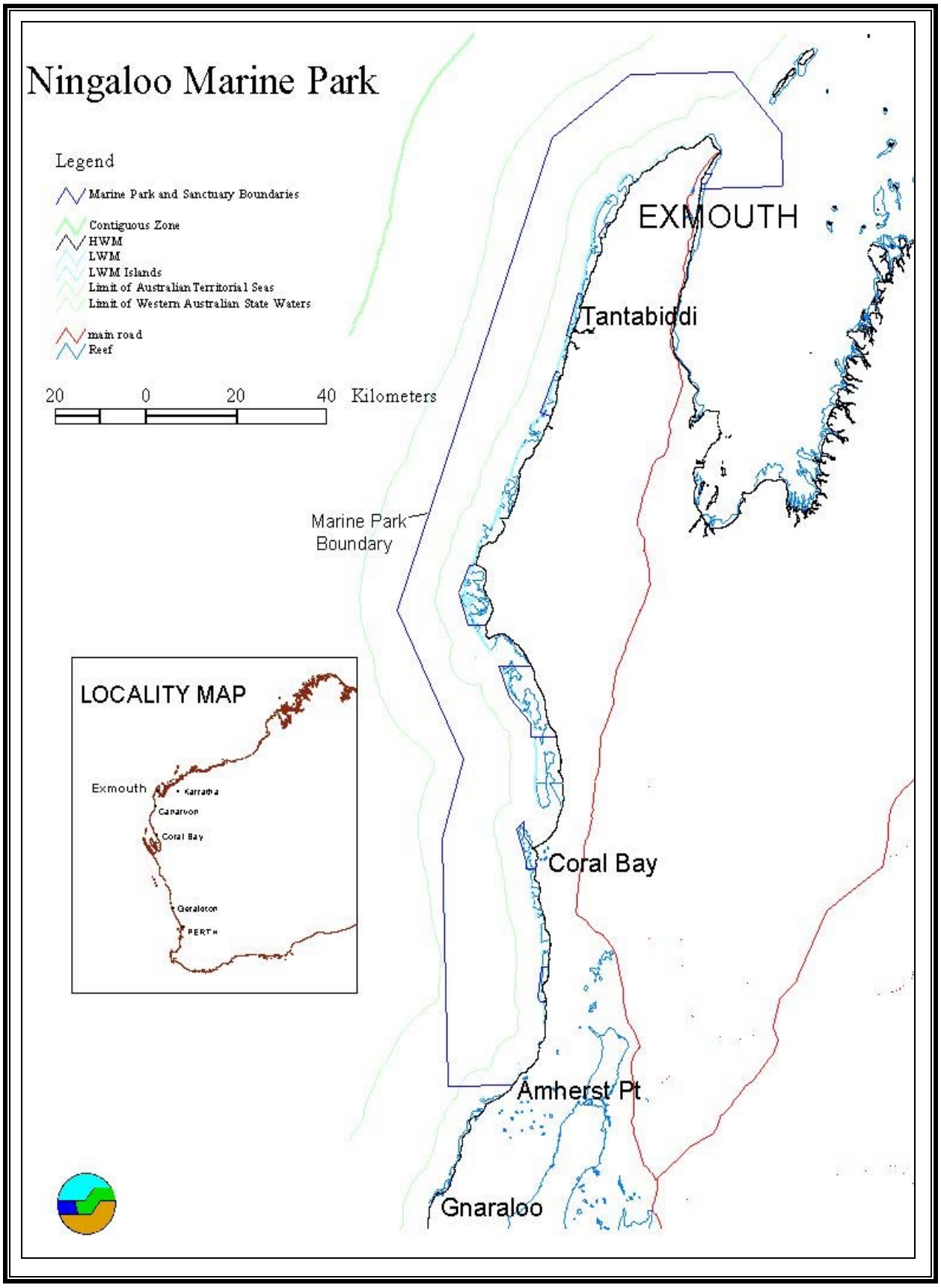

Figure 1: The study area, Ningaloo Marine Park

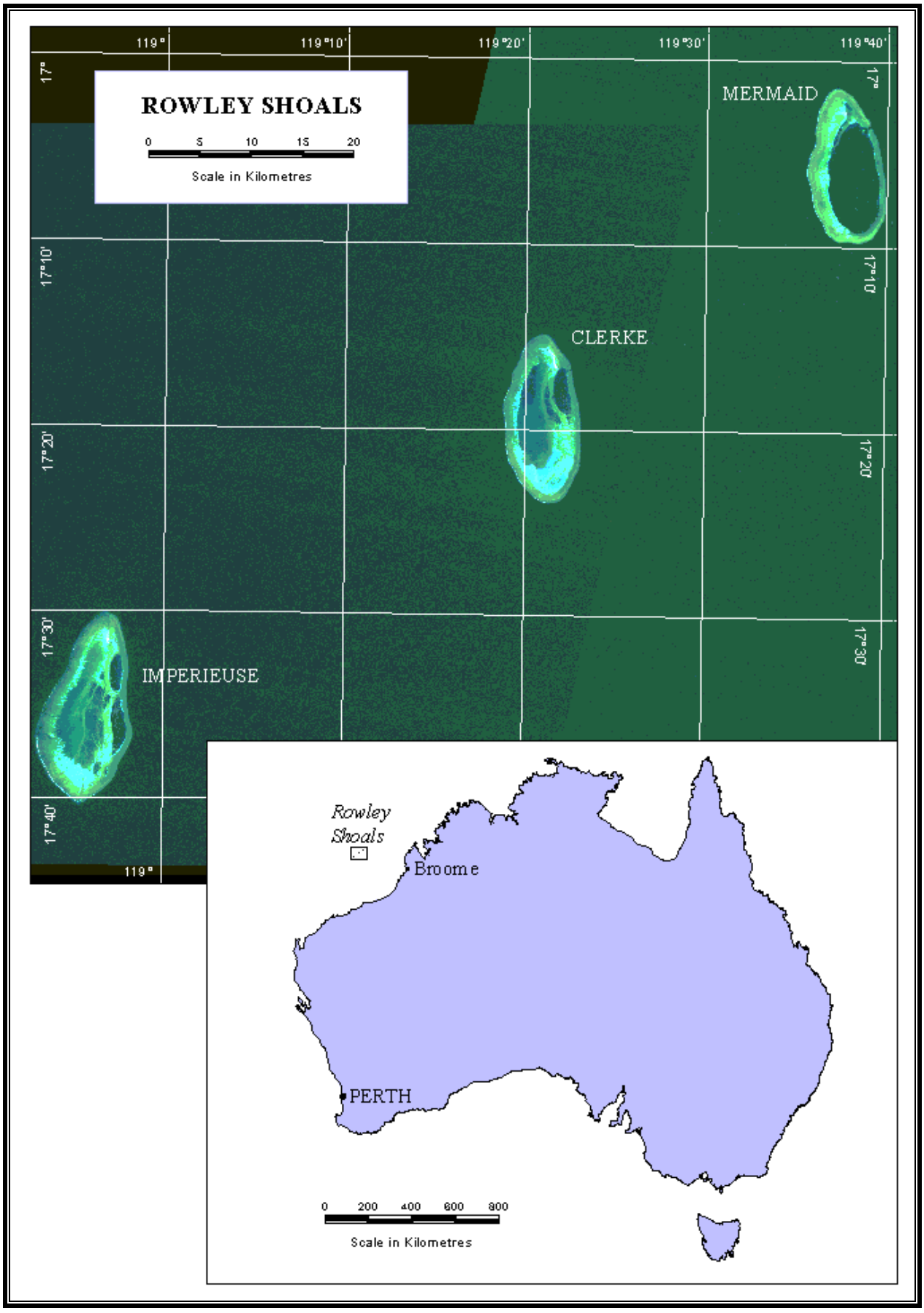

Figure 2: The study area, Rowley Shoals

Figure 3: Approximate location of the water temperature monitoring site (NO1) at Tantabiddi, Ningaloo Marine Park

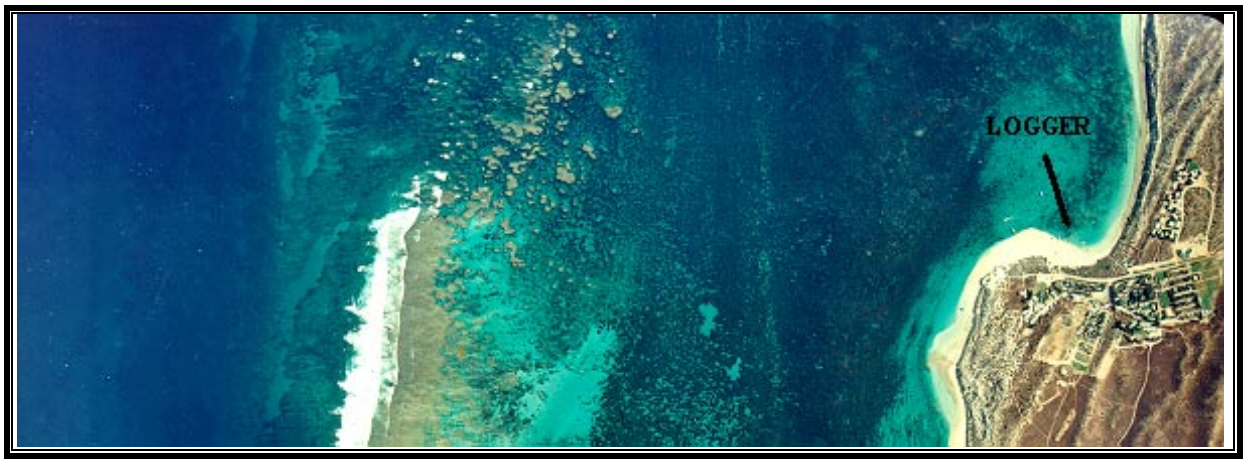

Figure 4: Approximate location of the water temperature monitoring site (N48) at Bills Bay, Ningaloo Marine Park

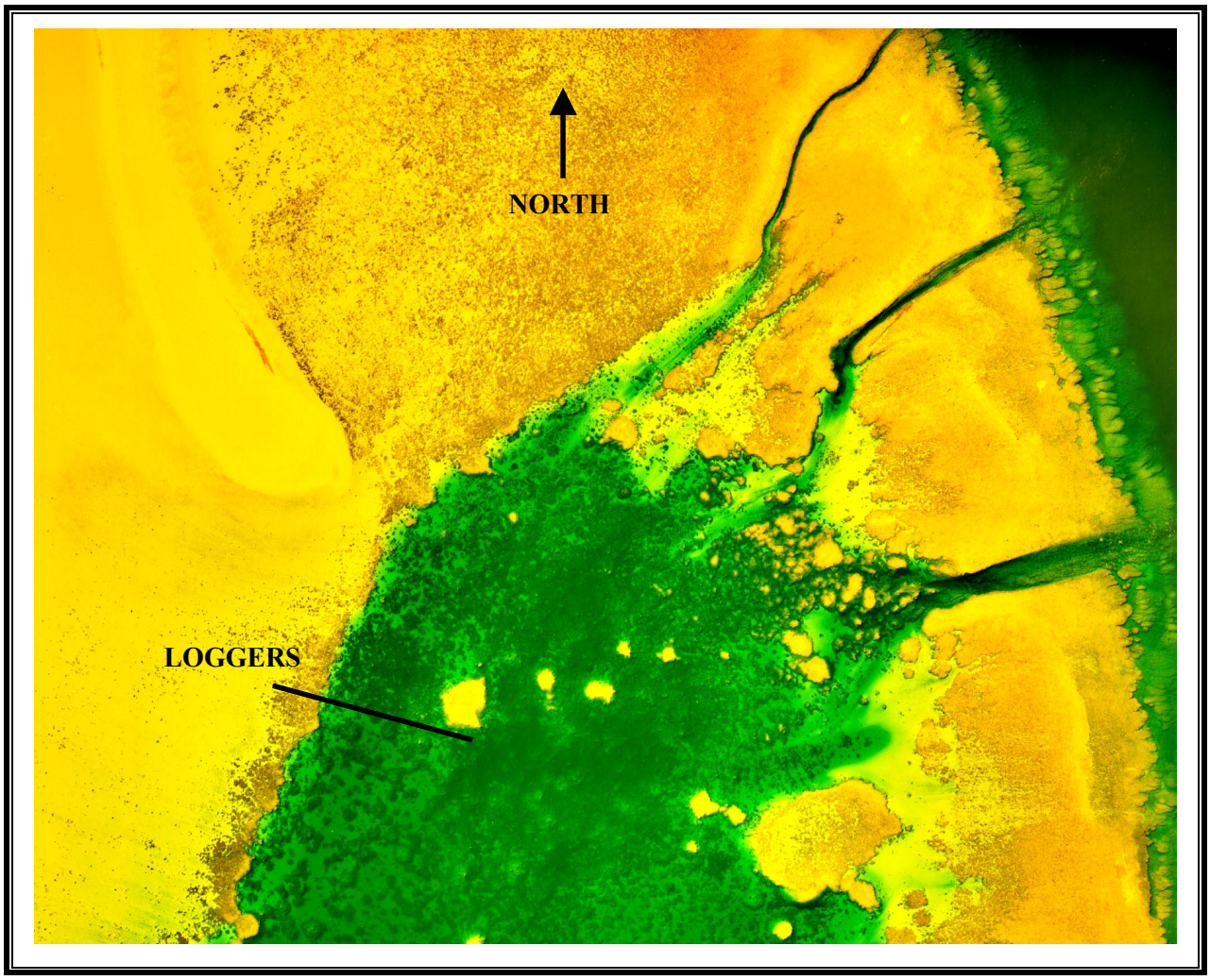

Figure 5: Approximate location of the temperature loggers at Clerke Reef, Rowley Shoals Marine Park (deployed on 20th October 2001)

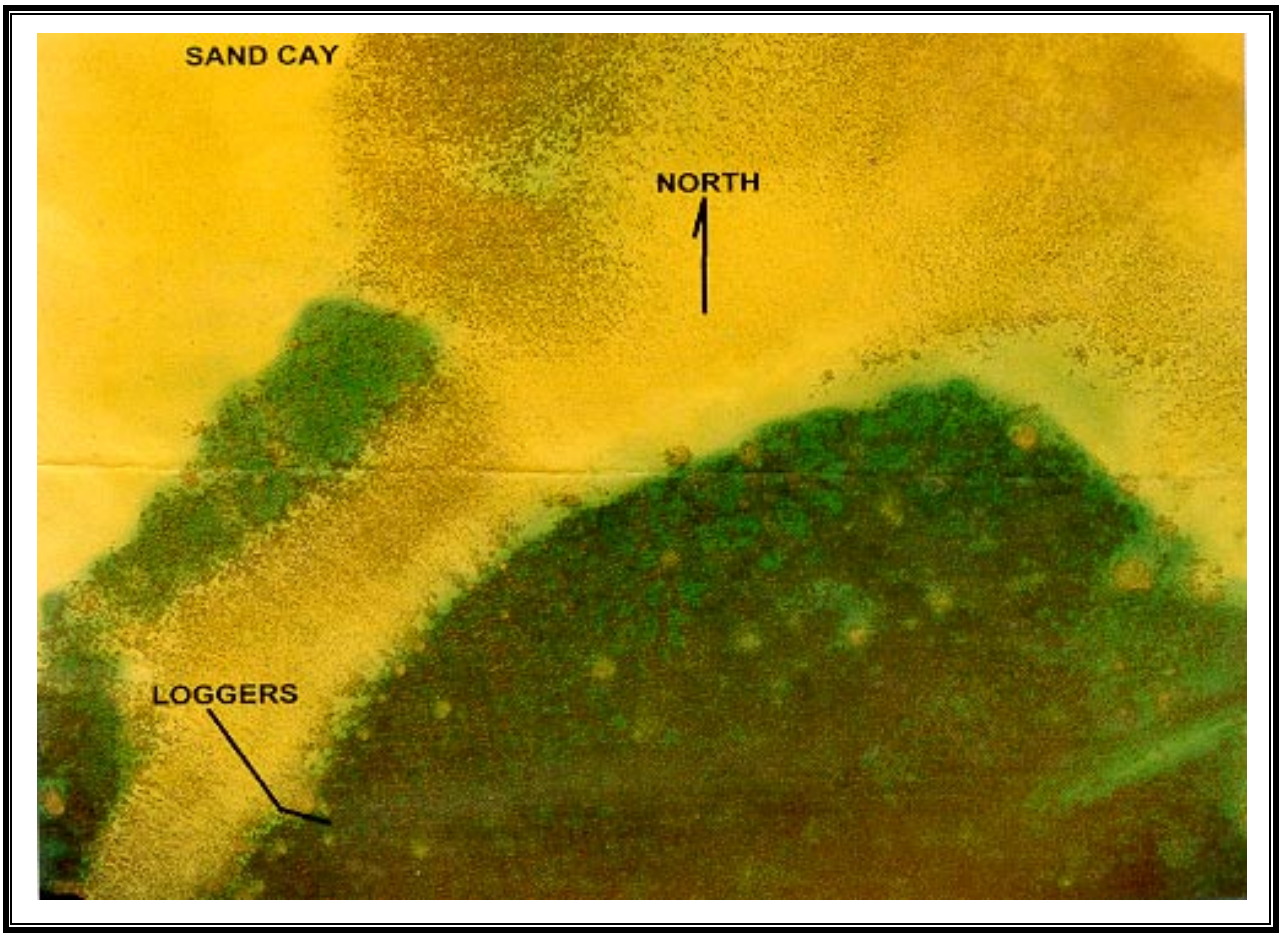

Figure 6: Approximate location of the temperature loggers at Mermaid Reef, Mermaid Reef Marine National Nature Reserve (deployed on 17th October 2001)