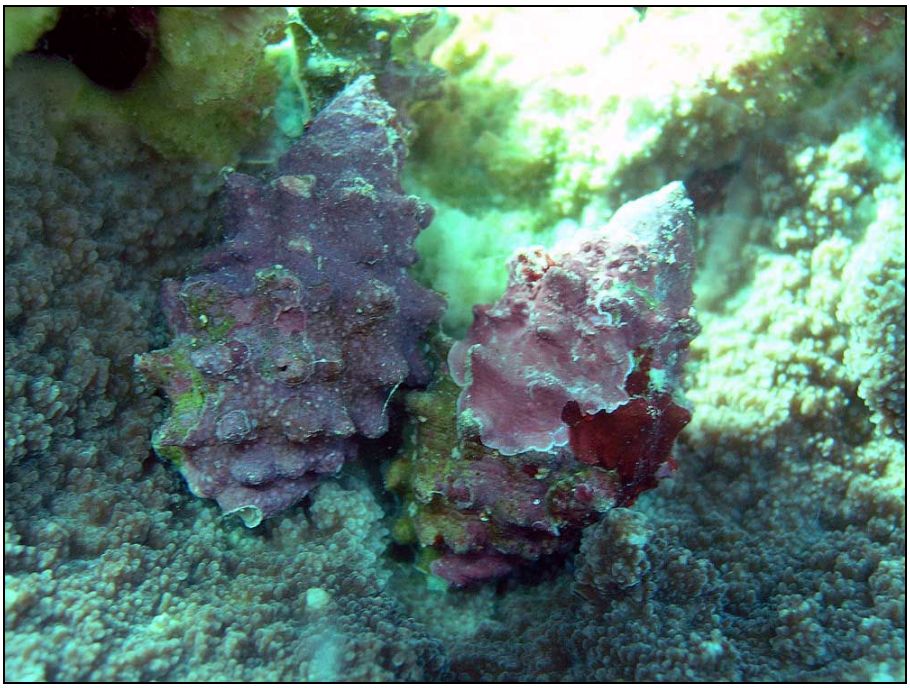
THE NINGALOO MARINE PARK DRUPELLA LONG-TERM MONITORING PROGRAM: 2008 SURVEY

31 March - 11 April 2008

Field Operations Plan



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Cover image: Drupella cornus at Ningaloo Reef. Photo: Shannon Armstrong (DEC).

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1 INTRODUCTION

1.1 BACKGROUND

Between the mid 1980s and early 1990s, the feeding activity of unusually high densities of the corallivorous gastropod *Drupella cornus* resulted in massive coral damage along at least 100 km of Ningaloo Marine Park (NMP), with coral mortality approaching 100% at some areas. The density of *D. cornus,* the area and severity of associated coral damage and longevity of the outbreak itself that occurred at NMP during this event was on a greater scale than recorded on other reefs elsewhere in the world to date.

As the health of coral communities is a key performance indicator of management of NMP and the Muiron Islands Marine Management Area (MIMMA), it is essential to keep a watching brief on spatial and temporal changes to *D. cornus* densities and cover of associated corals in these conservation reserves. Adhering to this management need, the aim of the Ningaloo Marine Park *Drupella* Long-term Monitoring Program (NMPDMP) is to monitor long-term changes in the density of *D. cornus* and cover of associated coral communities at the NMP and the MIMMA. Monitoring of *D. cornus* at NMP has produced a long-term data set with information describing the status of *D. cornus* populations and coral communities dating back to 1987.

The results of the surveys indicate that between 1987 and 2006 the direction and amplitude of change in *D. cornus* density and percent cover of live hard coral has varied considerably between locations. Relative to the outbreak densities recorded during the late 1980s and early 1990s, *D. cornus* densities have been low to moderate since 1994 and have not greatly affected coral cover at the NMP and MIMMA.

A strategy in the revised Ningaloo Marine Park Management Plan 2005-2015 requires that *D. cornus* abundance and the health of coral communities be surveyed at least every three years. The next major survey is due in 2008, during which we will determine whether *D. cornus* densities remain in the low-moderate range.

1.2 OBJECTIVES

- The overall objective of the NMPDMP is to identify trends in *D. cornus* density and cover of associated benthic communities at NMP and MIMMA, by monitoring these variables on a long-term basis.
- The objective of the 2008 survey is to provide an update on the status of *D. cornus* populations and cover of associated coral communities at NMP and MIMMA.

2 STUDY LOCATIONS, METHODS AND EQUIPMENT

2.1 STUDY LOCATIONS

A selection of the nineteen locations will be surveyed on a tri-annual basis. Two locations from the north, north-central, south-central and south regions of NMP will be surveyed in 2008. In addition, the locations at North Muiron and Bundegi will also be surveyed (Fig 1).

North: Tantabiddi, Turquoise Bay
North-central: Winderabandi, Cloates
South-central: Pelican Point, Coral Bay backreef
South: Cape Farquhar, Gnaraloo Bay (and Turtles*)
Exmouth Gulf: Bundegi
MIMMA: North Muiron

The locations have been selected on the following basis:

- To provide *D. cornus* density data that is representative of the north, north-central, south-central, south and gulf sections of NMP and the MIMMA.
- To represent the full range of *D. cornus* density and live coral cover values that have been recorded at NMP and MIMMA to date.
- Locations that have had consistently high or low densities of *D. cornus* relative to other locations over time.
- Locations where high numbers of *D. cornus* recruits have been recorded in the past as these areas may provide an early warning of future outbreaks (i.e. Cloates).

* The location at Turtles will also be surveyed because only one of three sites at Turtles was completed in 2006 due to adverse weather conditions. Baseline data is therefore needed for the location at Turtles.

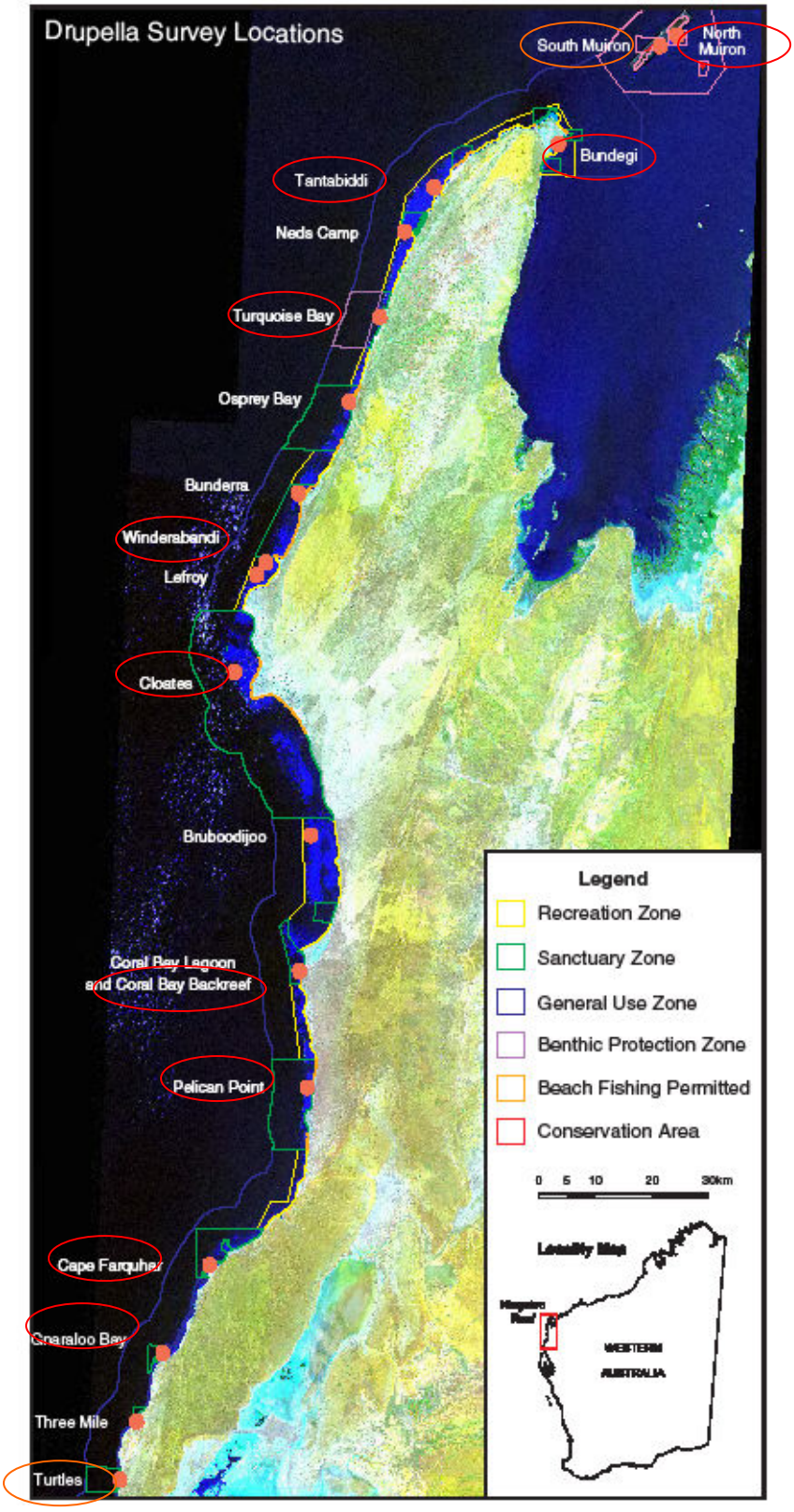


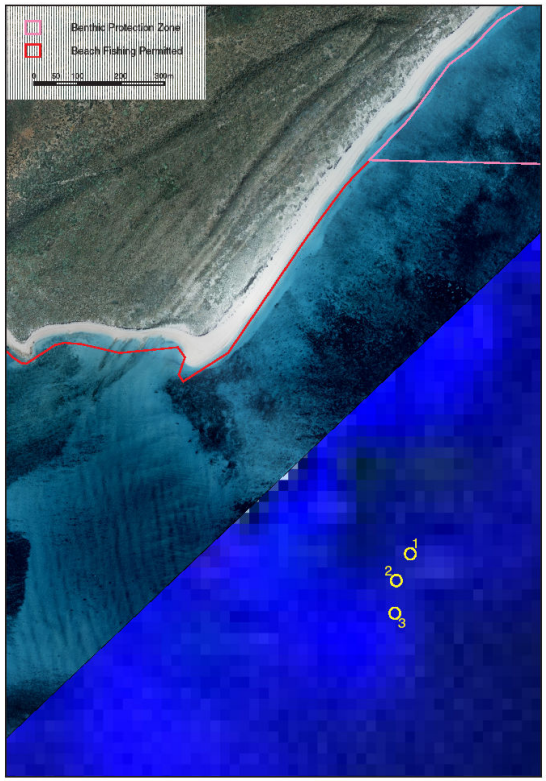
Figure 1. Overview of the nineteen *Drupella* long-term monitoring locations at NMP and MIMMA. Locations to be surveyed during 2008 are circled in red. The location at Turtles will also be established and the location at South Muiron will be moved to an area of higher live hard coral cover.

Table 1. GPS coordinates of the sites. Sites to be surveyed in 2008 are highlighted.

Location Name	Site number	Lat deg	Long deg	Lat deg	Long deg
		decimal minutes		decimal degrees	
North Muiron	1	21°39.343	114°22.478	-21.65572	114.37463
	2	21°39.377	114°22.460	-21.65628	114.37433
	3	21°39.418	114°22.459	-21.65697	114.37432
South Muiron	1	21°40.397	114°20.780	-21.67328	114.34633
	2	21°40.346	114°20.807	-21.67243	114.34678
	3	21°40.486	114°20.712	-21.67477	114.34520
Bundegi	1	21°49.920	114°10.623	-21.83200	114.17705
	2	21°49.726	114°10.836	-21.82877	114.18060
	3	21°50.549	114°10.621	-21.84248	114.17702
Tantabiddi	1	21°54.286	113°58.030	-21.90477	113.96717
	2	21°54.470	113°57.993	-21.90783	113.96655
	3	21°54.507	113°57.964	-21.90845	113.96607
Ned's Camp	1	21°58.557	113°55.088	-21.97595	113.91813
	2	21°58.167	113°55.161	-21.96945	113.91935
	3	21°58.337	113°55.062	-21.97228	113.91770
Turquoise Bay	1	22°06.717	113°52.734	-22.11195	113.87890
	2	22°06.867	113°52.668	-22.11445	113.87780
	3	22°07.178	113°52.763	-22.11963	113.87938
Osprey Bay	1	22°14.884	113°49.731	-22.24807	113.82885
	2	22°15.336	113°49.481	-22.25560	113.82468
	3	22°14.644	113°49.718	-22.24407	113.82863
Bunderra	1	22°23.685	113°44.716	-22.39475	113.74527
	2	22°23.273	113°44.946	-22.38788	113.74910
	3	22°22.966	113°44.958	-22.38277	113.74930
Winderabandi	1	22°30.342	113°41.560	-22.50570	113.69267
	2	22°30.333	113°41.784	-22.50555	113.69640
	3	22°29.925	113°42.028	-22.49875	113.70047
Lefroy Bay	1	22°31.534	113°40.607	-22.52557	113.67678
	2	22°31.525	113°40.530	-22.52542	113.67550
	3	22°31.434	113°40.603	-22.52390	113.67672
Cloates	1	22°40.817	113°38.525	-22.68028	113.64208
	2	22°41.480	113°45.935	-22.69133	113.76558
	3	22°41.397	113°45.751	-22.68995	113.76252
Bruboodijoo (9 Mile)	1	23°09.241	113°46.683	-23.15402	113.77805
	2	23°09.005	113°46.708	-23.15008	113.77847
	3	23°09.227	113°46.664	-23.15378	113.77773
Coral Bay Lagoon	1	23°09.207	113°45.766	-23.15345	113.76277
	2	23°08.560	113°45.935	-23.14267	113.76558
	3	23°08.964	113°45.751	-23.14940	113.76252
Coral Bay Backreef	1	23°09.241	113°45.030	-23.15402	113.75050
	2	23°09.005	113°45.020	-23.15008	113.75033
	3	23°09.227	113°45.103	-23.15378	113.75172
Pelican Point	1	23°20.153	113°46.760	-23.33588	113.77933
	2	23°19.825	113°46.790	-23.33042	2.03333
	3	23°19.641	113°46.721	-23.32735	113.77868
Cape Farquhar	1	23°37.374	113°37.055	-23.62290	113.61758
	2	23°37.517	113°37.063	-23.62528	113.61772
	3	23°37.529	113°36.888	-23.62548	113.61480
Gnaraloo Bay	1	23°45.886	113°32.356	-23.76477	113.53927
	2	23°45.804	113°32.334	-23.76340	113.53890
	3	23°45.882	113°32.264	-23.76470	113.53773
Three Mile Lagoon	1	23°52.396	113°29.780	-23.87327	113.49633
	2	23°52.366	113°29.786	-23.87277	113.49643
	3	23°52.327	113°29.794	-23.87212	113.49657
Turtles	1	23°57.952	113°28.170	-23.96587	113.46950
	2	not surveyed due to adverse weather conditions			
	3	not surveyed due to adverse weather conditions			

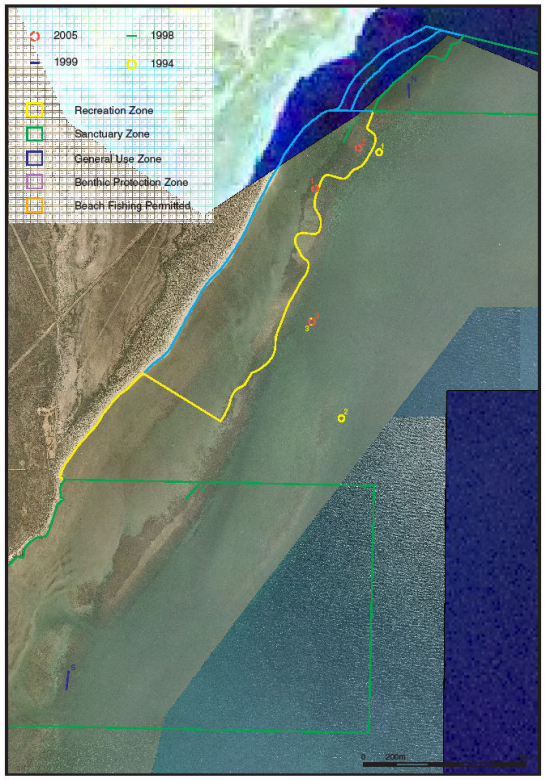
Maps of the NMPDMP locations to be surveyed in 2008

North Muiron



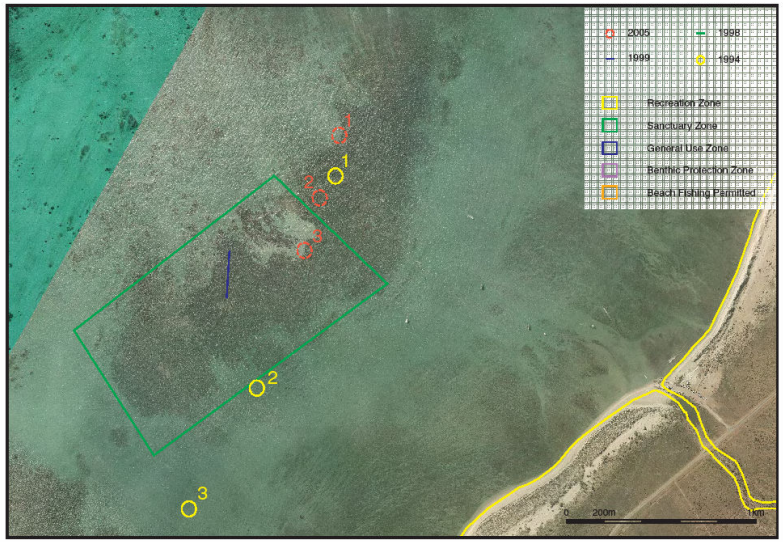
1 21° 39.343' 114° 22.478'
2 21° 39.377' 114° 22.460'
3 21° 39.418' 114° 22.459'

Bundegi



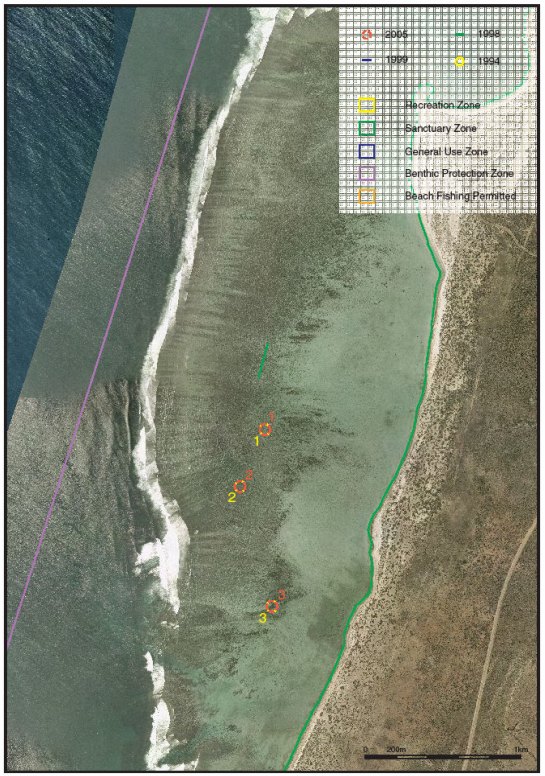
2005		1999		1998		1994	
1 21 49 920	114 10 623	S 21 52 222	114 09 432	N 21 49 622	114 10 800	1 21 49 743	114 10 941
2 21 49 726	114 10 836	N 21 49 421	114 11 082	S 21 51 322	114 10 062	2 21 51 002	114 10 779
3 21 50 549	114 10 621					3 21 50 549	114 10 621

Tantabiddi



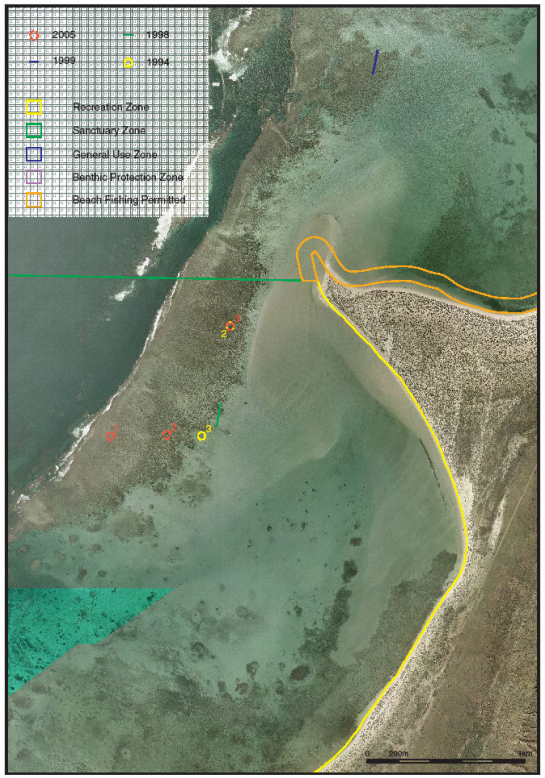
2005			1999			1994		
1	21 54 286	113 58 030	21 54 511	113 57 511	1	21 54 365	113 58 024
2	21 54 470	113 57 993			2	21 54 769	113 57 873
3	21 54 507	113 57 964			3	21 55 000	113 57 740

Turquoise



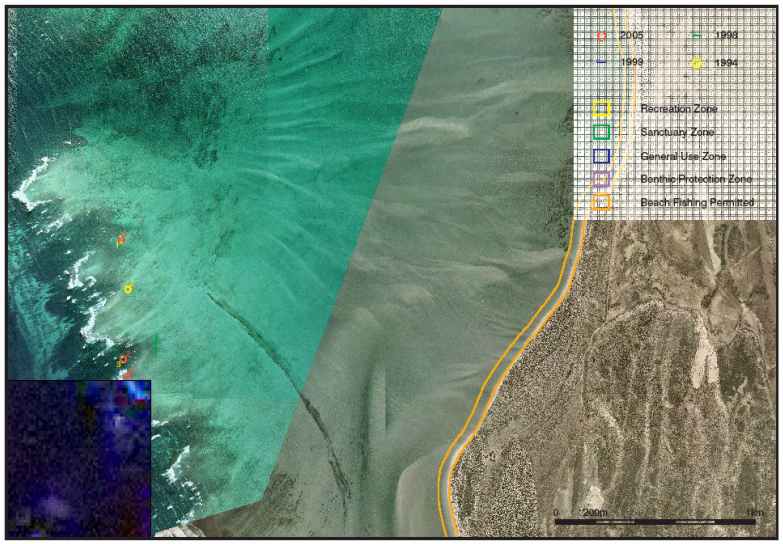
2005			1998		1994		
1	22 06 717	113 52 734	22 06 493	113 52 740	1	22 06 717	113 52 734
2	22 06 867	113 52 668			2	22 06 867	113 52 668
3	22 07 178	113 52 763			3	22 07 178	113 52 763

Winderabandi



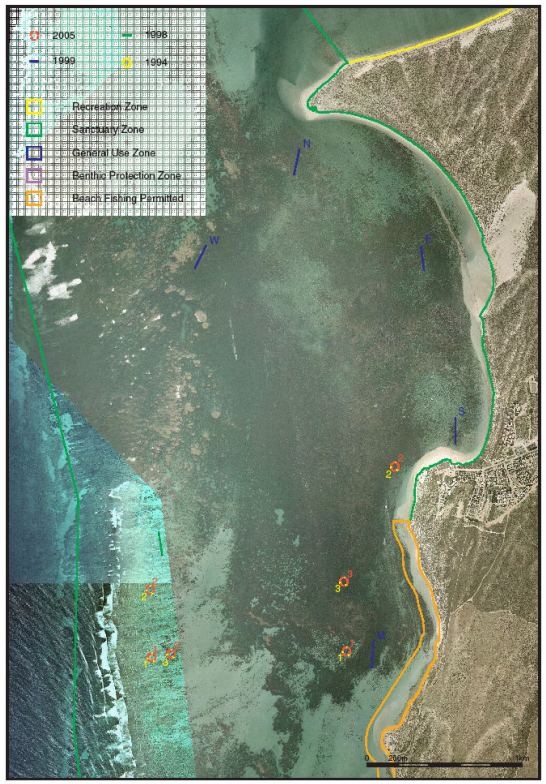
2005		1999	1998		1994	
1	22 30 342 113 41 560	22 28 890 113 57 821	22 28 890	113 42 594	1	22 30 747 113 44 579
2	22 30 333 113 41 784				2	22 30 335 113 41 922
3	22 29 925 113 42 028				3	22 29 925 113 42 028

Cloates



2005		1998		1994	
1	22 40 817 113 38 525	22 41 281	113 38 718	1	22 40 817 113 38 525
2	22 41 480 113 45 935			2	22 41 058 113 38 563
3	22 41 397 113 45 751			3	22 41 397 113 38 546

Coral Bay Backreef and Lagoon



Coral Bay Lagoon

2005/1994		
1	23 09 207	113 45 766
2	23 08 560	113 45 935
3	23 08 964	113 45 751

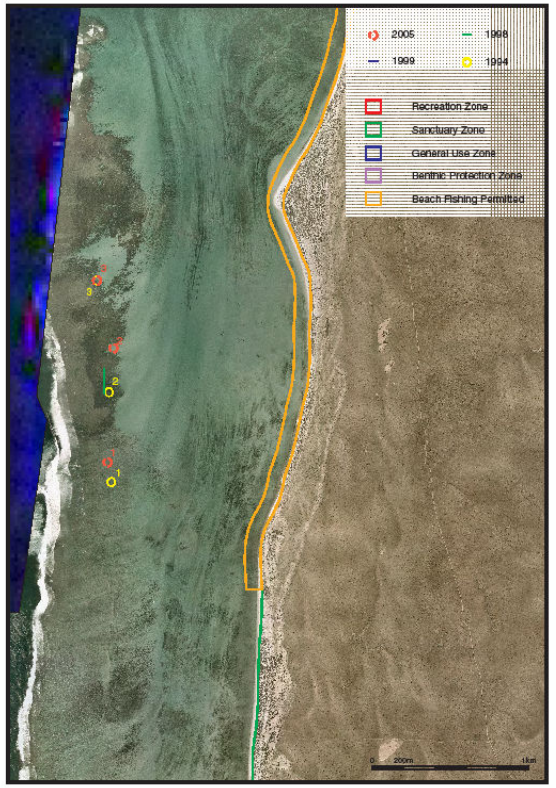
1999		
N	23 07 463	113 45 552
E	23 07 793	113 46 018
W	23 07 805	113 45 205
S	23 08 476	113 46 163
M	23 09 260	113 45 862

Coral Bay Backreef

2005/1994		
1	23 09 241	113 45 034
2	23 09 005	113 45 020
3	23 09 227	113 45 103

1998		
	23 08 804	113 45 408

Pelican Point

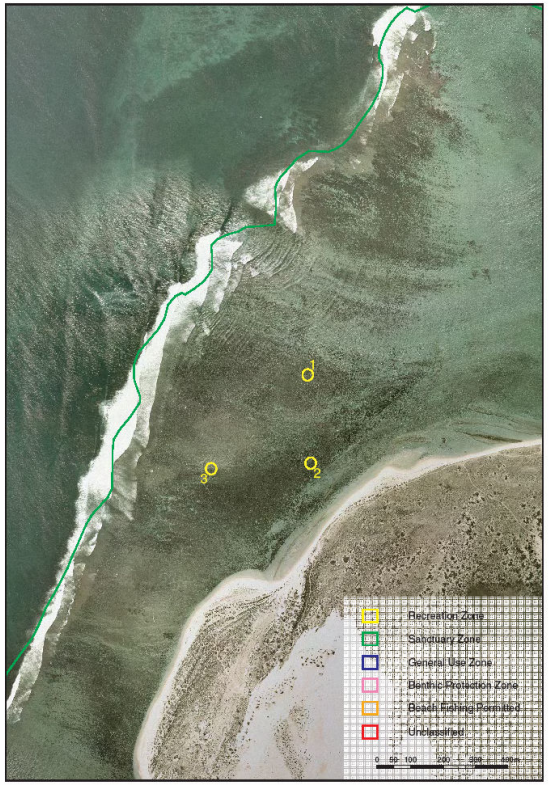


2005		
1	23 20 153	113 46 760
2	23 19 825	113 46 790
3	23 19 641	113 46 721

1998		
	23 19 946	113 46 752

1994		
1	23 20 338	113 46 789
2	23 20 027	113 46 774
3	23 19 641	113 46 721

Cape Farquhar



1 23° 37.374' 113° 37.055'
2 23° 37.517' 113° 37.063'
3 23° 37.529' 113° 36.888'

Gnaraloo Bay

1 23° 45.886' 113° 32.356'
2 23° 45.804' 113° 32.334'
3 23° 45.882' 113° 32.264'

2.2 METHODS

2.2.1 Survey Design

The NMPDMP uses a nested survey design of three replicate 0.5 x 20 m belt transects per site and three replicate sites per location (Fig 2).

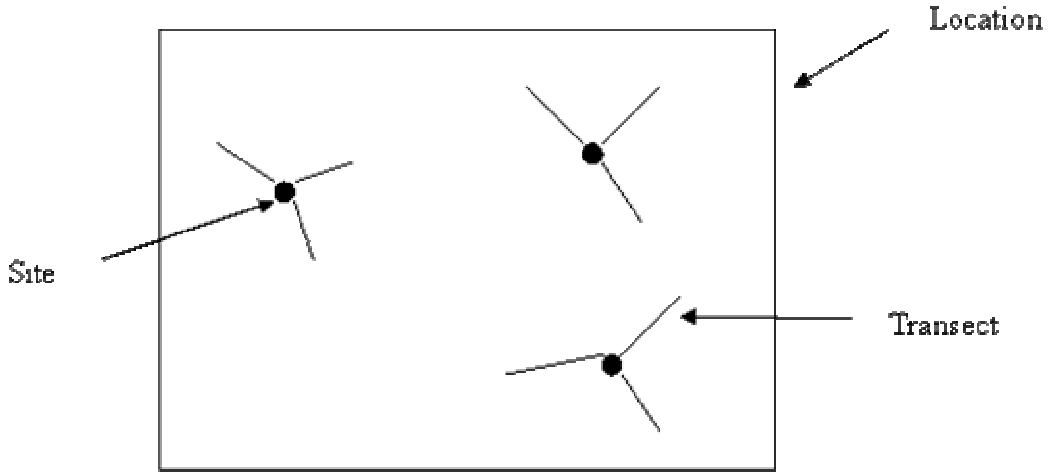


Figure 2: Diagram of the NMPDMP hierarchical or nested survey design.

2.2.2 Detailed survey methods

Nine of the locations will be sampled by snorkel. Two locations will be sampled by SCUBA: Tantabiddi and North Muiron.

The survey team will need to consist of at least 3 personnel: one videographer, one *D. cornus* counter and one vessel skipper (the skipper will also act as the standby snorkel diver). It is important that the *D. cornus* counter is very familiar with the cryptic nature of *D. cornus*, the appearance of their feeding scars and the identification of their preferred coral prey species. Effort must be made to ensure the ability of the *D. cornus* counter to find and identify *D. cornus* and their prey is consistent within and between surveys. In 2008, we will compare the density of *D. cornus* recorded by different staff along the same transects to get a better understanding of this variability. This will be undertaken prior to any staff being the *D. cornus* counter for the first time (i.e. prior to sampling).

The position of each survey site will be found using a handheld GPS (Datum WGS84) and marked with a weighted buoy. If the vessel can not closely approach the position of the site then a snorkeller will bring the GPS (waterproof to 1 m) to the site and mark the position of the site with a weighted buoy.

Using a random compass bearing from the GPS point for the site, the first of the three 0.5x20 m belt transects will be established and surveyed. Since sites are intended to represent *D. cornus* habitat, bearings will be avoided that have large areas of no *D. cornus* habitat i.e. sand.

In 2008, we will trial laying the transect line using a modified Chainman© instead of using fiberglass measuring tapes. This device measures distance by spooling out

biodegradable twine and displaying the length of twine leaving on a counter easily viewed by the diver. On reaching the seabed, the diver wraps a coil of twine around a solid structure then begins the 20 m transect. Upon reaching the end of the transect, the twine is wrapped around a structure, broken off, then left on the benthos to biodegrade within a few days. This method greatly increases the efficiency of the transect method since a line does not need to be laid or retrieved as would be necessary using the traditional tape measure approach (Babcock *et al.* 2007).

However, care must be taken to only record *D. cornus* that are within only 50 cm on the right hand side of the transect line. If the cotton spool is not visible enough or moves around too much to achieve this, then we will go back to the original fiberglass measuring tape method.

The benthic community along each transect will be recorded using a Sony HDR-HC1/E digital video camera in an Amphibico underwater housing. The diver will hold the camera at a height above the substratum so the field of view is approximately 30 cm (of substrate) when the camera is on wide angle zoom. The diver will video the entire 20 m transect, at a pace of approximately 10 m per minute (2 minutes to complete a 20 m transect).

Once the benthic video diver commences filming, the *D. cornus* counter will begin estimating density by visual search within 50 cm on the right-hand-side of each transect line and record the information on an underwater data sheet. It is very important for only the snails within 50 cm on the right-hand-side of the tape to be included in the count, as the total *D. cornus* count for each transect will be divided by 10 to give a density of *D. cornus* in m^{-2} values. The *D. cornus* counter will carry a length of pipe that is 50 cm long that will be used by the diver as a guide to determine if snails are inside the 50 cm boundary.

The size class of each *D. cornus* snail, as defined by Forde (1995), will also be recorded. A ruler will be attached to the clipboard for measuring the shell length of each snail. The number of *Acanthaster planci* within 2.5 m either side of the transect will also recorded. Once the first transect has been videoed and surveyed for *D. cornus* the process will be repeated for the remaining two transects for that site.

An underwater habitat data sheet will be completed at each site to record observations of the dominant fish species present and dominant substratum types. Several photographs and a 360° underwater video shot will also be taken at each site to provide a record of the habitat type and rugosity of the substrate for future reference. On completion of the field work habitat and spatial information about each survey location, including the bioregion, biological assemblage, video tape number and GPS coordinate will be entered into the Marine Science Program (MSP) Habitats Database.

In addition, each NMPDMP location has a long-term monitoring data sheet associated with it. This data sheet contains information that will aid re-location of the sites and helpful logistical information including: photograph of the vessel launch area used to access the survey location, distance of location from the vessel launch site, position of location in relation to obvious land and sea markers, availability of CDMA/digital mobile reception, the frequency and channel of available radio communications, mud

map of the location and details of the vehicle and vessel route used to access the location.

2.2.3 Data analysis

A random point sampling method will be used to analyze the video footage. A total of 31 different categories will be used to quantify the benthic community composition along each transect. The number of points recorded for each benthic category will be used to calculate the mean percentage cover of each benthic habitat type at each location. The *D. cornus* density data will be averaged to give a mean density m^{-2} value for each location.

2.2.4 Statistical analysis

Prior to all analyses, the normality of the density data will be tested. If significant skewness is detected, the density data will be transformed in order to achieve homoscedasticity. One-way ANOVA tests (SPSS 9.05 for Windows) will be used to identify significant differences in mean *D. cornus* density and mean live hard coral cover between locations and survey years. When significant differences are detected, pairwise differences will be tested using the Tukey honestly significant difference (HSD) method. Data from all survey years will be graphed for general comparisons of trends in mean *D. cornus* density and mean live hard coral cover over time.

3 EQUIPMENT

Camera Gear

- SONY Digital HD Video Camera (HDR-HC1E, HDV 1080i), with battery packs (3) and chargers (2), plus 1 spare
- Amphibico underwater housing, plus 1 spare
- Amphibico 3.5' LCD Monitor, plus 1 spare
- Leads
- Pelican Case
- O-ring kits and silicone grease
- Cleaning kits

General Survey Gear

- 1 x 30m measuring tape in a mesh bag (plus 1 spare tape and bag)
- 3 x cotton reel and cotton, plus spares
- GPS and batteries, plus spare GPS and batteries
- 1 underwater slate with pencil attached, plus 1 spare
- 1 underwater compass, plus 1 spare
- Water Proof envelope (for aerial map)
- Water Proof tub or bag (for mobile phones and other items that must keep dry)
- 'Marine Research' sign (for vessels)

Information

- Underwater datasheets, long-term monitoring data sheets, habitat data sheets, transect data sheets
- Reference books for the identification of corals, fish, birds, mammals and general marine fauna and flora
- 1 field notebook
- 1 stationery box (pens pencils, calculator)
- Equipment list
- Everyday survey checklist (to be checked off before leaving launch sites)
- Aerial photographs of sites
- Maps
- Copy of the Field Program Report (this report)

Camping Gear (for stay at Bothe)

- Car fridge
- Large (40L water tank) may not be needed
- Food
- Swags

Snorkel Gear (gear for 2 snorkellers and one standby snorkeller)

- 3 wetsuits

- 3 fins
- 3 masks and 3 snorkels
- 3 small dive knifes
- Dive flag
- 3 x dive weights

SCUBA Gear (gear for 2 divers and one standby diver. SCUBA is required for surveying Muiron, Tantabiddi and possibly Bundegi sites only)

- 3 Regs and Computers
- 3 BCDS
- 7 Tanks (at max, probably be able to use 1 tank for two sites)
- 3 wetsuits
- 3 fins
- 3 masks and 3 snorkels
- 3 small dive knifes
- Dive flag
- 3 dive weights

Vessels and Vehicles

- 1 x 4wd
- 1 x zodiac
- Yardiyarra
- Ningaloo 1

Safety

- CDMA mobile phone, car and wall charger
- CALM radio
- CALM vehicle equipped with CALM VHF
- Sat phone number: TBD
- Comprehensive diving first aid kit
- Comprehensive first aid kit for vehicle
- Small but useful first aid kit for zodiac
- Oxy-viva unit for zodiac, Yardiyarra and Ningaloo 1 will have one aboard already
- Sunscreen
- Water
- Spare sunglasses
- Dive knife worn by each diver
- Decompression flow charts
- Exposure dive suit
- Jump-start leads
- Vehicle tool kit
- Vessel tool kit
- Tow rope and rubber rollers

4 FIELD PROGRAM

4.1 FIELD ITINERARY

Survey Location/ Other	Activity	Logistics	Personnel Required	Date
Shannon A. to fly Perth to Learmonth	Travel	Shuttle bus from airport to DEC Exmouth	Shannon Armstrong	30/3/08 Arrive 1.45pm
Training day in Exmouth at Bundegi	Train staff in NMPDMP methods – survey Bundegi sites	Ningaloo 1 – launch at Marina; leave vessel on Bundegi mooring o/n	Shannon Armstrong Huw Dilley (DS) Roland Mau Brooke Halkyard Claire O'Callaghan Alana Whitford	31/3/08 Monday
North Muiron and South Muiron	Surveying NM plus re-establishing South Muiron location	Ningaloo 1, SCUBA, Vessel at Bundegi o/n	Shannon Armstrong Huw Dilley (DS) Claire O'Callaghan	1/4/08 Tues
Tantabiddi and Turquoise Bay High Tide of 1.2 m at 13:30	Surveying	Ningaloo 1 from Bundegi to Tandabiddi – (note high tide sufficient for survey and travel); Bundera mooring o/n plus vehicle to move south; Crew in Bothe o/n	Shannon Armstrong Huw Dilley (DS) Claire O'Callaghan	2/4/08 Wed
Winderabandi and Cloates	Surveying	Ningaloo 1 from Bundera surveying, then return to Bundera or Mesa (time and weather dependent);	Shannon Armstrong Huw Dilley (DS) Claire O'Callaghan	3/4/08 Thu
Travel day	Shannon drive to Coral Bay; Huw to organize Ningaloo 1 (note: patrol on 7/8 April)	Drive to Coral Bay and take semi-rigid zodiac	Shannon Armstrong Huw Dilley and Kevin Hughes	4/4/08 Fri
Pelican Point and Coral Bay Backreef	Surveying	Matt Smith to skipper Yardiyarra	Shannon Armstrong Matt Smith Alana Whitford	5/4/08 Sat
Drive to Gnaraloo Station, get fuel from Carnarvon first	Travel, prepare for survey	4WD Zodiac (new)	Shannon Armstrong Alana Whitford Claire O'Callaghan	6/4/08 Sun
Cape Farquhar and Gnaraloo Bay	Surveying	4WD Zodiac (new)	Shannon Armstrong	7/4/08 Mon

			Alana Whitford Claire O'Callaghan	
Turtles	Surveying, drive back to Coral Bay	4WD Zodiac (new)	Shannon Armstrong Alana Whitford Claire O'Callaghan	8/4/08 Tue
Drive back to Exmouth	Travel, clean up, pack up	4WD Zodiac (new)	Shannon Armstrong Alana Whitford Claire O'Callaghan	9/4/08 Wed
Contingency day		4WD Zodiac (new)	Shannon Armstrong Alana Whitford Claire O'Callaghan	10/4/08 Thu
Contingency day		4WD Zodiac (new)	Shannon Armstrong Alana Whitford Claire O'Callaghan	11/4/08 Fri
Shannon A. to fly Learmonth to Perth				TBD

5 SAFETY

5.1 FIELD TRIP SAFETY

To ensure the safety of all survey personnel a dive plan will be lodged to and approved by the Departmental Dive Officer. A field trip advice form containing preferred methods and details of communication contact will be lodged with the Exmouth DEC and Science Division offices. The field trip advice form also contains details of our scheduled twice-daily safety 'check-in' communications with the Exmouth DEC office.

5.2 PROJECT RESPONSIBILITIES

Boating

The skipper of the vessel will be responsible for boating and navigation in accordance with the 'Safe Marine Operations in Calm Procedure Guidelines (2002)'.
The vessel skippers are:

- Huw Dilley
- Matt Smith
- Alana Whitford
- Roland Mau

Diving

Diving will be in accordance with the 'CALM Diving Code of Practice (2005)'. Huw Dilley (Exmouth District) will be the Dive Supervisor and will be responsible for all diving activity.

Snorkelling

Snorkelling will be in accordance with the 'CALM Diving Code of Practice (2005)'.

Other Safety Issues

All other safety issues shall be in accordance with the CALM Occupational Health and Safety Procedures Manual (1995) and will be the responsibility of the project coordinator, Shannon Armstrong.

Field Staff

Shannon Armstrong – Project Leader
Field team member 1 – Alana Whitford (Coxswain)
Field team member 2 – Claire O'Callaghan
Skipper for Yardiyarra – Matt Smith
Skipper for Ningaloo 1- Huw Dilley/Roland Mau
Dive Supervisor – Huw Dilley
Diver – Brooke Halkyard

5.3 CONTACT DETAILS

Satellite Phone	0420101519
Claire O'Callaghan	0437209654
Alana Whitford	0427476663
Shannon Armstrong	0427519622
Roland Mau	0427171121
Matt Sith	0429685110
Huw Dilley	0439971582
Brooke Halkyard	0899478021
Ningaloo Station – Jane (tenetative)	0899425936
Tim -- Quabba	0899485098
Leonie McDiven (Horak) - Warrorra	0899425920
Paul Richardson at Gnaraloo Station	99425927
Frazer McGregor	0427848655
CBA Coral Bay	99425955
Pot Shot Hotel	9949 1200

6 PROJECTED BUDGET

Item	**Cost (estimates)**	**Source**
Salaries	$9030 SAR $1705 HD $3330 CO'C $2792 AW $828 RM $414 MS Total MSP: $9030 Total Exmouth District: $9069	Exmouth District MSP (SAR)
Air fares	$600	MSP
Accommodation	$300	MSP
Fuel	$1200	Exmouth District
Food	$700	MSP
Consumables	$100	Exmouth District/MSP
Analysis of data	$3000	MSP
Total	MSP: $13,630 Exmouth District: $10,369	