

Precontrol Survey  
for Crown of Thorns Starfish (Acanthaster planci)  
Holbourne Island

Report to GBRMPA by Karen Weaver

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## Introduction

Holbourne Island ( 19°44'S, 148°22'E) is a continental island with fringing reef. It lies some 30km ENE of Bowen, North Queensland.

Holbourne Island represents a unique recreational destination for the population of Bowen including outlying districts. The island lies reasonably close to the coast, close enough for easy access in small craft. The fringing reef adjoining the south of the island represents a coral community of large diversity. Recreational fishing, diving and snorkelling are popular activities (pers comm Mr Geoff Redfern) as is camping on the island. Within the Bowen region there are no other places that offer a similar choice of activities north of the Whitsundays, thus the preservation of Holbourne Island in its existing natural state is of considerable importance.

The Great Barrier Reef Marine Park Authority (GBRMPA) has coordinated two previous field exercises to remove the crown of thorns starfish, Acanthaster planci, from reefs offshore from Townsville. In July, 1986, a combined exercise utilizing civilian, scientific and service personnel removed 3175 starfish from 54 back reef bommies on Grub Reef (D. Johnson, report to GBRMPA). In February 1987, a total of 1003 starfish were removed from the lagoon side of the reef front of John Brewer Reef by servicemen from HMAS Penguin (K. Weaver, 1987). While many starfish were killed during these exercises, it is apparent that not all situations will be amenable to effective control programs similar to those which were carried out.

Two factors which are significant in limiting the effectiveness of removing starfish are the physical size of the reef and the mobility/crypticity of these animals. Where the whole of the immediate environment supporting the starfish population cannot be controlled, then it is likely that some of the residual population will migrate into the control area. In addition, the cryptic nature of some populations of starfish and/or some size classes effectively removes them from the control program when diving is limited to daytime.

Removal exercises, as carried out, are extremely labour intensive and therefore potentially very expensive. Ship time rapidly eats into funds available for work at sea. It has been essential that labour is provided voluntarily so that funds remain available for further control programs. Similarly, any savings in boat charters will be attractive.

Holbourne Island meets several criteria which it was determined should be fulfilled in providing a suitable site for forthcoming control exercises. The fringing reef surrounding this continental island is of such a size that the reef in its entirety can be controlled. There is very little hard coral cover below 15m depth so that the crown of thorns population should be located in depths which are available for no-decompression diving. Holbourne Island is relatively isolated from other reefs and distant from other identified populations of Acanthaster planci.

A preliminary survey (09/01/1987), by manta towing the reef slopes, identified a population of Acanthaster planci which was patchily distributed around the island but largely concentrated on the back reef slopes. To ensure careful monitoring of a projected control program on Holbourne Island it was decided to undertake a detailed survey of the reef slopes in order to identify the distribution and estimate the abundance of starfish. Concurrently, the benthic communities experiencing various predation pressures would be measured as part of an ongoing monitoring program.

## Methods

### 1/ Acanthaster planci Population

As a previous survey placed the bulk of the starfish population on the back reef slopes, sampling was restricted to this area. Ten transects were systematically worked across the reef slope equidistant between the northern and southern points of the island (Fig 1). A 100m tape was laid against the bottom extending from the shallowest corals into deeper water. Where the slope was wider than 100m the transects were moved further down the slope. Two divers, one on each side of the tape, swam the length of the tape and searched to 5m from the tape. Searching was undertaken so as to include all starfish which might be discovered hiding amongst the corals. Counts were recorded at 10m intervals when the depth was also noted. In this way, an area 100m X 10m (1000m<sup>2</sup>) was searched.

An estimate of the starfish population was obtained by direct multiplication of the inverse fraction of the back reef slope surveyed by the starfish count.

### 2/ Benthic Community Study

Physiognomic structural attributes (Done et al, 1981) of the benthic communities were recorded along 50m transects (Table 1). These transects were laid against the reef at depths of 3, 6 and 9m at three sites. Sites were chosen so as to provide a description of the benthos where no starfish predation had been experienced, where predation was severe and where predation had degraded the live coral cover (Fig 1).



Table 1.

## Physiognomic Structural Attributes

BENTHIC LIFE FORM	BENTHIC CODE
<u>Acropora</u>	
Branching	ACB
Tabulate	ACT
Encrusting	ACE
Submassive	ACS
<u>Non-Acropora</u>	
Branching	CB
Massive	CM
Encrusting	CE
Submassive	CS
Foliose	CF
Dead Scleractina	
(recent)	DC
(algal covering)	DCA
Algae	
Macro	MA
Turf	TA
Coralline	CA
<u>Halimeda</u>	HA
Algal assemblage	AA
Other Fauna	
Soft Corals	SC
Sponge	SP
Other	OT
Abiotic	
Sand & Rubble	SR
Water	WA

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Placement of Transects and Coral Community Sites around Holbourne Island.

Manta tow path   
 Coral Community site 

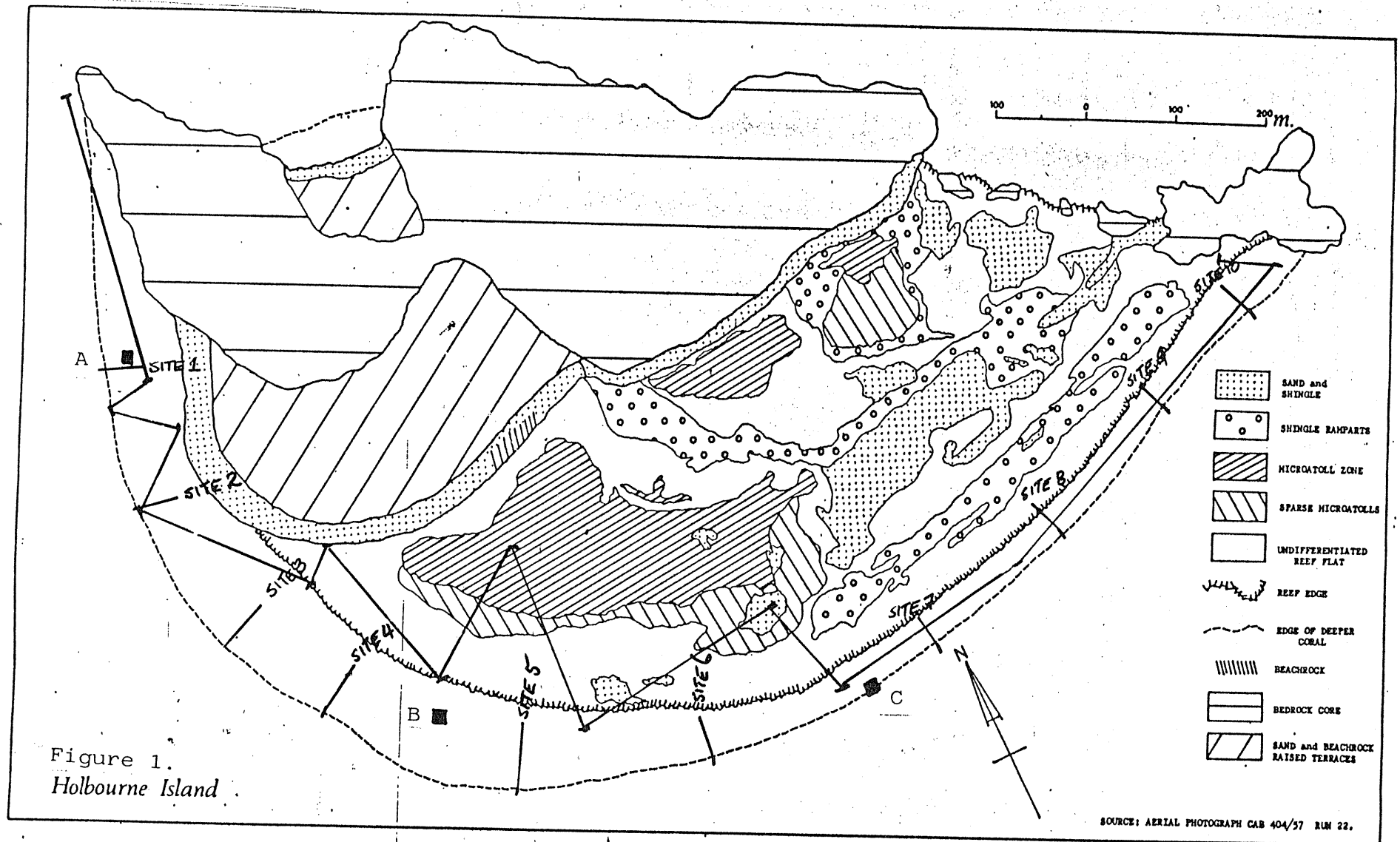


Figure 1.  
Holbourne Island

SOURCE: AERIAL PHOTOGRAPH CAB 404/57 RUN 22.

## Results

### 1/ Acanthaster planci Population.

567 starfish were recorded from a total area of 10 000m<sup>2</sup> or 1 hectare (10 of 100 X 10m). The back reef on Holbourne Island is about 2.0 km long and varies from 80m to about 150m in width. Using a nominal width of 100m for the reef slope, the transect samples represent 1/20 of the total back reef area. A figure in excess of 11 000 was calculated for the starfish population.

Counts from the belt transects revealed a patchy distribution both along the reef slope and with respect to depth (Table 2). Large numbers of starfish were recorded from transects 5, 7 and 8 which correspond with the central area of the back reef slope. They were found in predominantly shallow waters, 6-8m depth (Fig 3)

### 2/ Benthic Community Study

Live hard coral cover was greatest at site B where little starfish predation had been experienced. Branching Acropora was especially abundant at 3m and 6m depths. Other hard corals were poorly represented in terms of percentage cover (Table 3).

Site A which contained a large percentage of dead coral with an algal film was designated as having previously suffered Acanthaster related coral mortality. Branching Acropora was the predominant morphology recorded and was most abundant at 3m and 9m depths. At 6m the soft corals were very abundant where they were overgrowing dead corals. Site C had a high cover of branching Acropora at 3m depth below which this cover was greatly attenuated. Maximum cover of other coral genera especially branching morphologies, was recorded from the 9m transect. Algae was most predominant at site C.

TABLE 2 Belt Transects Counts along slope with respect to depth

Transect Number										Depth	
1	2	3	4	5	6	7	8	9	10		
0	0	0	0	0	0	0	0	0	0	0-2m 0	
16	1	2	1	0	0	0	28	0	46	2-4m 94	
11	3	5	8	109	1	42	70	0	0	4-6m 249	
1	0	31	1	33	0	65	19	10	3	6-8 163	
0	0	2	0	15	0	15	0	5	0	8-10m 37	
0	0	0	0	0	0	0	0	0	0	10-12m 0	
0	0	0	0	0	0	0	0	0	0	12-14m 0	
0	0	0	0	0	0	5	1	0	0	14-16m 6	
0	0	0	0	0	0	0	0	0	0	16-18m 0	
<b>Total</b>	<b>28</b>	<b>4</b>	<b>40</b>	<b>10</b>	<b>157</b>	<b>1</b>	<b>127</b>	<b>118</b>	<b>15</b>	<b>49</b>	<b>549</b>

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TABLE 3

ESTIMATES OF AERIAL DENSITY OF THE MAJOR BENTHIC LIFE  
FORMS OF HOLBOURNE ISLAND (IN PERCENTAGES)

Category	SITE A			SITE B			SITE C		
	3M	6m	9m	3m	6m	9m	3m	6m	9m
ACB	29.6	16.0	30.3	54.6	61.9	33.6	46.7	14.5	3.0
ACS		0.8		2.2	2.9				
ACE					0.3				0.4
ACT					2.9	2.6		3.1	
Acropora	29.6	16.8	30.3	56.8	68.0	36.2	46.7	17.6	3.4
CF		0.2						1.1	3.1
CS			0.5	0.8					1.0
CM	2.3	2.2		2.2	2.0	0.6		0.7	1.3
CB	2.1	3.6	0.1		2.0	2.1	10.3	1.0	9.7
CE	0.2	0.2	0.1					0.1	3.4
Coral	4.6	6.2	0.7	3.0	4.0	2.7	10.3	1.8	18.5
Coral	34.2	23.0	31.0	59.8	72.0	38.9	57.0	19.4	21.9
AA	1.5	7.2			1.8	0.9	12.5	10.8	18.2
CA		1.7	2.4						0.3
MA									0.2
Algae	1.5	8.9	2.4		1.8	0.9	12.5	10.8	18.7
SP	0.4	1.1			0.5	0.4	0.8	0.4	16.4
SC	6.5	23.7	2.7	0.7	7.3	18.3	3.5	8.0	13.1
OT					0.2	1.4		2.1	5.0
SR	5.9	5.3	44.4	13.3	10.8	26.1	22.3	12.0	0.3
WA									
ACA	50.0	38.0	15.6	26.2	5.6	8.3	3.9	42.2	24.3
RC	1.5				1.8	5.7		4.0	
TOTAL (%)	100	100	100	100	100	100	100	100	100

## Discussion

### 1/ Acanthaster planci Population

The estimate of 11 000 starfish on the back reef slopes of Holbourne Island depends on several variables for its accuracy. These may include:

- i) Diver error in estimating the 5m distance from the tape
- ii) Failure to locate all starfish on a transect.
- iii) Over counting of starfish where aggregations occurred about the 5m distance from the tape.
- iv) Estimation of the fraction of the whole of the back reef surveyed.
- v) Undersampling of the higher density areas of the starfish distribution.

All of these sources of error have a direct impact on the calculation of population size. These errors will compound to produce a larger overall error in the population size estimate.

It was unlikely that divers consistently searched  $> + 0.5m$  from the nominal 5m wide strip. Searching was undertaken methodically but where dense stands of branching Acropora were encountered, it is possible that some starfish were overlooked. While branching corals were frequently encountered on transects (Table 3), any failure to record starfish from this type of habitat will not increase the total counts per se but that fraction of the count obtained from these habitats. An underestimation of 5% is assigned to this likely source of error. Similarly, aggregations of starfish would not account for  $> 5%$  error.

Values used to give the total area of the back reef slope may be subject to considerable error especially in the central and southern sections where starfish counts were highest. If the higher density areas in the starfish distribution were more extensive in this section of the reef then undersampling and underestimation of the habitat available to the starfish may be the greatest sources of error. By applying these errors, the estimate of the crown of thorns starfish population size may be between ca 10 000 and 16 000 ( $- 11%$ ,  $+ 40%$ ). It is felt that the estimate is closer to 16 000.

### 2/ Benthic Community Study

Sites were selected after initial observations established that, in general, the feeding front of Acanthaster planci was moving from the western end of the back reef towards the eastern. It was felt that the position of three sites 'behind', 'within' and in 'front' of the main strength of starfish would field useful information over time on:

- i) rate of destruction and percent coral destroyed by the starfish
- ii) rate of recovery of coral communities after starfish have moved on (or been removed)

If the feeding rate of Acanthaster planci on the coral community at Holbourne Island can be established with confidence as well as the growth/replacement rate of the corals themselves then it is possible to compute the number of Acanthaster planci constituting a sustainable population; ie a population whose feeding rate on it's prey does not exceed the rate of growth and replacement of the prey. It may be important to consider other factors, such as the change in composition of the coral community over time, as these may also be important in determining the "normal" Acanthaster population for Holbourne Island.

## References

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