

Planning for Crown-of-thorns Starfish Population Increases



CROWN-OF-THORNS
STARFISH

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Planning for Crown-of-thorns Starfish Population Increases

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Published April 1995
by the Great Barrier Reef Marine Park Authority

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National Library of Australia Cataloguing-in-Publication data:

Lassig, Brian.

Planning for crown-of-thorns starfish population increases.

ISBN 0 642 17423 7.

1. Crown-of-thorns starfish - Queensland - Great Barrier Reef. 2. Great Barrier Reef Marine Park (Qld.). I. Great Barrier Reef Marine Park Authority (Australia). II. Cooperative Research Centre for the Ecologically Sustainable Development of the Great Barrier Reef. III. Title.

593.93



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I ntroduction

Crown-of-thorns starfish (COTS) are natural inhabitants of coral reefs throughout the Indian and Pacific Oceans, including the Great Barrier Reef. Like many other coral reef animals, COTS feed on hard corals, digesting the coloured living tissue to expose the underlying white coral skeletons. At low or 'normal' starfish densities, this feeding activity probably helps to maintain the high diversity of corals that characterise coral reefs. There is no standard figure for 'normal' COTS densities. In theory, it is the density of COTS that can be sustained by the corals in that area, i.e. coral cover regenerates at the same rate it is eaten by the starfish. Estimates of 'normal' vary enormously. The density of starfish that can be sustained in a particular area will depend on such things as the amount of coral cover, size of the starfish, water temperature and even the weather.

When the coral in an area is eaten faster than it can regenerate, the starfish populations are called 'outbreaking'. As a result coral cover declines, coral diversity may also decline and the area loses, to a greater or lesser extent, its aesthetic appeal to divers. Outbreaks are extremely variable. At one end of the spectrum, they may consist of several hundred to a thousand individuals, affect only small areas on reefs for a short period

and then disappear, leaving most of the reef unaffected. At the other extreme they may consist of hundreds of thousands of starfish, last for several years and leave very little living coral. A lot of intermediate situations occur. There are a lot of different views on what constitutes 'normal' and outbreaking COTS populations (see the table next page) because of this variability in outbreaks, differences of opinion among scientists, and because different survey techniques have been used to assess COTS densities.

Although it is obvious that COTS outbreaks can cause problems for management and Reef-based tourist operations, even relatively low densities of the starfish can cause concern. This is certainly the case if the numbers are reported to be increasing, as they are now on some reefs in the northern Great Barrier Reef (GBR), the Cook Islands, Western Samoa, the Solomons, Malaysia, Indonesia, Fiji, the Cocos (Keeling) Islands, South Africa and in the Red Sea (Egypt).

Damage by COTS is likely to have a most significant impact on site-specific tourism operations because of their substantial investment in infrastructure and the high cost of relocation. In some areas (e.g. off Cairns) the limited availability of alternative sites means that the maintenance of existing sites in good condition is vital. Although roving operators are likely to be less affected because of their generally lower capital investments and higher mobility, damage by COTS could result in a need

to abandon some 'special' sites, to search for alternative sites and modify marketing strategies. Costs may be significant and again, in high use areas, alternative sites may be limited.

This Plan is intended to form a key part of a comprehensive and integrated plan of action to be implemented in anticipation of increases in the number of COTS on the Great Barrier Reef. It focuses on interactions between individuals, industry groups and organisations, as well as issues of particular importance to day-to-day management of the Marine Park and the tourist industry. Additional parts of the Plan to be developed in 1995 will cover details of research and administration. The Plan is intended to be much broader than describing actions to be implemented in the event of another major outbreak episode on the Great Barrier Reef, should one occur. It covers day-to-day issues that need to be

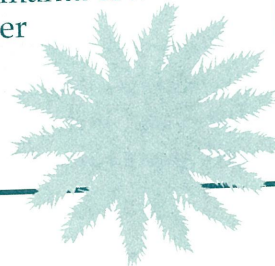
addressed to ensure that appropriate management actions are initiated with minimal delays when they are warranted.

For some activities described in this document (surveys and controls for example), the appropriate actions depend on the status of COTS in both local areas and on a broader scale. For these, actions are described for the current situation (*now scenario*) and for the situation where starfish densities are higher than they are at present (*if scenario*). Circumstances that signal a change from the current situation to that of higher COTS densities (triggers) are described in these cases. For other aspects (communication for example) this differentiation has not been made because the actions should remain the same, regardless of the numbers of starfish (although the intensity may increase!).

Some Definitions of Normal and Outbreaking COTS Populations

(adapted from Moran 1986)

Normal	Outbreaking
About 1 starfish per 100 m ² of reef	14 starfish per 1,000 m ²
About 6 starfish per km ² of reef	40 starfish per 20-minute swim
4-5 starfish per km of reef	100 starfish per 20-minute swim
5-20 starfish per km of reef	100 starfish per 20-minute manta tow
Less than 14 starfish per 100 m ²	10 starfish per 1-minute spot check
Less than 10 starfish per 20-minute swim	More than 40 starfish per reef perimeter manta tow
Less than 20 starfish per 20-minute swim	More than 1,500 starfish per km ² of reef
Less than 1,500 starfish per km ² of reef	Much more than an average of 0.22 starfish per 2-minute manta tow around an entire reef perimeter
Less than an average of 0.22 starfish per 2-minute manta tow around an entire reef perimeter	

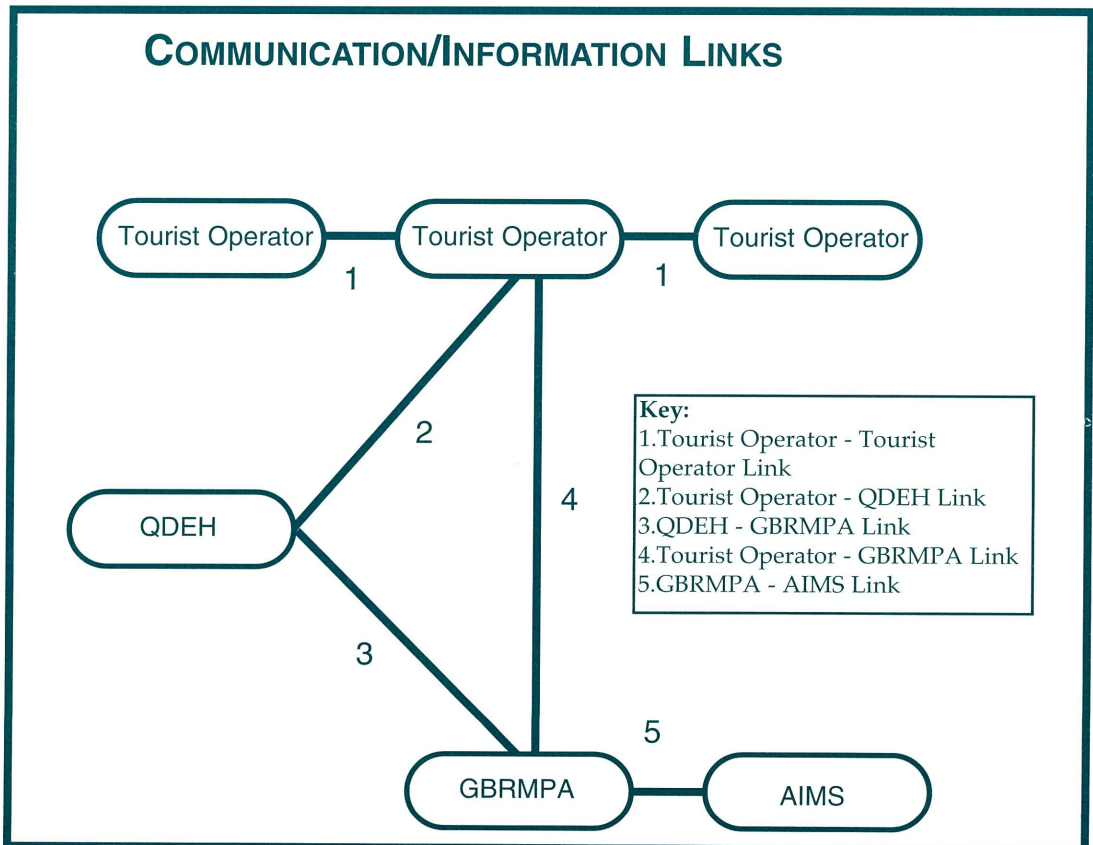


Communication and Information Links

The figure below shows the main lines of communication between the major players. The lines indicate the most common paths of information flow, but communication should not be restricted to these ways if other means are clearly more efficient. For instance, there may be occasions when Queensland Department of Environment and Heritage (QDEH) staff or Tourist Operators need to talk

directly with Australian Institute of Marine Science (AIMS) staff about surveys or survey techniques.

The flow of information should be seen as ongoing, not driven or triggered by particular problems or events. If everyone is kept well informed, surprises will be minimised, processes will become well established and the channels of communication well-worn. The bottom line is that all players should know what's going on and ALL players have a responsibility to ensure that relevant COTS information is appropriately disseminated in a timely manner.



1. *Tourist Operator / Tourist Operator Link*

Although Tourist Operations are commercial enterprises in competition (to greater or lesser extents) for business, there may be considerable benefits if staff of companies operating in similar areas (e.g. out of Cairns and Port Douglas) maintain regular contact over the COTS issue. It's usually easier to talk and relate to someone who's 'in the same boat'.

It is recommended that Operators freely share information on such things as observations of COTS numbers in their areas, as well as knowledge and experience with local controls. Contacts for a number of Operators who have agreed to participate in this arrangement are included in this Plan.

2. *Tourist Operator / QDEH Link*

In most cases, QDEH staff will act as the front-line of communication with Tourist Operators and as an intermediary between Operators and Great Barrier Reef Marine Park Authority (GBRMPA) staff. QDEH has nominated contact officers for each permitted Operator. Communications should be channelled through these contact officers. While Operators should keep a close watch on COTS numbers and coral damage at their own sites, QDEH staff should be able to conduct surveys for COTS and coral damage in areas of concern

to Operators. QDEH staff should be able to conduct surveys within 2 weeks of requests being made, weather and vessel availability permitting. It may be necessary for industry to provide vessel access to the site concerned if Marine Park vessels are unavailable. Good descriptions of sites (preferably mud-maps and/or aerial photographs) will help in locating area(s) of concern. Global Positioning System coordinates may also help, although there have been problems with pin-pointing sites using this method in the past.

3. *QDEH / GBRMPA Link*

GBRMPA and QDEH staff should maintain frequent contact on the regional status of COTS. QDEH staff should provide GBRMPA COTS staff with completed COTSWATCH forms (Reef-user COTS sighting questionnaires) as soon as possible after conducting any field surveys where COTS information is collected. GBRMPA COTS staff may request QDEH to survey areas where unusually large numbers of COTS have been reported through the COTSWATCH Program.

GBRMPA COTS staff will provide QDEH with summaries of COTS information from the COTSWATCH Program and other surveys (e.g. AIMS monitoring program) on a regular (3-monthly) basis. This information will be provided either through presentations at regional offices, and/or through written advice (including *Reef Research*). Such information will also be provided on an ad hoc basis if requested.

4. *Tourist Operator / GBRMPA Link*

Tourist Operators and GBRMPA COTS staff should communicate through a variety of channels. Information on the regional status of COTS, controls etc. should be provided by GBRMPA COTS staff through the COTS extension program (3-monthly visits to regional centres to conduct public lectures and presentations) and through targeted distribution of COTS COMMS in *Reef Research*.

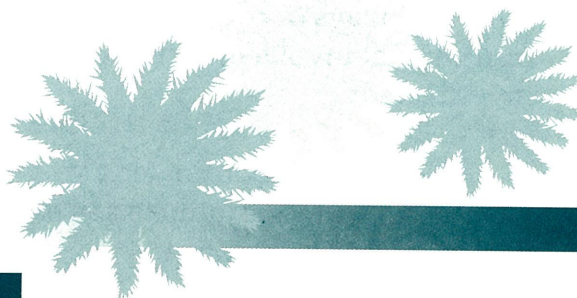
Although Tourist Operators could contact either QDEH or GBRMPA staff in matters relating to permits to control COTS (permit applications and reporting of control details), the process is likely to be expedited if the GBRMPA COTS staff are contacted directly. Tourist Operators should also contact the GBRMPA COTS staff in providing information through the COTSWATCH Program, and in requesting any information relating to research. It is vital that information on COTS sightings (including zero sightings) through the COTSWATCH Program be provided on a regular basis and not just if higher than usual numbers of COTS are observed. As well as helping to build a realistic, unbiased picture of what's going on in an area, the information could help with speeding up the processing of any control permit applications.

Tourist Operators are also likely to communicate with other GBRMPA and QDEH staff from time to time on other matters (e.g. permit

applications for operations, involvement in public participation and extension programs). Comments from Operators on any matter relating to Reef management should, as part of normal duties, be conveyed by GBRMPA and QDEH staff to those responsible for the areas of concern.

5. *GBRMPA / AIMS Link*

GBRMPA COTS staff should liaise with the AIMS Monitoring Team Leader on aspects relating to field surveys and the regional status of COTS. GBRMPA should provide AIMS with regular reports of information obtained through the COTSWATCH Program and may request surveys of particular reefs in areas scheduled for survey. Such requests may be to provide detail to supplement information provided through the COTSWATCH Program (e.g. to survey a larger area of reef where reasonably high numbers of COTS have been reported at a limited number of sites) or to confirm particular observations. In making such requests it should be recognised that planned schedules need to be adhered to and any supplementary surveys will be made only if time and resources permit.



Surveys

Reef-wide monitoring of COTS populations on the Great Barrier Reef has been conducted since 1985. A survey team at the Australian Institute of Marine Science (AIMS) is currently assessing COTS numbers on around 80 - 100 reefs each year using the manta-tow technique. Additional information on COTS is gathered through the COTSWATCH scheme. Reef-users such as divers, snorkellers, tourist operators, researchers as well as Marine Parks staff are being asked to inform GBRMPA of their observations in relation to COTS.

A recent increase in starfish numbers on some reefs between Cairns and Lizard Island has prompted the Crown-of-Thorns Starfish Research Committee (GBRMPA's advisory committee on the COTS issue) to recommend that additional, detailed surveys of COTS be undertaken in the 1994-95 financial year. The Committee also recommended that, in order to get a comprehensive understanding of the current status of COTS in this area, new ways of community and institutional involvement be investigated.

This project, coordinated by GBRMPA, is being conducted as a project of the Cooperative

Research Centre for Ecologically Sustainable Development of the Great Barrier Reef (CRC Reef Research Centre) in Townsville. About 24 reefs between Cairns and Lizard Island will be surveyed during the 1994-95 financial year. Logistic and other support offered by members of the tourism industry in relation to the conduct of the surveys will be treated as an 'in-kind' contribution to the CRC: Reef Research Centre. Such contributions will not, however, affect an Operator's obligations to pay the Environmental Management Charge.

The type and intensity of surveys will need to adapt to the prevailing conditions. The following sections deal with actions that need to be implemented now and others that need to be implemented if starfish numbers increase, either locally or on a broader scale.

Actions to be implemented NOW:

Information on the status of COTS populations (including numbers and sizes of starfish and the changes in these over time) is critical to understanding the causes of outbreaks. It is also vital to assessing the need to undertake local controls. The three main hurdles to getting this information are:

- Because of the high costs it is impossible to survey all reefs or even all of the individual reefs (e.g. the GBR Marine Park is about 350,000 km² and

includes about 2900 reefs; 300 of which are in the area between Cairns and Lizard Island);

- Different methods are used by different people or organisations or in different areas of reefs (e.g. reef slopes compared with bommie fields) to assess COTS populations, making comparisons between areas and times extremely difficult; and

- Incidental reports of COTS by divers are extremely variable - divers have different interests, skill levels and experience so that two divers swimming side-by-side are likely to see different numbers of COTS.

There are several actions that can be implemented to overcome these problems:

- Develop a cooperative approach to COTS surveys involving both individuals and institutions (see also communication links) so that as many areas and reefs can be surveyed in a cost-effective way;

- Identify appropriate cost-effective fine-scale survey methodologies and the extent of surveys to be conducted in response to increasing numbers of COTS in high-use areas; and

- Determine the training needs of interested parties to further improve the quality of the survey data and provide necessary training in survey methods.

GBRMPA will take the lead coordinating role in these actions, and will seek assistance from AIMS and QDEH field staff, particularly with training activities.

Because of the variability in the number of COTS that divers are likely to see if they are diving for reasons other than to specifically survey for COTS, it is recommended that Tourist Operators arrange for staff to conduct dedicated COTS surveys. These surveys should be undertaken in key sites (e.g. snorkelling areas, dive sites and semi-sub routes) every month or so. For larger operations, this could involve one staff member snorkelling or diving to survey one key site to record COTS and coral damage (from COTS feeding) during a lunch break each week. Dedicated COTS surveys will significantly improve the accuracy of information on COTS numbers.

GBRMPA staff will ensure that regular (i.e. quarterly) updates on the reef-wide status of COTS is made available to all interested parties. The GBRMPA newsletter *Reef Research* as well as public lectures and presentations in regional centres along the coast will be used as the primary means of providing this information.



CROWN-OF-THORNS STARFISH SURVEY



Great Barrier Reef Marine Park Authority

Please read this section before you complete this form. Simply complete this assessment for each reef you visit. During your visit, note the condition of the coral and the presence or absence of crown-of-thorns starfish. Count all the crown-of-thorns seen on each dive. The information you provide will help us to keep a check on the starfish on the Great Barrier Reef. If you would like more information on the crown-of-thorns just tick the box on the back of this form. **Zero Sightings:** Please note that it is equally important to complete reports for reef visits during which no starfish are sighted.

- Name of reef:
(or number from GBRMPA map)
Date of visit:
- If possible, please sketch a map of the reef in the space provided on the back of this page. (You can use your GBRMPA zoning map to help you identify the exact location)
- How did you examine the reef?:
Scuba Diving Snorkelling Reef Walking
Other:
- How much of the reef did you examine?:
Most Several sites One site
(Mark on your map the site/s examined.)
- About how long did you examine each site?:

Site 1	hr.	min.
Site 2	hr.	min.
Site 3	hr.	min.

6 What proportion of the corals appeared to be dead?

A recently dead (ie. corals white or covered by fuzzy, green algae)

	Site 1	Site 2	Site 3
No dead coral			
Few < 1/4			
Some < 1/2			
Much < 3/4			
Most > 3/4			

B long dead (ie. corals entirely covered by brown algae)

	Site 1	Site 2	Site 3
No dead coral			
Few < 1/4			
Some < 1/2			
Much < 3/4			
Most > 3/4			

7 Did you see any crown-of-thorns? Yes No

If NO, please seal and post your survey, thank you for your assistance. If YES, please continue.

8 How many crown-of-thorns did you see on each site?

Site 1 Site 2 Site 3

9 What depth of water were they in?

Site 1 m, Site 2 m, Site 3 m.

10 Generally, where were the crown-of-thorns seen?

- Hidden under coral
On top of coral
On sand

11 Generally, how were they grouped?

- Clustered together
 Uniformly scattered
 Single individual

12 How large were the crown-of-thorns starfish?

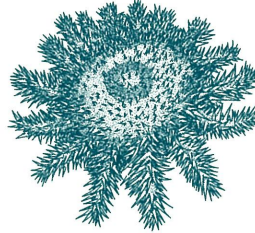
- Smaller than palm
 Size of outstretched hand
 Much larger than hand

13 Have you visited this reef before?

Yes No if yes, when? / /

Did it have similar numbers of crown-of-thorns?

Yes No if no, more less



WARNING

THE SPINES OF THE CROWN-OF-THORNS ARE TOXIC AND MAY PRODUCE PAINFUL INJURIES. ALWAYS KEEP A SAFE DISTANCE.

Please seal and post your assessment. Thank you for your assistance.

The Authority's
COTSWATCH
reporting form

Actions to be implemented IF starfish numbers increase:

The primary trigger for a change from the norm requiring consideration of additional action would usually be if 10 or more COTS are reported in a single dive (approximately 30 minutes) or at a single site (recorded during a dedicated COTS survey). Reports of fewer than 10 COTS in an area may cause concern to Tourist Operators in some instances. This figure should be used as a guide only - Operators should not feel constrained to contact GBRMPA staff regarding options only when this number is exceeded. In many instances, a trend of increasing COTS numbers and/or the extent of coral damage will be more significant than the density of starfish at any point in time.

Starfish at this density (10 per dive or per site) would not be classified as an outbreak, but it is high enough to warrant consideration of local control action, depending on the location of the starfish (e.g. in a snorkelling area).

Other information should also be taken into account in this assessment:

- Historical information on COTS at that site or reef;
- Other reports of COTS in that area;
- The proportion of juveniles (starfish less than 15 cm in diameter);
- The density of the starfish; and
- The amount and type of coral damage.

As a result of this assessment the following actions may be necessary:

- GBRMPA to coordinate additional quantitative fine-scale surveys in areas perceived to be under threat by increasing numbers of COTS and adjacent areas on the reef; and
- GBRMPA (in consultation with Tourist Operators, QDEH and AIMS) to evaluate the extent and meaning of increased population densities to assess the need for additional resources for surveys and/or local controls.

Local Controls

The GBRMPA's current policy on controlling COTS numbers allows for the killing or collecting of COTS in areas of scientific or economic importance. Reef sites that are frequently visited by dive tourism operations clearly fall into this category. However, a GBRMPA/QDEH permit is still required before local-scale controls can be undertaken in most areas (see page 14).

Actions to be implemented NOW:

Reviews of the effectiveness of local COTS control programs show that controls were generally successful in protecting coral when

there was adequate warning of an approaching outbreak; the starfish were aggregated in small, accessible areas; the population was small; there was a rapid response; there were sufficient, dedicated personnel for the job; and the controls were repeated. Controls failed when there were too many starfish for the resources available; when there was migration of starfish into the cleared areas; when starfish were difficult to detect; and when there were long delays in initiating control action. The most critical factor appears to be the early detection of outbreaks and the subsequent initiation of control action.

Although a number of Tourist Operators have suggested that the easiest way to minimise delays in initiating control action is to abolish the need to have a permit to control COTS, the Authority does not see this as an acceptable option. COTS are natural inhabitants of coral reefs and they may play a key role in the maintenance of coral species diversity. Many tourist operations are situated in higher protection zones (such as Marine National Park 'B', Conservation Park or National Park Zones) where collecting (which includes killing) is not allowed for any species without a permit. Allowing COTS controls without a permit would be treating this species differently to any other and set a precedent that may be exploited - to the detriment of the local ecology of particular areas.

The following actions will help to ensure any necessary control action is given the best chance of success:

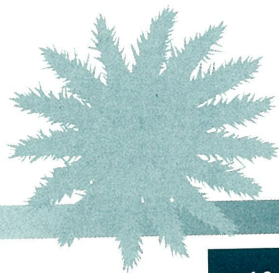
- Continuation of dedicated COTS and coral damage surveys to ensure that any increases in COTS numbers are detected at the earliest possible time;
- GBRMPA and QDEH to minimise administrative requirements in relation to control permit applications to expedite processing of any future applications. A class assessment for local control of COTS has been completed to reduce permit assessment times, but there is still a lag caused by the backlog of applications for the host of (mainly tourism) activities that require approval. Actual processing time is minimal. Mechanisms to shorten lead times are being investigated. A period of approximately 3 weeks (maximum) from submission of the application to the permit being received is seen as both desirable and achievable; and
- A detailed manual on the effective conduct of controls will be published and distributed to interested Reef-users.

Actions to be implemented IF starfish numbers increase:

If numbers of COTS increase to, or are at, a level where Tourism Operators are concerned that starfish numbers observed at their sites may adversely affect the use or amenity of those sites, a permit application to control the starfish should be lodged with either the regional QDEH office or GBRMPA. Staff from these organisations may contact the Operator for further details to assess the situation as described in the previous section. Permit applications will be dealt with as quickly as possible. Previous reporting on the status of COTS at the site to provide historical information will help to expedite the application. To assist in the conduct of effective control programs GBRMPA staff will take responsibility for the following:

- Development of a training program dealing with important aspects of local-scale controls to be offered to concerned parties on a needs basis; and
- Investigation of the possibility of an accredited training program to avoid liability and insurance problems associated with using volunteers.

If COTS numbers increase over a broader scale and have the potential to adversely affect a number of tourist operations,



GBRMPA may liaise with the armed services to seek possible assistance in attempting more extensive and intensive local-scale controls (as has happened in the past).

Research Directions

Actions to be implemented NOW:

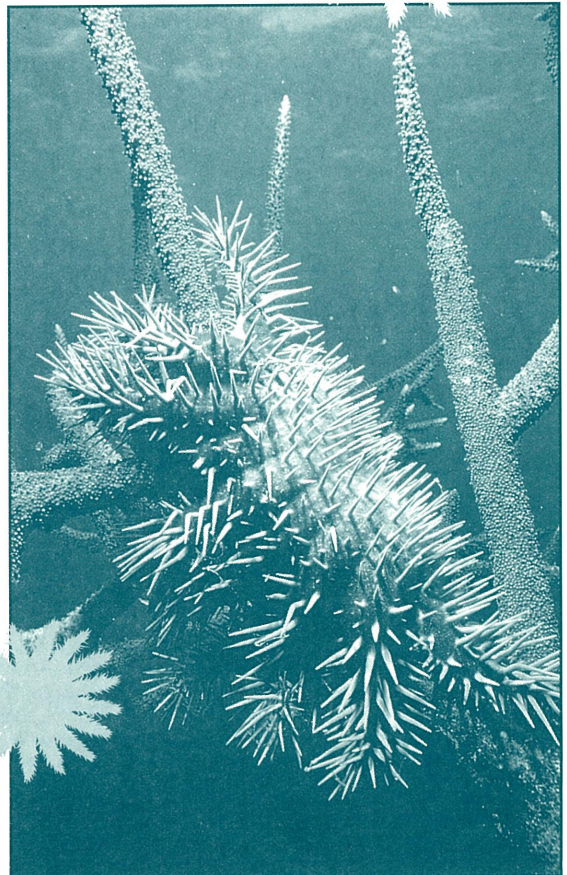
A review of the last 5 years of research and a description of possible future research areas are presented elsewhere (Lassig et al. in press). The Authority's COTS Research Program will continue to focus on monitoring the status of COTS and their effects on the GBR, and investigating the causes of outbreaks. Current research to develop efficient and environmentally friendly local control techniques will also be continued.

Tourist Operators and QDEH staff can contribute to research through completion of COTSWATCH forms and in providing details of control programs (numbers and sizes of starfish killed or collected). This information will give indications of when previous recruitment occurred (for correlations with any known events) and allow projections of future COTS population densities.

There is potential for Tourism Operators to contribute to field research through providing logistic support as a contribution to the CRC Reef Research Centre.

Actions to be implemented IF starfish numbers increase:

In the event of significant increases in the numbers of COTS and damage to reefs, there will be an urgent need for additional funding. The initial priority will be to instigate more intense regional surveys to establish the scale of



COTS population increases and to gather baseline information (pre-outbreak conditions) for later (post-outbreak) comparisons, e.g. coral cover and community structures.

An outline of a contingency plan for research has been developed (Lassig et al. 1993). A detailed research program will be compiled in collaboration with researchers during 1995. This plan will include research that should be done in anticipation of another outbreak episode and research to be started if another episode occurs. The completed plan will be submitted to the Authority's advisory committee on the crown-of-thorns starfish (COTSREC - the Crown-of-Thorns Starfish Research Committee) for their endorsement and it will serve as a foundation for the development of future research programs.

Media

Keeping the public informed on the status of COTS on the GBR and results of the COTS Program is a vital function of the Authority. The media is an effective vehicle for disseminating public information, and therefore it forms an important component of the COTS Extension Program. The Authority needs to provide facts on COTS to the media regularly, so there can't be any substance to possible accusations

that we have 'covered up' or suppressed information. Such accusations have been made in the past and resulted in a considerable waste of resources in 'fire-fighting'. Information should be provided to the media through press releases and/or conferences, distribution of COTS COMMS in *Reef Research* and the *Great Barrier Reef Reference File*, and interviews. All media interaction for the Authority (including COTS) is coordinated through the GBRMPA Media Office.

Much of the media coverage of COTS in the past has been over-dramatic, inaccurate and sensationalised. The industry is justifiably concerned that reporting in this way has a negative impact on Reef visitation rates and therefore private enterprise. Inaccurate reporting is also a concern for the Authority because of the unfounded criticism and unwarranted anxiety it generates. There are seven things that can be done to minimise the likelihood of sensationalised reporting:

- Press releases should contain essential facts and limited information to encourage contact with COTS Program staff;
- The GBR situation should be placed in a broader perspective (emphasising that the GBR is not unique - COTS undergo similar population fluctuations on reefs throughout the Indo-Pacific region);



Close-up of crown-of-thorns starfish arm

- COTS Program staff should try to help increase the knowledge and understanding of media representatives through invitations to attend local COTS presentations and detailed briefings from COTS Program staff;

- Stress positive angles, especially in regard to local control measures;

- COTS Program staff should get to know the best way to deal with particular reporters and publications (e.g. some may produce more accurate reports from hardcopy material rather than interviews);

- COTS Program staff should request pre-publication proofs of reports for comment (this is generally acceptable for magazines, but not for newspapers); and

- All interviewees should avoid over-dramatic and emotive language.



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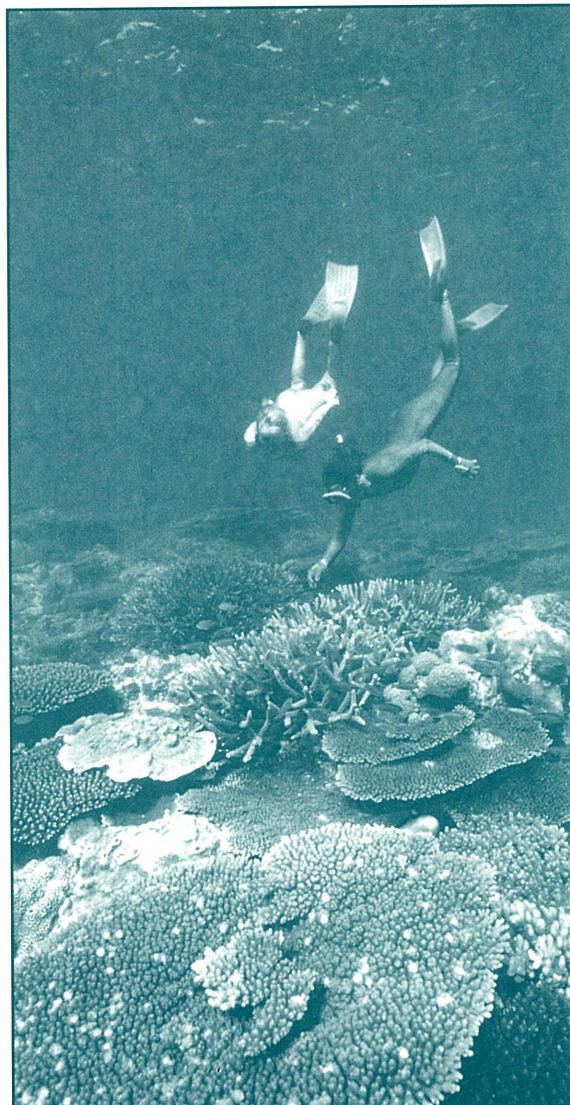
GBRMPA Policy on Controls

Broadscale control of crown-of-thorns starfish is not to be attempted in the Great Barrier Reef Marine Park unless human activity is proven to cause or exacerbate outbreaks, or unless any future outbreaks are much more extensive and intensive than the two that have been observed.

Local control of crown-of-thorns starfish (by any method involving treatment of individual starfish) must be consistent with zoning plan provisions and should be consistent with management plan provisions.*

Recognising the potentially high risks associated with biological and chemical control measures in complex coral reef environments, research into biological and chemical control of crown-of-thorns starfish should not be supported other than is identifying potential agents whose application is consistent with the two policies above.

In the event of a causal relationship between human activity and crown-of-thorns starfish outbreaks being established, the Authority should use all its powers and influence to regulate that activity to minimise the effects of that activity on crown-of-thorns starfish populations, and should also seek to minimise the effects of outbreaks.



**Note: A permit will be required for local control measures in General Use 'A' and 'B' Zones where it is desired to collect more than 5 starfish per person in any 28-day period. A permit may be granted for local control measures in higher protection areas (MNP 'A' and 'B', Conservation Park, Buffer and National Park Zones) where the provisions allow for the taking of animals that pose a threat to ecosystems or the use and amenity of an area.'*

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C contacts for COTS Information

The following contacts are people who have helped in the development of this Plan and who have agreed to discuss their experience and knowledge of COTS with others. If you are not on the list but feel you would like to be, or know of someone who would, please contact the COTS Program Coordinator.

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