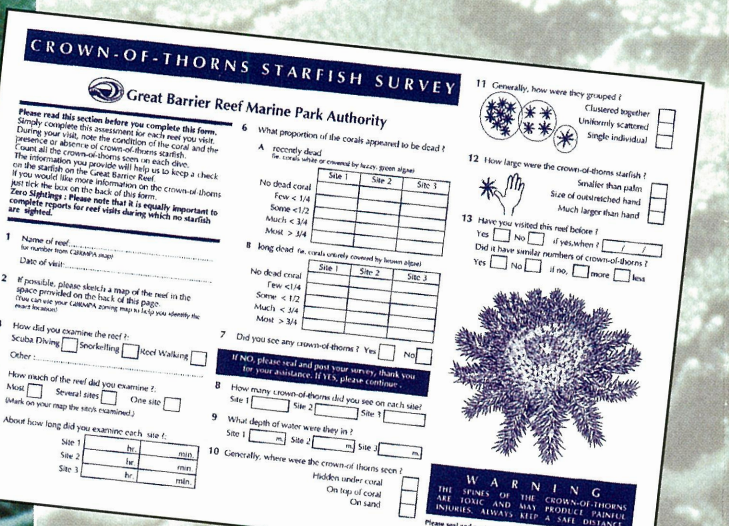
How you can help

Researchers have asked the general public, and especially tourist operators and their staff, to help them and the response was immediate. A network of information gatherers called COTSWATCH has been running since 1993. Divers, snorkellers, charter boat operators and tour guides count COTS underwater and fill in a simple reply-paid form (below) showing where starfish are sighted, and just as importantly, where none are seen. Forms returned to the Great Barrier Reef Marine Park Authority are entered into a computer database. The efforts of individuals have proved to be of vital importance in alerting scientists so that they could investigate the early stages of the current outbreak and help prepare for it.



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.

1 Name of reef.................. (or number from GBRMPA map)
Date of visit:..................

2 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)

3 How did you examine the reef ? Scuba Diving ☐ Snorkelling ☐ Reef Walking ☐
Other :..................

4 How much of the reef did you examine ? Most ☐ Several sites ☐ One site ☐ (Mark on your map the site/s examined.)

5 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.

Who are the scientists?

Research and monitoring are being carried out by scientists from the Cooperative Research Centre for the Ecologically Sustainable Development of the Great Barrier Reef (CRC Reef), the Great Barrier Reef Marine Park Authority (GBRMPA), the Australian Institute of Marine Science (AIMS), the Queensland Department of Environment and Heritage (QDEH), the tourism industry, and many other organisations giving valuable assistance.

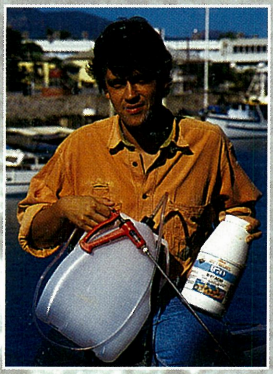


Photo: Don Alcock

Udo Engelhardt, a GBRMPA/CRC Reef scientist, spearheads the research team investigating the latest outbreak of COTS on the Great Barrier Reef.

CRC Reef Research Centre

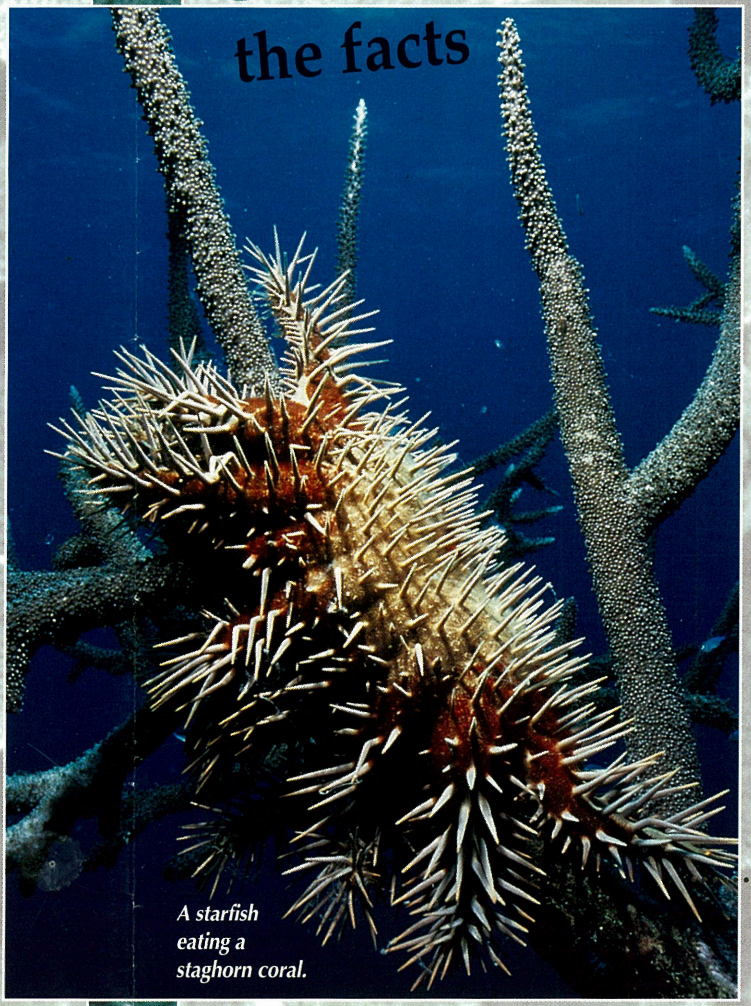
Great Barrier Reef Marine Park Authority

FOR FURTHER INFORMATION CONTACT

The COTS Coordinator
Great Barrier Reef Marine Park Authority
PO Box 1379
TOWNSVILLE QLD 4810
Phone: (077) 500 700
Fax: (077) 726 093

Feb '96
Design: Andreas Wagner

Crown-of-thorns starfish on the Great Barrier Reef:



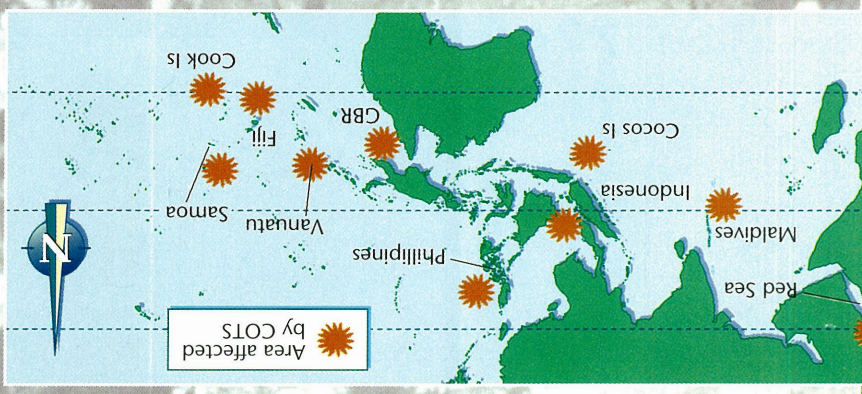
A starfish eating a staghorn coral.

CRC Reef Research Centre

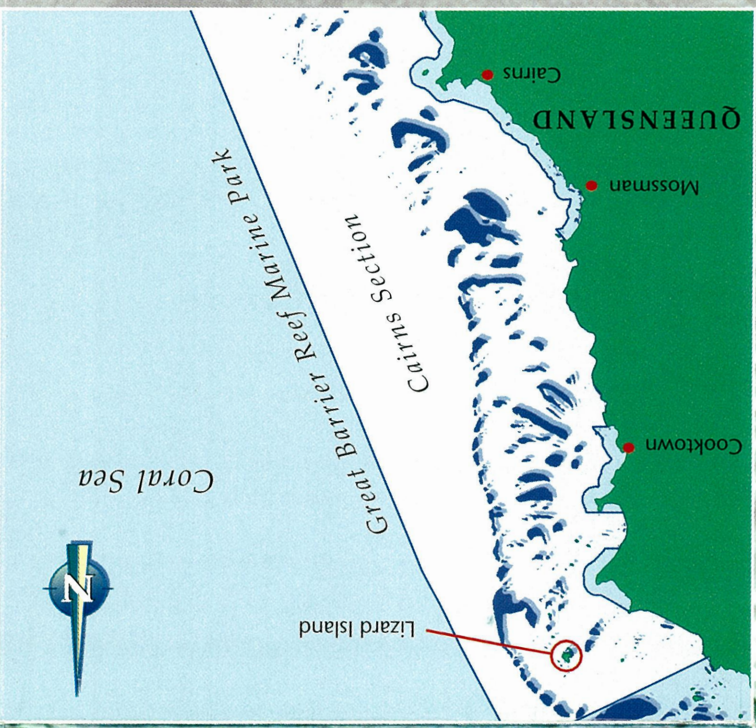
Great Barrier Reef Marine Park Authority

Marine scientists have recently announced another outbreak of crown-of-thorns, the coral-eating starfish researchers call COTS. The outbreak has started again where previous outbreaks began, in the Cairns Section of the Great Barrier Reef Marine Park. While small numbers of COTS can be found at any time along most of the length of the Great Barrier Reef, some reefs between Cairns and Lizard Island now have three to eight times as many starfish as can be sustained by the live cover of corals. Just as areas of land can be badly damaged by bush fires, so this part of the Great Barrier Reef is suffering across a widespread area but the damage is patchy.

COTS researchers work closely with their counterparts in other countries, and it appears that this outbreak is not unique. Tropical areas around the Indo-Pacific are affected - in the Red Sea, South Africa, Maldives, Indonesia, Vanuatu, Cook Islands and Fiji. Scientists expect to record outbreaks off Okinawa, Guam and the Marianas within the next 12 months. Sharing research results is adding to the common pool of knowledge, and we may be able to observe a whole cycle, and control specific areas. We are no longer watching helplessly as we were in the 1960s.



COTS outbreaks are an Indo-Pacific phenomenon. Researchers have found increasing numbers on many coral reefs.



This time, Reef managers and the research community are ready. Work over the past ten years is paying off.

- We have developed new survey techniques to allow the early detection of any increase in populations of small, juvenile COTS. Previously we only realised they were increasing in numbers when large adults suddenly appeared on a reef.
- We have developed a safe method of controlling their numbers by injecting them with 'Dry Acid', and tourist operators have been trained to conduct local-scale controls in small areas important either to tourism or science.
- Because we are detecting juveniles at an early stage, we may be able to pinpoint the factors which trigger significant outbreaks of COTS.
- Scientists and managers of the Great Barrier Reef have a contingency plan now being activated to deal with this outbreak, including localised control measures, an expanded observer network and new research initiatives.

Marine scientists classify reefs into four conditions according to the number of COTS found in a certain area:

- Non-outbreak - there are less than 10 COTS per hectare
- Incipient-outbreak - high densities of juveniles are found which are likely to survive and grow
- Spot-outbreak - high density populations of a very local distribution
- Active-outbreak - there are more than 30 mature COTS per hectare.

Above: A juvenile starfish eats a mushroom coral. COTS consume about half their diameter in coral in 24 hours.

Left: Outbreaks begin in the same section of the Great Barrier Reef, between Cairns and Lizard Island.

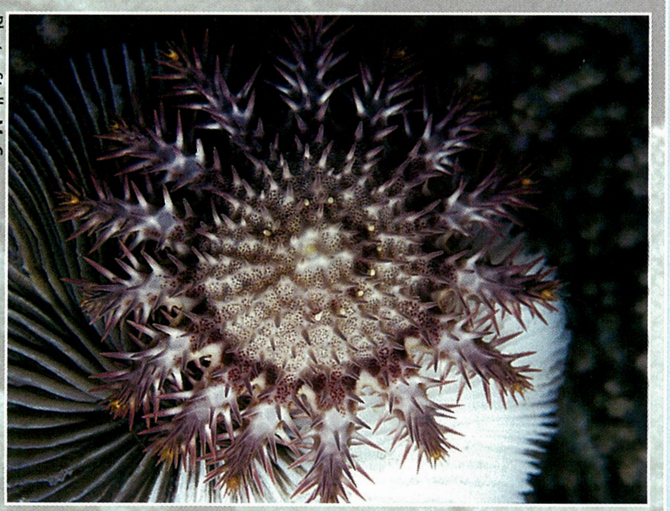


Photo: Stella M. Covre

The history of COTS outbreaks

European visitors to the Great Barrier Reef have only observed COTS outbreaks since the introduction of SCUBA equipment in the 1950s, but it has been shown that these population increases may have occurred for many decades. Oral historians from James Cook and Griffith Universities have interviewed trochus divers from the Torres Strait who knew about COTS in the early part of the century, but were never concerned, regarding them as a natural part of the environment.

Since COTS were first recorded in large numbers at Green Island in 1962, outbreaks have followed a pattern. They spread south to the Innisfail region between three and five years later, to reefs off Townsville five to eight years later, and to the Whitsundays 10 to 12 years later, by which time the northern part of the Great Barrier Reef is already in recovery mode. Outbreaks occur predominantly on mid-shelf reefs, and on these reefs outbreaks are extremely variable, ranging from slight to very severe.

During the last outbreak in the late 1970s and 1980s, approximately 17% of the 2900 reefs that make up the Great Barrier Reef were affected by starfish. Of those, only 5% of reefs were classified as having severe outbreaks.

The biology of COTS

Typically, COTS spawn in midsummer when the surface water temperature reaches about 28°C. Each mature female may produce up to 100 million eggs in a single spawning season. While drifting

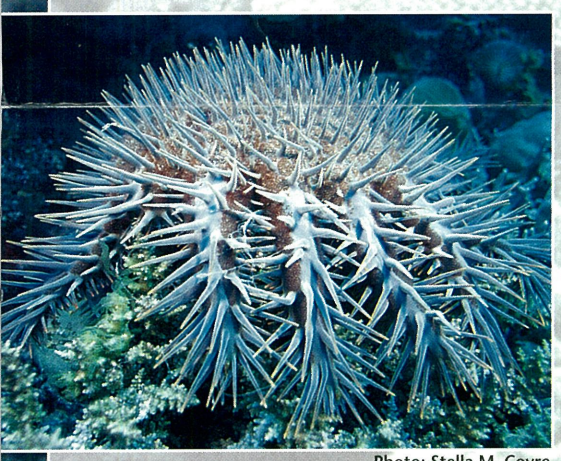


Photo: Stella M. Covre

An adult starfish in feeding position, sitting on top of a coral and turning its stomach inside out to envelope its food.

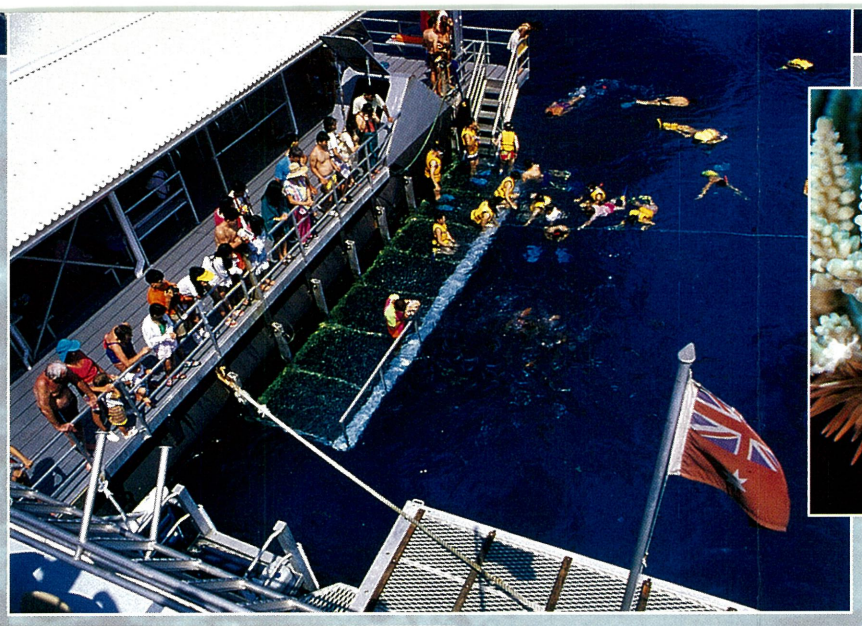
in the ocean currents, the larvae feed on microscopic algae. After several weeks of drifting between the reefs, the small larvae finally settle amongst the coral "rubble", where they continue to feed on types of algae. When they reach the age of six months, their diet changes and the coral itself becomes their main food source.

COTS reach sexual maturity after two to three years and can live for 12 to 14 years. However, during an outbreak when food becomes scarce, their life span is much shorter. Often the starfish die of starvation after just a few years.

How corals recover

Large aggregations of COTS may eat most of the hard corals on a reef, although remnants are often left behind which can regenerate. But after the mass spawning of coral in the following October or November, various coral species start to recolonise the reef. Staghorn and table corals are amongst the first to re-establish themselves.

Within 10 to 20 years, reefs can have good coral cover again, although the corals are predominantly the fast growing varieties. Massive coral takes longer to regrow and must compete with the faster growing corals for light and space. Some reefs which were affected by COTS two decades ago have now recovered so completely that they are major tourist attractions.



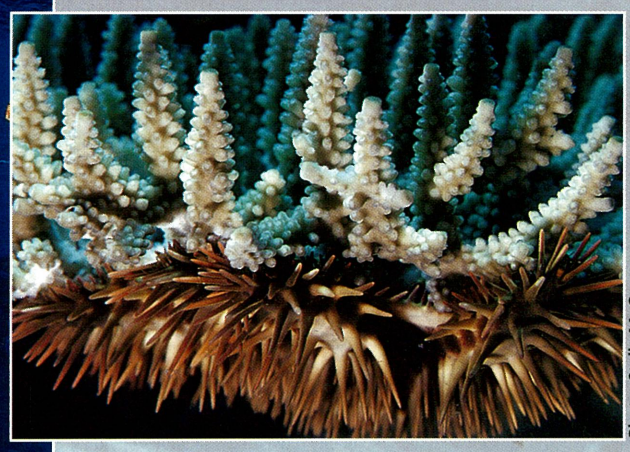


Photo: Stella M. Covre

Photo: Dave & Noreen Downs

Top left: Snorkelling over coral is a major tourist attraction and local-scale control measures are used at sites which may be affected.

Top right: Starfish, especially small ones, hide underneath the coral in crevices during the day and feed actively at night.

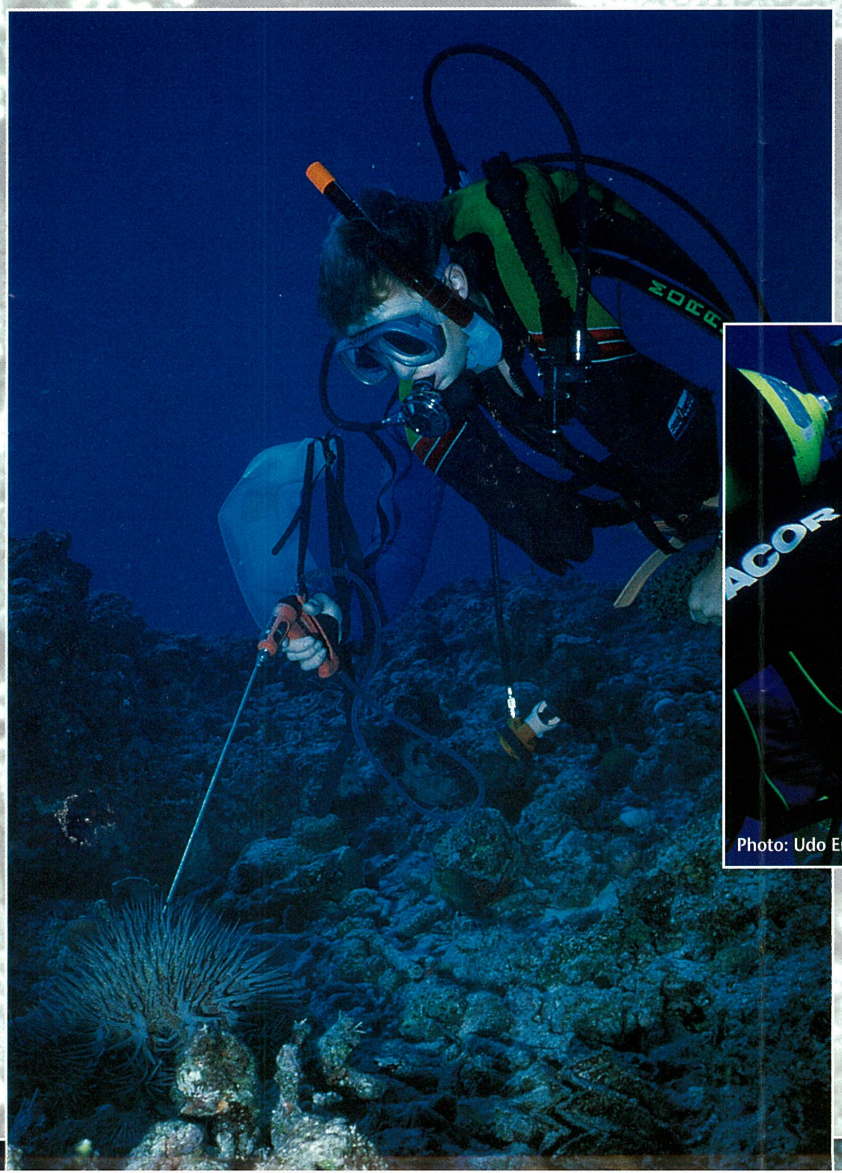
Left: An adult starfish beside the coral it ate the previous night. The starfish has digested all the flesh, leaving only the bleached limestone skeleton.

Research underway

This latest outbreak presents unique opportunities for state-of-the-art research programs. In addition to continued monitoring of the entire Great Barrier Reef for COTS, which builds on many years of observations, several new experiments have been started in direct response to this outbreak:

A new genetic study, which will attempt to identify the source area of current COTS populations. AIMS scientists are investigating samples taken from initial brood stocks of COTS in the Lizard Island area and from further south. Using DNA sampling techniques, this research might shed light on whether or not these new outbreaks come from a single source area, or have developed simultaneously on many separate reefs.

Better predictions of outbreaks from surveys of juvenile COTS. More fine-scale surveys will be carried out. This involves following a line of tape underwater (a transect) and looking at everything within this "corridor" minutely.



This close examination means that even juvenile COTS can be seen and counted, and predictions may be made about the likely future of the area.

How best to control local outbreaks. CRC Reef researchers in cooperation with the Australian Museum's Lizard Island Research Station are testing options for localised control of COTS - whether or not it is better to conduct controls sporadically (for a short period every day) or as part of an intensive effort every few weeks. This research will help to make local-scale controls more effective and cheaper to carry out.

GBRMPA policy

The Great Barrier Reef Marine Park Authority has a general policy of not interfering with natural processes, and there is a strong belief within the science community that COTS are most likely to be a naturally occurring phenomenon. They are not a pest accidentally introduced to the environment, like the rabbit on land or the Japanese sea-star carried into Australian waters in ships' ballast. Because of the remaining uncertainty about the possible role of human activities, controls are limited to small-scale clearing of COTS in areas that are important to research or tourism, such as around permanent pontoon sites. Managers can respond quickly to rising numbers and issue permits to conduct controls so that tourist operators can start straight away. GBRMPA and the CRC Reef Research Centre have also produced a training manual setting out exactly how to inject COTS with a lethal, yet environmentally friendly chemical called 'Dry Acid' (sodium bisulphate, normally used to clean swimming pools and quite harmless to surrounding corals).

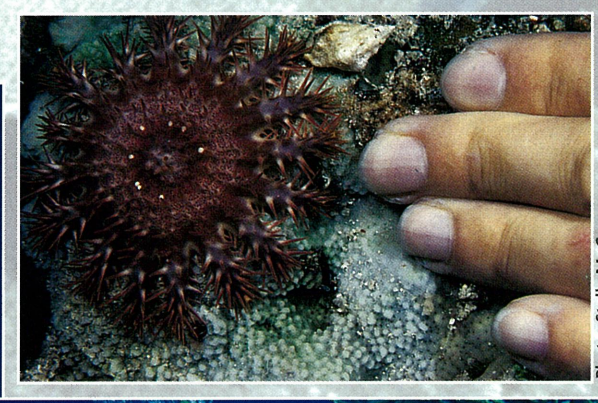


Photo: Stella M. Covre

Photo: Udo Engelhardt

Left: A scientist injects an adult starfish with lethal 'Dry Acid', an environmentally friendly method of control.

Top: A juvenile starfish, about one year old. Very small COTS feed on algae but at about one cm in diameter they switch to eating coral and begin to grow very rapidly.

Bottom: GBRMPA/CRC researchers record detailed information on the sizes and probable ages of starfish observed during fine-scale surveys.