Australian Government
Great Barrier Reef
Marine Park Authority

Crown-of-thorns starfish on the Great Barrier Reef

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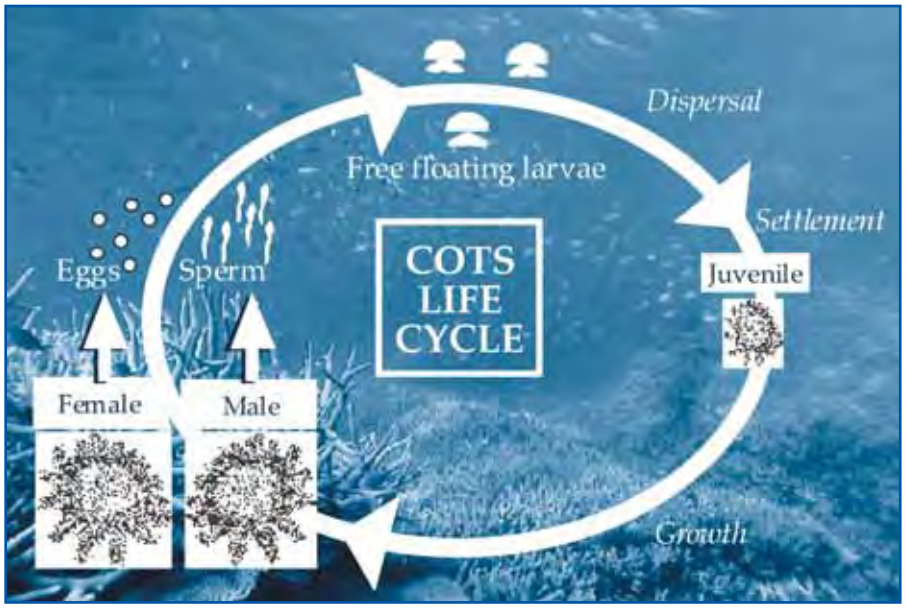
What is it?

The crown-of-thorns starfish (COTS), known scientifically as *Acanthaster planci*, is related to sea urchins, sea cucumbers and brittle stars. The COTS has four to five centimetre long poisonous spines covering its body. A puncture wound from these will cause severe pain, swelling and often vomiting. Adult COTS generally range from 25 to 35cm in diameter, however individuals up to 80cm in diameter have been recorded. The COTS is a widespread marine species present on reefs throughout the Indo-Pacific, ranging from east Africa to the west coast of the Americas. COTS are found along the whole of the Great Barrier Reef. Depending on geographic location, the colouration of COTS varies, with those from South-East Asia exhibiting a metallic blue body with red spines, while on the Great Barrier Reef the colouration pattern is a grey body with orange-tipped spines.

Feeding and Breeding

The diet of the COTS varies depending on its developmental stage. Juvenile COTS (less than one



centimetre) feed on crustose coralline algae, whereas the adults eat living coral tissue.

The adult COTS' method of consuming coral is quite unusual. It feeds by extruding its stomach out through its mouth to cover the coral surface, where it proceeds to digest the living coral tissue with stomach enzymes. The digested coral tissue is then absorbed and the stomach re-ingested, leaving a white round feeding scar of coral skeleton. It has been estimated that an individual starfish will consume five to six square metres of coral tissue per year, however like many starfish and sea urchins, COTS may survive without feeding for up to nine months.

The COTS usually breed from December to April, when the ambient water temperature is approximately 28^{o}C. COTS may spawn during the day or at night, and at various stages of the tide during different times in the month. When spawning, male and female starfish gather in shallow water, and release their eggs and sperm. Each individual female starfish may release up to 60 million eggs in a single spawning season. The larvae of COTS are free-floating (pelagic) and may spend two to four weeks drifting on ocean currents before settling onto a reef. The free-floating larvae are dispersed between reefs by these currents, with studies showing that they have the potential to be transported up to 100km in a week.

Outbreaks

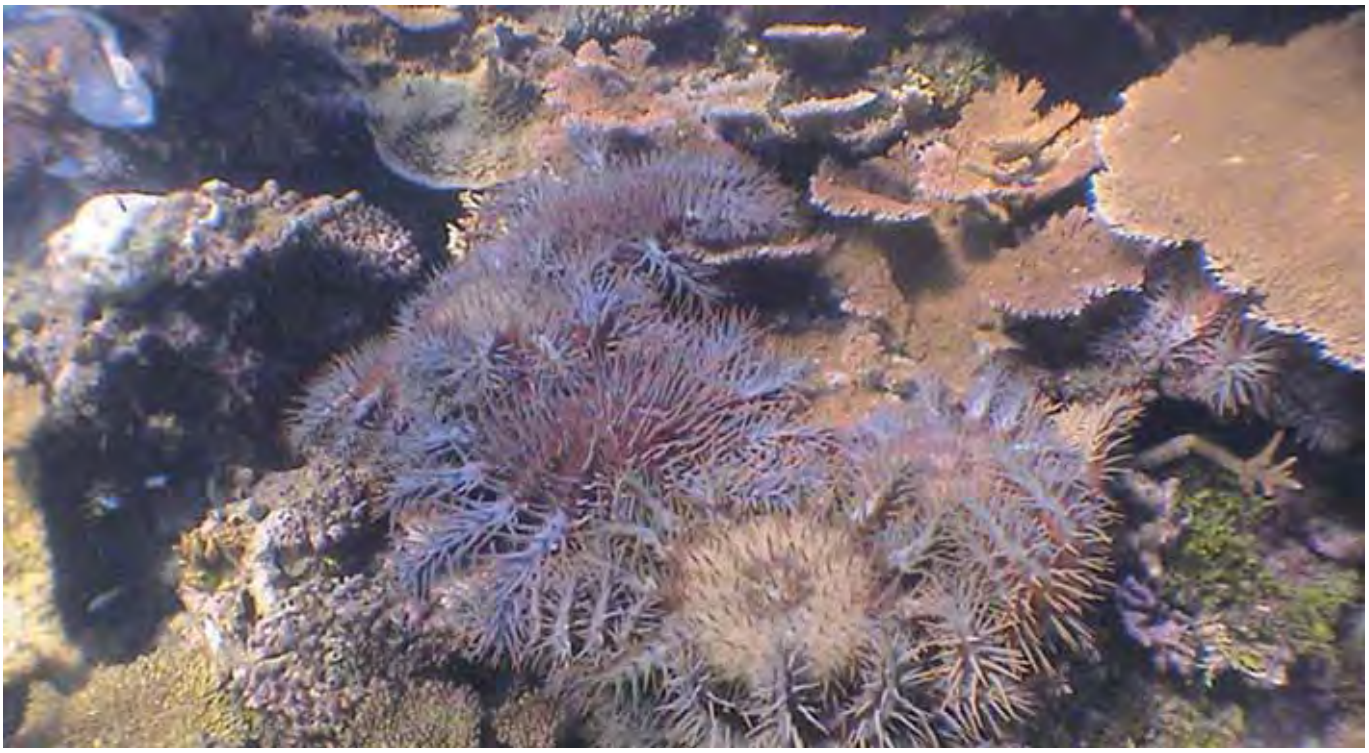
The impact of the COTS' feeding habits on a reef depends on the density of starfish. When there are few starfish, the COTS will tend to feed nocturnally on a number of preferred coral species (generally fast growing *Acropora* corals such as staghorn and plate corals), and rarely consume whole colonies of coral. This selective feeding may not kill live coral and is a part of the natural ecology of a coral reef. However, outbreaks of COTS can have large impacts on coral reefs.

When is it an outbreak?

An outbreak occurs when the density of COTS is high enough that they consume coral faster than the corals can grow. Under outbreak conditions the preferred *Acropora* corals, as well as other less favoured corals, are eaten. In outbreak conditions coral cover can decline to less than one per cent. However, not all reefs are equally affected by a COTS outbreak. During the 1979 to 1991 outbreak, only 17 per cent of more than 2800 coral reefs in the Great Barrier Reef World Heritage Area were affected by COTS, with only five per cent of reefs having severe outbreaks. The decline in coral cover resulting from an outbreak has significant ecological flow-on effects on the whole reef community. However, corals

DID YOU KNOW?

Fertilisation of COTS gametes has been recorded when parents are up to 100 metres apart!



usually recover during the years between outbreaks.

History of outbreaks

Inconclusive historical evidence, in the form of skeletal remains within reefal sediments, indicates COTS were present on the Great Barrier Reef at least 3000 years ago. There is little historical record of COTS outbreaks around the world, and many link increased human interaction with the reef environment, particularly the advent of SCUBA, with increased awareness of the COTS. Since 1962 there have been three major documented COTS outbreaks in the Great Barrier Reef. Outbreaks have generally followed the same pattern, beginning in the north between Cairns and Lizard Island and migrating south before dying-out in the Mackay and Whitsunday region. There have also been populations of COTS observed in the Swain reef area (200km off the coast of Mackay). Although this population is genetically similar to the rest of the Great Barrier Reef, it does not appear to follow the general southward pattern of outbreaks. The latest series of outbreaks peaked between 2001 and 2004.

Causes of Outbreaks

Since the first documented outbreak of COTS there have been numerous theories about the cause of these dramatic fluctuations in COTS numbers.

Scientific research has discredited many of these and currently there are three major theories which the scientific community considers may be valid explanations. Presently, these theories have been neither proven nor disproved. These are:

- **Natural phenomenon** – natural fluctuations in the environment, such as water temperature, nutrient upwellings and salinity, are thought to influence the numbers of COTS
- **Removal of predators** – it is possible that overfishing may decrease the predators of COTS
- **Land use/run-off impacts** – COTS' larvae may have an increased survival rate due to the high levels of nutrients washed into the inshore environment from catchments which have been either urbanised or which support large agricultural industries.

Management of COTS

Numbers of COTS are naturally controlled by various ecological processes including high mortality of the larvae, disease, and predators. However, when an outbreak occurs these natural controls do not have a significant impact on COTS numbers, and techniques have been developed to protect specific sites of interest. It is impossible to eliminate COTS from a reef when they occur in outbreak densities, however intensive and localised efforts, may successfully protect small areas of coral. The recommended control technique involves trained divers injecting the starfish with sodium bisulfate solution, which is harmless to other organisms. Although this technique has a high success rate with the majority of individuals dying quickly, it must be an ongoing control process, as new individuals will re-populate the area. The ongoing and time-consuming nature of this technique makes it very costly and limits it to small areas.

Due to the limited capacity for control measures and the natural role COTS play in the reef ecosystem, management attention is focused on regulating the possible human causes of the outbreaks, such as overfishing and poor land use practices. Regardless of the impact these human activities have in instigating COTS outbreaks, they are already important management and research priorities for the Great Barrier Reef Marine Park Authority. *The Reef Water Quality Protection Plan* and the re-zoning of the Great Barrier Reef Marine Park in 2004 are major steps to reducing these pressures.

DID YOU KNOW?

Starfish are attracted to the 'smell' of other starfish feeding, which can cause them to form large groups called feeding aggregations.

For Further Information

Visit the Great Barrier Reef Marine Park Authority's web site:
www.gbrmpa.gov.au

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