



# Crown-of-Thorns Sea Stars (COTS) Facts

## What are COTS?

Crown-of-thorn sea stars (COTS) are unusually large sea stars that can grow to almost a meter in diameter. They have up to 19 arms, with the entire upper surface covered with sharp venomous spines and can move up to 20 meters an hour. Due to their voracious appetites for live coral, COTS are one of the best known sea stars.

Crown-of-thorns can take over coral reefs quickly due to their ability to spawn millions of eggs a year. Once fertilized, eggs grow into planktonic larvae in 24 hours, which drift in ocean currents. The juveniles are 1-2 mm across when they settle onto the reef and live among rocks and rubble, eating encrusting coralline algae. At approximately six months of age they start to eat coral and begin to grow more rapidly, reaching reproductive maturity when they are 2-3 years old, breeding up to 7 years. Each female can produce up to 60 million eggs during a single spawning season. As COTS have the highest measured fertilization rate of any invertebrate, a small population of COTS has the potential to produce a very large number of offspring. COTS feed on coral by pulling its stomach out of its mouth with its tube feet and placing it on the coral. Digestive enzymes kill the live coral and the stomach absorbs the tissue, leaving the white calcium carbonate skeleton.



Top: Adult crown-of-thorns sea star.  
Bottom: Closeup of spines and feet.



## COTS on Hawaiian Reefs



Triton's trumpet (*Charonia tritonisa*), a predator of COTS.

In Hawai'i, COTS primarily feed on rice, lace and cauliflower corals. Healthy reef systems can support small populations of COTS for many years with only a small reduction in coral cover. But when a COTS outbreak occurs, there can be many animals per square meter, and competition for food forces them to eat all coral species, killing most of the living coral in the area. It can take decades for the reef to recover.

Natural controls include the high mortality of the larvae, high predation of juvenile COTS, and feeding on adults by Triton's trumpets, Harlequin shrimp, and stripebelly puffers.

## What causes COTS outbreaks?

**Natural fluctuations in populations.** Natural fluctuations in temperature, salinity or planktonic food availability could all contribute to improving the survival of COTS larvae.

**Removal of natural predators.** Loss of natural predators that feed on the juvenile and adult COTS can be costly. Predation on juveniles decreases the number of COTS that reach reproductive maturity.

**Increased nutrients lead to increased planktonic food, improving larvae survival.** Crown-of-thorn sea stars have been present on reefs for millions of years, but major outbreaks were not observed until the 1960s. Outbreaks sometimes occur in areas with high levels of nutrients, which generally accumulate from terrestrial runoff.

During outbreaks, crown-of-thorns sea stars not only eat live, adult coral, but also prevent the recruitment of juvenile corals. This prevents coral population growth, hindering a coral colony's ability to recover from predation. Each sea star can eat up to a meter-squared of coral each month, so when their populations become large they can quickly kill entire coral colonies. Once the sea stars deplete one area of live coral, they move on to adjacent regions. Outbreaks of crown-of-thorns typically last between 1-5 years, although on large complex reef systems an outbreak can last 15-20 years. This is due to the fact that many reefs are in close proximity, which allows the crown-of-thorns to spread from reef to reef. After an outbreak, the reefs begin to recover, but it may take one or many decades for them to reach original levels of coral cover. In some case studies, the reef's community structure completely changes as the reef shifts from coral to algae dominated.

Dave Krupp photo?

## You can help stop a COTS outbreak.

There are few options to manage outbreaks of COTS and it is impossible to eradicate COTS from reefs where they are in outbreak densities. However, with sufficient effort, small areas can be protected. Because sea stars can quickly move from one area to another, control of a specific area must be an ongoing effort and may be required on a daily basis. Thus, early detection and reporting of any unusual numbers of COTS can help reef managers minimize the impact of a COTS outbreak.



## Help monitor our coral reefs

Join the Eyes of the Reef network and let us know if you see coral bleaching or disease, COTS outbreaks or marine invasive species. If you are a scuba diver then also join Reef Check Hawaii where you can get trained to collect scientific data on the condition of Hawaii's reefs.

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