DISCOVER — ENGAGE — IMPACT

TOPPLING THE CROWN

The crown-of-thorns starfish is one of the Great Barrier Reef's fiercest enemies, a voracious predator of the corals that build the reef. For an already struggling reef, these starfish pose an enormous threat.

When crown-of-thorns starfish are in population outbreaks, they are one of the most aggressive destroyers of coral reefs in the world. A long-standing problem for the Great Barrier Reef and across the Pacific, more recent years have seen outbreaks also occurring in the Indian Ocean.

When major outbreaks of crown-of-thorns starfish happen, the sheer number of starfish decimate reefs. The outbreaks severely compromise the three-dimensional reef structure and the homes of other reef-dwelling animals. The compromised reefs are then more susceptible to other kinds of impacts – storms, cyclones, and the effects of climate change.

"These starfish pose an enormous threat due to the ability of a single female to produce up to 120 million offspring in one spawning season," says Professor Bernard Degnan, UQ Development Fellow at UQ's School of Biological Sciences.

Professor Degnan works on ways to tackle this thorny problem alongside his wife, Associate Professor Sandie Degnan; UQ research colleagues; and long-standing colleagues at the Australian Institute of Marine Science (AIMS), the Okinawa Institute of Science and Technology (OIST) and the University of the Sunshine Coast (USC).

"Millions of dollars have been spent over many years on a variety of ways to capture crown-of-thorns starfish via diver collection, injections or robotics," he says.

"To date, the approach has been to remove or kill individual starfish, which is both labour intensive and inefficient."

But Professor Degnan and his team have had a breakthrough discovery. In the esteemed journal Nature, the team revealed that crown-of-thorns starfish gather en masse due to a release of pheromones, particularly when they are ready to reproduce – a scent the team have decoded.

Their project was built on the premise that if the communications systems of starfish could be tapped into, then the researchers could use the starfish's own aggregation behaviour to set up a system to capture them in a large-scale way, rather than individually. The pheromones are unique to the crown-of-thorns starfish, so any attractants or baits will only be recognised by crown-of-thorns starfish, and won't impact other species.

"Now we've found the genes the starfish use to communicate, we can begin fabricating environmentally safe baits that trick them into gathering in one place," Professor Degnan says.

Associate Professor Sandie Degnan agrees and says, "It is a more efficient method of removal because we can get the starfish to do some of the work for us."

No-one knows for certain how many crown-of-thorns starfish there are around Australia, but some Queensland reefs have had hundreds of thousands – even millions – removed by conservation projects. If those numbers are evident on individual reefs, the true numbers across the Indo–Pacific must be enormous.

The exciting aspect of this project is the possibility of wider applications.

"Using the genome to unlock the secrets of the biology of an animal and then using those secrets to manage the animal is a strategy that can be applied elsewhere," Associate Professor Degnan says.

This project is investigating very tangible ways to help manage the Great Barrier Reef, and potentially to manage a wide range of invasive species. Pest organisms are a multibillion-dollar global problem. This discovery could mean we move beyond mitigating invasive species and actually start controlling them.

Associate Professor Degnan says that the causes of major outbreaks of crown-of-thorns starfish are not yet well understood, but are probably a combination of natural cycles and human-induced changes to our oceans.

"Given that the COTS threat to our reefs is, at least in part, human-induced, I think that we all have a responsibility to do what we can to slow that threat down."

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Key milestones:

1987: The Degnans begin the first molecular genetic analyses on the Great Barrier Reef

1991: They move to the Marine Biotechnology Center at the University of California, Santa Barbara

1994: They return to the Zoology Department, UQ, and establish a Genetics Laboratory

2002: Bernard participates in the first marine genome project published in *Science*

2004: Sandie is awarded a UQ Women's Fellowship; together, they establish the Marine Genomics Laboratory at UQ

2010: The Marine Genomics Laboratory publishes the first genome project from the Great Barrier Reef, Australia, and the southern hemisphere – the marine sponge *Amphimedon queenslandica* from Heron Island

2013: Crown-of-thorns starfish genome project begins in the Marine Genomics Laboratory with Mike Hall at Australian Institute of Marine Science

2013: Nori Satoh's laboratory in the Okinawa Institute of Science and Technology and Scott Cummin's laboratory at the Sunshine Coast University join the project

2017: Crown-of-thorns starfish genome project is published in *Nature*

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