

EnviroWinBlog 03. Successful progress against the Crown-of-Thorns Starfish (COTS)

Introduction

This EnviroWinBlog 03 is part of a set of three EnviroWinBlogs describing the success of large-scale environmental actions. EnviroWinBlog 01 describes the success against the problem of acid rain, whilst EnviroWinBlog 02 describes success against the problem of the hole in the ozone layer, and EnviroWinBlog 03 describes successful progress against the Crown-of-Thorns starfish. Promotion of the successes of these three environmental wins is detailed in EnviroWinBlog 04.

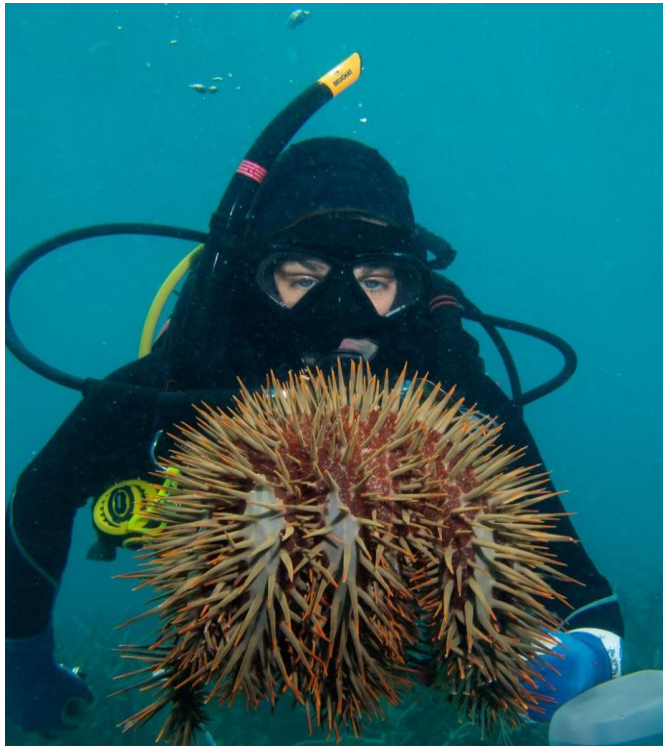
Citation references, Paragraph and Section references are those contained in the PhD Thesis “Values and science in contemporary education: The study and impact of student orientation”. The Thesis document is available in the University of Newcastle repository, here: <http://hdl.handle.net/1959.13/1501410> (and then by clicking on Attachment01).

3.1.3 Win No. 3. Successful progress against the Crown-of-Thorns Starfish (COTS)

COTS

The COTS is a coral-eating starfish, with the scientific name *Acanthaster planci*. During the 1960s and 1970s, the bulk of the hard coral cover of reefs in the central region of the Great Barrier Reef (GBR) was reported as killed because of population outbreaks of millions of COTS. The GBR is a vast and spectacular ecosystem and one of the most complex and beautiful natural systems on Earth. The GBR is composed of a series of coral reefs, located adjacent to the Queensland coastline of Australia. The GBR is the world’s largest coral reef ecosystem, stretching 2300 kilometres and comprising almost 3000 individual reefs. It is a significant economic and recreational resource for regional communities and Australia as a whole, with an asset value of \$A56 billion, and supporting 64,000 jobs annually (O'Mahony et al., 2017). Therefore, major changes to the condition of the GBR ecosystem have social and economic implications for regional communities (Great Barrier Reef Marine Park Authority, 2019b).

In an attempt to gain an in-depth understanding of COTS, research has been conducted in high value areas, by esteemed institutions such as the Great Barrier Reef Marine Park Authority (GBRMPA), the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and James Cook University (JCU). Where appropriate, these institutions have co-operated with local communities to respond to the threat posed by COTS. As a result, the current COTS threat is under control and long-term programs are in place to continue the management of the COTS threat. Since the initial attacks during the 1960s and 1970s, the devastated coral reefs have experienced extensive re-colonisation and recovery (Endean, 1982). Refer to Figures 3.2 and 3.3 regarding visual details of COTS and the attacks on coral.



(James Cook University, 2017, p. 1)

Figure 3. 1 Single COTS with diver



(CSIRO, 2020, p. 1)

Figure 3. 2 Attack of several COTS on staghorn coral

In the period from the 1960s to 1982, it was recognised that recently recovered reefs were subject to further Crown-of-thorns starfish (COTS) attack, giving rise to concern that reefs in the region would be impoverished for long periods of time (Endean, 1982). Four major COTS outbreaks have occurred on the Great Barrier Reef (GBR) since the 1960s, each lasting approximately 10 years. The most recent outbreak started in 2010 and has spread along various parts of the GBR (Great Barrier Reef Marine Park Authority, 2019a). In the period 1985-2012, surveys identified that for each individual reef, coral cover reduced on average, from 28% to 13.8% of reef. The three major causes of coral loss and their respective percentage loss were tropical cyclones 48%, COTS 42% and bleaching 10%. The data indicates that if COTS degradation were eliminated, the natural growth of coral cover of 2.85% per year would exceed the average degradation due to cyclones and bleaching of 1.96% per year. Given the impossibility (in the short term) of controlling the incidence of cyclones and temperature rise causing bleaching, these circumstances comprise a compelling rationale for human intervention in the mitigation of COTS (De'ath, Fabricius, Sweatman, & Puotinen, 2012).

Human intervention in the mitigation of the COTS

In an attempt to gain an in-depth understanding of COTS, research was conducted to comprehend how COTS infestations propagate from primary outbreak sites. Connectivity patterns of the ecosystem that help turn local outbreaks into a system-wide contagion through a series of transmission events were identified. Researchers found that the regions where COTS epidemics are known to originate are predictable by virtue of their high local and system-wide connectivity. Accordingly, the observed centre of origin for COTS epidemics (the Cooktown – Cairns region) can be predicted from its elevated short-range and long-range levels of larval connectivity. Summarising, research has provided an insight into the mechanism of COTS infestations via connectivity analysis of the per-reef risks. This research has identified spatially explicit targets, which guide surveillance and control measures that might help curtail COTS epidemics through prioritisation of highly connected reefs (Hock, Wolff, Condie, Anthony, & Mumby, 2014).

The first broad-scale, government-funded COTS control program began in 2012, implemented by the Great Barrier Reef Marine Park Authority (GBRMPA). To date, the control program has been successful in maintaining starfish densities below ecologically sustainable thresholds for coral growth on 75% of the 57 priority reefs between Port Douglas and Townsville, and in other high value areas. Priority reefs have been identified to focus program efforts and resources to make the largest positive impact on the resilience of the Great Barrier Reef (GBR) (Great Barrier Reef Marine Park Authority, 2019a).

The CSIRO is managing the Crown-of-thorns starfish (COTS) on the GBR by applying ecological and environmental management expertise in responding to the threat posed by COTS, thus reducing the spread of existing outbreaks and promoting coral recovery. CSIRO activities include development of oceanographic models to predict dispersal of COTS and the prediction of the reefs that are most at risk (CSIRO, 2020).

Researchers from Vanuatu and JCU have refined a handy and inexpensive treatment against the COTS via divers injecting the starfish with either vinegar or bile salt solution. This technique kills quickly and effectively, within 24 hours. Because vinegar is affordable and readily available, it can be used both in small community efforts, and in large-scale programs. This enables operators to target specific priority reefs. This contributes significantly to the long-term resilience of the GBR (A. Edwards, 2019).

In research to develop autonomous facilities for COTS eradication, scientists have developed a new robot to hunt and kill COTS. This is an autonomous underwater vehicle called RangerBot which is the result of more than a decade's worth of research and development by Queensland University of Technology (QUT), backed by a grant from Google's non-profit arm. The RangerBot followed an earlier proof of concept called COTSbot, which could recognise COTS with 99.4% accuracy. The CSIRO is optimistic about RangerBot's potential to expand COTS control efforts into deep, less accessible waters and gather high-quality data on corals and COTS to inform current management. Eventually, it is hoped that fleets of RangerBots may autonomously monitor vast areas of the GBR, complementing current monitoring systems and arming reef managers with better data, providing early warning signs of COTS outbreaks across the GBR (A. Braun, 2018).

A design of a robotic autonomous surface vehicle which automatically and precisely deploys coral larvae across entire reefs for regeneration purposes has been implemented by Mou (2022). This vehicle has demonstrated a 20 times increase in coverage area when compared with manual methods, and constitutes a valuable tool in efforts to rectify the ravages of COTS.

Summary of progress against the Crown-of-Thorns Starfish (COTS) problem and conclusion

Despite the first reports of the COTS threat to the Great Barrier Reef (GBR) being raised in the 1960s, it was not until the 1980s that serious research was conducted into the issue (Endean, 1982). Since that period, various national and academic institutions such as the CSIRO, GBRMPA and JCU have co-operated with local communities to respond to the threat posed by COTS. As a result, the current COTS threat is under control and long-term programs are in place to continue the management of the COTS threat (A. Edwards, 2019).

Additional successes are described in EnviroWinBlog 01 regarding the problem of acid rain, and in EnviroWinBlog 02 regarding the problem of the hole in the ozone layer. Promotion of the successes of these three environmental wins is detailed in EnviroWinBlog 04.

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