The need for a crown-of-thorns starfish contingency plan

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Abstract

Delays in the provision of funding for research and the initiation of research during both crown-of-thorns starfish outbreak episodes on the Great Barrier Reef resulted in lost opportunities to study primary outbreaks, truncated research program duration, and minimal opportunities for cost-effective research. If control of the outbreaks had been considered a desirable option, the delays would have meant that such action would have been too late to have any chance of successfully preventing the southward progression of outbreaks. A Contingency Plan to secure funds and outline appropriate actions in the event of another outbreak would facilitate a timely and effective response.

The First Outbreak Episode: 1962 - 1975

The first outbreak of crown-of-thorns starfish on the Great Barrier Reef (GBR) was reported at Green Island in 1962. However the extent of the problem was not recognised and brought to the attention of responsible authorities until late 1965 when fisheries biologists from the Queensland Department of Primary Industries (QDPI) were sent to investigate the situation. Surveys of Green Island and neighbouring reefs indicated that large populations of starfish were causing considerable coral mortality. The QDPI staff recommended to the Queensland Government that a research program to investigate the extent, effect and cause of the outbreaks be initiated.

The recommendation was accepted and a two-year study of the problem commenced in 1966. The program involved two field personnel under the supervision of Dr RE

Endean of the University of Queensland. The total budget for the program was $26,400 over two years. Reflecting a lack of appreciation of the scope of the problem and the feasibility of studying it, aims of the investigation were incredibly ambitious given the resources provided:

1. To assess the extent of infestation by *A. planci* of the Great Barrier Reef.
2. To assess the extent of the damage caused by the starfish to living corals on infested reefs.
3. To obtain relevant information about the general biology of the starfish including information on its feeding behaviour, reproduction, habitat preferences, growth rate, predators etc.
4. To determine the cause of the apparent plague of *A. planci* on certain reefs of the Great Barrier Reef.
5. To obtain information which could provide a factual basis for predicting the future course of the *A. planci* plague if it is not controlled.
6. To find a practical means of controlling populations of the starfish on reefs of the Great Barrier Reef.

The report of the study was submitted to the Queensland Government in June 1968 but not published until a year later. It concluded that the starfish represented a serious threat to the Great Barrier Reef (Endean 1969). The Queensland Government continued to support some monitoring of the situation but no further research or attempted control action was supported, contrary to recommendations of the report.

Concern over the findings of the study and liberal interpretation of the study's results elevated the issue to a high media profile. Criticism of the Government's inaction over the problem was a common theme in the media through the early 1970s. The solution from the public's perspective, fuelled by media coverage, was simple - eradicate the pest.

Official responses to the criticism and calls for controlling the starfish involved the establishment of committees to review available information and advise on the seriousness of the threat to the Great Barrier Reef. Reviews were undertaken by the Australian Academy of Science (Walsh *et al.* 1970) and a joint Federal and Queensland Governments Committee of Inquiry (Walsh *et al.* 1971). Both committees concluded that the starfish did not constitute a threat to the GBR as a whole, but both committees highlighted the need for further research.

In 1972 the Commonwealth and Queensland Governments acted on these recommendations, establishing an advisory committee to recommend priority research. Funding was provided for three years with $90,000 in the first year, increasing by $20,000 annually. By 1975 starfish numbers had declined significantly with a commensurate abatement in public outcry. The advisory committee was disbanded on its own recommendation and special crown-of-thorns starfish research funding stopped. The only remaining large populations of starfish were in the Swain Reefs area - too remote for cost-effective research, too far south and remote to constitute a further threat to the GBR.

Significant funds for targeted crown-of-thorns starfish research were thus first made available some 10 years after the outbreak was first detected at Green Island. The cyclic pattern of starfish outbreaks had allowed only three years of concerted research into the problem. Because of the paucity of knowledge of the GBR at that time, the lack of available scientific expertise and proven practical field techniques (particularly for surveying large areas of reef), liberal scrutiny of proposed research and non-specific guidelines for research support, a high proportion of the program's funds were spent on projects not directly focused on crown-of-thorns starfish. Six of the 15 projects funded were only marginally related to crown-of-thorns starfish, covering such diverse topics as identification of zooplankton assemblages, coral taxonomy, reef fish ecology and coral skeleton microstructure (Walsh *et al.* 1975). Advances in understanding of the crown-of-thorns starfish phenomenon were limited.

The Second Outbreak Episode: 1979- 1992

Large numbers of *A. planci* were again reported from Green Island reef in 1979. The biological pattern of southward moving outbreaks was repeated and the socio-political history relived. In the interim between outbreak episodes the GBRMPA had been established and the crown-of-thorns starfish was now the Authority's concern. Review committees were convened in 1980 and again in 1984. The two committee meetings in 1980 recommended four major research directions before disbanding:

- GBR-wide surveys of crown-of-thorns starfish and coral damage;
- Starfish population dynamics;
- Reef sediment analysis for evidence of outbreaks over geological time; and
- Documentation of past human activity on the GBR.

Research in some of these areas was funded by the GBRMPA in the early 1980s, but because of funding constraints, commitments to zoning plans and lack of resources, a comprehensive program of research was not able to be instigated (Kenchington 1987). The GBRMPA established a database and a public questionnaire program to determine the distribution of starfish outbreaks.

In 1984 the Advisory Committee considered available information from research conducted up to that time and noted that the current level of research activity was unlikely to lead to a short-term (3-5 years) resolution to the questions raised by *A. planci* outbreaks on the GBR. To deal with this deficiency, the Committee identified a number of research initiatives which it believed should be implemented immediately (COTSAC 1985). These included:

1. risk analysis to contribute to assessment of the need for controls;
2. monitoring the effectiveness of existing control techniques;
3. feasibility of developing more efficient control techniques such as biological control by predators of pathogens;
4. review of monitoring techniques for crown-of-thorns starfish and corals;
5. surveys of selected reefs;

6. oral history of human use and of experience of the Great Barrier Reef;

7. surface and soft sediment cores to evaluate evidence of prior outbreaks;

8. analysis of existing field data and modelling studies (leading to the identification of priority research);

9. high priority research;

10. testing of hypotheses regarding human factors that may trigger or exacerbate outbreaks;

11. use of geological techniques of climate reconstruction to identify past periods when climatic conditions resembled those prevailing during recent outbreaks;

12. and economic and social consequences of outbreaks.

The Committee recommended the research program be coordinated by the GBRMPA and supported by funding of approximately $3 million over 5 years. In July 1985 the Commonwealth Government indicated the GBRMPA would receive $971,000 for the first year of the program. A Record of Understanding between the GBRMPA and AIMS in which it was agreed that the GBRMPA would coordinate all management-related research projects while the AIMS would be responsible for the "mainly ecological" projects (Zann and Moran 1988). The research program was advertised in the Australian Press, calling for proposals and expressions of interest for relevant research. Following receipt and review of proposals, the program was approved in February 1986. To advise on a program of research and regularly review progress of the program, the GBRMPA established the Crown of Thorns Starfish Advisory Review Committee (COTSARC). Funds of around $1 million were provided annually until 1988/89 but at no stage were funds committed beyond a one-year period.

In a parallel initiative the Australian Institute of Marine Science (AIMS) was provided with over $1 million through the Commonwealth Community Employment Program, primarily to conduct a GBR-wide survey to determine the distribution and abundance of starfish and its effects on the Reef. This field program was commenced in March 1985.

All of the processes associated with the establishment of a research program (reviews of current knowledge, acquisition of funding, advertising for research, establishment of advisory committees, reviewing proposals etc) led to a delay of 6-7 years after the outbreak was first detected at Green Island. The time lags associated with research program initiation during both outbreak episodes are depicted in *Figure 1*.

At the time the GBRMPA research program commenced most of the reefs carrying outbreaks were located off Townsville (Bass *et al.* 1988). Active outbreaks were some 500 km to the south of the area now suspected of being the origin of primary outbreaks (Dight *et al.* 1990). There was no opportunity to study primary outbreaks.

The number of outbreaking populations increased from 1985/86 to a peak in 1988/89 (16% of reefs affected) and has declined to the present (Moran *et al.* 1991). Researchers thus had a 3-4 year window of opportunity to study active outbreaks conveniently located off Townsville, the location of AIMS and James Cook University.

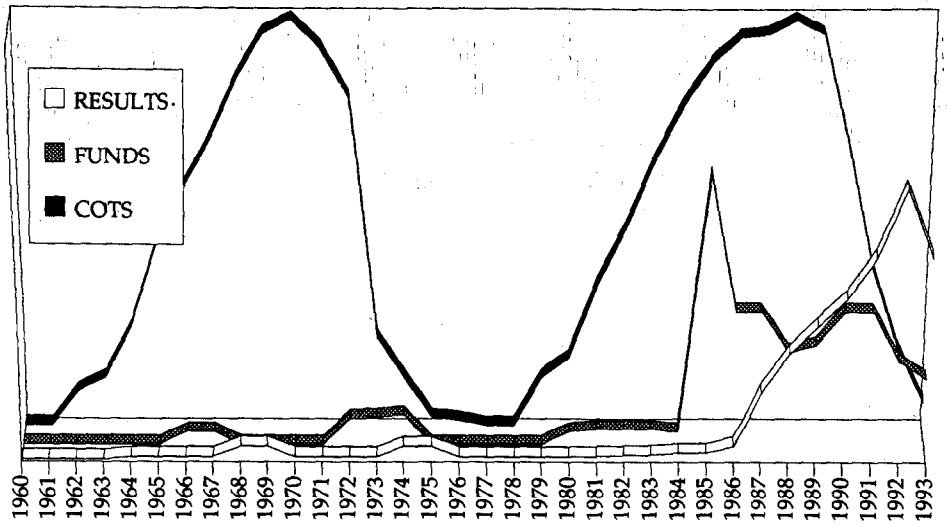

Figure 1: Graphical representation of the time lags between crown-of-thorns starfish abundance (COTS), the provision of funds for research (FUNDS) and the availability of results from the research (RESULTS) during the two outbreak episodes on the Great Barrier Reef. Outbreaks were initially detected at Green Island in 1962 and 1979. Major research funding became available in 1972 and 1985. Y-axis calibrations are approximately consistent for each individual line but different between lines.

The COTSAC program was superseded in 1989/90 following a review requested by the then Minister for the Arts, Sport, the Environment, Tourism and Territories, Senator Graham Richardson (the Portfolio Minister responsible for GBRMPA). Following recommendations of the review, the new program (the COTSREC program, named after the new advisory committee - the Crown-of-thorns Starfish Research Committee) was guaranteed funding of around $1 million per annum for three years, subject to a review before entering into the third year. Critical research that could have been conducted with these funds could not be undertaken because of the unavailability of conveniently located outbreaks. Projects requiring young juvenile starfish (e.g. predation studies) necessitated the development of a rearing program for the production of experimental specimens. Thus, although the funds were put to good use, research would have been much more productive had the support been available considerably earlier in the outbreak episode.

Contingency Plan Recommendation

The review of the COTSREC research program following its second year was conducted by Dr RE Johannes. In reviewing the crown-of-thorns starfish research program Johannes noted that three things were necessary to ensure early detection of the next COTS outbreak and an effective response to it - continued reef-wide monitoring, maintenance of a core research program and the development of a contingency plan (Johannes 1991). He noted that the establishment of a contingency plan would assure the quickest and most effective response to the detection of a future outbreak.

Johannes indicated that the plan should identify:

1. Priority research projects to be activated or expanded in the event of another outbreak.

2. Mechanisms for quickly recruiting and deploying the necessary personnel.

3. Means of making funding available immediately in the event of an outbreak.

Johannes' recommendation was supported by the Crown-of-thorns Starfish Research Committee and accepted by the GBRMPA in late 1991.

The Plan

An outline of the Contingency Plan is provided by Lassig *et al.* (*in press*). The Plan comprises a set of standardised procedures to be followed if outbreaks of COTS occur on the GBR in the future. The plan is intended to enable rapid initiation of actions that are appropriate to the nature and extent of the perceived problem as well as the prevailing political, social and scientific environments. Development of the plan has identified a number of issues in need of resolution if the plan is to be effective. The early detection of outbreaks is paramount.

Discussion

Delays in the provision of funding for research and the initiation of research during both crown-of-thorns starfish outbreak episodes on the GBR resulted in lost opportunities to study primary outbreaks, truncated research program duration, and minimal opportunities for cost-effective research. If control of the outbreaks had been considered a desirable option, the delays would have meant that such action would have been too late to have any chance of successfully preventing the southward progression of outbreaks (see Gladstone 1992).

Cyclicity of funding and research is not unique to the crown-of-thorns starfish phenomenon. After the locust threat receded in Africa in the 1960s control organisations lost their operational edge, research funding was scaled down, expertise was lost and equipment was not maintained (Walsh 1986). When the threat reappeared in the 1980s infrastructure was inadequate and control measures that had been effective during the 1940s and 1950s were regarded as being unsafe and alternatives to toxic pesticides had not been tested for effectiveness and safety.

During previous outbreak episodes a lack of available information on the nature, extent and consequences of the phenomenon contributed to the delays. Research conducted through the GBRMPA program has significantly contributed to our knowledge of the phenomenon but there remain major gaps in our understanding of the causes of outbreaks and long-term ecological consequences. Advances in knowledge mean that further research can be much more focused than in the past, however there is a danger of research being abandoned in the absence of "threatening" outbreaks on the GBR over the next few years.

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