Protecting the Great Barrier Reef

Crown-of-thorns starfish and Reef resilience

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One Reef, many reasons to protect it

Biodiversity

More than 1,500 fish species and six of the world's seven marine turtles

World Heritage

Listed in 1981 for its outstanding universal value

Economy and jobs

Tourism and fishing support tens of thousands of jobs

Culture

Sea country for more than 70 Traditional Owner groups

Coastal protection

A living breakwater for the Queensland coast

2,300 km

The world's largest coral reef system

Multiple threats

Marine heatwaves

Mass coral bleaching

NEEDS GLOBAL ACTION

Cyclones

Physical damage to reef structure

CANNOT BE PREVENTED

Crown-of-thorns starfish

Outbreaks that eat coral faster than it grows

DIRECTLY MANAGEABLE TODAY

Crown-of-thorns starfish (COTS)

- In normal numbers COTS are an important part of the ecosystem
- In outbreak proportions the damage to corals can be disastrous
- Outbreaks every 15-20 years
- Sheltering by day and feeding at night, they are hard to detect before numbers are high
- Linked to over 40% of coral decline on the Great Barrier Reef, 1985 to 2012
- Amenable to human intervention (culling)



Vinegar injections are used to kill Crown-of-Thorns Starfish.
Photo: Lyle Vail.

Targeted control on the GBR

830,000+

hectares of reef habitat protected

1.4 million

coral-eating starfish removed (almost)

451

reefs where outbreaks were suppressed

A$175

approximate cost per hectare protected

Source: Great Barrier Reef Marine Park Authority, January and March 2026. Totals since 2012.

Where CSIRO science fits

Integrated approach

Integral to the integrated pest management program behind starfish control

Reef prioritisation

Designed the process that decides which reefs are protected first

COTSpotter

Machine learning that detects starfish in underwater images

Tool calibration

Making the different tools that monitor starfish and coral give comparable numbers

Data analysis

Analysing the program's data streams to improve efficiency and decisions

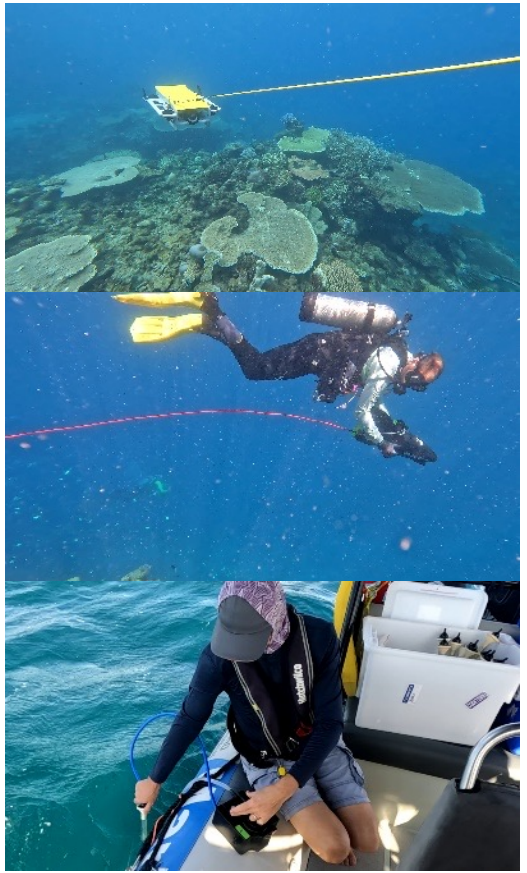
Monitoring design

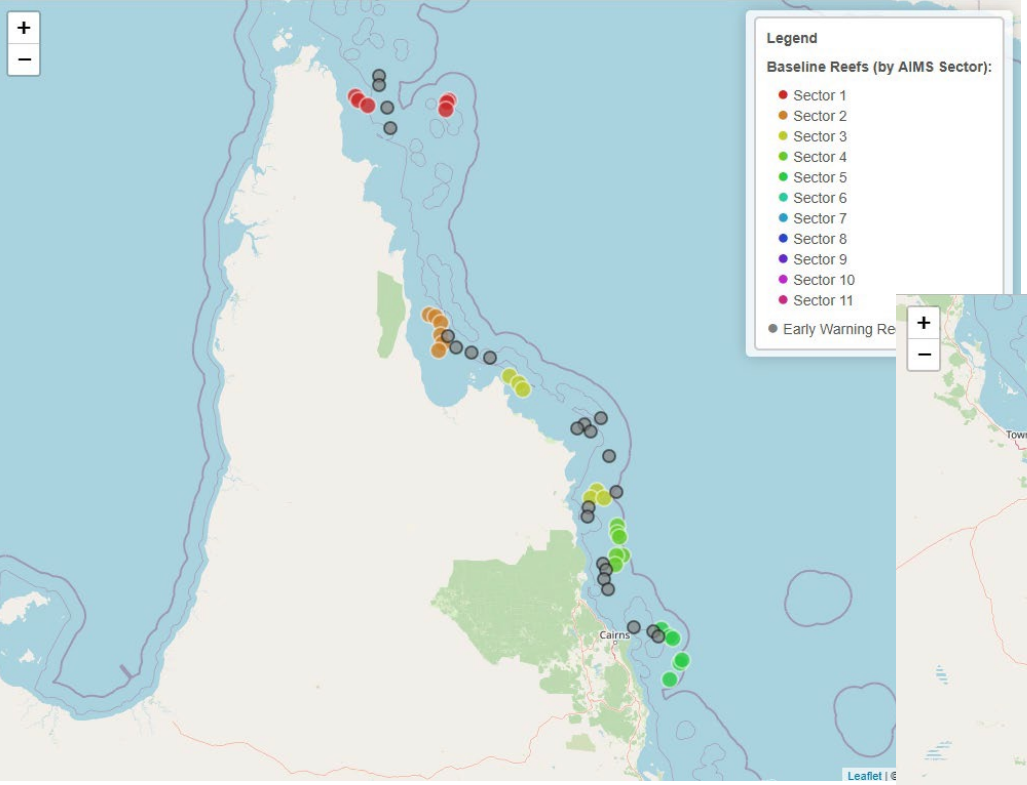
Designing more robust monitoring to better answer strategic management questions

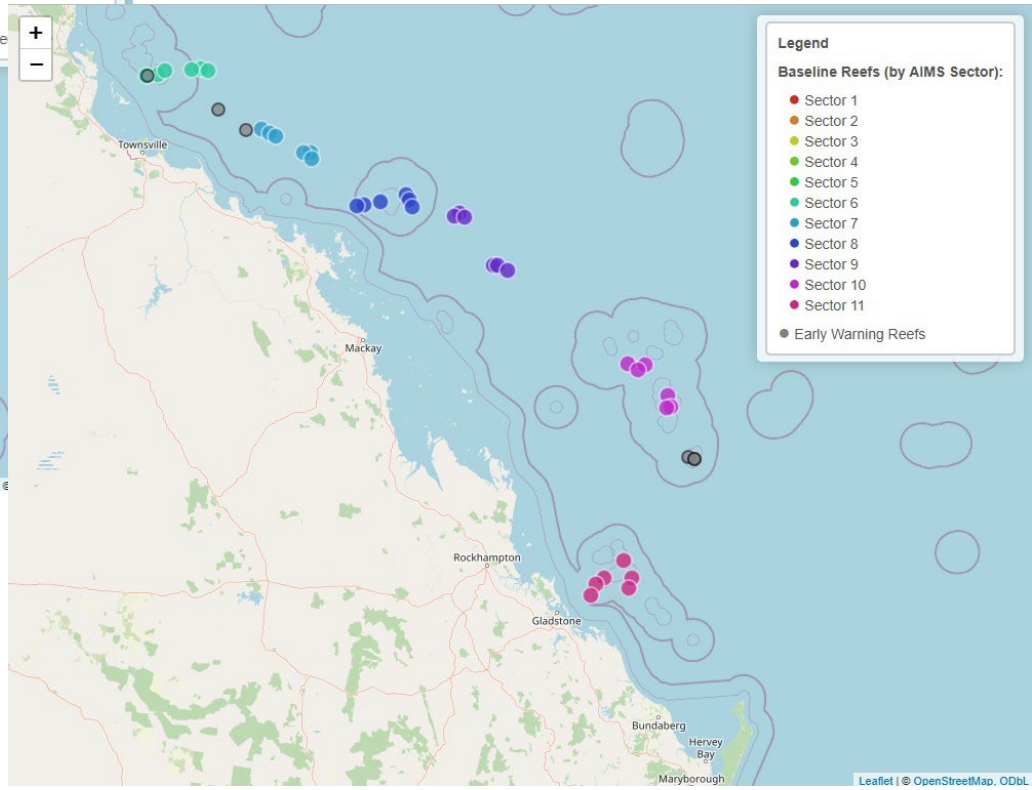
* Funded by the COTS Control Innovation Program

Building a baseline monitoring program

- Monitoring is focused on outbreak-prone areas, which is right for control but gives a skewed view of the Reef overall.
- Statistically robust Reef-wide monitoring would provide unbiased estimates of COTS numbers and coral condition, and show real trends over time.
- New methods can detect COTS at lower densities for earlier warning and measure coral more consistently than current surveys.







- **Safety considerations:** Crocodile risk, depth constraints, strong tidal
- **Weather dependencies:** Exposure to swell or accessibility challenges
- **Cultural sensitivities:** Areas requiring consultation with Traditional Owners or sites with cultural significance,
- **Physical constraints:** Reefs with very large margins, shallow areas or deep drop-offs or reefs too deep for safe operations,
- **Temporal constraints:** Reefs that could only be safely surveyed during particular tidal conditions or specific seasons.

Monitoring tool calibration

Table 3 Predicted COTS densities/rates and associated prediction intervals for each COTS measurement tool, based on cull rates of 0.00–0.20 COTS per minute culled

Cull rate (COTS per min)	SALAD density (COTS & scars per ha)	SALAD rate (COTS & scars per min)	Manta tow (proportion with scars)	eDNA (proportion samples positive)
0.00	9.50 (2.71, 22.30)	0.11 (0.02, 0.27)	0.24 (0.00, 1.00)	0.19 (0.00, 0.50)
0.02	15.97 (5.42, 34.60)	0.16 (0.05, 0.34)	0.34 (0.00, 1.00)	0.41 (0.08, 0.75)
0.04	20.62 (6.61, 42.44)	0.19 (0.06, 0.38)	0.40 (0.00, 1.00)	0.54 (0.17,0.92)
0.06	24.52 (8.35, 53.10)	0.21 (0.06, 0.44)	0.46 (0.00, 1.00)	0.63 (0.25, 0.92)
0.08	27.98 (9.35, 62.98)	0.23 (0.07, 0.47)	0.50 (0.00, 1.00)	0.68 (0.33, 1.00)
0.10	31.13 (9.59, 71.05)	0.25 (0.07, 0.53)	0.52 (0.00, 1.00)	0.72 (0.33, 1.00)
0.12	34.06 (10.41, 76.68)	0.26 (0.09, 0.56)	0.55 (0.00, 1.00)	0.75 (0.33, 1.00)
0.14	36.82 (11.57, 80.21)	0.28 (0.09, 0.62)	0.58 (0.00, 1.00)	0.78 (0.42, 1.00)
0.16	39.43 (11.68, 91.75)	0.29 (0.09, 0.66)	0.60 (0.00, 1.00)	0.80 (0.42, 1.00)
0.18	41.93 (11.72, 98.63)	0.31(0.09, 0.69)	0.61 (0.00, 1.00)	0.81 (0.42, 1.00)
0.20	44.33 (12.67, 111.94)	0.32 (0.09, 0.69)	0.62 (0.00, 1.00)	0.82 (0.42, 1.00)

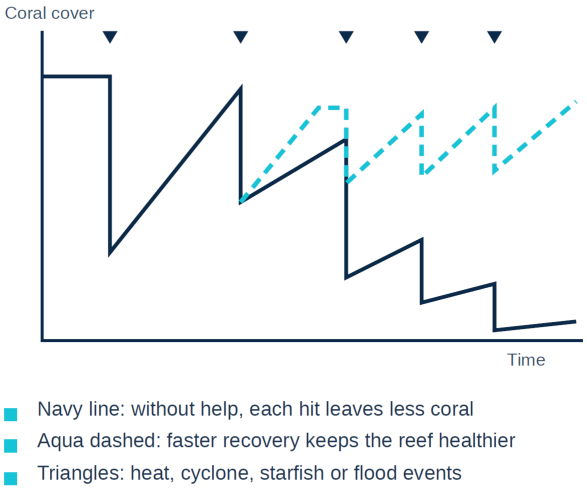
Reef Resilience Project

- Heatwaves, cyclones, COTS and floods all affect the GBR
- This project brings these pressures together into maps for reef managers
- It helps answer three questions:
  - How hard has each reef been hit over time? (Combining disturbance layers)
  - How quickly is it likely to recover? (Larvae from neighbouring reefs)
  - Where will action help most? (Simulations)

* Collaborative project funded by NESP (National Environmental Science Program) with the Reef Authority, University of Queensland and James Cook University

Why the GBR needs a network view

- Disturbances are more frequent
  - More severe and more varied
  - Less time to recover between events
- Reefs recover as a network
  - Coral larvae drift between reefs
  - Healthy upstream reefs reseed damaged ones downstream
- We can’t protect every reef
  - Focus on reefs that help others recover: larval sources, stepping stones, climate refuges



What we're improving this year

- Adding flood water (low salinity) to the disturbance layers
- Updating maps of how coral larve drift between reefs to improve estimates of recovery
- Finding refugia – reefs likely to be sheltered from future heat, cyclones and COTS
- Validation – comparing maps with years of field monitoring so managers understand where/when the results are reliable.

Thank you

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