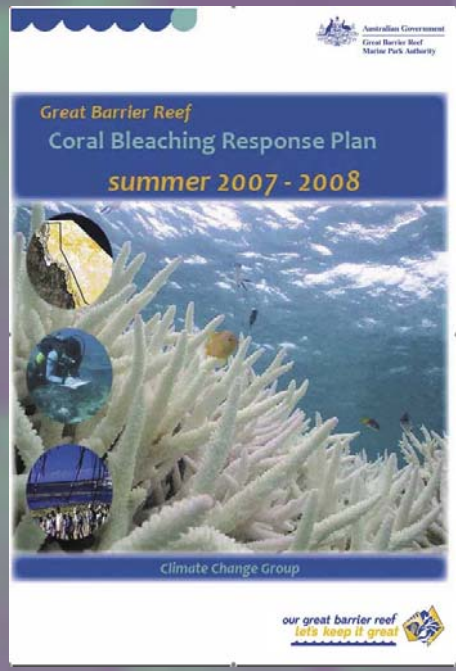
Hawaii's rapid response contingency plan for unusual events of coral bleaching or disease

Dr. Greta Smith Aeby
Hawaii Institute of Marine Biology
Hawaii's climate change and marine disease
LAS coordinator

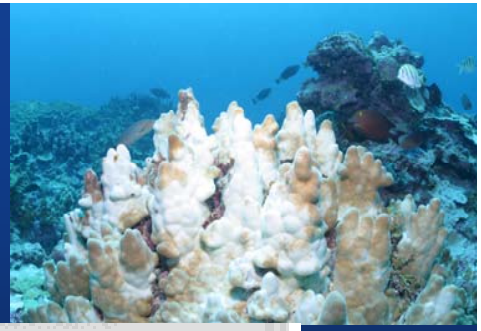
A reef manager's guide to coral bleaching

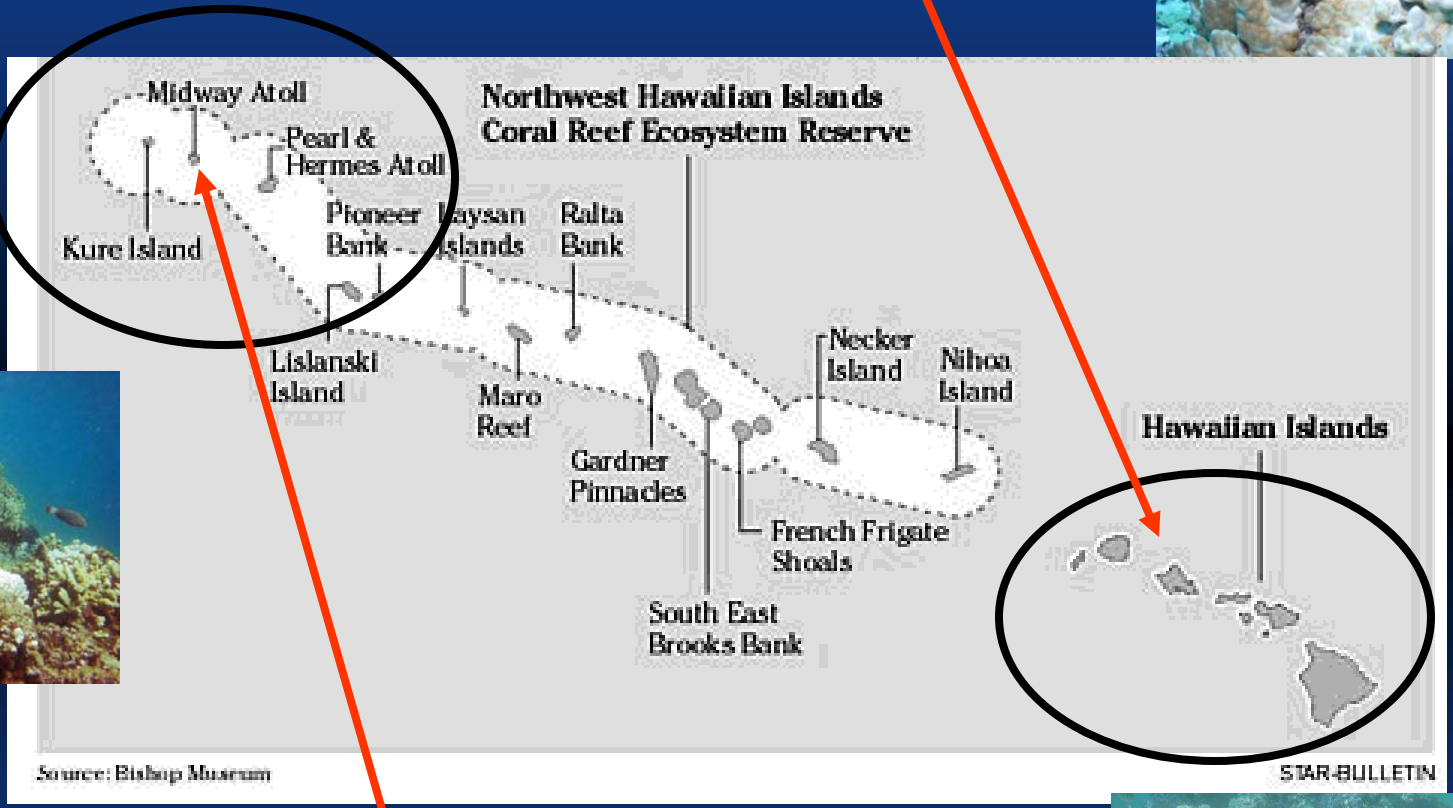
Developing a bleaching response plan

- Predicting - be prepared
- Setting thresholds - when to act
- Assess ecological impacts - how/who
- Assess socio-economic impacts - how/who
- Communicate - why/who
- Management interventions - options
- Funding - uh huh
- Capacity - resources
- Support - decision-makers/stakeholders



The first mass bleaching occurred in 1996 in the main Hawaiian Islands.





A second major bleaching event occurred in 2002 centered in the northern portion of the Archipelago

Global Climate Change

↓

Changing weather patterns

Increased sea surface temperatures

Increases in:

Coral bleaching →

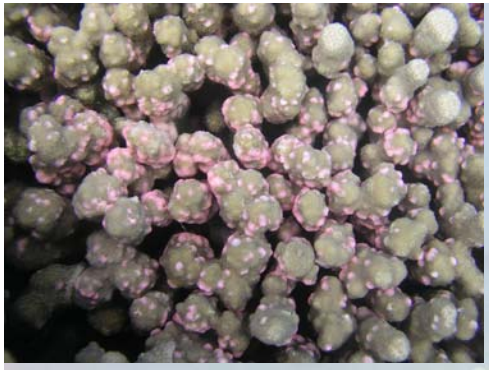
← Coral disease

Ocean acidification

Decreases in:

Coral & CCA growth and recruitment

Coral disease in Hawaii



Por **trematodiasis**

Acrop **white syndrome**

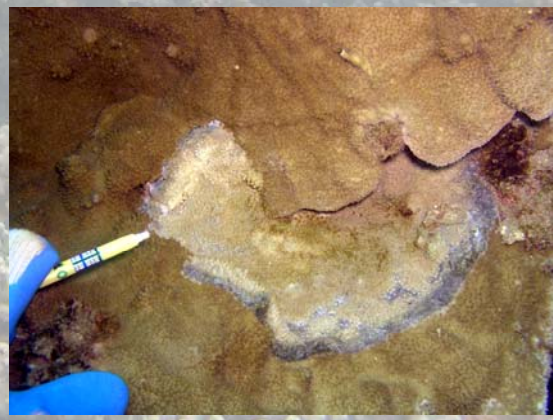
18 disease states
widespread
low prevalence

Poc **white-band disease**

Acrop **growth anomalies**

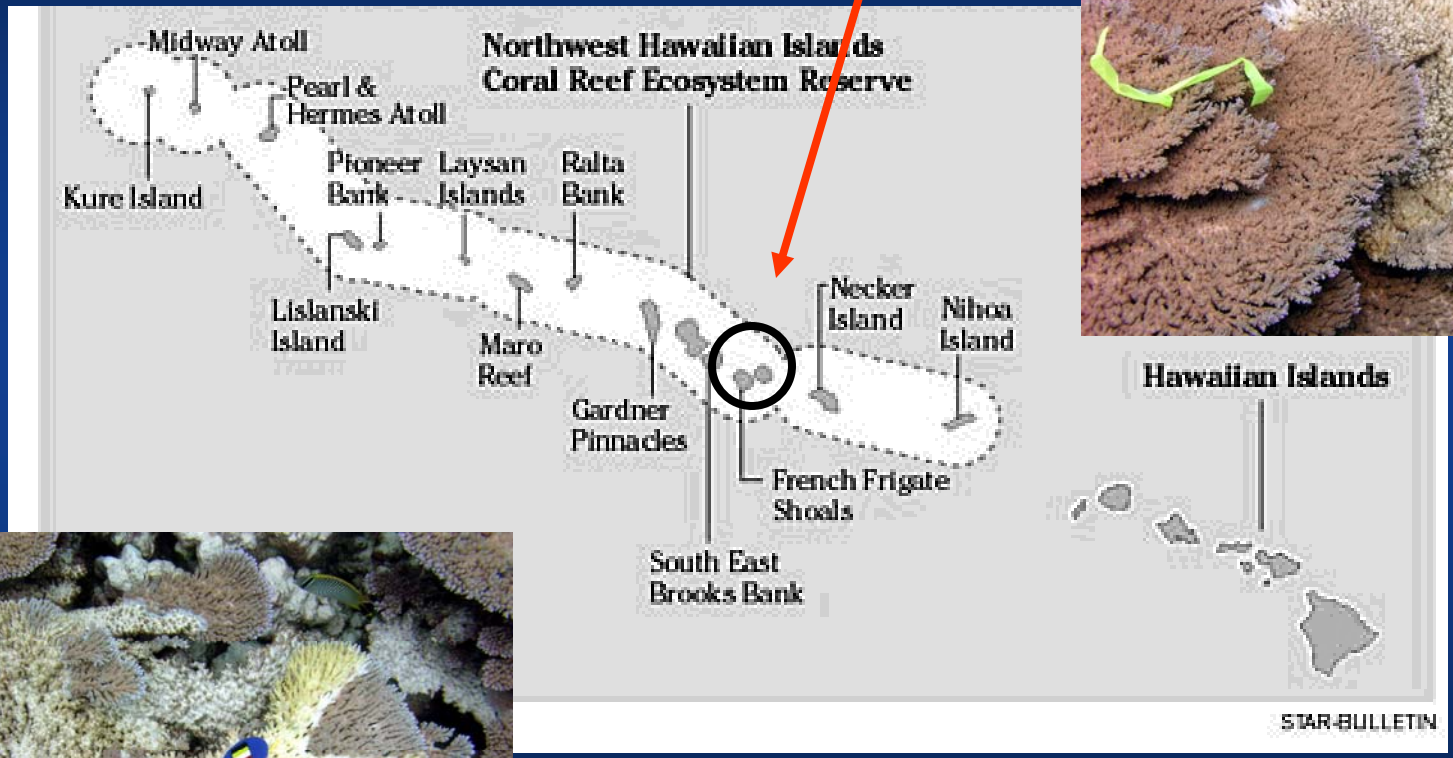
Montipora **multi-focal TLS**

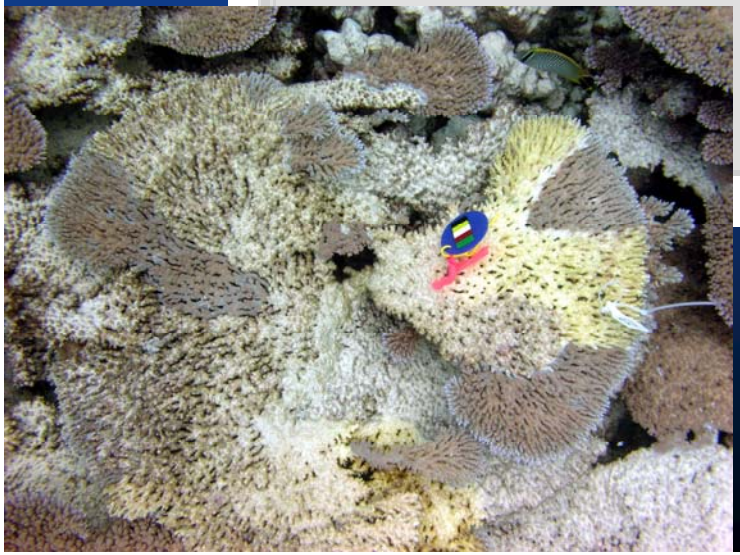
Porites **growth anomalies**



Montipora **dark band**

The first disease outbreak occurred in 2003 at French Frigate Shoals



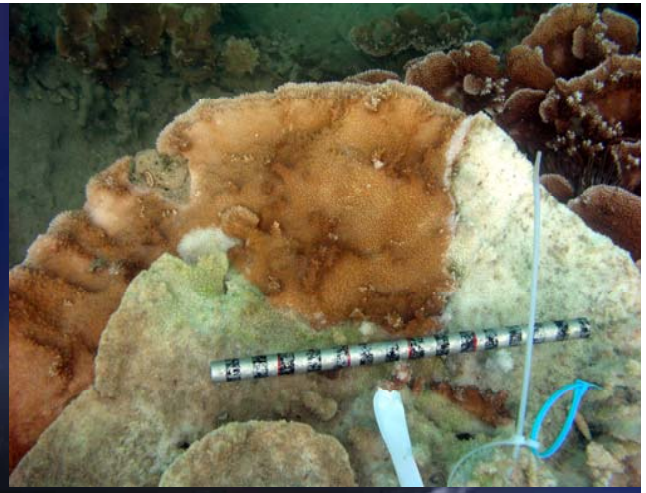


Acropora white syndrome

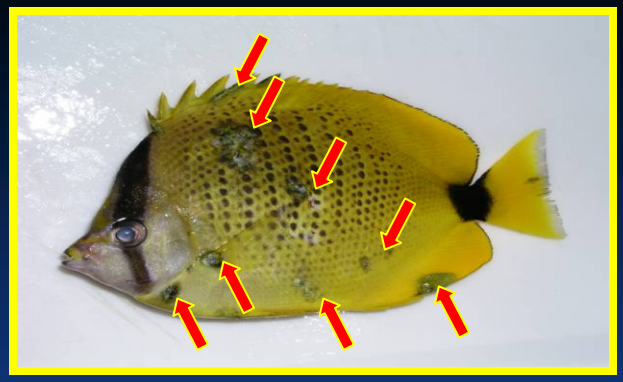
Montipora white syndrome

Kaneohe Bay

- Terrestrial run-off
- Reduced water circulation

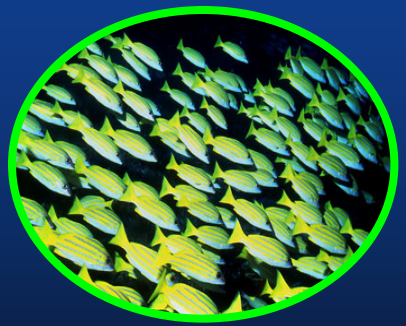


Fish and turtle disease



- Tumors in turtles and butterflyfish

- Bacterial and protozoal diseases in taape and goatfish



- Skin cancer in kole

GBR- 3 major COTS outbreaks in the past 40 years

Australian Government | Australian Institute of Marine Science

AIMS: Australia's tropical marine research agency.

Contacts | Site index

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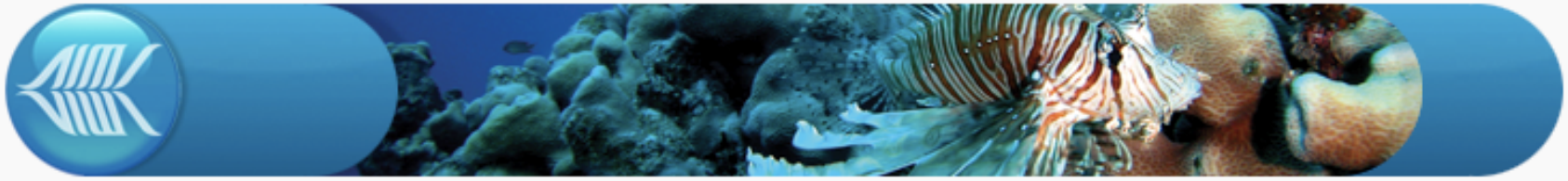

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Crown-of-thorns starfish

Crown-of-thorns starfish (COTS) are marine invertebrates that feed on coral and occur naturally on reefs throughout the Indo-Pacific region. When conditions are right for COTS to multiply, they can reach plague proportions and devastate the hard coral population on affected reefs.

In the past 40 years, three major COTS outbreaks have had a major impact on many reefs of the Great Barrier Reef (GBR). COTS outbreaks are responsible for a greater decline in coral cover than any other threat to the GBR.

AIMS has implemented the most comprehensive COTS monitoring program in the world across the GBR. This long-term program, combined with genetic studies, has shown that COTS outbreaks begin in the north and migrate southward on ocean currents over a 15 year period. These surveys also show that healthy reefs generally fully recover between outbreaks, taking 10-20 years to do so. Reefs affected by additional stresses, such as coral bleaching, cyclones or poor water quality, may take a lot longer.

serums of these fishes may have glycoproteins similar to those present in the blood of the Antarctic fishes.

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References and Notes

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23 February 1971; revised 8 April 1971

Coral-Eating Sea Stars Acanthaster planci in Hawaii

Abstract. *An aggregation of 2 × 10⁴* Acanthaster planci *was observed from September 1969 to November 1970. The sea stars within the aggregation were very uniform in size, and their reproduction was seasonal. Their average diameter and weight also varied seasonally in a manner that suggests a correlation between average size and breeding condition. The aggregation remained compactly situated in a band a few to tens of meters wide and about 2 kilometers long, parallel to the shore. The band did not move appreciably during the observation period. The sea stars were feeding selectively on a coral which was a minor component of the total coral cover. The coral in the area was predominantly alive, and the proportion of dead coral did not increase appreciably during our period of observation.*

Since 1963 large aggregations of *Acanthaster planci*, the crown-of-thorns starfish, have been observed grazing on reef corals in the Pacific (*1*, *2*). They were observed to be killing most of the hermatypic corals in several places along Australia's Great Barrier Reef and on the lee coast of Guam. In other places "dead" reefs are believed to have resulted from the feeding of *A. planci*.

In August 1969 a dense aggregation of *A. planci* was reported in the Kalohi Channel [8 miles (12.8 km) wide] off the south (lee) coast of the island of Molokai, Hawaii. This aggregation was featured in a documentary produced by a Honolulu TV station and has subsequently been investigated by the State Fish and Game Division and by a group of biologists from the University of Hawaii and the Bernice P. Bishop Museum. In April 1970, the State Fish and Game Division, in just after the attempted eradication.

Approximately 20,000 *A. planci* were aggregated in a band varying from a few to tens of meters wide and about 2 km long. The axis of the aggregation was oriented east and west, almost parallel to the coast and about 3 km offshore at depths varying from 12 to 30 m.

The bottom in the vicinity of the aggregation is covered with a dense uniform growth of coral, with occasional narrow sand channels running diagonally out from shore in a northeast-southwest direction. The coral cover is predominantly (about 90 percent) *Porites compressa*, a finger coral, extending about 1 m above the substrate. The second most abundant species (about 5 percent of the corals) is *Montipora verrucosa*, a sheetlike encrusting coral which usually occurs at the base of the *P. compressa* but occasionally grows over it to form bottom becomes a sandy slope. It continues to the west of the aggregation for at least several kilometers. To the east of the aggregation, the coral cover is interrupted by a canyon 30 m deep. East of the canyon the uniform area of coral resumes and extends toward the end of the island. The head of the canyon is a steep slope. At depths of less than 20 m this slope is predominantly covered with *M. verrucosa*. At greater depths there is no coral cover.

In October 1969 a mile-long transect line approximately parallel to the aggregation was laid on the bottom by the State Fish and Game Division. This main east-west line was crossed every 250 yards (228 m) by lines extending north and south 250 yards on either side of it. The junctions and inshore ends of the lines were marked, both on the bottom with concrete blocks and on the surface with buoys. Five censuses of the sea stars were taken by the State Fish and Game Division at approximately 2-month intervals. Divers swam along these bottom lines, recording the numbers of *A. planci* within 10 yards on either side of 25-yard line segments. In April 1970 approximately 10,000 individuals were injected, each with 10 ml of household ammonia by means of hypodermic syringes, in an attempt to eradicate the aggregation. During the survey, from October 1969 to May 1970, the aggregation remained in the vicinity of the transects but moved up 55 m or less toward shore at the western end of the aggregation.

The aggregation was also sampled at about the same times by biologists from the University of Hawaii. *Acanthaster planci* were collected from the aggregation and examined aboard ship. Each animal was measured, weighed wet, and examined for sex and gonad state. Teams of divers also made estimates of species composition and the amount of dead coral along the transect lines. A few tagging experiments were also conducted.

The density of animals within the Molokai aggregation was variable. In one location 158 animals were collected from a circle of radius 10 m. The density was therefore one animal per 2 m². In other locations the animals were crowded together so that they often overlapped each other. Densely aggregated patches did not

Sept 1969-Nov 1970

Outbreak of COTS off Molokai

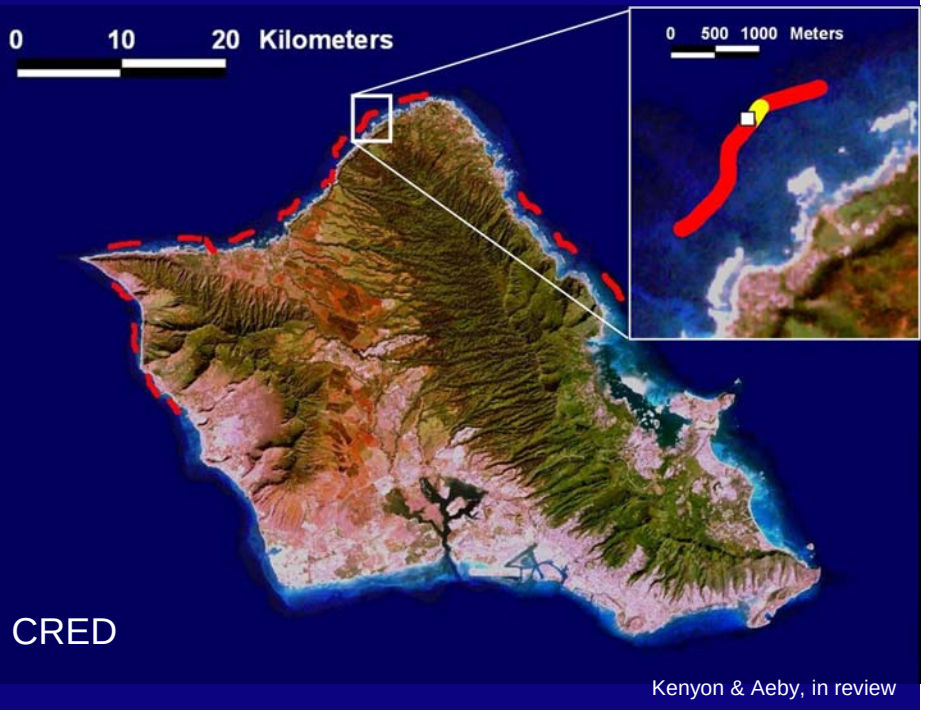
20,000 animals

Branham et al. 1971. Science 172(3988):1155-1157

Sept 2005

Outbreak of COTS
off Oahu

1,000 animals
5 min tow
2,260m^2

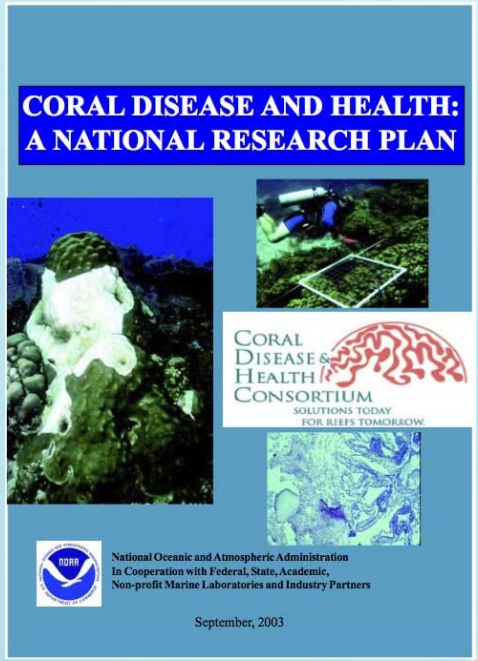


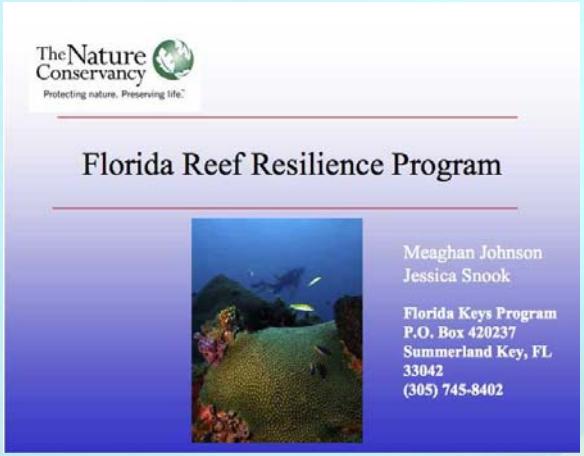
Kenyon & Aeby, in review

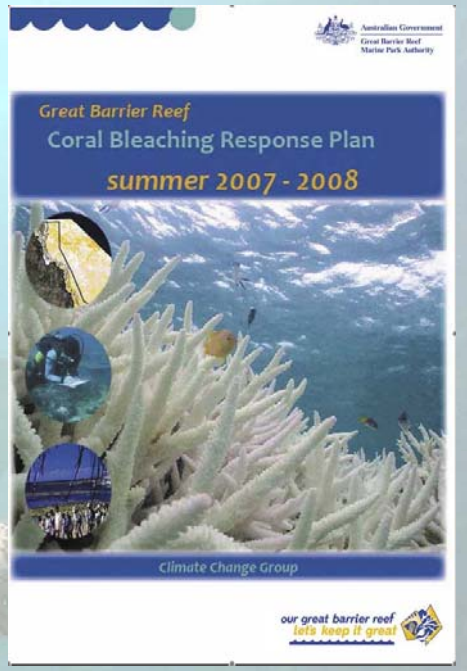
Hawaii's rapid response contingency plan for unusual events of coral bleaching, disease or COTS

Develop capacity to collect reports of events and initiate response teams

- **Respond to events rapidly and efficiently**
- **Involve stakeholders that work in the field on a daily basis and can make field observations (i.e ocean tourism industry, scientists, surfers)**
- **Develop infrastructure to receive and follow-up on reports**
- **Create, train and equip response team to assess impacts & make recommendations for management**







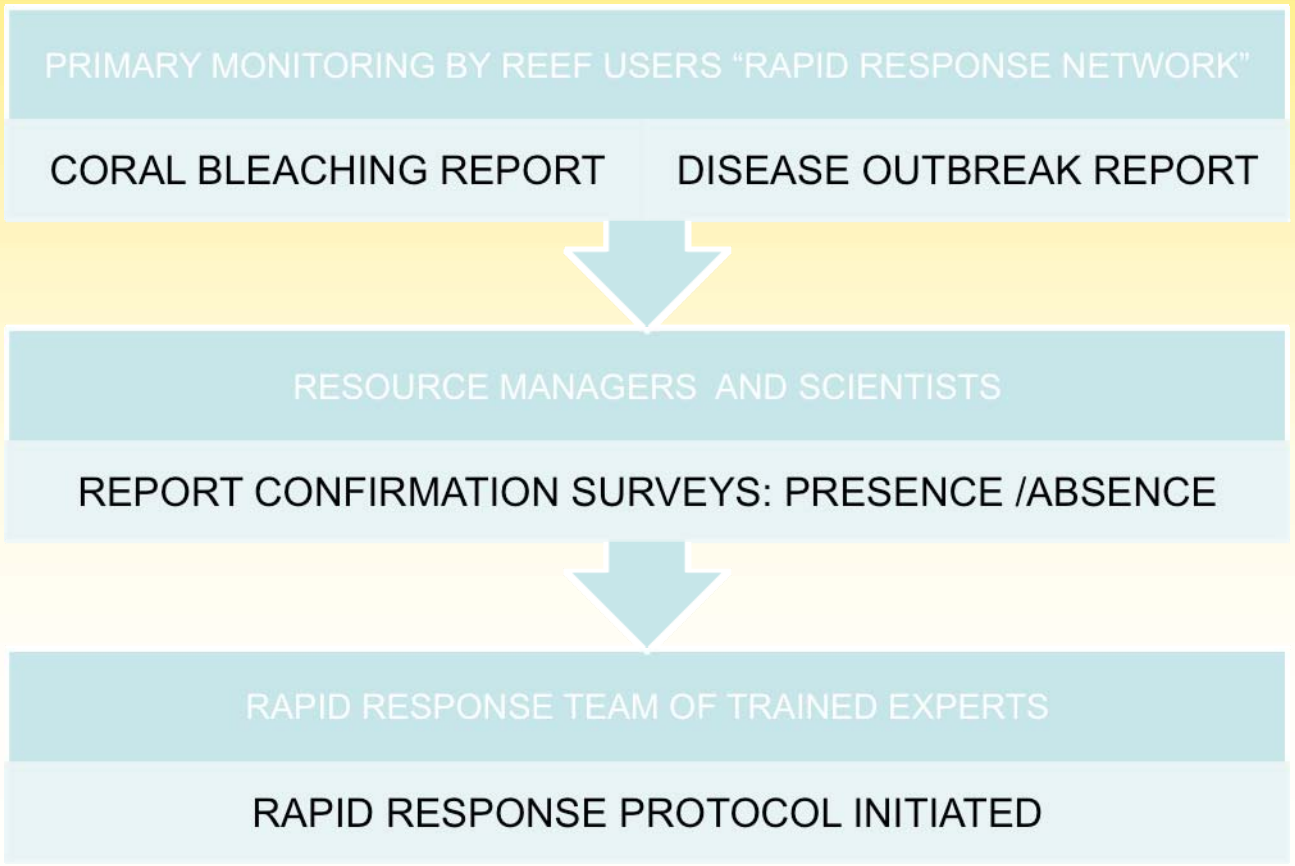
Workshops for development of Hawaii's rapid response contingency plan for coral bleaching & disease events

Education & Outreach

Protocol development

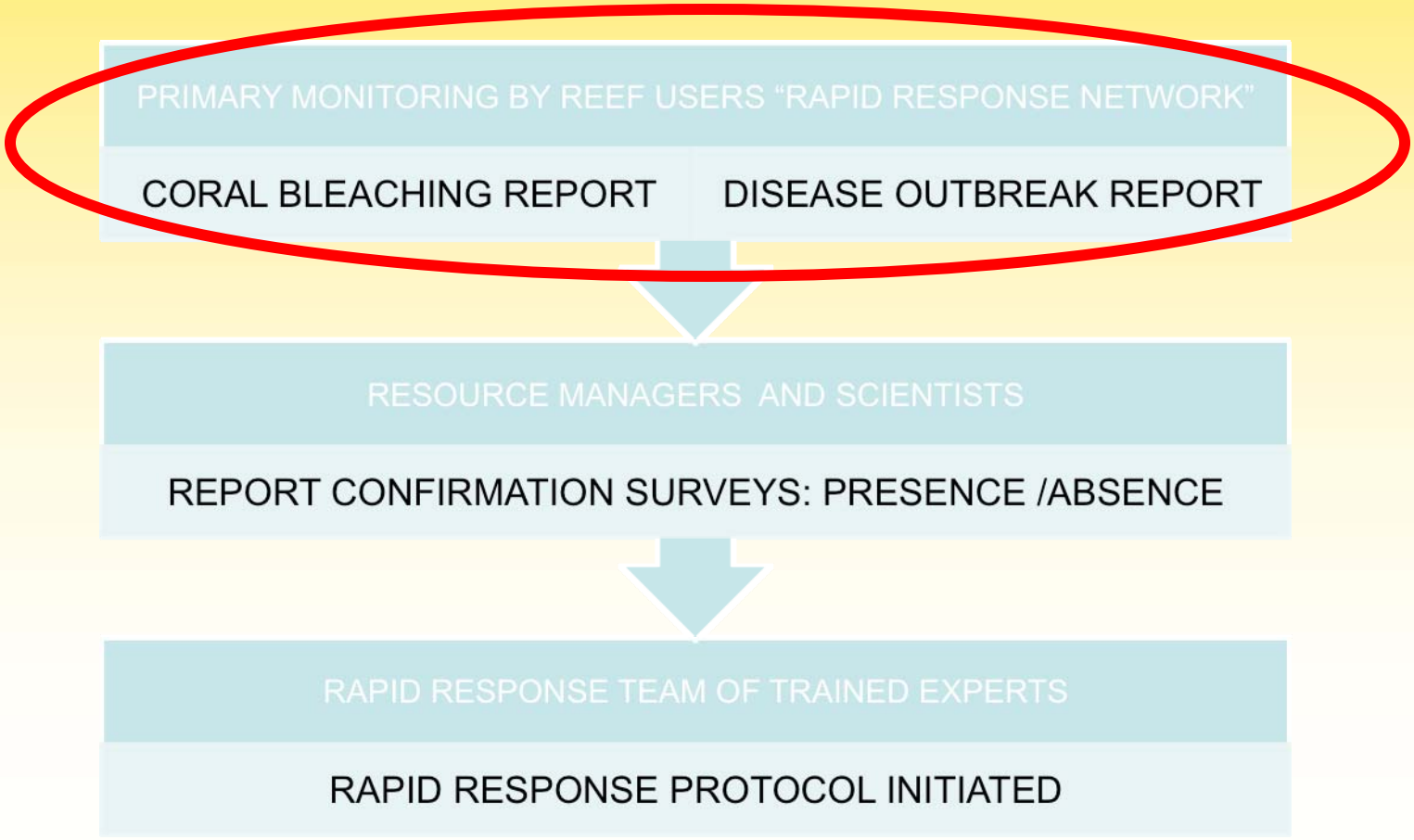
HAWAII'S RAPID RESPONSE CONTINGENCY PLAN

3 TIERED RESPONSE PROGRAM



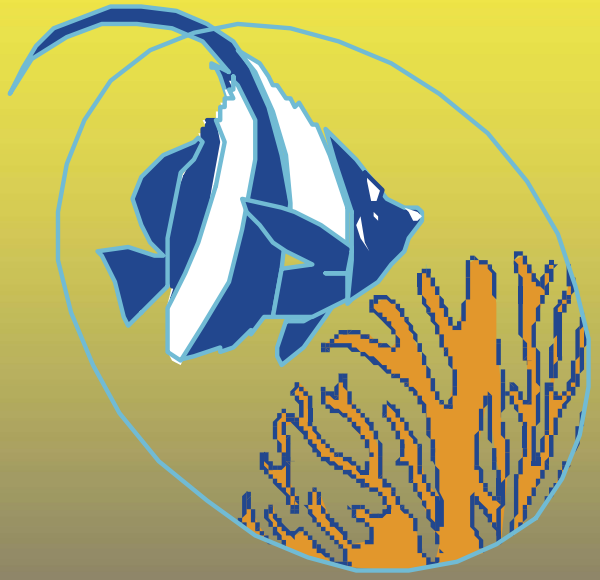
HAWAII'S RAPID RESPONSE CONTINGENCY PLAN AND THE ROLE OF THE RAPID RESPONSE NETWORK

3 TIERED RESPONSE PROGRAM



Reef Check Foundation

Saving Reefs Worldwide



Coral Reef Education, Conservation & Monitoring

RAPID RESPONSE NETWORK

PRIMARY TIER

Coral bleaching & disease monitoring network

HAWAIIAN REEFS AT RISK

Under pressure by coastal development and global warming, Hawai'i's fragile reef ecosystems are threatened with rising levels of coral bleaching, disease and crown-of-thorns sea star outbreaks. Join the "Eyes of the Reef" network and report sightings of these events.

We are an island-wide association of community volunteers, businesses, scientists, non-governmental organizations, and governmental agencies who report upon the health of Hawaiian reefs.

HELP KEEP HAWAIIAN REEFS HEALTHY

A healthy Hawaiian reef.

From the ocean comes life.
Protect the ocean.

JOIN THE EYES OF THE REEF NETWORK AND REPORT SIGHTINGS OF CORAL DISEASE, CROWN-OF-THORNS SEA STARS AND CORAL BLEACHING.

If you see these threats, please report them to:
www.reefcheckhawaii.org/eyesofthereef
or, call (808) 953-4044

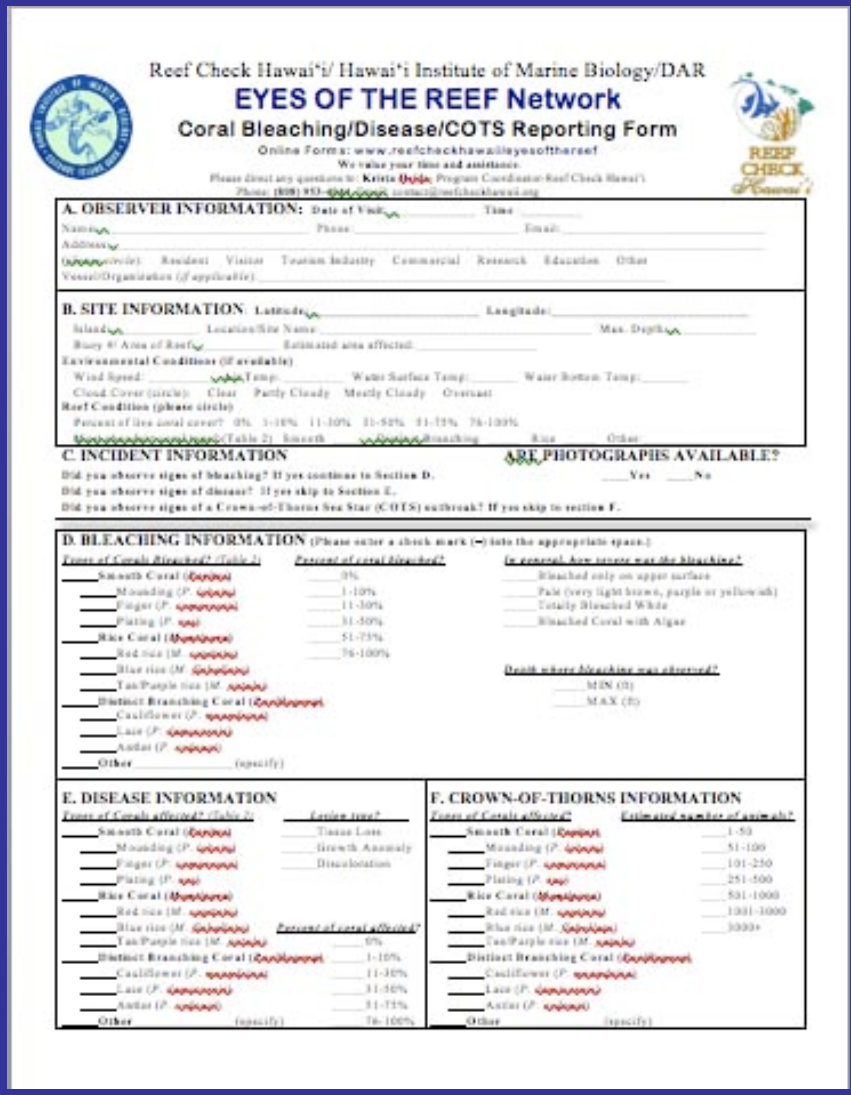
REEF CHECK Hawai'i

HAWAIIAN INSTITUTE OF MARINE BIOLOGY

EYES OF THE REEF

HAWAI`I'S CORAL BLEACHING, DISEASE AND CROWN-OF-THORNS SEA STAR MONITORING NETWORK

Eyes of the Reef reporting form



Reef Check Hawai'i/ Hawai'i Institute of Marine Biology/DAR

EYES OF THE REEF Network

Coral Bleaching/Disease/COTS Reporting Form

Online Forms: www.reefcheckhawaiieyesoftheree

We value your time and assistance.

Please direct any questions to: Kristin [redacted], Program Coordinator/Reef Check Hawai'i

Phone: (808) 953-[redacted] contact@reefcheckhawaii.org

A. OBSERVER INFORMATION: Date of Visit: _____ Time: _____

Name: _____ Phone: _____ Email: _____

Address: _____

(circle): Resident Visitor Tourism Industry Commercial Research Education Other

Vessel/Organization (if applicable): _____

B. SITE INFORMATION: Latitude: _____ Longitude: _____

Island: _____ Location/Site Name: _____ Max. Depth: _____

Buoy #/ Area of Reef: _____ Estimated area affected: _____

Environmental Conditions (if available)

Wind Speed: _____ Temp: _____ Water Surface Temp: _____ Water Bottom Temp: _____

Cloud Cover (circle): Clear Partly Cloudy Mostly Cloudy Overcast

Reef Condition (please circle)

Percent of live coral cover? 0% 1-10% 11-30% 31-50% 51-75% 76-100%

(Table 2) Smooth Branching Rice Other

C. INCIDENT INFORMATION **ARE PHOTOGRAPHS AVAILABLE?**

Did you observe signs of bleaching? If yes continue to Section D. ___Yes ___No

Did you observe signs of disease? If yes skip to Section E.

Did you observe signs of a Crown-of-Thorns Sea Star (COTS) outbreak? If yes skip to section F.

D. BLEACHING INFORMATION (Please enter a check mark (—) into the appropriate space.)

Types of Corals Bleached? (Table 2) | Percent of coral bleached? | In general, how severe was the bleaching?

___Smooth Coral (*[redacted]*) | ___0% | ___Bleached only on upper surface

___Mounding (*P. [redacted]*) | ___1-10% | ___Pale (very light brown, purple or yellowish)

___Finger (*P. [redacted]*) | ___11-30% | ___Totally Bleached White

___Plating (*P. [redacted]*) | ___31-50% | ___Bleached Coral with Algae

___Rice Coral (*[redacted]*) | ___51-75% |

___Red rice (*M. [redacted]*) | ___76-100% |

___Blue rice (*M. [redacted]*) | | Depth where bleaching was observed?

___Tan/Purple rice (*M. [redacted]*) | | ___MIN (ft)

___Distinct Branching Coral (*[redacted]*) | | ___MAX (ft)

___Cauliflower (*P. [redacted]*)

___Lace (*P. [redacted]*)

___Antler (*P. [redacted]*)

___Other _____ (specify)

E. DISEASE INFORMATION

Types of Corals affected? (Table 2) | Lesion type?

___Smooth Coral (*[redacted]*) | ___Tissue Loss

___Mounding (*P. [redacted]*) | ___Growth Anomaly

___Finger (*P. [redacted]*) | ___Discoloration

___Plating (*P. [redacted]*)

___Rice Coral (*[redacted]*)

___Red rice (*M. [redacted]*)

___Blue rice (*M. [redacted]*) | Percent of coral affected?

___Tan/Purple rice (*M. [redacted]*) | ___0%

___Distinct Branching Coral (*[redacted]*) | ___1-10%

___Cauliflower (*P. [redacted]*) | ___11-30%

___Lace (*P. [redacted]*) | ___31-50%

___Antler (*P. [redacted]*) | ___51-75%

___Other _____ (specify) | ___76-100%

F. CROWN-OF-THORNS INFORMATION

Types of Corals affected? | Estimated number of animals?

___Smooth Coral (*[redacted]*) | ___1-50

___Mounding (*P. [redacted]*) | ___51-100

___Finger (*P. [redacted]*) | ___101-250

___Plating (*P. [redacted]*) | ___251-500

___Rice Coral (*[redacted]*) | ___501-1000

___Red rice (*M. [redacted]*) | ___1001-3000

___Blue rice (*M. [redacted]*) | ___3000+

___Tan/Purple rice (*M. [redacted]*)

___Distinct Branching Coral (*[redacted]*)

___Cauliflower (*P. [redacted]*)

___Lace (*P. [redacted]*)

___Antler (*P. [redacted]*)

___Other _____ (specify)

Coral disease identification cards

Hawaii's rapid response contingency plan

Hawaii's early warning network

Climatic monitoring
Local weather forecasts
In situ data loggers
NOAA Coral Reef Watch

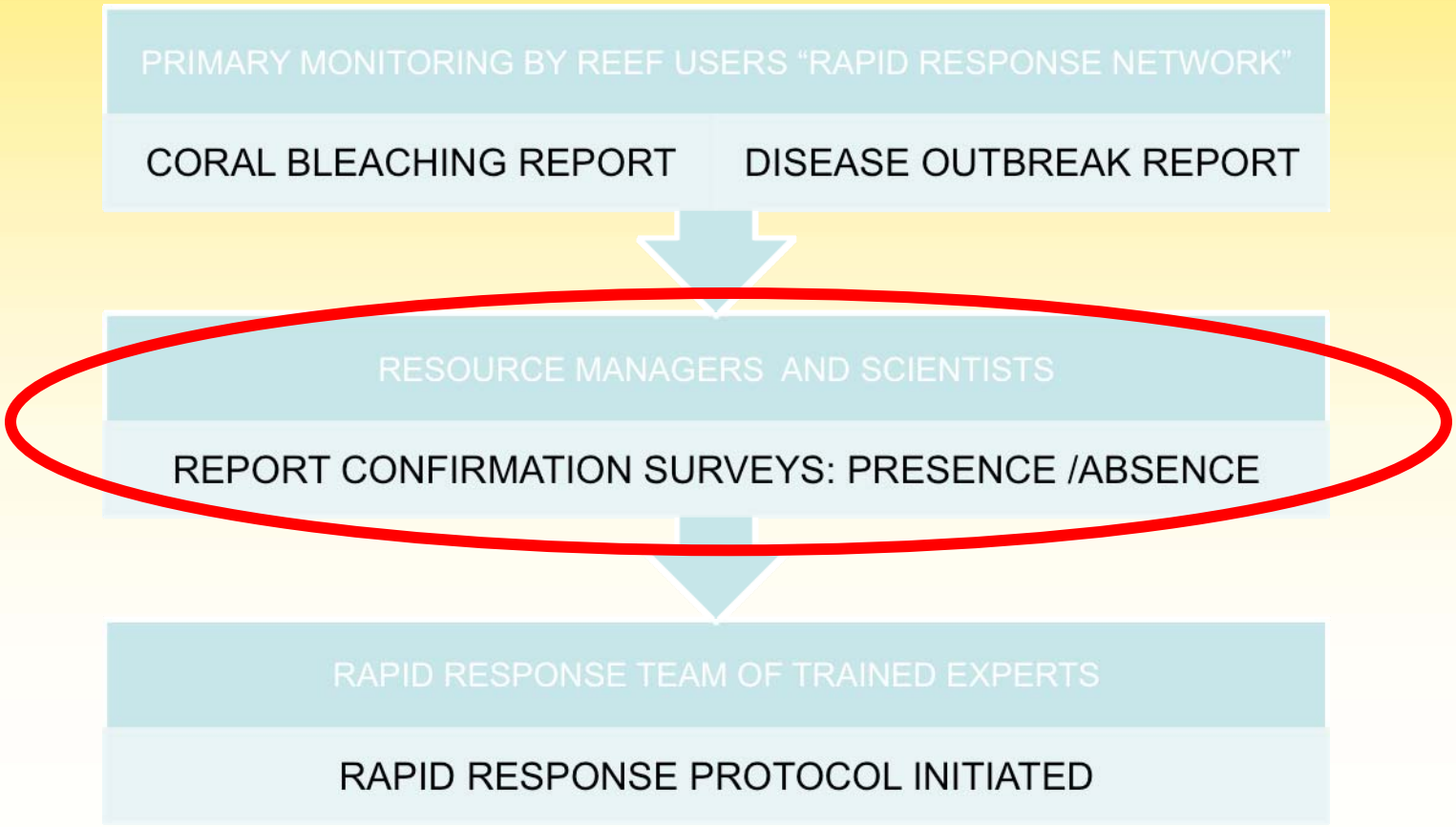
Community monitoring
Eyes of the reef
Community
Dive shops
Makai watch

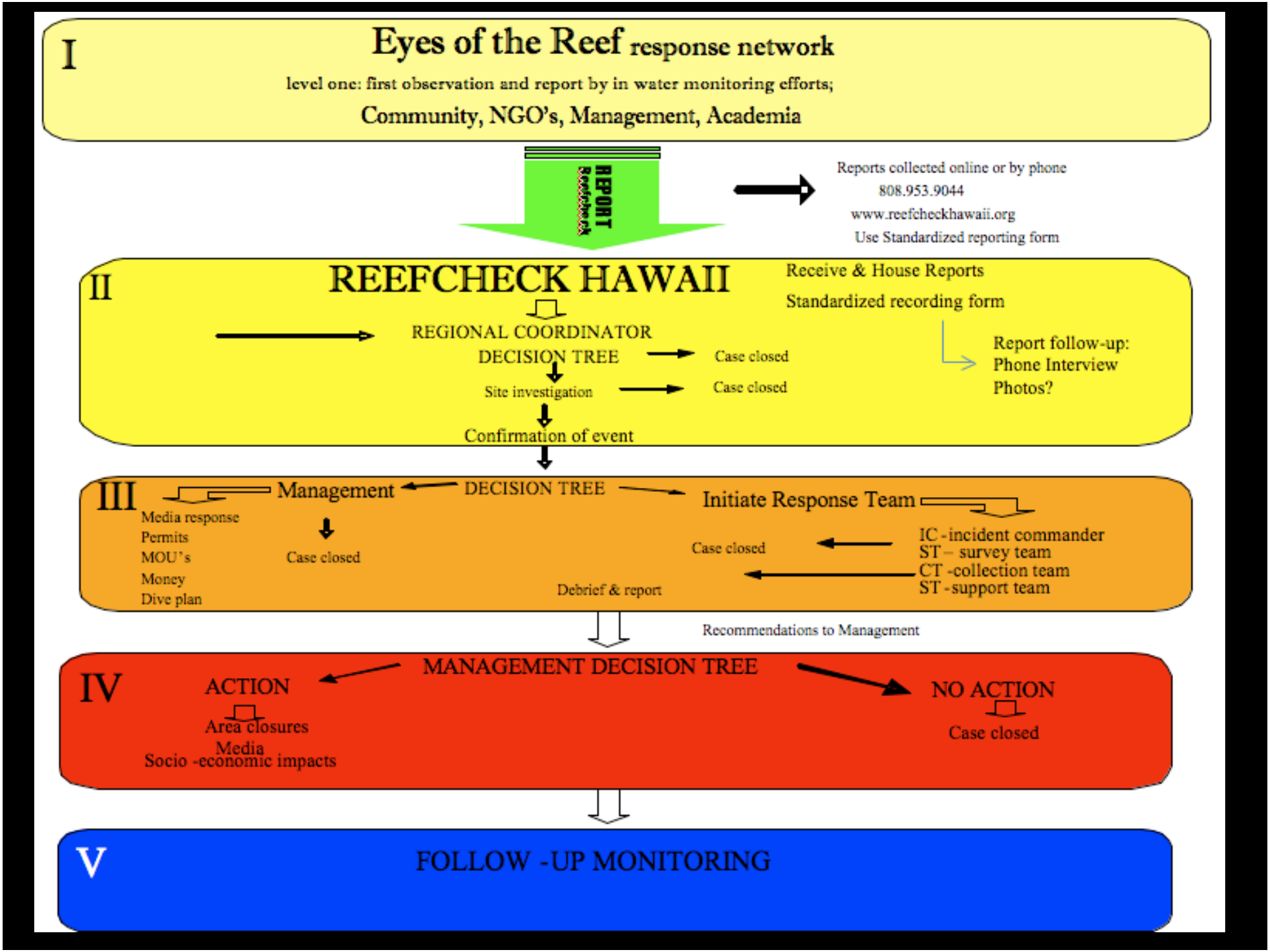
Reef Check Hawaii
Receive & report

Scientific monitoring
DAR CRAMP CRED

HAWAII'S RAPID RESPONSE CONTINGENCY PLAN

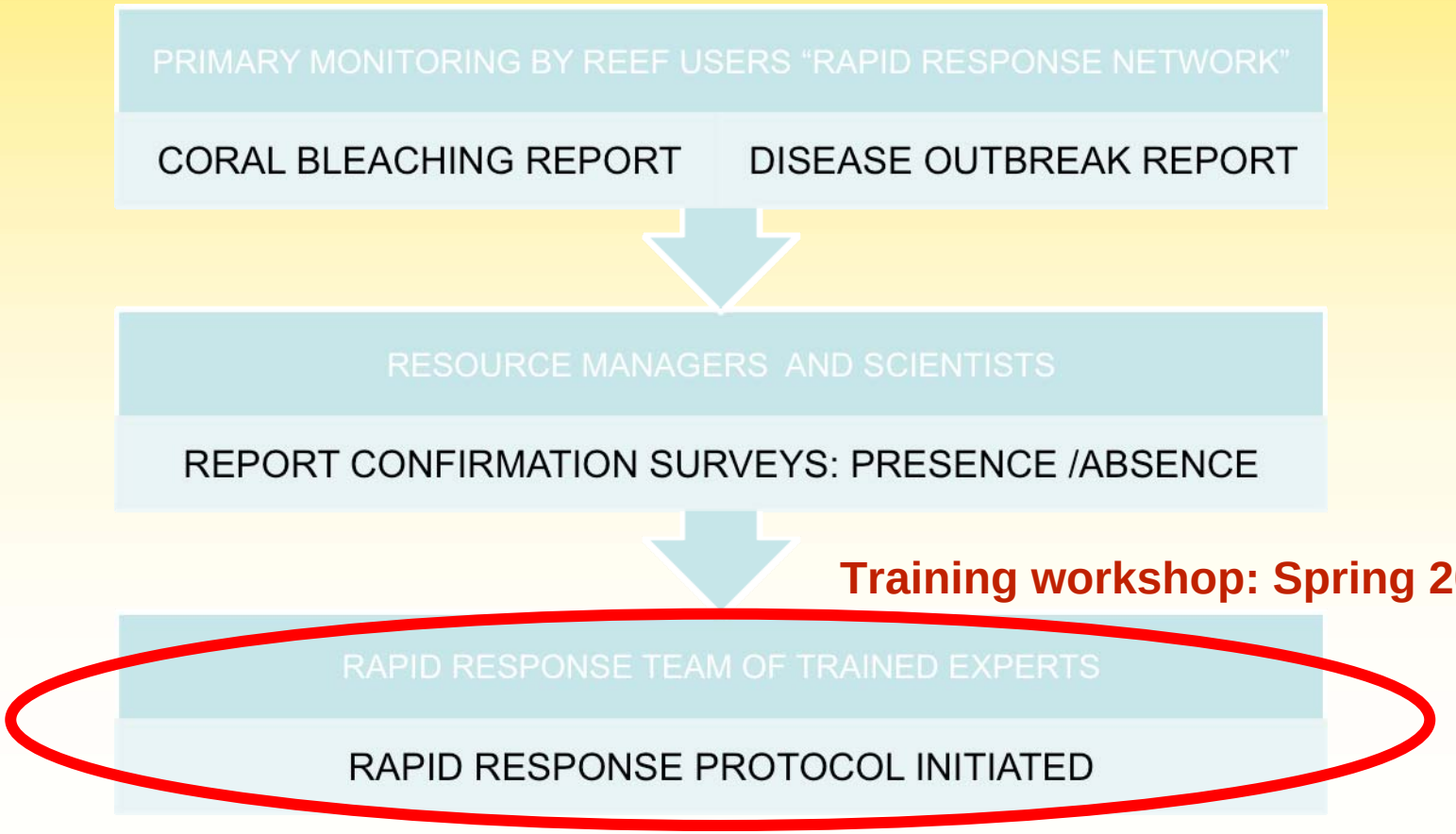
3 TIERED RESPONSE PROGRAM




I
Eyes of the Reef response network
level one: first observation and report by in water monitoring efforts;
Community, NGO's, Management, Academia
REPORT
Reefcheck
Reports collected online or by phone
808.953.9044
www.reefcheckhawaii.org
Use Standardized reporting form
II
REEFCHECK HAWAII
Receive & House Reports
Standardized recording form
REGIONAL COORDINATOR
DECISION TREE
Case closed
Site investigation
Case closed
Report follow-up:
Phone Interview
Photos?
Confirmation of event
III
Management
DECISION TREE
Initiate Response Team
Media response
Permits
MOU's
Money
Dive plan
Case closed
Case closed
IC - incident commander
ST – survey team
CT - collection team
ST - support team
Debrief & report
Recommendations to Management
IV
MANAGEMENT DECISION TREE
ACTION
Area closures
Media
Socio -economic impacts
NO ACTION
Case closed
V
FOLLOW -UP MONITORING

HAWAII'S RAPID RESPONSE CONTINGENCY PLAN

3 TIERED RESPONSE PROGRAM



Training workshop: Spring 2009

Developing a bleaching response plan

- Predicting
- Setting thresholds
- Assess ecological impacts
- Assess socio-economic impacts
- Communicate Management interventions
- **Funding**
- **Capacity**
- **Support**

Climate change and coral reef health

Integrate reef resilience into management plans:

- **Reduce anthropogenic stressors NOW**
  - Overfishing
  - Land-based pollution
  - Human useage

- **Protect more reefs**
  - Marine protected areas

- **Develop response plans**

- **Support research**
  - minimize and mitigate damage from climate change