Developing Practical Management Strategies to Promote Coral Recovery Following a Severe Bleaching Event in Hawai'i
Project Team

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Question:

What management strategies are considered the most effective at promoting coral recovery following a mass bleaching event?
Approach

1. Global coral bleaching expert survey
2. Literature review of reef recovery recommendations and case studies
3. Hawaii managers decision-making workshop

Photo: Hawaii Division of Aquatic Resources
Global Coral Bleaching Expert Survey: Respondents

1. Lead author on a scientific paper or peer-reviewed article related to coral bleaching or other relevant topic (e.g. herbivory, coral propagation).
   - Paper focused on Hawaii – all authors
   - Paper focused outside of Hawaii – lead author only

2. Participant in 2014-2015 Hawaii coral bleaching workshops

3. Resource manager/scientist outside of Hawaii who has responded to bleaching events.
Global Coral Bleaching Expert Survey: Management Strategy Categories

- Marine Protected Areas
- Fisheries Rules
- Human In-water Activity Rules
- Aquaculture techniques
- Land-based strategies
- Eradication Techniques
- Other Strategies
Global Coral Bleaching Expert Survey: Implementation

- Online targeted interview shared with 174 coral bleaching experts

- 5-point weighted Likert scale from “not effective” to “very effective”

- Score 22 management strategies based on ecological effectiveness
Global Coral Bleaching Expert Survey: Results

n = 82 (47% response rate)

Mahalo to ICRS survey respondents!
Results: Respondent Demographics

- Scientist: 78%
- Manager: 14%
- Other: 8%

Number of Respondents vs. Number of Publications:
- 0 publications: 5
- 1-5 publications: 15
- 6-10 publications: 10
- > 10 publications: 30

Number of Respondents vs. Professional Experience:
- 1-5 years: 5
- 6-10 years: 15
- > 10 years: 30
Results – Top 5 Most Ecologically Effective Management Strategies

- Reduce sediment stress on coral reefs by implementing additional land-based mitigation in adjacent watersheds
- Reduce nutrient/chemical stress on coral reefs by implementing additional land-based mitigation in adjacent watersheds
- Establish a network of permanent, fully protected no-take MPAs
- Enhance marine enforcement efforts to ensure the effectiveness of rules relating to coral reef protection
- Establish a network of permanent Herbivore Fishery Management Area (FMA) which fully protect all herbivores
Results – Top 5 **LEAST** Ecologically Effective Management Strategies

- Create artificial reefs in heavily bleaching-impacted reef areas
- Attempt to eradicate introduced fish species such as the Roi, or Peacock Grouper, Cephalopholis argus
- Establish a network of temporary, rotationally closed, no-take MPAs
- Attempt to eradicate the Crown of Thorns Starfish, Acanthaster plancii
- Establish a temporary moratorium on aquarium collecting
Coral Recovery Literature Review: Resulting Framework

Is there capacity for natural recovery?
- Yes
- No

Is the natural rate of recovery sufficient?
- Yes
- No

Monitoring
- Prevent additional damage to coral
  - Creation of MPAs
  - Reduction of harmful human activities
- Control algae overgrowth
  - Protection of herbivores through fisheries management
  - Reduction of anthropogenic factors that promote algal growth
- Bolster existing management
  - Stimulate new coral settlement
    - Protect larval sources
    - Ensure adequate settlement substrate
  - Stimulate coral regrowth
    - Reduction of anthropogenic factors that affect early coral life stages
    - Facilitate conditions for rapid tissue regeneration
  - Replacing dead coral
    - Transplantation of fragments from healthy reefs
    - Farming bleaching resistant genotypes
  - Active recovery
Coral Recovery Literature Review: Management Intervention Case Studies

- Creation of no-anchor zones on GBR (Beeden et al 2014)
- Transplantation of coral fragments in Philippines (Gomez et al 2014)
- Closure of high-traffic dive sites in Southeast Asia (Hyde 2013, Yeemin et al 2012, Tun et al 2010)
- Aquarium fishers impose self-moratorium on GBR (Great Barrier Reef Authority 2008)
Coral Bleaching Recovery Workshop Output – Top 10 Statewide Management Recommendations

<table>
<thead>
<tr>
<th>Action</th>
<th>Points</th>
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<tbody>
<tr>
<td>Establish a network of permanent, fully protected no-take MPAs</td>
<td>50</td>
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<tr>
<td>Reduce sediment stress on coral reefs by implementing additional land-based mitigation in adjacent watersheds</td>
<td>29</td>
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<td>Reduce nutrient/chemical stress on coral reefs by implementing additional land-based mitigation in adjacent watersheds</td>
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<td>Enhance marine enforcement efforts to ensure the effectiveness of rules relating to coral reef protection</td>
<td>17</td>
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<tr>
<td>Prohibit all take (commercial and non-commercial) of herbivorous fish</td>
<td>16</td>
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<tr>
<td>Establish a network of permanent Herbivore Fishery Management Area (FMA) which fully protect all herbivores</td>
<td>10</td>
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<tr>
<td>Identify, collect, propagate and replant corals found to be resistant to bleaching</td>
<td>9</td>
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<tr>
<td>Prohibit all take (commercial and non-commercial) of parrotfishes</td>
<td>8</td>
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<tr>
<td>Establish bag limits to protect parrotfishes</td>
<td>6</td>
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<tr>
<td>Prohibit aquarium collecting of herbivorous fishes</td>
<td>6</td>
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<tr>
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Next Steps

Meet with Hawaii Division of Aquatic Resources to choose management strategy

Photo: Hawaii Division of Aquatic Resources