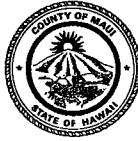


Council Chair
Mike White

Vice-Chair
Robert Carroll

Presiding Officer Pro Tempore
Stacy Crivello

Councilmembers
Alika Atay
Elle Cochran
Don S. Guzman
Riki Hokama
Kelly T. King
Yuki Lei K. Sugimura



Director of Council Services
Sandy K. Baz

COUNTY COUNCIL
COUNTY OF MAUI
200 S. HIGH STREET
WAILUKU, MAUI, HAWAII 96793
www.MauiCounty.us

February 13, 2017

RECEIVED
2017 FEB 15 PM 3:44
OFFICE OF THE
COUNTY CLERK

The Honorable Mike White
Council Chair
County of Maui
Wailuku, Hawaii 96793

Dear Chair White:

SUBJECT: **RESTORATION OF MAUI'S CORAL REEFS** (PAF 17-020)

May I request the matter relating to saving, protecting, and enhancing the reef ecosystems; including its relation to cultural, ecological, subsistence, and economic benefits; incorporating attached documents from Council term (2015-2017), be placed on the next Council meeting agenda.

Sincerely,

A handwritten signature in black ink, appearing to read "Elle Cochran", is written over the typed name.

ELLE COCHRAN
Councilmember

paf:grs:17-020a

Enclosure

COUNTY COMMUNICATION NO. 17-123

JEFFREY T. KUWADA
County Clerk



JOSIAH K. NISHITA
Deputy County Clerk

OFFICE OF THE COUNTY CLERK

COUNTY OF MAUI
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793
www.mauicounty.gov/county/clerk

September 20, 2013

RECEIVED
2013 SEP 20 PM 3:17
OFFICE OF THE
COUNTY COUNCIL

Honorable Elle Cochran, Chair
Infrastructure and Environmental
Management Committee
Council of the County of Maui
Wailuku, Hawaii 96793

Dear Chair Cochran:

Respectfully transmitted are copies of the following communications that were referred to your Committee by the Council of the County of Maui at its meeting of September 20, 2013:

COUNTY COMMUNICATIONS:

- No. 13-300 - David C. Goode, Director of Public Works
- No. 13-301 - David C. Goode, Director of Public Works
- No. 13-302 - Kyle K. Ginoza, Director of Environmental Management
- No. 13-303 - Elle K. Cochran, Council Member

Respectfully,

A handwritten signature in black ink, appearing to read "Jeffrey T. Kuwada", is written over a horizontal line.

JEFFREY T. KUWADA
County Clerk

/jym

Enclosures

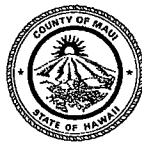
cc: Director of Council Services

Council Chair
Gladys C. Baisa

Vice-Chair
Robert Carroll

Presiding Officer Pro Tempore
Michael P. Victorino

Council Members
Elle Cochran
Donald G. Couch, Jr.
Stacy Crivello
Don S. Guzman
G. Riki Hokama
Mike White



Director of Council Services
David M. Raatz, Jr., Esq.

COUNTY COUNCIL
COUNTY OF MAUI
200 S. HIGH STREET
WAILUKU, MAUI, HAWAII 96793
www.mauicounty.gov/council

September 12, 2013

RECEIVED
2013 SEP 12 PM 4:12
OFFICE OF THE
COUNTY CLERK

The Honorable Gladys C. Baisa
Council Chair
County of Maui
Wailuku, Hawaii 96793

Dear Chair Baisa:

**SUBJECT: RESOLUTION URGING SUPPORT FOR "OLA NA PAPA I
MALAMAIA: A PRACTICAL PLAN FOR THE
TECHNICAL AND CULTURAL RESTORATION OF
MAUI'S CORAL REEFS" (PAF 13-233)**

Please find attached a proposed resolution entitled "URGING SUPPORT FOR 'OLA NA PAPA I MALAMAIA: A PRACTICAL PLAN FOR THE TECHNICAL AND CULTURAL RESTORATION OF MAUI'S CORAL REEFS'".

May I request that the attached proposed resolution be placed on the next Council agenda.

Sincerely,

A handwritten signature in black ink that reads "Elle Cochran".

ELLE COCHRAN
Council Member

paf:scj:13-233b

Enclosure

COUNTY COMMUNICATION NO. 13-303

Resolution

No. _____

URGING SUPPORT FOR “OLA NA PAPA I MALAMAIA: A PRACTICAL PLAN FOR THE TECHNICAL AND CULTURAL RESTORATION OF MAUI’S CORAL REEFS”

WHEREAS, the value of Maui’s coral reefs is widely recognized and appreciated, but not always appropriately valued when decisions are made regarding land use and marine resources; and

WHEREAS, a 2011 study by the National Oceanic and Atmospheric Administration estimated the economic value of Hawaii’s coral reefs at \$33.57 billion; and

WHEREAS, significant declines in the health, abundance, and diversity of coral and reef fish populations have been documented at eight vital coral reefs on Maui over the last 20 years; and

WHEREAS, the Maui Island Plan (Chapter 2, Objective 2, Implementing Action D) encourages the implementation of a reef protection restoration plan; and

WHEREAS, the Maui Nui Marine Resource Council established a Maui Coral Reef Recovery Team that, among other efforts, worked to develop a practical plan for the technical and cultural restoration of Maui’s coral reefs, and

WHEREAS, the practical plan outlines four goals and 16 associated objectives to be achieved between 2015 and 2025, and

WHEREAS, accomplishing these goals and objectives will require a united effort from County, State, and Federal agencies; non-profit and non-governmental organizations, and citizen and ocean-user groups; and

WHEREAS, local management strategies designed to meet community goals can achieve greater good than those designed solely for biodiversity conservation; now, therefore,

BE IT RESOLVED by the Council of the County of Maui:

1. That it recognizes the importance of saving, protecting, and enhancing the reef ecosystems of Maui County for their cultural, biological and economic benefits; and

Resolution No. _____

2. That it urges support for “Ola Na Papa I Malamaia: A Practical Plan for the Technical and Cultural Restoration of Maui’s Coral Reefs”; and
3. That certified copies of this resolution be transmitted to the Mayor; the Department of Public Works; the Department of Planning; the Department of Environmental Management; the Maui Nui Marine Resource Council; the Aha Moku o Maui; the Aha Moku Advisory Committee, the State Department of Land and Natural Resources; the Office of Hawaiian Affairs; the University of Hawaii’s Institute of Marine Biology; the Hawaiian Islands Humpback Whale National Marine Sanctuary, the National Oceanic and Atmospheric Association; the Natural Resource Conservation Service, the United States Department of Agriculture; and the United States Coral Reef Task Force.

APPROVED AS TO FORM AND LEGALITY

Department of the Corporation Counsel
County of Maui

paf:scj:13-233a



Working together to restore clean water, healthy coral reefs
and abundant native fish populations to the islands of Maui Nui.

Sarah McLane,
Executive Director

Robin Newbold, Chair

Dale Bonar

Irene Bowie

Rich Brunner

Jay Carpio

Maile Carpio

Linda Nakagawa Castro

Rhiannon Chandler

Mark Deakos

Lucienne De Naie

Scott Fisher

John Gorman

Wendy Harvey

Harry Hecht

Sol Kaho'ohalahala

Robin Knox

Ekolu Lindsey

Takeo Miyaguchi

Tamara Paltin

Pam Pogue

Rina Sampson

Larry Stevens

Ananda Stone

Darla White

March 21, 2013

Members of the Maui Nui Marine Resource Council are proud to introduce the **Maui Coral Reef Recovery Plan – titled “Ola nā Papa i Mālama ‘ia: A Practical Plan for the Technical and Cultural Restoration of Maui’s Coral Reefs.”**

Inside you will find information on how we aim to bring back healthy, vibrant coral reefs and fish populations to Maui Island, through a science-based, results-driven, community and peer-reviewed coral reef recovery plan for Maui.

Success of our Plan will only be possible through the support of our communities, our governmental and non-governmental agencies and our policy makers.

Please take the time to review the plan – An Executive Summary on page 12 hits the highlights – and let us know what you think!

The Maui Nui Marine Resource Council (MNMRC) consists of 28 members and numerous advisors who represent a broad spectrum of the community including commercial, recreational and subsistence fishers; ocean tourism businesses; scientists, educators and cultural practitioners. Our goals for Maui County are to have an abundance of reef fishes and clean water.

With support from the National Fish and Wildlife Foundation, the Harold K.L. Castle Foundation and the Maui County Office of Economic Development, the MNMRC coordinated a Maui Coral Reef Recovery Team (MCRT) to research and develop this Recovery Plan. This document was collaboratively authored by the sixteen members of the Maui Coral Reef Recovery Team (MCRT): Eric Brown, PhD (United States Department of the Interior, National Park Service); Jay Carpio (Abundance of Fish Committee Chair, Maui Nui Marine Resource Council); Rhiannon Chandler (Community Work Day Program); Mark Deakos, PhD (Hawai'i Association for Marine Education and Research, Inc.); Alan Friedlander, PhD (University of Hawai'i); Robin Knox (Water Quality Consulting, Inc.); Robin Newbold (Chair, Maui Nui Marine Resource Council); Dan Polhemus, PhD (United States Department of the Interior, U.S. Fish and Wildlife Service); Tony Povilitis, PhD (Life Net Nature); Robert Richmond, PhD and MCRT Chair (University of Hawai'i); Celia Smith, PhD (University of Hawai'i); Russell Sparks, MSc (State of Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources); John Summers (Maui County Planning Department, Administrator, Long Range Planning Division); Brian Tissot, PhD (Washington State University); Wendy Wiltse, PhD (United States Environmental Protection Agency); and Darla White, MSc (State of Hawai'i, Department of Land and Natural Resources, Division of Aquatic Resources).

RECEIVED AT IEM MEETING ON 12/16/13

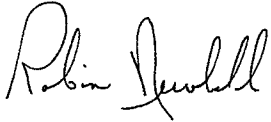
Sarah McLane

Working together to restore clean water, healthy coral reefs
and abundant native fish populations to the islands of Maui Nui.

We are encouraged by the support of our local communities, MCRT members and others in County and State government who understand the importance of this plan, and of implementation from the bottom up! One goal found in the Maui Island Plan for Maui County is to "implement a reef recovery plan" and to further protect our important natural resources. This Coral Reef Recovery Plan is one step towards that goal.

Working together, clean water and healthy reefs can be a reality and we look forward to working with you on the Plan's implementation!

Mahalo,



Robin Newbold
Council Chair
robin@mauirobin.com



Sarah E. McLane
Executive Director
808.268.6680
mclane@mnmrc.org



Maui Nui Marine Resource Council
presents

The Maui Coral Reef Recovery Plan

Maui Nui Marine Resource Council



www.mnmrc.org

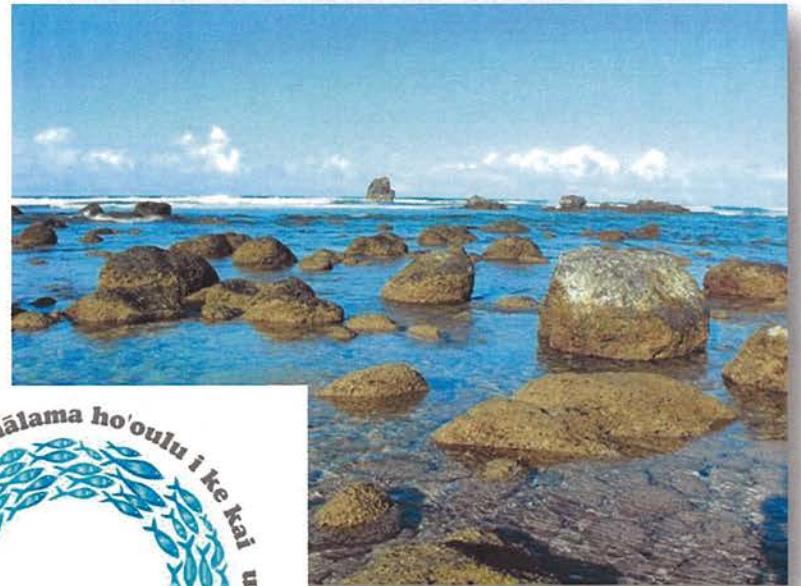
The Maui Nui Marine Resource Council (MNMRC) was formed in 2007 to be an effective voice for better marine resource management in Maui County.

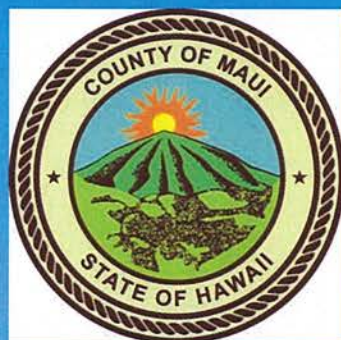
The Council consists of 28 representatives for a broad spectrum of the community including commercial, recreational and subsistence fishers, ocean tourism businesses, scientists, educators and cultural practitioners as well as non-voting advisors. .

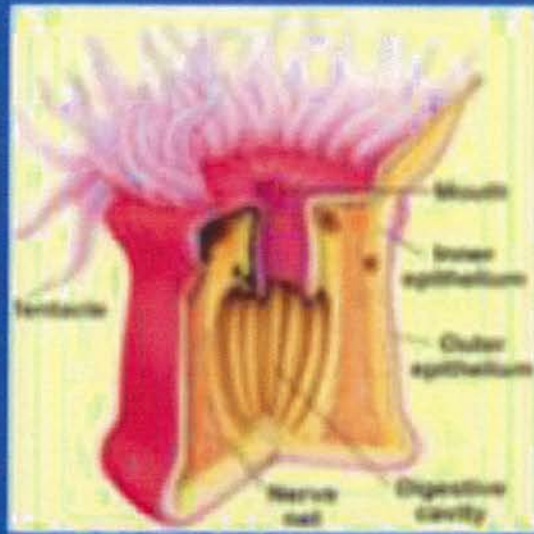
Major accomplishments include: Community Managed Makai Areas (CMMAs), the Maui Coral Reef Recovery Plan, Flood Forums

What does the MNMRC do?

- * Clean Water
- * Abundance of Fish
- * Community Managed Makai Areas







Coral reefs are geological structures made by living organisms



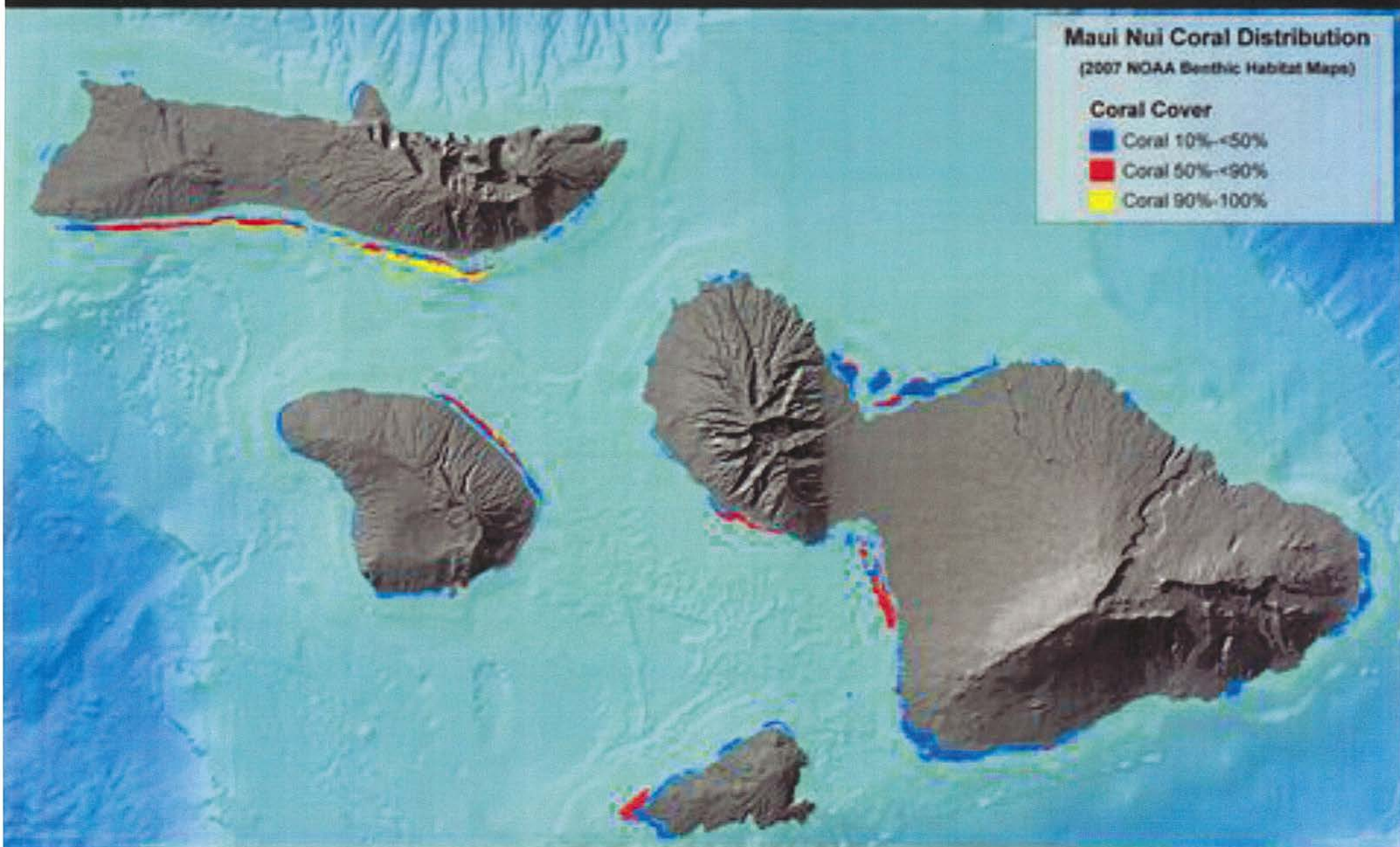
Maui Nui Coral Distribution
(2007 NOAA Benthic Habitat Maps)

Coral Cover

Blue Coral 10%–<50%

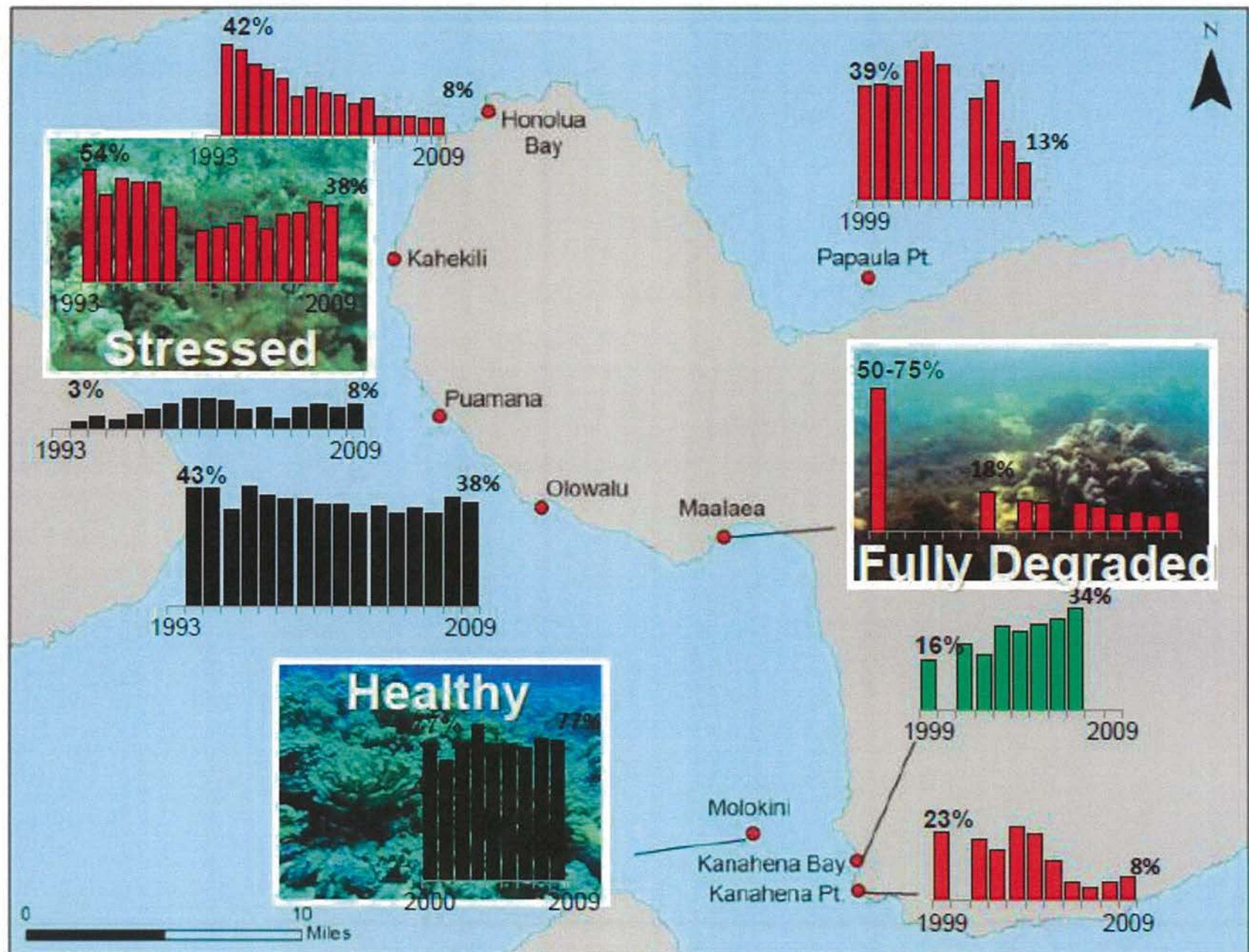
Red Coral 50%–<90%

Yellow Coral 90%–100%



Trends in Coral Cover

DAR-DLNR

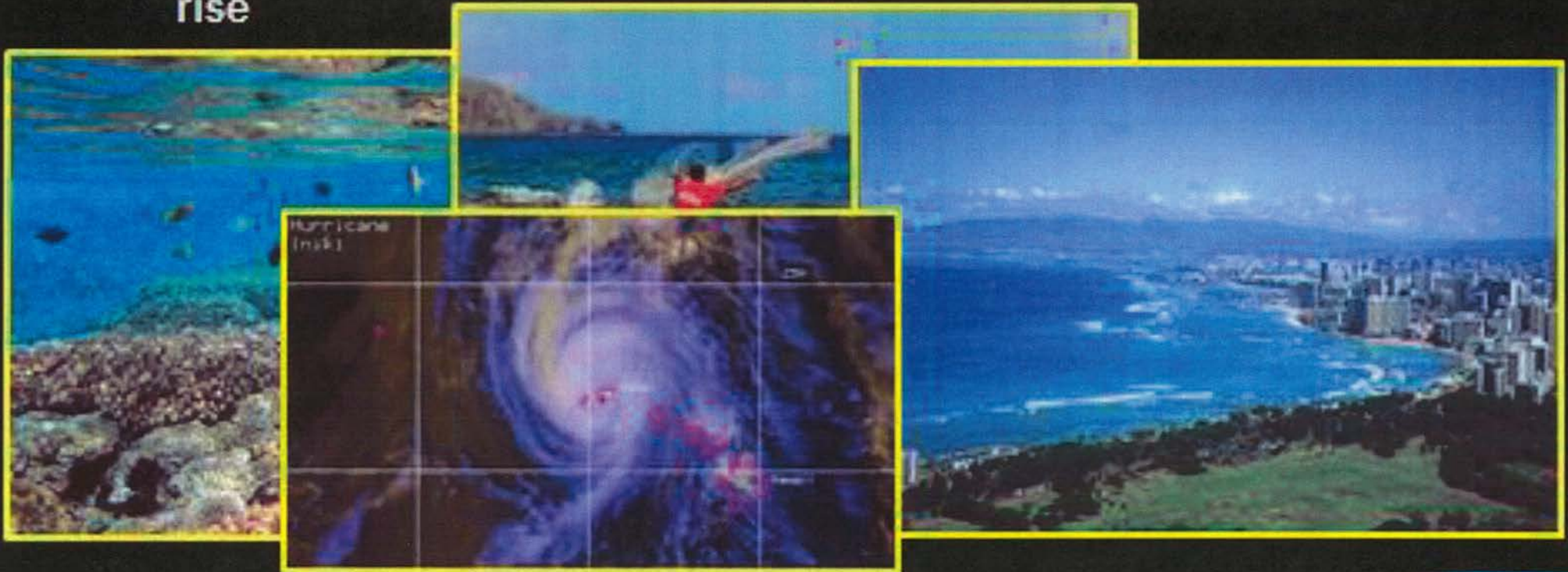


Role of Coral Reefs:

Biodiversity – Only cover 0.5% of sea floor but house more than 25% of all marine species

Food – a primary source of protein for most island nations; nursery habitat for many commercial species

Coastal resilience – protection from storms, hurricanes, typhoons, tsunamis (2009 Samoan, 2011 Japan), and predicted sea-level rise



Three major human-induced activities affecting coral reefs:

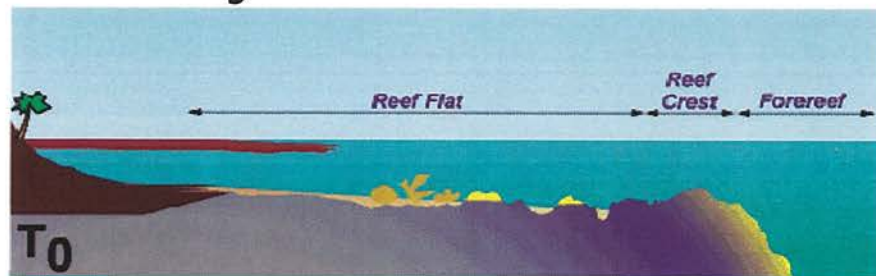
- Land-based Sources of Pollution
- Unsustainable Fishing
- Climate Change



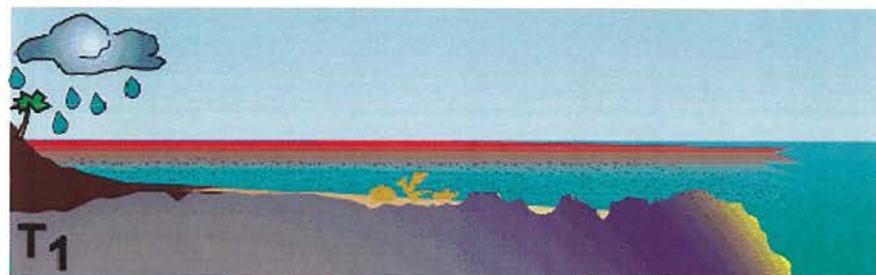




Heavy Rains and Coastal Flooding



Normal run-off event
(pre-development)

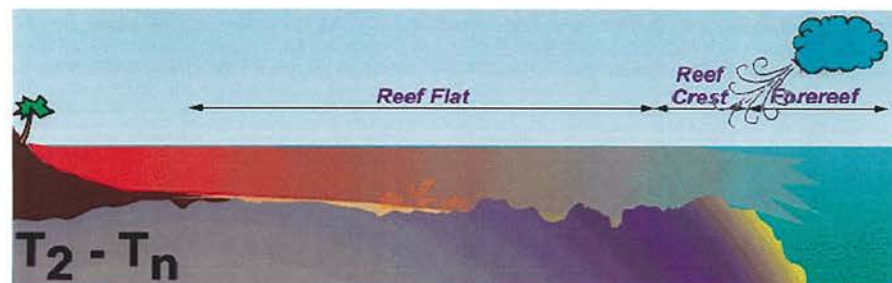


Large run-off event
(high basin yield)



Temporary deposition

Tradewind regime - daily resuspension



Tradewinds + high tide =
resuspension and high turbidity



What is Ecological Resilience?

Avoid collapse into a different state
with different ecological processes:

Coral dominance



Photo by Darla White

Algal dominance



Photo courtesy Resilience Alliance

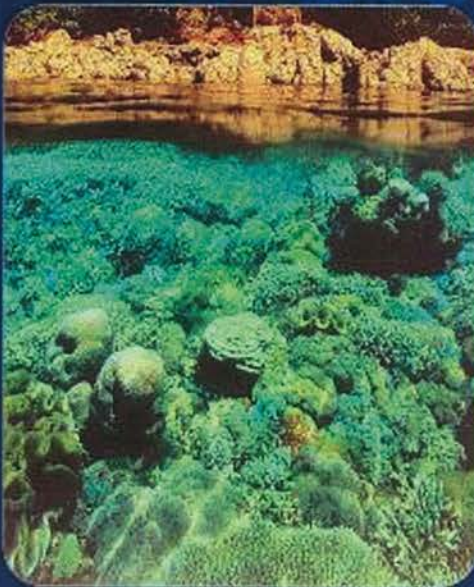
So what does resilience look like?



- High cover
- High diversity
- Low disease
- Good water quality



Photo by Russell Sparks



- Broad size/age range
- Corals survived stress
- Good recruitment
- Connectivity & larval sources
- Functional Groups

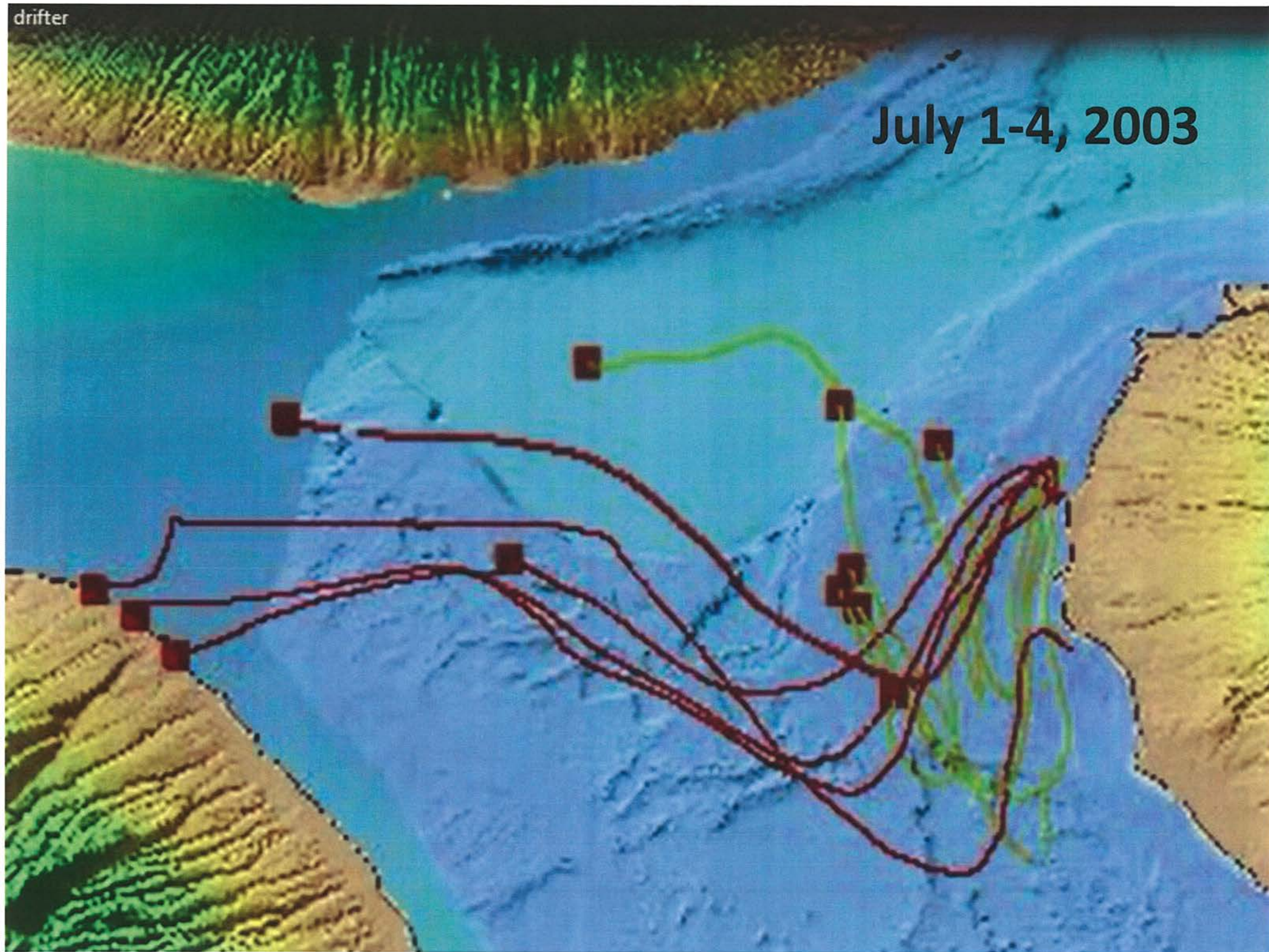


Photo by coral.org



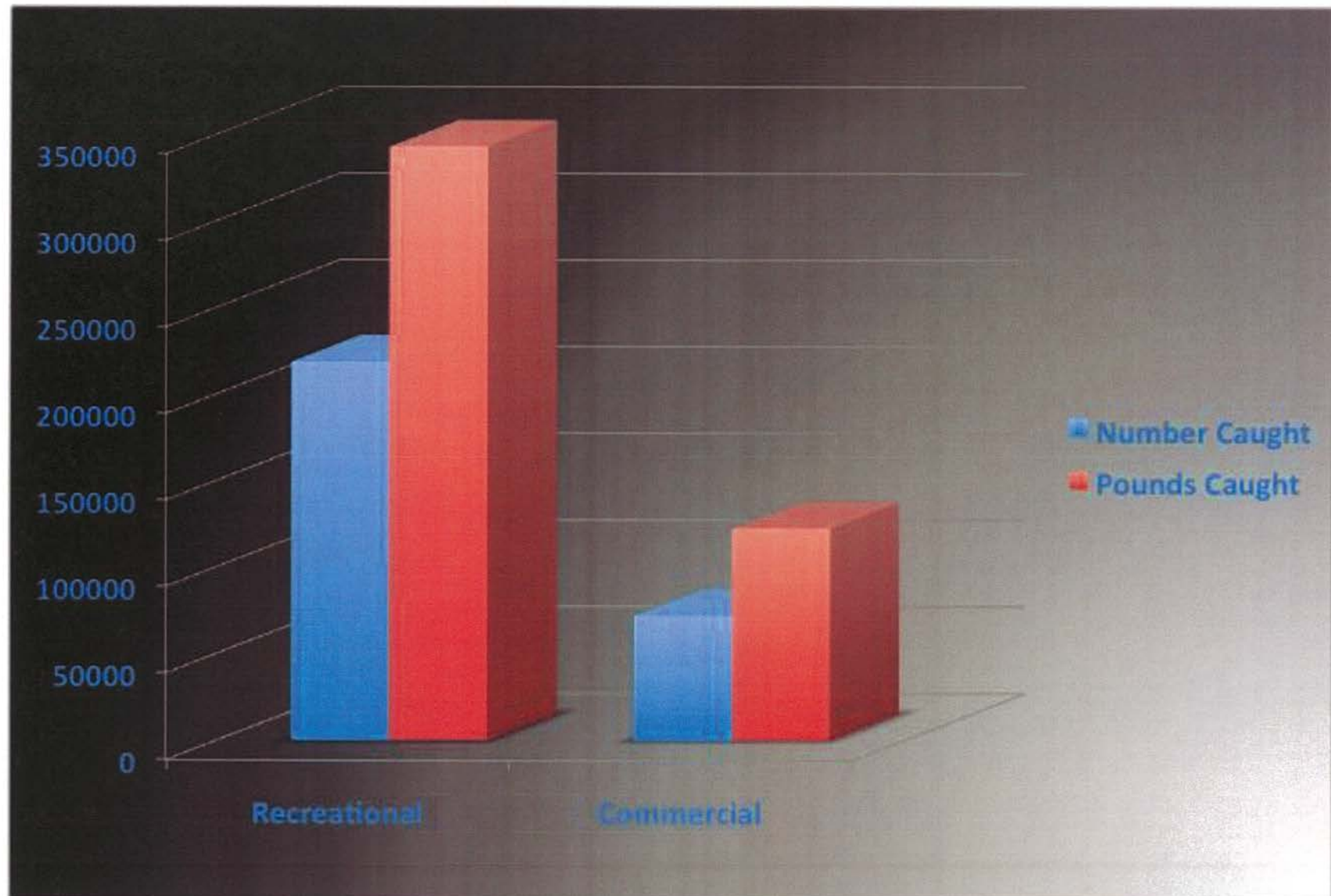
drifter

July 1-4, 2003

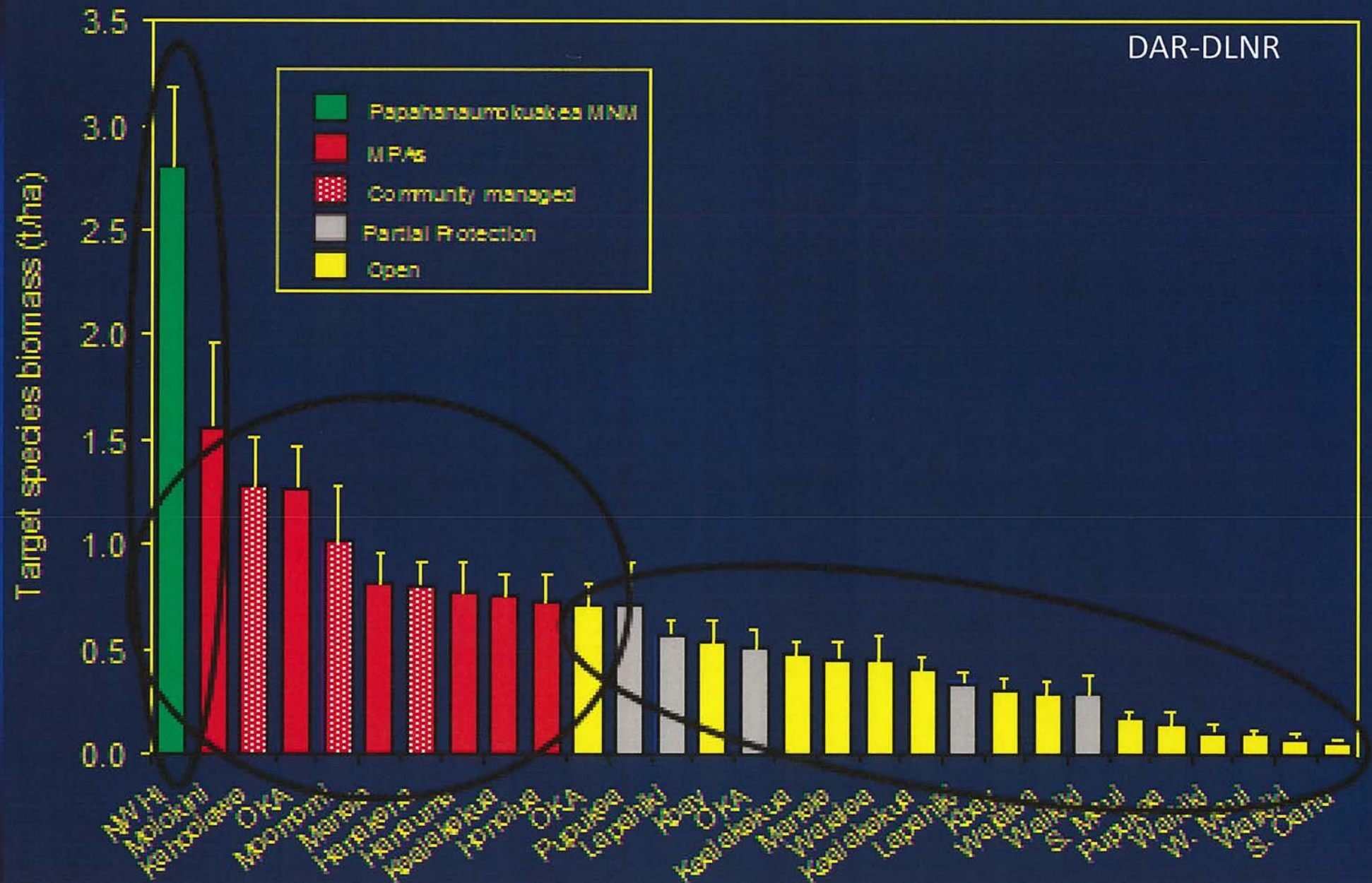


Commercial Vs. Recreational Take

Average Annual Number and Weight (2008 – 2011) of Reef Fishes Caught by Recreational and Commercial Fishers on Maui (DAR-DLNR)



Comparison of Target Fish Biomass among locations in Hawaii



Ola nā Papa i Mālama 'ia
A Practical Plan for the Technical and Cultural
Restoration of Maui's Coral Reefs



Prepared by
The Maui Coral Reef Recovery Team



Maui Nui Marine Resource Council
Kihei, Maui

Goals and Objectives of the Maui Coral Reef Recovery Plan

© Fernando Lopez A
www.TheReefAlive.com

Evidence of coral reef ecosystem recovery at selected sites around Maui

Advance knowledge to improve our understanding of the state of Maui's coral reef ecosystems and document coral recovery

Strengthen public awareness regarding the status, threats, and trends facing Maui's coral reefs

Strengthen the capacity for effective coral reef management on Maui

VISION FOR MAUI

Maui's coral reef ecosystems are biologically intact, ecologically functional, and sustainably managed through a partnership arrangement of government, non-government, and community stakeholders. Thriving, dense coral habitat supports an abundant diversity of native marine life, in turn providing a wide range of ecological, economic, and cultural benefits and services to current and future generations of Maui residents and visitors. They are a beautiful and thriving example of successful coral reef management and restoration that is recognized around the world.

GOAL 1. Evidence of coral reef ecosystem recovery at selected sites around Maui

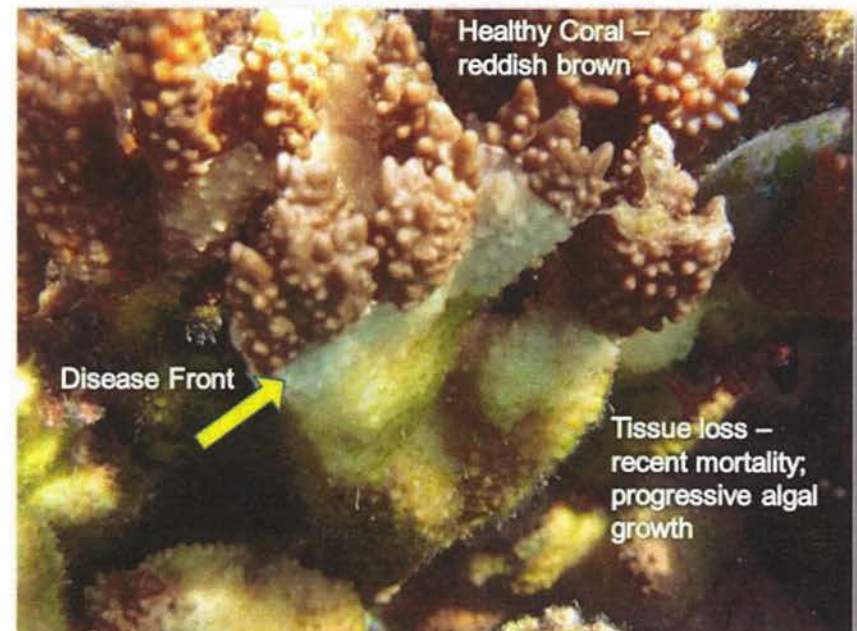
Objective 1a: Increase the live coral reef and crustose coralline algal cover with essential fish habitat at two priority sites by 2020, and at five sites by 2025.

Objective 1b: Increase the relative abundance of two functional groups of culturally and ecologically important coral reef fish and/or invertebrates¹ and their average individual biomass at two sites by 2020 and at five sites by 2025.

Objective 1c: Decrease the observed algal (macro and turf algae) cover (including both invasive and native species) at two sites by 2020 and at five sites by 2025.

Objective 1d: By 2020, measure and document increased or sustained coral reef recruitment and survivorship rates, as well as decreased disease prevalence, at sites that were observed as experiencing declining health between 2000 and 2012.

Objective 1e: Incorporate Native Hawaiian traditional management practices into the restoration activities at two priority sites by 2015 and at five sites by 2020.



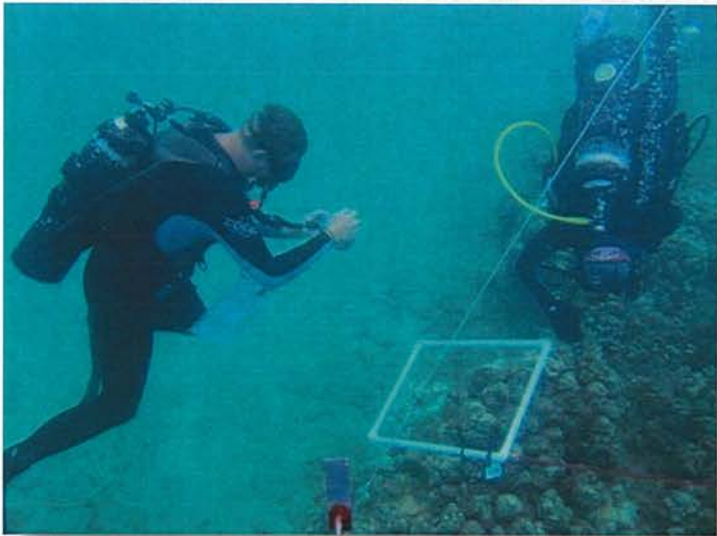
Coral Disease photo by Darla White

GOAL 2. Advance knowledge to improve our understanding of the state of Maui's coral reef ecosystems and document coral reef recovery

Objective 2a: Periodically monitor the status and health of coral reefs at paired priority and control sites, and empirically measure the rate of coral reef recovery.

Objective 2b: Summarize and communicate the findings via a technically comprehensive and rigorous “State of Maui’s Reefs” assessment conducted every three years, and share findings with stakeholders and relevant government agencies.

Objective 2c: By 2016, refine our understanding of the causes of coral decline, including the relative contributions of known threats and synergistic interactions and share findings with stakeholders, the scientific community and relevant agencies.



Reef Monitoring photo by Darla White



Demonstrating underwater monitoring techniques to community members photo by The Nature Conservancy

GOAL 3 Strengthen public awareness regarding the status, threats, and trends facing Maui's coral reefs

Objective 3a: By 2014 ensure that the recovery plan has been reviewed, endorsed and adopted by Maui decision makers and residents.

Objective 3b: By 2015, increase the awareness of Maui's residents regarding the status, threats, and trends facing Maui's coral reefs, as well as the relationship between the health of Maui's coral reefs and their own economic and cultural well-being.

Objective 3c: By 2015, active community involvement and consistent local participation in coral reef management efforts is underway at three sites, including proper stewardship practices by residents and visitors.

Objective 3d: By 2013, share recommended methods and processes for active remediation and scientific research with priority target audiences through the focused delivery of communication products, using appropriate messages and media.



Community Outreach
photo by Lisa K. Agdeppa

GOAL 4. Strengthen the capacity for effective coral reef management on Maui

Objective 4a: By the end of 2012 and periodically thereafter, convene a Coral Reef Recovery Council that works to:

- Ensure that recovery goals, objectives and activities are achieved in a timely manner;
- Enhance consistent and transparent collaboration between community groups, non-governmental organizations and government agencies;
- Provide input to government decision-makers on how to incorporate coral reef protection into their actions and decisions; and
- Guide spending for recovery plan implementation.

Objective 4b: By June 2013, work with Maui County and local partners and elected official to have a clear set of coral reef policies to improve and build upon existing federal, state, and local ordinances, regulations, and policies.

Objective 4c: By mid-2015, support and expand community involvement and participation through a Community Managed Makai Area (CMMA) process at five successful sites including corresponding watershed planning processes.



Polanui Hiu CMMA
photo by Manuel Mejia

GOAL 4. Strengthen the capacity for effective coral reef management on Maui

Objective 4d: By 2015, thorough incorporation of the recovery plan into local government policy and practice, improve the awareness and technical ability of County decision makers to address the primary threats facing Maui's reefs and include adequate protection in County plans, decisions and actions by using recommended coral reef and watershed management tools.

Objective 4e: By 2020 secure grant funding and initiate a private sector partnership led by the tourism sector (as the primary economic driver on Maui) to support the recovery plan and generate funding (via a small fee) and in-kind support for coral reef and watershed restoration and management activities around Maui to a level equivalent to 5% of total gross revenues of all ocean-related activities managed by Maui-based private businesses.

Objective 4f: By 2015, through a partnership-driven process, add two full-time enforcement, management and scientific staff within relevant County and State agencies to focus on water quality protection and watershed and coral reef management around Maui, growing to five staff by 2020.



Mā'alaea to Kihei Coast photo by Ron Dahlquist

Strategies & Practices for Implementation

Strategy: Associated Practice		<i>Priority</i>
Direct Restoration		
	Reduce nutrient, pathogen and sediment inputs	High
	Remove invasive marine algae	High
	Restock native marine species	Medium
	Propagate and transplant corals	Low
Indirect Restoration		
	Increase site-based management efforts and presence	High
	Encourage compliance with rules and regulations	Medium
	Increase community involvement	High
	Recommend resource management policies	Medium
Cultural and Traditional Management		
	Promote local marine resource management leaders	High
	Encourage the use of traditional resting periods	Medium
	Encourage stewardship efforts that serve both culture and ecology	High
Public and Partner Engagement		
	Identify and engage key stakeholders	High
	Promote public participation	High
	Support community-managed marine areas	High
	Develop partnerships and collaboration	High

Specific activities and methods will be developed and reviewed by an Advisory Council, with direction and oversight from the MCRT and the MNMRC.

Targets, Standards & Measuring Success

Socio-Cultural Recovery Targets

Sustainable commercial & recreation fisheries

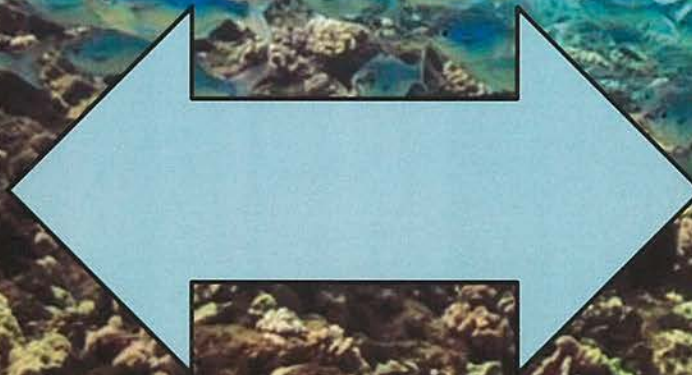
Traditional knowledge & customary management practices

Biological Recovery Targets

Coral Reef Habitat

Coral Reef Fish & Invertebrates

Coastal Wetlands, estuaries & shoreline habitat



In this plan, biomass will be the primary target in recovery.

photo by Fernando Lopez Arbarello

Biological Recovery Standards

The standards of recovery are the benchmarks against which the progress of the targets in their restoration is to be measured (i.e., “to what” the targets will be restored).

Signs of Coral Ecosystem Recovery at 2 sites over 10 years include:

- (a) Increase in coral cover; (b) Increase in fish abundance and biomass;
- (c) Decrease in algal cover (invasive or otherwise); (d) Increase in coral recruitment;
- (e) Larger and older fish; and (f) Increased recruitment events and survivorship.



**Coral
Reef
Habitat**



**Coral Reef
Fish &
Invertebrates**

Recovery Standards

The standards of recovery are the benchmarks against which the progress of the targets in their restoration is to be measured (i.e., “to what” the targets will be restored).

Coral Reef Habitat Recovery

Recovery standards for the benthic habitat quality and quantity include:

- (1) Stable or relative increase in percent coral cover of 10% within 10 years;
- (2) Relative increase in coral species richness of 10% within 10 years;
- (3) Relative decrease in macroalgae percent cover of 10% within 10 years; and
- (4) Stable or relative decrease in disease frequency of 10% within 10 years.

Recovery Standards

The standards of recovery are the benchmarks against which the progress of the targets in their restoration is to be measured (i.e., “to what” the targets will be restored).

Coral Reef Fish & Invertebrates

Recovery standards for reproductive and recruitment success include:

- (1) Stable or relative increase in coral settlement rate of 10% within 10 years;
- (2) Relative increase in abundance of 10% for target female fish of reproductive size within 10 years; and
- (3) Relative increase in abundance of 5% for target fish recruits within 10 years.

NEXT STEPS

Continue Maui Coral Reef Recovery Team

- Will determine the science behind all recovery projects and prioritize the Recovery Sites



MCRP Outreach – Build support and Partners:

- Reef Recovery Plan Resolution – County Council
- Work with local community and *kupuna* to outreach on the Plan and build partnerships for implementation
- Conduct outreach and share finalized plan with potential implementation partners; and those who are able to finance certain sections of plan

NEXT STEPS

Priority Site Determination

The MCRT has decided on the first initial sites for Implementation:

Olowalu and Polanui Hiu CMMA



MCRP Sites



MCRP Sites

Olowalu Watershed

Olowalu Makai Project Area

West Maui Mountains Watershed Partnership Boundary

Harbors or Boat Ramps

Honoapiilani Highway

Streams (DAR)

West Maui Mountains Watershed Partnership Boundary



Area of Interest
West Maui, Hawaii

Olowalu Watershed - 5,003 acres

Ukumehame Watershed - 5,576 acres

Olowalu

Maui Coral Reef
Recovery Plan
Olowalu
Lahaina, HI

0 0.3 0.6 1.2
Miles



NEXT STEPS

Priority Site Determination

The MCRT has decided on the first initial sites for Implementation: Olowalu & Polanui Hiu

OLOWALU REEF

- Extensive, aggregate coral reef with over 50-90 percent live coral cover in an area covering roughly 940 acres in shallow water close to shore.
- More than 24 species of corals recorded in this area, many of which are extremely large (over 7 meters in diameter) and old (over 500 years old).
- A nursery area for black-tipped reef sharks
- Home to a resident population of over 300 manta rays
- One of the 10 most important reefs sites state-wide (DLNR- Hawai'i Statewide Coral Reef Working Group).
- Most importantly, scientists have demonstrated that corals at Olowalu provide larvae "seed" for the reefs in West Maui, Moloka'i and Lana'i islands.
- Currently threatened by proposed urbanization, sedimentation and human use (USGS, 2012).

NEXT STEPS

Priority Site Determination

The MCRT has decided on the first initial sites for Implementation: Olowalu & Polanui Hiu

Polanui Hiu Community Managed Makai Area (CMMA)

- The Polanui Hiu CMMA is a small community who is concerned over the decline of our marine resources.
- The project site encompasses 222 acres of sandy and rocky beach and fringing/patch coral reefs. This area is small enough to be managed by the community group and large enough to show biological gains under the appropriate strategies.
- Threats to this area include: disruption of accretion and erosion patterns, overharvesting, reduction of fresh water input and flow, sedimentation/non-point source pollution, recreational overuse of near shore waters, and discharge of chlorinated water from pools.
- Polanui Hiu aims to educate, advocate, create awareness, and reestablish best management practices, which will help to ensure a healthy marine eco-system.





NEXT STEPS

MCRP Coordinator Position Hire

MNMRC will be hiring a Coordinator who will lead the implementation efforts, with the guidance and leadership from the Council and the MCRT.

Upon start of this position:

Work will begin on a 2 year implementation work plan to include the initiation of these 4 goals:

- 1. Implement reef recovery at the two initial priority sites under the MCRP;**
- 2. Build public and private support for and participation in MCRP implementation;**
- 3. Document recovery progress at two sites; and**
- 4. Support the MNMRC in the administration and financing of the MCRP.**



Questions?

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Ola nā Papa i Mālama 'ia
A Practical Plan for the Technical and Cultural
Restoration of Maui's Coral Reefs



Prepared by
The Maui Coral Reef Recovery Team



Maui Nui Marine Resource Council
Kihei, Maui

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This document was collaboratively authored by the sixteen members of the Maui Coral Reef Recovery Team (MCRT): Eric Brown, PhD (United States Department of the Interior, National Park Service); Jay Carpio (Abundance of Fish Committee Chair, Maui Nui Marine Resource Council); Rhiannon Chandler (Community Work Day Program); Mark Deakos, PhD (Hawai'i Association for Marine Education and Research, Inc.); Alan Friedlander, PhD (University of Hawai'i); Robin Knox (Water Quality Consulting, Inc.); Robin Newbold (Chair, Maui Nui Marine Resource Council); Dan Polhemus, PhD (United States Department of the Interior, U.S. Fish and Wildlife Service); Tony Povilitis, PhD (Life Net Nature); Robert Richmond, PhD and MCRT Chair (University of Hawai'i); Celia Smith, PhD (University of Hawai'i); Russell Sparks, MSc (State of Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources); John Summers (Maui County Planning Department, Administrator, Long Range Planning Division); Brian Tissot, PhD (Washington State University); Wendy Wiltse, PhD (United States Environmental Protection Agency); and Darla White, MSc (State of Hawai'i, Department of Land and Natural Resources, Division of Aquatic Resources).

Tony Povilitis, PhD, conceived the project, wrote the grant proposal, produced a 52-page review of all prior coral reef conservation efforts on Maui (Povilitis, 2011), and participated on the MCRT. Mia Charleston, administrative assistant (Maui Nui Marine Resource Council), provided organizational support and coordination for all MCRT meetings and contributed to plan development. Amy Hodges, Program & Data Assistant for MNMRC, helped with photos and produced the reference section, while Sarah McLane, Executive Director for MNMRC produced all maps, added photos, and combined all sections. David Newbold completed the design and layout of the final document pro bono and the generous donation of his time and skills is greatly appreciated. Ku'ulei Rodgers, PhD (University of Hawai'i), with support from Eric Brown, PhD (United States Department of the Interior, National Park Service), wrote the technical paper and non-technical review of the current status of Maui's coral reefs. Russell Sparks (Hawaii DAR) provided the "Status of Maui's Reefs" paper. Editing, coordination of plan preparation, and facilitation of the MCRT throughout the eighteen-month plan development, writing, and peer review process was led by John Parks (Marine Management Solutions). Robin Newbold, Chair of MNMRC, managed the project from start to finish.

We are deeply grateful to all of the above-mentioned individuals for sharing their expertise and contributing their time to the development of coral reef recovery plan for Maui.

For more information:

Visit the Maui Nui Marine Resource Council website
at www.mnmrc.org or on Facebook at www.facebook.com/MNMRC.

Maui Coral Reef Recovery Team



Maui Coral Reef Recovery Team: (From Left to Right, Top Row) Rhiannon Chandler, Jay Carpio, Robin Newbold, Russell Sparks, John Parks, Dan Polhemus, John Summers, Wendy Wiltse, Darla White, Robin Knox, Mark Deakos, Bob Richmond, Mia Charleston, and Brian Tissot. (Bottom row) Eric Brown, Tony Povilitis, Alan Friedlander, and Celia Smith.

Photo credit: John Parks

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Foreword

The Maui Nui Marine Resource Council (MNMRC or Council) was formed in 2007 as the vehicle for concerned community members to provide guidance for improving marine resource management of the coastal waters of Maui County, Hawai'i. The Council's founding chairman, Edwin Lindsey, was a widely respected and much loved native Hawaiian community leader on Maui. "Uncle" Ed's constructive approach to working with others made him a role model in the community. His effectiveness came in part from his commitment to adhere to the traditional Hawaiian principles of *aloha* (caring for each other and the land and sea), *kōkua* (compassion and honesty), *mālama* (taking care of things, properly), *ho'omanawanui* (being patient), and *'ike* (acknowledging, recognizing, and respecting the knowledge and opinions of others). The Council continues to abide by these principles. It is in this spirit that this document is offered.

The Council consists of twenty-eight voting representatives from the community and numerous advisors. Voting members represent a broad spectrum of the community including: commercial, recreational and subsistence fishers; ocean tourism and other Maui-based businesses, non-profit organizations, scientists, educators and cultural practitioners from throughout Maui County. Advisory members include: fishers, cultural, technical, and scientific representatives from a broad cross-section of the public and a variety of government and non-governmental organizations, including federal, state, and county government, academia, the private sector and not-for-profit organizations including The Nature Conservancy of Hawai'i.

The Council works through its two committees of local volunteers to help restore and maintain Maui's marine resources. The Clean Water Committee collaborates with partner organizations to find and implement solutions that address water quality issues. The Abundance of Fish Committee addresses threats facing Maui's coral reefs and reef fish communities, primarily by establishing and supporting Community Managed Makai Areas (CMMAs). The Council as a whole is dedicated to the development and implementation of this Maui Coral Reef Recovery Plan to achieve its goals: an abundance of native fish, healthy coral reefs and clean water.



In mid-2010, the Maui Nui Marine Resource Council was awarded a two-year grant under the Coral Reef Conservation Fund of the National Fish and Wildlife Foundation to develop a Coral Reef Recovery Plan. During late 2010, the Council established the Maui Coral Reef Recovery Team (MCRT), a volunteer group comprised of sixteen of Hawai'i's most widely recognized coral reef management and scientific research experts, and community representatives. Through a series of meetings, from early 2011 through mid-2012, the MCRT focused its considerable experience and knowledge on developing a science-based, results-driven, community- and peer-reviewed coral reef recovery plan for Maui. This document is the result of this eighteen-month effort. Pursuant to County and State approvals, the Council aims to support the implementation of this recovery plan with community, government, non-governmental, and donor partners starting in 2013.

This document represents a truly remarkable group effort, conceived by and reflecting the perspectives of not only scientific experts and management professionals, but also community leaders, local fishers, and ocean recreation enthusiasts. The Council would like to again express our deepest gratitude for the sustained commitment, tireless effort, and consistent enthusiasm and support that was graciously and optimistically provided by all sixteen MCRT members acknowledged in the Preface above.

In addition, individual Council representatives and advisors were highly instrumental from project conceptualization and design through the recovery plan development process. These include: Dale Bonar, PhD and Scott Fisher, PhD (Hawaiian Islands Land Trust); Maile Carpio (Wailuku Community Managed Makai Area); Lucienne deNaie (Maui Tomorrow Foundation); Terry George and Eric Co (Harold K.L. Castle Foundation); Kim Hum, Emily Fielding, Manuel Mejia and Roxy Sylva (The Nature Conservancy of Hawai'i); John Gorman, PhD (Maui Ocean Center); Solomon Kaho'ohalahala (former Maui County Council Member, Maunalei Ahupua'a - Lāna'i); John Kittinger, PhD (Stanford University Center for Ocean Solutions); John Parks (Marine Management Solutions); Jeff Schwartz (Kela Associates); Robert Parsons (Environmental Coordinator, Maui County); Robert J. Toonen, PhD (University of Hawai'i Institute of Marine Biology); and Ivor Williams, PhD (United States National Oceanic and Atmospheric Administration, National Marine Fisheries Service).

Several draft versions were generated during the iterative process of this document's development. One of the most important steps in this process was the review of a revised draft by external peers, including community representatives. These peer reviewers tremendously strengthened and shaped the final version of this recovery plan, for which the Council and MCRT are most grateful. To that end, the Council and MCRT would like to recognize and sincerely thank the following peer reviewers for their useful insights, constructive criticism and excellent suggestions which significantly improved the plan's content and structure: Thorne Abbott (CARDNO); Carl Berg, PhD (Surfrider Foundation, Kauai Chapter); Eric Brown, PhD (National Park Service); Meghan Dailer, PhD (University of Hawai'i); Gerry Davis, PhD (United States National Oceanic and Atmospheric Administration, National Marine Fisheries Service); Emily Fielding (The Nature Conservancy of Hawai'i); Liz Foote (Coral Reef Alliance); John Gorman, PhD (Maui Ocean Center); Ekolu Lindsey (Maui Cultural Lands); John Kittinger, PhD (Stanford University Center for Ocean Solutions); Kem Lowry, PhD (University of Hawai'i); Dwayne Minton, PhD (The Nature Conservancy of Hawai'i); Takeo Miyaguchi (fishing

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Development of this recovery plan was made possible through the generous financial support of the National Fish and Wildlife Foundation, the Harold K.L. Castle Foundation and the Maui County Office of Economic Development. The Council's fiscal agent, Tri-Isle Resource Conservation and



Photo credit: J. Petruzzi

Development Incorporated, effectively conducted financial management of funding awarded in support of this project. We also thank Stuart Funke-d'Egnuff (Executive Director) and his team at Tri-Isle for their invaluable administrative support of the Council's efforts. The Council would also like to thank the NOAA Office of National Marine Sanctuaries for graciously hosting all of the MCRT meetings at its Hawaiian Islands Humpback Whale National Marine Sanctuary Education Center, in Kīhei, Maui. The NOAA Sanctuary team ensured that the Council and MCRT members were able to effectively complete the design and drafting of this plan from within a comfortable and productive workspace.

It is the hope and intention of the Council that this document can be used in collaboration with community, government, and non-government partners to encourage a more sustainable future for Maui. We invite you to be a part of this process by incorporating your aspirations and interests and taking an active role in the conservation and restoration of Maui's coral reefs.

We are grateful to all those mentioned above for their enthusiastic support of and participation in the development of the Maui Coral Reef Recovery Plan.

Robin Newbold
Chair
Maui Nui Marine Resource Council

Sarah E. McLane
Executive Director
Maui Nui Marine Resource Council

Preface

The value of Maui's coral reefs for its economy, fisheries, culture, habitats, and aesthetics is widely recognized and appreciated, although not always appropriately considered in land-use and marine resource decision-making. Twenty-five percent of the marine species living on Hawai'i's coral reefs are found nowhere else in the world (Friedlander *et al.*, 2008). Hawai'i's coral reefs are renowned for their natural beauty and have long been an integral part of Hawaiian culture and sense of place. Hawai'i's coral reefs are the foundation of a thriving marine ecosystem, and offer essential shoreline protection from wave action, storm surge, and erosion.



Coral reefs also provide subsistence, recreational and commercial fishing, offer world-class surfing and diving locations, and are vital to Hawai'i's \$12 billion annual tourism industry (Hawai'i Tourism Authority, 2010). The economic value of the State's coral reefs was estimated at \$10 billion with direct economic benefits to the ocean tourism industry of \$800 million per year in 2002 (Cesar and van Beukering, 2004 in: Friedlander *et al.*, 2008). A peer-reviewed study released in October 2011 surveyed the economic value that the American people hold for Hawai'i's coral reefs at \$33.57 billion dollars (Bishop *et al.*, 2011). Outdoor activities of Hawaiian residents and visitors are closely linked to coral reefs. From 2005 to 2010, nearly 50% of all visitors participated in diving or snorkeling activities during their stay in Hawai'i (Hawai'i DBEDT, 2005 in: Friedlander *et al.*, 2008; Hamnett, Liu, and Johnson, 2004; Hawaii Tourism Authority, 2010).



Photo credit: Save Honolua Coalition

Safeguarding coral reef health and the economic and environmental benefits that they provide to residents and visitors requires maintaining a healthy balance between land-sea connections and reducing harmful land-based sources of nutrients into near-shore waters (Goreau, 2003).

Significant declines in the health and abundance of corals and reef fish populations have been documented at eight important coral reefs on Maui over the last twenty years (DAR and HCRI, 2008). Major threats facing Maui coral reefs include: overfishing, declining water quality, invasive algae, coastal development and climate change.

The Maui Coral Reef Recovery Team (MCRT) is a group of committed community, government and scientific representatives who are concerned with these declines. We came together to: (1) create a practical plan to reverse coral reef declines around Maui and demonstrate that recovery is possible; and (2) offer technical and experiential expertise to decision-makers, through recommendations. We do this to ensure a future where Maui coral reef ecosystems are biologically intact, ecologically functional and sustainably-managed, for the benefit of current and future generations.

To meet the challenge, in 2009 Maui County committed to develop and implement a protection and restoration plan (County of Maui, 2009). In support of this initiative, in late 2010 the Maui Nui Marine Resource Council assembled the Maui Coral Reef Recovery Team (MCRT) to provide a science-based, results-driven and publicly supported plan to achieve coral reef restoration.

Past efforts to conserve Maui coral reef ecosystems have fallen short (Povilitis, 2011), because recovery has, almost exclusively, involved a "species approach," as, for example, with the humpback whale (NMFS, 1991) and endangered forest birds (USFWS, 2006). We aim to apply holistic "recovery planning" concepts and procedures, because coral reefs are complex natural environments. We intend that the methods outlined in this document provide a learning opportunity for coral scientists and reef managers. Such learning can be shared among a wide variety of stakeholder interests and increase our collective understanding of how to manage coral reefs around Maui. When successful on Maui, this process will provide a model for efforts elsewhere in Hawai'i and beyond.



Maui Coral Reef Recovery Team – third meeting

Photo credit: John Parks – Facilitator



Maui Coral Reef Recovery Team – Objectives Exercise

Photo credit: John Parks



Maui Coral Reef Recovery Team – Final Meeting

Photo credit: John Parks

The development of this recovery plan during 2011-2012 involved an exciting, energetic and collaborative process during our 5 all-day workshops and through email. The plan begins by acknowledging the value and importance of coral reefs to residents and visitors, and stating our vision for what implementation will provide. We then list recovery goals, with associated objectives to guide action. We provide background information on the status of Maui coral reefs, threat assessment and situation analysis. We define geographic scope and priority areas. The strategy section summarizes specific practices that will be employed at priority sites. Appendices provide additional details, including specific components underlying our vision, in-depth analysis on some of the threats and preliminary thinking on how to measure progress, including biological and social outcomes and metrics that constitute "recovery".

Our next step is to seek government adoption of the plan and begin implementation. In collaboration with partners, we will develop a work plan and timeline to guide efforts over five and ten years. The work plan will delineate the various activities to be accomplished under each objective, supported through technical and funding partnerships. The plan will involve a broad cross-section of our community in one of Maui's greatest environmental challenges: sustainability of coral reef ecosystems.

According to the Hawaiian Creation Chant, the *Kumulipo*, the coral polyp was the first living thing to emerge from the sea during creation and is regarded as a foundational ancestor. The early Hawaiians recognized that coral reefs were an important part of the near-shore environment and used coral in religious ceremonies to honor and care for the ocean (Friedlander *et al.*, 2005). Life as we know it in Hawai'i has been and remains tightly connected to healthy coral reefs. This Coral Reef Recovery Plan for Maui will help sustain and enrich that connection.



Coral polyps

*Photo credit:
Pauline Fiene*

Executive Summary

In 2010, the Maui Nui Marine Resource Council was awarded a two-year grant (under the Coral Reef Conservation Fund program of the National Fish and Wildlife Foundation) to develop a Coral Reef Recovery Plan and coordinate its implementation. Later that year, the Council established the Maui Coral Reef Recovery Team (MCRT) composed of researchers, managers and stakeholders, to develop a science-based and results-driven plan for the recovery of Maui's coral reefs. The effort was spearheaded by concerned community members and was based on documented declines at important coral reef sites on Maui over the last twenty years that showed that collapse would continue if management efforts did not improve. These declines included decreases in both coral cover and reef fish populations, which negatively affects important sectors of the island community including the \$800 million ocean tourism industry. The plan addresses the major causes (i.e., land-based sources of pollution, overfishing, deteriorating water quality, invasive algae, and climate change) of this decline, and increases the adaptability of Maui's reefs to changing climates.

The principles supporting the recovery plan include:

- Halting and then measurably reversing the declines in live coral reef cover at specified sites can be accomplished within seven to nine years;
- Improved prioritization and allocation of the necessary human and financial resources to protect Maui's coral reefs will occur;
- Increased public awareness and community involvement in reef management will manifest itself within local decision-making;
- Improved integration of science-based knowledge for coral reef management will reduce costs and improve outcomes;
- Improved intergovernmental coordination will support the plan; and
- Legislative and regulatory actions to address coral reef issues will result from the plan's improvements to knowledge sharing among researchers, managers and stakeholders.



Community mapping project at Polanui CMMA

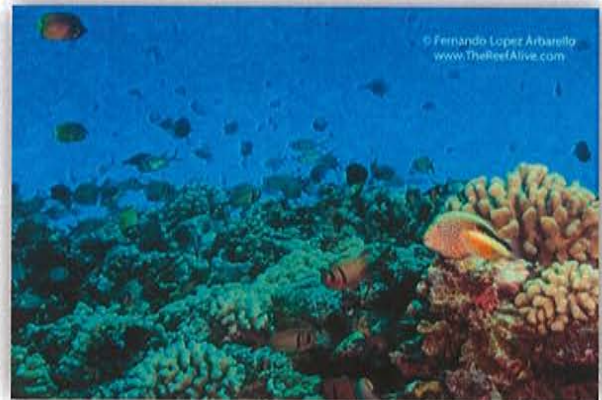
Photo Credit: Manuel Mejia

The core values embraced by the MCRT are: optimism, pragmatism, credibility, accountability, respect and impact, with the understanding that to be successful, this Plan requires:

- Accountability and transparency;
- Scientific integrity and rigor;
- Respect for the host culture;
- Trust by the public; and
- Valuable community service.

Vision

Over the next fifteen to twenty years Maui's coral reef ecosystems are biologically intact, ecologically functional, and sustainably managed. They support an abundant diversity of native reef fishes and invertebrates. Maui's coral reefs are healthy, resilient and provide a wide range of ecological, economic, and cultural benefits and services to current and future generations of Maui residents and visitors. They are a beautiful and thriving example of successful coral reef restoration and management that is recognized around the world.



The plan proposes four goals and sixteen associated objectives to be achieved between 2015 and 2025:

Goal 1: Provide evidence of coral recovery at selected sites around Maui;

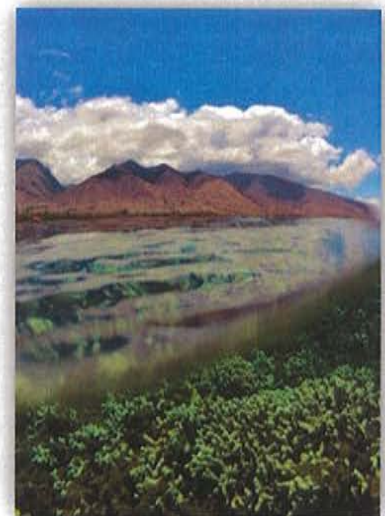
Goal 2: Use science to advance knowledge, improve understanding of the state of Maui's coral reef ecosystems, and document coral recovery;

Goal 3: Strengthen public awareness regarding the status of threats to and trends facing Maui's coral reefs; and

Goal 4: Strengthen the capacity for effective coral reef management on Maui.

Achievement of the goals will produce six major outcomes:

- (1) Maui's coral reefs and reef fish populations are abundant, diverse and resilient;
- (2) Coral reef ecosystems surrounding Maui are ecologically functional, dominated by native species and serve as a refuge for Hawaii's unique biological diversity;
- (3) The economic and other values of healthy and abundant coral reefs around Maui are widely recognized and used, fully and fairly, to guide public policy and decision-making;
- (4) Cultural practices, traditional knowledge and traditional family activities in Maui's inshore waters thrive and are sustained through time;
- (5) Maui's coral reefs support local jobs, a sustainable tourist industry, and other compatible uses; and
- (6) There is a widely exercised and recognized ethic of coral reef conservation on Maui.



Healthy reef at Olowalu

Photo credit: Drew Sudlock

Priority sites to implement restoration effort will be selected by an Advisory Council, based on scientific feasibility, social value, logistical feasibility, ecological representation, measurability, leverage, partnership suitability, financial feasibility, spatial discreteness, and vulnerability level. Examples of the potential priority sites include Kahekili, Olowalu and Mā'alaea to Kalama,

among others. These sites have elements of baseline data, protection status, public interest, and economic value in tourism. Adjacent to each priority site, comparison sites will be selected where restoration techniques will not be applied. This will allow for comparisons in recovery levels between the two types of sites. At least three to five study sites must be assigned for each comparison area.

Specific actions of the Recovery Plan include direct restoration activities such as:

- (1) Removal of high nutrient and sediment sources,
- (2) Removal of invasive marine species,
- (3) Restocking of native marine species, and
- (4) Propagation and transplantation of corals;

Indirect restoration efforts such as:

- (5) Use of "Best Management Practices" to control land-based pollution,
- (6) Site-based coral reef management,
- (7) Enforcement of current regulations,
- (8) Community involvement, and
- (9) Developing and recommending resource management policies;

Incorporation of cultural practices and traditional ecological knowledge by

- (10) Promoting local marine resource management leaders,
- (11) Encouraging the use of traditional resting periods, and
- (12) Encouraging stewardship efforts that serve both culture and ecology; and

Engaging the public and partners by

- (13) Identifying and engaging key stakeholders,
- (14) Promoting public participation,
- (15) Supporting community managed marine areas, and
- (16) Developing partnerships and collaboration in restoration efforts.

Collaboration between government and non-government partners will be crucial to develop an activity work plan, and timeline to implement the recovery plan, as well as to guide, monitor and periodically evaluate the implementation through time. The plan will also serve as a model for other coral reef management and restoration interests in the Hawaiian Islands and beyond.



Photos credit: (left to right) Cynthia Matzke, Cynthia Matzke, Rick Long and Cynthia Matzke

I. Background

A. Value of Maui's Coral Reefs

Coral reefs provide great biological, economic, and cultural value to the people of Maui. Hawaii's coral reefs include a large number of marine species found only in Hawaii (Friedlander *et al.*, 2008), are renowned for their great natural beauty and inspiration, and have long been an integral part of Hawaiian culture and sense of place. Maui's reefs have provided subsistence, recreational, and commercial fishing opportunities, offer world-class surfing, snorkeling and SCUBA diving, protect our shores from storm waves and are vital to Hawaii's marine tourism industry.

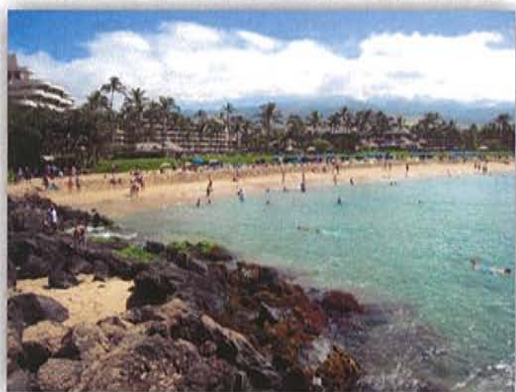


Photo credit: Darla White

The economic value of the State's coral reefs was estimated at US \$10 billion with direct economic benefits of \$364 million per year in 2002 (Cesar and van Beukering, 2004 in Friedlander *et al.*, 2008). Outdoor activities of Hawaiian residents, as well as visitors, are closely linked to coral reefs (see Table 1). From 2005 to 2010, nearly 40-50% of all visitors participated in diving or snorkeling activities during their stay in Hawai'i (Hawai'i DBEDT, 2005 in: Friedlander *et al.*, 2008; Hamnett, Liu, and Johnson, 2004; Hawaii Tourism Authority, 2010).

Table 1. Uses of the near shore environment by Hawaii residents (Hamnett *et al.*, 2006 in: Friedlander *et al.*, 2008).

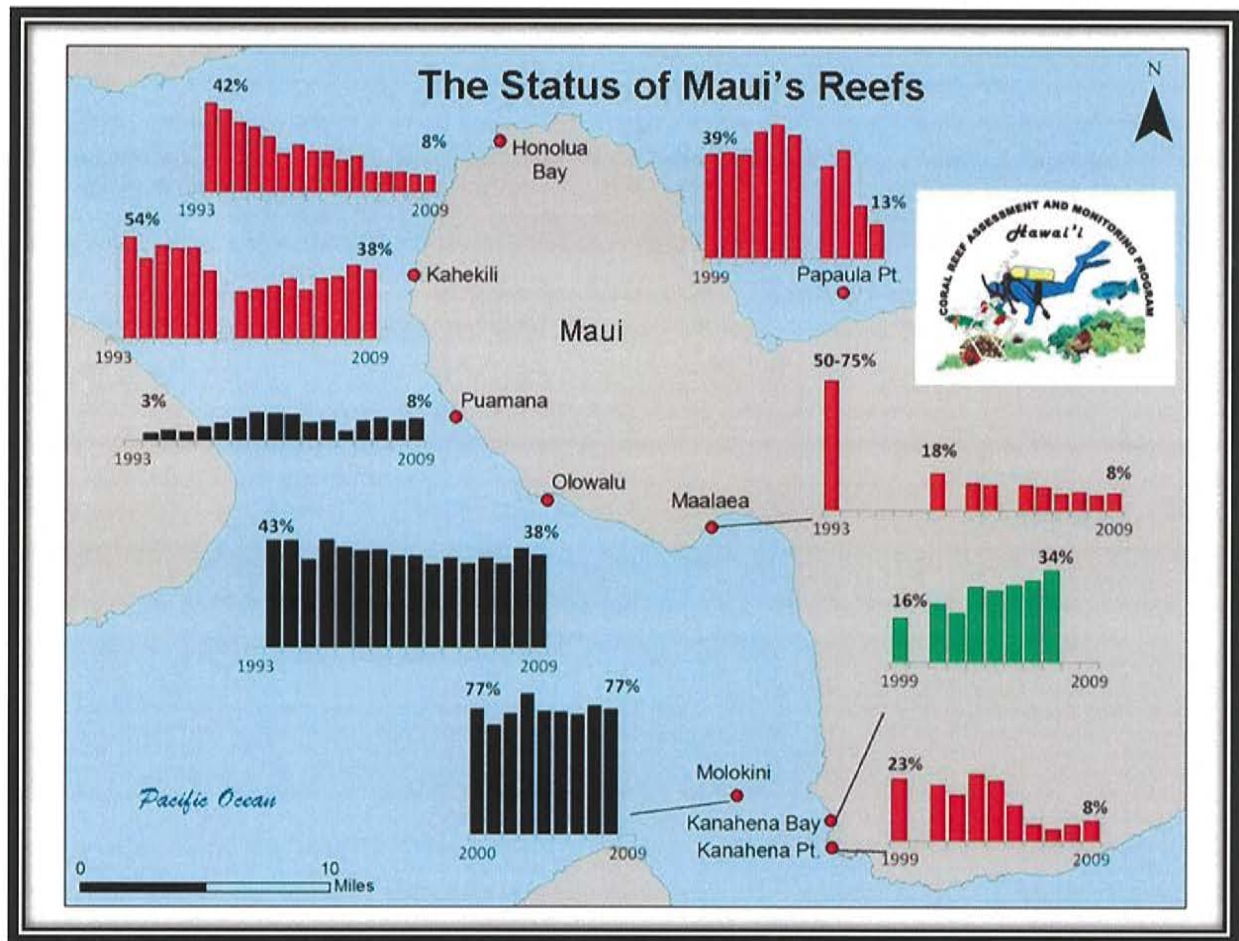
Activity	% of total households participating	Average number of times participating annually
Ocean swimming	66%	28
Recreational fishing	31%	10
Surfing	29%	18
Snorkeling	32%	6
Subsistence fishing	10%	5



Photos credit: Darla White (left) and Linda Nakagawa (right)

B. Status of Maui's Coral Reef Ecosystems

Despite their value, significant declines in coral cover and reef fish abundance and biomass have been documented on Maui over the last 20 years by the scientific community, particularly at eight well-documented study sites (DAR and HCRI, 2008). Some coral reef sites around Maui have experienced slower declines than others, while only a few show any evidence of possible increases in coral cover (DAR and HCRI, 2008). Coral and reef fish populations are declining less within Maui's Marine Life Conservation Districts (MLCDs) and other marine protected areas (MPAs) than in open areas (DAR and HCRI, 2008). However, the overall trend documented by the scientific community is a general decline in the health of Maui's coral and reef fish populations.



Status of Maui Reefs Report Graph – 2009

Each chart shows percent of healthy coral cover in each location over time

Credit: DAR and HCRI – 2008 – graph updated in 2009.

C. Threat Assessment and Trends

Like many of the main Hawaiian Islands, Maui's coral reefs face growing pressure from a wide range of threats (State of Hawai'i, 2010). During late 2010, the MCRT worked with the Maui Nui Marine Resource Council to assess and rank known threats that negatively impact the health of Maui's coral reefs. The primary threats are: land-based pollution, overfishing, recreational overuse, invasive species, and climate change (see Appendix Two for further details regarding this analysis).

Land-based, anthropogenic sources of pollution include (1) sediment runoff from coastal development, road construction, agricultural lands, and watershed erosion; (2) excess nutrients from human waste (injection wells, cesspools, and leaking wastewater pipes); and (3) toxins and nutrients from chemical runoff (e.g., fertilizers and pesticides used in agricultural and landscaping practices).



Flood water from upcountry runs through North Kihei to the reefs

Photos by: (From left to right) Ed Lyman, Hugh Starr, Mark Deakos.

Overfishing includes commercial fishing (for food and the aquarium trade), by recreational fishers (residents and visitors), and by local fishers (for subsistence or supplemental dietary protein needs).

Recreation overuse not only includes recreational fishing, but also non-extractive impacts such as coral trampling by swimmers and snorkelers, anchor damage from recreational watercraft, and habitat disturbance by unknowledgeable or unconcerned visitor sites. Recreation overuse often can be clearly evident and reefs appear more disturbed than at non-recreation sites.



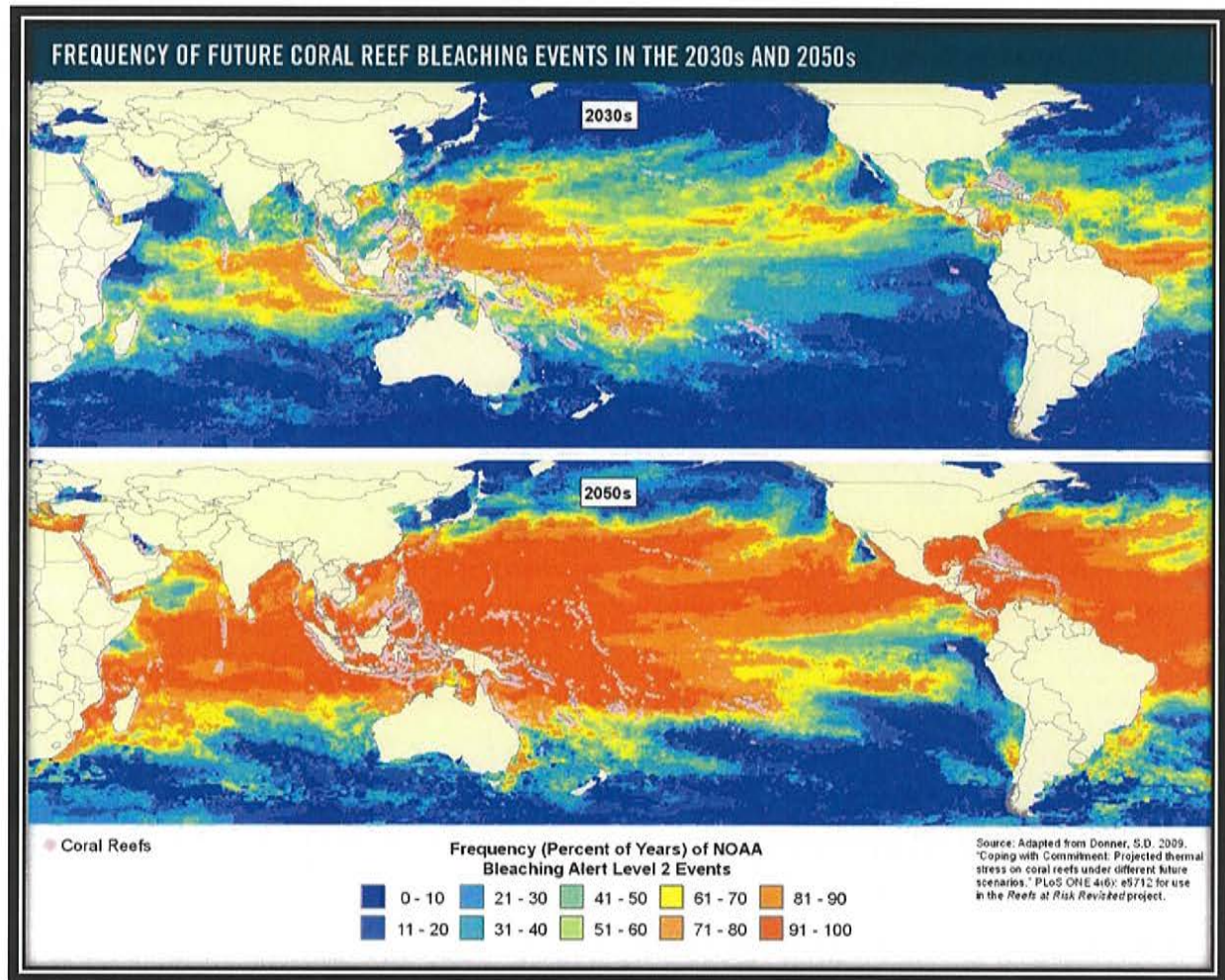
**Trampling of reef (Left)
and invasive algae
smothering a reef**

*Photos Credit: Liz Foote (left)
and Darla White (right)*



Invasive marine species are an increasing problem on Maui's reefs, particularly alien algae that proliferates with increased nutrient availability. These species compete with corals for space and often overgrow coral reefs, especially when an abundance of nutrients are present. Overgrowth leads to an undesirable phase shift in the reef community structure to one dominated by microalgae, as pictured at right, bottom (Hughes, 1994).

While the impacts of climate change on Hawaii's coral reefs have only recently being scientifically documented and are still being investigated, they will increasingly become an issue. Impacts include: a) warming of sea surface temperature which causes more frequent coral bleaching events, b) coral de-calcification and dissolution due to increasing ocean acidification, and c) increased storm and wave damage due to changing weather patterns and increased storminess.



Map Credit: World Resources Institute – Reefs at Risk Revisited Project

D. Situation Analysis

At the outset of the MCRT's efforts a study was conducted to assess prior coral reef management efforts for Maui Island. A literature review was conducted and consultations made with key informants. Summary profiles were prepared including a synopsis of supporting legislative mandates. A draft version of the report was peer reviewed for accuracy and completeness, including by MCRT members

This assessment (see Appendix Three) concluded that past coral reef management efforts to address threats facing Maui's reefs have fallen short (Povilitis, 2011). This is partly due to insufficient effort in light of the pervasive and widespread impacts of current threats. Another reason is lack of sufficient human, technical, and financial resources to adequately support the necessary management actions. This includes inadequate capacity and resources to fully implement and enforce existing regulations by local and State management authorities. A cumbersome legislative process and lack of political will to adopt recommended management policies or choose lower environmental impact development alternatives has also slowed progress. Finally, the majority of visitors, residents and public officials has been unaware of the declining health of Maui's coral reefs, and therefore has not changed their behavior or engaged in protection efforts to benefit Maui's reefs.



Fishing at the border of a marine protected area, Maui, Hawai'i

Photo Credit: Povilitis, 2011



Clearing waterfront land for Maluaka development, Makena, Maui

Photo Credit: Povilitis, 2011

Degradation of Maui's coral reef ecosystems, and decreased health of their component parts, will continue unless focused, collaborative action at an appropriate scale by scientists, managers, governing officials, and citizens is taken. The rationale for immediate action is clear.

Fortunately, two case examples in Hawaii demonstrate how focused recovery efforts have improved coral reef health: Kaho'olawe Island and Kāne'ohe Bay (see Appendix Four). The Kaho'olawe example illustrates how measures which successfully control sedimentation and reduce land-based pollution to inshore waters allow recruitment of new coral colonies to occur. The Kāne'ohe Bay case history illustrates how coral reefs can recover quickly from major natural disturbances, but not necessarily under polluted conditions.

Some of the State's Marine Life Conservation Districts (MLCDs) illustrate benefits of protection from certain threats (e.g., overfishing) or reduction from other threats (e.g., recreation overuse and land-based pollution). O'ahu's Hanauma Bay Nature Preserve is one example (Friedlander and Brown, 2004). Honolua Bay on Maui was another until runoff from development above the bay significantly impacted corals.



Hanauma Bay Nature Preserve, O'ahu (left) and sediment in Honolua Bay, a Marine Life Conservation District, West Maui (right)

Photo Credits: University of Hawai'i (left) and John Carty (right).

II. Aims

This section outlines the aims of the Maui Coral Reef Recovery Plan, including underlying tenets and core values, a vision of success and the goals and objectives that are to be achieved.

A. Tenets and Core Values

1. Tenants

The Maui Coral Reef Recovery Team (MCRT) asserts that by acting boldly and strategically we can first halt and then measurably reverse the declines in coral reef health at specified sites within seven to nine years. This plan will promote coral reef recovery around Maui through effective partnerships and establish a process to advise county, state, and federal decision makers and the public on the status and trends in Maui's coral reef health.

This plan will allow Maui's coral reef ecosystems to

- (a) Recover from current stressors, thereby restoring and strengthening the human-ecological connection that was once commonplace for Maui's residents;
- (b) Leave behind a legacy of balance, improvement and resilience instead of decline, destruction and regret;
- (c) Serve as a thriving natural "savings account" of abundant and healthy marine resources that can be sustainably used into perpetuity and successfully adapt to global climatic, environmental, and social changes.

2. Core Values

Five core values underlie this Maui Coral Reef Recovery Plan. These five values are the cornerstones upon which successful implementation of this plan will be achieved.

- (a) Optimism – The necessary tools exist to assess, diagnose and restore our coral reefs. We recognize the challenges of global climate change and together we will prepare Maui's reefs to cope with and adapt to these stressors.
- (b) Pragmatism – Our vision is realistic and obtainable and our foundation is strong. We can build from existing efforts and plans (Povilitis, 2011). The technical skill, practical knowledge and expertise already exist to do the work outlined. Sufficient scientific data and methods to characterize threats and measure changes in reef health over time are available.
- (c) Credibility – We represent a broad range of scientists and other recognized experts. Our work and this plan are based on scientific integrity and rigor that the public can trust. Credibility, objectivity and the highest professional standards will be maintained. The plan will be open to public involvement and peer review in a fully transparent manner.
- (d) Accountability – Regular reporting to the public and policy makers by resource managers will ensure that progress is made and appropriate management activities undertaken.
- (e) Respect – We respect the beauty, complexity, and diversity of the natural world. We recognize the intrinsic value of coral reefs and fish populations to exist and thrive in balance

with human interests and uses. We respect the people and local communities of Maui Island. We respect the ancient and honorable fishing traditions of Maui's people. We recognize that our families benefit from the food and income that Maui fishers provide. Our work is an attempt to honor the knowledge and traditions of the Native Hawaiian people and follow in their stewardship footsteps.

B. Vision

Our vision affirms in the present tense what Maui's coral reefs will look like fifteen to twenty years following the effective implementation of this restoration plan.

Maui's coral reef ecosystems are biologically intact, ecologically functional, and sustainably managed through a partnership arrangement of government, non-government, and community stakeholders. Thriving, dense coral habitat supports an abundant diversity of native marine life, in turn providing a wide range of ecological, economic, and cultural benefits and services to current and future generations of Maui residents and visitors. They are a beautiful and thriving example of successful coral reef management and restoration that is recognized around the world.

The underlying biological, economic and socio-cultural elements associated with this vision statement are listed in Appendix One.



C. Goals and Objectives

This section presents the four goals and eighteen associated objectives of the Maui Coral Reef Recovery Plan.

Goal 1: Evidence of coral reef ecosystem recovery at selected sites around Maui

Recovery will be demonstrated and measured at selected “priority” sites. Technical and scientific resources will be focused at these sites. Observed changes will be carefully documented.

Progress toward this goal will expedite coral reef recovery elsewhere around Maui and throughout Maui Nui, with a concurrent expansion of technical capacity; human and financial resources (see Goal 4).

Goal 1 has five objectives:

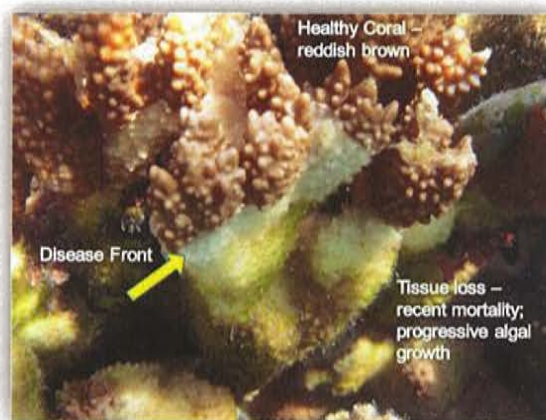
Objective 1a: Increase the live coral reef and crustose coralline algal cover with essential fish habitat at two priority sites by 2020, and at five sites by 2025.

Objective 1b: Increase the relative abundance of two functional groups of culturally and ecologically important coral reef fish and/or invertebrates¹ and their average individual biomass at two sites by 2020 and at five sites by 2025.

Objective 1c: Decrease the observed algal (macro and turf algae) cover (including both invasive and native species) at two sites by 2020 and at five sites by 2025.

Objective 1d: By 2020, measure and document increased or sustained coral reef recruitment and survivorship rates, as well as decreased disease prevalence, at sites that were observed as experiencing declining health between 2000 and 2012.

Objective 1e: Incorporate Native Hawaiian traditional management practices into the restoration activities at two priority sites by 2015 and at five sites by 2020.



Coral disease

Photo Credit: Darla White

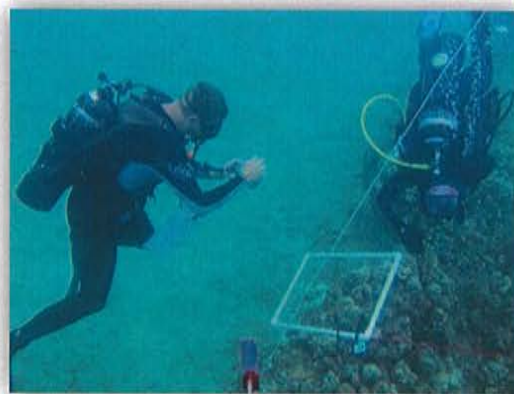
¹ Functional groups of “culturally and ecologically important” coral reef fish and/or invertebrates will be identified through a participatory process conducted by an appropriate group of stakeholders for each priority site. Some overlap may occur between sites in terms of which species are selected.

Goal 2: Advance knowledge to improve our understanding of the state of Maui's coral reef ecosystems and document coral recovery

The purpose of this goal is to provide the best available ecological science that is accurate, adequate and accessible to:

- (a) Identify the key stressors influencing the health of Maui's coral reefs and related marine resources;
- (b) Evaluate the effectiveness of implemented restoration strategies;
- (c) Serve as an "early warning system" to guide threat prevention and mitigation decision-making and planning.

Achieving this goal will improve our understanding of the causes of coral reef decline around Maui and provide the necessary scientific evidence to document reef recovery (DAR and HCRI, 2008).



Reef Monitoring

Photo credit: Darla White

Goal 2 has three objectives:

Objective 2a: Periodically monitor the status and health of coral reefs at paired priority and control sites, and empirically measure the rate of coral reef recovery.

Objective 2b: Summarize and communicate the findings via a technically comprehensive and rigorous "State of Maui's Reefs" assessment conducted every three years, and share findings with stakeholders and relevant government agencies.



Objective 2c: By 2016, refine our understanding of the causes of coral decline, including the relative contributions of known threats and synergistic interactions and share findings with stakeholders, the scientific community and relevant agencies.

**Demonstrating
underwater monitoring
techniques to community
members**

*Photo credit: The Nature
Conservancy*

Goal 3: Strengthen public awareness regarding the status, threats, and trends facing Maui's coral reefs

The purpose of this goal is to build awareness and understanding of Maui residents and visitors about threats to Maui's coral reefs and what they can do to help. Increased awareness can be an important, although admittedly not always successful, first step toward desired behavior change, such as personal action or consumer preference. Increased awareness can be a critical precursor

to affecting social change, including increased acceptance and support of management actions and restrictions, inter-generational “peer pressure”, and conflict reduction or resolution. This goal focuses on education and outreach efforts.

Achievement of this goal will increase sustainable resource use and encourage compliance with management rules and resource regulations. It will also help strengthen cultural identity and connection to Maui's reefs and enhance understanding of the responsibility for maintaining them. Key elements include documenting historical changes and declines while demonstrating cause and effect for positive changes (for example, increased fish abundance and biomass).

Goal 3 has four objectives:

Objective 3a: By 2014 ensure that the recovery plan has been reviewed, endorsed and adopted by Maui decision makers and residents².

Objective 3b: By 2015, increase the awareness of Maui's residents regarding the status, threats, and trends facing Maui's coral reefs, as well as the relationship between the health of Maui's coral reefs and their own economic and cultural well-being.

Objective 3c: By 2015, active community involvement and consistent local participation in coral reef management efforts is underway at three sites, including proper stewardship practices by residents and visitors.

Objective 3d: By 2013, share recommended methods and processes for active remediation and scientific research with priority target audiences through the focused delivery of communication products, using appropriate messages and media.



Community Outreach

Photo credit: Lisa K. Agdeppa

Goal 4: Strengthen the capacity for effective coral reef management on Maui

The purpose of this goal is to support and expand the technical capacity, human and financial resources necessary for effective coral reef and water quality management around the entire island of Maui. This will involve improving capacity at community, county, state and federal levels to better address the full range of threats to coral reefs, both from the watershed and in the water.

Improved capacity must include on-site management, signage, enforcement and surveillance of resource rules and regulations and governance and policy making, as well as integration of native Hawaiian traditional marine resource management practices (Jokiel *et al.*, 2011).

² This may include members of the 'Aha Kiole Advisory Committee.

Goal 4 has six objectives:

Objective 4a: By the end of 2012 and periodically thereafter, convene a Coral Reef Recovery Council that works to:

- Ensure that recovery goals, objectives and activities are achieved in a timely manner;
- Enhance consistent and transparent collaboration between community groups, non-governmental organizations and government agencies;
- Provide input to government decision-makers on how to incorporate coral reef protection into their actions and decisions; and
- Guide spending for recovery plan implementation.

Objective 4b: By June 2013, work with Maui County and local partners and elected official to have a clear set of coral reef policies to improve and build upon existing federal, state, and local ordinances, regulations, and policies.

Objective 4c: By mid-2015, support and expand community involvement and participation through a Community-Managed Makai Area (CMMA) process at five successful sites including corresponding watershed planning processes.



Polanui CMMA in Lahaina
Photo Credit: Manuel Mejia

Objective 4d: By 2015, thorough incorporation of the recovery plan into local government policy and practice, improve the awareness and technical ability of County decision makers to address the primary threats facing Maui's reefs and include adequate protection in County plans, decisions and actions by using recommended coral reef and watershed management tools.

Objective 4e: By 2020 secure grant funding and initiate a private sector partnership led by the tourism sector (as the primary economic driver on Maui) to support the recovery plan and generate funding (via a small fee) and in-kind support for coral reef and watershed restoration and management activities around Maui to a level equivalent to 5% of total gross revenues of all ocean-related activities managed by Maui-based private businesses.

Objective 4f: By 2015, through a partnership-driven process, add two full-time enforcement, management and scientific staff within relevant County and State agencies to focus on water quality protection and watershed and coral reef management around Maui, growing to five staff by 2020.

D. Intended Outcomes

An adaptive management approach will be taken to systematically learn and objectively assess progress toward our objectives and to adapt as necessary. Modification of the stated goals and objectives may be result.

Achieving our goals and objectives is expected to result in 6 major outcomes:

- a) Maui's coral reefs and reef fish populations are abundant, diverse and resilient;
- b) Coral reef ecosystems surrounding Maui are ecologically functional, dominated by native species and preserve Hawaii's unique biological diversity;
- c) The economic and other values of healthy and abundant coral reefs around Maui are widely recognized and used to guide public policy and decision-making;
- d) Cultural practices, traditional knowledge and traditional family activities in Maui's inshore waters thrive and are sustained through time;
- e) Maui's coral reefs support local jobs, a stable economy and sustainable uses;
- f) A widely exercised and recognized ethic of coral reef conservation becomes widespread on Maui.

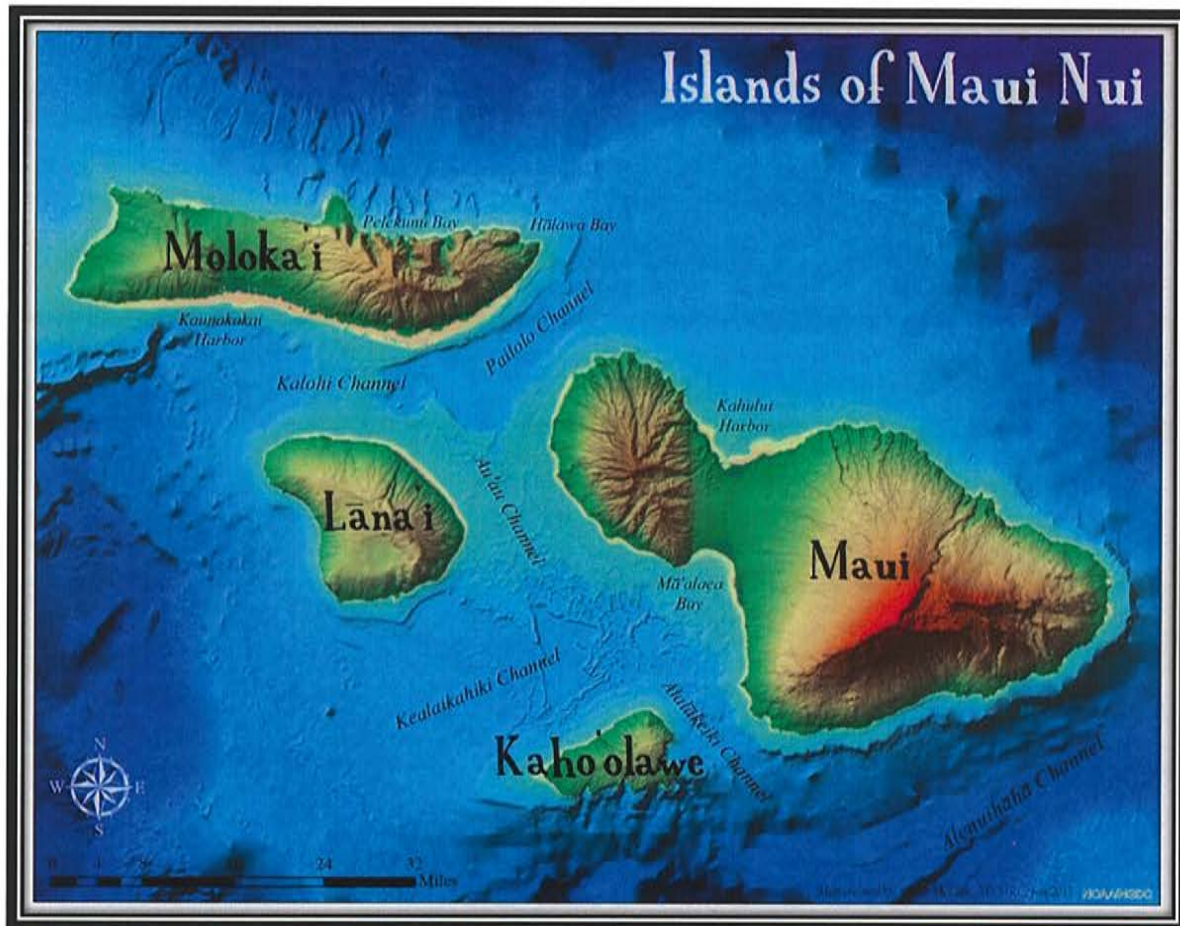


Mā'alaea to Kīhei Coast
Photo Credit: Ron Dahlquist

III. Geographic Scope

Accurately defining the geographic scope of site-based reef recovery efforts requires clearly understood, accepted and peer-reviewed terms and definitions. For the purposes of this plan, definitions for biodiversity, coral, coral reef, coral reef component, coral reef ecosystem, research and restoration will be adopted from the United States Coral Reef Conservation Act (as proposed under Reauthorization language introduced by the United States Congress (2011).) Definitions are found in this plan's glossary.

The geographic scope of this Coral Reef Recovery Plan is the island of Maui located within the Maui Nui complex of the Hawaiian Archipelago. Maui Nui includes the islands of Maui, Lānaʻi, Molokaʻi, and Kahoʻolawe. Initial recovery efforts will focus on sites selected as priority recovery sites in order to showcase recovery efforts.



Islands of Maui Nui

Map created by: Sarah McLane, MNMRC

A. The Island of Maui

This coral reef recovery plan is focused on restoration efforts to be carried out around the island of Maui, home to some of Hawai'i's most heavily impacted coral reefs. Such impact is partly due in to a high rate of land development, shoreline change and engineering, coastal residential housing construction and commercial development. Maui's rapidly growing resident population and increasing number of visitors have had significant negative impacts on Maui's coral reefs over the past three decades. Scientific monitoring results clearly illustrate that Maui has the majority of the most degraded and unhealthy coral reefs in Maui Nui.

Successful coral reef recovery around Maui should encourage similar efforts not only in Maui Nui, but also throughout the main Hawaiian Islands and perhaps, beyond. The coral reef restoration techniques and marine stewardship efforts outlined under this recovery plan will provide many process lessons and management recommendations that can be applied elsewhere.



Coastal Stabilization in Kā'anapali to protect hotel fronts after repeated coastal erosion

Photo credit: Zoe Norcross-Nu'u

B. Priority Recovery Sites

The Maui Coral Reef Recovery Plan requires the active implementation, demonstration, and evaluation of restoration strategies focused around specific "priority recovery sites." These sites will provide evidence of successful coral recovery techniques and will serve as a foundation for expanded efforts throughout the Maui Nui island complex, and beyond.

The recovery sites are a critical step to the overall viability of the recovery plan, as successful recovery at these sites will demonstrate the cause-and-effect relationship of applied restoration strategies compared to similar sites with no restoration efforts. Pairing managed sites with unmanaged sites will provide evidence that intervention leads to recovery.

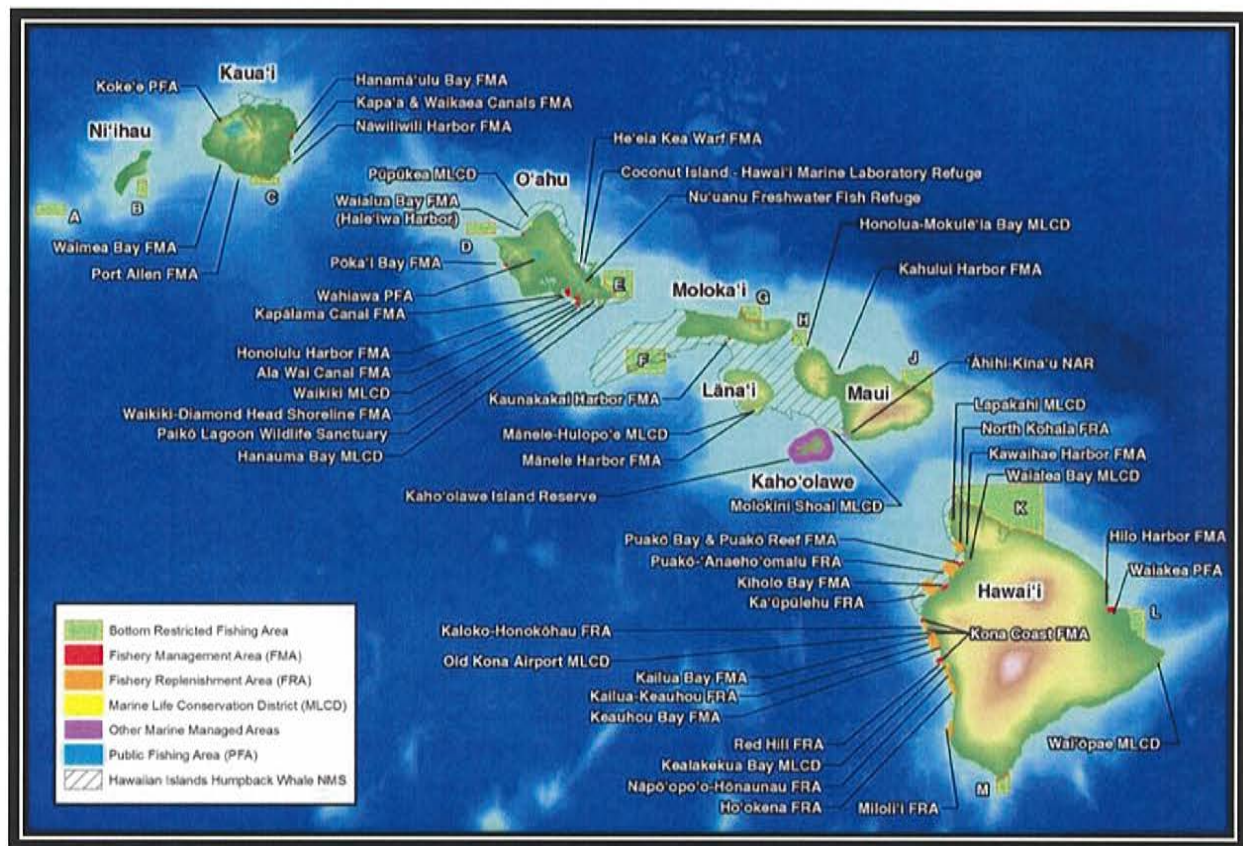
The MCRT recommends that restoration efforts also move forward elsewhere on Maui through the application of island-wide policies and regulations.

Selection criteria for priority recovery sites include:

- *Scientific Feasibility* – the site is scientifically viewed as having the potential for biological recovery (including water quality considerations);
- *Socially Acceptable* – the local community supports recovery efforts and shows interest and readiness to participate in reef restoration efforts;
- *Logistical Feasibility* – the site is logistically easily accessible;

- *Technical Feasibility* – it is technically possible for reef restoration strategies to be implemented at the site (for example State law allows coral propagation or transplantation);
- *Ecologically Representative* – the site is inclusive of a wide range of representative habitats, known threats (including sources of common land-based pollution), and management opportunities;
- *Measurability* – the site has an existing, base-line data set associated with previous and current conditions and trends;
- *Leverage* – recovery efforts will build upon existing site-based coral reef conservation or other marine resource management efforts;
- *Partnership Suitability* – the site lends itself to strategic and useful partner organizations which would cooperate with and support reef restoration efforts;
- *Financial Feasibility* – the site ideally already has, or is likely to secure, financial resources to support reef restoration efforts;
- *Spatially Discrete* – the site offers clear boundaries; and
- *Vulnerability* – the site is at risk of degradation in the near future - including from global climate change.

In addition to these selection criteria, the MCRT recognizes that for comparative purposes, it will be important to select sites both within areas that are currently benefiting from active marine management efforts (such as Marine Life Conservation Districts, Fishery Management Areas, Community Managed Marine Areas, or other State-led marine managed areas), and sites that have no current management efforts.



Marine Protected Areas in Hawaii'i.

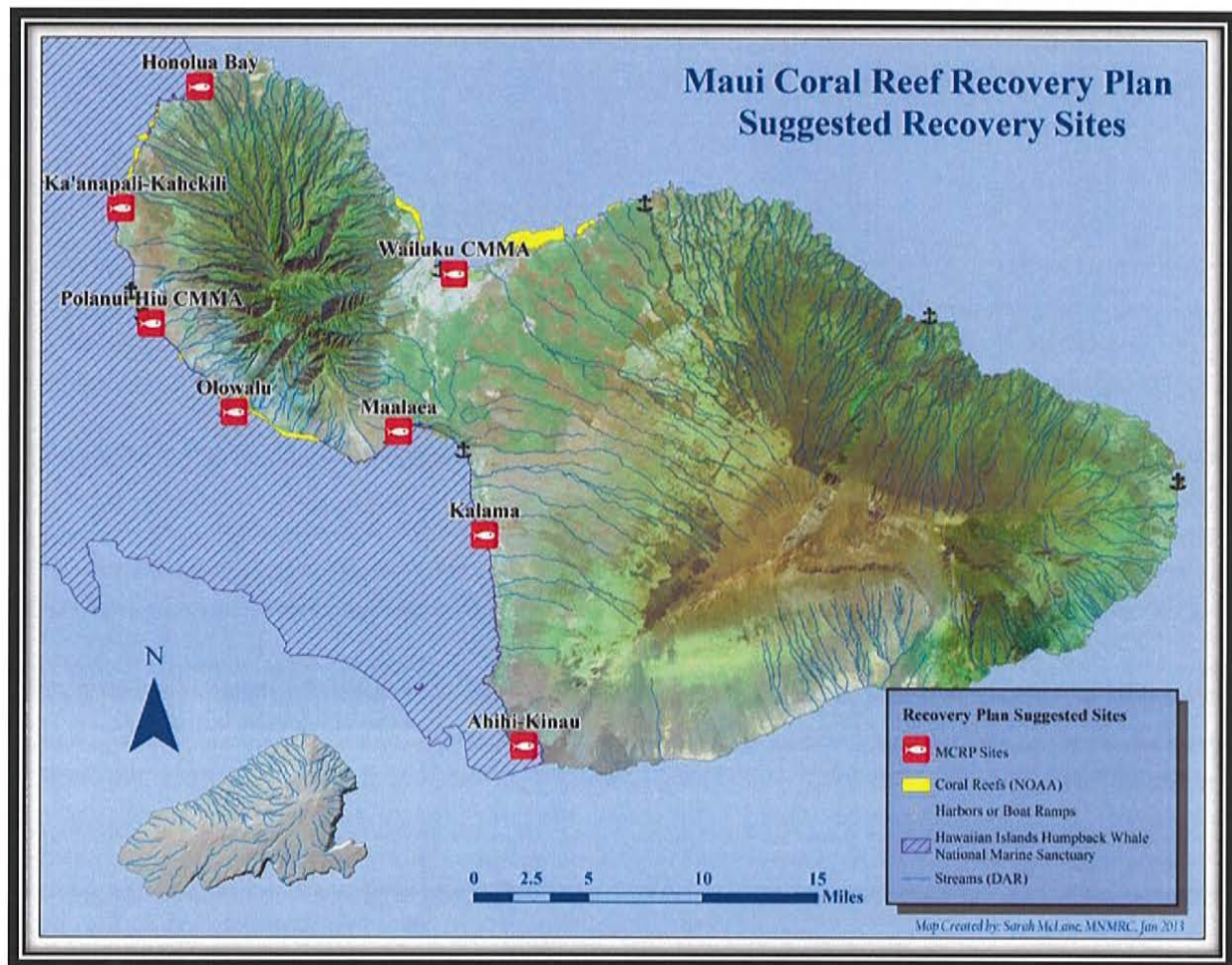
Even though more than 60% of the coral reefs found in U.S. waters are in Hawaii'i, less than 4 percent of the State's near shore waters (less than 60 feet deep) have some level of protection.

Photo credit: DLNR

The MCRT (with input from the State of Hawai'i Department of Land and Natural Resources) recommends the following sites be considered:

Priority Level	Name of Area	Comments
Primary	Kahekili	• Fishery Management Area, with potential for success; • Designated a priority coral reef and watershed area by federal and state authorities as potential implementation partners; • Existing management efforts and community outreach led by potential partners; • Opportunity to strengthen traditional use and subsistence harvest.
Primary	Mā'alaea-Kalama	• Limited areas of coral reef still in decent condition; could be starting point for wider restoration efforts within the area; • High public interest and use; outreach opportunity with public and business support; • High economic dependence of residents on healthy marine waters due to tourism industry and water sport operators; • Could serve as an important 'hope site'; high demonstration value; • There is concern about lumping these sites together because the reef communities are quite different and have different levels of stressors (Brown); • There is also concern due to the extreme degradation of Mā'alaea (Brown).
Secondary	'Āhihi-Kīna'u	• Natural Area Reserve, with potential for success; • Could build on significant management efforts; community outreach underway, led by partners; • Upland management efforts underway (e.g. ungulate fencing); • La Perouse Bay current reef monitoring study site by State and University, showing reef in decent condition; • Opportunity to strengthen reef conservation, work with proposed adjacent development efforts and encourage remediation measures.
Secondary	Honolua Bay	• Within Honolua - Mokule'ia Marine Life Conservation District, with potential for success; • Could build on marine and watershed management efforts led by a number of community, government, and non-government partners; • Upland watershed management efforts underway with

		partners; • Opportunity to promote traditional management and use.
Secondary	Olowalu	• Rare, unique and old corals; reef in good condition; larvae populate West Maui, Moloka'i and Lāna'i reefs; • Important site for mantas, black-tip sharks; could be starting point for wider restoration efforts; • Threatened by proposed urbanization; • Opportunity to strengthen reef conservation, work with proposed adjacent development efforts and encourage remediation measures; • Designated a priority reef site under the Hawai'i Coral Reef Strategy; • Marine area of high public and visitor use; affords outreach opportunity with residents, visitors, fishers and water sport business support; • Important cultural site with traditional and historic significance; opportunity to strengthen traditional use.
Secondary	CMMAs	• Community Managed Makai Areas (CMMAs) with strong local management support systems in place; • CMMAs have partnership and Network interest and support; • Opportunity to build on existing community outreach and engagement efforts; • Opportunity to strengthen traditional use and subsistence harvest; • CMMAs have high public interest and use with local oversight and enforcement from engaged community members • CMMAs afford an opportunity to build public support for priority reef restoration efforts.



Map of Potential Recovery Plan sites on Maui Island

Map created by: Sarah McLane, MNMRC, January 2013.

MCRT recommends that at least two secondary priority sites also be considered for the start-up phase of this plan; one with active marine management efforts (similar to Kahekili), and one without such efforts (similar to Mā'alaea-Kalama).

Adjacent to each priority site identify comparison areas where restoration techniques are not being applied. At least three to five study sites should be assigned for each comparison areas.

1. Kahekili Proposed Reef Recovery Priority Site

The Kahekili Fishery Management Area (FMA) is located along the West Maui coastline (see map), and has been proposed as a reef recovery priority site by the MCRT based on input from the State of Hawai'i and local community members.

Expert coral reef scientists and knowledgeable members from Hawai'i and other U.S. coral reef jurisdictions of the U.S. Coral Reef Task Force (USCRTF), identified Kahekili as a high priority site as it meets many of the site selection criteria. West Maui and Kahekili are officially designated management priorities under the State of Hawai'i (2010) Coral Reef Strategy (the "Kā'anapali-Kahekili priority near-shore coral reef site"), and also priority watershed areas (the West Maui Watershed) within the U.S. Pacific Islands region, by the U.S. Coral Reef Task Force.

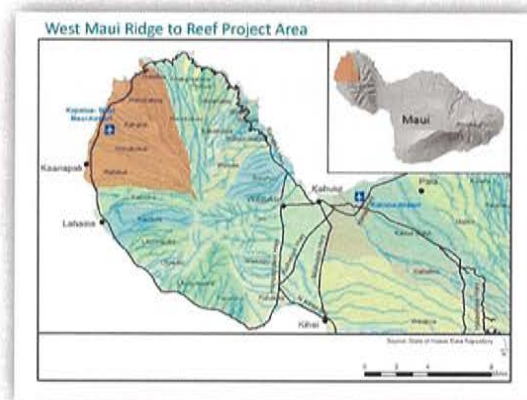
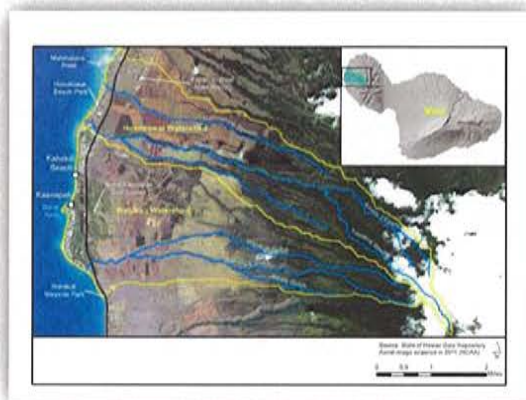
Nuisance algae blooms at Kahekili in 1989, 1991 and 1992 initially raised concerns among community members and prompted a search for influencing factors (Soicher and Peterson, 1997). Since then, community support has grown for research activities (Smith, J., J. Runcie and C. Smith, 2005) and management actions (West Maui Watershed Management Advisory Committee, 1997) to understand and reduce the potential threats to the fringing reef tract fronting Kahekili Park.



**Map of Potential Recovery Site –
Kahekili in West Maui**

Map created by: Sarah McLane, MNMRC, January 2013.

Monitoring programs at this site documented declines in coral cover in the late 1990s with improvements in coral cover since 2006 (DAR and HCRI, 2008). Consequently this site has potential for coral recovery. Fish assemblages, especially herbivore stocks, appear to be depleted



**Maps of West Maui Ridge to Reef Initiative Project Area and
of the two priority watersheds – Honokōwai and Wahikuli**

Maps provided by West Maui Ridge to Reef Initiative

(DAR and HCRI, 2008). This prompted the Hawai'i Division of Aquatic Resources to establish the Kahekili herbivore protected area. With growing community support, existing baseline information, management actions currently underway, and a full range of anthropogenic impacts, this site is well suited as a coral reef recovery priority site.

2. Mā'alaea-Kalama Proposed Reef Recovery Priority Site

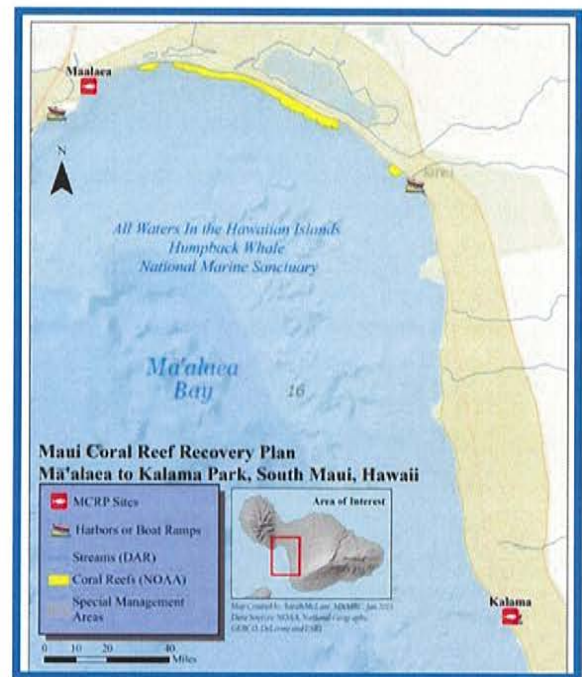
The second recommended priority site is the Mā'alaea and Kalama Park reef area adjacent to Kīhei along the South Maui coast.

Mā'alaea Bay hosts a moderate amount of marine transportation activity via its small boat harbor, including dive/snorkel tour operators, whale watching cruises, commercial transportation, shipping and recreation watercraft. The presence of Kīhei town and corresponding commercial and housing development has resulted in significant land use impacts and littoral habitat modification or destruction.

Nuisance algal blooms since the mid-1980s engaged the community and led to research activities (Dailer *et al.*, 2010) to address the issue. Management actions focused on studying and mitigating effluent from the Kīhei Wastewater Reclamation Facility. Maui's population has grown 27% since 1990, and is projected to increase further in the next ten years, adding to the problem.

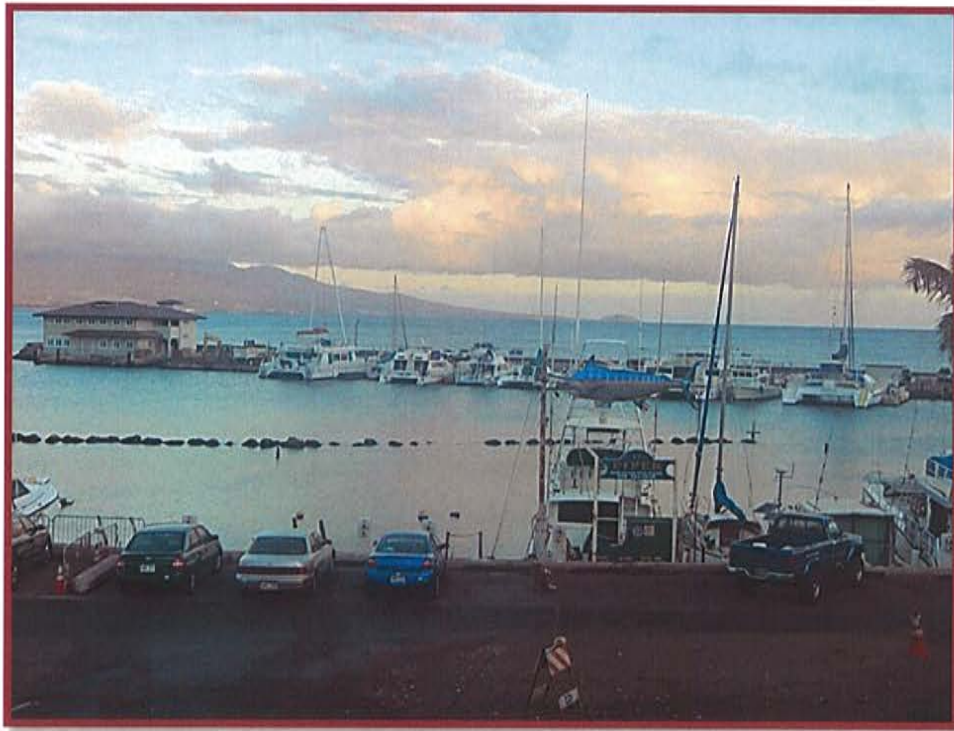
Currently, the reef areas fronting Kīhei do not have any spatially defined marine management or protected area designation, nor is there any process underway to establish one despite recent calls to do so. Proposals have been put forth to restrict aquarium fish collection on resident reefs and the local community has expressed interest and willingness to explore activities that would allow them to protect near-shore marine resources.

Some MCRT members believe that this site, while not satisfying as many of the selection criteria as Kahekili, is still one of the highest priority candidate sites for reef restoration efforts and a fully viable option as a priority reef recovery site. There is concern, however, over lumping Mā'alaea and Kalama Park into one site as the reef communities seem quite different and are subjected to different stressors. Another concern is the extreme degradation of much of the Mā'alaea area.



Map of Potential Recovery Site – from Mā'alaea Bay to Kalama Park in South Maui

Map created by: Sarah McLane, MNMRC, January 2013.



Mā'alaea Harbor, Maui

Photo credit: Mia Charleston

IV. Strategies and Practices

Strategies are the basic approaches to accomplishing the objectives. For a strategy to be appropriate, it must:

1. Directly address objectives;
2. Identify and focus on specific practices;
3. Match available human and financial resources;
4. Respond to site-specific biophysical conditions; and
5. Be acceptable to residents and decision-makers, given local cultural and social norms.

Practices are the specific policies and actions that enact the strategies. For a practice to be desirable, it must:

1. Reflect accepted standards;
2. Offer the highest probability of accomplishing a given task, based on past experience;
3. Be practical, with reasonable training and orientation; and
4. Be foundational, in that it is an activity upon which other activities follow.

The plan adopts four strategies. The first two are direct and indirect restoration. A third strategy, to support cultural and traditional management, will ensure the appropriateness of the first two. A fourth strategy, to engage the public and build partnerships, will broaden support and expand

implementation resources. Each strategy is outlined below, along with its associated practices. The recommended level of priority for each practice is listed in Table 2. Priorities were based on cost, technical requirements, logistics and legal provision.

Table 2. Strategies, Practices and Priorities

Strategy: Associated Practice		<i>Priority</i>
Direct Restoration		
	Reduce nutrient, pathogen and sediment inputs	High
	Remove invasive marine algae	High
	Restock native marine species	Medium
	Propagate and transplant corals	Low
Indirect Restoration		
	Increase site-based management efforts and presence	High
	Encourage compliance with rules and regulations	Medium
	Increase community involvement	High
	Recommend resource management policies	Medium
Cultural and Traditional Management		
	Promote local marine resource management leaders	High
	Encourage the use of traditional resting periods	Medium
	Encourage stewardship efforts that serve both culture and ecology	High
Public and Partner Engagement		
	Identify and engage key stakeholders	High
	Promote public participation	High
	Support community-managed marine areas	High
	Develop partnerships and collaboration	High

Specific activities and methods will be developed and reviewed by an Advisory Council, with direction and oversight from the MCRT and the MNMRC.

The following descriptions are summaries. The specifics of the methods and processes to be used, under each practice, are to be developed, peer-reviewed and approved following adoption of this recovery plan.

A. Direct Restoration

1. Reduce Nutrient, Pathogen and Sediment Inputs

Nutrients are essential to the health of near-shore waters. Eutrophic coral reef ecosystems feature an unnatural overabundance of nutrients and are detrimental to reef health. Eutrophication can occur as a result of land-based pollution, including: (a) fertilizers from agricultural runoff and livestock waste; (b) urban runoff, including from impervious surface and storm drains; (c) suburban runoff, including from landscaping, golf courses and pet and animal waste; (d) wastewater from injection wells, leach fields and cesspools; and (e) eroded soil, carried by rainwater runoff into coastal waters.



Aerial Images of Honolulu Bay (Left) and Kā'anapali Beach, Maui

Photos Credit: Coastal Geology Group – University of Hawai'i - SOEST

Eroded soil can remain suspended within the water column, reducing sunlight needed by the corals' zooxanthellae for photosynthesis. When the sediment settles out of the water column onto the coral in sufficiently high volumes, it can cover and smother the coral polyps. Low sunlight and sedimentation allows both native and invasive algae to grow, out-compete and replace live coral and coralline algae as the dominant habitat type (Littler and Littler, 1984; Steneck, 1997). Global climate change may accelerate and magnify the negative impacts of land-based pollution (for example, through increased storminess leading to more frequent sediment 'pulse' events).

Herbivorous animals such as fish and urchins help limit algal growth and keep it from overtaking live coral cover. Reducing herbivore populations through overfishing or encourages algae growth on an unhealthy reef (for example, urchin die-off due to disease, overfishing for food, or the poaching of sea turtles).

“The long-term consequences of the resultant phase shifts from coral to algal dominance include loss of productivity and biodiversity, a decrease in the intrinsic value of the reef, changes in the community structure of reef fishes dependent upon corals and algae and ultimate erosion of the physical structure of the reef.” (Hughes, 1994).

Sediment exposed in Watershed areas, such as from illegal dirt biking (top), after fires (middle), or from agriculture or development leaves large, open areas of soil to be washed into near shore reefs during storms

Photos Credit: West Maui Mountains Watershed Partnership, Wahikuli-Honokōwai Watershed Management Plan and Save Honolulu Coalition



Reducing nutrient and sediment inputs to coastal waters near coral reefs is an important practice. Clean water is essential to support coral recruitment and growth of corals.

Nutrient and sediment sources are generally well understood for Maui's watersheds. More work is needed to identify loads from specific land uses and disturbances within individual watersheds. We also need to improve our ability to determine the cause(s) of coral decline and to identify pollutants of concern. Because land-based pollutant controls can be costly, these two pieces of information help to focus management efforts to benefit corals. Watershed plans developed for West and South Maui identify and prioritize pollutant sources and offer effective practices for restoring coastal water quality.

Active methods to remove or reduce nutrient and sediment loads will be employed under this strategy. Careful consideration must be given to where and how to take action, given the different impacts of persistent versus pulse (infrequent but high impact) rain events and surface versus groundwater loading and retention.

The following list identifies specific management actions that the MCRT suggests could be used, through this recovery plan, to reduce nutrient and sediment inputs and help restore water quality, as an essential condition for coral reef recovery:

- Develop ahupua`a (watershed-based) plans and priorities initially for MCRT priority sites and eventually all Maui watersheds. Institute planning committees within each targeted watershed to inform decision-makers of actions to protect watersheds and coral reefs.
- Reduce nutrient and pollutant loads from wastewater injection wells. This can be achieved via increased reuse, wastewater nutrient removal, constructed wetlands, deep well injection, deep ocean outfall, decentralized treatment, etc.
- Reduce nutrient loads from onsite cesspools and septic systems by upgrading or connecting to sewer lines. Focus on systems close to the shoreline, near streams and in low-lying areas, where the groundwater table is high.
- Improve storm water management with expanded use and design of construction and post-construction best management practices (BMPs), retrofit problematic storm water systems, improve drainage and storm water requirements and grading ordinance, improve compliance and enforcement, limit impervious surfaces, etc.

**BMPs such as Rain gardens (top) or
Constructed Wetlands (bottom) can
help to accumulate and settle sediment
before it reaches storm drains**

*Photos Credit: CWRM, 2008 – Handbook for
Stormwater Reclamation and Reuse – Best
Management Practices in Hawaii*



- Reduce erosion and sedimentation by removing feral ungulates from watersheds and implement improved agricultural erosion BMPs. Stabilize abandoned plantation and farmland by planting drought-tolerant groundcover, native trees and shrubs and installing BMPs to reduce erosion and allow runoff infiltration.
- Reduce sediment transport and loading by installing BMPs that facilitate onsite infiltration of storm water and restoring riparian corridors, floodplains and wetlands.
- Maintain existing sediment retention basins, via regular inspections and removal of accumulated sediment. Expand the capacity of existing basins where feasible and consider appropriate retrofits.
- Maintain agricultural diversion, dam and ditch structures to prevent catastrophic failure and mass loading of sediment and pollutants.
- Replace impervious surfaces with permeable surfaces and native plant species that allow for rainwater absorption and reduced runoff.
- Restore flood storage capacity in urbanized areas and along shorelines by installing infiltration basins and creating or enhancing wetlands.
- Improve technical, financial and human capacity of communities, NGOs, county, state and federal governments for reducing land-based pollution.
- Improve harbor practices to reduce pollutant loads from waste disposal, fueling, wastewater disposal and boat cleaning and maintenance activities. Ensure that fuel- or oil-spill prevention and cleanup measures are in place and that personnel are trained. Provide adequate pump-out facilities at all marinas and develop enforceable measures to ensure proper wastewater disposal.
- Ensure that watersheds adjacent to marine managed areas have adequate storm water management, erosion control, pollution control measures and land protection, to maintain good water quality.
- Improve linkages between land-use planning and marine spatial planning.



Photo Credit: Fernando Lopez Arbarello

Implementation of such measures may reduce the level and frequency of harmful pathogens, associated with sewage, that are introduced into inshore waters and may lead to the spread of coral disease (as well as human health issues).

2. *Physically Remove Invasive Marine Algae*

Employ control methods that have been tested and used successfully in the marine environment. These methods fall into three categories:

1. Mechanical removal, using a barge with a pump-driven vacuum to remove algae;
2. Manual removal, through contract labor and/or volunteers, who remove invasive alien algae by hand; and
3. Limiting the introduction and spread of invasive alien algae species.

Hawaii has a reasonable level of expertise and experience with employing these practices to learn from and build upon, particularly on O'ahu.

The 'Supersucker' is an underwater mechanical suction device that a dive team uses to vacuum invasive algae off of reef habitat and onto a barge. The Supersucker uses a bladeless Venturi pump system to avoid fragmentation and spread of siphoned algae and to allow native marine life, unintentionally taken up in the process, to be returned to the water unharmed, following manual sorting on the barge. Recovered algae can be used for compost. Five to eight divers and operators are capable of removing up to 750 lbs. of algae per hour. Mechanical removal works as a temporary solution; it does not prevent the same species from reclaiming the area. The Hawaii Marine Algae Group (a partnership between Hawaii DLNR-DAR, The Nature Conservancy (TNC) and the University of Hawaii) successfully deployed the Supersucker in Kaneohe Bay, O'ahu. Mālama Maunalua and TNC partnered at Maunalua Bay, O'ahu, using a 'Minisucker', essentially a smaller version of the Supersucker.



Photo Credit: Jonathan Blodgett

The second practice for algae removal is manual removal, typically by volunteers. Community participants concentrate on specific areas of local interest sometimes transplanting native algae from areas of cleaned reef. Volunteers see first-hand the algae's destruction, becoming both more aware of its presence and better stewards of their area. Such projects have proven successful on other islands. O'ahu's Maunalua Bay Reef Restoration Project successfully used both paid labor and community volunteers during 2010 and 2011 to remove over 2.5 million pounds of invasive, alien, leather mudweed (*Avrainvella amadalpha*) from Maunalua Bay, clearing more than twenty-two acres of reef in the process.



Photo Credit: Jonathan Blodgett

Due to incomplete understanding of the effectiveness and impacts of such practices, an experimental approach with scientific partners is recommended for both: (1) the removal of invasive fish species, such as 'roi' (peacock grouper), from coral reefs, in order to protect native herbivore populations; and (2) the control of invasive alien algae, through the capture and redistribution of sea turtles or herbivorous fish, into coral reef areas with high algae growth. Increased experience and objective measurement of the effects of such practices may elevate them to standard recommended best practices for removing invasive marine species, under this strategy and future reef recovery plans.

3. Restock Certain Native Marine Species (non-coral)

Previous research on problem algae and herbivores in Hawaii (and elsewhere) has indicated "strong negative associations between local biomass of herbivorous fishes and percent cover of problem algal species" (Williams and Polunin, 2001). This suggests that efforts to increase populations of herbivorous fishes could help to reduce vulnerability to invasive algae blooms and even reverse previous coral-to-algal shifts.

Herbivore populations help to prevent the proliferation of nuisance macroalgae. Therefore, in areas where the water quality is good and herbivores are under some form of active management or full protection, both passive and active restocking of native marine species may be helpful for reef recovery.

Passive restocking is achieved through the fisheries management (for example, allowing natural replenishment of native herbivores). Hawaii's Division of Aquatic Resources is studying the benefits of protecting herbivores from fishing pressure within a Beach Herbivore Fisheries Management Area in Kahekili, Maui. Natural recruitment, coupled with harvest restrictions, may be a cost-effective method of increasing stocks, compared to active restocking. Full prohibition of harvest of herbivores would likewise allow for replenishment of stocks through natural recruitment.



Fish disease

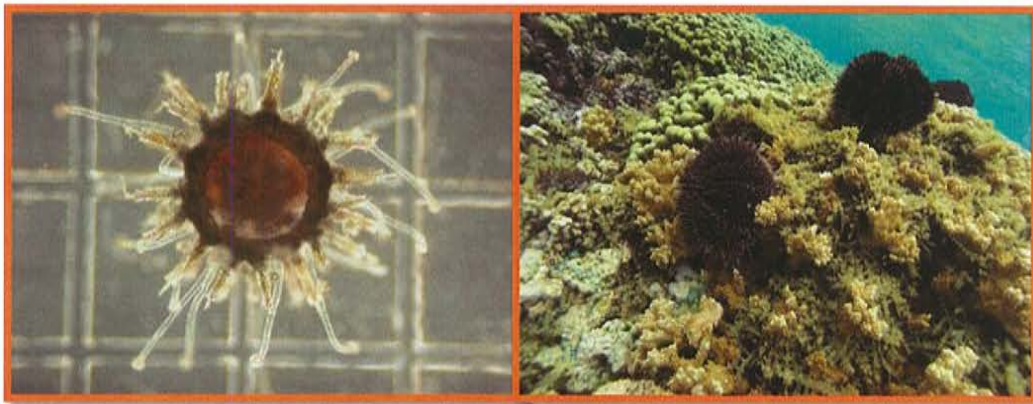
Photo Credit: M. Ramsey

In some locations outside Hawaii, native herbivores are repopulated through ranching: the capturing or collecting of juveniles and holding them until adulthood for relocation into depopulated areas, or moving adults from areas of high concentration into lower ones.

Aquaculture can generate juveniles through captive-breeding programs, where they are held and grown in culturing facilities until they reach appropriate size to release into the wild. Specialized feeding mechanisms and variable diet preferences among herbivorous species, imply that some groups or size-classes of reef fishes are more important in controlling invasive algae (Choat, Robbins, and Clements, 2004; Hobson, 1974).

Active restocking efforts require precautions to prevent disease transmission. Restocking of native herbivorous fish within coral reef areas is under investigation in Hawaii. It could become a useful active restoration practice on coral reefs where fish populations have been decimated. Active replanting of native marine algae species may be useful at restoration sites, where appropriate, particularly following the removal of invasive marine algae species. There are several projects in the main Hawaiian Islands, including sites at Waihe'e, Maui and Ewa, O'ahu, where native algae transplanting and cultivation is underway.

Urchin propagation and restocking is under investigation on O'ahu, via hatchery and could be a useful element, should research and trials verify their potential. Although some argue that ancient Hawaiian fishpond husbandry was essentially a restocking effort (due to accidental introduction or intentional release of managed reef fish from fishponds), active restocking is not a common practice in modern-day Hawaii. Replanting native species in wetlands and littoral habitat adjacent to reef areas may also be a useful element of this practice.



Sea urchin larvae and grazing sea urchins

Photos Credit: Jonathan Blodgett

Active restocking would likely require substantial financial and technical investment, over a significant period of time, to be deployed at scale. Further, current State and Federal laws restrict or even prohibit such activities. Therefore, active restocking is not considered a high priority. Instead, this plan recommends experimental trials at priority locations with scientific partners to assess their potential as reef restoration efforts.

4. Propagate and Transplant Corals

Coral restoration, through propagation and transplantation, is underway in many places around the world that have suffered high coral mortality. MCRT reviewed the methods, lessons and cost estimates from these programs. International experience in establishing and maintaining low-cost, community-led 'coral gardens' of transplants has grown within the past two decades, particularly within the Indo-Pacific and Caribbean regions.

International organizations such as Global Coral Reef Alliance and TNC now provide detailed, peer-reviewed guidance and technical capacity for establishing, maintaining and monitoring coral transplantation programs. Such efforts are often promoted locally with fishing communities to increase awareness of the need for coral management and recruit volunteer labor, via snorkel, scuba or hookah operations.

In the Philippines and Indonesia, some coral gardens became popular dive sites and attract dive tourism operators who also assist with maintenance costs. In some cases, propagation and transplantation sites were designated as MPAs, to prevent fishing or destructive practices from occurring at restoration sites. Maintenance includes removal of invasive algae and clean-up of marine debris. Local reef health and threats education and outreach programs, particularly targeting youth, often occur as part of coral garden programs. The conservation benefits and effectiveness of such programs has yet to be validated scientifically and is viewed as a questionable management practice by most marine management professionals. Transplantation may not achieve comparable genetic diversity. This is due to the lack of sufficient polymorphic genetic markers for most coral species. Further, aquaculture facilities often do not maintain genetic diversity because they have limited brood stock.

Coral propagation and transplantation has neither a current legal basis within Hawaii's inshore waters nor a strong base of existing political support. However, CMMA members have expressed interest in experimental redistribution of components of an artificial reef within their managed area, with assistance from scientific partners.

Global experience suggests that the cost runs to thousands of dollars per acre. Such costs exceed the budgets of the partners to this plan. Given the costs and the demanding technical requirements, the restoration value of coral propagation and transplantation may not be justifiable over that of improving environmental conditions (e.g., water quality) and allowing natural recovery to occur.



Growing Coral at the Maui Ocean Center

Photos Credit: John Gorman



The Out to Sea museum exhibition in Switzerland contains shocking amounts of plastic flotsam and garbage, including 6.6 tons collected on Kaho'olawe by Hawaii Wildlife Fund. HWF's Cheryl King traveled overseas to educate on the cleanup

Photo Credit: Cheryl King/Hawai'i Wildlife Fund

Coral propagation and transplantation was carefully considered and discussed by the MCRT, which resulted in its low priority rating. Peer-review feedback from outside the team, strongly agreed with this conclusion. Experimentation and research to explore the potential for future application was preferred. Even in ideal conditions, coral propagation and transplantation would only be part of the overall solution to reef restoration.

MCRT members recognize that coral transplantation is useful only in locations where the root causes of reef decline are addressed; i.e., where land-based pollution has been minimized, overfishing curbed and resiliency built to adapt to climate change.

Experimentation is recommended only in areas of ideal conditions, including high water quality, healthy surrounding habitat and absence of significant human disturbance or stressors (for example, within well-managed marine protected areas). Such candidate sites are rare around Maui Island.

Experimental coral propagation would require producing corals and live rock prior to transplantation, at facilities on land (e.g., the Maui Ocean Center, Waikiki Aquarium or inland artificial seawater facility.) It could involve ocean-based propagation stations (tethered floating or stationary grow-out cages (e.g., within a MLCD or Hawaiian fishpond), prior to the redistribution and transplantation of propagated corals.

B. Indirect Restoration

Indirect restoration efforts focus on controlling and modifying people's behavior, rather than manipulation of the biological environment. Indirect restoration is seen by the MCRT as a critically important piece of Maui's reef restoration effort.

This recovery plan focuses on the four following indirect restoration practices:

1. Increase site-based management efforts and presence;
2. Encourage compliance and enforce rules and regulations;
3. Increase community involvement; and
4. Recommend appropriate resource management policies.

Such practices require significant volunteer and paid labor investments. MCRT recognizes that volunteer efforts alone would be insufficient to effectively employ all four practices.



Reef Resilience Training for the community

Photo Credit: Mia Charleston

1. Increase Site-based Management Efforts and Presence

Increased management efforts include the following activities:

- (a) Cooperatively develop and implement site-based action plans with community members, stakeholders, user group representatives and government officials;
- (b) Expand previously-designated marine managed areas (MMAs) around Maui, including MLCDs and NARs;
- (c) Legally designate new MMAs around Maui as components of a biologically representative and redundant MPA network;
- (d) Support TNC's effort to establish and manage a Maui MMA learning network;
- (e) Explore opportunities to implement collaborative fisheries management with local communities and local, state and federal government authorities;
- (f) Periodically characterize, assess and map habitat, water and the biological community, including quantity and quality;
- (g) Review, update and identify critical and sensitive coral reef sites, based on a geospatial analysis for decision-making purposes (e.g., TNC's assessment of priority conservation areas of Maui's coral reefs);
- (h) Develop and implement conservation plans for landowners and neighboring priority recovery sites, to protect stream and riparian areas and for land use decision making;
- (i) Assess neighboring watershed conditions (e.g., forest cover, water quality, vulnerability level) and create ahupua'a-based watershed-management plans at neighboring reef recovery demonstration sites and MMAs;
- (j) Selectively and cautiously institute participatory coastal and marine spatial planning exercises, both for recovery sites and, at the seascape level, with users, stakeholders and community groups (e.g., see the NOAA-supported West Maui Coastal Mapping project);
- (k) Document and integrate customary practices (e.g., harvest calendar) and traditional knowledge (e.g., spawning grounds) within management efforts;



Community training at Polanui Hiu CMMA

Photo Credit: Mia Charleston



Train the Trainers Events to facilitate community management of marine resources

- (l) Develop and implement site-based climate change adaptation plans for recovery of demonstration sites; and
- (m) Define NOAA's Marine Sanctuary role in assuming jurisdiction of near-shore marine ecosystems in State waters, recognizing their plan to expand from a single-species to a broad-based ecosystem approach, along with expansion to new areas within the main Hawaiian Islands.

Increased management presence includes periodic visits by professional management staff and researchers in support of the recovery plan (e.g., State DLNR/DAR representatives, DOCARE officers, University researchers and NGO staff), as well as the regular presence of participating community volunteers and supporting fishers and non-extractive users. An example of such an effort is the 'Opihi Monitoring Partnership.

2. *Encourage Compliance and Enforce Rules and Regulations*

Another important indirect restoration practice is improving compliance with current marine resource rules and regulations through education and enforcement.

Encouraging compliance with existing rules and regulations involves education and outreach (such as public awareness campaigns), installing signage and operating informational kiosks at recovery demonstration sites, working with schools to build curricula related to coral reef conservation, designing and focusing compliance messages to specific target audiences, using appropriate media (e.g., radio/TV, handouts, newspapers, social media) and community meetings.



Marine resource management rules and regulations are poorly enforced on Maui. MCRT emphasizes the need for a sufficient DOCARE presence, including enhanced on-site patrolling. This requires increased budgets and legislative approval. Community volunteers can be trained, via community 'watch' programs, to provide surveillance (including documentation of observed user type and frequency), real-time position and activity of suspected violators and approach and confront suspected violators, in an appropriate way, in order to inform them of possible rule infractions. An example of such an effort is the DLNR-sanctioned Makai Watch program, which is supported by Conservation International and TNC. It provides capacity-building opportunities and private funding.

3. Increase Community Involvement in Coral Reef Management

Top-down management practices require substantial financial and human resources and are needed where human presence is low or uninformed and disengaged from management issues.

In areas where enforcement is lacking, local management strategies, designed to meet community goals, can achieve greater compliance and conservation than those designed solely for biodiversity conservation (Churnpagdee, Fraga, and Jorge, 2004; Chuenpagdee and Jentoft, 2007; Kittinger in review; McClanahan et al., 2006). Community participation in

coral reef management efforts has been successful in areas such as the Philippines, Fiji, Indonesia, Palau, the Federated States of Micronesia and Papua New Guinea, leading to documented improvements in coral reef health, and improved socioeconomics and supportive governance and policy decision making (LMMA Network, 2010).

Community Managed Makai Area (CMMA) efforts on Maui combine traditional knowledge and customary management practices with modern management and scientific approaches. They exemplify and support the case for the relevance of traditional management practices within management program. Once a community group has been formed to support local management, the CMMA process involves three phases:

- 1) Site appraisal through direct observation; documentation of historical information; and development of seasonal harvest calendars;
- 2) Designate area boundaries and establish a community vision, core values and prioritized management goals and strategies; and
- 3) Develop and implement an action plan.

CMMAs encourage local participation and active support of restoration efforts. CMMAs at restoration sites would engage with efforts already underway for Polanui Hiu in Lahaina, Wailuku, Kīpahulu, Mū'olea and emerging CMMAs on Lāna'i and Moloka'i, along with 'Āhihi-Kīna'u NAR. The MNMRC is also now a supporting member of the Maui Nui Community Managed Makai Area Learning Network.



**CMMA members
examine root
causes of coral
reef degradation**

*Photos Credit: Mia
Charleston*



**Upgrading a fishing check in station
at the Wailuku CMMA**

4. Recommend Passage of Appropriate Marine Resource Management Policies

The goals and objectives reflect the MCRT's understanding that effective reef restoration requires supporting rules and policies. Accordingly, indirect restoration practices must include communicating findings and recommendations to policy-makers. This includes the State legislature and Maui County officials and local decision-makers (for example, within processes to develop County Community Plans). Potential policy recommendations include:

- (1) Requesting the Maui County Council adopt this Recovery Plan;
- (2) Linking recovery plan actions with site-based development plans, through the County Council, including exploring how specific language under this plan could be incorporated in Community Plans;
- (3) Building policy support for improved regulatory compliance and increased site-based enforcement;
- (4) Ceding State management authority to certified community groups, implementing collaborative marine management;
- (5) Requesting State administrative support for restoration practices, such as on-site enforcement presence and abatement of land-based pollution sources;
- (6) Building a network of MMAs, across Maui, with ecological and social connectivity (including securing the legislative mandate to create such a network);
- (7) Defining climate change adaption policies; and
- (8) Providing alternative scenarios that reflect the impacts of action versus inaction.



Olowalu reef

Photo Credit: Cynthia Matzke



Maui Nui Community Managed Makai Area Learning Network meeting, Ke'anae, Maui

Photo Credit: The Nature Conservancy

C. Cultural and Traditional Management

Even fifty years ago, educational material was already in circulation to encourage resource managers to adopt traditional cultural practices that had maintained human societies in the Hawaiian Islands for over 1,500 years. Thomas Maunupau describes such practices in the 1965 book, *Ancient Hawaiian Civilization*:

“The ancient Hawaiian did everything he could to preserve the fishing ground. No fishing ground can be preserved unless precautions such as the Hawaiians observed are taken. This is true not only of Aku and Ahi fishing but of every other kind of fishing. The Hawaiians had a *kapu* on alongshore fishing in certain places when deep sea fishing was open. In the case of inshore fishing, one place was *kapu* for a month; then this area was open and the next was *kapu*. At certain times of the year, certain seaweeds were *kapu*, because when fish food was preserved by this means, the shore fishing was saved for the people. There used to be plenty of fish in Hawaiian waters, but these have to a great extent disappeared because constant fishing has wiped them out. The fish are gone for good unless we have closed and open seasons for different kinds of fishing. The government is trying to place certain restrictions on fishing. If the ancient form of *kapu* used by the old time Hawaiians could be revived in these new governmental restrictions, we should again have plenty of fish, provided the restrictions were observed as were the *kapus* in the old days.” (Maunupau, 1965)

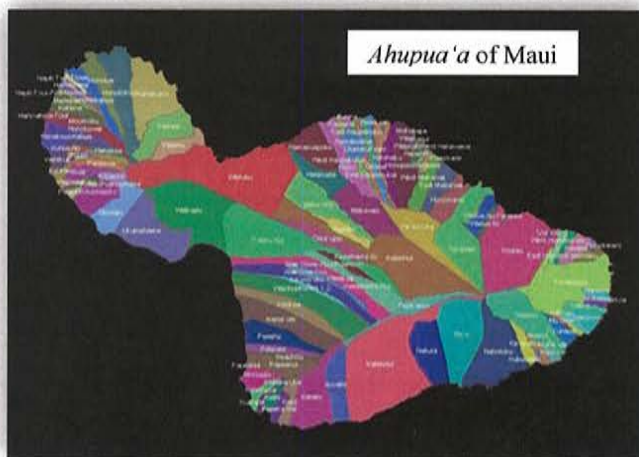
Traditionally, natural resources were managed by the law of the *Ali'i* (Chiefs) to ensure the sustainability of life in each location – whether on an island, an *ahupua'a* (land division of the island), or an area within an *ahupua'a*. Each district of the island was distinct, comprised of different ecosystems, climates, seasonal reproduction periods and populations. The *ahupua'a*'s population directly influenced the

management of its natural resources.

Hawaiians had no way to import food. Survival meant living sustainably. Unchecked, overharvested, or unmanaged natural resources could lead to starvation, warfare and even extinction.

Early residents placed high value on natural resources. Polynesian religion sees the natural environment as a physical manifestation of gods and ancestors. Natural resources were typically managed by *Konohiki* – stewards appointed by the *Ali'i* to carry

out the will of the chiefs. *Konohiki* were aware (or had *kahuna* who were aware) of the spawning periods and rate of repopulation of each species and enforced *Kapu* (or no-take restrictions) accordingly, to ensure sustainability. The pollution of natural resources and the harvesting of items that were *Kapu* – either forbidden or



Ahupua'a on Maui – Maui Island Plan

Photo Credit: County of Maui

aware (or had *kahuna* who were aware) of the spawning periods and rate of repopulation of each species and enforced *Kapu* (or no-take restrictions) accordingly, to ensure sustainability. The pollution of natural resources and the harvesting of items that were *Kapu* – either forbidden or

restricted – were among the most serious crimes. Penalties ranged from additional taxation to execution.

In the context of this restoration plan, early Polynesian resource managers practiced “rest” rather than “restoration.” In *Hawaiian Fishing Traditions*, Mary Kawena Pukui explains how the fishing *kapu* worked, in the district of Ka‘ū, on the Big Island, both to allow people to use the resources and to ensure a continuous supply:

“There was never a time when all fishing was tabu. When inshore fishing was tabu (kapu), deep sea fishing (lawai‘a-o-kai-uli) was permitted and vice versa. Summer was the time when fish were most abundant and therefore the permitted time for inshore fishing. Salt was gathered at this time, also and large quantities of fish were dried...In winter, deep sea fishing was permitted....A tabu for the inshore fishing covered also all the growths in that area, the seaweeds and shellfish, as well as the fish. When the kahuna had examined the inshore area and noted the condition of the animal and plant growths and decided that they were ready for use, that is, that the new growth had had a chance to mature and become established, he so reported to the chief of the area and the chief ended the tabu.” (Titcomb, 1952)

Traditional marine resource management practices, as stated in *Ancient Hawaiian Civilization*, also included the following perspective on the role of fishers in management:

“The old Hawaiian fisherman was a skilled and selected person. He had knowledge of and respect for, the traditions and customs of fishing. He was careful to observe these customs, because through them, fishing was preserved for the coming generations and his children were trained in the skill they would need as they became fishermen. Fishing in those days was not a matter of getting all the fish and moving on to another fishing ground. The Hawaiian fisherman was much too clever to do this and he respected the traditions of his people too much to do it.

Laws today cannot help to preserve the fish in Hawaiian waters, unless in addition to the laws, we have a feeling of respect for them and observe them because we see that they are beneficial.” (Maunupau, 1965)



Throw net demonstration and practice

Photo Credit: Manuel Meija

Such traditional management practices, in Hawaii, have been of recent research interest as possible sources of contemporary management alternatives (McClenachan and Kittinger, 2012). From this rich cultural history, we can glean several important resource management practices that are clearly relevant today, from the perspective of coral reef restoration efforts outlined under this plan:

1. Promote and support local marine resource management leaders;
2. Encourage the use of traditional resting periods; and
3. Encourage community stewardship over neighboring inshore waters.

Each of these cultural and traditional management practices is briefly described below.

1. Promote and support local marine resource management leaders

Resource managers must have first-hand knowledge of the status of local marine resources. Resident families and local fishers, with the knowledge of cultural management practices in an area, must be actively incorporated into local coral reef restoration efforts, assuming that they have the interest and willingness to support them. Our contemporary government system often attempts to manage Maui's marine resources from Honolulu or Washington DC alone and this is ineffective. The traditional practice of promoting and supporting experienced and respected local leaders, with significant first-hand knowledge, as *Konohiki*, allowed them to assess and share perspectives on the health of the local shoreline ecosystem, prior to the creation or removal of restrictions or closures. Under this plan, such knowledgeable and respected local voices, within priority recovery areas, must be identified and supported.



Wailuku CMMA training

Photo Credit: Mia Charleston

2. Encourage the use of traditional resting periods

Like Native Hawaiians of the past, today's resource managers understand the interdependence of marine resources. Species-specific catch limitations and size restrictions, alone, are not as successful as closing the entire fishery in a given area to harvest activities, either permanently or temporarily (Friedlander *et al.*, 2007). Because permanent closures may not be socially acceptable or operationally possible to achieve in all locations of concern around Maui, temporary closures, consistent with traditional practice, may be a feasible alternative.



Ko'ie'ie Fishpond

Photo Credit: Darla White

Polynesia), including Hawaii. Traditionally, such closures, or "resting periods," occurred on a rotational basis.

Temporary (typically six months to a few years in duration) closure is an ancient practice throughout the Pacific Islands (e.g., "tabu" and "tambu" declarations in Melanesia, "bau" in Micronesia and "kapu" in

Data from contemporary rotational closures indicate that recovery is not always evident, particularly for shorter closure periods and/or where high poaching and human activity occur. Waikiki beach is an example: rotational closures exhibited low effectiveness (Williams *et al.*, 2006).

However, in low population areas of Maui, where shoreline residents actively support closures and regularly monitor and encourage compliance, rotational closures may experience greater success. Coupled with the other three strategies, periodic closures within active CMMAs may meaningfully contribute to recovery.

Resting periods, even where effectively managed, may not be able to offset the negative effects of global climate change. Conventional wisdom holds that a sufficiently large network of both MPAs and CMMAs, with resting periods, must be created, in order not only to encourage reef recovery, but also to increase the likelihood of successful adaptation, by Maui's coral reefs, to the negative impacts of climate change.



Photo Credit: Linda Nakagawa

3. Encourage stewardship efforts that serve both culture and ecology

MPAs and CMMAs around Maui must include active surveillance and enforcement efforts, designed to encourage compliance and deter or penalize violators.

Traditionally, the reopening of a *Kapu* area was decided locally, based on the observed abundance of target resources rather than on a specific date. The area remained closed until the *Konohiki* decided that the resources were ready. *Kapu*'s were sometimes reinstated after limited harvesting. *Kapu* was strictly enforced, with dire consequences for violators.

Increasing public awareness of and respect for such traditional stewardship practices mean that it may be appropriate, in certain areas, to empower CMMAs that employ these practices. Within communities of numerous Native Hawaiian ancestry households, active support of CMMA activities encourages both reef recovery and cultural practice.

Several marine organisms are both integral to Hawaiian culture and ecology. Such organisms can become important 'keystone' species, around which to rally the support of cultural practitioners.

Preliminary research suggests that *Kapu* areas may have yielded standing fish biomass roughly equivalent to no-take MLCs of today (Friedlander, Shackeroff, and Kittinger in review).



Polanui CMMA Training

Photo Credit: Mia Charleston

D. Public and Partner Engagement

Public and partner engagement is a critical requirement for effective plan implementation. The public and partner engagement strategy will focus on the beneficiaries of the recovery plan, including local community residents, user groups and other stakeholders.

Four additional practices will be enacted, under a public and partner engagement strategy, as follows:

- 1) Identification and engagement of Key Stakeholders in each community or *ahupua'a*;
- 2) Promotion of public participation in restoration efforts;
- 3) Support by community-managed marine areas; and
- 4) Development of reef recovery partnerships and collaborations.



Healthy reefs will require healthy watersheds and successful partnerships with landowners

Photo Credit: WMMWP

1. Identification and Engagement of Key Stakeholders

MCRT will work with potential partners to complete a stakeholder analysis that identifies priority stakeholder groups and characterizes their interests and influences. MCRT will strategically engage with key stakeholder groups and recruit their support and participation.

Stakeholder engagement will remain a core practice, underlying all recovery actions.

2. Promotion of Public Participation in Restoration Efforts

MCRT recognizes that Maui residents must play an active and vital role throughout the entire reef recovery process. Accordingly, members of the public will be encouraged to participate, including:

- (a) Site-based volunteer efforts such as surveillance and documentation of user activity at recovery sites, fish and water quality monitoring and manual algae removal;
- (b) Attending MCRT and MNMRC meetings;
- (c) Providing input into public opinion polls to assess public awareness and reactions to proposed actions, such as user fees; and
- (d) Providing input on how best to frame the issue of reef degradation and recovery (for example, how coral reefs relate to Maui's visitor industry).



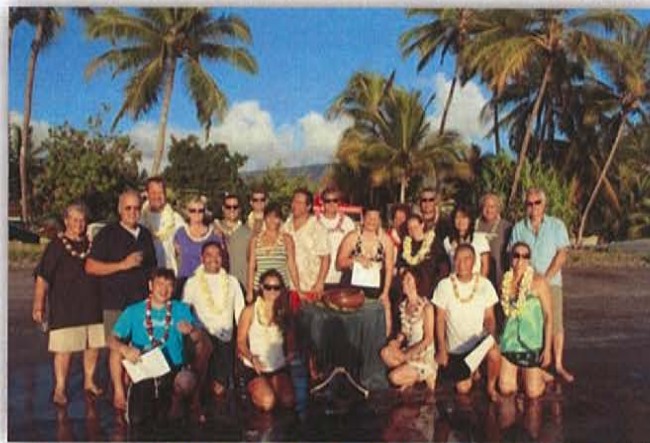
MNMRC Meeting

Photo Credit: Mia Charleston

3. Support by Community-Managed Marine Areas

On August 18, 2010, a group of community leaders and resource users, from Polanui Hiu (Lahaina area) and Wailuku Ahupua'a requested assistance from the Maui Nui Marine Resource Council to design and implement CMMAs within their areas. Making use of traditional knowledge and based on established community trust, two CMMA working groups were formed.

Between September 2010 and November 2011, these two CMMA working groups were trained to design and develop local management plans, in conjunction with their



Graduates of the CMMA Train the Trainers Program

Photo Credit: The Nature Conservancy

local communities and user groups. These CMMAs incorporated traditional and modern practices in their plans. They plan to seek formal recognition by the State government and authority to manage their own resources, as has been done at Mo'omomi and Ha'ena.

During early 2011, these two CMMAs expressed their interest to actively support the implementation of the Maui Coral Reef Restoration Plan. MCRT intends to build CMMA participation into restoration plan implementation.

4. Development of Reef Recovery Partnerships and Collaboration

This plan aims to support the ability of Maui's people to sustainably harvest marine resources. MCRT views Maui's fishing families, community groups, private businesses, educators, non-governmental organizations and agency authorities as critical partners and allies in the implementation of this plan. The MCRT recognizes potential partners to invite support of the recovery plan, including those listed in the table below:

<i>Government</i>	<i>Non-government Organizations</i>	<i>User/stakeholders</i>
Maui County Mayor's office Governor's office Policy Makers NRCS State DOH State DOA USDA/Farm Bureau NOAA Sanctuaries NOAA Fisheries CRC HTA/Maui Visitor's Bureau DBEDT - OP/CZM DOT/State Transportation DHHL, OHA Watershed Partnerships USFWS NPS/DOI USGS USEPA USACOE DLNR	Hawaii Water Environmental Association The Nature Conservancy Coral Reef Alliance (CORAL) South Maui Sustainability Maui Tomorrow Surfrider Foundation Hawaii Wildlife Fund Sierra Club Bishop Estate Kamehameha Schools University of Hawaii Hawaii Sea Grant Project S.E.A.-Link Castle Foundation Hawaii Community Foundation Watershed management NGOs Soil/water conservation districts Hawaii Association for Marine Education and Research, Inc.	Land owners Community associations Local fishing clubs Taro farmers Dive Tour associations Whale watching tour operators Maui visitor industry businesses Commercial fishers

MCRT acknowledges that responsibility for the plan's implementation and evaluation must be shared among several partners, including government authorities (e.g., Governor's office, DLNR, DOH, County Commission and managers at local, county, state and federal levels), non-

governmental groups (e.g., fishing clubs, community groups, MNMRC, The Nature Conservancy, Conservation International) and academia (e.g., DOE, University of Hawaii, local schools).



To coordinate these groups, MCRT proposes creation of a Reef Restoration Council (RRT). This Council will assume the lead decision-making role and lead engagement with public decision-makers for all recovery activities. The Restoration Council will oversee the MCRT, which will remain a separate, scientifically-focused body, providing independent analysis and

objective review of the condition of Maui's reefs, along with technical implementation support. The roles and functions of this partnership-driven governance over the plan will be defined by relevant authorities and partners, immediately following the adoption of the plan.



Maui businesses, NGOs and government agencies, committed to the success of this plan, sponsored the North Kihei Flood Forum in 2011

Photo Credit: Mia Charleston

V. Appendix One – Elements of the Recovery Plan Vision

The vision of successful coral reef recovery around Maui in 15 to 20 years is as follows:

Maui's coral reef ecosystems are biologically intact, ecologically functional, and sustainably managed through a partnership arrangement of government, non-government, and community stakeholders. Thriving, dense coral habitat supports an abundant diversity of native marine life, in turn providing a wide range of ecological, economic, and cultural benefits and services to current and future generations of Maui residents and visitors. They are a beautiful and thriving example of successful coral reef management and restoration that is recognized around the world.



Photo Credit: Don McLeish

There are several biological, economic, and socio-cultural elements associated with this recovery plan's vision statement:

Biologically, we envision that in 15 to 20 years:

- Maui's coral reefs will be intact and ecologically functional, with balanced populations of thriving native marine organisms inhabiting the reef.
- Maui's reefs will have increased live coral cover and health, and host abundant and thriving reef fish populations.

- Maui's reefs will be able to sufficiently replenish themselves through time due to high reproductive capacity, connectivity, and consistently successful recruitment of juvenile organisms.
- Maui's reefs will be home to the full range of biological diversity and endemism that makes Hawai'i's near shore marine environment globally unique and special (Roberts *et al.*, 2002).
- Maui's reefs will be resistant to natural and human disturbances with relatively low rates of disease and be successfully adapting to the effects of periodic land-based pollution. Effective management will successfully address threats and minimize negative impacts on coral reef habitats and fish populations.
- Maui's reefs will be more resilient and have a higher likelihood of recovery following periodic natural and human disturbances. Maui's reefs will be as best prepared as they can be to successfully cope (in the short term) and then adapt (over the long term) to the effects of global climate change, including sea level rise, sea surface temperature increases, and ocean acidification.

Economically, we envision that in 15 to 20 years:

- A thriving and sustainable inshore recreational, cultural and subsistence fishery will support local residents and communities engaging in *pono* fishing practices that are widely understood and followed. These practices will support local livelihoods and interests, including dive tourism, recreational fishing, and supplying sustainably- and locally-caught seafood for Maui restaurants.
- The sustainable extractive and non-extractive use of Maui's coral reefs will support a stable local economy and a wide range of local businesses and diverse job opportunities, including the beach hotel industry, scuba-diving related tourism, whale watching tours, and other ocean recreation activities, as well as supporting the availability of locally-caught seafood within Maui restaurants, through small-scale commercial fishing efforts.
- Some Maui families will be engaged in small-scale commercial reef fisheries in a sustainable manner that allows them to maintain their traditional livelihoods and provide for their families.
- The inherent value of Maui's coral reefs will be widely recognized and accepted by the public, and incorporated appropriately into economic assessments of Maui's natural marine environment.
- Decision-making regarding coastal development will reflect the intrinsic value of Maui's coral reefs.
- Local career opportunities will exist relating to the health and wellbeing of Maui's coral

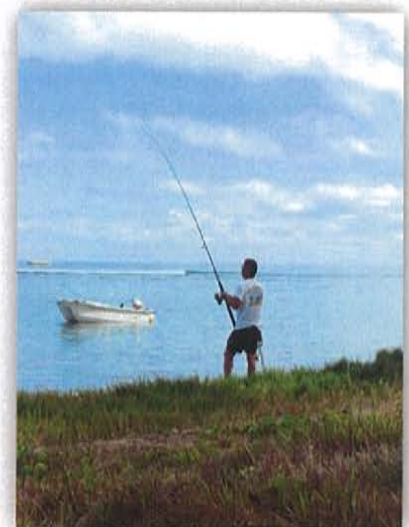


Photo Credit: Mia Charleston

reefs, including natural resource managers, marine educators, marine scientists, community project participants, individuals involved in restoration, and environmental engineers.

Socio-culturally, we envision that in 15 to 20 years:

- Maui residents will have a strong awareness of the need for preserving and protecting coral reefs through effective resource management. Increased citizen peer pressure and self-policing to observe reef management rules and obey marine resource regulations will encourage compliance and minimize violations. This will lead to increased respect and value for Maui's reefs by its users and visitors, who will consistently strive for "zero impact."
- Due to a participatory management approach, the Maui public will be actively engaged in the management of Maui's inshore waters. Stakeholders will fully participate in and support consensus-driven decision making processes that effectively maintain the health of Maui's reefs under a "culture of care."
- Culturally appropriate resource management efforts will be utilized as an important component to reef sustainability. Management efforts will incorporate



Photo Credit: Don McLeish

traditional place-based observations and scientific methodologies to provide the best information available for resource managers.

- Traditional knowledge will be perpetuated through the generations, and continue to evolve naturally through the course of history. Maui's coral reefs will support a wide variety of cultural practices to maintain this traditional knowledge.
- Restored Hawaiian fishponds will thrive, supported by restored streams, and Native Hawaiian seasonal harvest calendars will be observed.
- Traditional fishing and gathering techniques will be practiced effectively because healthy coral ecosystems support an abundance of marine resources. Maui families will be able to maintain fishing traditions and sustainably gather marine resources for cultural practice.
- The lost connection between Maui's people, its coral reefs, and the ocean will be revived. Maui residents will understand and share the belief that their health and well-being is closely tied to that of Maui's coral reefs. Maui's families and communities will maintain a strong cultural identity with healthy coral reefs and inshore waters.

VI. Appendix Two – Threat Analysis

A. Threat Identification and Assessment

The MCRT conducted a qualitative assessment during late 2010 of known threats that are most frequently having a negative impact on Maui's coral reefs. The assessment involved the participation of 29 knowledgeable and recognized coral reef experts, including the MCRT members. Based on this assessment, the most frequently identified threats facing Maui's coral reef ecosystems are as follows (listed from most to least often cited by respondents):

1. Land-based sources of pollution in the form of:
(1) sediment runoff from coastal development, road construction, agricultural lands, and watershed erosion; and (2) excess nutrients from human waste (e.g., injection wells, cesspools, and leaking wastewater pipes; agricultural and landscaping practices).
2. Overfishing by non-aquarium commercial fishing operations.
3. Land-based sources of pollution in the form of chemical runoff (e.g., fertilizers and pesticides).
4. Overfishing by recreation fishers (both residents and visitor charter boats).
5. Invasive species, particularly alien algae that proliferate from increased nutrient availability.
6. Climate change impacts in the form of ocean acidification.
7. Overfishing by local fishers for subsistence or supplemental protein needs.
8. Climate change impacts in the form of sea surface temperature rise.



Invasive algae smothering a reef

Photo Credit: Greta Smith Aeby

Some of these threats cumulatively degrade or destroy coral reef habitat. The 29 assessment participants reported that the severity of the majority of these threats is increasing through time. The threats that assessment participants cite that are increasing the most rapidly are human waste and chemical runoff, overfishing, and coral habitat alteration/destruction due to coastal development or ocean acidification.

Other threats and confounding factors identified by the MCRT include:

1. Coral reef habitat alteration or destruction due to vessel groundings.
2. Coral reef habitat alteration or destruction due to non-extractive recreational uses and trampling.

3. Invasive fish species.
4. Marine pollution spills or dumps (accidental or otherwise), including oil and toxic chemicals and boat exhaust.
5. The spread of coral disease.
6. Incompatible land use policies and practices and poor urban/suburban growth planning.

The root cause for all of these threats and confounding factors is thought to be increasing use of coral reef habitat as a result of human population growth and immigration to Maui Island.



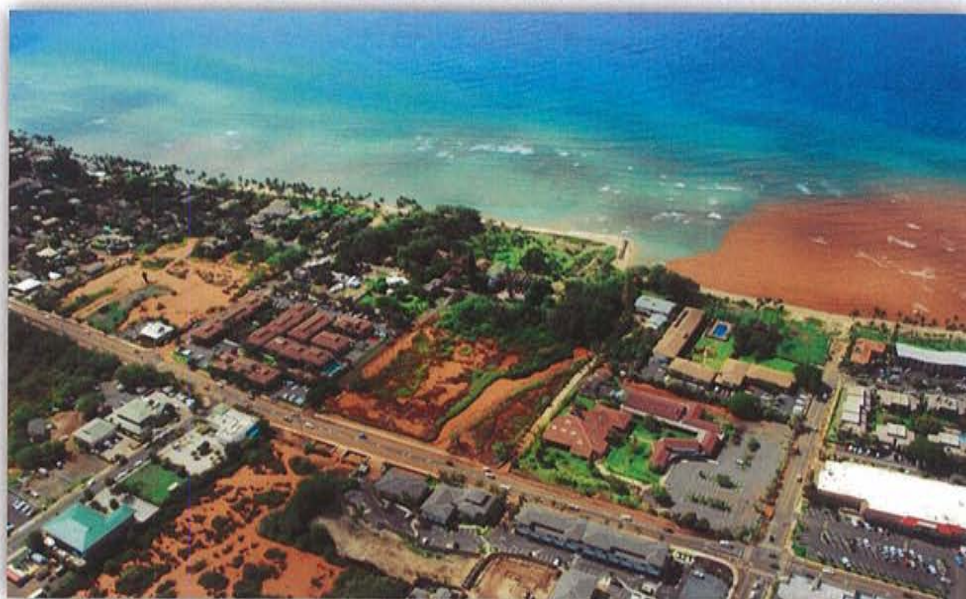
Invasive Roi fish harvested during the 2008 Roi Roundup public fishing event

Photo Credit: Coral Reef Alliance

B. General Points of Agreement

The MCRT came to consensus on the following general points of agreement regarding the overall status of Maui's coral reef ecosystems:

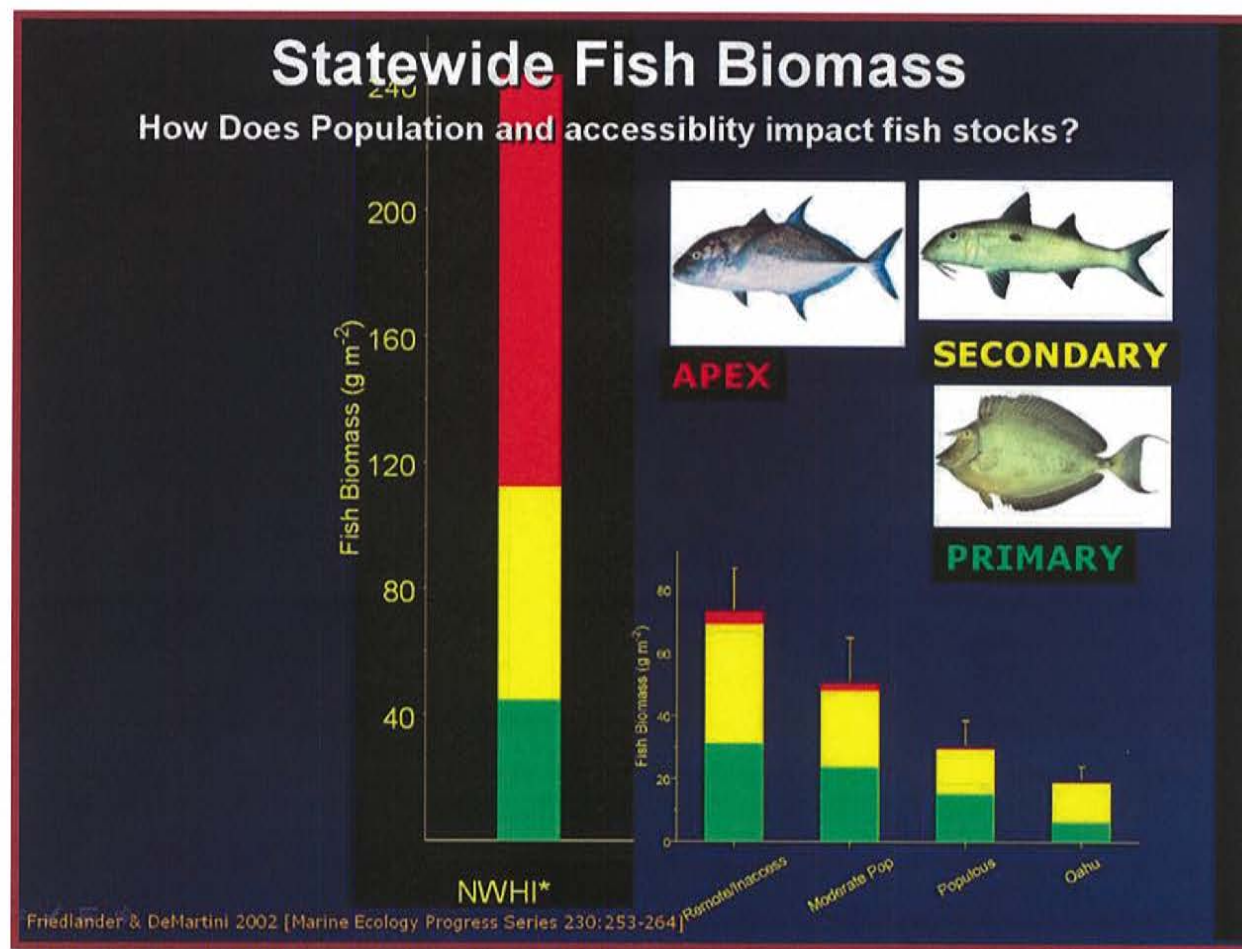
- Maui's coral reefs face growing pressure from a range of threats. Significant declines have been documented on Maui's coral reef communities over the last 20 years, particularly at eight well-documented study sites. Decreases are also being observed in the relative abundance, species diversity, and individual biomass of coral reef fish populations. Some coral reef sites have declined less than others; only a few sites show any evidence of possible increases in coral cover (recovery). Reef and reef fish populations declined less within Maui's Marine Life Conservation Districts (MLCDs) and other marine protected areas (MPAs). In general, the trend is an overall decline in the health of Maui's coral and reef fish populations.
- Land-based pollution is one of the top threats to Maui's coral reefs. Land development and construction has resulted in increased degradation of near shore habitat through the destruction (conversion or removal) of coastal wetlands adjacent to coral reefs. Periodic storms and seasonally heavy rains create events of high rainwater volume runoff that carry and deposit sediment and non-point source pollutants onto Maui's reefs. Development practices (for commercial space, housing, road construction, agriculture, golf courses, etc.) contribute to land-based pollution and reef degradation when proper regulations and practices are not fully implemented. Feral ungulates such as goats, deer, and pigs contribute to soil erosion and thereby increase the amount of runoff discharge that negatively impacts reefs.



Silt choked runoff in North Kihei following a heavy rain on Haleakalā

Photo Credit: Hugh Star

- Overfishing is also thought to be another primary threat to Maui's coral reefs. This includes over harvesting of reef fish for the commercial aquarium trade as well as heavy recreational fishing pressure and small-scale commercial fishing. Neither proposed bans on aquarium fishing or attempts to reform the fishery into a 'sustainable' practice through voluntary, non-governmental certification efforts have been successful at getting aquarium fishers to set and follow harvest restrictions. Bag and size limits for recreational fishers are difficult to enforce due to the low number of enforcement officers and lack of a recreational fishing license. Small-scale commercial fishing operations, including operators from neighbor islands, are known to regularly harvest fish from already overfished reefs.
- Other threats facing Maui's coral reefs include the spread of invasive marine species like alien algae and introduced fish, coral damage caused by scuba divers and snorkelers, trampling of live coral by recreational users, oil and sewage spills, and boating and ship impacts (e.g., groundings, anchor damage, and collisions with marine species).
- The increasing impacts of global climate change will negatively impact Maui's coral reefs through sea level rise (reduces sunlight), increased sea surface temperature (triggering coral bleaching), increased frequency and intensity of storm events (eroding the shoreline), and coral habitat loss due to ocean acidification (decalcification).



Relationship of fish biomass to remoteness

Photo Credit: Alan Friedlander

Given these direct threats, improved local decision-making support and political will by Maui County elected officials is essential. There is a lack of a legal basis upon which appropriate action can take root and be nurtured through time. Managers often have insufficient information to plan or make informed management decisions. In addition, they may not have access to the latest management techniques and technology needed for effective management, despite its availability.

In general, assessment participants acknowledged that the compound threat of land-based sources of pollution (viewed as having the most acute, pervasive, and destructive impacts) and the emerging and poorly understood threat of climate change warranted further analysis and consideration. The results of the assessment of these two threats are described below.

C. Detailed Threat Analysis: Land-based Sources of Pollution

Common land-based sources of pollution include sediment runoff from suburban centers and roadways, coastal construction and development projects, feral ungulates in the watersheds, households and landscaping, agricultural areas, disturbed watersheds and gulches. Land-based pollution from fertilizer and pesticide runoff and human waste via cesspools and injection wells are also of great concern. Animal waste (domestic and feral) contains disease that can kill marine animals. Storm water management needs to be improved for developed and agricultural land.

Hawaiian corals and coral reefs are sensitive to sediment loading (Jokiel, 2008; Wolanski, Martinez, and Richmond, 2009). Sediment is considered a primary, if not the leading, land-based pollutant causing alteration of reef community structure in the main Hawaiian Islands (Friedlander *et al.*, 2008). Impacts of sediment on corals include detrimental effects to living tissue and coral larvae (recruits), as well as other reef organisms. Impacts reviewed and documented by Rogers (1990) and Jokiel (2008) include: (a) reduced sunlight penetration and thus reduced coral photosynthesis and reef development and growth; (b) direct burying, smothering and physical abrasion of living coral polyps/tissue; (c) expenditure of energy to remove sediments, reducing reproductive potential; (d) inhibition of larval recruitment/settlement; and (e) addition of significant nutrients and sediment toxins into the ecosystem and food web.

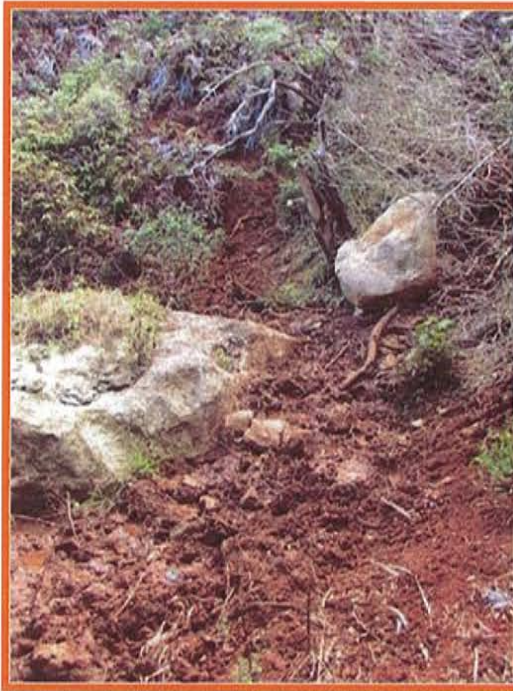


MNMRC hosted public Flood Forums in response to severe runoff in Kīhei during heavy rain events

Photo credit: The Nature Conservancy

Observed coral declines around Maui correlate with land use change and development. Areas of reef decline appear to be concentrated in areas with high human population or in areas suffering from extensive land disturbance and sedimentation (Jokiel *et al.*, 2004; Jokiel, 2008).

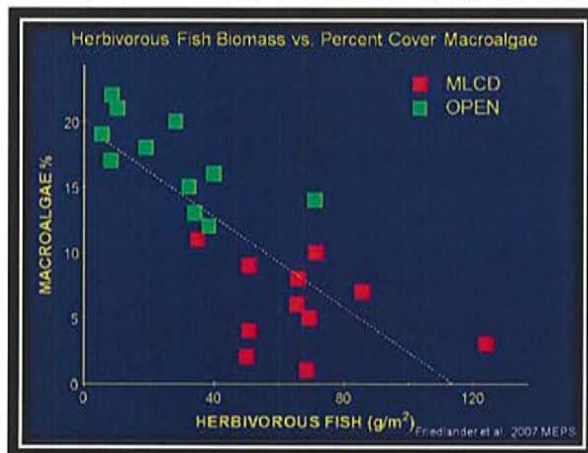
Historically a major cause of erosion, runoff and accelerated sedimentation on Hawaiian coral reefs has been plantation agriculture and overgrazing of agricultural lands in watersheds adjacent to reef areas. A review has been completed on the importance of this process on the reefs of south Moloka'i (Jokiel, 2008; Field *et al.*, 2008). Overgrazing by feral ungulates (e.g., pigs, goats, and deer) continues to damage watersheds on Moloka'i, Lāna'i, West Maui and the north coast of Kaua'i.



Feral ungulates root up native plants, spread disease and exacerbate erosion (at left). Species like Axis deer (*Axis axis*) have no predators in Hawai'i and unchecked populations can lead to severe land-based degradation that flows downstream during storms

Photo Credits: Left – West Maui Mountains Watershed Partnership, Right – DLNR-DOFAW.

Increased land-based pollution can lead to an over-abundance of nutrients (eutrophication) resulting in algal blooms which negatively impact coral reef communities. Municipal wastewater injection plumes have been detected in the ocean at Kīhei and Lahaina, Maui (Hunt and Rosa, 2009). Wastewater presence was confirmed by the detection of multiple wastewater tracers, the most conclusive being bacteria, pharmaceuticals, organic waste indicator compounds, and heavy $\delta^{15}\text{N}$ in submarine seeps near the shore. The effluent plumes likely constitute large nutrient fluxes to the near shore environment. The effluent plumes are not the sole source of nutrients discharging to the ocean on Maui. Groundwater contaminated by fertilized agriculture and landscaping is similarly enriched in nitrogen, while phosphorus concentration is considerably higher in effluent than in contaminated groundwater by forest or agricultural land cover. It should be noted that groundwater is naturally much higher in nitrogen than ocean waters, even in areas where anthropogenic nutrient inputs are absent. Sections of the Kīhei and

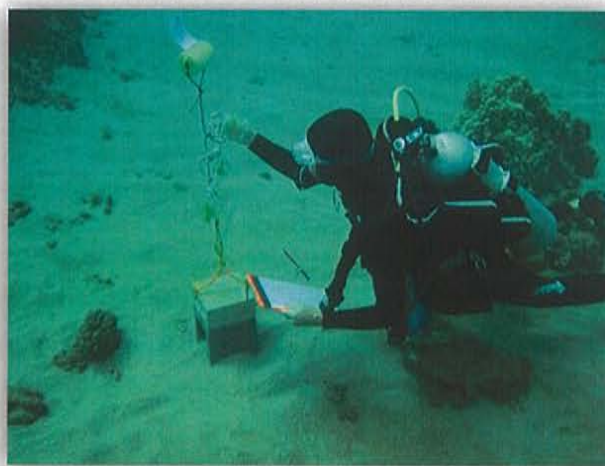


Herbivorous fish can help to prevent an overabundance of macroalgae in reefs, as long as their populations stay healthy and can be protected, either by conservation areas (such as a Marine Life Conservation District (MLCD)) or by sustainable harvesting

Photo Credit: Friedlander et al., 2007.

Lahaina coasts have been designated as impaired water bodies or “Water Quality Limited Segments” because surface water exceeds one or more water-quality criteria, such as nitrogen, turbidity, or suspended sediment (State of Hawai‘i, 2012).

Macroalgal blooms of *Hypnea musciformis* and *Ulva lactuca* in coastal waters of Maui occur only in areas of substantial anthropogenic nutrient input, sources of which include wastewater effluent from injection wells, leaking cesspools and agricultural fertilizers. Algal $\delta^{15}\text{N}$ signatures were used to map anthropogenic nitrogen through coastal surveys (island-wide and fine-scale) and algal deployments along near shore and offshore gradients. Algal $\delta^{15}\text{N}$ values of 9.8‰ and 2.0–3.5‰ in Waiehu and across the north-central coast, suggest that cesspool and agricultural nitrogen, respectively, reached the adjacent coastlines (Dailer *et al.*, 2010). Nitrogen derived from wastewater was detected in areas proximal to the Wastewater Reclamation Facilities (WWRF) operating Class V injection wells in Lahaina, Kihei and Kahului through elevated algal $\delta^{15}\text{N}$ values (17.8–50.1‰). From 1997 to 2008, the three WWRFs injected an estimated total volume of 193 million cubic meters (51 billion gallons) of effluent with a nitrogen mass load of 1.74 million kilograms (3.84 million pounds) (Dailer *et al.*, 2010). Nutrient inputs from sewage systems are of highest concern on the developed and urbanized coasts of O‘ahu and Maui (Friedlander *et al.*, 2008).



Measuring algae growth off
Kahekili Beach Park in West Maui

Photos Credit: Megan Dailer

D. Detailed Threat Analysis: Climate Change

Another threat to Maui's reefs arises from the impacts of global climate change which leads to changes to: (a) sea surface temperature (SST), with associated potential for coral bleaching and subsequent increased susceptibility to disease (Hoeke *et al.*, 2011; Veron *et al.*, 2009); (b) sea

surface height (SSH), with attendant threats from coastal inundation and erosion (Nicholls *et al.*, 2011); and (c) ocean chemistry, particularly ocean acidification (Hoeke *et al.*, 2011). Because these potential impacts are the result of global stressors, local management alone will not be sufficient to prevent them. Since land-based pollution also affects acidification, and can intensify its effects (Kelly *et al.*, 2011), concentrating management efforts on stressors that are under local control will provide Maui reefs with the possible chance of withstanding climate change impacts (Selig, Casey, and Bruno, 2012).

Considerable uncertainty still exists in regard to global projections of climate change (National Research Council, 2011). In addition, these effects may or may not scale linearly with global mean temperature, sea surface temperature, or ocean circulation patterns (Hansen and Sato, 2011). Even so, data from the last 50-100 years reveal certain broad trends. First, there has been a gradual warming throughout the twentieth century across most of the Indo-Pacific (Hoegh-Guldberg and Bruno, 2010). This warming has been relatively uniform, despite annual variations on local scales, and has been accompanied in Hawaii by a slight reduction in precipitation and stream base flow (Oki, 2004). Current global circulation models predict warming of SSTs in an equatorial strip, stronger evaporative cooling outside the equator, a weakening of Hadley Cells and associated atmospheric circulation (Vecchi *et al.*, 2006), and more persistent El Niño

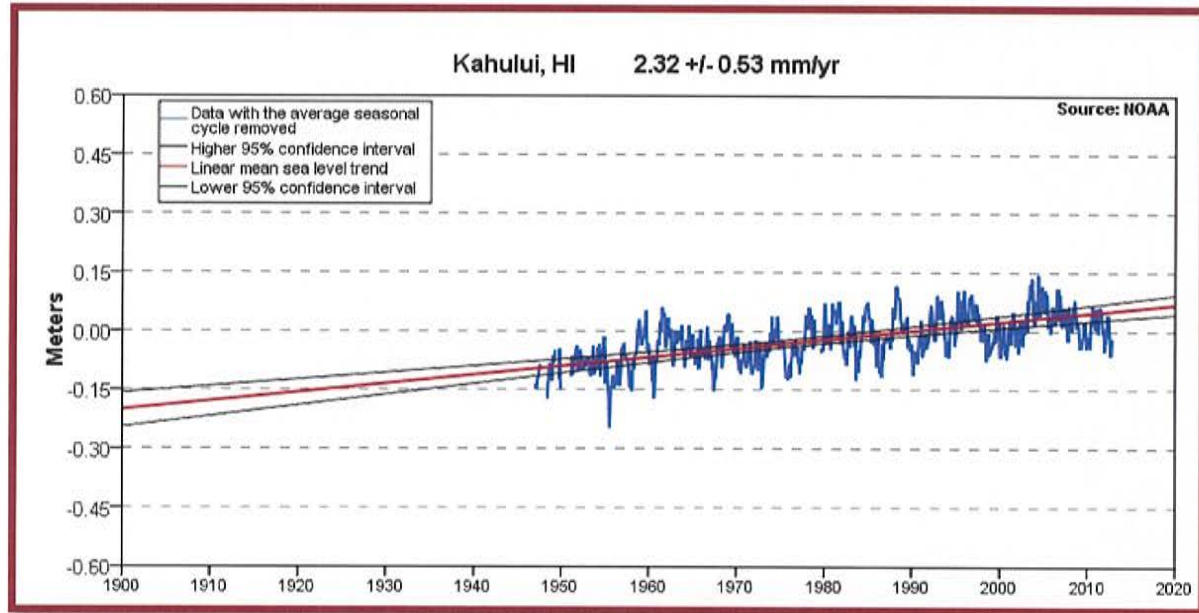


Coral bleaching and disease events on Maui

Photos Credit: Greta Aeby, Hawai'i Institute of Marine Biology.

conditions in the Eastern Pacific (Xie *et al.*, 2010). These model predictions, however, are based primarily on data collected prior to 1995, and are not supported by more recent observations. Instead, climate in the Eastern Pacific during the past 15 years has been characterized by increasing trade wind speeds, cooler SSTs, and more persistent La Niña conditions. This dichotomy between global model predictions and current reality may possibly be linked to the Pacific Decadal Oscillation (PDO), a climate cycle that operates on a much longer scale than the ENSO cycle that drives El Niño and La Niña events. The current 15 year prediction (2009-2024) for the PDO indicates that SSTs in the Hawaii sector will remain cooler than long term averages during this period (Meehl, Hu, and Santer, 2009), which if true may buy Maui time to implement improved management practices before the PDO cycle shifts to a heightened warm phase and brings additional stress to Maui's reef ecosystems.

Global sea level has been rising steadily at 3 mm/year from 1993 onward, but this rate is not uniform around the globe (Nicholls and Cazenave, 2010). In Hawaii, the average rate of sea level rise has been 1.46 mm/year since 1900, half the global rate yet similar to trends seen on the West Coast of North America). Even within the archipelago this rate is variable, being fastest at Midway in the far northwest (+5 mm/year.), and lowest at Hilo (+1 mm/year.). By contrast, there has been a rapid rise in sea level in the Western Tropical Pacific from 1995 onward (Merrifield, M., S. Merrifield, and Mitchum, 2009), a rise that correlates well with the above noted onset of stronger winds and SST cooling in the Eastern Pacific (Firing *et al.*, 2004).



Sea level rise in Kahului, Hawai'i in meters, from 1900 – 2012, with projections through 2020

Photo Credit: NOAA

These trends have been largely collected from tide gauge records, and recently cross-validated with satellite altimetry; the data correlate well, indicating that the tide gauge records are accurate for the pre-satellite time series. For Maui, these trends mean that sea level around the island is rising at approximately one half the global rate (i.e., about +1.5 mm/year.), one inch every 7 years, and one foot every 82 years. As such, threats to Maui from rising sea level, if current rates are maintained, are potentially less than for other areas of the world.



Beach erosion in front of the Kahului Wastewater Treatment Plant

Photo Credit: Zoe Norcross-Nu'u and Chip Fletcher

Global models indicate a total global rise in sea level of 3-5 feet in the next one hundred years, particularly if current rates of carbon emission continue on their sharp upward trend (Nicholls *et al.*, 2011; Rignot *et al.*, 2011). Therefore, the currently low level of sea level rise on Maui may well be an interim anomaly linked to the current phase of the PDO, and more rapid, non-linear rises in sea level may manifest themselves in future decades. Maui's reef managers should consider the impact of possible future sea levels

in regard to various land-based facilities such as sewage plants, dump sites, and other contaminant sources that could adversely impact reefs if flooded, and actively seek relocation of such facilities. Rising sea level and increasing storm frequency will increase coastal erosion and sediment transport to the reefs.

As ocean temperature and atmospheric carbon dioxide concentrations change, the amount of carbon sequestered in the ocean in the form of carbonic acids also changes (Feely *et al.*, 2001, 2009). The concentration of hydrogen ions increases, making it more difficult for many organisms, including corals, to incorporate calcium carbonate into their shells (Wootton, Pfister, and Forester, 2008). Although current models and observations indicate that ocean acidification proceeds more rapidly at depth and in colder waters, its effects eventually work their way into the upper ocean layers inhabited by reef-building corals, a trend that already appears to be playing out in the northern Pacific (Byrne *et al.*, 2010). Statistical analysis of trends in pH as measured at more than 50 stations in Hawaii by the Department of Health shows pH decreasing at significantly faster rates in inshore waters than at Station Aloha, an oceanographic monitoring site northeast of O'ahu (Karl and Lukas, 1996). Land-based sources of groundwater pollution are suspected (Dulaiova and Berg, 2010). Previous data from Station Aloha indicate that water density is increasing near the surface, and decreasing at depth. This is an unstable equilibrium that results in greater mixing at depth; it is gradually bringing more acidic water toward the ocean surface. Overall, the upper ocean mixed layer appears to be thickening at a rate of about 4 m/decade and its temperature increasing at 0.5 °C/decade, both trends that correlate with increasing ocean acidification at the surface. For Maui, these trends put greater stress and have unpredictable effects on the island's coral reefs. This is a problem that is not fully amenable through local management alone and highlights the importance of addressing stressors that can be controlled. This will promote the best possible resilience in the face of the all but certain globally based climate stresses to come.



Ocean acidification can make the food web collapse, effecting even larger predators

Photo Credit: Don McLeish

VII. Appendix Three – Coral Reef Management Assessment

A. Summary of Coral Reef Management Efforts to Date

A study was conducted at the outset of the formation of the MCRT to assess and evaluate past coral reef management efforts for Maui Island (Povilitis, 2011). A literature review of previous coral conservation and management efforts was conducted, paired with a series of consultations with key informants. Summary profiles were prepared for previous coral reef management efforts, including a synopsis of their supporting legislative mandates. A draft version of the report was peer reviewed for accuracy and completeness, including by MCRT members.

In sum, the study documents that the majority of management efforts to date have been non-regulatory. Most have been implemented since 2000. Overall, Maui has seen a proliferation of efforts, with more than 50 programs and plans dedicated to conserving marine resources completed to date, including: 7 efforts/projects by the County of Maui, 16 by the State of Hawaii, 8 with the US Federal Government and 20 with non-government organizations. Only a few efforts involved academia or private business.

Strengths of previous coral reef management efforts around Maui include a robust policy commitment and framework (particularly at the federal level), large investments in awareness and education and a recent surge in coral conservation interest and initiatives, particularly by non-governmental groups. Weaknesses of prior efforts to date include uncertainty that management efforts can meet the requirements for coral reef recovery and health, a heavy emphasis on process instead of local action and results and a disconnect between policies and specific decisions needed to meet conservation goals.

The study recommends that for future efforts to be effective:

- (a) Decision-making processes must be aligned with policy commitments.
- (b) Elected officials and key decision makers must be directly involved throughout the process.
- (c) Coverage beyond a single, small Maui reef site must be attempted.
- (d) Best management practices (BMPs); water quality standards and fisheries management efforts must be applied to specific coral reef recovery requirements.
- (e) The public should be educated and informed strategically, not broadly.



Community driven, non-governmental groups have been successful with conservation efforts across Maui

Photo Credit: Ka'anapali Makai Watch Program

The study concludes with the following recommendations:

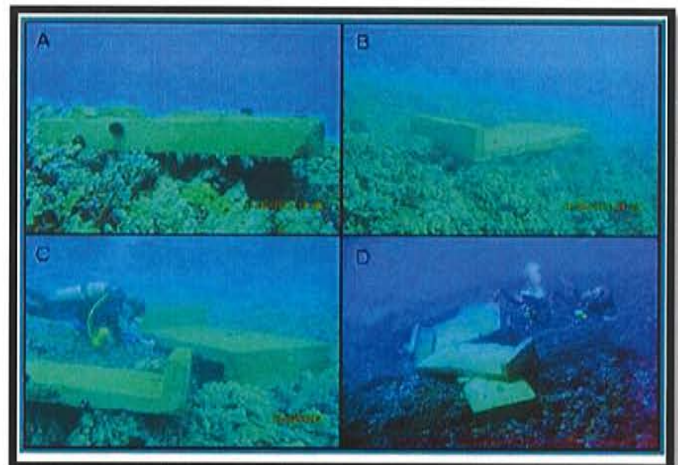
- (a) An objective non-government scientific body of trusted scientific and management experts should be formed to periodically monitor and report on Maui's coral reef status, threats and trends, providing a complementary function that is currently missing in Maui's local government.
- (b) This scientific body should offer policy implementation advice and solutions to local decision makers and work closely with them to meet their policy needs.
- (c) This scientific body should systematically apply technical expertise, including by compiling and disseminating management and recovery standards for coral reefs, fish populations and water quality, assisting federal and state agencies in developing related bio-criteria, evaluating and improving BMPs to curtail polluted runoff and identifying data needs, rapid assessment procedures and priorities for research.
- (d) A Maui Coral Reef Recovery Plan should be approved and implemented.
- (e) Non-government groups and local government (particularly Maui County) should work together to provide factual information for public outreach, education and decision making.
- (f) The effort for Maui should position county, state and federal agency decision makers at the cutting edge of conservation efforts.

B. Retrospective Analysis of Management Challenges and Failures

The MCRT came together a few times during 2011 to complete a retrospective analysis that examines past failures and challenges for Maui County. The summary results from this group analysis are:

*Past resource management decisions or efforts that have **failed** to conserve or fallen short of the desired level of conservation include:*

- (a) Storm water management and flood control measures;
- (b) County approval of development planning in floodplains and wetlands;
- (c) Statutory initiatives led by the State Legislature;
- (d) Placement of injection wells and wastewater treatment facilities;
- (e) State implementation of federally-funded coastal zone management efforts;



Damaged healthy reef at Keawakapu due to an accident during the creation of an artificial reef nearby

Photo Credit: NOAA, NMF, DLNR-DAR

- (f) Federally-funded past local efforts (outputs, but not outcomes);
- (g) Scientific studies not anchored to follow-on actions;
- (h) Lack of accounting of cumulative impacts on coral reefs;
- (i) Unrealistically high community expectations;
- (j) Poorly chosen indicators of stress and recovery and measures of success;
- (k) Mismanaged artificial reef efforts damaged live reef; and
- (l) Coastal zone management program not fully or effectively implemented.

*Inhibiting conditions that created management **challenges** and contributed toward the failure to conserve or protect Maui's coral reef ecosystems include:*

- (a) Lack of political will;
- (b) Lack of scientific evidence and knowledge on reef health;
- (c) Lack of public awareness of the problem;
- (d) Inconsistent, insufficient and ineffective State enforcement of rules and regulations;
- (e) Lack of State resources to manage and enforce marine resource rules and regulations;
- (f) Cumbersome State rule-making process and timeframe (2-3 years);
- (g) State legislative willingness to compromise coral reef health for special interests and limited but vocal public opinion groups;
- (h) Decision-makers placing economic development ahead of natural resource protection;
- (i) Poor or absent State agency leadership;
- (j) Polarization of stakeholders and special interest groups from decision making; including between adversarial/non-collaborative stakeholder groups;
- (k) Inadequate application of integrated land/coastal management principles;
- (l) Lack of infrastructure and technical capacity to implement best management practices regarding water management;



Concerned residents protest the practice of boats dumping their wastewater in near shore ocean waters, resulting in pump out stations being installed in the Lahaina and Mā'alaea harbors

Photo Credit: Pump Don't Dump

- (m) Poor integration of science, policy and management;
- (n) Poor integration of social science knowledge into coral conservation projects;
- (o) Federal loopholes allowing for development permits with negative impacts;
- (p) Lack of understanding and appreciation of coastal resources economically, socially, culturally; and
- (q) County-level missteps, including inadequate planning for climate change and sea level rise and acquiescence to land developers.

C. Retrospective Analysis of Management Successes

The MCRT also met and completed a group retrospective analysis to examine past coral reef management successes for Maui County. The summary results from this group analysis are:

- (a) Maui Nui's Marine Life Conservation Districts (i.e., Honolua, Molokini, 'Āhihi-Kīna'u, Mānele) have protected reefs, increased fish populations, enhanced tourism, increased landowner and local resident awareness of the value of protected marine resources;
- (b) Kahekili Herbivore Fisheries Management area has broad stakeholder support and improving enforcement;
- (c) The Maui County government is a progressively environmentally-friendly county in the Hawaiian Islands and is interested in supporting the implementation of a coral reef recovery plan;
- (d) Efforts to address land-based sources of pollution have been completed or are underway, including closing and scaling back plantations and agricultural runoff, construction of ungulate fencing in upper watershed areas, increased wastewater reuse, construction of sediment retention basins, improved use of construction and erosion control BMPs and increased public awareness and community action;
- (e) Community-based marine resource management efforts are getting underway around Maui, including at community managed makai areas (CMMAs) and have international and Hawaii-based experience and lessons to build upon;
- (f) Lay gill net ban (administrative only; no legislation) success;
- (g) Ballast water rule success;
- (h) Opportunity to build sustainability measures into Maui County Ordinances, including within the General Plan; and
- (i) Development of watershed plans and conservation action plans for Kahekili area and a watershed plan for Kīhei watersheds.

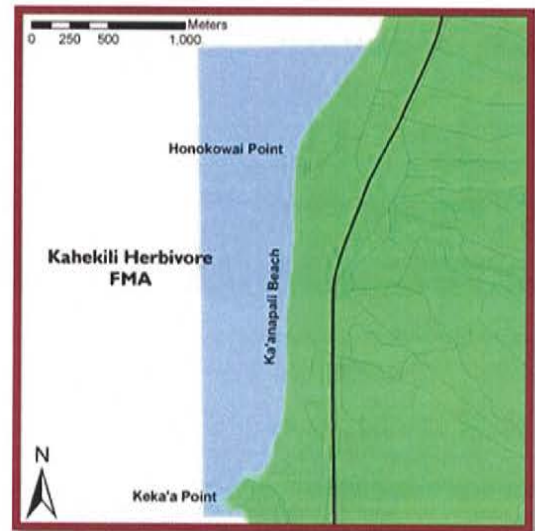
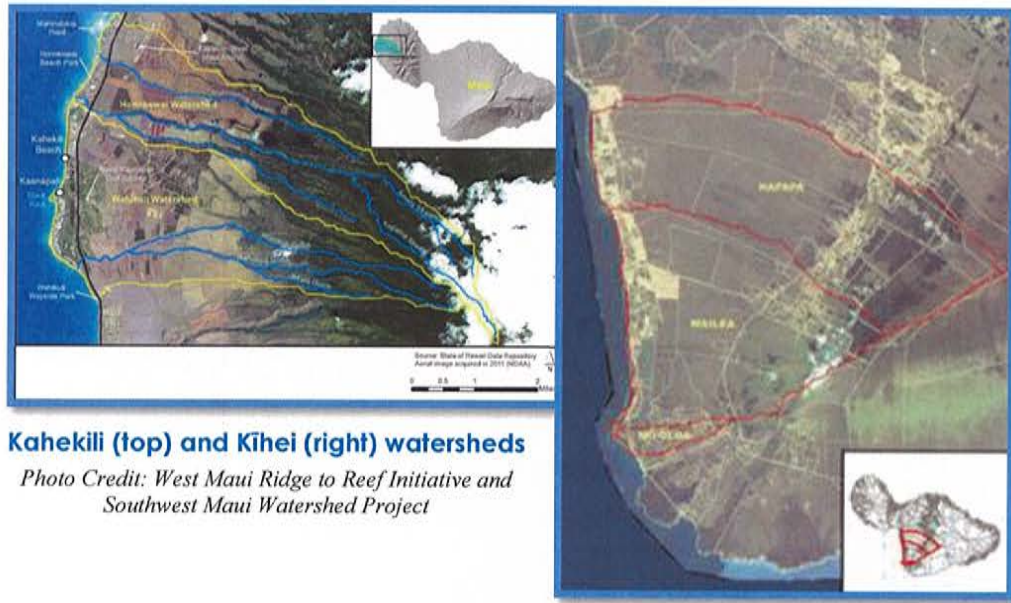


Photo Credit: DAR

Ola nā Papa i Mālama 'ia
A Practical Plan for the Technical and Cultural Restoration of Maui's Coral Reefs



Kahekili (top) and Kihei (right) watersheds

*Photo Credit: West Maui Ridge to Reef Initiative and
Southwest Maui Watershed Project*

VIII. Appendix Four – The Case for Action

Maui's coral reefs face multiple impacts, and the significance of specific threats varies by location. However, evidence locally and from around the world indicates an ominous and all too familiar pattern: excessive fishing alters the food web and allows algae to thrive



Dead zone off Kahekili Reef in Ka'anapali

Photo Credit: Darla White

and smother coral, runoff and sewage-contaminated ground water supports algal growth and diseases of coral, sediment from runoff directly smothers corals, and rising sea-surface temperatures cause coral bleaching and trigger coral diseases. Below we examine case histories of both coral reef collapse and recovery, to emphasize the point that actions taken in a timely fashion can save coral reefs and foster their recovery back to health. Secondly, we provide a concise overview of the range of threats to Maui's coral reefs within each case history, as a rationale for action to protect and recover them.

Coral Reef Demise: Mā'alaea Bay, Maui – In 1972, Mā'alaea coral reefs were described as being striking in their diversity and containing rare coral species. As late as 1993, estimated coral cover was 50- 75% close to the site where cover is now 8% (DAR and HCRI, 2008). Between 1996 and 1998, coastal vegetation was removed during the construction of commercial development in the area, resulting in the introduction of large sediment loads and other pollutants on Mā'alaea reefs (Jokiel and Brown, 1998). In just a few decades, the Mā'alaea reef has transformed from a healthy and diverse ecosystem into a badly degraded habitat overgrown by algae and with little surviving coral (DAR and HCRI, 2008). One consequence of severe loss of living coral is that degrading reefs change from being actively-growing and structurally-complex habitats, into eroding and relatively flat areas which do not support abundant marine



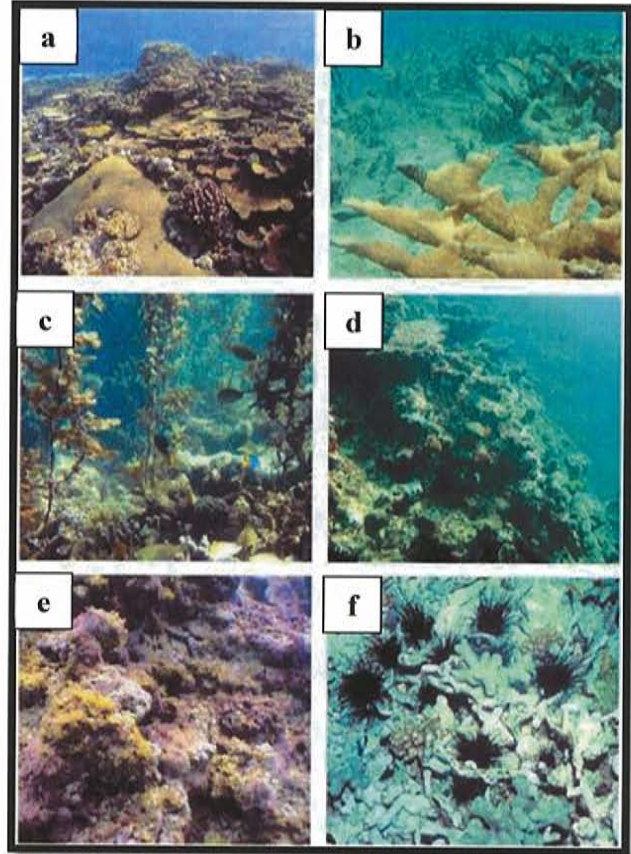
Coral in Mā'alaea being smothered by invasive algae

Photo Credit: DAR

life or biological diversity. That process is well advanced in Mā'alaea. Fish stocks are now in very poor condition, dominated by small wrasse, triggerfish and puffers. Given that the Mā'alaea reef is now a poor habitat for most grazing fishes, and that existing blooms of macroalgae will continue to inhibit new coral growth, even in the best of circumstances (elimination of water pollution and fishing impacts), recovery of Mā'alaea would likely take many years (DAR and HCRI, 2008). Such coral reef demise is being observed throughout Maui County, including on Moloka'i (Field *et al.*, 2008).

Coral Reef Demise: The Caribbean – The collapse of many Caribbean coral reefs was long preceded by dwindling stocks of fishes and increased nutrient and sediment runoff from land. On overfished reefs, the prevention of macroalgal blooms was increasingly dependent on a single species of sea urchin, *Diadema antillarum* (Bellwood *et al.*, 2004). In the 1980s a disease outbreak heavily impacted the sea urchin population and precipitated macroalgal blooms destructive to corals. Today what remains of coral populations are further affected by increasingly prevalent coral diseases and climatically-induced coral bleaching. Several studies have documented phase changes from coral- to algal-dominated states on Caribbean reefs (Hoegh-Guldberg *et al.*, 2007). The loss of sea urchins meant that the health of corals depended mostly on the grazing of algae by herbivorous fishes that were already overfished. Similar conditions occur in the main Hawaiian Islands.

Coral Reef Revival: Kaho'olawe – Overgrazing by goats led to massive erosion on the island of Kaho'olawe. The Kaho'olawe situation was corrected with the complete eradication of over 20,000 goats in 1990 (Jokiel *et al.*, 1993). Elimination of the goats and efforts to reestablish vegetation on the island and stabilize its soils appear to be having a positive effect on the reefs. Sediment deposits are being winnowed off the reefs by wave action faster than new sediments are being deposited. Following conservation measures, rapid recruitment of new coral colonies onto the recently uncovered reef surfaces was noted at all sites around the island. The reefs appeared to be undergoing recovery. Similar responses of coral reefs to prevention of sediment damage have also been observed on the islands of Hawai'i (Grigg, 1995) and Kaua'i (Jokiel *et al.*, 2004; Jokiel, 2008).



Six characteristic reef states : a) "Healthy reef", b) "stressed", c) macro algae, d) or turf, e) heterotrophic, f) barren. Images from sites on the Great Barrier Reef (a, c, d, e) and in the Caribbean (b, f)

Image credit: Bellwood 2004.

Coral Reef Revival: Kāne'ohe Bay, O'ahu --

Starting in the early 1960s, raw sewage discharged into the south basin of Kāne'ohe Bay, O'ahu had a dramatic effect on the reefs (Maragos, 1972; Banner, 1974; Smith *et al.*, 1981; Hunter and Evans, 1995). High nutrient levels led to blooms of phytoplankton, which reduced water transparency and blocked light to the photosynthetic benthos. Massive mats of the native "green bubble algae" overgrew and choked out living corals. The benthic community became dominated by macroalgae and filter feeding invertebrates. Sediments became anoxic and seaweed washed ashore to form large rotting berms of organic matter. Removal of sewage outfalls in Kāne'ohe Bay in 1979 led to dramatic decrease in nutrient levels, turbidity and phytoplankton abundance (Smith *et al.*, 1981) and a rapid recovery of reef coral populations (Maragos *et al.*, 1985). A major reef kill occurred in Kāne'ohe Bay in 1965 due to heavy rains acting upon soil instability (Banner, 1968). However, conditions of heavy sewage pollution prevented recovery of the reefs until after sewage abatement in 1979. The same coral reefs were subjected to a similar reef kill in late 1987, but showed substantial recovery within 5 years (Jokiel *et al.*, 1993). It appears that coral reefs can recover quickly from major natural disturbances, but not polluted conditions (Jokiel, 2008).

What these and other case studies tell us is that coral reefs can recover from chronic disturbances, including human impacts *if* the stress on the ecosystem is greatly reduced or eliminated, although full

recovery may take much longer than degradation took (Connell, 1997; USGS, 2009). However, if conservation action is not taken in time, coral reefs can fail to regenerate and instead undergo a rapid shift to an alternate degraded state (e.g., dominance by fleshy seaweed) that may be impossible to reverse (Bellwood *et al.*, 2004).



Sediment deposits on coral

Photo credit: Mike Field



Native collector sea urchins graze on invasive algae in Kāne'ohe Bay. By augmenting the native urchin population, the *Kappaphycus* is effectively managed and the reef was kept clear of the smothering growth.

Photo credit: University of Hawaii

IX. Appendix Five – Targets, Standards, and Measuring Success

A. Biological Recovery Targets

Targets are the specific biological resources and socio-cultural conditions that are being restored (i.e. the “what” is being restored). The primary biological targets to be restored under this recovery plan are:

- (a) Coral reef habitat;
- (b) Associated coral reef fish and invertebrate populations; and
- (c) Adjacent coastal wetlands, estuaries, and shoreline habitat.

Increasing the abundance (percent cover), diversity (species richness), and health of reef building corals is one of the primary targets for recovery. Coral reef habitat protection will focus on mitigating stressors such as excess nutrients, pollutants, excess sediment, and overfishing. Restoration efforts such as urchin restocking, invasive algae removal, and coral propagation and transplantation could be done concurrently, but fewer resources would be dedicated to these projects compared to protection.

Coral reef fishes in Hawaii represent a diverse group that includes over 500 species ranging in size from small gobies and blennies that are only a few cm in length to large sharks and *ulua* (jacks) that exceed a meter and can weigh > 100 lbs. Because of this broad diversity, there is no one single measure that can adequately characterize the entire assemblage. Typical measures of fish assemblage structure include the total number of species, the total number of individuals, and biomass or weight. However, coral reef fishes vary in what they eat, where they live, and their importance in cultural, recreational, commercial, and subsistence fisheries. In this plan, **biomass** will be the primary target in recovery.



Photo credit: Mark Deakos

Biomass is considered a good proxy of ecosystem function as it represents metabolic requirements and therefore energy fluxes in the ecosystem. Therefore fish biomass is often used as an important measure of fish assemblage structure and ecosystem health. Based on an analysis

of multiple datasets, fish biomass around the main Hawaiian Islands ranged from 1.28 t ha⁻¹ on Kaho'olawe (Friedlander and DeMartini, 2002) to 0.4 t ha⁻¹ on O'ahu (Friedlander *et al.*, 2008). Fish biomass on Maui was 0.65 t ha⁻¹, was similar to Kaua'i and slightly lower than Hawai'i Island. However, separating biomass into fished ("targeted") and un-fished groups help to examine the effects of fishing compared with other potential impacts such as habitat degradation. For example, Williams *et al.* (2008) showed that declines in fish biomass for targeted species around the main Hawaiian Islands correlated with increasing human populations, while non-targeted biomass did not change. Therefore, fishing pressure rather than habitat quality was affecting the abundance of fishes observed.



Total fish abundance and the number of species present can be indications of fish assemblage health. These measures, however, are extremely habitat dependent and relative trends over time are therefore a better indication of "health" and recovery rather than absolute values. For example, basalt boulder habitats harbor fewer fish species compared to coral rich habitats because the latter provides a greater diversity of habitats and "pukas" or holes.

Coastal wetlands are among the most productive, valuable, and yet most threatened ecosystems in the world due to their desirability for human habitation. They provide a variety of functions that reduce the impact of land-based storm flow and associated stressors on the coastal zone, such as slowing the flow of water from the mountains to the sea, trapping of sediments, and retaining or transforming nutrients (Bruland, 2008). At one time Hawaii contained an estimated 59,000 acres of wetlands (Fabricius, 2005). Although the remaining wetlands cover less than three percent of Hawaii's surface area, they are extremely important because they support a suite of plant and animal species found only in the Hawaiian Islands. Hawaii's wetlands are inhabited by five endangered endemic water bird species, including the Hawaiian duck, Hawaiian stilt, Hawaiian moorhen, Hawaiian goose and the Hawaiian coot. A major contributing factor to declining populations of these species is the loss



Ka'onoulu Gulch outlet wetland at high tide

Photo credit: Sarah McLane

of wetland habitats due to coastal development (Hawaii Wetland Joint Venture, 2007).

Land-based pollution is causing degradation of coral reefs and fisheries on the Island of Maui (DAR and HCRI, 2008). Numerous studies (Fabricius, 2005) have reported that increased soil erosion and nutrient export from land-based management are threatening estuaries, coastal zones, and adjacent coral reef ecosystems. Coastal wetlands are located at a critical interface between the terrestrial and marine environments and are ideally positioned to reduce impacts from land-based sources (Bruland, 2008).

Federal biologist Terrell Erickson stated that more than half of south Maui's coastal wetlands have been lost to development in the past 40 years. Kīhei had 199 wetland acres in 1965. That number shrunk to 83 acres in 2001 and still continues to drop.



Wetlands collect sediment prior to reaching the reef

Photo credit: Mia Charleston

Due to the high amounts of rainfall and steep slopes of the Pacific Islands' landscape, researchers at the University of Hawai'i contend that all lands should be classified and treated as coastal lands (Bruland, 2008).

The MCRT and peer reviewers also considered including the following biological targets once the recovery plan had been implemented and experienced success, but agreed that it would be important to first focus on the three previously stated targets above:

- (a) Deep water corals;
- (b) Gorgonians;
- (c) All inshore habitat; and/or
- (d) Pelagic waters.

B. Socio-Cultural Recovery Targets

The primary socioeconomic and cultural targets to be restored are:

- (1) Sustainable commercial and recreation fisheries; and
- (2) Traditional knowledge and customary management practices.

A goal of recovery would be to integrate traditional knowledge into modern resource management. Our communities today must rely upon existing knowledge of marine resources to find a balance between human harvesting and resource replenishment. Elders in the community and members with extensive knowledge of specific locations should be brought into the process of setting new limitations for consumption in their respective communities.

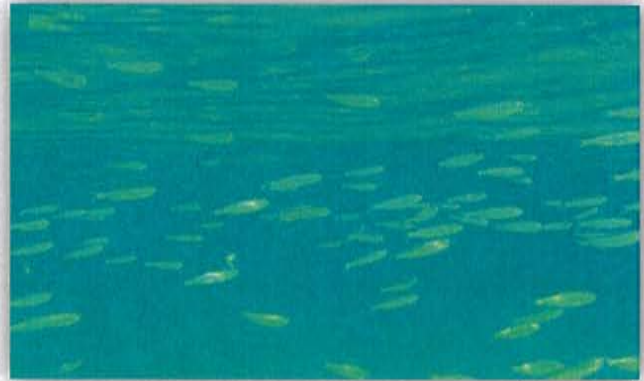


Photo credit: Paul Hanada

C. Recovery Standards

The standards of recovery are the benchmarks against which the progress of the targets in their restoration is to be measured (i.e., “to what” the targets will be restored).

The ultimate outcomes desired from achievement of this plan include:

- (1) Fish and coral are abundant, diverse, and resilient;
- (2) Coral reef ecosystems are balanced;
- (3) The economic value is recognized and used fairly in decision-making;
- (4) Cultural practices and activities thrive;
- (5) The reef supports local jobs and sustainable harvesting; and
- (6) There is a widely-exercised ethic of coral reef protection.

Signs of coral ecosystem recovery at two sites over ten years include:

- (a) Increase in coral cover;
- (b) Increase in fish abundance and biomass;
- (c) Decrease in algal cover (invasive or otherwise);
- (d) Increase in coral recruitment;
- (e) Larger and older fish; and
- (f) Increased recruitment events and survivorship.

Recovery standards for reproductive and recruitment success include:

- (1) Stable or relative increase in coral settlement rate of 10% within 10 years;
- (2) Relative increase in abundance of 10% for target female fish of reproductive size within 10 years; and
- (3) Relative increase in abundance of 5% for target fish recruits within 10 years.

In the case of fish species, larger, older individuals typically have exponentially greater reproductive output and the larvae of these individuals often have substantially better survival potential than do larva from younger fishes. Fishing disproportionately targets larger individuals, but these individuals are the most important for the reproductive success and sustainability of the population. We need to focus on protecting the larger or older individuals of long-lived fish species rather than concentrating on regulating the total numbers harvested from the population. For example, Hawaiians traditionally harvested intermediate-sized *moi* (*mana* and *pala moi*) rather than taking the juveniles or large reproductively important females (Poepoe, Bartram, and Friedlander, 2007).



Photo Credit: Mark Deakos

Information on the relative abundance of the newly recruited fishes should allow for assessment of the future health and population dynamics of the assemblage. Monitoring recruitment can help inform future management decisions.

Recovery standards for the fish assemblage include:

- (1) Relative increase in fish species richness of 5% within 10 years;
- (2) Relative increase in fish abundance of 10% within 10 years; and
- (3) Relative increase in fish biomass of 50% within 10 years.



Robin Knox, water quality expert, collects water samples for a monitoring program.

Photo Credit: Watershed Advisory Group

In terms of standards for ecological function, the recovery plan can look to large apex predators, such as sharks and jacks that exert a strong top-down control on the ecosystem. They structure prey population sizes and age distributions and strongly influence the reproductive and growth dynamics of harvestable fishes as well as smaller-bodied, lower-trophic-level fishes. In addition to the direct effect on the abundance of these species, apex predators indirectly affect the structure and function of the entire ecosystem through top-down control. Based on a meta-analysis of fish count data around the main Hawaiian Islands, apex predators only accounted for 4% of the total fish biomass observed. In contrast, apex predators accounted for > 50% of the biomass on reefs in the northwestern Hawaiian

Island (Friedlander and DeMartini, 2002). Within the main Hawaiian Islands, apex predator biomass ranges from 19% on Kaho‘olawe to < 1% on O‘ahu. Overall apex predator biomass on Maui is 3%.

Water quality and native stream restoration standards also apply under this plan. This restoration plan will apply the State of Hawaii, Department of Health water quality standards as targets for water quality improvements. Hawaii’s standards for nutrients and turbidity are relatively stringent, but are not based specifically on coral reef protection. However, in the absence of coral-based targets, the Hawaii water quality standards are a starting point and would mark significant improvements for many of Maui’s coastal waters.

Water and substratum quality must be restored to levels allowing for successful reproduction and recruitment of corals, fishes and invertebrates. Success of coral recruitment is a useful target for assessing the adequacy of water quality improvement. The sensitive stages of coral reproduction include reproductive synchronization among individuals of the same species (chemical cueing), successful egg-sperm interactions leading to fertilization of eggs and development of embryos, survivorship of embryos as they develop in the water column, the ability of competent larvae to detect and respond to chemical cues responsible for site selection and subsequent metamorphic induction, and in the case of coral larvae, their ability to recognize and take up the proper clades of symbiotic zooxanthellae when needed.

Another useful indicator of water quality conditions is the prevalence of nuisance macroalgal blooms. We seek to reduce nutrient loads to the point where the standing stocks of *Hypnea*, *Ulva*, *Cladophora* and other nuisance blooms are reduced in extent and frequency. Macroalgae can overgrow and smother coral reefs due to this increased nutrient input as well as from a



Coral spawn event

Photo Credit: Pauline Fiene

reduction in herbivore abundance. There is a strong positive correlation between high herbivore (surgeonfishes and parrotfishes) biomass and reduced cover of macroalgae. In locations around Maui where herbivore biomass was greater than 0.2 t ha^{-1} , macroalgae cover, on average, was less than 10%. Targeting a reduction in macroalgal blooms through improved water quality and protection of herbivore fish populations should in turn, have positive effects on coral reef communities.

Recovery standards for the benthic habitat quality and quantity include:

- (1) Stable or relative increase in percent coral cover of 10% within 10 years;
- (2) Relative increase in coral species richness of 10% within 10 years;
- (3) Relative decrease in macroalgae percent cover of 10% within 10 years; and
- (4) Stable or relative decrease in disease frequency of 10% within 10 years.

In terms of climate change adaptation standards, ecosystems that are more “intact” are more resistant and resilient to episodic natural disturbances such as hurricanes as well as potential long-term chronic perturbations such as climate change. Reefs lacking the full complement of ecosystems components will be less stable and more susceptible to these large-scale changes.

D. Measuring Success

The monitoring and evaluation of coral reef recovery efforts will require incorporation of recovery standards into existing measures and data collection efforts. This plan will take an adaptive management approach to monitoring coral recovery performance. Development of adaptive management actions will occur concurrently.

The specific measures and methods used will be identified once an implementation activity work plan has been developed following the approval, adoption, and implementation of this plan. During 2012, the MCRT began the process of developing a draft implementation activity work plan. Once finalized, appropriate measures of success underlying the specific objectives and associated activities will be identified and proposed for measurement.



Reef Monitoring

Photo Credit: Megan Dailer

Monitoring of both the status of the targets and the management effectiveness of recovery actions will occur periodically throughout the implementation of the recovery plan. Status measures periodically track changes in the both the biological and social targets. Status measures will be used to document ecosystem response to actions taken under practices within restoration strategies. Implementation of performance diagnostics, with community inputs, will occur at demonstration sites. Performance measures will be evaluated to periodically track progress being made against recovery standards and intended goals and objectives. Targeted, site-specific monitoring and evaluation plans will be implemented at each demonstration site, and will use available data sources already under collection.

Maui Coral Reef Recovery Team

Eric Brown (National Park Service)



Eric is the Marine Ecologist for Kalaupapa National Historical Park on Moloka'i. He received his B.S. in Marine Biology from Occidental College, his M.S. in Biology from Texas A&M University and his Ph.D. in Zoology from the University of Hawaii. His Ph.D. research focused on coral reef community ecology, specifically spatial and temporal trends in community structure at six reefs on Maui. After moving to Hawaii in 1986, Eric worked with the Pacific Whale Foundation, documenting the recovery and general biology of humpback whales and other endangered marine mammals. In 1989, he branched out into coral reef research and served as principal investigator, for nine years, on Maui's Threatened Reef project with the Foundation. This project was done in conjunction with Earthwatch Institute, based in Watertown, Massachusetts. His current research focus, at Kalaupapa and across the state, examines coral recruitment dynamics, long-term trends in coral community structure, and watershed activities in relation to the condition of the marine environment.

Jay Carpio (Fisherman)



James "Jay" Carpio holds a Bachelor's Degree in Horticulture from UH Hilo. He is an avid fisherman, hunting guide, farmer, and sheep rancher, along with an Ahupua'a Steward. Jay is also Lawai'a, Mahi'ai and program manager for Wailuku CMMA, is a Cub Scout leader, and Chair of the Abundance of Fishes Committee for the MNMRC.

Rhiannon Chandler (Community Work Day)



Rhiannon has been a member of the MNMRC since 2009. She has a B.A. in Ethnic Studies, with emphasis in Hawaiian Studies, from the University of Hawai'i at Mānoa. Rhiannon is passionate about Hawaiian language and culture and supports the return to traditional Polynesian natural resource management practices. She is the Executive Director of the Community Work Day Program, a non-profit organization, dedicated to restoring and enhancing public places.

Mia Charleston (Maui Nui Marine Resource Council)



Mia was born in landlocked Pennsylvania but fell in love with the ocean watching Jacques Cousteau and reading Eugenie Clark books such as *Lady and the Sharks*. This led to the completion of a B.S. degree in Oceanography (with GIS Certification) from the University of West Florida. Mentors include professors Peter Lutz and Edward Petuch. Mia has worked in the marine and environmental fields for over 20 years including positions with the Florida Department of Environmental Protection, and Southwest Maui Watershed Group and the Maui Nui Marine Resource Council in Maui, Hawaii.

Mark Deakos (PhD UH)



Mark was fortunate to experience living in various countries around the globe during his early years. A common thread in his life has always been water. His chosen career working in wildlife biology and marine research is an extension of his passion for the natural world and his marvel of the ocean environment. Mark obtained his Biology degree from the University of Waterloo. At the University of Hawaii, he completed his master's degree studying humpback whale behavior and his doctoral degree focused on manta ray ecology. In 2004, Mark founded The Hawaii Association for Marine Education and Research, a not-for-profit corporation with the mission of better understanding and protecting Hawaii's marine resources.

Alan Friedlander (UH-Adjunct Associate Professor)



Alan Friedlander is currently the assistant leader of the Hawaii Cooperative Fishery Research Unit and associate professor in the Department of Zoology at the University of Hawaii at Mānoa. He holds a Ph.D. from the University of Hawaii and was a National Research Council Postdoctoral Associate with the Pacific Fisheries Environmental Laboratory in Pacific Grove, California. Alan was as a fisheries extension officer in the Kingdom of Tonga in the early 1980s and for nearly 30 years he has conducted coral reef fisheries and ecosystem-based research throughout the Indo-Pacific and Caribbean regions. His work incorporates ecology, remote sensing and GIS technologies, along with traditional resource knowledge to better understand coral reef ecosystem function and how best to conserve and manage these resources for future generations. He has authored or co-authored 65 peer-reviewed publications and 15 book chapter over the course of his career.

Robin Knox (Coordinator – Southwest Maui Watershed Plan)



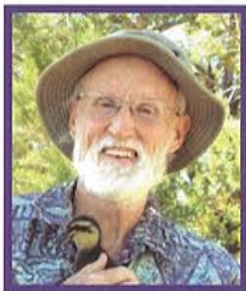
Robin Knox is the Owner and Principal Scientist of Water Quality Consulting, Inc., an environmental services firm specializing in Clean Water regulation and policy, water quality management and aquatic ecosystem restoration. She has close to 30 years of experience including project management, water quality monitoring, coastal biogeochemistry, wastewater treatment, watershed planning, water quality modeling, total maximum daily loads, coastal restoration, the Clean Water Act, and National Pollutant Discharge Elimination System (NPDES) permitting. For the past six years, Robin has been supporting local communities around Maui Island to address and resolve clean water issues for both human and coral reef health, and is a recognized expert in water quality management, monitoring, and regulatory compliance for Maui. She serves as the Coordinator of the Southwest Maui Watershed Plan and a member of the University of Hawaii interdisciplinary research team investigating the impacts of injection wells on Maui's water quality and coral reef ecosystems. She is a member of the Maui Nui Marine Resource Council, and served as a founding member of the Council's Clean Water Committee and Turbidity Task Force. She served on the County of Maui Community Wastewater Working Group appointed by Mayor Charmaine Tavares. She serves on the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) Water Quality Working Group and serves as science advisor to the Sanctuary's Citizen Science program.

Robin Newbold (MNMRC, Chair)



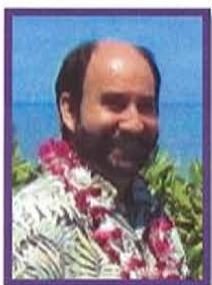
Robin Newbold, Chair of the Maui Nui Marine Resources Council (MNMRC) co-founded the Council with *Kupuna* Ed Lindsey in 2007, and succeeded him as Chair. Robin is a former professor of marine biology and oceanography at Saddleback College in California and is an active SCUBA diver and spokesperson for Maui's reefs. Beginning in 1995 Robin participated in coral reef research efforts around Maui Nui and spearheaded the introduction of REEF to Hawaii in 1999 to foster a sense of reef awareness and stewardship among Maui's residents. Robin is the Maui representative to the Hawaiian Islands Humpback Whale National Marine Sanctuary's advisory council and recently chaired the Sanctuary's Water Quality Working Group during the management plan review process. Robin was recently appointed to the Natural Area Reserves System (NARS) Commission. She has made over a thousand research-oriented SCUBA dives throughout the Pacific and recently participated in the Palau-Hawaii learning exchange in Palau. Robin is committed to involving the community in restoration of our reefs through the Community Managed Marine Areas (CMMA) effort.

Tony Povilitis (Director, Life Net Nature)



Tony Povilitis directs LifeNetNature, a nonprofit conservation organization promoting wildlife research, citizen science, and progressive public policies. He has a B.S. in entomology from the University of Maine, received his M.S.P.H. from the University of North Carolina in environmental science. In 1979 Tony acquired a Ph.D. Colorado State University in wildlife biology. Tony has worked around the world as a Conservation director, American Wildlands, Montana; Border Impacts Program coordinator, National Park Service, Organ Pipe Cactus National Monument, Arizona; Earthwatch principal investigator (PI), Chile, and co-PI, Ecuador; Director, Fish and Wildlife Department, Pueblo of Zuni, New Mexico and as the acting director for the Division of Natural Resources, Pueblo of Zuni.

Bob Richmond (UH – Principal Investigator)



Professor Bob Richmond is a Pew Fellow in Marine Conservation, President of the International Society for Reef Studies and a Leopold Fellow in Environmental Leadership. He has a Ph.D. from SUNY at Stony Brook, in Biological Sciences and has been an acting Director and Research Professor for the Kewalo Marine Laboratory of the University of Hawaii at Mānoa. He has been on the Organizing Committee for the International Coral Reef Symposia and now serves as the Pacific Scientific Representative for the U.S. Coral Reef Task Force as well as a member of the University of the Virgin Islands NSF-EPSCoR Program Review Committee. He also served as the Associate Editor, for the *Marine Biology* journal. His recent research has been focusing on reproduction and coral recruitment, and looking at cellular diagnostics as a way to measure coral reef decline.

Brian Tissot (Washington State University- Marine Ecologist)



Brian is a Professor in the School of the Environment at Washington State University in Vancouver. Professor Tissot runs the WSU Vancouver Benthic Ecology Laboratory which is focused on the ecology and conservation of marine invertebrates and fishes. They investigate issues at the interface between conservation science, management, and policy, using quantitative statistical approaches combined with geospatial tools to explore the ecology of physical and biological components of habitat for commercially important fishes with an emphasis on structure-forming invertebrates. In his work in West Hawaii, he helped improve the management of an aquarium fishery along the Kona coast by being a part of a collaborative research program with state biologists and policy makers, Sea Grant extension, and the local community.

Celia Smith (UH-Marine Botanist)



Dr. Smith is a Ph.D. from Stanford University in Botany, and is a professor at the University of Hawai'i-Mānoa (UHM). Smith was involved in saturation diving research projects using the National Oceanic and Atmospheric Administration's Florida-based Aquarius research station, where she and a team of colleagues from five other institutions studied the ecology of two species of *Halimeda* (Genus of green macroalgae). While heading her own laboratory at the UHM, Smith continues to play integral roles in various phycologically-based areas such as native algae, invasive alien algae, and biofouling research. Dr. Smith contributes her expertise in the genus *Halimeda* and other algae in Hawaii towards a better understanding of deep water algal assemblages in Hawaii.

Russell Sparks (Maui Division of Aquatic Resources)



Russell Sparks received his B.S. in Biology from Oregon State University. He received his M.S. in Marine Biology from University of Hawai'i at Mānoa in 1996. Since 1998 Russell has worked as the Education Specialist for the State of Hawai'i, Department of Land and Natural Resources, Division of Aquatic Resources, Maui, Hawaii. He is responsible for designing and instituting educational programs intended to increase public awareness about conservation and responsible use of our aquatic resources. Other duties include leading the design, implementation, and overall management of all the Maui marine resource assessment and monitoring projects.

John Summers (Maui Planning Department)



John Summers is the Administrator for the Long-Range Planning Division of the Maui County Planning Department. Prior to taking on the Long Range Division, John was responsible for the Planning Department's legislative policy development and redevelopment programs. Before joining the County of Maui, John was a senior Planner and Policy Analyst with the State of Hawai'i's Office of State Planning. John has a MURP in Urban and Regional Planning from the UH Mānoa and a B.S. in Business Economics.

Dan Polhemus (US Fish & Wildlife Service)



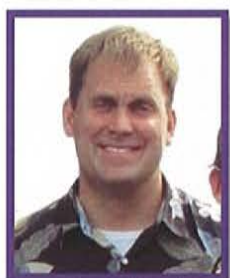
Dr. Polhemus is an administrator for the Pacific Islands US Fish & Wildlife Service on O'ahu. Dr. Polhemus also served as an Administrator of the Division of Aquatic Resources at the Hawai'i State Department of Land and Natural Resources and a Research Associate at the Bishop Museum in Honolulu, Hawai'i. Dan has been conducting research on the semi-aquatic insects (*Heteroptera*) and Damselflies (*Odonata*) of the Pacific region for over 20 years, with a particular concentration of survey effort on New Guinea and adjacent island arc systems. His major interest is in attempting to integrate patterns of species richness and phylogenetic evolution in freshwater aquatic biotas with evolving earth history models to understand the zoogeographic development of the Asia-Pacific region during the last 70 million years. Dan has authored over 120 scientific papers and several books, and is a world authority on the taxonomy and systematics of aquatic and semi-aquatic insects (*Heteroptera*), and Pacific basin Damselflies (coenagrionid *Zygoptera*). He has participated as a member of the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve Advisory Council, and aided in the creation of the Papahānaumokuākea Marine National Monument, serving as their Chair of the Monument Management Board.

Darla White (Maui Division of Aquatic Resources)



Darla White is the Special Projects Coordinator for the Hawai'i DLNR Division of Aquatic Resources on Maui and is part of the Marine Monitoring Team that looks at near shore fish populations and coral health. She is also the Eyes of the Reef Network Coordinator for Maui Island, and is an Ex-officio member of the Maui Nui Marine Resources Council. Darla attended the University of Hawaii at Hilo, where she received a Bachelor's degree in Marine Science and a Master's of Science Degree in Tropical Conservation Biology and Environmental Science. She has been a research diver in Hawaii since 2000, and has had the rare privilege to dive on scientific expeditions to nearly all of the islands in the Hawaiian Archipelago. Her experience and interests are wide ranging, including fishes, coral reef ecology, climate change, marine disease, ocean acidification, water quality, harmful algal blooms, ciguatera, marine ecosystem monitoring, anthropogenic impact assessment, reef resilience and network marine reserves.

John Parks (Facilitator)



For more than 15 years, John Parks has worked with local communities, indigenous leaders, resource users, and governmental and non-governmental groups throughout the Pacific Islands and Southeast Asia to address marine conservation needs and improve the effectiveness of marine protection efforts. He specializes in community-based marine conservation, adaptive small-scale fisheries management, and strategic planning and program development for conservation groups and agencies. John earned his undergraduate and graduate degrees from the University of Miami in Florida, with a dual focus on behavioral science and tropical coastal ecology.

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Glossary

Biodiversity — The term 'biodiversity' (i.e., biological diversity) refers to the variability among living organisms, from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part, including diversity within species, between species, and within the ecosystem, as a whole.

Coral — The term 'coral' refers to any species of the phylum *Cnidaria*, that produces a stony exoskeleton or forms sclerites, including:

- (a) All species of the orders *Antipatharia* (black corals), *Scleractinia* (stony corals), *Gorgonacea* (horny corals), *Stolonifera* (organpipe corals and others), *Alcyonacea* (soft corals), and *Helioporacea* (blue coral) of the class *Anthozoa*; and
- (b) All species of the families *Milleporidea* (fire corals) and *Stylasteridae* (stylasterid hydrocorals) of the class *Hydrozoa*.

Coral reef — The term 'coral reef' refers to the hard or unconsolidated carbonate structures and their associated natural formations and biological communities, composed of living organisms (being dominated by zooxanthellate stony corals (Class *Anthozoa*, Order *Scleractinia*), soft corals (Class *Anthozoa*, Subclass *Alcyonaria*), zooanthids (Class *Anthozoa*, Order *Zoanthiniaria*), algae (both fleshy and calcareous) or sea grasses) and which often include: echinoderms, mollusks, crustaceans, fishes, sponges and annelids. Coral reefs may include associated sand, mud, rock, sea grass and/or mangrove habitats, and their physical, chemical, trophic and/or ecological interactions and integration. For the purposes of this recovery plan, coral reefs are generally restricted to shallow (< 500 feet depth) tropical and subtropical estuarine, coastal and/or oceanic waters.

Coral reef component — The term 'coral reef component' refers to any part of a coral reef, including individual living or dead corals, and their associated vertebrates (e.g., fish), invertebrates (e.g., crustaceans, echinoderms) and marine plants, including any adjacent or associated sea grasses.

Coral reef ecosystem — The term 'coral reef ecosystem' refers to the system of coral reefs and geographically-associated species, habitats and dependent environmental linkages, including any adjacent or associated aquatic habitats (e.g., wetlands and sea grasses), as well as the processes that control their dynamics. Such systems are significantly influenced by neighboring terrestrial (upland) and atmospheric systems, such as watersheds, drainage systems, atmospheric and sunlight considerations, or any other natural system contributing to the health of a coral reef. Coral Reef Ecosystems include the physical, chemical, trophic and ecological interactions with all the surroundings that contribute to maintain the natural optimum functions and organisms represented.

Research – The term ‘research’ refers to *bona fide* scientific investigation on corals, the results of which are likely:

- a) To be published (or be eligible for publication) in a peer-reviewed scientific journal;
- b) To contribute to the basic knowledge of the biological or social sciences; and/or
- c) To identify, evaluate, or resolve conservation problems, including status, effectiveness monitoring and evaluation.

Restoration – The term ‘restoration’ is defined as returning stable ecological functioning and health to systems that are damaged or no longer fully functional. This includes restoration of the natural capital, or ecosystem goods and services that are provided by a healthy and functional ecosystem. This definition recognizes that ecosystems naturally change over time, and that a return to “pre-contact” state is not possible, given global climate change.

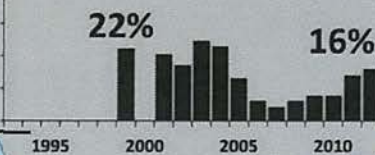
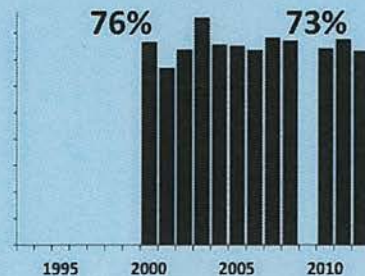
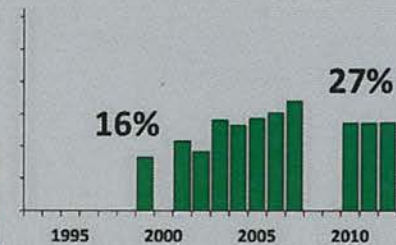
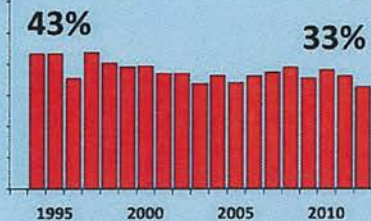
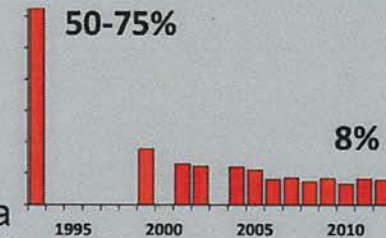
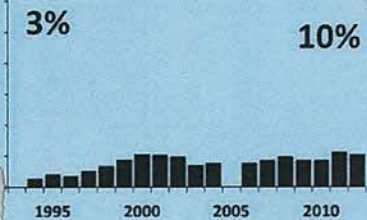
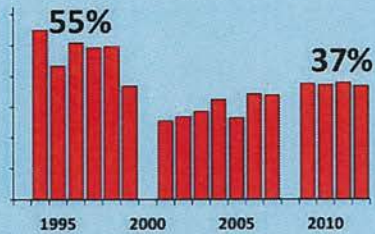
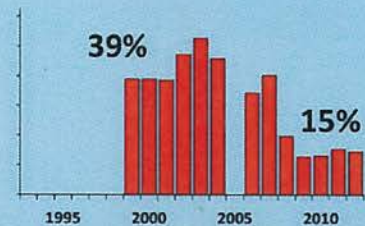
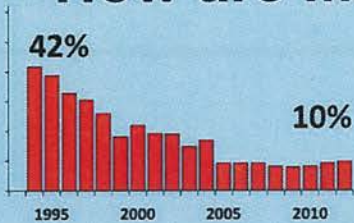
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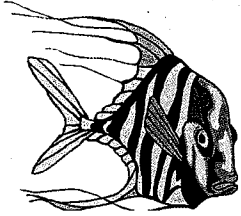
Photo Credit: Don McLeish

How are Maui's reefs? Trends in Coral Cover 2012



0 10 Miles

RECEIVED AT 15m MEETING ON 12/16/13 Dada White



Darla J. White

Marine Research / Scientific Diver
PO Box 532462, Kihei, HI 96753 Cell: (808) 345-2312
E-mail: onareef@yahoo.com

December 16, 2013

RE: Adopting Ola Nā Papa i Mālama'ia:
A Practical Plan for the Technical and Cultural Restoration of Maui's Coral
Reefs

My name is Darla White and I am here today to testify on behalf of myself. I am a marine scientist with the Hawaii DLNR Division of Aquatic Resources and a member of the Maui Coral Reef Recovery Team. I have been a research diver in Hawaii for 13.5 years, and spend a great deal of time underwater with coral reef ecosystems throughout the archipelago.

I strongly support the adoption of the Maui Coral Reef Recovery Plan into the Maui Island Plan.

The resolution is in alignment with the
The Maui Island Plan Heritage Resources Goal:

An intact, ecologically functional system of reef, shoreline and nearshore waters that are protected in perpetuity.

For too long our island systems have been divided by jurisdictional boundaries, with the county jurisdiction above the high tide line and the state from the high tide to three miles out, but the ecosystems do not know these boundaries. They do not know cities or districts, such as Olowalu and Ukumehame...that is one functional reef. Our reefs all around Maui Nui are connected. If you degrade or lose a reef in one place, it can have cascading effects on other reefs in Maui Nui.

Functionally, the ecosystems are connected from the top of the mountain to beyond the reefs, underwater. What happens on the land has impacts on our nearshore ecosystems in ways that slowly degrade these habitats, these complex and precious coral reefs that are so vital to our way of life here. In turn, the loss of a reef can have implications to fisheries, shoreline and infrastructure protection, tourism, recreation, and lifestyle. Our lives and livelihoods extend mauka to makai. This is reflected both in the traditional 'ahupua'a system and in the contemporary watershed systems. It is all connected and here we have an opportunity to

RECEIVED AT 1pm MEETING ON 12/16/13
Darla White

recognize that by adopting the Maui Coral Reef Recovery Plan into the Maui Island Plan.

The Maui Coral Reef Recovery Plan was put together by a team of some of the most knowledgeable scientists, managers, cultural advisors, fishers, water quality experts, and local agency professionals in Hawaii. The Maui Nui Marine Resource Council has been there to lead the process and give input throughout its entirety. This is a practical plan based on the best available science by a technical team of experts with priorities driven by the Maui community. This is a very strong start in the right direction, one where there is a good opportunity for success. This team is recognized by the US Coral Reef Task Force and will also be available to educate and provide technical expertise to decision makers, such as yourselves, on future decisions.

I would like to invite each and every one of you, at your convenience, to come and take a tour of the reef with me. To see it for yourselves. Nothing can replace actually being there. To learn and see what I see. At your convenience.

I strongly support the adoption of the Maui Coral Reef Recovery Plan into the Maui Island Plan.

Mahalo for your consideration.

Sincerely,

Darla White

IEM Committee

From: thorne abbott <thorneabbott@yahoo.com>
Sent: Friday, December 13, 2013 10:16 AM
To: hodges@mnmrc.org; Elle Cochran; IEM Committee
Subject: MNMRC Coral Reef Conservation Plan, Dec 16 IEM Committee meeting
Attachments: 12.12 MCMRC Plan Council Testimony.pdf

Please see the attached testimony in support of the Plan
Mahalo for your consideration!
Thorne

For additional information visit <http://www.CoastalZone.com>

OFFICE OF THE
COUNTY COUNCIL

2013 DEC 17 PM 7:44

RECEIVED

December 12, 2013

TO: Infrastructure and Environmental Management Committee:
IEM Committee Chair Elle Cochran
and fellow honorable Councilmembers

Via: iem.committee@mauicounty.us
elle.cochran@mauicounty.us.

RE: Maui Coral Reef Recovery Plan

Dear Committee Chair Ms. Cochran:

I strongly urge the Committee to support the Maui Coral Reef Recovery Plan (Plan). I served as a member of the peer-review team for the Plan and believe it meets both the intent and the criteria for coral reef conservation, education and outreach, and public involvement and participation, as called for in the Council's recently adopted Maui Island Plan. The Coral Reef Recovery Plan is based on using good science for decision-making and has incorporated management approaches that adapt to new and changing circumstances as determined by ongoing active monitoring of the results of the Plan's implementation.

I recognize the prudent of the Plan's approach having served as the Maui County's Coastal Resources and Shoreline Planner from 2004-2009, as a current appointee to the National Marine Humpback Whale Sanctuary Advisory Committee (Conservation Alternate), as a Governor Lingle-appointed member of the Hawaii Ocean and Coastal Council, and as a former U.S. Delegate to the United Nation's World Parks Congress where I assisted in writing international policy for marine and coral reef conservation.

My perspective comes from having served as a Chief Researcher for the Great Barrier Reef Marine Park in Townsville Australia, where I conducted research on reef and visitor management at James Cook University. In addition, I have completed coral reef histology courses at George Washington University, participated and presented at many of the U.S. Coral Reef Task Force and All Islands Committee meetings since 1999, and have 31 peer-reviewed publications relating to coastal and reef management stretching over 14 countries and locations.

I believe the Plan offers and effective and efficient means to conserve important functions of Maui's nearshore reef ecosystems. This biological resource offers ongoing visitor use attraction, buffers storm surge and tsunamis, protects and restores sandy beaches, and enhances our resilience to climate change and sea level rise. A dead reef with small or minimal fish mass and biodiversity doesn't create an attraction for tourists, nor does it protect homes, condominiums, and hotels from storms, and it doesn't provide the spill-over effect that allows fisher-folk to catch the 'big one' on a regular, recurring basis due to a healthy, vibrant and fully functioning coral reef ecosystem.

I applaud the efforts of the Maui Nui Marine Research Council to develop the Maui Coral Reef Recovery Plan and allow it to be reviewed by members of the scientific community and cultural practitioners. Many hours of community service were dedicated to the Plan because of its importance to Maui's future, our lifestyles and our keiki's future. I respectfully request that you adopt the Plan and its implementation to help protect Maui's shoreline and coastal resources, from which we all derive diverse and numerous benefits.

Mahalo for you consideration and Mele Kalikimaka.



Thorne Abbott
Coastal Planners, LLC
www.CoastalZone.com
3993 Maalaea Bay Place
Wailuku, HI 96793

From: Tony Povilitis <a_povilitis@yahoo.com>
Sent: Sunday, December 15, 2013 04:51 PM 2013 DEC 17 PM 7:45
To: IEM Committee; Maui_County Council_mailbox
Subject: Please adopt the Maui Coral Reef Recovery Plan

**OFFICE OF THE
COUNTY COUNCIL**

Dear Maui County Council and IEM Committee Members:

I am writing to urge adoption of the Maui Coral Reef Recovery Plan as the formal recovery plan called for in the Maui Island Plan.

Maui will be proud to be the first of Hawaii's counties to have an official, scientifically and community-based plan to recover threatened and degraded coral reefs. As a matter of fact, Maui would probably be the first island anywhere in the world to have a coral reef recovery plan!

As a former resident and now visitor to Maui - one of the world's great places, I know the cultural, economic, and ecological importance of the island's coral reefs. We now have a clear and exciting pathway for their protection and recovery!

So please, seize the opportunity and adopt the plan fully as Maui County's own, and move swiftly with its implementation.

Let Maui become a showcase for coral reef recovery in this challenging world. Māui, the legendary hero, would be proud of that!

Mahalo Nui Loa for considering my comment.

Sincerely,

Tony Povilitis

Tony Povilitis, Ph.D.
Life Net Nature
<http://lifenetnature.org>
<http://www.facebook.com/LifeNetNature>

From: Charlene Griffin <charonmaui@yahoo.com>
Sent: Sunday, December 15, 2013 07:02 PM
To: IEM Committee
Subject: Testimony on the Maui Coral Reef Recovery Plan

2013 DEC 17 PM 7:45

**OFFICE OF THE
COUNTY COUNCIL**

Aloha,
Infrastructure and Environmental Management Committee and all those present.
Thank you for the opportunity to testify.

I urge the Committee to adopt *the Maui Coral Reef Recovery Plan*.

Coral is Life.
It is of tremendous Cultural importance.

*Hanau ka 'Uko-ko'ako'a, hanau kana, he Ako'ako'a, puka.
"Born the coral polyp, born of him a coral colony emerged"*

Coral reefs are among the oldest ecosystems on earth, and are not only hotspots for biodiversity, but also provide countless services and economic benefits to local communities.

Unfortunately, our coral, marine and coastal ecosystems are in in crisis and in decline. Our coral reefs are invaluable ecosystems that are in need of protection and proper management. Not only are coral reef ecosystems biologically rich and a source of natural beauty, they provide countless services to our coastal communities. If any coral polyp or coral reef is degraded or destroyed, the services it once provided will be reduced or eliminated; possibly forever.

The cumulative effects of: human uses, unsustainable fishing impacts, both marine and land-based pollution, climate change, storm impacts, global warming, acidification, habitat fragmentation, sea level rise, coastal development, wastewater treatment, disease, amongst many others, are all taking their toll; making coral reefs particularly vulnerable.

In other words, the fate of coral reef ecosystems will increasingly be determined by their resilience, their potential for recovery and long-term maintenance of structure, function and goods and services.

By providing valuable and vital ecosystem services, coral reefs, and their inhabitants are a source of food for millions. They protect coastlines from storms and erosion; they provide habitat, spawning and nursery grounds for economically important fish and other species; they are a source of new medicines; and they provide jobs and income to local businesses from fishing to recreation, tourism and much more.

Every year, millions of scuba divers and snorkelers visit our coral reefs to enjoy their abundance of life. These visitors are seeking water clarity, high-quality coral reef habitats that have plenty of live coral, fish and other specie diversity.

Our local economy receives billions of dollars through: our beaches, diving tours, recreational fishing trips, hotels, restaurants, and a host of other businesses based near our reef ecosystems.

Recreation and tourism are "high value" industries that are especially sensitive to reef condition, and thus particularly vulnerable to degradation which in turn has an impact on people whose livelihoods rely solely on reef tourism.

Once coral reefs are damaged, they are less able to support the many creatures that make their home on the reef, along with its value as destination location for tourists.

Most importantly, Maui loses its refrigerator, our own local culture, recreation, and way of life.

The economic importance of our coral reefs when combining recreational, amenity, fishery, and biodiversity values, are estimated to have direct economic benefits of \$364 million per year. It has been said, our nearshore reefs annually contribute nearly \$1 billion in gross revenues for the entire State. We do not want to lose this vital source of revenue.

Ecological impacts of marine invasive invertebrates and overgrowth of invasive algae can, and have resulted in direct socioeconomic impacts. These include changes in community structure in the invaded community and reduced abundance, diversity, feeding, performance, and function of native species.

An example of this has cost Maui alone about \$20 million per year to manage the impacts of algal blooms (in terms of beach clean-ups, reduced property values, and reduced occupancy rates in hotels and condominiums in impacted areas).

Displacement of native species, changes to community structure and food webs, along with alteration of fundamental processes, such as nutrient cycling current changes, movement of larvae, and sedimentation open the door for native species to become invasive when they cause harm by bioerosion and dominant colonization of an ecosystem due to loss of natural controls (i.e., loss of predators or herbivores).

Doing nothing, being quiet or turning a blind eye by maintaining the status quo and observing reef decline with no plan to address ongoing impacts would be a total decimation of the reef. In the long run, it would simply destroy life; the future of our keiki and the Kanaka Mauoli.

At one time Hawaii was at the forefront and one of the most educated societies in the world. It is time to bring this back by interconnecting, taking action, educating everyone, and enlisting community support to protect all of our treasures.

The demand for goods and services from marine ecosystems like coral reefs are ever increasing.

We simply need to act now. The combination of escalating stressors, threats and rising demands are driving a needed trend toward more integrated approaches to the planning and management of our coral reefs, our native and tropical rainforests and our watersheds.

At this time, managers and other informed stakeholders are in a position to take actions to implement *the Maui Coral Reef Recovery Plan*; thus providing support for coral reef resilience.

Conserving these valuable habitats and ecosystems for future generation now, isn't a question, it is a must.

Thank you for your time and consideration,

Charlene Griffin

IEM Committee

From: Mark Deakos <deakos@hawaii.edu>
Sent: Monday, December 16, 2013 01:43 AM
To: IEM Committee; Maui_County Council_mailbox
Cc: Mike White; Michael Victorino; Elle Cochran; Robert Carroll; Gladys Baisa; Don Couch; Riki Hokama; don.guzman@mauicounty.us; Stacy S. Crivello
Subject: Testimony in Support of Adopting the Resolution Recognizing the Maui Reef Recovery Plan
Attachments: DeakosMauiCountyCouncilResolSupport.pdf; ATT00001.htm

Dear Maui County Council Members,

On behalf of the Hawaii Association for Marine Education and Research, Inc., I write this letter to encourage all members of the Maui County Council to pass the resolution in support of the Maui Coral Reef Recovery Plan, developed by the Maui Coral Reef Recovery Team, as the plan referenced in the the Maui Island Plan.

In the following table I provide two critical pieces of information that identify the importance and urgency in adopting this resolution:

- A conservative mean estimate of the annual value of coral reef goods and services is \$6,075 per hectare (Costanza, et al., 1997), whereas the estimate to replace a coral reef is between \$100,000 - \$1,000,000 per hectare (Edwards, et al., 2007). The following table will hopefully put these numbers into perspective for two of Maui's coral reefs:

Reef Name	Reef Size (Hectares)	Estimated Reef Value (\$US per year)	Estimated Replacement Cost (\$US)
Olowalu	380	\$2,308,500	\$38 – 380 million
Kihei/Wailea	622	\$3,778,650	\$62 – 622 million

- In 2000, the U.S. Coral Reef Task Force estimated that 10 percent of all coral reefs were degraded beyond recovery, 30 percent were in critical condition and may die within 10 to 20 years, particularly those reefs near human populations, and if current pressures continue unabated, another 30 percent may perish completely by 2050 (Force, 2000).

I have provided a list of literature cited since as a scientist, we are bound to provide supporting evidence for any statements made, a mechanism used to help differentiate truth from fiction.

We can learn from other Pacific Island regions that have recognized the value of their reef ecosystem services (e.g.: Palau) and have implemented successful management policies and practices. Today, many of them are reaping the benefits of sustainable tourism, bountiful fish stocks, and shoreline protection. With your leadership and support of this resolution, you can put Maui on a path towards a sustainable future. Thank you for your support of this resolution.

Sincerely,

Mark Deakos, Ph.D.

Executive Director
808-280-6448

Literature Cited

Costanza, R., d'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., & Paruelo, J. (1997). The value of the world's ecosystem services and natural capital. *Nature*, 387(6630), 253-260.

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COUNTY COUNCIL

Edwards, A. J., & Gomez, E. D. (2007). Reef restoration concepts and guidelines: making sensible management choices in the face of uncertainty.

Force, U. S. C. R. T. (2000). The National Action Plan to conserve coral reefs. Washington, DC, 34.

The Hawaii Association for Marine Education and Research, Inc.



PMB#175
5095 Napilihau St. 109B
Lahaina, HI, 96761
USA
Phone: 808-280-6448
Fax: 866-594-1896
Email: mdeakos@hamerinhawaii.org
www.hamerinhawaii.org

December 15, 2013

Maui County Council
200 S. High St.
Kalana O Maui Bldg, 8th Fl
Wailuku, HI 96793

RE: Support of Resolution Adopting Ola Nā Papa i Mālama'ia

Dear Maui County Council Members:

On behalf of the Hawaii Association for Marine Education and Research, Inc., I write this letter to encourage all members of the Maui County Council to pass the resolution in support of the Maui Coral Reef Recovery Plan, developed by the Maui Coral Reef Recovery Team, as the plan referenced in the the Maui Island Plan.

In the following table I provide two critical pieces of information that identify the importance and urgency in adopting this resolution:

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I have provided a list of literature cited since as a scientist, we are bound to provide supporting evidence for any statements made, a mechanism used to help differentiate truth from fiction.

We can learn from other Pacific Island regions that have recognized the value of their reef ecosystem services (e.g.: Palau) and have implemented successful management policies and practices. Today, many of them are reaping the benefits of sustainable tourism, bountiful fish stocks, and shoreline protection. With your leadership and support of this resolution, you can put Maui on a path towards a sustainable future. Thank you for your support of this resolution.

Sincerely,

A handwritten signature in black ink, appearing to read 'Mark Deakos', with a large, stylized initial 'M'.

Mark Deakos, Ph.D.
Executive Director

Literature Cited

Costanza, R., d'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., & Paruelo, J. (1997). The value of the world's ecosystem services and natural capital. *Nature*, 387(6630), 253-260.

Edwards, A. J., & Gomez, E. D. (2007). Reef restoration concepts and guidelines: making sensible management choices in the face of uncertainty.

Force, U. S. C. R. T. (2000). The National Action Plan to conserve coral reefs. *Washington, DC*, 34.

IEM Committee

RECEIVED

From: Tova Callender <tovacallender@gmail.com>
Sent: Monday, December 16, 2013 11:56 AM
To: IEM Committee; Elle Cochran
Subject: support for the Maui Coral Reef Recovery Plan
Attachments: Supporting testimony for Coral Reef Recovery Plan 12-16-13.docx

2013 DEC 17 PM 7:46
OFFICE OF THE
COUNTY COUNCIL

Dear Infrastructure Committee Chair and Honorable County Council Members,

Please see my attached testimony in support of the Maui Coral Reef Recovery Plan.

Should there be any questions, please do not hesitate to contact me.

Mahalo, Tova

--

Tova Callender

West Maui Watershed & Coastal Mg Coordinator

NFWF's Consultant to coordinate the activities of the Coral Reef Task Force in West Maui

(808) 214-4239

www.westmauir2r.com

www.westmauikumuwai.com

www.hawaiiicoralreefstrategy.com

Dec. 16, 2013

To: COM Infrastructure and Environment Committee

Re: Support for the Maui Coral Reef Recovery Plan

Honorable County Council Members,

I urge the Committee to support the Maui Coral Reef Recovery Plan. I work as the coordinator for the watershed effort in West Maui aimed at reducing stress to an already stressed marine ecosystem, and see support for this plan as a critical step in increasing the commitment to take the needed actions to prevent the irreversible collapse of our coral reef systems.

While the role of coral reefs is generally recognized as important culturally, economically and ecologically by county leadership, in our efforts, we have not seen these vague notions translated to commitment to participate in funded pollution reduction projects aimed at increasing water quality and therefore coral health. Hopefully, by adopting support for this plan, coral reef recovery will be seen as a clear priority by county department heads, increasing participation in the many projects currently being funded by state and federal agencies to improve coral reef health in West Maui.

Healthy coral reefs benefit us all. Thank you for standing up for the need for greater resolve to protect these integral and fragile ecosystems.

Respectfully submitted,

Tova Callender

West Maui Watershed & Coastal Management Coordinator

tova@westmauir2r.com

IEM Committee

RECEIVED

From: Wailuku CMMA <wailukucmma@gmail.com>
Sent: Monday, December 16, 2013 12:17 PM
To: IEM Committee; Maui_County Council_mailbox
Subject: Maui County Resolution to support Maui Coral Reef Recovery Plan

2013 DEC 17 PM 7:46
OFFICE OF THE
COUNTY COUNCIL

Aloha Chair and Members of the Maui County Council,

My Name is James "Jay" Carpio I am submitting written testimony today regarding the proposed Resolution for The Maui Coral Reef Recovery Plan. As a fishermen, farmer, kanaka maoli of the Wailuku Ahupua'a, member of the Maui Nui Marine Resource Council, and Po'o of the Wailuku CMMA "a Community Managed Makai Area" I support this resolution.

Historically, every generation since western contact we have seen the decline in our fisheries, in our marine resources, in our ecosystem habitats, and in our Ahupua'a Management.

We as a individuals, as a community, and as people of the archipelego Hawai'i Nei have the kuleana to malama. This Resoultion is a great start in that direction to ensure that our generations forward will have a greater abundance of marine resources then we have. This is who we are; This is Hawai'i, This is Hawaiian.

Mahalo Nui Loa
Jay Carpio

IEM Committee**RECEIVED**

From: Jordan Molina
Sent: Monday, December 16, 2013 04:07 PM 2013 DEC 17 PM 7: 47
To: IEM Committee
Subject: FW: Testimony - Reef Restoration Plan

**OFFICE OF THE
COUNTY COUNCIL**

Testimony received in Councilmember Cochran's email.

Testimony being sent through my email address due to the current limitation with Microsoft Outlook.

Jordan Molina
Executive Assistant to
Councilmember Elle Cochran
200 S. High St., Rm 812
Wailuku, HI 96793
808-270-5512
808-270-5505 (fax)
jordan.molina@mauicounty.us

From: William Spence [<mailto:William.Spence@co.maui.hi.us>]
Sent: Monday, December 16, 2013 2:08 PM
To: Elle Cochran
Cc: John Summers
Subject: Testimony - Reef Restoration Plan

Councilmember Cochran,

I apologize that I could not stick around, another meeting is waiting.

As Planning Director, I support the Ola Na Papa I Malamaia: A Practical Plan for the Technical and Cultural Restoration of Maui's Coral Reefs.

During my review of the document, I was pleased to find a spirit of cooperation and mutual benefit in formulating a plan. I believe it is much like the preservation approach the Nature Conservancy takes in their efforts, where the environment, landowners, scientists, conservationist, government agencies, etc., all benefit from a cooperative, collaborative effort.

I think the document would be good for Maui County and I support the passage of the resolution.

Will

William Spence
Planning Director
Maui Planning Department
One Main Plaza Bldg.
2200 Main Street, Suite 315
Wailuku, Hawaii 96793
(808) 270-7735

From: Cheryl Sterling <reefgirlmaui@hotmail.com>
Sent: Monday, December 16, 2013 05:56 PM
To: IEM Committee
Subject: Support for the Maui Coral Reef Recovery Plan

2013 DEC 17 PM 7: 47

**OFFICE OF THE
COUNTY COUNCIL**

RE: Support for the Maui Coral Reef Recovery Plan (MCRP)

Aloha Chair Cochran and Committee Members:

I am a charter member of the Maui Nui Marine Resource Council and have observed Maui's coral reefs over the past 22 years. I have witnessed a decline of our reefs and fish numbers due to well-documented impacts including: land-based sedimentation and pollution that smother the coral polyps, marine debris, collisions, and the onset of climate conditions that result in coral bleaching.

Maui's reefs grew slowly over time and serve as an integral part of the marine ecosystem. They provide a habitat and nursery for numerous fish species and seed new coral growth. They nourish us with their beauty and food that anchors the traditional lifestyle.

Visitors are drawn to Hawaii because reefs and marine life distinguish our destination as one still pristine enough to support this life, adding economic impacts in the \$ millions annually. As an ocean state, island living is as much about what occurs in the sea as on land, they are interdependent. Maui's ancestral inhabitants knew this, yet these days the fragile condition of our coral reefs are unseen or unconsidered, which causes further impacts.

Please help to restore this priceless natural resource by adopting the MCRP. This well conceived plan will take time to implement, and recovery may be in steps, yet we must begin this important work to maintain a healthier reef environment. Protecting our marine ecosystem is an investment in sustaining ourselves well into the future.

Mahalo nui loa,

Cheryl Sterling

Council Chair
Gladys C. Baisa

Vice-Chair
Robert Carroll

Presiding Officer Pro Tempore
Michael P. Victorino

Council Members
Elle Cochran
Donald G. Couch, Jr.
Stacy Crivello
Don S. Guzman
G. Riki Hokama
Mike White



COUNTY COUNCIL
COUNTY OF MAUI
200 S. HIGH STREET
WAILUKU, MAUI, HAWAII 96793
www.mauicounty.gov/council

August 11, 2014

MEMO TO: Patrick K. Wong
Corporation Counsel

F R O M: Elle Cochran, Chair
Infrastructure and Environmental Management Committee

SUBJECT: **RESTORATION OF MAUI'S CORAL REEFS** (IEM-27)

At the Infrastructure and Environmental Management Committee's meeting on December 16, 2013, you expressed concern that provisions in *Ola nā Papa i Mālama 'ia: A Practical Plan for the Technical and Cultural Restoration of Maui's Coral Reefs* may impact other matters pending before Council; thus, you recommended the Committee defer action on the pending resolution for reposting and redrafting.

Please advise whether the recommendation you provided at the December 16, 2013 meeting has changed in light of the United States District Court for the District of Hawaii's May 30, 2014 ruling in Hawaii Wildlife Fund et al v. County of Maui, CIV. 12-00198 SOM/BM, 2014 WL 2451565 (D. Haw. May 30, 2014). If so, please provide your current recommendation. If your recommendation has not changed, then may I request you transmit a revised proposed resolution, approved as to form and legality, for the Committee's consideration.

I would appreciate receiving a response by **Tuesday, August 26, 2014**. To ensure efficient processing, please include the relevant Committee item number in the subject line of your response.

Should you have any questions, please contact me or the Committee staff (Jordan Molina at ext. 7134, or Rayna Yap at ext. 8007).

iem:ltr:027acc01

Attachment

Resolution

No. _____

URGING SUPPORT FOR “OLA NA PAPA I MALAMAIA: A PRACTICAL PLAN FOR THE TECHNICAL AND CULTURAL RESTORATION OF MAUI’S CORAL REEFS”

WHEREAS, the value of Maui’s coral reefs is widely recognized and appreciated, but not always appropriately valued when decisions are made regarding land use and marine resources; and

WHEREAS, a 2011 study by the National Oceanic and Atmospheric Administration estimated the economic value of Hawaii’s coral reefs at \$33.57 billion; and

WHEREAS, significant declines in the health, abundance, and diversity of coral and reef fish populations have been documented at eight vital coral reefs on Maui over the last 20 years; and

WHEREAS, the Maui Island Plan (Chapter 2, Objective 2, Implementing Action D) encourages the implementation of a reef protection restoration plan; and

WHEREAS, the Maui Nui Marine Resource Council established a Maui Coral Reef Recovery Team that, among other efforts, worked to develop a practical plan for the technical and cultural restoration of Maui’s coral reefs, and

WHEREAS, the practical plan outlines four goals and 16 associated objectives to be achieved between 2015 and 2025, and

WHEREAS, accomplishing these goals and objectives will require a united effort from County, State, and Federal agencies; non-profit and non-governmental organizations, and citizen and ocean-user groups; and

WHEREAS, local management strategies designed to meet community goals can achieve greater good than those designed solely for biodiversity conservation; now, therefore,

BE IT RESOLVED by the Council of the County of Maui:

1. That it recognizes the importance of saving, protecting, and enhancing the reef ecosystems of Maui County for their cultural, biological and economic benefits; and

Resolution No. _____

2. That it urges support for "Ola Na Papa I Malamaia: A Practical Plan for the Technical and Cultural Restoration of Maui's Coral Reefs"; and
3. That certified copies of this resolution be transmitted to the Mayor; the Department of Public Works; the Department of Planning; the Department of Environmental Management; the Maui Nui Marine Resource Council; the Aha Moku o Maui; the Aha Moku Advisory Committee, the State Department of Land and Natural Resources; the Office of Hawaiian Affairs; the University of Hawaii's Institute of Marine Biology; the Hawaiian Islands Humpback Whale National Marine Sanctuary, the National Oceanic and Atmospheric Association; the Natural Resource Conservation Service, the United States Department of Agriculture; and the United States Coral Reef Task Force.

APPROVED AS TO FORM AND LEGALITY

Department of the Corporation Counsel
County of Maui

paf:scj:13-233a

IEM Committee

From: Liz Foote <lfoote@hawaii.rr.com>
Sent: Wednesday, January 28, 2015 12:43 PM
To: IEM Committee
Subject: Letter of Support, IEM-27
Attachments: ReefResSupportLetter_Foote.pdf

Aloha, attached is a letter of support for the upcoming resolution, IEM-27.

Thank you,
Liz Foote
Wailuku, Maui
(808) 669-9062

January 28, 2015

Councilmember Elle Cochran
Chair, Infrastructure and Environmental Management Committee
200 South High Street
Wailuku, HI 96793

Re: Testimony supporting IEM-27 proposed resolution *Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County*.

Dear Councilmember Cochran and IEM Committee Members:

I am submitting this letter in support of the proposed resolution "Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County" (IEM-27).

The people of Maui Nui depend on our coral reef ecosystems for cultural, ecological, subsistence, and economic purposes. Our reefs provide us with jobs and economic security, protection from storms, and food for our families. It is impossible to truly quantify the value of Maui's reefs; their value is intrinsic. It is the responsibility of all stakeholders – federal, state and local government agencies, businesses, landowners, educational institutions, non-governmental organizations, and community members – to take the necessary steps needed to protect, preserve, and restore them.

Please support this resolution recognizing the importance of Maui's reefs, now and in the future.

Sincerely,



Liz Foote

West Maui Kumuwai Campaign
Kā'anapali Makai Watch
Project S.E.A.-Link

IEM Committee

From: John Parks <jeparks5@gmail.com>
Sent: Wednesday, January 28, 2015 1:39 PM
To: IEM Committee
Cc: MN MRC; Robin Newbold
Subject: Testimony supporting IEM-27 proposed resolution Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County.

Follow Up Flag: Follow up
Flag Status: Flagged

Wednesday, 28 January 2015

Councilmember Elle Cochran

Chair,

Infrastructure and Environmental Management Committee

200 South High Street

Wailuku, HI 96793

Re: Testimony supporting IEM-27 proposed resolution *Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County*.

Dear Councilmember Cochran and IEM Committee Members:

I am writing in support of the proposed resolution "Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County" (IEM-27).

The people of Maui Nui depend on our coral reef ecosystems for cultural, ecological, subsistence, and economic purposes. Maui's reefs provide its residents with jobs and economic security, protection from storms, and food for our families. The survivability of these ecosystems calls for the cooperation of the State, County, and community-based groups such as the Maui Nui Marine Resource Council, in management and conservation efforts.

Maui County's coral reef ecosystems hold intrinsic value for future generations and it is our responsibility to care for them. I urge you to support this resolution recognizing this important resource.

Sincerely,

John Parks

--

Marine Management Solutions LLC
7192 Kalanianaʻole Highway
Suite A143A, #319
Honolulu, HI 96825-1832 USA
+1 (808) 783-5476

IEM Committee

From: Harry Hecht <hectkh@gmail.com>
Sent: Thursday, January 29, 2015 9:31 AM
To: IEM Committee
Subject: RE:Testimony supporting IEM-27
Attachments: ReefTest1.doc

Follow Up Flag: Follow up
Flag Status: Flagged

Attached is testimony supporting IEM-27.

Harry R. Hecht, PE, Ph.D

Harry R. Hecht
1032 South Kihei Road
Kihei, HI 9753

Councilmember Elle Cochran
Chair, Infrastructure and Environmental Management Committee
200 South High Street
Wailuku, HI 96793

Subject: **Testimony supporting IEM-27 proposed resolution *Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County*.**

Dear Councilmember Cochran and IEM Committee Members:

I support the proposed resolution "**Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County**" (IEM-27).

\\

Maui is blessed with beautiful coral reef ecosystems. It is our duty, as stewards of our island, to protect these priceless systems and protect them for future generations. Our reefs provide us with food, economic security, and protection from storms. The protection of these ecosystems calls for the cooperation of the State, County, and community-based groups such as the Maui Nui Marine Resource Council, in management and conservation efforts.

I urge you to support this resolution recognizing this important resource.

Sincerely,

Harry R. Hecht, PE, Ph.D
Vice Chair Clean Water Committee
Maui Nui Marine Resource Council

IEM Committee

From: mclane@makaliigroup.com on behalf of Sarah McLane <sarah@ponoproject.org>
Sent: Thursday, January 29, 2015 12:30 PM
To: IEM Committee
Cc: MN MRC
Subject: Letter of support: (IEM-27) "Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County"
Attachments: SarahMcLaneBryan_ReefResSupportLetter_1-29-15.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Aloha - please find my attached letter of support for Resolution IEM-27, "Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County."

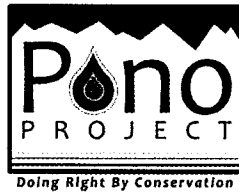
I could not be there in person for the testimony, but I want to express my sincere appreciation for your diligence in bringing this to the Committee.

Please see my attached letter of support!

Sarah

Sarah McLane
Founder
www.ponoproject.org





January 29, 2015

Councilmember Elle Cochran
Chair, Infrastructure and Environmental Management Committee
200 South High Street
Wailuku, HI 96793

Re: Testimony supporting IEM-27 proposed resolution *Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County*.

Dear Councilmember Cochran and IEM Committee Members:

I am writing in excitement and support for the proposed resolution "**Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County**" (IEM-27).

I could not be here in person during the testimony as I am in a conference on the Big Island, but I wanted to personally express my appreciation for your persistence on this Resolution, through all of its edits and faces, and the forward thinking of its impacts on our vital coastal and ocean resources. As the previous Executive Director for the Maui Nui Marine Resource Council, I saw firsthand how our local families live and thrive off of our near shore resources, and how they are actively working to restore and preserve these resources for our future. Gaining the support of our local, state and national government will mean that we can continue these noble efforts, all going in the same direction – forward! This resolution will build upon the already solid foundations of local organizations, agencies and generations of local residents who live responsibly and protect our resources every day.

Although a resolution isn't a law or ordinance, it sets the intention of the island – an intention that has been there for generations already, but that gets clarified and renewed by the passing of this resolution. I think that this makes our Resolution so incredibly powerful and it will mean that we can start to work together towards a common vision, to be the example for island communities worldwide.

Here's to a future of clean water, healthy reef and abundant fish!

Thank you for supporting this resolution and formally recognizing this important resource.

With appreciation,

Sarah McLane Bryan

Pono Project, LLC
sarah@ponoproject.org
808-268-6680

IEM Committee

From: Charlene Griffin <charonmaui@yahoo.com>
Sent: Thursday, January 29, 2015 6:49 PM
To: IEM Committee
Subject: Testimony: County Communication 13-303: "Recognizing The Importance Of Protecting and Enhancing the Reef Ecosystems in Maui County (IEM-27)
Attachments: Testimony Importance of Protecting Reef Ecosystems 2015.docx
Follow Up Flag: Follow up
Flag Status: Flagged

Aloha, and Thank You for the opportunity to testify.

I am in support of the County Resolution Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui.

Coral is Life.

It is of tremendous Cultural importance.

*Hanau ka 'Uko-ko'ako'a, hanau kana, he Ako'ako'a, puka.
"Born the coral polyp, born of him a coral colony emerged"*

Coral reefs are among the oldest ecosystems on earth, and are not only hotspots for biodiversity, but also provide countless services and economic benefits to local communities.

Unfortunately, our coral, marine and coastal ecosystems are in in crisis and in decline. Our coral reefs are invaluable ecosystems that are in need of protection and proper management. Not only are coral reef ecosystems biologically rich and a source of natural beauty, they provide countless services to our coastal communities. If any coral polyp or coral reef is degraded or destroyed, the services it once provided will be reduced or eliminated; possibly forever.

The cumulative effects of: human uses, unsustainable fishing impacts, both marine and land-based pollution, climate change, storm impacts, global warming, acidification, habitat fragmentation, sea level rise, coastal development, wastewater treatment, disease, amongst many others, are all taking their toll; making coral reefs particularly vulnerable.

In other words, the fate of coral reef ecosystems will increasingly be determined by their resilience, their potential for recovery, and long-term maintenance of structure and function.

By providing valuable and vital ecosystem services, coral reefs, and their inhabitants are a source of food for millions. They protect coastlines from storms and erosion; they provide habitat, spawning and nursery grounds for economically important fish and other species; they are a source of new medicines; and they provide jobs and income to local businesses from fishing to recreation, tourism and much more.

Every year, millions of scuba divers and snorkelers visit our coral reefs to enjoy their abundance of life. These visitors are seeking water clarity, high-quality coral reef habitats that have plenty of live coral, fish and other specie diversity.

Our local economy receives billions of dollars through: our beaches, diving tours, recreational fishing trips, hotels, restaurants, and a host of other businesses based near our reef ecosystems.

Recreation and tourism are "high value" industries that are especially sensitive to reef conditions; particularly vulnerable to degradation that have impacts on people whose livelihoods rely on the reef, and its value as a destination location for tourists.

Once coral reefs are damaged, they are less able to support the many critters and creatures that make their home in, around and on the reef.

Most importantly, Maui loses its treasures, its refrigerator, our own local culture, recreation, enjoyment, and way of life.

The economic importance of our coral reefs when combining recreational, amenity, fishery, and biodiversity values, are estimated to have direct economic benefits of approximately \$364 million per year.

It has been said, our nearshore reefs annually contribute nearly \$1 billion in gross revenues for the entire State. We do not want to lose this vital source of revenue.

Ecological impacts of marine invasive invertebrates and overgrowth of invasive algae can, and have resulted in direct socioeconomic impacts. These include changes in community structure in the invaded community and reduced abundance, diversity, feeding, performance, and function of native species.

An example of this has cost Maui alone about \$20 million per year to manage the impacts of algal blooms (in terms of beach clean-ups, reduced property values, and reduced occupancy rates in hotels and condominiums in impacted areas).

Displacement of native species, changes to community structure and food webs, along with alteration of fundamental processes, such as nutrient cycling, current changes, movement of larvae, and sedimentation, opens the door for native species to become invasive when they cause harm by bioerosion and dominant colonization of an ecosystem due to loss of natural controls (i.e., loss of predators or herbivores).

By not uniting, by being quiet, or turning a blind eye, maintaining the status quo, while still observing reef decline with no structured plan would be a continued total decimation of the reef. In the long run, it would simply destroy life; the future of our keiki and the Kanaka Mauoli.

At one time Hawaii was at the forefront and one of the most educated societies in the world.

It is time to bring this back by realizing the importance of sharing, inter-connecting, take action, educate everyone, and enlisting community support to protect all of our treasures.

The demand for goods and services from marine ecosystems like coral reefs are ever increasing.

We simply need to act now. The combination of escalating stressors, threats and rising demands are driving a needed trend toward more integrated approaches to the planning and management of our coral reefs, our native and tropical rainforests and our watersheds.

Conserving these valuable habitats and ecosystems for future generation now, isn't a question, to me, it is a must.

Mahalo for your time, consideration, and all that you do.

Charlene Griffin

IEM Committee

From: Dana Reed <dreed@hawaii.edu>
Sent: Thursday, January 29, 2015 8:32 PM
To: IEM Committee
Cc: Amy Hodges
Subject: Support for Reef Resolution (IEM-27)
Attachments: ReefResSupportLetterDanaReed.docx

Follow Up Flag: Follow up
Flag Status: Flagged

Aloha,

Please find attached my letter of support for the resolution under consideration.

Sincerely,

Dana Reed

January 29, 2015

Councilmember Elle Cochran
Chair, Infrastructure and Environmental Management Committee
200 South High Street
Wailuku, HI 96793

Re: Testimony supporting IEM-27 proposed resolution *Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County*.

Dear Councilmember Cochran and IEM Committee Members:

I am writing in support of the proposed resolution "Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County" (IEM-27).

Protecting the reef ecosystems is crucial at many levels. At the Maui Nui level, the reefs provide local residents with recreation, food, and are culturally significant. The reef systems also protect the islands from storm swells. The reefs serve to support employment for the people of Maui Nui, particularly in the tourism industry. Tourists would be far less interested in visiting our islands if there were no reefs to snorkel, waves to ride, or clean clear water to enjoy. It is everyone's responsibility to protect these valuable natural resources; the State, the County, and individuals in the community. As part of the Maui Nui Marine Resource Council I am working diligently to become more educated in reef conservation and to share this information with others. I am learning the importance of clean water to our reef ecosystems and am working with others on the MNMRC to help monitor our coastal waters to catch problems quickly that might harm our reef systems. Our community-based efforts will help government agencies by providing information needed to take corrective actions.

Maui County's coral reef ecosystems hold intrinsic value for future generations and it is our responsibility to care for them. I urge you to support this resolution recognizing this important resource.

Sincerely,

Dana Reed

Maui Nui Marine Resource Council
Email: dreed@hawaii.edu
Phone: 808-669-4105
Address: 100 Ridge Road #1221, Lahaina 96761

IEM Committee

From: LHWRP <outreach@lhwrp.org>
Sent: Friday, January 30, 2015 9:16 AM
To: IEM Committee
Subject: Testimony (IEM-27 Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County)

Follow Up Flag: Follow up
Flag Status: Flagged

January 30, 2015

Councilmember Elle Cochran

Chair, Infrastructure and Environmental Management Committee

200 South High Street

Wailuku, HI 96793

Re: Testimony supporting IEM-27 proposed resolution *Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County*.

Dear Councilmember Cochran and IEM Committee Members:

I am writing in support of the proposed resolution "Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County" (IEM-27).

The people of Maui Nui depend on our coral reef ecosystems for cultural, ecological, subsistence, and economic purposes. Our reefs provide us with jobs (just consider the number of fishing charter, kayak, snorkel and dive boats and the associated retail shops associated with this industry), economic security and food for our families.

Coral Reef Ecosystems also provide protection from storms (according to the NOAA website:

a) Coastal storms account for 71 percent of recent U.S. disaster losses annually. Each event costs roughly \$500 million, and while not all of these events occur in areas that would naturally contain reefs, healthy reefs could reduce the cost in those regions that do. In fact, each meter of reef protects an estimated \$47,000 of property value

b) Up to 90 percent of the energy from wind-generated waves is absorbed by reefs

c) Coral reefs harbor as much diversity of life as a rainforest

The survivability of these ecosystems calls for the cooperation of the State, County, and community-based groups such as the Maui Nui Marine Resource Council, in management and conservation efforts.

Maui County's coral reef ecosystems hold intrinsic value for future generations and it is our responsibility to care for them. I urge you to support this resolution recognizing this important resource.

Sincerely,

Mia Charleston

15 Apuhihi Lane #15H

Kihei, HI 96753

IEM Committee

From: MMMMahalo2000@aol.com
Sent: Friday, January 30, 2015 11:53 AM
To: IEM Committee
Cc: mmmmahalo2000@aol.com
Subject: Testimony supporting IEM-27 proposed resolution 2/2/15 1:30PM

Aloha Chair Cochran and Committee members,

Mike Moran, President, Kihei Community Association (KCA) testifying for the Organization.

IEM-27, Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County

KCA has long supported preservation of natural resources, including the coral reef systems. Several years ago we participated in a program of placing Coral Reef Etiquette signs and around shoreline areas, and placed several in our area which still stand proudly and educate visitors every day. I see them and talk to them.

So when this matter came up for discussion at KCA, someone posed the question, who would oppose this? I can't imagine any on this committee would; nor anyone in this room. In fact is there anyone in Maui County who does not recognize the importance of protecting and enhancing our coral reef system?

Chair, your people have know this for centuries. We have several government agencies such as NOAA and DLNR who know this and we have laws in place to do so..We know all the reasons to do so.

So we concluded everyone already knows this and supports it. This is nothing new, right?

There is probably no way to quantify the value of it, but perusing some sources of information we came up coral reefs worldwide value was \$ three billion billion (or \$150 quintillion) NOAA came up with \$33.57 billion for Hawaii.

With all of this, why are we supporting this MNMRC's Resolution? Because when we look around our near shore waters we see reef destruction and decimation almost everywhere. It is our understanding that Olowalu is the only healthy one left, and that is almost constantly threatened by pollution and run off. So we conclude that while everyone knows this, there are some who do not care, who place a higher personal value on short term monetary profit, and the rest of us and future generations be damned. So an action such as this can offer support and a reminder to the "rest of us" to be vigilant, to look around, to say no, not on my watch.

Please support this reso.

Mahalo.

Mike Moran for KCA www.gokihei.org
891-9176

IEM Committee

From: orchid6128@aol.com
Sent: Sunday, February 01, 2015 10:30 PM
To: IEM Committee
Cc: hodes@mnmrc.org
Subject: "Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County" (IEM-27)

Councilmember Elle Cochran
Chair, Infrastructure and Environmental Management Committee
200 South High Street
Wailuku, HI 96793

Re: Testimony supporting IEM-27 proposed resolution Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County.

Aloha Councilmember Cochran and IEM Committee Members:

I am writing in support of the proposed resolution "Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County" (IEM-27). The reef is a living body of organisms that our ecosystem depends on. When healthy, the reef provides us with food, abundance, and life. Living in Kihei, I can tell you that the reef is not healthy in N Kihei. Dead coral is a permanent fixture on the beach, the water quality seems poor, less aquatic life, which affects not only the health of the ocean, but all other beings that are dependent on the reef. It is our responsibility to care for the reef, to ensure that human actions are not damaging it. It is our responsibility to care for our environment, which includes the complex reef system, so that generations to come can continue to live in harmony with the ocean. It is our duty to take care of the reef for future generations.

I support IEM-27 which recognizes the importance of protecting and enhancing the reef ecosystems in Maui. I urge your support to pass this resolution.

Mahalo,
Deb Mader Creagh
Kihei HI

IEM Committee

From: Mark Deakos <deakos@hawaii.edu>
Sent: Monday, February 02, 2015 4:01 AM
To: Don Couch; Mike White; Elle Cochran; Riki Hokama; Michael Victorino; Robert Carroll; Stacy S. Crivello; Donald S. Guzman
Cc: IEM Committee
Subject: Please Support the Resolution Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County (IEM-27)

Dear Honorable Council Members,

I ask that you please support the resolution "Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County (IEM-27)".

Over the past few years we have come to understand the tremendous value that the coral reefs of Maui Nui provide in terms of food, culture, recreation, shoreline protection, surf, and significant economic revenue. Unfortunately, Maui's coral reefs have suffered a 25% decline in the past decade alone due to the lack of proper oversight to ensure they are protected and preserved. With our reefs not only facing the threats of human impacts (land based sources of pollution, sedimentation and overfishing) and of climate change, it is more critical than ever that our County leadership show their support in regenerating our coral reefs and preserving them for the benefit of all current and future Maui residents.

Thank you for your kokua,

Mark Deakos

Mark H. Deakos, Ph.D.
Executive Director, Chief Scientist
HAMER
Hawaii Association for Marine Education and Research, Inc.
PMB#175
5095 Napilihau St. 109B
Lahaina, HI 96761
808-280-6448 (cell)
866-594-1896 (fax)
www.hamerinhawaii.org

Testimony in support of the County Resolution Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County

Good afternoon. My name is Tova Callender, and I am a resident of Kihei. I am in SUPPORT of the County Resolution Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County.

I work as the Watershed Coordinator for the West Maui Ridge to Reef Initiative. The goal of this Initiative is to find and address the sources of land based pollution to reduce the stress impacting West Maui's reefs. The Initiative brings together federal, state, local and community partners, who in the last two years have secured over \$1 million of agency funds and ~\$400K of local match for the implementation of pollution reduction projects. We have a tough sell, because none of the recommendations in our watershed plan guiding our actions come with a regulatory requirement, rather are voluntary actions that are the right thing to do if we value our reefs and the many services they provide our community.

Directors from departments in our county have told me in the past, that they would like to support our projects, which to date have come with funds to support capital improvements, but could not, because coral reef protection was not a priority for the leadership of this county. In adopting this resolution it is my hope that coral reef ecosystem protection and enhancement will become a priority, and be reflected in the actions of county departments.

On a personal note, my home is in North Kihei, one short block from the beach paralleling one of the largest tracks of contiguous reef in Maui. I see South Kihei road being undermined by storm surge, and recognize that in this changing climate, we rely of the wave energy dissipating abilities of the reef to slow down the damage to this primary access route, and this is the case in many coastal areas of Maui. This observation is substantiated by the work of Greg Guannel from Stanford University who looked at how reefs can effectively assist with coastal protection, and recommended West Maui, Kihei and Kahului as prioritized areas for conservation.

My family and I take great pleasure stand up paddling, surfing, kayaking and kiting from our beach. There is nothing like those calm days when the ocean is like a lake and we can explore the reef and all the life it supports from above. I taught my nephews to snorkel on these reefs, to love and respect the ocean and I want the awe and wonder of those reefs to be there for their children a generation from now.

Thank you for adopting this resolution that reflects how important coral reefs are to our community, and the recognition that their protection is within our collective ability to act.

Tova Callender

208-214 4239

55 Konale Pl., Kihei HI 96753

RECEIVED AT IEM MEETING ON 2/2/15
Tova Callender

IEM-27

RECEIVED

2015 FEB -2 PM 3: 48

OFFICE OF THE
COUNTY COUNCIL

Bette A. Belanger
2495 S. Kihei Rd
Kihei, HI 96753

January 29, 2015

Councilmember Elle Cochran
Chair, Infrastructure and Environmental Management Committee
200 South High Street
Wailuku, HI 96793

Re: Testimony supporting IEM-27 proposed resolution *Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County*.

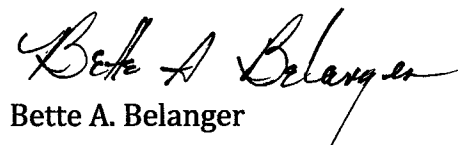
Dear Councilmember Cochran and IEM Committee Members:

I am writing in support of the proposed resolution "Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems of Maui County" (IEM-27).

The people of Maui Nui depend on our coral reef ecosystems for cultural, ecological, subsistence, and economic purposes. Our reefs provide us with jobs and economic security, protection from storms, and food for our families. The survivability of these ecosystems calls for the cooperation of the State, County, and community-based groups such as the Maui Nui Marine Resource Council, in management and conservation efforts.

Maui County's coral reef ecosystems hold intrinsic value for future generations and it is our responsibility to care for them. I urge you to support this resolution recognizing this important resource.

Sincerely,


Bette A. Belanger

*Working together to restore clean water,
healthy coral reefs, and abundant native fish
populations to the islands of Maui Nui*



RECEIVED AT IEM MEETING ON 2/2/15
Robin Alpert and Tegan Hammond

LEM-27
018

Our Goals

- clean water
- abundant fish





HAROLD K.L. CASTLE
FOUNDATION



FERNANDO LOPEZ ARBARELLO PHOTOGRAPHY | WWW.THEREEFALIVE.COM

4 Main Project Areas

- Community Managed Makai Areas – CMMAs
- Water Sampling for Department of Health
- Implementation of Maui Coral Reef Recovery Plan
- And Brown water issues..



Maui Nui Makai Network Meeting - Olowalu





Hawaii Conservation Conference











UNITED STATES

2014

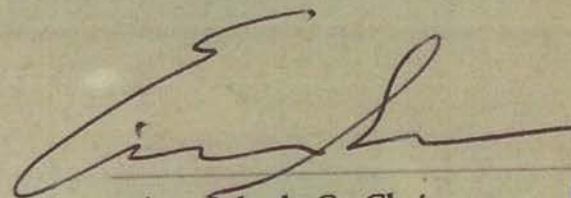
CORAL REEF TASK FORCE

Recognizes the Significant Contributions of Maui Nui Marine Resources Council

In recognition of Maui Nui Marine Resources Council's excellent ability to address degradation of coral reefs in Maui Nui by involving communities in more traditional management while supporting the State's efforts to protect the resources. MNMRC is an inspirational model of community-based management.



Lori Faeth, Co-Chair
Deputy Assistant Secretary for Policy
and International Affairs, Department of the Interior



Eileen Sobeck, Co-Chair
Assistant Administrator for NOAA F
Department of Commerce



Maui Coral Reef Recovery Team



Maui Coral Recovery Team; *The Voice of the Reef*



The Nature Conservancy Kako'o Award

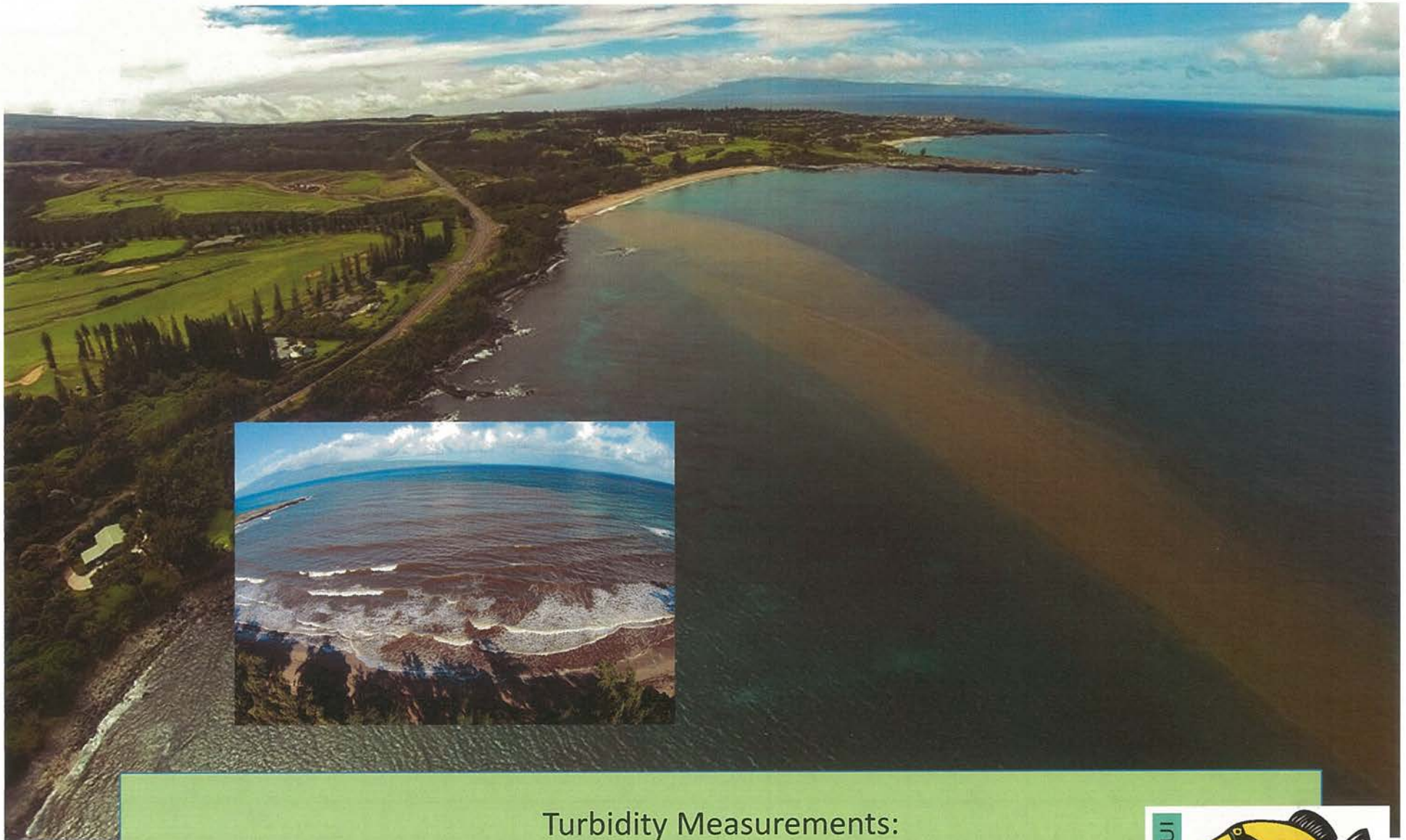






Hui O Ka Wai Ola – Water Quality Hui Meeting

March 7, 2014



Turbidity Measurements:

Stream: 156.0 Mouth: 24.2 Life Guard station: 1.02



Olowalu Beach Clean Up Jan 31, 2015



East Maui Taro Fest & Hana Limu Festival 2014



Reef Recovery Implementation

Maui Coral Recovery Plan



Brief Coral Recovery Plan Overview:

4 goals to be achieved between 2015 and 2025:

Goal 1: Provide evidence of coral recovery at selected sites around Maui;

Goal 2: Use science to advance knowledge, improve understanding of the state of Maui's coral reef ecosystems, and document coral recovery;

Goal 3: Strengthen public awareness regarding the status of threats to and trends facing Maui's coral reefs; and

Goal 4: Strengthen the capacity for effective coral reef management on Maui.

Rx: What's The Prescription.....

Strategies and Practices

- Direct Restoration
 - Includes: Reduce nutrient, pathogen and sediment inputs
- Indirect Restoration
 - Includes: Increase community involvement in coral reef management
- Cultural and Traditional Management
 - Includes: promote and support local marine resource management leaders
- Engaging Community and Partners
 - Includes: Engagement of stakeholders and reef recovery collaborations

Projects and Activities

- *“State of Maui’s Reefs Report” - Fall 2015*
- *Maui Coral Recovery Team expert trainings supporting community restoration sites and Makai Network Sites*
- *Ongoing events open to community...*
- First series of Maui Coral Recovery Team papers on key coral reef topics to be published in 2015
- *Continued partnership building in spirit of supportive and innovative collaborations...*



"State of Maui's Reefs Report"

Presented by Maui's own "Coralax"

Maui Coral Recovery Team; The Voice of Maui's Reefs

- How are the reefs doing at present?
- What is their current state and likely trajectory?



Maui Coral Recovery Team

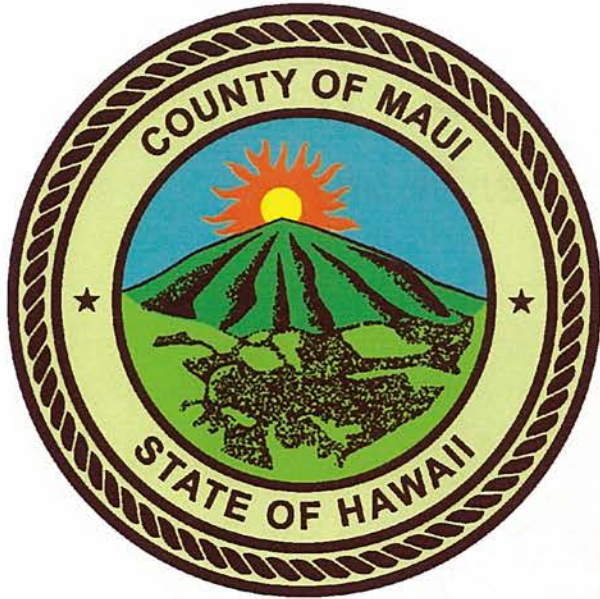
2015 Training series for community based restoration



Get Involved / Open Invitation

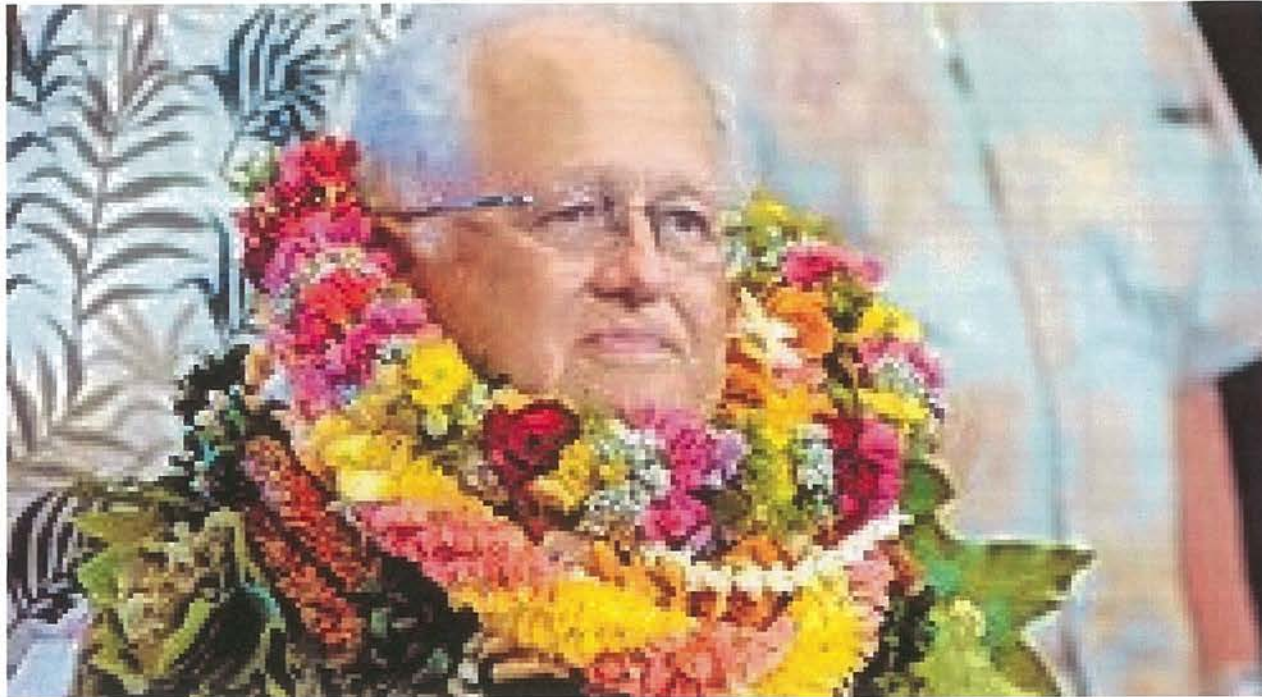
- Monthly Marine Resource Council Meetings
- Polanui Hiu - Monthly reef and fish surveys
- Monthly MNMRC Clean Water Committee Mtgs
- Olowalu Beach Clean Ups – Mile 14
- Stream Clean Ups & Water Quality Monitoring
- “Ask the Recovery Team”
 - Send us your questions...
- Stay in touch: Join our newsletter, Facebook

Mahalo



‘A’ohe hana nui ke alu ‘ia.

No task is too big when done together by all.



www.mnmrc.org



IEM Committee

From: Irene Bowie <huladog1@earthlink.net>
Sent: Monday, February 02, 2015 4:30 PM
To: IEM Committee
Subject: Maui Tomorrow written testimony from 2/2/15 IEM committee meeting
Attachments: MTcomments_02_02_2015_IEM_Committee.doc

Please see the attached. If you have questions or problems opening the document please contact me at this email address or the phone number below.

Mahalo,
Irene

Irene Bowie
Executive Director
Maui Tomorrow Foundation, Inc.
55 N. Church St., Ste. A4
Wailuku, HI 96793
808.244.7570



This email has been checked for viruses by Avast antivirus software.
www.avast.com



MAUI TOMORROW

Protecting Maui's Future

Feb. 2, 2015

Chair Elle Cochran
Infrastructure and Environmental Management Committee
Maui County Council

Good afternoon, I'm Irene Bowie, executive director of Maui Tomorrow Foundation. Maui Tomorrow supports Item IEM-27: The Resolution Recognizing the Importance of Protecting and Enhancing the Reef Ecosystems in Maui County. We hope it can become a working document as the County council considers development and infrastructure projects.

Regarding Item IEM-55: Definition of "Sustainability" and Implementation of Section 8-15.3(4) of the Revised Charter of the County of Maui (1983) as Amended, we hope you will consider our comments. Maui Tomorrow's mission is the protection of cultural and natural resources and the promotion of Smart Growth Principles.

We offer a definition of Sustainability put forth by noted ecologist, Aldo Leopold: *"We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."* I would also offer this definition, Preserve resources for future generations.

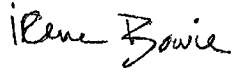
Maui Tomorrow is concerned that this action is in the purview of the County's Department of Environmental Management (DEM), especially in light of the upcoming audit of that department and questions about its performance.

We have been concerned for some time with DEM's continued defense of injection wells at the County's wastewater treatment plants; the recent rejection of a Zero Waste presentation at Council and efforts to stop recycling programs embraced by our community; as well as evasiveness when the community asks for information on practices at the Central Maui Landfill regarding leachate disposal.

Decisions for a growing population must be based on the Three-Legged Stool Principle, considering economic, environmental, and social impacts. In light of what we now know about the effects of climate change, urbanization and sprawl, energy (renewables vs. imported fuels); ocean acidification; and sea level rise it is

imperative, as an island community, that we make wise decisions for current and future populations.

We appreciate your consideration of our comments,

A handwritten signature in cursive script that reads "Irene Bowie".

Irene Bowie/Executive Director

COUNCIL OF THE COUNTY OF MAUI
INFRASTRUCTURE AND
ENVIRONMENTAL MANAGEMENT
COMMITTEE

February 18, 2015

Committee

Report No. 15-12

Honorable Chair and Members
of the County Council
County of Maui
Wailuku, Maui, Hawaii

Chair and Members:

Your Infrastructure and Environmental Management Committee, having met on February 2, 2015, makes reference to County Communication 13-303, from Councilmember Elle Cochran, transmitting a proposed resolution to support a coral reef recovery plan developed by the Maui Nui Marine Resource Council ("MNMRC").

The MNMRC is a community advocacy group dedicated to improving marine resource management in Maui County.

Your Committee notes that the Council's Infrastructure and Environmental Management Committee (2013-2015 Council term) met on this matter on December 16, 2013, and December 5, 2014.

By correspondence dated January 27, 2015, the Chair of your Committee transmitted a revised proposed resolution entitled "RECOGNIZING THE IMPORTANCE OF PROTECTING AND ENHANCING THE REEF ECOSYSTEMS IN MAUI COUNTY".

The purpose of the revised proposed resolution is to recognize the importance of saving, protecting, and enhancing the reef ecosystems of Maui County for their cultural, ecological, subsistence, and economic benefits.

At its meeting of February 2, 2015, your Committee received a presentation from Tegan Hammond, Maui Coral Reef Recovery Plan Coordinator, MNMRC, and Robin Newbold, Chair, MNMRC, providing an update on the MNMRC's activities relating to implementation of the plan.

COUNCIL OF THE COUNTY OF MAUI
INFRASTRUCTURE AND
ENVIRONMENTAL MANAGEMENT
COMMITTEE

Page 2

Committee
Report No. 15-12

Your Committee received comments relating to brown-water issues and community-managed marine areas (“CMMAs”) from a panel of resource persons. The panel was composed of members from the MNMRC’s Maui Coral Reef Recovery Team, including Dr. Robert Richmond, Director, Kewalo Marine Laboratory, University of Hawaii; Darla White, Special Projects Coordinator, Division of Aquatic Resources, Department of Land and Natural Resources, State of Hawaii; Edwin “Ekolu” Lindsey, President, Maui Cultural Lands; Ms. Hammond; and Ms. Newbold.

Your Committee notes brown water refers to nearshore waters that appear brownish in color because of elevated levels of sediment that enter the ocean in storm water runoff during heavy rain events. Brown water negatively impacts coral reef health by decreasing the availability of sunlight, depositing sediment that suffocates coral, and introducing toxins that affect ocean chemistry.

Your Committee further notes establishing CMMAs is a strategy that promotes resource stewardship among local communities and collaboration between government and community members in the management of marine areas. CMMAs have proven effective at sustaining the long-term support needed for coral reef recovery programs to succeed. An important component of the plan is the establishment of CMMAs at priority sites around Maui.

Your Committee noted concerns related to the prevalence of brown-water events and the need to mitigate the severity of these events.

Your Committee notes the Countywide Policy Plan calls for the protection and restoration of nearshore reefs and improving communication, coordination, and collaboration among government agencies, nonprofit organizations, communities, individuals, and landowners working for the protection of the natural environment.

COUNCIL OF THE COUNTY OF MAUI
INFRASTRUCTURE AND
ENVIRONMENTAL MANAGEMENT
COMMITTEE

Page 3

Committee
Report No. 15-12

Your Committee voted 5-0 to recommend adoption of the revised proposed resolution. Committee Chair Cochran and members Baisa, Carroll, Crivello, and Guzman voted "aye". Committee Vice-Chair Hokama and member White were excused.

Your Committee is in receipt of a further revised proposed resolution incorporating nonsubstantive revisions.

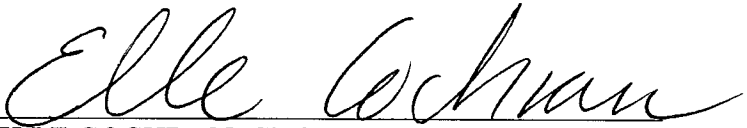
Your Infrastructure and Environmental Management Committee RECOMMENDS that Resolution _____, as revised herein and attached hereto, entitled "RECOGNIZING THE IMPORTANCE OF PROTECTING AND ENHANCING THE REEF ECOSYSTEMS IN MAUI COUNTY", be ADOPTED.

COUNCIL OF THE COUNTY OF MAUI
INFRASTRUCTURE AND
ENVIRONMENTAL MANAGEMENT
COMMITTEE

Page 4

Committee
Report No. 15-12

This report is submitted in accordance with Rule 8 of the Rules of the Council.


ELLE COCHRAN, Chair

iem:cr:15027aa:jkm

Resolution

No. _____

RECOGNIZING THE IMPORTANCE OF PROTECTING AND ENHANCING THE REEF ECOSYSTEMS IN MAUI COUNTY

WHEREAS, the value of Maui County's coral reefs is widely appreciated but not always appropriately considered when decisions are made regarding land use and marine resources; and

WHEREAS, according to the Hawaiian Creation Chant, the *Kumulipo*, the coral polyp was the first living thing to emerge from the sea during creation and is regarded as a foundational ancestor; and

WHEREAS, in the *Kumulipo*, Kānaka Maoli embrace the deep and inseparable relationship between the land and sea, and that the ocean is guarded by what is on the land; and

WHEREAS, the future quality of our lands, waters, and seas that our grandchildren will inherit depend deeply upon wise and careful decisions made today; and

WHEREAS, a 2011 study by the National Oceanic and Atmospheric Administration estimated the economic value of Hawaii's coral reefs at \$33.57 billion; and

WHEREAS, the people of Maui Nui depend on the reefs for nourishment, protection from storms, and jobs and economic security, making it incumbent upon all Hawaii to protect and replenish this critically important habitat; and

WHEREAS, the Maui Nui Marine Resource Council established a Maui Coral Reef Recovery Team that has undertaken efforts toward the technical and cultural restoration of Maui's coral reefs; and

WHEREAS, the United States Coral Reef Task Force acknowledges the significant contributions of the Maui Nui Marine Resource Council, including its model of community-based management and ability to address degradation of coral reefs in Maui Nui by involving communities

Resolution No. _____

in more traditional management while supporting the State's efforts to protect marine resources; and

WHEREAS, the Nature Conservancy recognized the Council's contribution to coral reef restoration with its 2014 Kāko'o 'Āina Award; and

WHEREAS, the Maui Island Plan (Chapter 2, Objective 2.2.2-Action 4), calls for the County to "implement a reef protection restoration plan"; and

WHEREAS, implementing reef restoration goals and policies will require a united effort from County, State, and Federal agencies; nonprofit and nongovernmental organizations; developers and landowners; commercial enterprises; schools and educators; and citizens and ocean users; and

WHEREAS, conservation-based goals and local management goals can work successfully together for the environmental, cultural, and economic well-being of the community; now, therefore,

BE IT RESOLVED by the Council of the County of Maui:

1. That it recognizes the importance of saving, protecting, and enhancing the reef ecosystems of Maui County for their cultural, ecological, subsistence, and economic benefits; and
2. That certified copies of this resolution be transmitted to the Hawaii delegation to the United States Congress; the County's delegation to the State Legislature; the Mayor; the Governor of the State of Hawaii; the National Oceanic and Atmospheric Administration, United States Department of Commerce; the Natural Resources Conservation Service, United States Department of Agriculture; the United States Army Corps of Engineers; the Aha Moku Advisory Committee, Department of Land and Natural Resources, State of Hawaii; the Clean Water Branch, Department of Health, State of Hawaii; the Department of Business Economic Development and Tourism, State of Hawaii; the Department of Transportation, State of Hawaii; the Hawaii Institute of Marine Biology, University of Hawaii; the Office of

Resolution No. _____

Hawaiian Affairs, State of Hawaii; the Office of Planning, State of Hawaii; the University of Hawaii Maui College; the Department of Environmental Management; the Department of Planning; the Department of Public Works; the Hawaiian Islands Humpback Whale National Marine Sanctuary; and the Maui Nui Marine Resource Council.

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15-12

IEM-27

COUNCIL OF THE COUNTY OF MAUI
INFRASTRUCTURE AND
ENVIRONMENTAL MANAGEMENT
COMMITTEE

February 18, 2015

Committee
Report No. _____

Honorable Chair and Members
of the County Council
County of Maui
Wailuku, Maui, Hawaii

Chair and Members:

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Your Committee notes that the Council's Infrastructure and Environmental Management Committee (2013-2015 Council term) met on this matter on December 16, 2013, and December 5, 2014.

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The purpose of the revised proposed resolution is to recognize the importance of saving, protecting, and enhancing the reef ecosystems of Maui County for their cultural, ecological, subsistence, and economic benefits.

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4

COUNCIL OF THE COUNTY OF MAUI
INFRASTRUCTURE AND
ENVIRONMENTAL MANAGEMENT
COMMITTEE

Page 2

Committee
Report No. _____

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Your Committee notes brown water refers to nearshore waters that appear brownish in color because of elevated levels of sediment that enter the ocean in storm water runoff during heavy rain events. Brown water negatively impacts coral reef health by decreasing the availability of sunlight, depositing sediment that suffocates coral, and introducing toxins that affect ocean chemistry.

Your Committee further notes establishing CMMAs is a strategy that promotes resource stewardship among local communities and collaboration between government and community members in the management of marine areas. CMMAs have proven effective at sustaining the long-term support needed for coral reef recovery programs to succeed. An important component of the plan is the establishment of CMMAs at priority sites around Maui.

Your Committee noted concerns related to the prevalence of brown-water events and the need to mitigate the severity of these events.

Your Committee notes the Countywide Policy Plan calls for the protection and restoration of nearshore reefs and improving communication, coordination, and collaboration among government agencies, nonprofit organizations, communities, individuals, and landowners working for the protection of the natural environment.

COUNCIL OF THE COUNTY OF MAUI
INFRASTRUCTURE AND
ENVIRONMENTAL MANAGEMENT
COMMITTEE

Page 3

Committee
Report No. _____

Your Committee voted 5-0 to recommend adoption of the revised proposed resolution. Committee Chair Cochran and members Baisa, Carroll, Crivello, and Guzman voted "aye". Committee Vice-Chair Hokama and member White were excused.

Your Committee is in receipt of a further revised proposed resolution incorporating nonsubstantive revisions.

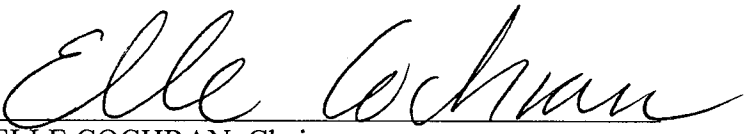
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COUNCIL OF THE COUNTY OF MAUI
INFRASTRUCTURE AND
ENVIRONMENTAL MANAGEMENT
COMMITTEE

Page 4

Committee
Report No. _____

This report is submitted in accordance with Rule 8 of the Rules of the Council.


ELLE COCHRAN, Chair

iem:cr:15027aa:jkm

Resolution

No. _____

RECOGNIZING THE IMPORTANCE OF PROTECTING AND ENHANCING THE REEF ECOSYSTEMS IN MAUI COUNTY

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WHEREAS, in the *Kumulipo*, Kānaka Maoli embrace the deep and inseparable relationship between the land and sea, and that the ocean is guarded by what is on the land; and

WHEREAS, the future quality of our lands, waters, and seas that our grandchildren will inherit depend deeply upon wise and careful decisions made today; and

WHEREAS, a 2011 study by the National Oceanic and Atmospheric Administration estimated the economic value of Hawaii's coral reefs at \$33.57 billion; and

WHEREAS, the people of Maui Nui depend on the reefs for nourishment, protection from storms, and jobs and economic security, making it incumbent upon all Hawaii to protect and replenish this critically important habitat; and

WHEREAS, the Maui Nui Marine Resource Council established a Maui Coral Reef Recovery Team that has undertaken efforts toward the technical and cultural restoration of Maui's coral reefs; and

WHEREAS, the United States Coral Reef Task Force acknowledges the significant contributions of the Maui Nui Marine Resource Council, including its model of community-based management and ability to address degradation of coral reefs in Maui Nui by involving communities

Resolution No. _____

in more traditional management while supporting the State's efforts to protect marine resources; and

WHEREAS, the Nature Conservancy recognized the Council's contribution to coral reef restoration with its 2014 Kāko'o 'Āina Award; and

WHEREAS, the Maui Island Plan (Chapter 2, Objective 2.2.2-Action 4), calls for the County to "implement a reef protection restoration plan"; and

WHEREAS, implementing reef restoration goals and policies will require a united effort from County, State, and Federal agencies; nonprofit and nongovernmental organizations; developers and landowners; commercial enterprises; schools and educators; and citizens and ocean users; and

WHEREAS, conservation-based goals and local management goals can work successfully together for the environmental, cultural, and economic well-being of the community; now, therefore,

BE IT RESOLVED by the Council of the County of Maui:

1. That it recognizes the importance of saving, protecting, and enhancing the reef ecosystems of Maui County for their cultural, ecological, subsistence, and economic benefits; and
2. That certified copies of this resolution be transmitted to the Hawaii delegation to the United States Congress; the County's delegation to the State Legislature; the Mayor; the Governor of the State of Hawaii; the National Oceanic and Atmospheric Administration, United States Department of Commerce; the Natural Resources Conservation Service, United States Department of Agriculture; the United States Army Corps of Engineers; the Aha Moku Advisory Committee, Department of Land and Natural Resources, State of Hawaii; the Clean Water Branch, Department of Health, State of Hawaii; the Department of Business Economic Development and Tourism, State of Hawaii; the Department of Transportation, State of Hawaii; the Hawaii Institute of Marine Biology, University of Hawaii; the Office of

Resolution No. _____

Hawaiian Affairs, State of Hawaii; the Office of Planning, State of Hawaii; the University of Hawaii Maui College; the Department of Environmental Management; the Department of Planning; the Department of Public Works; the Hawaiian Islands Humpback Whale National Marine Sanctuary; and the Maui Nui Marine Resource Council.

iem:027areso01:jkm

IEM Committee

From: Amy Hodges <amy@mnsrc.org>
Sent: Friday, October 30, 2015 9:37 AM
To: IEM Committee; Elle Cochran
Cc: Jordan Molina; Amie M. Stokes
Subject: MNMRC request letter for IEM Committee presentation
Attachments: 151029_RequestLetterIEMCommittee.pdf;
MauiCoralReefs_DecliningTrends_MCRT_FULLTEXT.pdf;
MauiCoralReefs_DecliningTrends_MCRT_SUMMARY.pdf

Aloha Chair Cochran and IEM Committee Members,

Attached please find the Maui Nui Marine Resource Council's letter requesting the opportunity to present our new report "Maui's Coral Reefs: Declining Trends 1993-2015" with the IEM Committee at their meeting on November 16th, 2015. I have also attached a copy of the full report and the report summary. Following the report briefing would be a discussion with the Committee about proposed solutions and ways to work together to achieve reef health.

Please contact me with any questions regarding this request. We look forward to a productive discussion with the IEM Committee.

Mahalo,
Amy

Amy Hodges
Maui Nui Marine Resource Council
Programs and Operations Coordinator
www.mnsrc.org



Working together to restore clean water, healthy coral reefs and abundant native fish populations to the islands of Maui Nui.

October 28, 2015

Chair Elle Cochran and Members of the Infrastructure and Environmental Management Committee
Maui County Council
200 South High Street
Wailuku, HI 96793

Attachments: "Maui's Coral Reefs: Declining Trends 1993-2015" and Summary Report

Re: RESTORATION OF MAUI'S CORAL REEFS (IEM-27)

Dear Chair Elle Cochran and Members of the IEM Committee,

The Maui Nui Marine Resource Council and members of the Maui Coral Reef Recovery Team respectfully request the opportunity to discuss our new report: "Maui's Coral Reefs: Declining Trends 1993-2015" (Report) at the IEM Committee meeting on November 16th, 2015.

Attached is a copy of both the Report and the Report Summary document.

On February 2, 2015, the Maui Nui Marine Resource Council last met with members of Maui County's IEM committee to support their Resolution "Recognizing the importance of protecting and enhancing the reef ecosystems in Maui County", and provided a panel of experts to during a question/answer period for members of IEM.

As a follow up to the successful passage of the reef resolution, we propose the following for the November 16th meeting: (1) briefing on a newly released report "Maui's Coral Reefs: Declining Trends 1993-2015", including summary of efforts underway to reverse the declines, (2) meaningful discussion on proposed solutions presented to identify ways the community members and the County can continue to work together to address land-based issues impacting the reefs, and (3) provide a panel of experts from the Maui Coral Reef Recovery Team to answer questions.

Proposed panelists might include up to five of the following Maui Coral Reef Recovery Team Members:

- Mark Deakos, Hawaii Association for Marine Education and Research
- John Gorman, Curator Maui Ocean Center Curator
- Tegan Hammond, Maui Coral Reef Recovery Plan Coordinator
- Ekolu Lindsey, Polanui Hiu Community Managed Makai Area
- Robin Newbold, Chair Maui Nui Marine Resource Council
- Dr. Robert Richmond, Director UH Manoa Kewalo Marine Laboratory
- Darla White, Division of Aquatic Resources
- Mike Field, Senior Scientist Emeritus U.S. Geological Survey
- Thorne Abbott, Coastal Planning

Thank you for the continued opportunity to work together to care for Maui County's coral reefs.

Sincerely,

Robin Newbold,
Chair Maui Nui Marine Resource Council



MAUI'S CORAL REEFS: DECLINING TRENDS 1993–2015

Report Summary



The health of Maui's coral reefs is inextricably linked to our local economy and well-being. However, Maui's coral reefs are in serious trouble.

- During the past two decades, nearly one-quarter of Maui's corals have been lost, with half of Maui's reef sites currently experiencing declining health.
- Since 1995, the biomass (amount, by weight) of culturally and economically important reef fish species found on Maui's reefs has declined significantly.
- The average amount of reef fish found around Maui's reefs is the second lowest of all of the islands in the State, behind only O'ahu.
- Nearly 90% of water quality samples taken around Maui in the period 2012–2014 exceeded State Water Quality Standards for turbidity, nutrients, and/or bacteria.
- There are three primary drivers behind Maui's negative coral reef trends: (1) introduced land-based pollutants and sediments; (2) overfishing coupled with poor fishing regulation enforcement; and (3) insufficient 'resting' (kapu) sites to provide the adequate time and space for marine species to recover from stresses, and then 'spill over' and replenish adjacent areas.

Our diagnosis for 2015: the status of Maui's coral reef health is **poor**. In the absence of increased treatment and effective management, continued declines in reef health are expected in coming years.

Reversing Maui's Declining Reef Health

Fortunately, experiences in Hawaii and other places around the world illustrate how to overcome such declines. There are 5 priorities we must act on in the next 3 years:

- Build the capacity and increase the number of community-managed marine areas (CMMAs) around Maui to implement coral reef recovery strategies through collaborative efforts;
- Enhance enforcement of current rules and regulations within Maui's coastal waters;
- Expand the network of coral reef areas under protection around Maui, with a target of protecting 20% of Maui's coral reef ecosystems sustainably managed by 2020 (currently <2%);
- Implement policies and practices to reduce the flow of sediment and nutrients onto Maui's reefs; and
- Promote a collaborative approach to marine resource management around Maui.

If we take appropriate action, Maui's reefs can recover. However, this vision depends on our collective commitment to do so.

Our recommendation for 2016+: the current level of action to restore the health of Maui's reefs is **insufficient**; we must **commit fully** to taking the actions necessary to protect Maui's coral reefs by urgently expanding the level and scope of management and protection.

To read the full report, please visit <http://www.mnmrc.org/mauis-coral-reefs-declining-trends-report>

© 2015 Maui Nui Marine Resource Council.

Our vision: the waters of Maui Nui are clean, our coral reefs healthy, and our native fishes abundant.

Learn more and get involved at <http://www.mnmrc.com> and <https://www.facebook.com/MNMRC>

This document was prepared by the Maui Coral Recovery Team: a voice for the health of Maui's reefs. We have created this report both for Hawaii's decision makers and the public. Our team is comprised of Hawaii's preeminent coral reef scientific and management experts from across the islands. We work together on a voluntary basis driven by our shared concern regarding the fate of Maui's coral reefs. We support decision makers and local communities to take action that effectively manages Maui's coral reefs for the benefit of current and future generations.



MAUI'S CORAL REEFS: DECLINING TRENDS 1993–2015

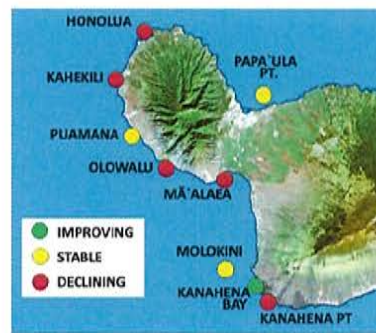
The health of Maui's coral reefs is inextricably linked to our local economy and well-being. However, Maui's coral reefs are in serious trouble. Recent scientific studies clearly illustrate the decline now underway. During the past two decades, nearly one-quarter of Maui's corals have been lost,^{1,2} with half of Maui's reef sites currently experiencing declining health (see map).^{3,4} The largest declines have been observed on reefs adjacent to residential centers and agricultural lands such as Kahekili, Papa'ula Point, Honolua Bay, and Mā'alaea Bay, where on average the percent of living coral at sites has dropped from more than 30–50% in 1993, to less than 5–10% today.^{5,6,7} Even with minimal upland development, Olowalu reef has declined from 43% to 33% live reef during this time.

As the amount of living reef has declined, so too have Maui's native reef fish populations. Since 1995, the biomass (amount, by weight) of culturally and economically important reef fish species found on Maui's reefs has declined significantly.⁸ As with other main islands, some fish stocks around Maui have seen declines of more than 90% over the past century.⁹ As a result, the average amount of reef fish found around Maui's reefs is the second lowest in the State, behind only O'ahu (see Figure 1).¹⁰

The quality of Maui's coastal waters is also a concern for coral reefs because reefs require clean clear water and bottom substrate for growth and reproduction. Nearly 90% of water quality samples taken around Maui in the period 2012–2014 exceeded State Water Quality Standards for turbidity, nutrients, and/or bacteria.¹¹ Maui's impaired waters are a public health concern for humans and for marine life. Improving coastal water quality is essential to the survival and recovery of reefs.

The reasons for these declines relate to the increasing use of Maui's coastal lands and waters. There are three primary drivers behind these negative trends: (1) introduced land-based pollutants and sediments onto reefs;^{12,13} (2) overfishing coupled with poor enforcement of current fishing regulations;^{14,15,16} and (3) insufficient 'resting' (kapu) sites that protect marine life by providing adequate time and space to recover from stresses, and then 'spill over' and replenish adjacent areas.^{17,18}

In addition, there are emerging impacts beyond Hawai'i's control that threaten to further damage Maui's reefs:^{19,20} increasing ocean temperatures²¹ that result in coral bleaching, rising sea levels²², ocean acidification²³, and increasing frequency and intensity of coastal storms.²⁴



Healthier reefs are more resilient and have a greater chance of recovery following disturbances and ocean change.

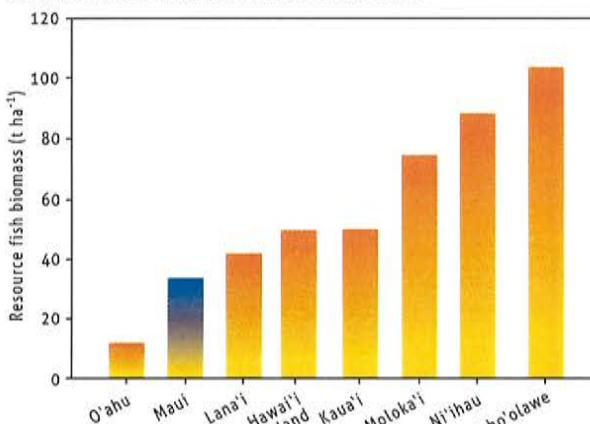
Our best hope to protect Maui's corals from global threats is to reduce local stressors like pollution and overfishing.

Similar to monitoring human health, we can periodically 'check-up' on the health of Maui's coral reefs. Like people, healthier reefs have a greater chance of recovery from periodic illnesses than ones that are continually stressed and/or diseased. Summary check-up results regarding the current health of Maui's reefs are presented below (Box 1). They are deeply alarming.

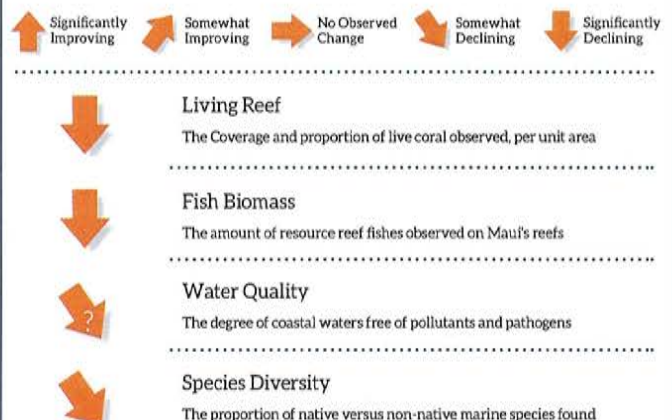
Our Diagnosis in 2015

The status of Maui's coral reef health is poor. In the absence of increased treatment and effective management, continued declines in reef health are expected in coming years.

Figure 1: Resource fish biomass across the main Hawaiian Islands. Data courtesy of Friedlander et al. 2015.



Box 1: Summary results on the current health of Maui's coral reefs (trends in key diagnostics of health: 1995–2015)



REVERSING THE DECLINE

Why We Should Care About Maui's Reefs

Maui is home to some of the largest and most complex coral reefs in the main islands. These reefs provide innumerable cultural, economic, and recreational benefits to the people and the visitors of Maui. Continued losses will forever alter the economic value, quality of life, and traditional and cultural connections of these irreplaceable resources for Maui's people.

Simply acknowledging that there is a problem is not enough to solve it. Through the customary and shared native Hawaiian value of kuleana, we feel strongly compelled to let the public know about the observed declines in the health of Maui's coral reefs. Fortunately, Hawai'i and other places around the world have shown us how to reverse such declines, and we believe that it is not too late to do so. Accordingly, we must act immediately to reverse and stop these alarming trends.

We are encouraged by the recent increased local engagement and action that has been taken to restore reefs in people's communities.

The creation of community-managed makai areas (CMMAs) starting in 2010 and the initiation of the Maui Community Managed Makai Area Network in 2013 hold great promise.

At Kahekili a new preserve is protecting herbivorous reef fish. New rules were also recently passed limiting the number of parrot and goatfish that can be fished. We also have a much stronger scientific understanding of the status and trends in the health of Maui's reefs and fish populations than we did a generation ago, providing us with an improved level of precision to guide our actions and objectively measure the outcomes of our management efforts. For example, we know through a recent comparison of 310 sites around the world that using resting areas (kapu) in modern times typically helps to restore both reef fish populations and coral habitat.²⁵ Despite these successes, we remain deeply concerned.

This report has been written for you, because you can help to reverse Maui's declining reef health.

There are 5 priority actions that we must increase beyond current levels of effort (see Box 2) during the next 3 years: (1) building the capacity and increasing the number of CMMAs around Maui to implement coral reef recovery strategies through collaborative efforts; (2) enhance enforcement of current marine resource rules and regulations within Maui's coastal waters; (3) expand the network of coral reef areas under protection around Maui, with a target of protecting 20% of Maui's coral reef ecosystems sustainably managed by 2020 (currently < 2%); (4) implementing policies and practices to reduce sediment and nutrients flowing onto Maui's reefs; and (5) promote a collaborative approach to marine resource management around Maui.²⁶ If we take appropriate action, Maui's reefs will recover. This hope depends on our collective commitment to do so.

Our Recommendation for 2016+

The current level of action to restore the health of Maui's reefs is insufficient; we must commit fully to taking the actions necessary to protect Maui's coral reefs by urgently expanding the level and scope of protection and community involvement.

All footnoted references are available online at:

<http://www.mnmrc.org/maui-coral-reefs-declining-trends-report>

Box 2: Taking Action for Maui's Coral Reefs

Degree of Action to Date:

LOW

MODERATE

HIGH

Build the capacity and number of Maui's CMMAs

Community-Managed Marine Areas (CMMAs) organized and implemented by local communities and their partners around Maui



Enhance enforcement of current rules and regulations

Increase the effectiveness of local enforcement of current coastal and marine resource rules and regulations by designated authorities



Expand network of coral reef protected areas around Maui

Coral reef sites that have been designated as kapu to allow the necessary time and space for corals and reef fish to recover



Reduce sediment and nutrients flowing onto reefs

Implement best management practices to control storm- and waste-water runoff onto coral reefs adjacent to Maui's coastline



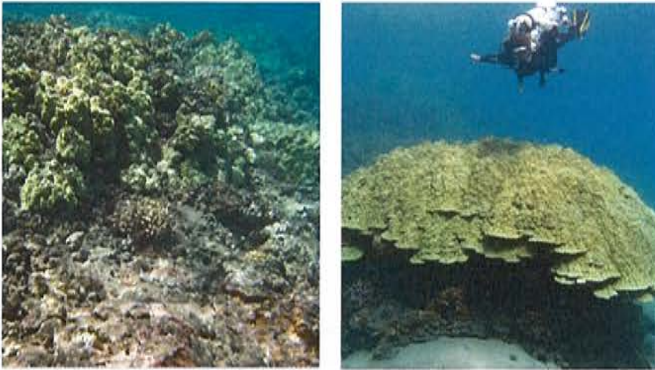
Promote collaborative marine resource management

Shift marine resource management authority and responsibility from State-only to a collaboration between State and local Maui communities



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**This report was prepared by the Maui Coral Recovery Team:
A voice for the health of Maui's reefs**



We have created this report both for Hawai'i's decision makers and the public. Our team is comprised of Hawai'i's preeminent coral reef scientific and management experts from across the islands. We work together on a voluntary basis driven by our shared concern regarding the fate of Maui's coral reefs. We support decision makers and local communities to take action that effectively manages Maui's coral reefs for the benefit of current and future generations.

¹ DAR 2014. Status and Trends of Maui's Coral Reefs. State of Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources and the Hawai'i Coral Reef Initiative Research Program. Honolulu, HI. 2 pages.

² Rodgers et al. 2015. "Over a decade of change in spatial and temporal dynamics of Hawaiian coral reef communities." *Pacific Science*. 69(1): 1–13.

³ CRAMP map for Maui Nui

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¹⁴ Walsh et al. 2009. "Long-term monitoring of coral reefs of the Main Hawaiian Islands: final report." NOAA Coral Reef Conservation Program and the State of Hawai'i. Report NA06NOS4260113. Honolulu, HI.

¹⁵ Friedlander, A.M., E.K. Brown, and M. E. Monaco 2007. "Defining reef fish habitat utilization patterns in Hawai'i: comparisons between MPAs and areas open to fishing." *Marine Ecology Progress Series*. 351: 221–233.

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¹⁷ Friedlander et al. 2010. "Monitoring Hawai'i's Marine Protected Areas: Examining Spatial and Temporal Trends Using a Seascape Approach." NOAA Technical Memorandum NOS NCCOS 117. Prepared by the NCCOS Center for Coastal Monitoring and Assessment Biogeography Branch. Silver Spring, MD. 130 pp.

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Download online at: <http://www.mnmrc.org/maui-coral-reefs-declining-trends-report>



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Our vision: the waters of Maui Nui are clean, our coral reefs healthy, and our native fishes abundant.

Learn more and get involved at <http://www.mnmrc.com> and <https://www.facebook.com/MNMRC>

This document was prepared by the Maui Coral Recovery Team; a voice for the health of Maui's reefs. We have created this report both for Hawaii's decision makers and the public. Our team is comprised of Hawaii's preeminent coral reef scientific and management experts from across the islands. We work together on a voluntary basis driven by our shared concern regarding the fate of Maui's coral reefs. We support decision makers and local communities to take action that effectively manages Maui's coral reefs for the benefit of current and future generations.

Survey for briefing "MAUI'S CORAL REEFS: DECLINING TRENDS 1993-2015"

PRE-SURVEY

1. [Circle One] The economic value of our State's coral reefs was estimated in 2002 at:

- a. (~\$1 billion) b. (\$1 bill-\$7 bill) c. (\$7 bill-\$12 bill) d. (\$12 bill-\$20 bill) e. (~\$34 bill)

2. [Circle One] The Economic value the American people hold for Hawaii's coral reefs is:

- a. (~\$1 billion) b. (\$1 bill-\$7 bill) c. (\$7 bill-\$12 bill) d. (\$12 bill-\$20 bill) e. (~\$34 bill)

3. [Circle one] During the past two decades nearly what % of Maui's corals have been lost:

- a. (~15%) b. (15% - 30%) c. (30%-50%) d. (50%-75%)

4. [Please number #1,#2,#3] What are the 3 biggest threats to coral reefs **locally** today:

- _____ Invasive Algae _____ Climate change
 _____ Sunscreen _____ Sediment & other land-based pollutants
 _____ Over-fishing coupled with poor enforcement of current fishing regulations
 _____ Insufficient resting sites to protect essential recovery functions from stressors

5. [Please write out] CMMA is an acronym that stands for: _____

6. [Circle One] There are currently how many CMMAs in Maui Nui?

- a. (None) b. (1-4) c. (5-7) d. (8-11) e. (12+)

7. [Please rank] your present knowledge and/or experience about how marine management network planning works for both fish replenishment for our fishers and coral reef health:

- 1 2 3 4 5 6 7 8 9 10

8. [Please circle] The current % of Hawaii's waters that are now a part of some kind of marine management is:

- (None) (Less than 2%) (2%-10%) (10%-30%) (30%-40%) (Greater than 50%)

9. [CheckOne] The current ranking of Maui's "resource fish biomass" (how many by weight of the ones we like catch!) is _____ among the main Hawaiian Islands?

- _____ The most abundant
 _____ 3rd lowest
 _____ 2nd lowest

10. [Please rank] your level of interest and motivation in actively fostering solutions & partnerships for caring for our coral reefs?

- 1 2 3 4 5 6 7 8 9 10

(Optional) Please list any additional thoughts/questions you would like us to follow up on:

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Robin Newbold

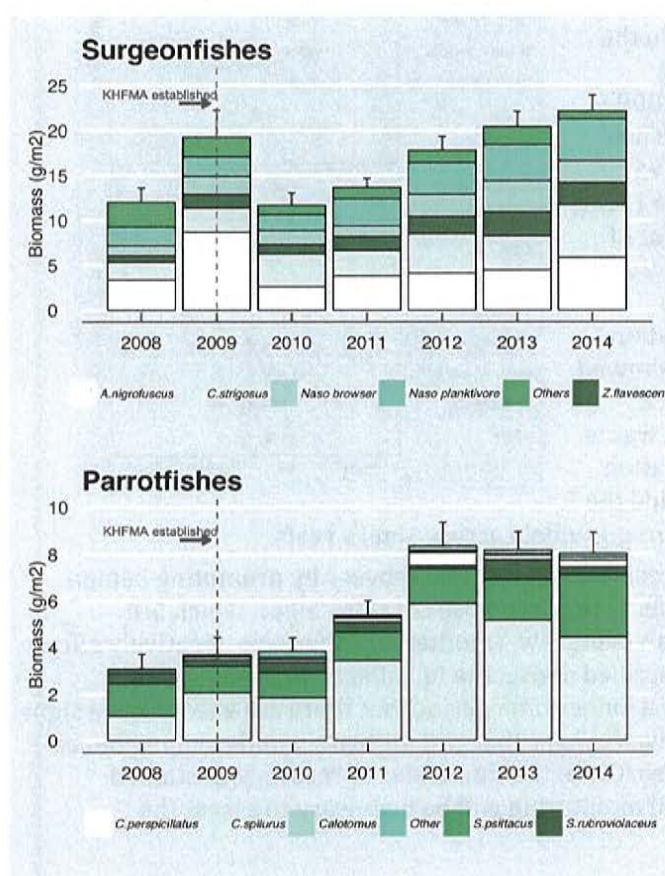
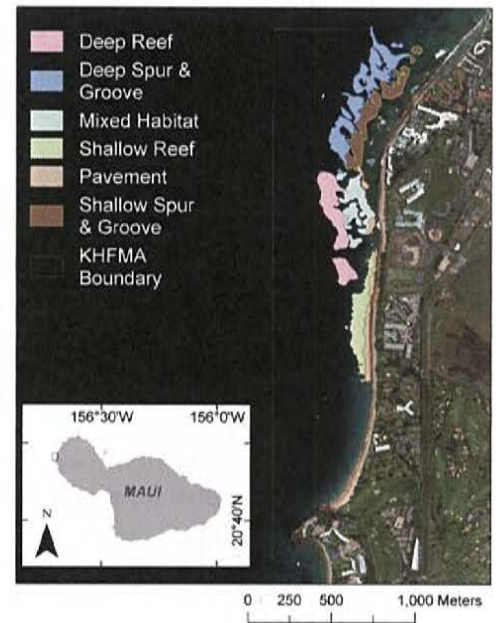
- (Optional) Please list any additional thoughts/questions you would like us to follow up on:**

Results Brief:

5 Years of Protection at Kahekili Herbivore Fisheries Management Area

Summary. In response to concerns about long-term declines on local reefs, in 2009, the State of Hawaii established the Kahekili Herbivore Fisheries Management Area (KHFMA) in Ka'anapali, West Maui. Within the KHFMA, herbivorous fishes and sea urchins are protected, with the goal of restoring natural grazing processes and thereby ultimately increasing the reef's ability to resist and recover from excessive algal growth. Over the first 5 years of closure, parrotfish biomass increased by 138%, and surgeonfish biomass by 42%. Likely as a response to increased herbivory, there has been a concurrent increase in crustose coralline algae (CCA) that is preferred habitat for coral settlement and growth. Following a period of decline, coral cover has stabilized and even slightly increased in recent years. These encouraging early results indicate that a more naturally resilient reef ecosystem is developing at the KHFMA, but sustained protection will be necessary before the full effects of this form of management will be known.

Coral reef monitoring within the KHFMA. The Hawai'i Division of Aquatic Resources (HDAR) in partnership with the University of Hawai'i began a comprehensive monitoring program of coral reef areas within the KHFMA in January 2008 (~18 months prior to the closure). Subsequently, that program has been maintained using consistent methods and survey design - since 2010 as a partnership between HDAR and NOAA Pacific Islands Fisheries Science Center. Monitoring involves 1-2 rounds per year, generally in spring and late summer, with each round comprising co-located surveys of fishes, sea-urchins, and benthic habitat (e.g., corals and algae) at ~80-100 haphazardly located sites. The figure above shows the coral reef areas within the KHFMA, classified into 6 reef types. Summary results from the KHFMA monitoring program and additional survey work by HDAR at other locations in Maui County are presented below.

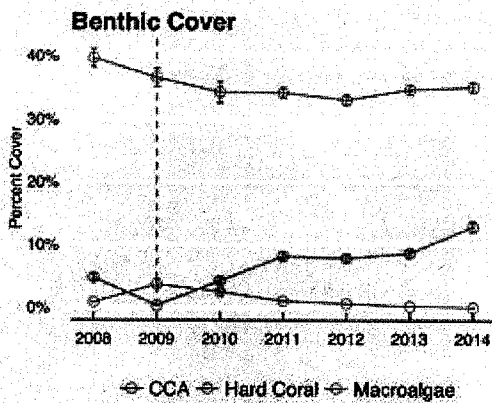


Trends in protected fish families after 5 years of closure. Increases in 2-yr average biomass between the pre-closure period 2008-9 and the most recent post-closure period 2013-14 are evident for both surgeonfish and parrotfish:

- Surgeonfish biomass increased by 42%. While the net overall change is relatively small, there has been a steady increase in biomass in all years from 2010 onwards. Much of that increase has been of smaller-bodied species including yellow tang (*Zebrasoma flavescens*) and kole (*Ctenochaetus strigosus*). Mean biomass of browsing *Naso* species, e.g. kala (*Naso unicornis*) has also increased, but the change so far is not statistically significant.
- Parrotfish biomass has more than doubled, increasing by 138%. Most of that increase has been of two species, the bullethead and palenose (*Chlorurus spilargenteus* and *Scarus psittacus*), but larger bodied species - redlip and spectacled (*S. rubroviolaceus* and *C. perspicillatus*) - have been more frequently encountered in recent years.

Other long-term studies of coral reef closures have shown that full recovery can take many years, and that surgeonfishes, which can live for > 40 years, tend to have particularly long trajectories of recovery. Further increases in herbivorous fish biomass are expected, particularly for surgeonfishes and the larger-bodied and longer-lived parrotfishes, if the protections are continued.

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Russell Sparks



Trends in coral and algal communities after 5 years of closure.

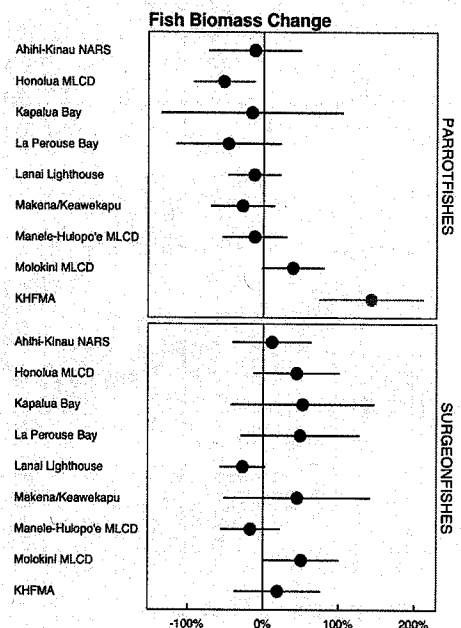
As noted above, sustained protection over many more years will be necessary to properly assess the full impacts of herbivore management at the KHFMA. This is particularly true for corals, which grow relatively slowly. However, there have already been some changes to benthic communities within the KHFMA that are consistent with the expected beneficial effects of herbivore protection.

- Cover of crustose coralline algae (CCA) has increased from 2.5% in 2008-9 to 12.8% in 2013-14. Coral will tend to grow and recruit more readily on reefs with abundant CCA.
- Cover of macroalgae (i.e. 'large' fleshy algae that will tend to inhibit coral growth and recruitment) has remained low throughout the monitoring period, declining to negligible levels over the last few years.

Increased CCA cover and the decline of macroalgae signal a shift in the benthic algal community towards one that is more beneficial for coral settlement and growth. The response of the coral assemblage inevitably lags behind those changes, and therefore it is difficult to predict the ultimate effects of herbivore management at KHFMA on corals. However, after declining between 2008 and 2010 (i.e. one year prior to closure till one year post closure), hard coral cover has since stabilized. Over the last 2 years there has even been a small uptick in coral cover (from 32.9% in 2012, to 34.9% in 2014). It is, however, too early to know if that increase in coral cover represents the start of a meaningful longer-term trend.

Changes in the KHFMA compared to wider patterns across Maui Nui.

Clearly there are larger-scale factors that influence the condition of fish and benthic communities in the KHFMA and beyond. It is therefore important to compare change within the KHFMA with what is happening more widely. One way to do that is to use data from other long-term monitoring surveys conducted by HDAR and partners over the same time period. For example, the figure to the right shows percent change (and 95% confidence interval) in biomass (g/m^2) of parrotfishes and surgeonfishes between 2008-9 and 2013-14 at the 8 locations surveyed by HDAR's 'resource fish' monitoring program and inside the KHFMA. For consistency with that larger survey program, the data used are only for fishes >15cm long and some lightly targeted surgeonfishes are excluded. Out of the 9 locations, the only significant increase in parrotfishes across the 5-yr time interval was at the KHFMA. There have been no significant changes in surgeonfish biomass at any survey location. A similar assessment of benthic changes at 9 Maui locations showed no clear overall trend for CCA, which significantly declined at 2 locations and increased at 2. By far the largest change in CCA was at Kahekili – an increase of ~ 10%; the increase at the other location was ~2%. Therefore, it appears that the positive changes inside the KHFMA since its creation are not part of a larger pattern occurring widely across Maui's reefs.



Looking ahead. Protection of herbivores could increase reef resilience and coral recovery by promoting benign algal forms that tend to dominate in heavily grazed environments (e.g., crustose coralline algae, which are important for coral settlement), and by reducing algae that can overgrow, smother, or otherwise negatively affect corals (generally upright macroalgae and dense turfs). As described above, the full effects on fishes and on relatively slow-growing corals will only become evident over a longer time period, but there are encouraging signs that herbivore management at KHFMA is leading to the positive changes that will ultimately underpin resilience and recovery of the coral assemblage within the protected area. Given the timescales of recovery, sustained compliance with KHFMA regulations and continued ecological monitoring will be necessary to assess the effectiveness of this management initiative.

____.B. NO.____

A BILL FOR AN ACT

RELATING TO AQUATIC RESOURCES.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF HAWAII:

1 SECTION 1. Traditional Hawaiian stewardship practices
2 include the careful management of ocean and marine life
3 resources. Today many Hawaiian communities, especially in the
4 County of Maui, are revitalizing and implementing traditional
5 marine stewardship, such as Ko'ie'ie Fish Pond in Kihei, Ali'i
6 and Kalokoeli Fish Ponds on Molokai. Despite these efforts to
7 help replenish aquatic life; declines in various marine species
8 has resulted from the taking of excess fish and other aquatic
9 life. Unfortunately, damage to marine resources is often not
10 well documented or understood until irreversible or severe
11 damage occurs. These impacts can be reversed by proactive
12 stewardship. For the sake of preservation of the environment,
13 economy, social and cultural importance to the people of Hawaii
14 and its future generations, controlling the taking of marine
15 life must be regulated. Spearfishing is an ancient method of
16 fishing that has been used throughout the world for millennia,
17 however spearfishing for commercial purposes does not perpetuate

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Councilmember Carroll

spearfishing_bill

X

____.B. NO. _____

1 the tradition as implemented within Hawaiian history and
2 culture.

3 Therefore, the purpose of this Act is to prohibit the sale
4 of marine life that has been secured by the use of a spear.

5 SECTION 2. Chapter 188, Hawaii Revised Statutes is amended
6 by adding a new section to be appropriately designated and to
7 read as follows:

8 "§188- Selling of aquatic life secured by spearfishing,
9 prohibited; penalties and fines. (a) It shall be unlawful for
10 any person at any time to knowingly or intentionally sell or
11 offer to sell aquatic life acquired by use of a spear and
12 removed from any of the waters within the jurisdiction of the
13 State.

14 (b) This section shall not apply to a person exercising a
15 customary and traditional right for subsistence, cultural, or
16 religious purposes, subject to the right of the State to
17 regulate that right, including native Hawaiian gathering rights
18 and traditional cultural practices as authorized by law or as
19 permitted by the State pursuant to article XII, section 7, of
20 the Hawaii state constitution.

____.B. NO. _____

1 (c) This section shall not apply to individuals that
2 spearfish for personal use as human consumption or bait and have
3 no intention to sell the aquatic life.

4 (d) Any person violating this section or any rule adopted
5 pursuant to this section shall be guilty of a misdemeanor;
6 provided that the fine for violating this section shall be:

7 (1) \$500 for a first offense;

8 (2) \$2,000 for a second offense; and

9 (3) \$10,000 for a third or subsequent offense.

10 (e) In addition to any other penalty imposed under this
11 section, a person violating this section shall be subject to:

12 (1) An administrative fine of not more than \$1,000 for
13 each aquatic life specimen sold;

14 (2) Seizure and forfeiture of any taken aquatic life
15 specimens, fishing and commercial marine license, vessel and
16 equipment; and

17 (3) Assessment of administrative fees and costs and
18 attorney's fees and costs.

19 "§188- Definitions. As used in this chapter, the following
20 terms shall have the following respective meanings, unless the
21 context requires otherwise:

.B. NO.

1 "Aquatic life" means any type or species of mammal, fish,
2 amphibian, reptile, mollusk, crustacean, arthropod,
3 invertebrate, coral, or other animal that inhabits the ocean and
4 freshwater environments.

5 "Sell" means to transfer, prescribe, give, or deliver to
6 another; to leave, barter, or exchange with another; or to offer
7 or agree to do the same to another for consideration."

8 "Speared" means pierced, impaled, penetrated, struck, or
9 run through by a sharp, pointed implement.

10 "Spearfishing" means fishing by the use of a speargun,
11 polespear or handspear, Hawaiian sling, elastic-powered speargun
12 and sling, pneumatic speargun, or mechanically powered
13 speargun."

14 SECTION 3. Statutory material to be deleted is bracketed
15 and in strikethrough. New statutory material is underscored.

16 SECTION 4. This Act shall take effect upon its approval.

17
18 INTRODUCED BY: _____

Maui's Coral Reefs: Declining Trends 1993-2015

and

Restoration of Maui's Coral Reefs (IEM-27)

Maui County Council

Infrastructure and Environmental Management Committee Meeting

November 16, 2015



RECEIVED AT IEM MEETING ON 11/16/15

IEM-27





MAUI'S CORAL REEFS: DECLINING TRENDS 1993–2015

The health of Maui's coral reefs is inextricably linked to our local economy and well-being. However, Maui's coral reefs are in serious trouble. Recent scientific studies clearly illustrate the decline now underway. During the past two decades, nearly one-quarter of Maui's corals have been lost,^{1,2} with half of Maui's reef sites currently experiencing declining health (see map).^{3,4} The largest declines have been observed on reefs adjacent to residential centers and agricultural lands such as Kahekili, Papa'ula Point, Honolua Bay, and Mā'alaea Bay, where on average the percent of living coral at sites has dropped from more than 30–50% in 1993, to less than 5–10% today.^{5,6,7} Even with minimal upland development, Olowalu reef has declined from 43% to 33% live reef during this time.

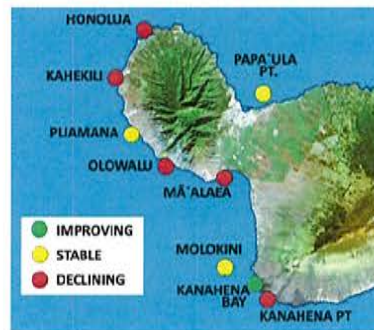
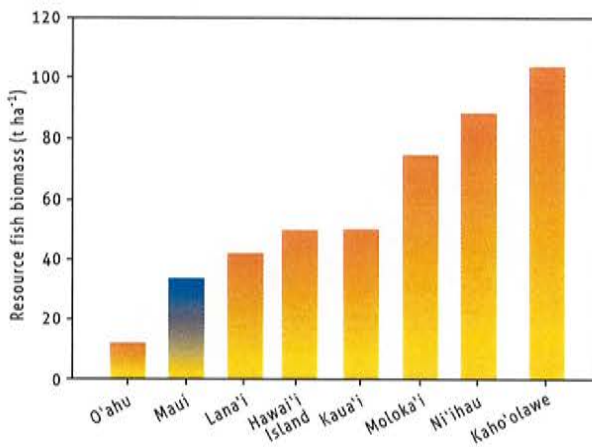
As the amount of living reef has declined, so too have Maui's native reef fish populations. Since 1995, the biomass (amount, by weight) of culturally and economically important reef fish species found on Maui's reefs has declined significantly.⁸ As with other main islands, some fish stocks around Maui have seen declines of more than 90% over the past century.⁹ As a result, the average amount of reef fish found around Maui's reefs is the second lowest in the State, behind only O'ahu (see Figure 1).¹⁰

The quality of Maui's coastal waters is also a concern for coral reefs because reefs require clean clear water and bottom substrate for growth and reproduction. Nearly 90% of water quality samples taken around Maui in the period 2012–2014 exceeded State Water Quality Standards for turbidity, nutrients, and/or bacteria.¹¹ Maui's impaired waters are a public health concern for humans and for marine life. Improving coastal water quality is essential to the survival and recovery of reefs.

The reasons for these declines relate to the increasing use of Maui's coastal lands and waters. There are three primary drivers behind these negative trends: (1) introduced land-based pollutants and sediments onto reefs;^{12,13} (2) overfishing coupled with poor enforcement of current fishing regulations;^{14,15,16} and (3) insufficient 'resting' (kapu) sites that protect marine life by providing adequate time and space to recover from stresses, and then 'spill over' and replenish adjacent areas.^{17,18}

In addition, there are emerging impacts beyond Hawai'i's control that threaten to further damage Maui's reefs:^{19,20} increasing ocean temperatures²¹ that result in coral bleaching, rising sea levels²², ocean acidification²³, and increasing frequency and intensity of coastal storms.²⁴

Figure 1: Resource fish biomass across the main Hawaiian Islands. Data courtesy of Friedlander et al. 2015.



Healthier reefs are more resilient and have a greater chance of recovery following disturbances and ocean change.

Our best hope to protect Maui's corals from global threats is to reduce local stressors like pollution and overfishing.

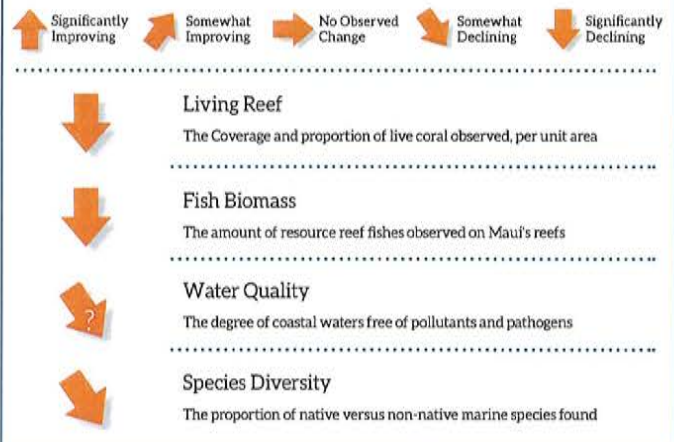
Similar to monitoring human health, we can periodically 'check-up' on the health of Maui's coral reefs. Like people, healthier reefs have a greater chance of recovery from periodic illnesses than ones that are continually stressed and/or diseased. Summary check-up results regarding the current health of Maui's reefs are presented below (Box 1). They are deeply alarming.

Our Diagnosis in 2015

The status of Maui's coral reef health is poor. In the absence of increased treatment and effective management, continued declines in reef health are expected in coming years.

Box 1: Summary results on the current health of Maui's coral reefs

(trends in key diagnostics of health: 1995–2015)



REVERSING THE DECLINE

Why We Should Care About Maui's Reefs

Maui is home to some of the largest and most complex coral reefs in the main islands. These reefs provide innumerable cultural, economic, and recreational benefits to the people and the visitors of Maui. Continued losses will forever alter the economic value, quality of life, and traditional and cultural connections of these irreplaceable resources for Maui's people.

Simply acknowledging that there is a problem is not enough to solve it. Through the customary and shared native Hawaiian value of kuleana, we feel strongly compelled to let the public know about the observed declines in the health of Maui's coral reefs. Fortunately, Hawai'i and other places around the world have shown us how to reverse such declines, and we believe that it is not too late to do so. Accordingly, we must act immediately to reverse and stop these alarming trends.

We are encouraged by the recent increased local engagement and action that has been taken to restore reefs in people's communities.

The creation of community-managed makai areas (CMMAs) starting in 2010 and the initiation of the Maui Community Managed Makai Area Network in 2013 hold great promise.

At Kahekili a new preserve is protecting herbivorous reef fish. New rules were also recently passed limiting the number of parrot and goatfish that can be fished. We also have a much stronger scientific understanding of the status and trends in the health of Maui's reefs and fish populations than we did a generation ago, providing us with an improved level of precision to guide our actions and objectively measure the outcomes of our management efforts. For example, we know through a recent comparison of 310 sites around the world that using resting areas (kapu) in modern times typically helps to restore both reef fish populations and coral habitat.²⁵ Despite these successes, we remain deeply concerned.

This report has been written for you, because you can help to reverse Maui's declining reef health.

There are 5 priority actions that we must increase beyond current levels of effort (see Box 2) during the next 3 years: (1) building the capacity and increasing the number of CMMAs around Maui to implement coral reef recovery strategies through collaborative efforts; (2) enhance enforcement of current marine resource rules and regulations within Maui's coastal waters; (3) expand the network of coral reef areas under protection around Maui, with a target of protecting 20% of Maui's coral reef ecosystems sustainably managed by 2020 (currently < 2%); (4) implementing policies and practices to reduce sediment and nutrients flowing onto Maui's reefs; and (5) promote a collaborative approach to marine resource management around Maui.²⁶ If we take appropriate action, Maui's reefs will recover. This hope depends on our collective commitment to do so.

Our Recommendation for 2016+

The current level of action to restore the health of Maui's reefs is insufficient; we must commit fully to taking the actions necessary to protect Maui's coral reefs by urgently expanding the level and scope of protection and community involvement.

All footnoted references are available online at:
<http://www.mnmrc.org/maui-coral-reefs-declining-trends-report>

Box 2: Taking Action for Maui's Coral Reefs

Degree of Action to Date:

LOW MODERATE HIGH

Build the capacity and number of Maui's CMMAs

Community-Managed Marine Areas (CMMAs) organized and implemented by local communities and their partners around Maui



Enhance enforcement of current rules and regulations

Increase the effectiveness of local enforcement of current coastal and marine resource rules and regulations by designated authorities



Expand network of coral reef protected areas around Maui

Coral reef sites that have been designated as kapu to allow the necessary time and space for corals and reef fish to recover



Reduce sediment and nutrients flowing onto reefs

Implement best management practices to control storm- and waste-water runoff onto coral reefs adjacent to Maui's coastline



Promote collaborative marine resource management

Shift marine resource management authority and responsibility from State-only to a collaboration between State and local Maui communities



REFERENCES

This report was prepared by the Maui Coral Recovery Team:
A voice for the health of Maui's reefs



We have created this report both for Hawai'i's decision makers and the public. Our team is comprised of Hawai'i's preeminent coral reef scientific and management experts from across the islands. We work together on a voluntary basis driven by our shared concern regarding the fate of Maui's coral reefs. We support decision makers and local communities to take action that effectively manages Maui's coral reefs for the benefit of current and future generations.

- ¹ DAR 2014. Status and Trends of Maui's Coral Reefs. State of Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources and the Hawai'i Coral Reef Initiative Research Program. Honolulu, HI. 2 pages.
- ² Rodgers et al. 2015. "Over a decade of change in spatial and temporal dynamics of Hawaiian coral reef communities." *Pacific Science*. 69(1): 1–13.
- ³ CRAMP map for Maui Nui
- ⁴ Walsh et al. 2009. "Long-term monitoring of coral reefs of the Main Hawaiian Islands: final report." NOAA Coral Reef Conservation Program and the State of Hawai'i. Report NA06NOS4260113. Honolulu, HI.
- ⁵ Brown et al. 2015. "State of the Coral Reef Ecosystems of Maui and Lāna'i, Hawai'i." Manuscript in review.
- ⁶ Rodgers et al. 2015. "Over a decade of change in spatial and temporal dynamics of Hawaiian coral reef communities." *Pacific Science*. 69(1): 1–13.
- ⁷ DAR 2014. Status and Trends of Maui's Coral Reefs. State of Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources and the Hawai'i Coral Reef Initiative Research Program. Honolulu, HI. 2 pages.
- ⁸ Friedlander et al. 2008. "The state of coral reef ecosystems of the main Hawaiian Islands." Pages 219–261 in J. Waddell (ed.): *The state of coral reef ecosystems of the United States and Pacific Freely Associated States*. NOAA Technical Memorandum NOS NCCOS 11. Prepared by the NCCOS Center for Coastal Monitoring and Assessment Biogeography Branch. Silver Spring, MD.
- ⁹ Friedlander AM., Nowlis J, Koike H. 2015. Stock assessments using reference points and historical data: stock status and catch limits. Pages 91–118 In: *Applying Marine Historical Ecology to Conservation and Management: Using the Past to Manage for the Future* (JN Kittinger, LE McClenachan, K Gedam, LK Blight ed.). University of California Press. Williams et al. 2008. "Assessing the importance of fishing impacts on Hawaiian coral reef fish assemblages along regional-scale human population gradients." *Environmental Conservation*. 35 (3): 261–272.
- ¹⁰ Friedlander AM, Donovan MK, Stamoulis KA, Williams ID, Brown EK, Conklin EJ, DeMartini EE, Rodgers KS, Sparks RT, Walsh WJ. Human-induced gradients of reef fish declines in the Hawaiian Archipelago through the lens of traditional management boundaries. In Review. *Conservation Biology*. Friedlander, Biomass by Island graph.
- ¹¹ State of Hawai'i Water Quality Monitoring and Assessment Report: Integrated Report to the U.S. Environmental Protection Agency and the U.S. Congress Pursuant to §303(d) & §305(b), Clean Water Act (P.L. 97–117).
- ¹² Dailer et al. 2010. "Using $\delta^{15}N$ values in algal tissue to map locations and potential sources of anthropogenic nutrient inputs on the island of Maui, Hawai'i, USA." *Marine Pollution Bulletin*. 60: 655–671.
- ¹³ Smith, C. E., and J. E. Smith. 2006. "Algal blooms in North Ki'he: An assessment of patterns and processes relating nutrient dynamics to algal abundance." A Report to the City and County of Maui. Kahului, Maui.
- ¹⁴ Walsh et al. 2009. "Long-term monitoring of coral reefs of the Main Hawaiian Islands: final report." NOAA Coral Reef Conservation Program and the State of Hawai'i. Report NA06NOS4260113. Honolulu, HI.
- ¹⁵ Friedlander, A.M., E.K. Brown, and M. E. Monaco 2007. "Defining reef fish habitat utilization patterns in Hawai'i: comparisons between MPAs and areas open to fishing." *Marine Ecology Progress Series*. 351: 221–233.
- ¹⁶ Williams et al. 2011. "Differences in reef fish assemblages between populated and remote reefs spanning multiple archipelagos across the Central and Western Pacific." *Journal of Marine Biology*. vol. 2011, Article ID 826234, 14 pages, 2011.
- ¹⁷ Friedlander et al. 2010. "Monitoring Hawai'i's Marine Protected Areas: Examining Spatial and Temporal Trends Using a Seascape Approach." NOAA Technical Memorandum NOS NCCOS 117. Prepared by the NCCOS Center for Coastal Monitoring and Assessment Biogeography Branch. Silver Spring, MD. 130 pp.
- ¹⁸ Friedlander et al. 2006. Fish Habitat Utilization Patterns and Evaluation of the Efficacy of Marine Protected Areas in Hawai'i: Integration of NOAA Digital Benthic Habitats Mapping and Coral Reef Ecological Studies. NOAA Technical Memorandum NOS NCCOS 23. 213 pp.
- ¹⁹ Hoeke et al. 2011. "Projected changes to growth and mortality of Hawaiian corals over the next 100 years." *PLoS ONE* 6(3).
- ²⁰ IPCC 2013. "Climate Change 2013: The Physical Science Basis." The 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press.
- ²¹ Neilson, B. 2014. "Coral bleaching rapid response surveys September to October 2014." Hawai'i State Department of Land and Natural Resources.
- ²² M.E.Field, A.S.Ogston and C.D.Storlazzi "Rising Sea Level May Cause Decline of Fringing Coral Reefs" *EOS Transactions, American Geophysical Union* Volume 92, Number 33 (2011): Pages 273–280.
- ²³ Hoegh-Guldberg et al. 2007. "Coral reefs under rapid climate change and ocean acidification." *Science* 318: 1737–1742.
- ²⁴ Hoegh-Guldberg, O., and J. F. Bruno 2010. "The impact of climate change on the world's marine ecosystems." *Science* 328: 1523–1528.
- ²⁵ Selig, E. R., and J. F. Bruno 2010. "A global analysis of the effectiveness of marine protected areas in preventing coral loss." *PLoS ONE*. 5(2): 1–7.
- ²⁶ For a practical guide on how to implement proven, peer-reviewed coral reef recovery strategies for Maui's reefs, see the Maui Coral Reef Recovery Plan (2nd edition; 2015). Download online at: <http://www.mnmrc.org/mauis-coral-reefs-declining-trends-report>



Maui Nui Coral Recovery Team Members

Thorne Abbott Coastal Planners LLC	Ekolu Lindsey Polanui Hiu CMMMA
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Tova Callender	Jack Kittinger PhD	Curt Storlazzi PhD
Lucienne De Naie	Tara Owens	Rob Toonen PhD
Emily Fielding	Rob Parsons	
Harry Hecht	Ku'ulei Rogers PhD	

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Our vision: the waters of Maui Nui are clean, our coral reefs healthy, and our native fishes abundant.

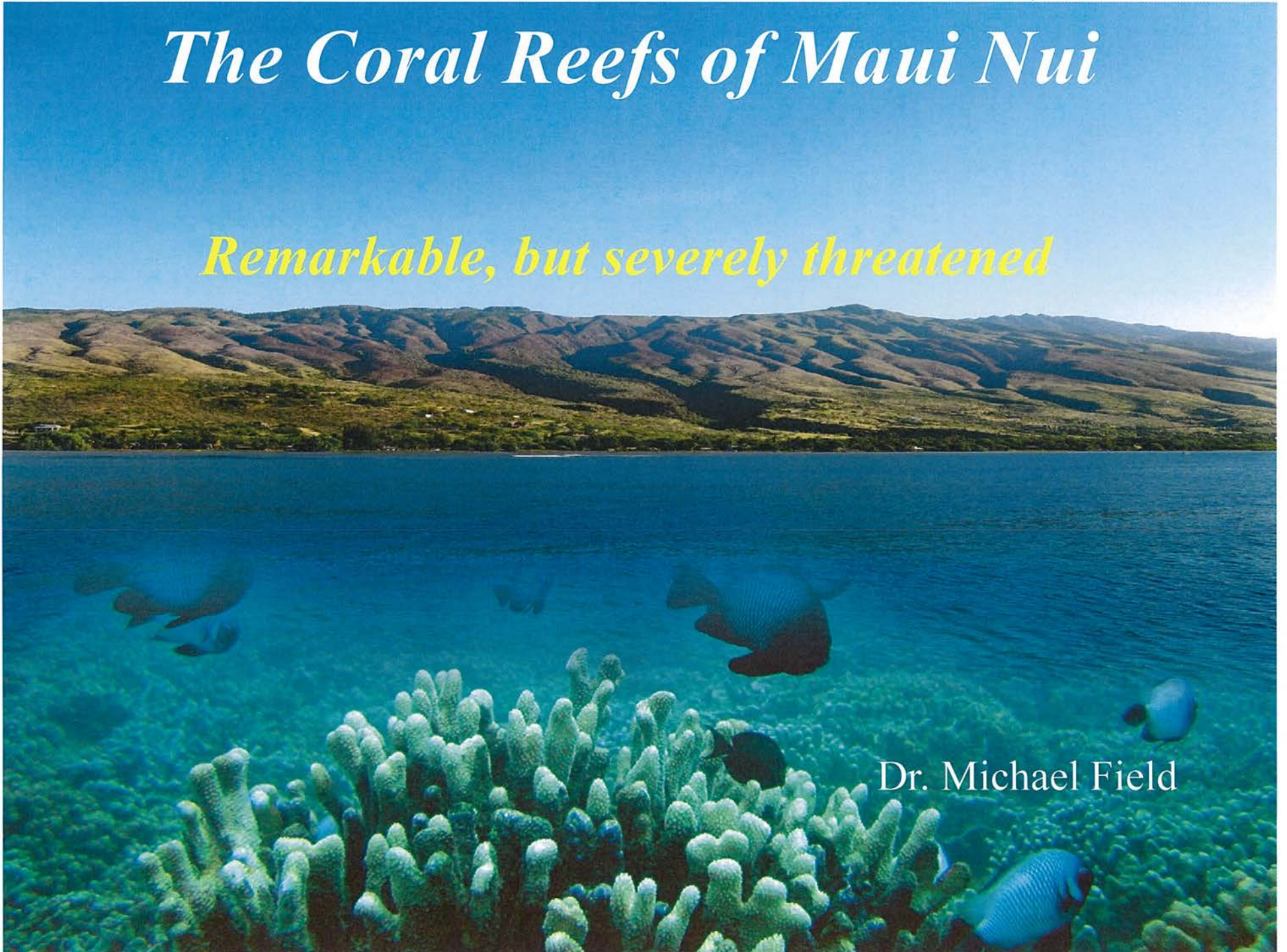
Learn more and get involved at <http://www.mnmrc.com> and <https://www.facebook.com/MNMRC>

This document was prepared by the Maui Coral Recovery Team: a voice for the health of Maui's reefs. We have created this report both for Hawaii's decision makers and the public. Our team is comprised of Hawaii's preeminent coral reef scientific and management experts from across the islands. We work together on a voluntary basis driven by our shared concern regarding the fate of Maui's coral reefs. We support decision makers and local communities to take action that effectively manages Maui's coral reefs for the benefit of current and future generations.

The Coral Reefs of Maui Nui

Remarkable, but severely threatened

Dr. Michael Field

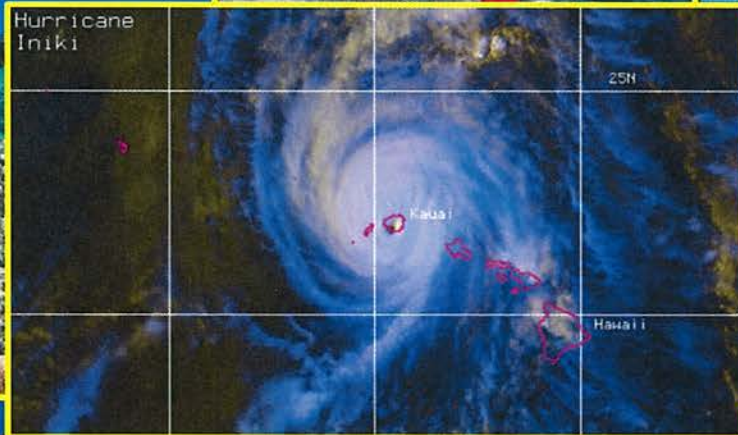
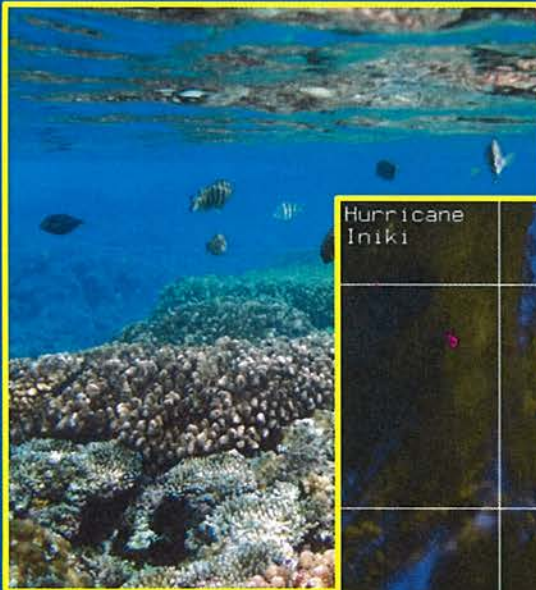


Role of Coral Reefs:

Biodiversity – Only cover 0.5% of sea floor but house more than 25% of all marine species

Food – a primary source of protein for most island nations; nursery habitat for many commercial species

Coastal resilience – protection from storms, hurricanes, typhoons, tsunamis (2009 Samoan, 2011 Japan), and predicted sea-level rise



A. We know that there is a world-wide crisis on coral reefs

B. We know the causes: 1) Unsustainable fishing; 2.) Land-based pollution, and 3.) **Climate change**

And now we know: The Problem has arrived in Hawai`i



West Maui



West Maui



South Moloka'i



Seattle Times, 10/27/2015



DLNR photo, Molokini



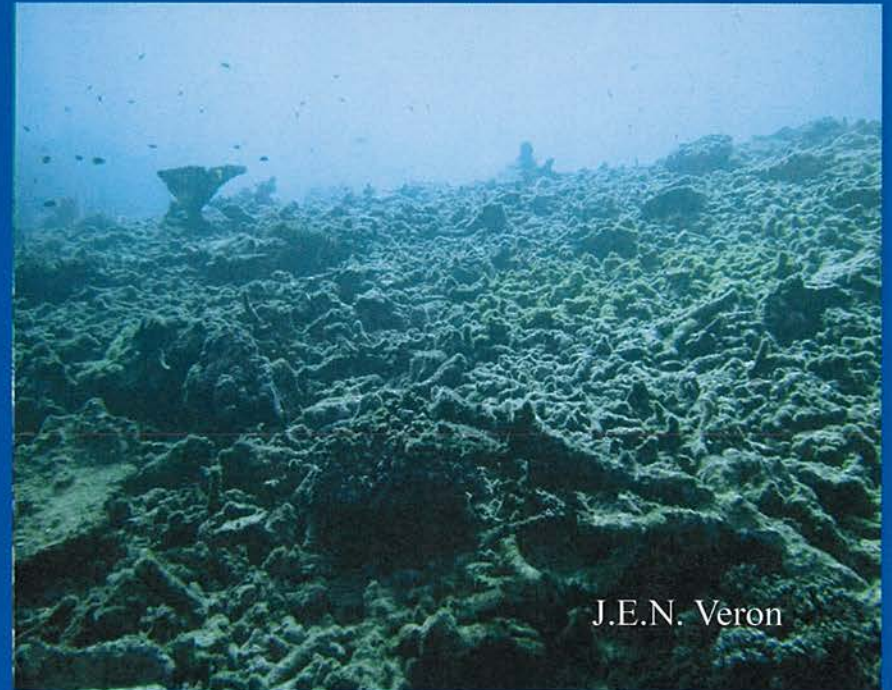
DAR photo, Olowalu

WHY THIS MATTERS:

- Dead reefs are quickly flattened
- Many/most will not come back

So.....we lose, **probably forever:**

1. Habitat for fish and invertebrates
2. Barriers for storm and flood protection
3. Sites for family and community recreation



J.E.N. Veron

THE RESULT ?

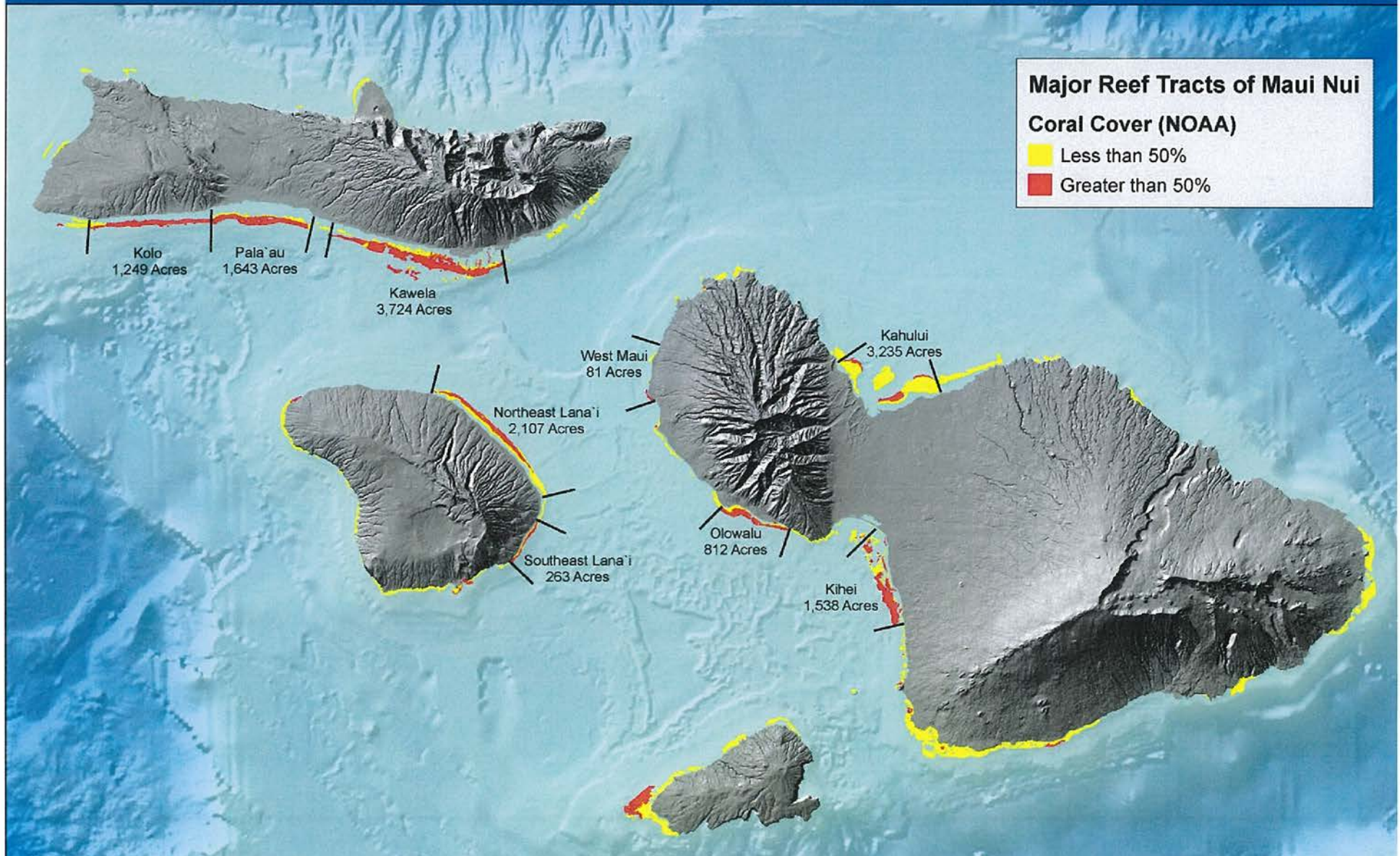
The economic and cultural value of Maui Nui coral reefs will be greatly reduced within one generation ...or sooner.

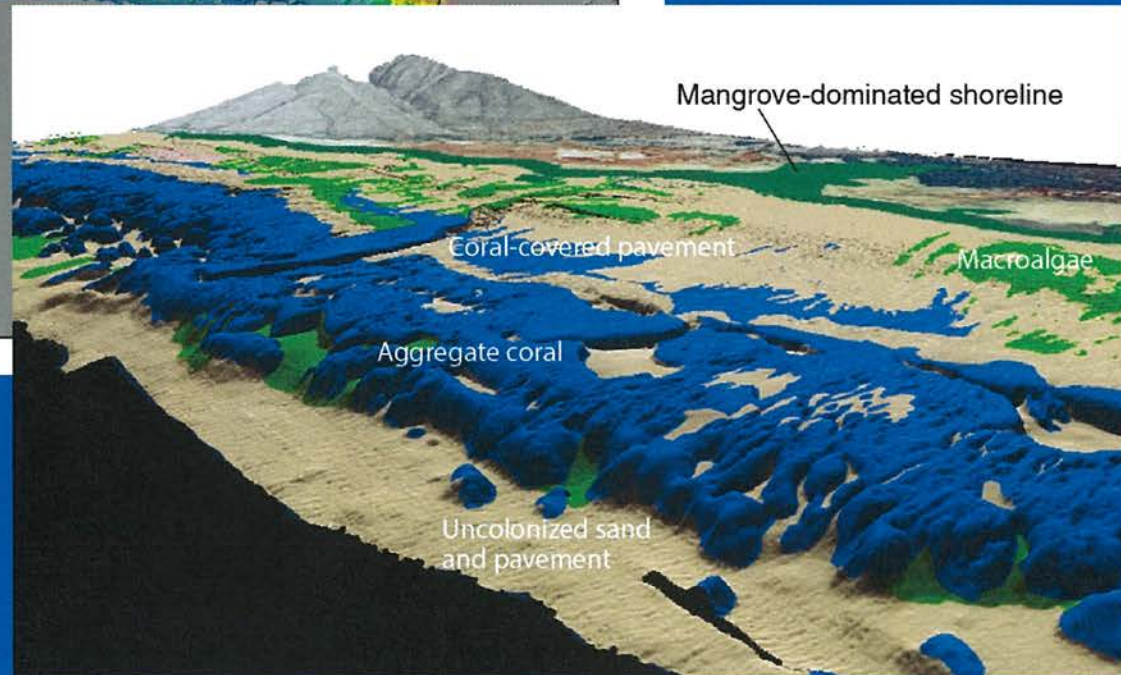
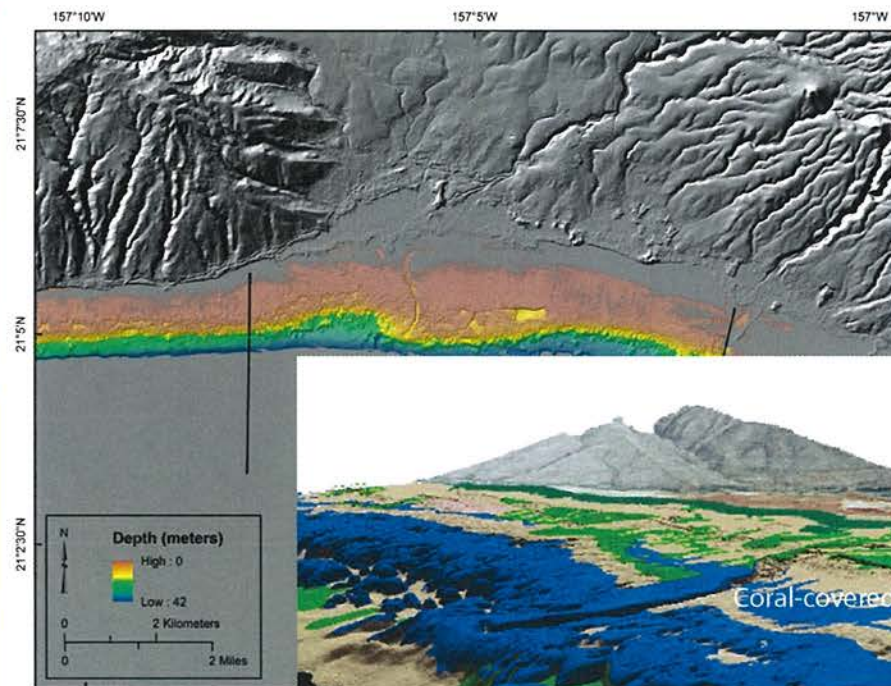
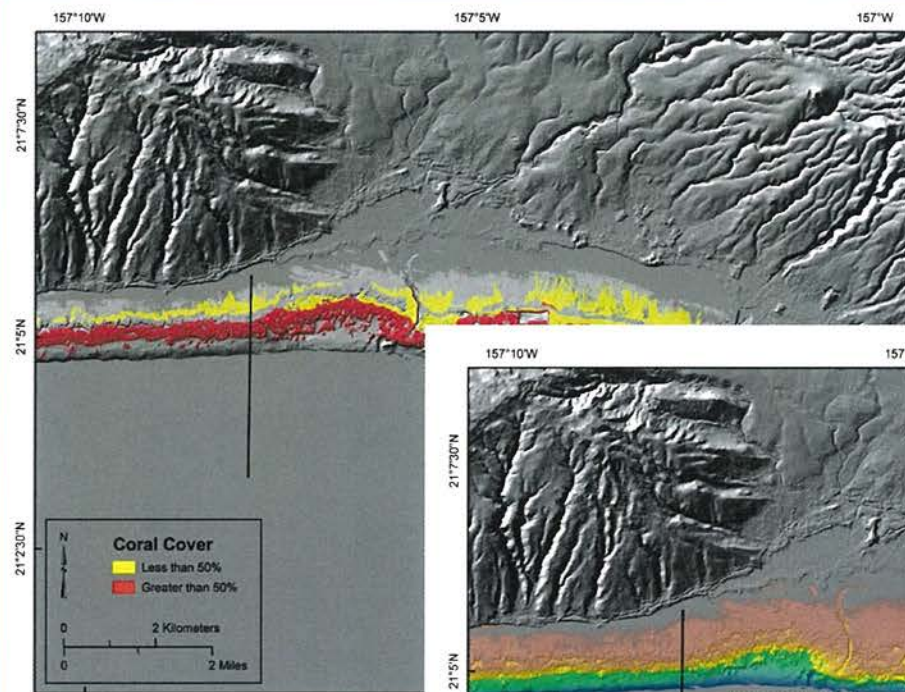
Sept 15, 2015

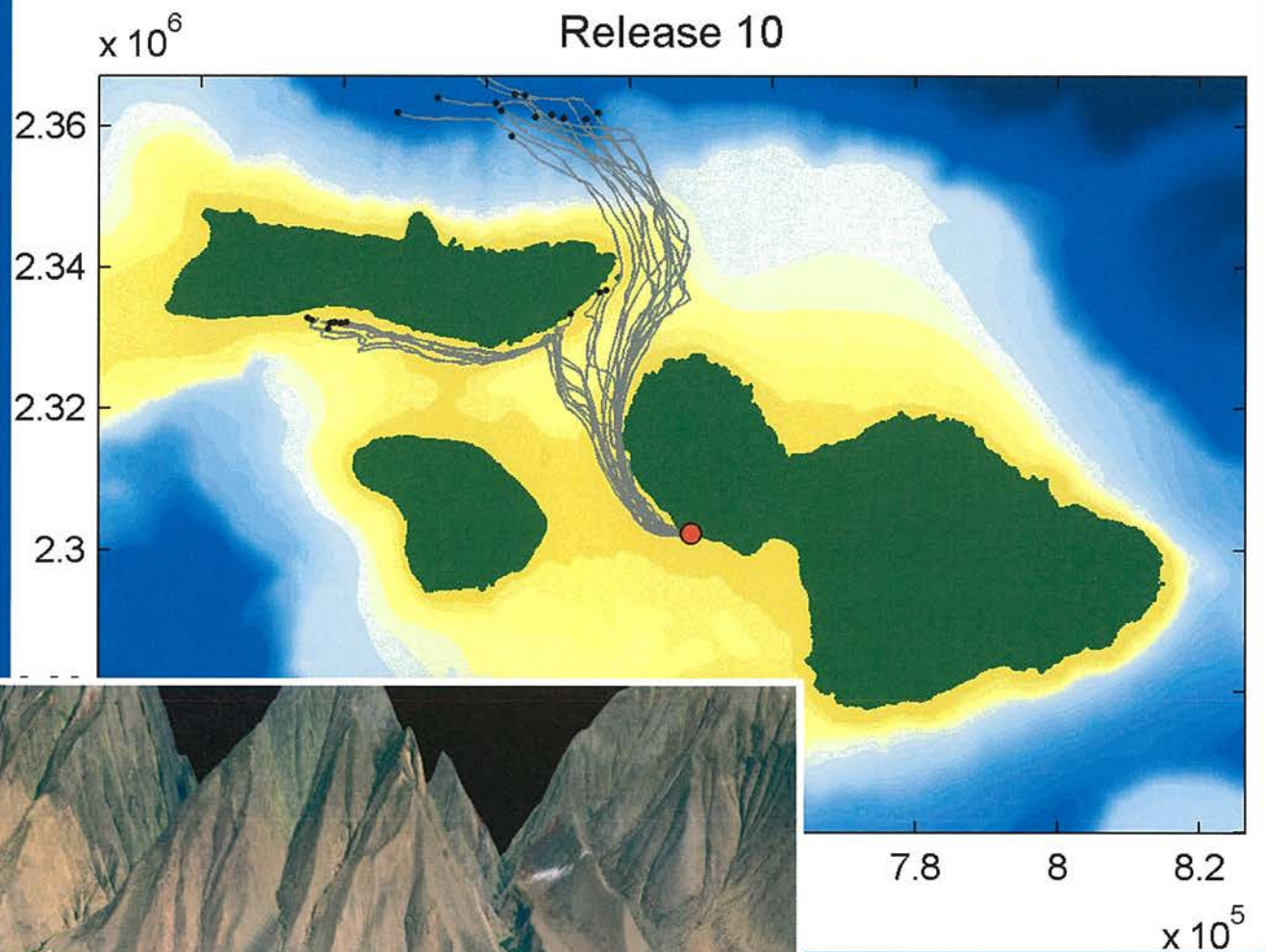
DLNR Chair Suzanne Case emphasized that Hawaii's coral reefs are the foundation of a healthy ocean. **"If we fail to protect them and lose them, it could have tremendously negative impacts not only on the overall ocean ecosystem but on Hawaii's economy."**

Maui Nui has the **largest, most complex, and richest coral reefs** in the Main Hawaiian Islands

9 reef tracts with ~ 15, 000 acres of reef , mostly over 50% live coral !







Given the ongoing and increasing threats to the Maui Nui coral reef complex, can anything be done?

YES

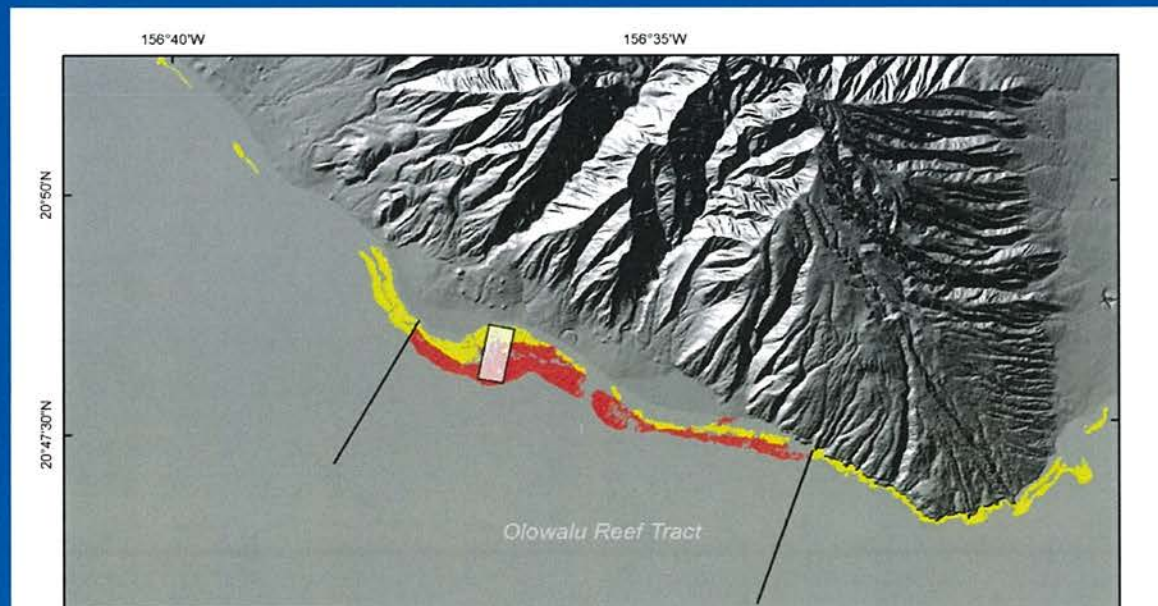
Given the ongoing and increasing threats to the Maui Nui coral reef complex, can anything be done?

YES

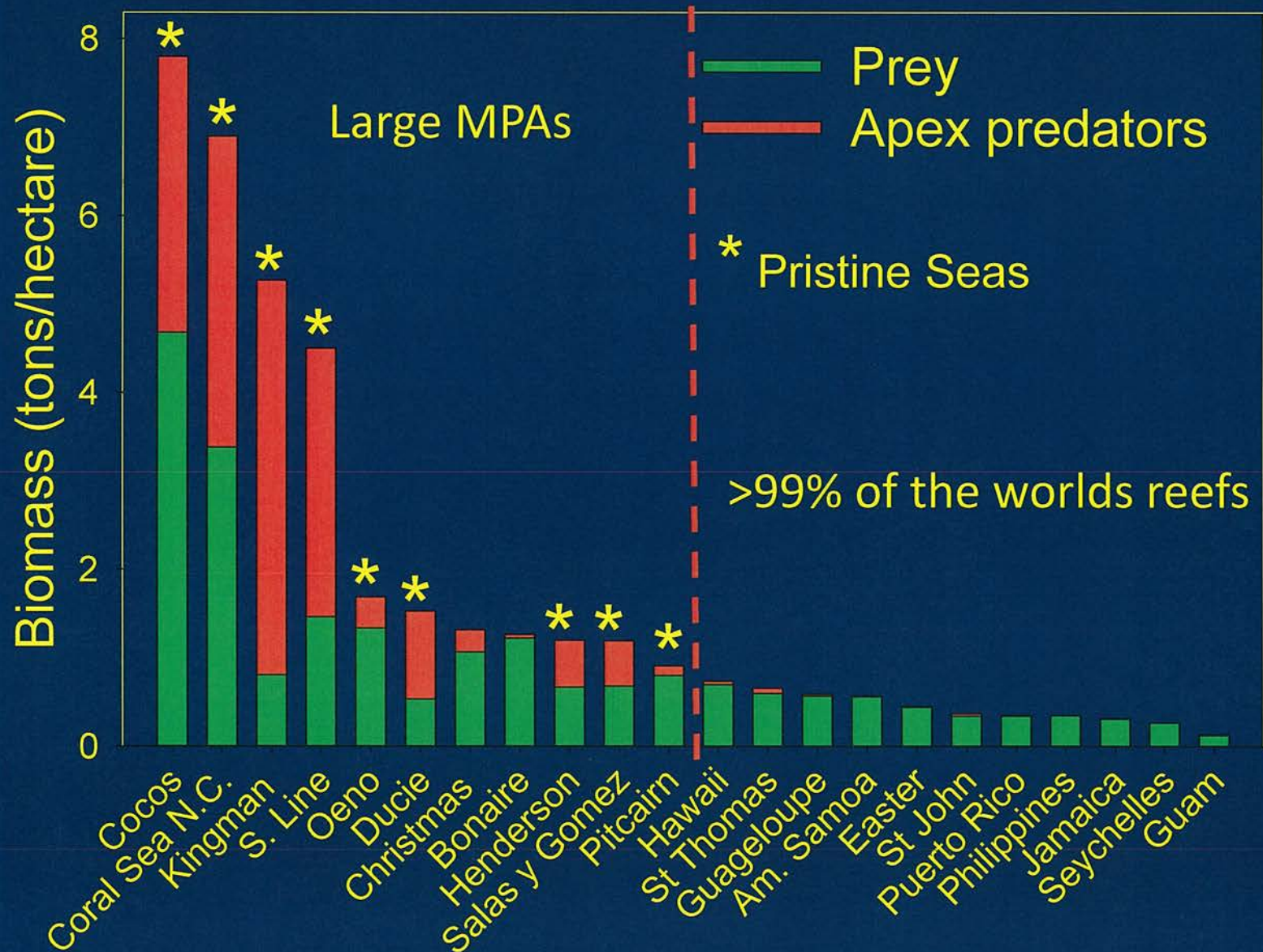
Reducing all other stresses to coral reefs is recognized as the 2nd most effective action for providing coral reefs a chance to survive.

Setting aside 15 to 20 % of the reefs so that fish can grow and corals can fight warming is the only way we can insure a coral reef future for Maui.

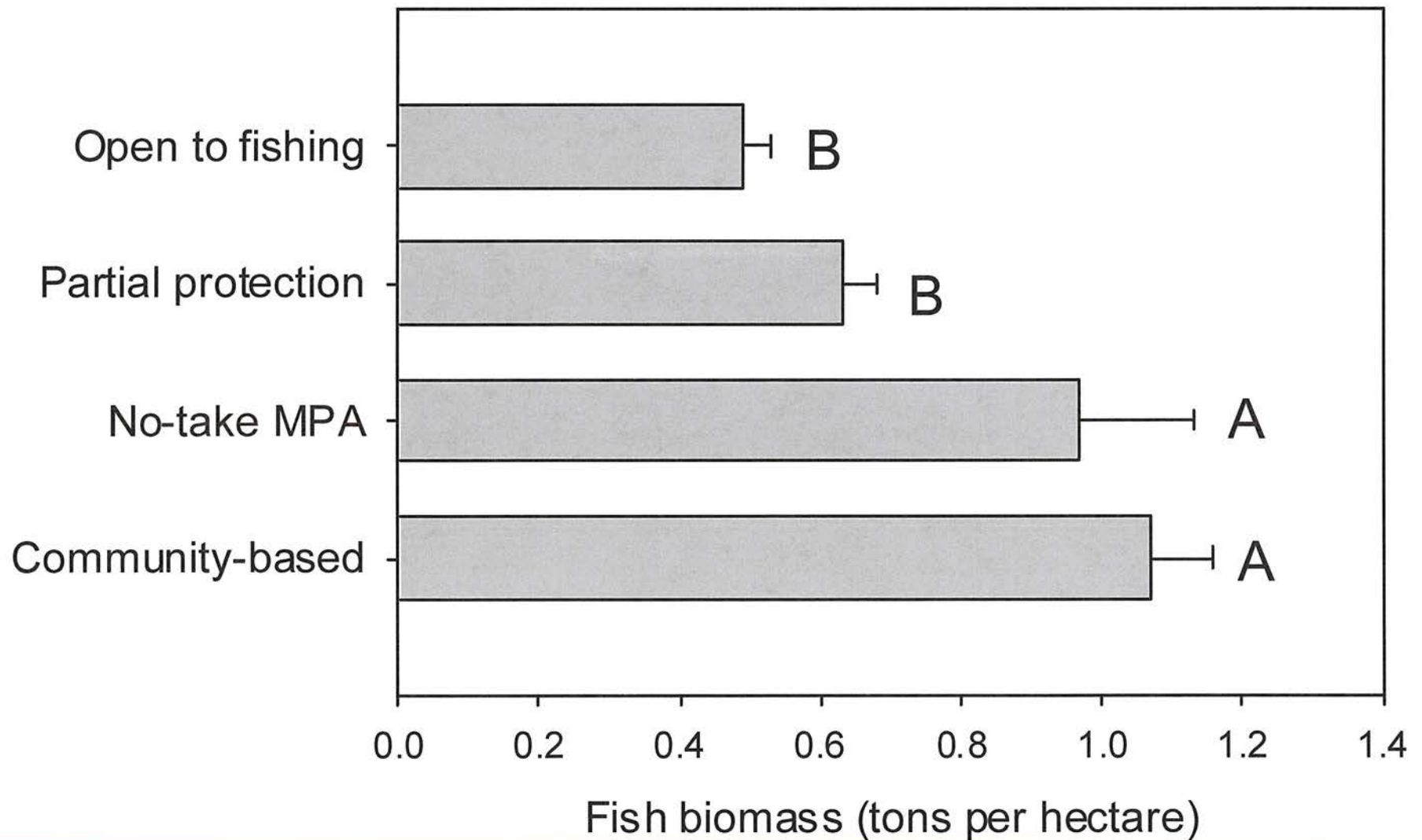
There is no other choice



Comparisons of fish biomass around the world



Fish biomass under different management in Hawaii



Design Criteria for Effective MPAs in Hawaii

- Range of habitat complexities
- Full protection from fishing or community-managed
- Shoreline to deep habitats
- Mosaic of habitats (sand corridors, etc.)
- Low macroalgae cover (invasives)
- Representative wave exposures



Conclusions

- MPAs effective tool for fisheries & conservation
- Account for <1% of oceans
- MPAs most effective when fishing pressure is high nearby
- Scaled for human needs

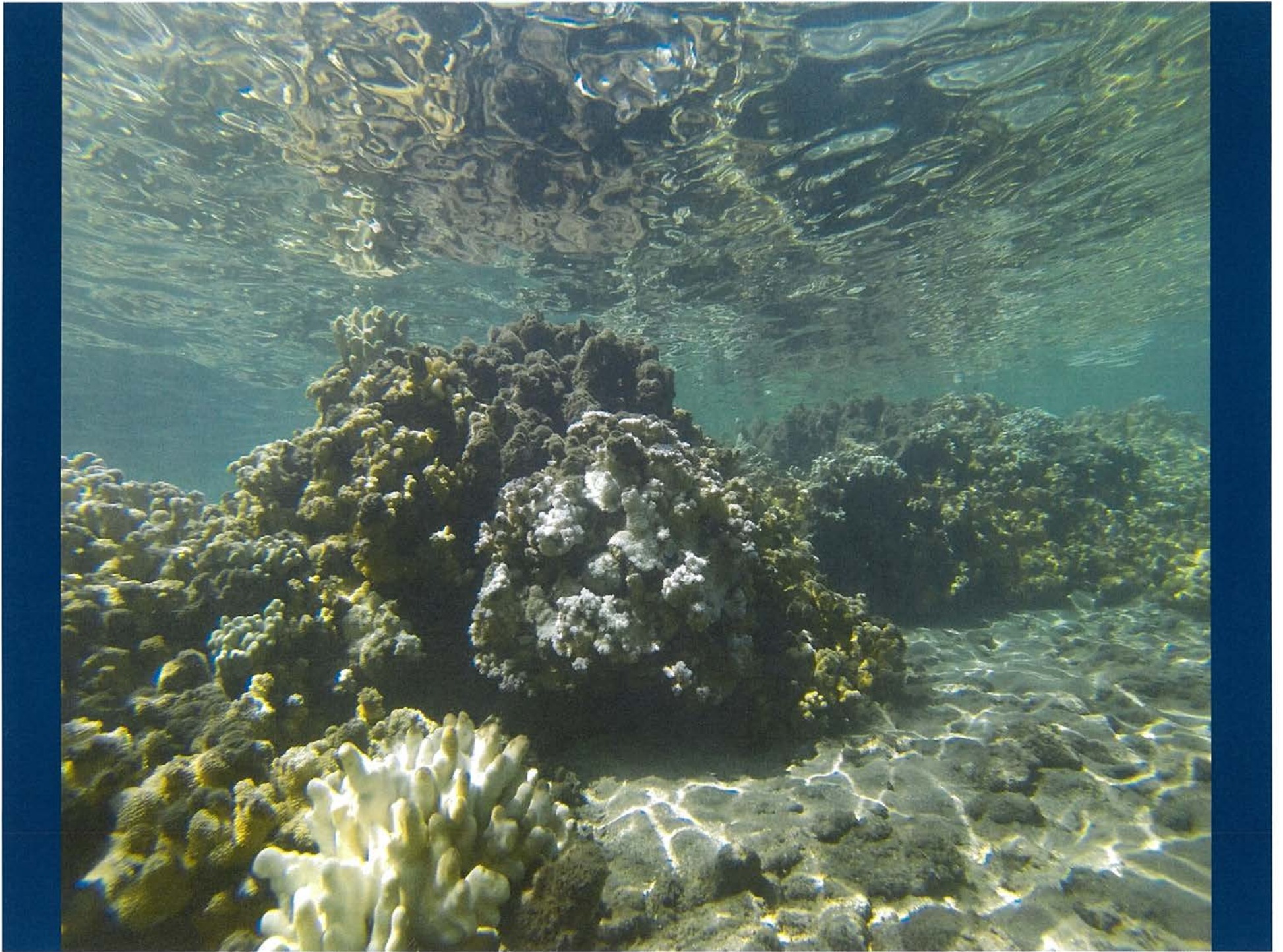
Polanui Hiu



Maui Digital Images.com
Maui Digital Images.com









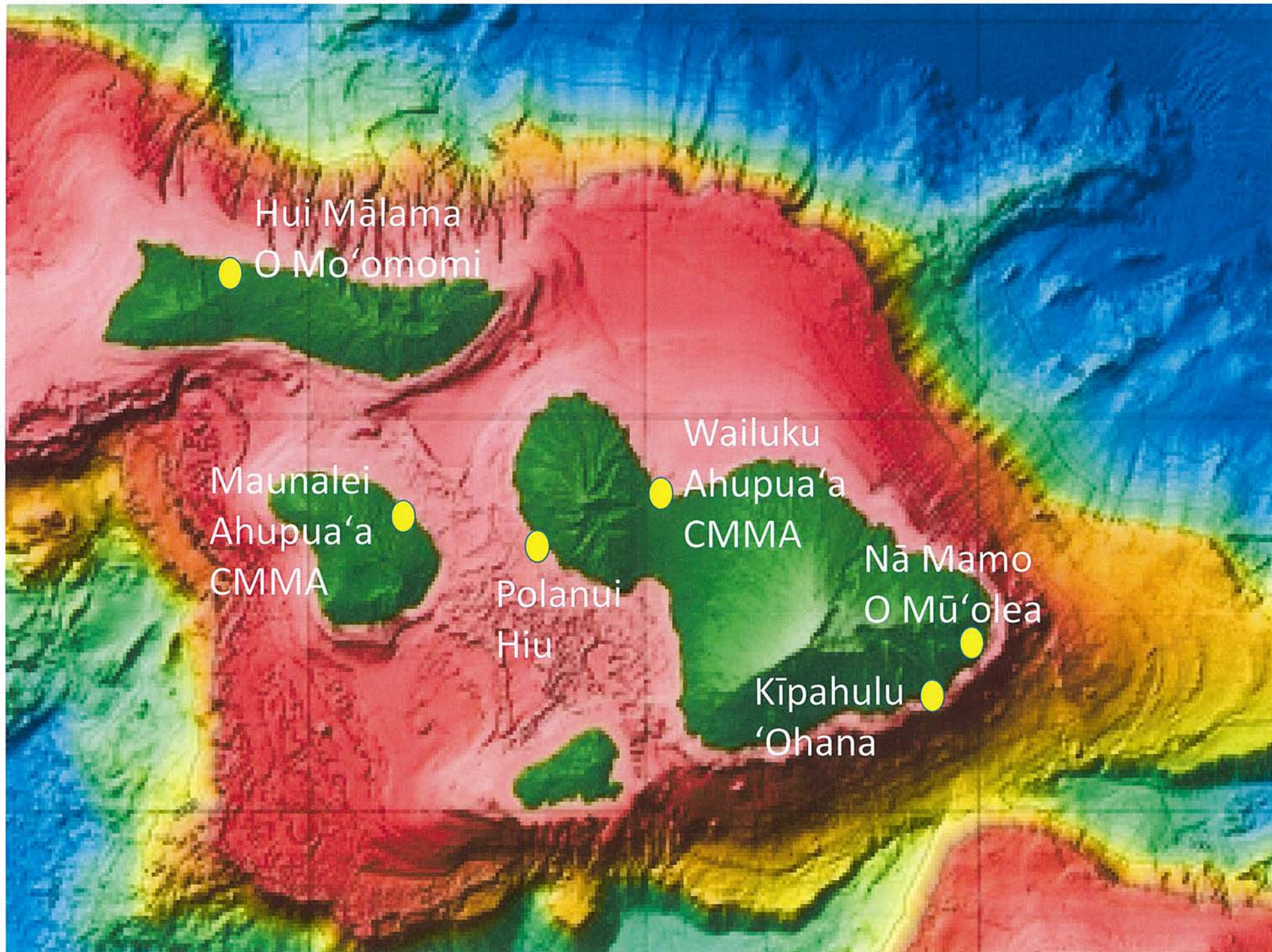




The Maui Nui Makai Network



Kako'o:
The Nature Conservancy
Maui Nui Marine Resource Council





- Maui Nui Network representatives
- with Majority Leader, Senator Kalani J. English
- District 7: Hana, East and Upcountry Maui, Molokai, Lanai,
- District 8: Kahakuloa, Waihe'e, Kaho'olawe, Pu'uohala, Wailuku, Waikapu



- Ekolu Lindsey, Sol Kaho'ohalahala & Jay Carpio meeting
- with Senator Rosalyn Baker (D)
- District 6: South and West Maui

• E Alu Pu and Maui Nui Network • Communities' Visit to the State Legislature

• February 18–19, 2015



11,800 acres

600+ PEOPLE ENGAGED

6 sites promoting pono fishing

3 sites seeking state rules



Maui's Coral Reefs

Current Management Successes and Challenges

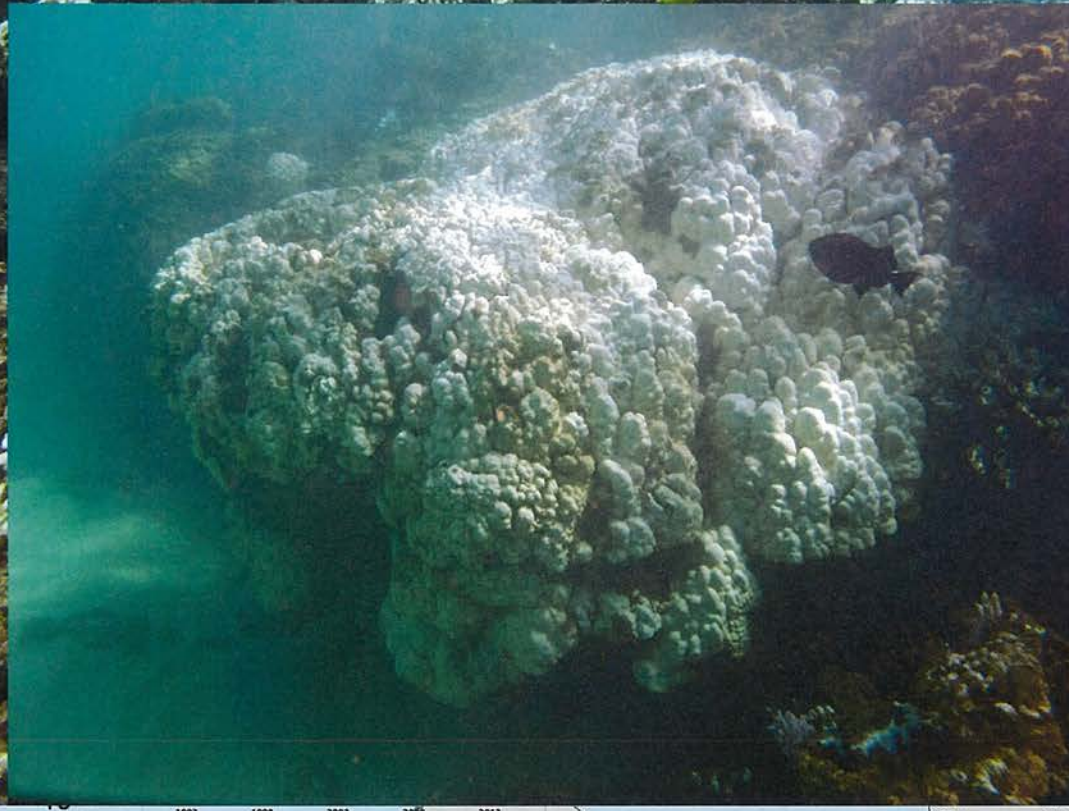


Russell Sparks, Aquatic Biologist
DLNR / Division of Aquatic Resources

42%

N

- Bleaching this Year was the Worst Event Ever Recorded in Hawaii
- This is a new and Major Stress to Our Reefs
- Long term survival of Coral Reefs will Depend on Our Ability to Reduce Overall Stressors to the Reef Ecosystem



0

Miles

1993

1998

2003

2008

2013

1993

1998

2003

2008

2013

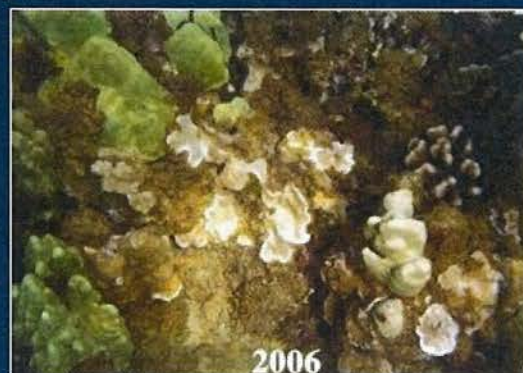
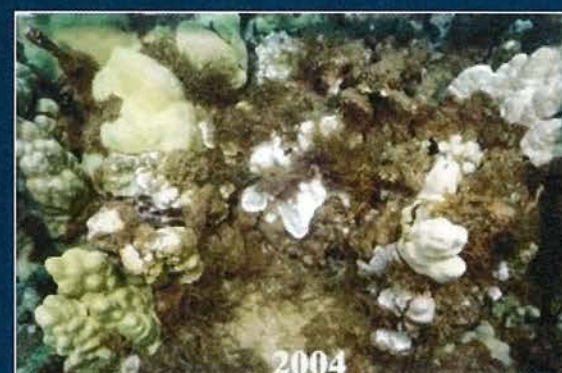
A Story of Management Success

The Kahekili Herbivore Fishery Management Area, Maui 2009-2015



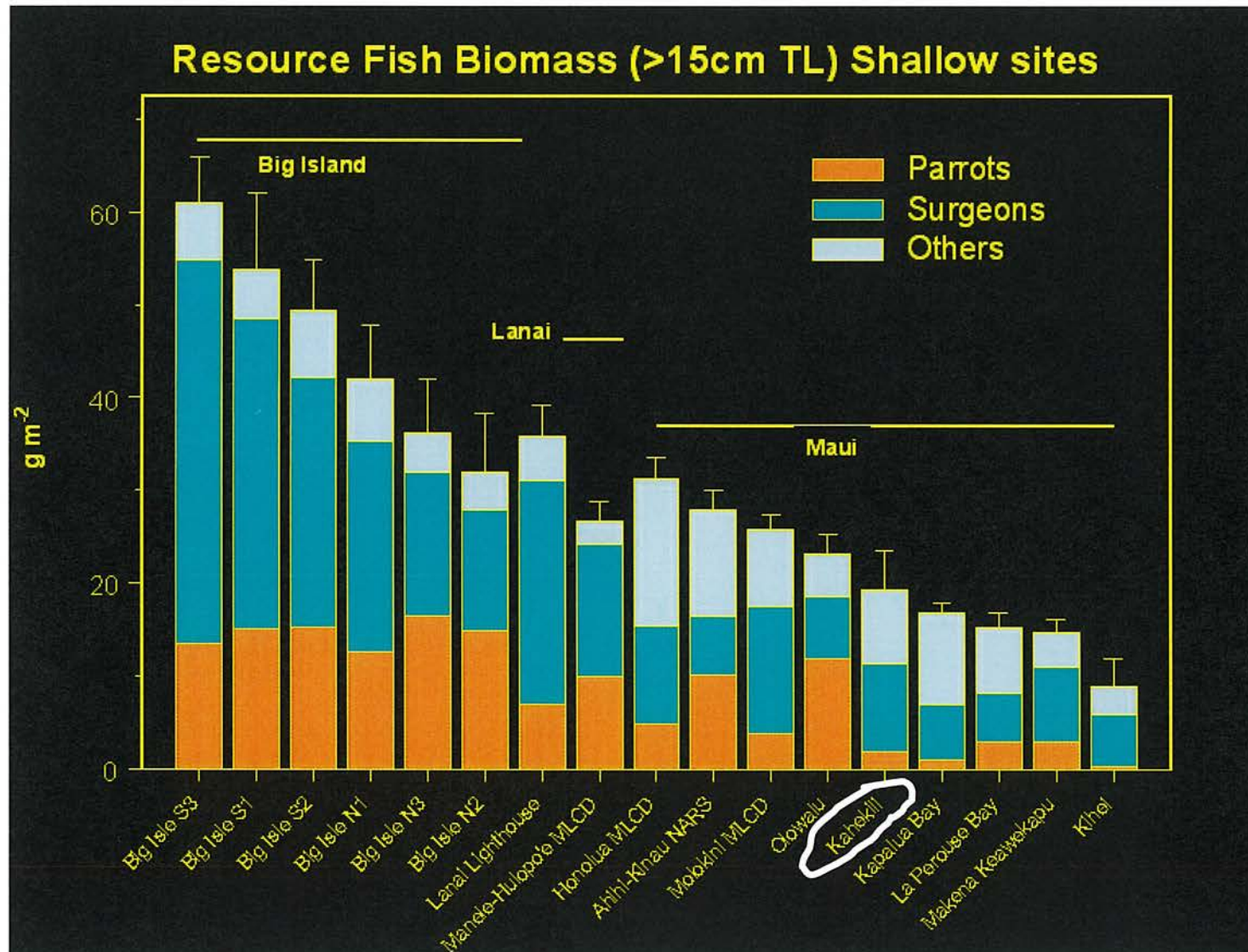
Ivor Williams & Kevin Lino, NOAA PIFSC
Russell Sparks & Darla White, DAR Maui

Kahekili Park 3m Site (1999 - 2006)



Comparisons of Fish Biomass

Kahekili compared to other MHI reefs surveyed by DAR



Honokowai
Beach Park

The Kahekili Herbivore Fisheries Management Area

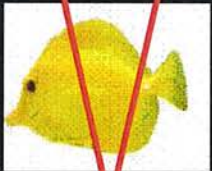
Prohibited:

- Removing or killing any surgeon fish, parrotfish, or chub
- Removing or killing any sea urchins.
- Fish feeding.

Allowed Activities:

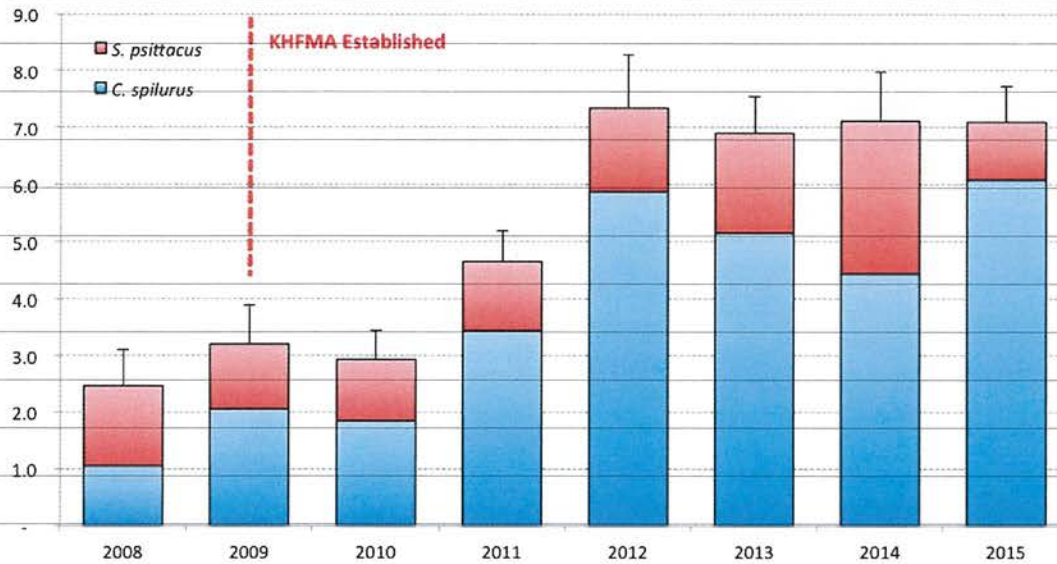
- Fishing/removing all other legally harvested marine life.
- Using bait and/or other attractants while legally fishing.

Keka'a Point
(Black Rock)



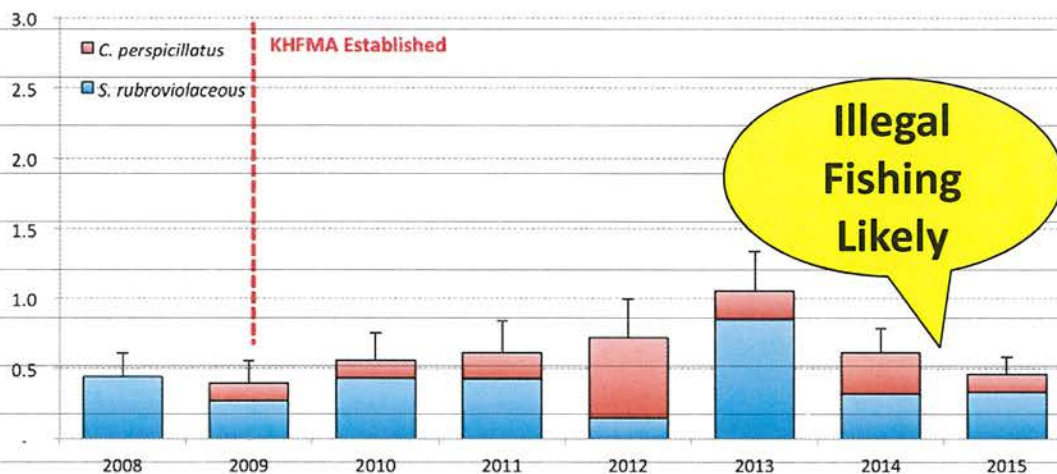
Small-Medium Parrotfishes

Lmax: 30-40 cm
Lifespan: 6-10 years



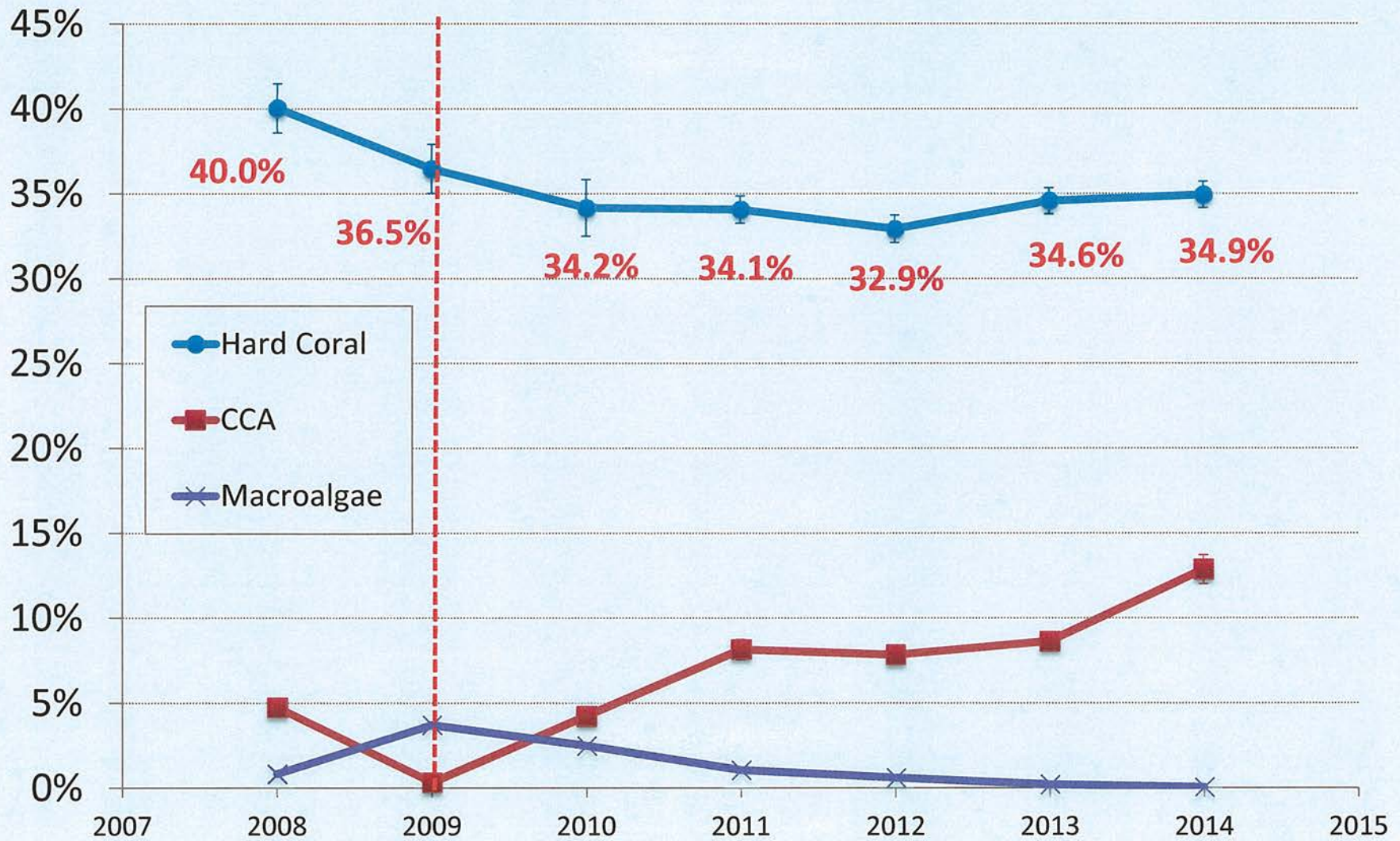
Large-bodied Parrotfishes

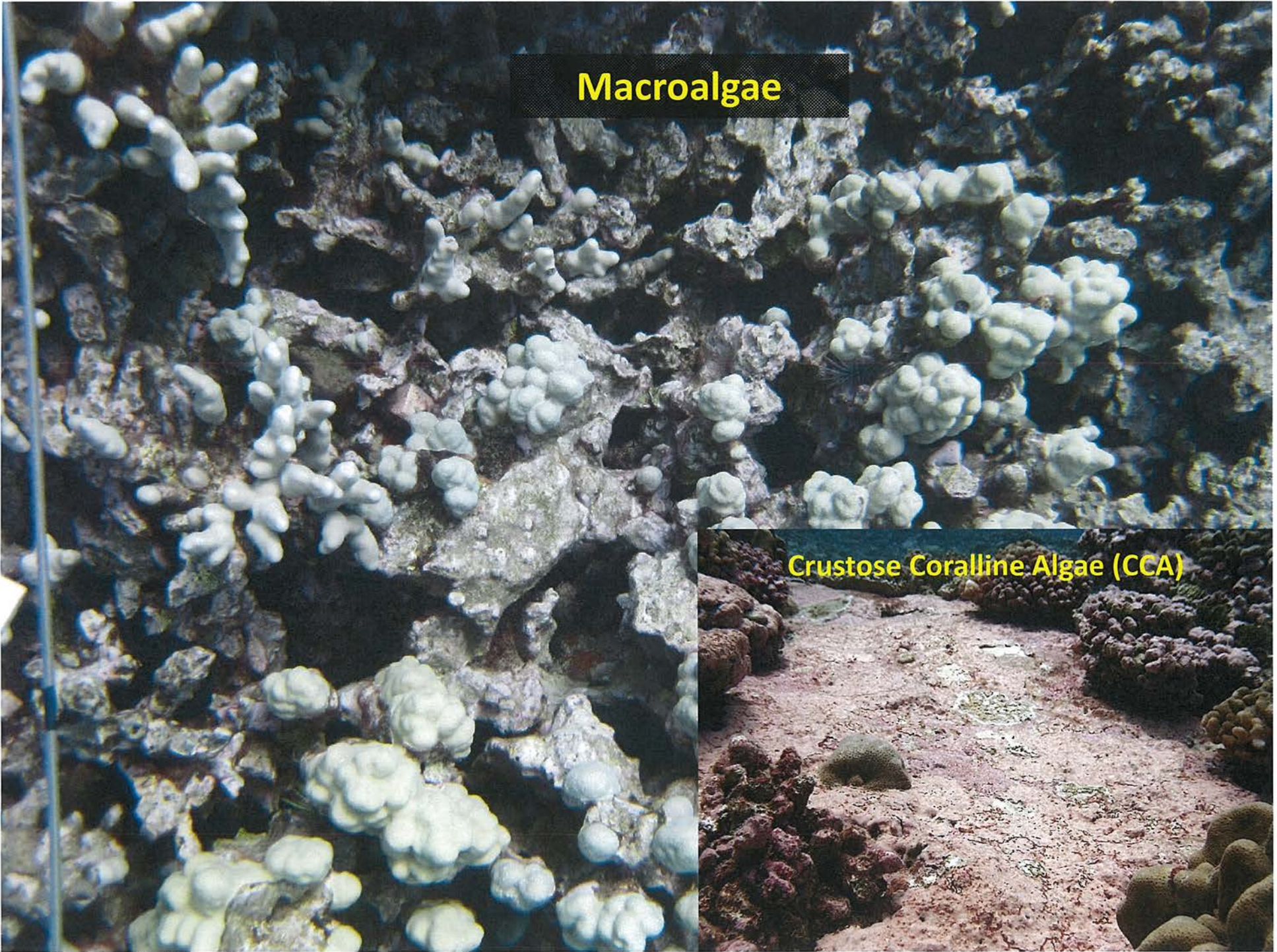
Lmax: ~70 cm
Lifespan: ~20 years



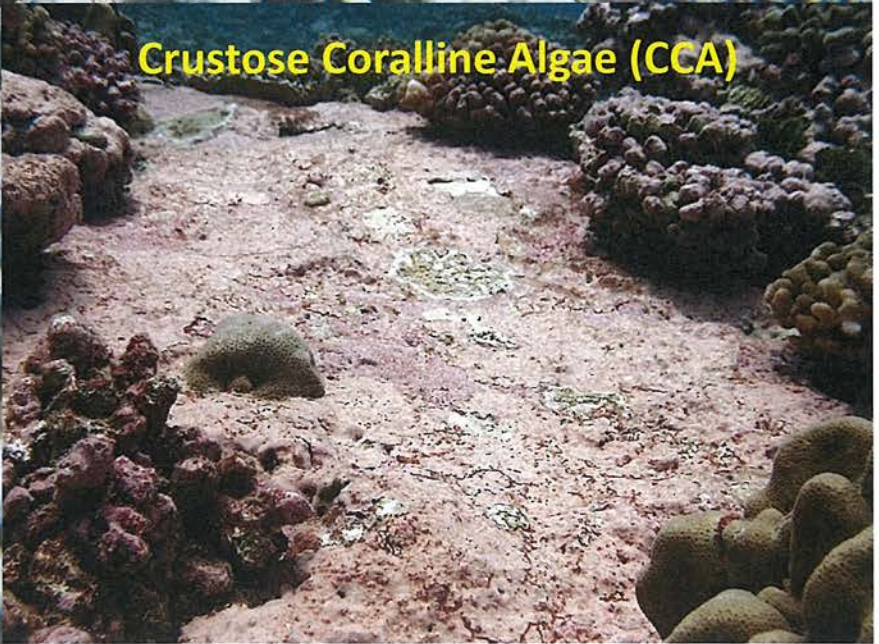
NWHI and remote MHI 5-10 g/m²

Benthic Cover Kahekili



A close-up photograph of a rocky reef surface. The rock is covered with various types of macroalgae. Some are large, white, and have a bumpy, cauliflower-like texture. Others are smaller, green, and have a more leafy or branching appearance. The background is dark, suggesting an underwater environment.

Macroalgae

A photograph of a sandy reef floor. The sand is a light pinkish-brown color. Scattered across the sand are patches of crustose coralline algae (CCA). These algae appear as small, greenish-brown, crust-like structures. Some larger, more rounded, brownish structures are visible in the foreground and background, possibly other types of coral or algae.

Crustose Coralline Algae (CCA)

2008/09 ('Before'):

3 rounds, 253 transects



Parrotfish Biomass
Coralline



Crustose
Algae (CCA)

2014:

2 rounds, 160 transects



Parrotfish Biomass
Coralline



Crustose
Algae (CCA)

Hope for the Future

Positive Maui Management Actions with County Support

- Maui Lay Gillnet Ban 2007
- Kahekili Herbivore Fisheries Management Area, 2009
- New Maui Parrotfish & Goatfish Bag and Size Limit Rules 2014

For Coral Reefs to Survive, much more needs to be done.

- Networks of Marine Managed Areas?
- Community Co-Management (CBSFA)
- More Maui County Support of Watershed Management efforts (West Maui R2R, etc)

Controlling Land-Based Sediment





NPDES Permit Requirement

CHAPTER 11-55 APPENDIX C

6. Water Quality-Based Effluent Limitations

6.1 General Effluent limitation to meet applicable water quality standards.

The permittee shall not cause or contribute to a violation of the basic water quality criteria as specified in section 11-54-4.

In the absence of information demonstrating otherwise, the department expects that compliance with the conditions in this permit will result in storm water discharges being controlled as necessary to meet applicable water quality standards. If at any time the permittee becomes aware, or the department determines, that the discharge is not being controlled as necessary to meet applicable water quality standards, the permittee must take corrective action as required in section 10.2.1., and document the corrective actions as required in section 10.2.1. and section 10.4.

The department will also impose additional water quality-based limitations on a site-specific basis, or require the permittee to obtain coverage under an individual permit, if information in the NOI, or from other sources indicates that the discharges are not controlled as necessary to meet applicable water quality standards. This includes situations where additional controls are necessary to comply with a wasteload allocation in a state-established and EPA-approved Total Maximum Daily Load (TMDL).

6.2. Discharge limitations for impaired waters

If discharge is to a state water that is impaired for (1) sediment or a sediment-related parameter, such as total suspended solids (TSS) or turbidity, and/or (2) nutrients, including impairments for nitrogen and/or

DOH Water Quality Requirements

§11-54-4 Basic water quality criteria applicable to all waters. (a) All waters shall be free of substances attributable to domestic, industrial, or other controllable sources of pollutants, including:

- (1) Materials that will settle to form objectionable sludge or bottom deposits;
- (2) Floating debris, oil, grease, scum, or other floating materials;
- (3) Substances in amounts sufficient to produce taste in the water or detectable off-flavor in the flesh of fish, or in amounts sufficient to produce objectionable color, turbidity or other conditions in the receiving waters;
- (4) High or low temperatures, biocides, pathogenic organisms, toxic, radioactive, corrosive, or other deleterious substances at levels or in combinations sufficient to be toxic or harmful to human, animal, plant, or aquatic life, or in amounts sufficient to interfere with any beneficial use of the water;
- (5) Substances or conditions or combinations thereof in concentrations which produce undesirable aquatic life; and
- (6) Soil particles resulting from erosion on land involved in earthwork, such as the construction of public works; highways; subdivisions; recreational, commercial, or industrial developments; or the cultivation and management of agricultural lands.

(b) The director is authorized to impose by order the penalties and fines and corrective measures as specified in chapters 342D and 342E, HRS, against any person who discharges or otherwise causes or allows water pollutants to enter State waters and cause violation of this chapter, unless that person acted in compliance with a permit or variance issued by the director pursuant to chapters 342D, HRS, for

NPDES Permit: Self-Monitoring

Mr. Patrick Shin
July 6, 2011
Page 3

R10C659.FNL.11

2. Notify the Director of Health of the construction start date by e-mail at cleanwaterbranch@doh.hawaii.gov or fax at (808) 586-4352 within seven (7) calendar days before the start of construction activities. All communication, including but not limited to the e-mail and fax, with the CWB shall include the File No. HI R10C659 and the certification statement below. The notification will only be accepted from the person qualified in accordance with HAR, Chapter 11-55, Section 11-55-34.08(f).
3. Complete and submit the Solid Waste Disclosure Form for Construction Sites to the DOH, Solid and Hazardous Waste Branch, Solid Waste Section, as specified on the form at least 30 calendar days before the start of the construction activities. The form can be downloaded at: <http://www.hawaii.gov/health/environmental/waste/sw/pdf/swdiscformnov2008.pdf>.
4. Implement, operate, and maintain the project site-specific Best Management Practices (BMPs) Plan to ensure that storm water discharges associated with construction activities will not cause or contribute to a violation of applicable State water quality standards.
5. Review the effectiveness and adequacy of the implemented site-specific BMPs Plan(s) and ESC Plan(s) at a minimum of once per week, and update the plan as often as necessary. Any change(s) to the site-specific BMPs Plans and/or ESC Plans or corrections to the information already on file with the CWB shall be maintained onsite and be available upon request. Any change(s) to the information on the CWB NOI General Form shall be submitted to the CWB within seven (7) calendar days of the change(s).
6. Retain a copy of this NGPC and all other related materials at the job site or nearby field office.
7. Comply with HAR, Sections 11-55-34.04(a), 11-55-34.07, 11-55-34.11, and 11-55-34.12 (enclosed) and any other applicable Sections of HAR, Chapter 11-55; HAR, Chapter 11-55, Appendix A, DOH, Standard General Permit Conditions (enclosed); HAR, Chapter 11-55, Appendix C, NPDES General Permit Authorizing Discharges of Storm Water Associated with Construction Activities (enclosed); and all materials submitted in and with the Notice of Intent (NOI), dated September 28, 2008 and all subsequent submittals.
8. Complete and submit the Notice of Cessation (NOC) Form (CWB-NOC Form) to the CWB within two (2) weeks of completion of the subject project. The CWB-NOC Form can be downloaded from our website at: <http://www.hawaii.gov/health/environmental/water/cleanwater/forms/pdf/cwb-noc.pdf>.
9. Mr. Patrick Shin of SMC Mahana LLC shall submit all information/documents for compliance with the NGPC conditions as of June 30, 2011. A new authorized representative may be appointed by updating the CWB NOI General Form (Item Nos. 6.c. or 6.d. – Authorized Representative Information); submitting a hard copy of CWB NOI General Form (Item No. 7. – Certification) with an original signature and date; and submitting the CWB NOI General Form (with the revisions to Item Nos. 6.c. or 6.d.) on a CD/DVD in pdf format.

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**manta2™
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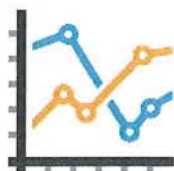


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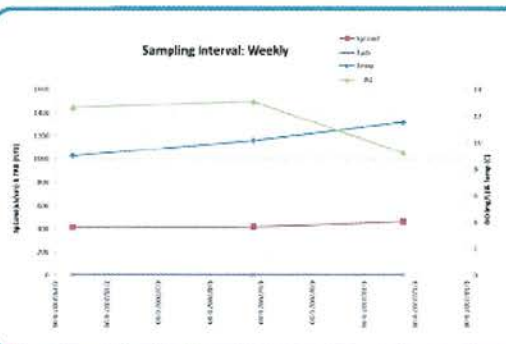




The Resolution Evolution

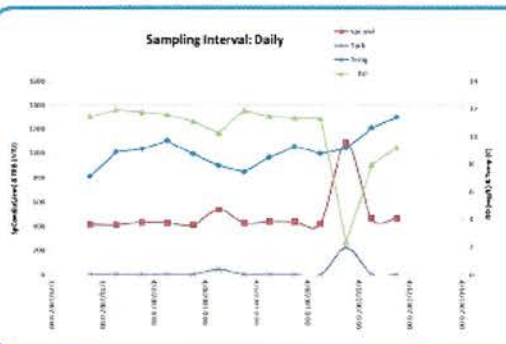


The evolution of water quality testing technology – and the lessons we can learn from it – is perfectly illustrated in these three charts. YSI calls the challenge of trying to make decisions – and assumptions – based on too little data the “undersampling dilemma.” Our goal in constantly evolving our instruments is to allow YSI customers to have enough information to understand the systems they are measuring and make sound decisions based on the highest quality data.



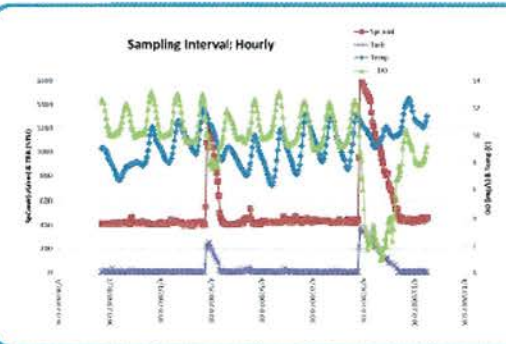
Sampling Weekly

Gathering data weekly for a two-week period yielded a simple, stable chart and the idea that dissolved oxygen fluctuates by about 3 mg/l at its most extreme and the average DO level is 11.66 mg/l.



Sampling Daily

Monitoring the river once a day yielded a dramatic look at the correlation among DO, temperature and specific conductance – in a huge drop of more than 10 mg/l that was not even detected in the weekly monitoring program.

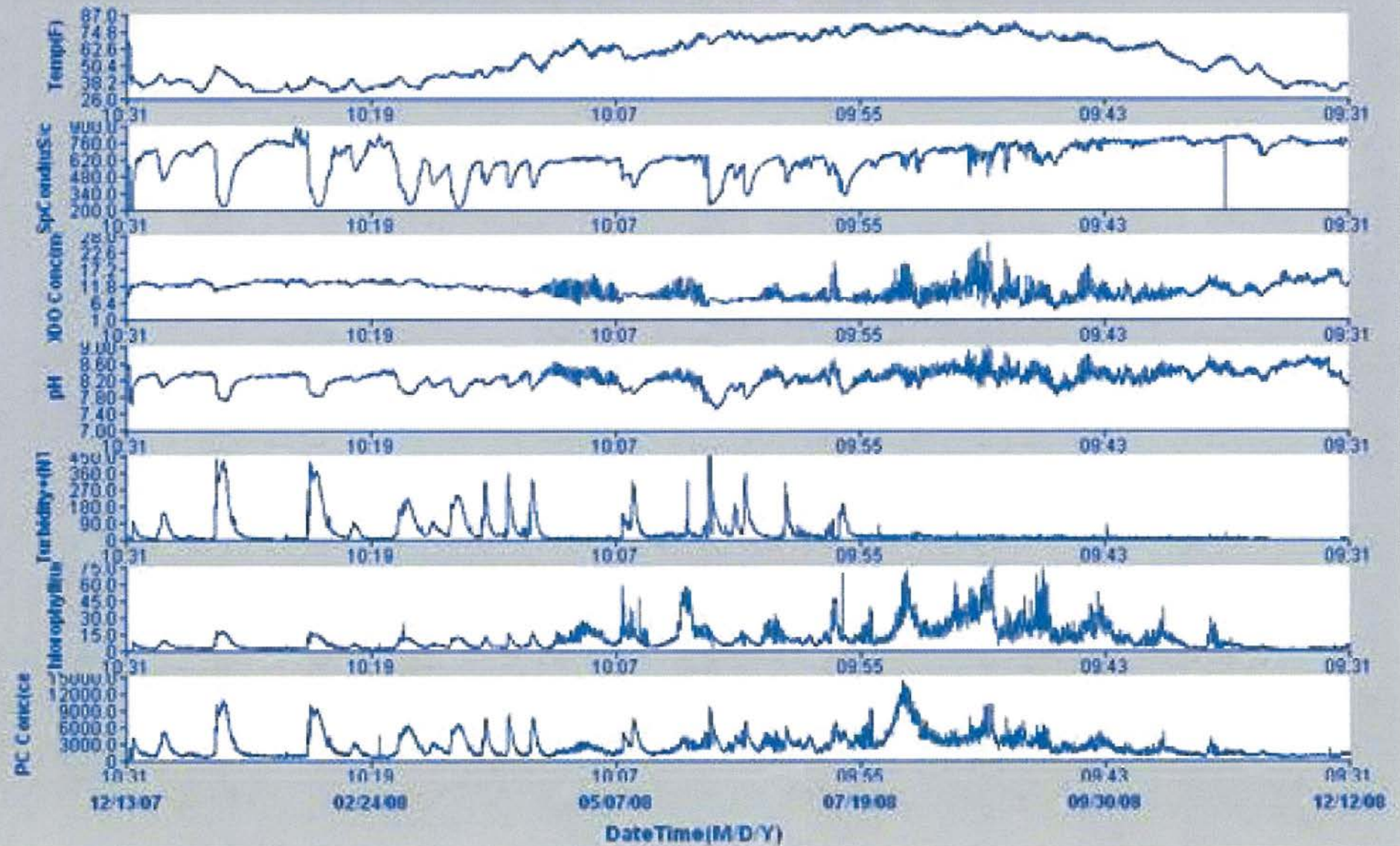


Sampling Hourly

Increasing the monitoring frequency to hourly by deploying a multiparameter sonde at the site reveals more dips and spikes in specific conductance, DO, turbidity and temperature. Diurnal cycles become clear and a brief event at the end of the deployment was detected.

MONITORING OF GREAT MIAMI RIVER IN DAYTON, OHIO

SONDE DEPLOYED JUST BELOW CONFLUENCE WITH THE STILLWATER RIVER







Controlling Land-Based Sediment



Gary Saldana

From: Reginald.M.Kokubun@hawaii.gov
Sent: Tuesday, September 29, 2015 8:29 AM
To: Gary Saldana
Cc: Alton.K.Miyasaka@hawaii.gov; Michael.M.Fujimoto@hawaii.gov
Subject: RE: Commercial Marine Landing Data Request ApplicationA
Attachments: spearfishing-rpt-rqst-dlnr.pdf; spear_fy2010_15.xls

Aloha Gary,

This is in response to your data request for commercial marine landing information. Attached is a spreadsheet containing non-confidential summary landings of commercial spear landings from Maui and the rest of the State. The statistical tables were grouped by fiscal year and then by species in descending order for pounds caught, except for all other species. I basically, presented the top 15 species landed (lbs. caught) per fiscal year and pooled the other species under the category "All others". The data source comes from the fishing report and fish dealer report databases, which were integrated by the fisher's license, report and purchase dates. For Fiscal 2015, only fishing and purchase dates from July 2014 through December 2014 were available.

All of the parrotfish species are reported under a generic species "Uhu parrot-misc.", and this was the primary target fish across the state for spear fishers. Several invasive species, including Roi, Taape and Toau were lesser targets, but of commercial significance, these species are highlighted in green font. The value is the monetary amount paid directly from the primary dealer to the licensed fisher. It should be noted that not all of the speared catch is sold. In this fishery there is a subsistence lifestyle for spear fishers who will keep some of the catch for home consumption. It is our understanding that spear fishing is also an important recreational fishing activity, too. Hope this helps.

Mahalo,
Reginald Kokubun
DLNR-DAR
State of Hawaii
(808) 587-0084

From: Gary Saldana <Gary.Saldana@mauicounty.us>
To: "Reginald.M.Kokubun@hawaii.gov" <Reginald.M.Kokubun@hawaii.gov>,
Date: 09/24/2015 03:25 PM
Subject: RE: Commercial Marine Landing Data Request ApplicationA

Aloha Reggie,
Thanks for the request form.

Attached please find attached sign request form from Councilmember Carroll. If you have any questions please let me know.

Mahalo,
gary

From: Reginald.M.Kokubun@hawaii.gov [mailto:Reginald.M.Kokubun@hawaii.gov]
Sent: Thursday, September 24, 2015 2:45 PM
To: Gary Saldana
Subject: Commercial Marine Landing Data Request ApplicationA

Aloha Gary,

Please complete the attached application form to request commercial marine landings on speared fish data. A non-confidential summary of the landings will be provided pending approval of the request by DLNR-DAR Administration. You may email or fax the completed application to me at (808) 587-0115.

Mahalo,
Reginald Kokubun
DLNR-DAR
State of Hawaii
Ph: (808) 587-0084

Fiscal	Species	No. fishers	No. caught	Lbs. caught	No. lost to predation	No. released	No. sold	Lbs. sold	Value
2010	Uhu parrot-misc.	12	2,869	10,974	0	0	1,230	5,662	\$17,176
2010	Menpachi	9	12,733	6,600	0	0	3,377	3,657	\$14,616
2010	Palani	10	3,041	3,487	2	0	1,335	2,109	\$3,952
2010	Kala	10	938	3,430	0	0	419	1,583	\$3,117
2010	Manini	7	5,885	2,458	6	0	2,576	1,414	\$4,187
2010	Moana	7	2,989	2,406	0	0	92	315	\$1,305
2010	Nenue	12	744	1,897	0	0	310	1,299	\$3,121
2010	Roi	10	1,038	1,650	0	0	411	829	\$1,937
2010	Day tako	8	649	1,384	0	0	238	498	\$2,213
2010	Maiko	3	1,695	1,228	0	0	17	69	\$148
2010	Kole	12	2,406	943	0	0	559	386	\$1,056
2010	Maomao	4	1,555	736	0	0	330	593	\$1,772
2010	Umaumalei	6	627	720	0	0	112	308	\$666
2010	Uku	6	66	595	0	0	58	525	\$2,688
2010	Nohu	6	148	564	0	0	68	268	\$929
2010	All others	22	2,191	3,804	0	2	599	1,353	\$4,406
2011	Uhu parrot-misc.	14	3,829	13,222	0	0	1,650	6,829	\$20,911
2011	Kala	10	1,642	7,183	0	0	606	2,667	\$5,211
2011	Nenue	9	1,304	4,691	1	0	162	1,329	\$2,412
2011	Menpachi	9	7,910	4,241	2	0	1,393	2,531	\$10,234
2011	Day tako	17	1,628	3,679	2	28	851	1,929	\$8,862
2011	Palani	9	3,507	3,489	0	0	1,247	1,790	\$3,255
2011	Manini	8	8,869	3,339	0	0	3,965	1,894	\$5,612
2011	Kole	14	5,261	2,097	11	0	882	958	\$2,727
2011	Moana	10	2,218	1,820	0	0	134	340	\$1,419
2011	Roi	10	834	1,694	2	0	270	792	\$2,078
2011	Umaumalei	5	1,023	1,607	0	0	187	466	\$945
2011	Maomao	5	2,426	1,045	0	0	396	671	\$2,014
2011	Nohu	8	217	758	0	0	118	456	\$1,481
2011	Omilu	7	120	627	0	0	21	72	\$193
2011	Naenae	4	308	380	0	0	12	28	\$49
2011	All others	23	5,710	5,947	0	0	476	1,389	\$5,993
2012	Uhu parrot-misc.	11	4,175	13,810	0	0	2,251	9,147	\$27,851
2012	Nenue	7	1,755	6,254	0	0	693	3,281	\$6,864
2012	Kala	7	1,850	5,889	0	0	827	3,224	\$6,462
2012	Menpachi	7	8,519	4,003	0	0	2,200	2,505	\$10,065
2012	Day tako	15	1,556	3,873	6	38	934	2,458	\$12,588
2012	Manini	6	9,229	3,744	0	0	3,804	2,001	\$5,653
2012	Palani	6	3,073	3,557	0	0	835	1,633	\$3,216
2012	Umaumalei	3	2,022	3,239	0	0	967	2,458	\$5,197
2012	Kole	8	6,425	2,751	0	0	1,383	991	\$2,826
2012	Moana	5	2,479	1,687	0	0	83	175	\$752
2012	Roi	5	699	1,387	0	0	377	1,034	\$2,477
2012	Maomao	3	2,993	1,367	0	0	1,233	1,099	\$3,355
2012	Weke a'a	3	1,556	1,052	0	0	203	183	\$491
2012	Nohu	6	258	905	0	0	189	592	\$1,953
2012	Omilu	4	97	636	0	0	17	120	\$322
2012	All others	21	6,091	6,166	0	0	621	1,699	\$6,762

2013	Uhu parrot-misc.	6	3,942	13,684	0	0	2,619	10,230	\$30,439
2013	Day tako	18	3,251	7,917	0	11	1,850	4,434	\$21,707
2013	Kala	6	2,179	7,286	0	0	1,538	5,261	\$10,667
2013	Menpachi	6	8,895	4,407	0	0	2,766	2,884	\$11,761
2013	Nenue	4	1,646	3,747	0	0	901	2,870	\$7,071
2013	Palani	6	2,970	3,447	0	0	1,560	2,429	\$5,090
2013	Manini	4	8,218	3,435	0	0	4,608	2,221	\$6,582
2013	Umaumalei	3	1,335	2,243	0	0	795	1,729	\$3,722
2013	Kole	7	4,145	1,657	0	0	1,074	1,011	\$2,734
2013	Maomao	3	3,324	1,584	0	0	1,320	1,088	\$2,966
2013	Roi	7	681	1,324	0	0	408	1,066	\$2,687
2013	Moana	4	1,766	1,156	0	0	131	201	\$822
2013	Nohu	4	238	757	0	0	154	459	\$1,530
2013	Weke a'a	3	1,045	720	0	0	221	182	\$382
2013	Uku	6	151	614	0	0	22	164	\$710
2013	Omilu	6	78	504	0	0	20	172	\$467
2013	All others	20	7,891	7,486	2	20	548	1,673	\$6,499
2014	Uhu parrot-misc.	6	3,213	11,129	0	20	2,082	8,259	\$25,061
2014	Kala	5	2,213	4,994	0	10	1,494	3,934	\$8,738
2014	Day tako	11	2,016	4,480	2	0	871	1,916	\$10,369
2014	Menpachi	4	7,720	3,675	0	0	2,955	2,454	\$9,416
2014	Palani	4	2,604	3,483	0	0	1,651	2,617	\$5,945
2014	Nenue	6	1,145	3,378	0	0	950	2,887	\$7,584
2014	Umaumalei	3	1,703	2,512	0	0	1,262	1,985	\$4,427
2014	Manini	4	6,256	2,459	0	0	4,210	1,796	\$5,344
2014	Moana	3	1,696	1,396	0	0	313	408	\$1,671
2014	Roi	5	422	681	0	0	258	492	\$1,305
2014	Kole	8	1,434	641	0	0	510	414	\$1,188
2014	Ono	4	27	507	0	0	16	432	\$2,632
2014	Omilu	5	45	315	0	0	15	131	\$378
2014	Nohu	3	89	287	0	0	59	219	\$788
2014	Kumu	5	89	156	0	0	73	144	\$959
2014	All others	16	5,103	4,750	0	0	750	1,879	\$5,386
2015	Uhu parrot-misc.	6	920	3,439	0	0	618	2,360	\$7,100
2015	Kala	5	1,072	2,761	0	0	772	2,197	\$5,082
2015	Day tako	10	910	2,454	2	9	609	1,640	\$9,330
2015	Palani	4	1,154	2,065	0	0	829	1,726	\$4,010
2015	Nenue	5	586	1,742	0	0	447	1,486	\$4,338
2015	Menpachi	4	2,890	1,521	0	0	1,012	1,001	\$3,701
2015	Manini	3	2,142	905	0	0	723	483	\$1,457
2015	Ono	3	15	393	0	0	9	235	\$1,106
2015	Kole	5	925	342	0	0	591	289	\$852
2015	Mahimahi	3	29	300	0	0	28	282	\$1,096
2015	Omilu	3	12	79	0	0	5	49	\$155
2015	All others	6	3,215	2,968	0	0	446	949	\$2,605

Fiscal 2015 - landings for first half, only, from July 2014 through December 2014