NOAA CORAL REEF CONSERVATION PROGRAM

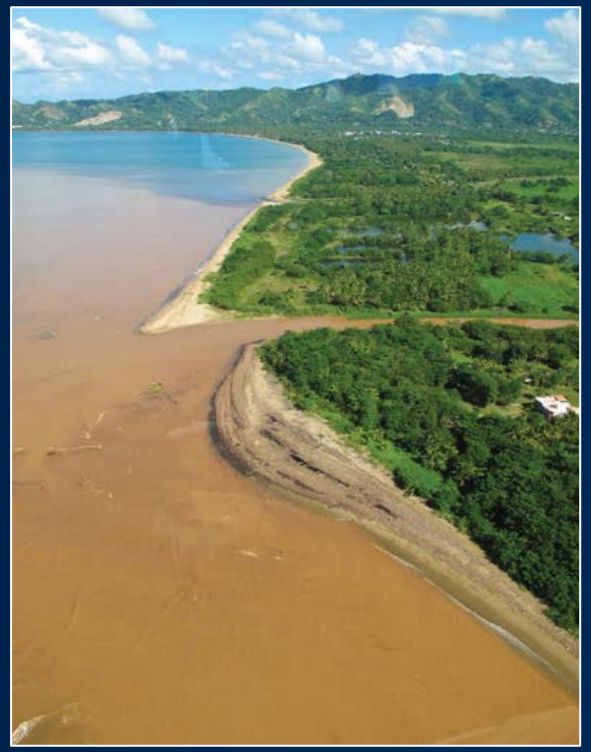
Managing Corals in Crisis:

How has NOAA approached resilience-based management for coral reef conservation?



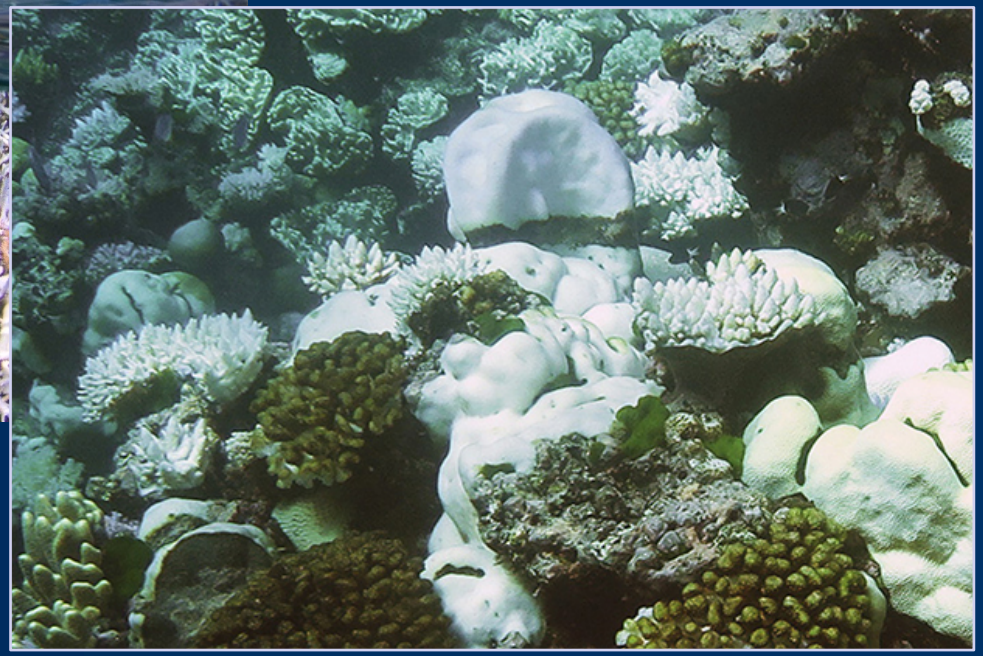

Jennifer Koss
Director, NOAA Coral Reef Conservation Program

Primary Threats to Corals



3 years of global coral bleaching, 2014–2017

2015: American Samoa before and after:
Flower Pot Island in Dec. 2014 & Feb. 2015



If that wasn't bad enough……

Stony Coral Tissue Loss Disease (SCTLD)

- Infectious, waterborne disease
- Impacting 20+ species of stony coral
- Outbreak ongoing since 2014
- Prevalence rates of 66-100%
- Mortality rates of >80%

Karen Neely, NSU

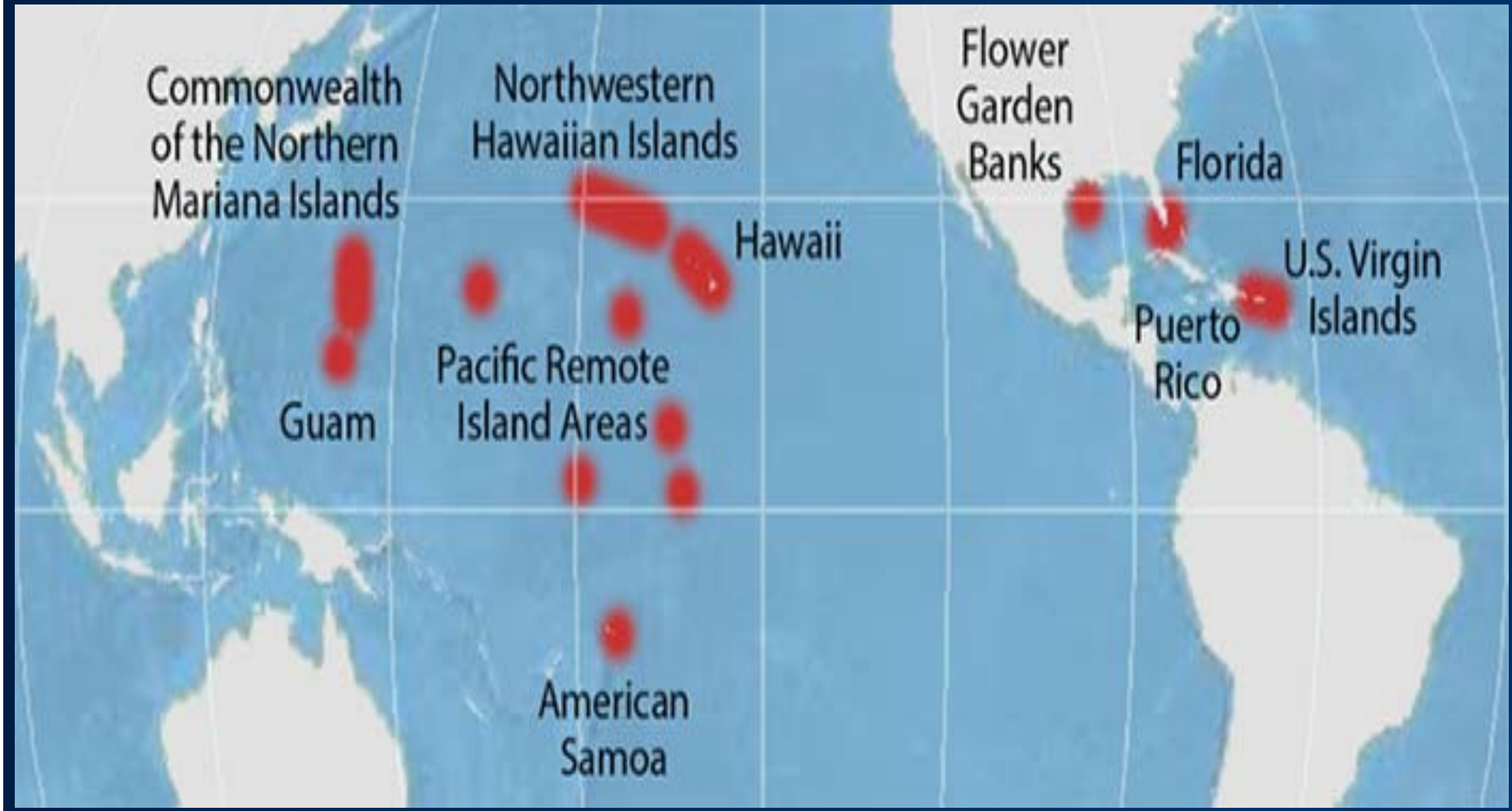
History of NOAA CRCP

- Coral Reef Protection Executive Order Established the U.S. Coral Reef Task Force (1998)
- National Action Plan (2000)
- Coral Reef Conservation Act Established the NOAA CRCP (2000)
- External Review/Roadmap (2007-2008)
  - Updated/Refined Goals & Objectives (2010)
- A Year of Assessment and Evaluation (2016)
  - New CRCP Strategic Plan (2018)





Where we work



Strategic Plan

Reduced Adverse Impacts of Human Activities

Conduct Restoration and Interventions

+

Improved Understanding of Coral Reef Ecosystems

Increased Partner Capacity to Manage Coral Reefs

=

Improved Management of Coral Reef Resources

Long-term Goals:

Corals: Restore key coral species to maintain ecosystem function

Key Fishery Taxa: Have stable or increasing abundance and average size

Water Quality: Priority CRCP watersheds have stable or improved water quality

Coral Recruitment Habitat: Hosts conditions to support recruitment

Climate Pillar: Increase Resilience to Climate Change

Strategy 1: Support a resilience-based management approach

Fisheries Pillar: Improve Fisheries Sustainability

Strategy 1: Provide essential data

Strategy 2: Build fisheries management capacity

LBSP Pillar: Reduce Land-based Sources of Pollution

Strategy 1: Conduct watershed management activities

Strategy 2: Build watershed management capacity

Restoration Pillar: Restore Viable Coral Populations

Strategy 1: Improve recruitment habitat quality

Strategy 2: Prevent avoidable losses

Strategy 3: Enhance resilient populations

Strategy 4: Improve health & survival

Research & Monitoring - Mapping – Social Science – Communications – Capacity Building

Increase Resilience to Climate Change

Support a resilience-based management (RBM) approach

- Build capacity on the principles of RBM
- Conduct and use vulnerability assessments
- Support monitoring, modeling, and integration to inform adaptive management
- Support research to validate and improve RBM
- Encourage partners to apply knowledge to management actions

Increase Resilience to Climate Change

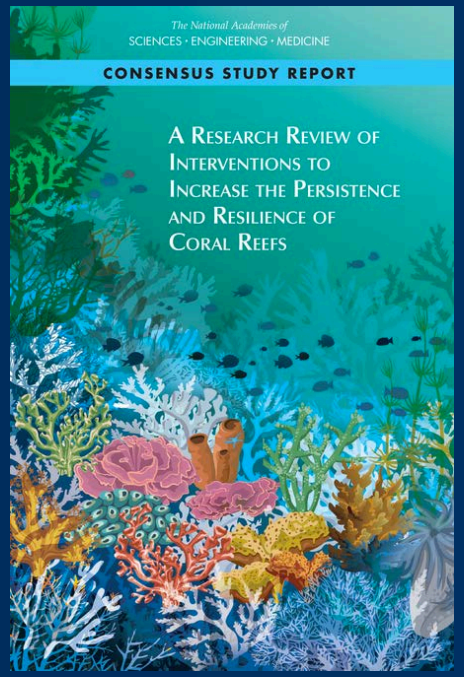
Support a resilience-based management (RBM) approach

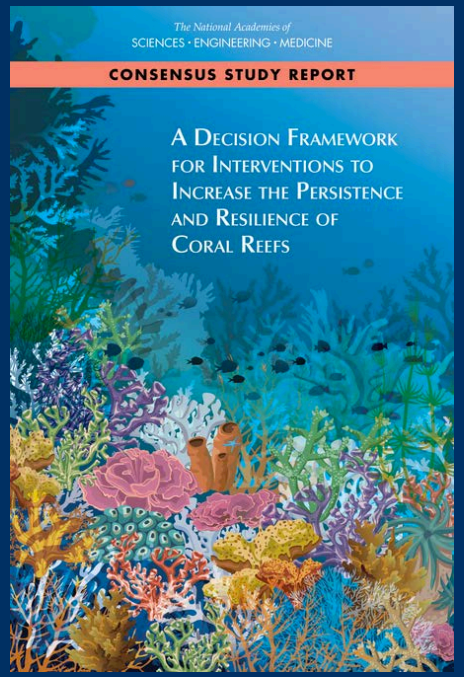
Restore Viable Coral Populations

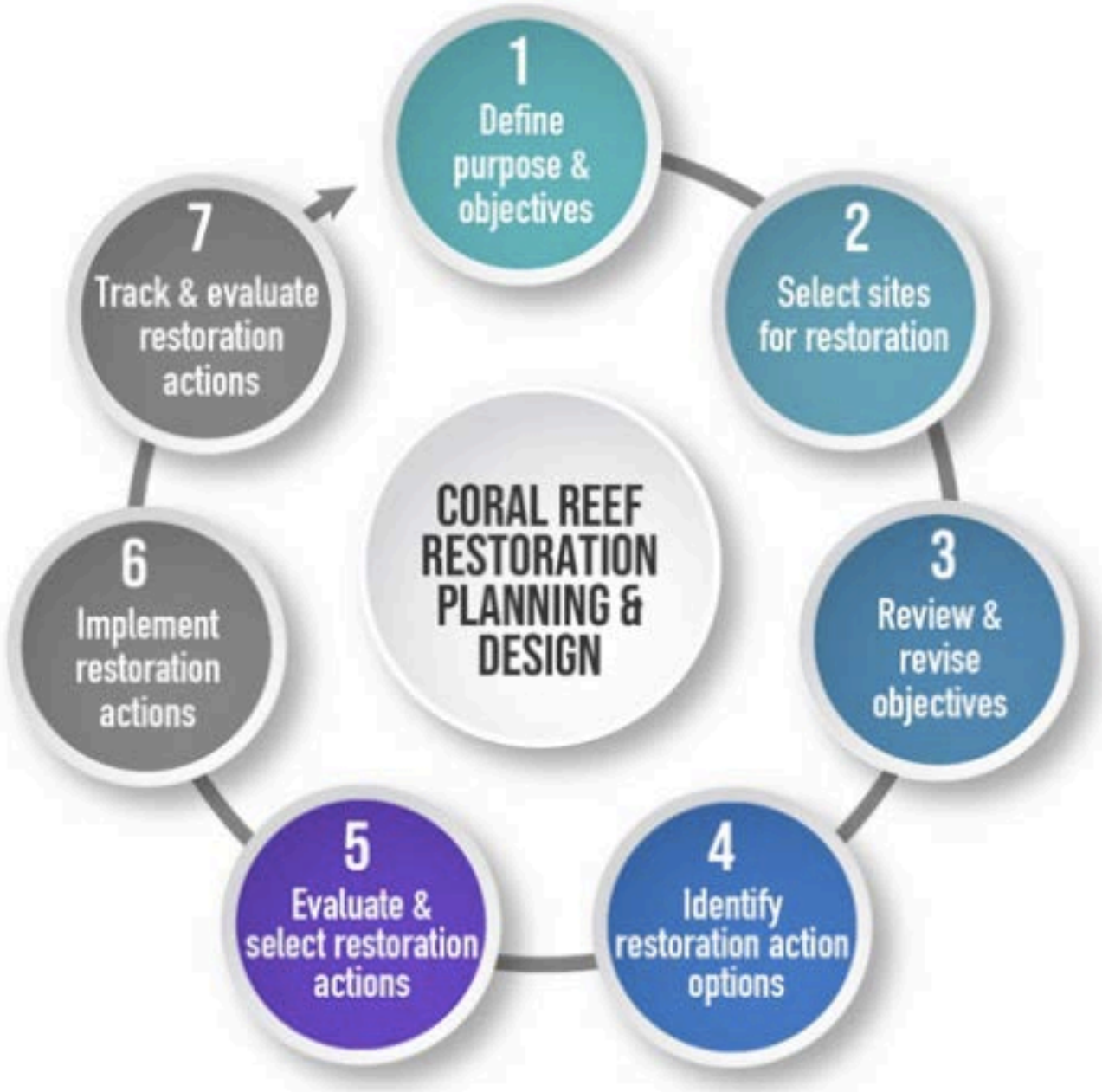
Improve recruitment habitat quality	• R&D/implement herbivore replenishment • R&D/implement invasive/nuisance species control
Prevent avoidable losses of corals and their habitat	• Identify high risk areas and implement risk reduction plans • Support emergency response and restoration • Support mechanisms for enforcement
Enhance population resilience	• Build partnerships • R&D/implement innovative resilience techniques • R&D/implement asexual and sexual propagation techniques
Improve coral health and survival	• R&D/implement control techniques for coral diseases • R&D/implement control techniques for corallivores

New Resilience-Based Strategies for Coral

- *National Academy of Sciences Review of Coral Interventions*
- *Manager's Guide to Coral Reef Restoration Planning & Design*
- Reef Futures 2021
- Florida Keys 7 Iconic Reefs Restoration Plan
- Ruth Gates Coral Intervention Restoration Grant Program







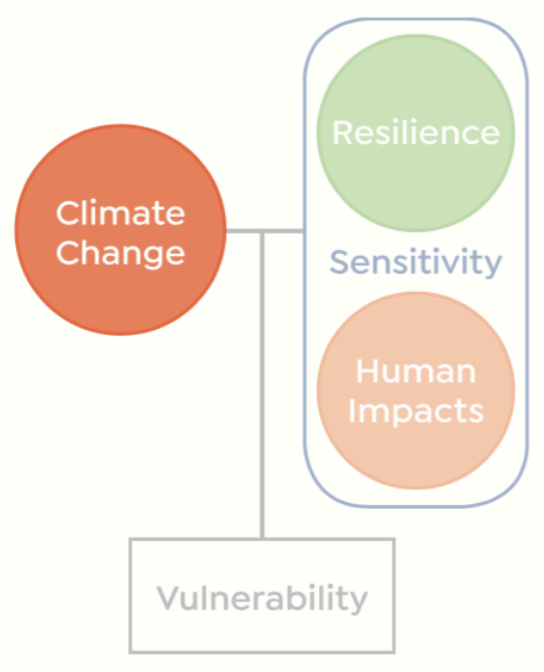
Effort led by Petra MacGowan, Liz Shaver, Jordan West Kitty Courtney and Jeff Maynard, with Jennifer Koss and Jason Philibotte.

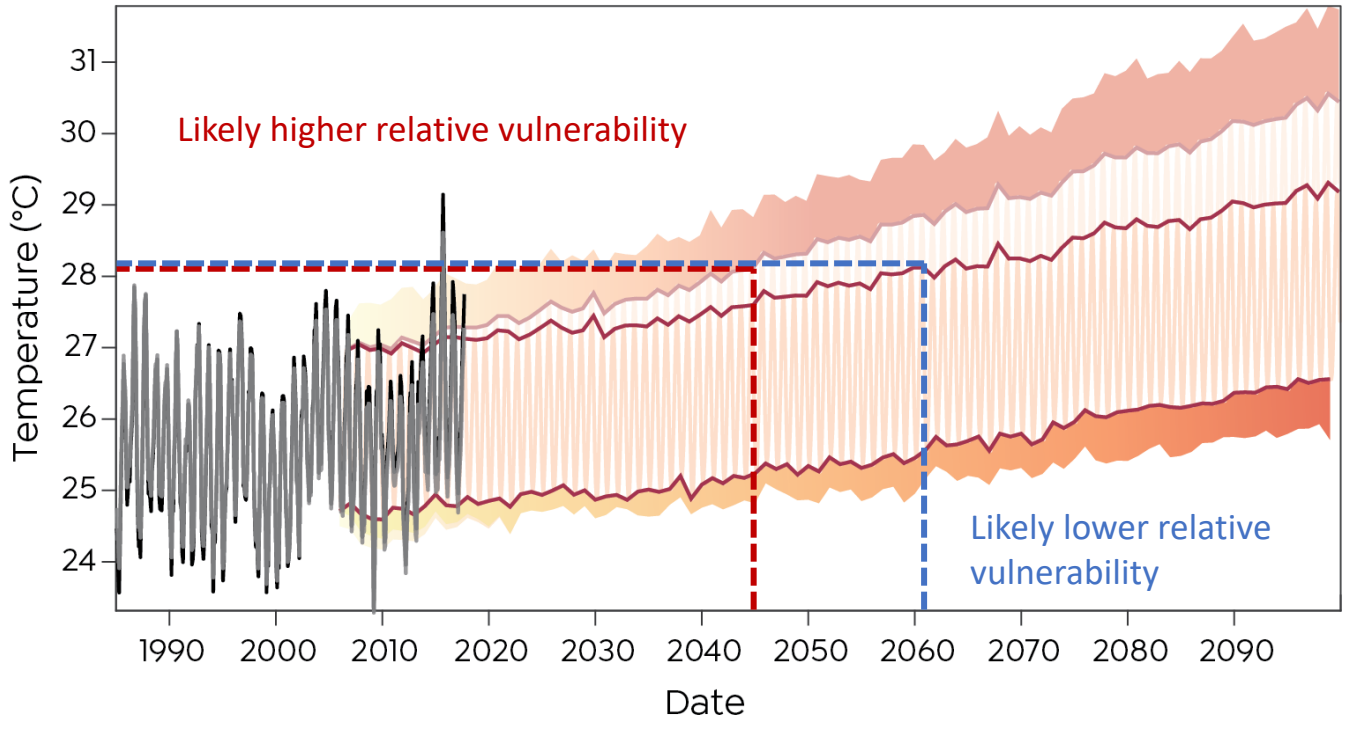
MANAGER'S GUIDE TO CORAL REEF RESTORATION PLANNING & DESIGN

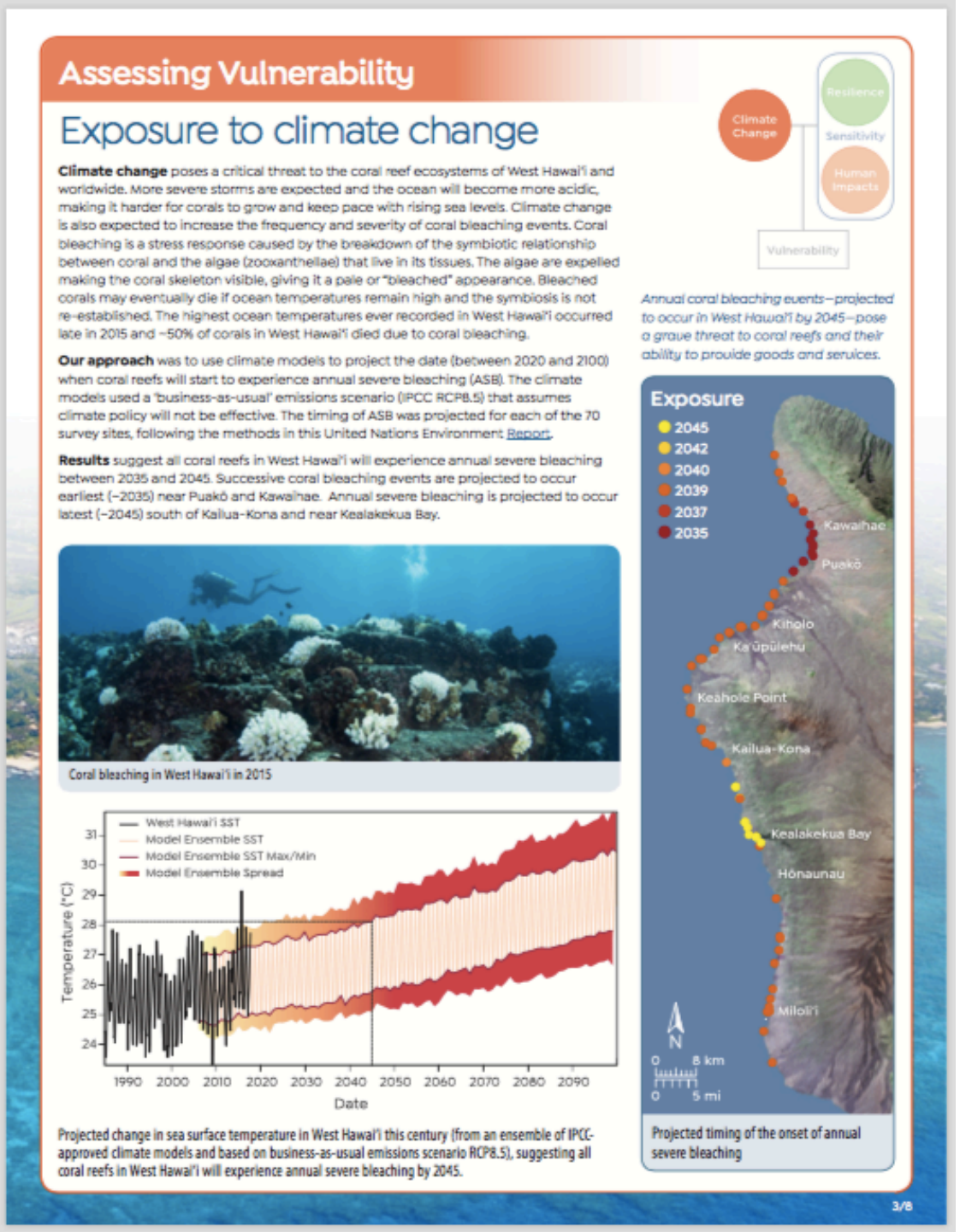
GUIDE WORKBOOK

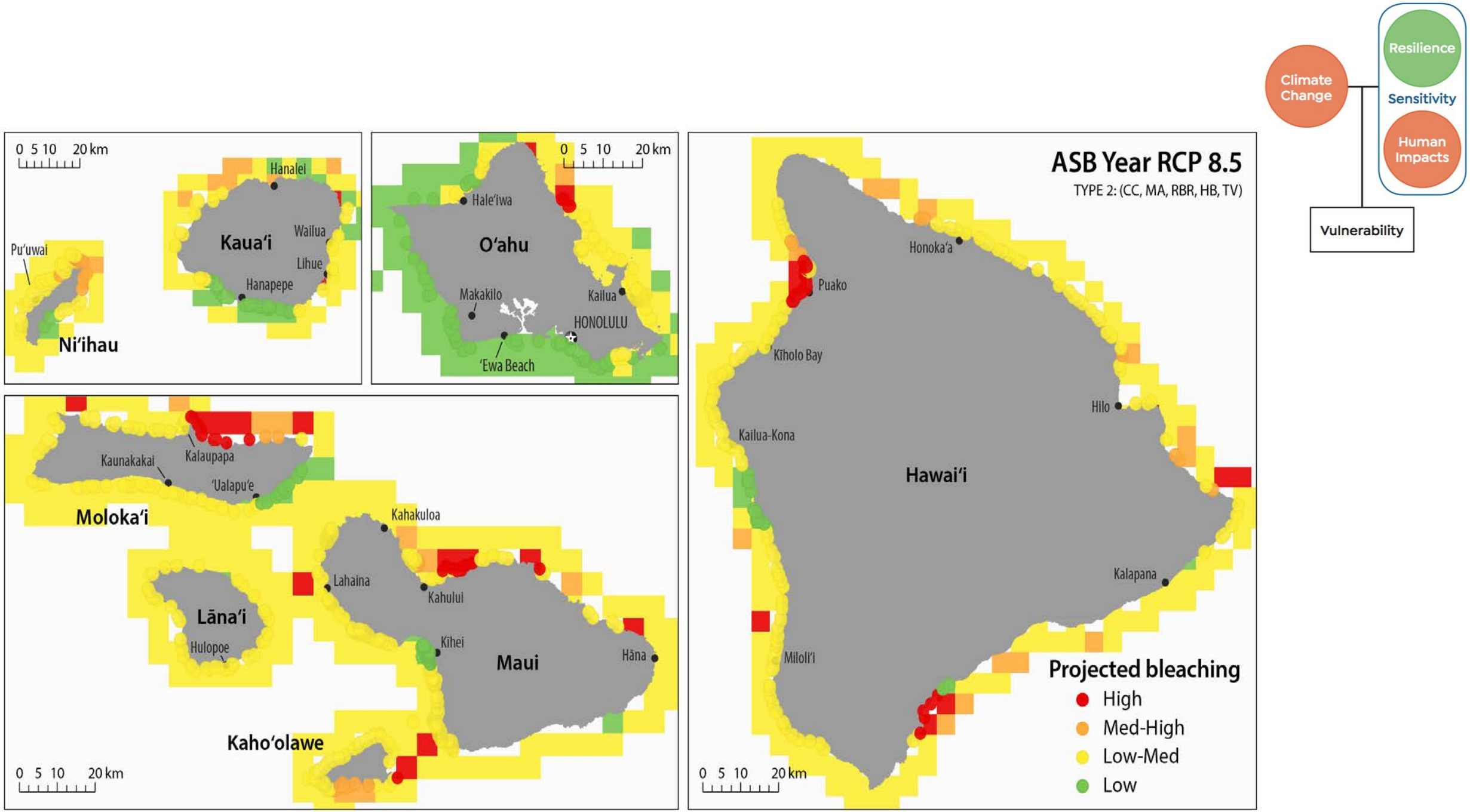
Elizabeth Shaver, The Nature Conservancy
Kitty Courtney, TetraTech
Cherie Wagner, The Nature Conservancy
Petra MacGowan, The Nature Conservancy
Jordan West, United States Environmental Protection Agency
Kristine Bucchianeri, United States All Islands Coral Reef Committee
Jason Philibotte, NOAA Coral Reef Conservation Program
Jennifer Koss, NOAA Coral Reef Conservation Program
Ian McLeod, James Cook University
Lisa Bostrom-Einarsson, James Cook University

Reef Resilience Network
NOAA CORAL REEF CONSERVATION PROGRAM
The Nature Conservancy
U.S. All Islands Coral Reef Committee


Climate Change
Resilience
Sensitivity
Human Impacts
Vulnerability

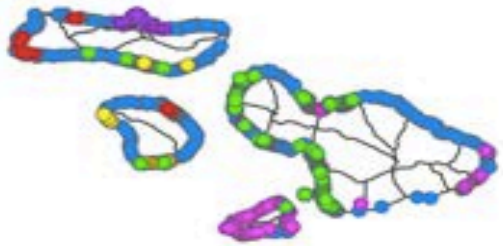

Likely higher relative vulnerability
Likely lower relative vulnerability
Temperature (°C)
Date
31
30
29
28
27
26
25
24
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090


Assessing Vulnerability
Exposure to climate change
Climate change poses a critical threat to the coral reef ecosystems of West Hawai'i and worldwide. More severe storms are expected and the ocean will become more acidic, making it harder for corals to grow and keep pace with rising sea levels. Climate change is also expected to increase the frequency and severity of coral bleaching events. Coral bleaching is a stress response caused by the breakdown of the symbiotic relationship between coral and the algae (zooxanthellae) that live in its tissues. The algae are expelled making the coral skeleton visible, giving it a pale or "bleached" appearance. Bleached corals may eventually die if ocean temperatures remain high and the symbiosis is not re-established. The highest ocean temperatures ever recorded in West Hawai'i occurred late in 2015 and ~50% of corals in West Hawai'i died due to coral bleaching.
Our approach was to use climate models to project the date (between 2020 and 2100) when coral reefs will start to experience annual severe bleaching (ASB). The climate models used a 'business-as-usual' emissions scenario (IPCC RCP8.5) that assumes climate policy will not be effective. The timing of ASB was projected for each of the 70 survey sites, following the methods in this United Nations Environment Report.
Results suggest all coral reefs in West Hawai'i will experience annual severe bleaching between 2035 and 2045. Successive coral bleaching events are projected to occur earliest (~2035) near Puakō and Kawaihae. Annual severe bleaching is projected to occur latest (~2045) south of Kailua-Kona and near Kealakekua Bay.
Climate Change
Resilience
Sensitivity
Human Impacts
Vulnerability
Annual coral bleaching events—projected to occur in West Hawai'i by 2045—pose a grave threat to coral reefs and their ability to provide goods and services.
Coral bleaching in West Hawai'i in 2015
West Hawai'i SST
Model Ensemble SST
Model Ensemble SST Max/Min
Model Ensemble Spread
Temperature (°C)
Date
Projected change in sea surface temperature in West Hawai'i this century (from an ensemble of IPCC-approved climate models and based on business-as-usual emissions scenario RCP8.5), suggesting all coral reefs in West Hawai'i will experience annual severe bleaching by 2045.
Exposure
2045
2042
2040
2039
2037
2035
Kawaihae
Puakō
Kiholo
Ka'ūpūlehu
Keahole Point
Kailua-Kona
Kealakekua Bay
Hōnaunau
Miloli'i
N
0 8 km
0 5 mi
Projected timing of the onset of annual severe bleaching
3/8


Climate Change
Resilience
Sensitivity
Human Impacts
Vulnerability
ASB Year RCP 8.5
TYPE 2: (CC, MA, RBR, HB, TV)
0 5 10 20 km
Hanalei
Kaua'i
Wailua
Lihue
Hanapepe
Pu'uwai
Ni'ihau
Hale'iwa
O'ahu
Makakilo
Kailua
HONOLULU
'Ewa Beach
Honoka'a
Puako
Kīholo Bay
Hilo
Kailua-Kona
Hawai'i
Kalapana
Miloli'i
Kaunakakai
Kalaupapa
'Ualapu'e
Moloka'i
Kahakuloa
Lahaina
Kahului
Kīhei
Maui
Hāna
Lāna'i
Hulopoe
Kaho'olawe
Projected bleaching
High
Med-High
Low-Med
Low

NOAA CORAL REEF CONSERVATION PROGRAM

	Benthic	Fish
Sites	5,674	8,067
Surveys	7,972	10,475



NATIONAL PARK SERVICE

2017 and 2018 data will be available in early 2020

DAR Hawaii Division of Aquatic Resources

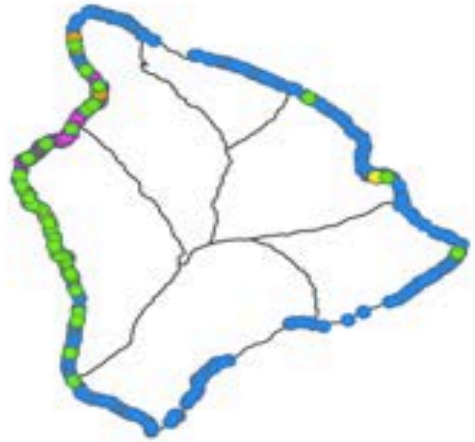
CORAL REEF ASSESSMENT AND MONITORING PROGRAM Hawai'i

The Nature Conservancy

NOAA Fish Habitat Utilization Surveys

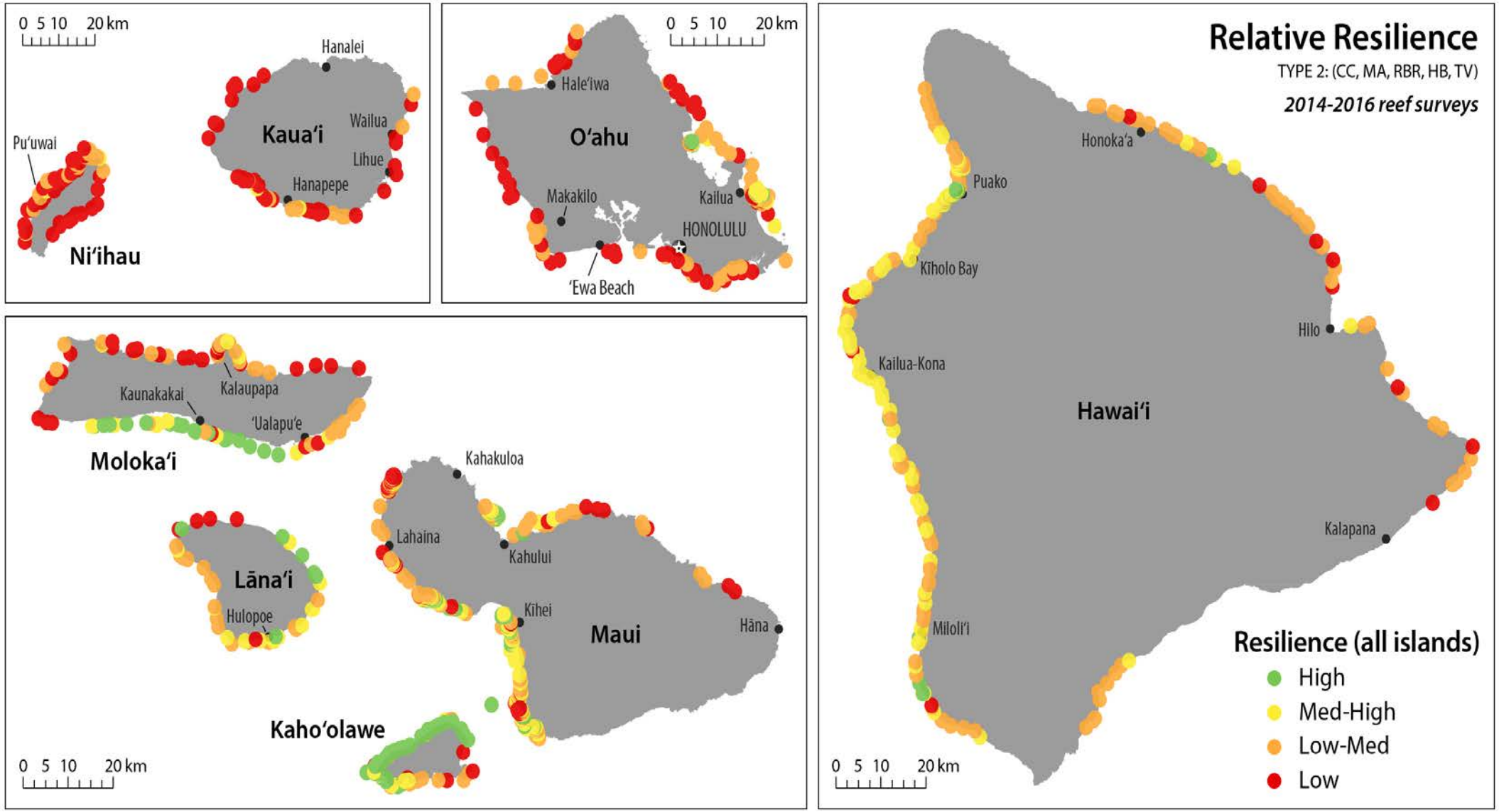
NOAA FISHERIES Pacific Islands Fisheries Science Center

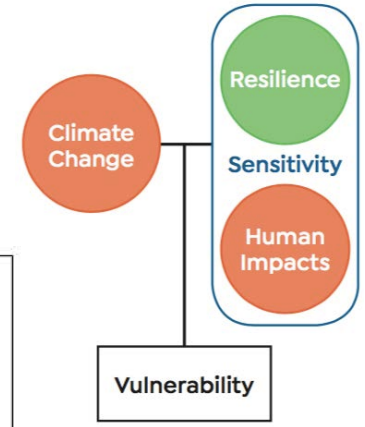
UNIVERSITY OF HAWAI'I Fisheries Ecology Research Laboratory

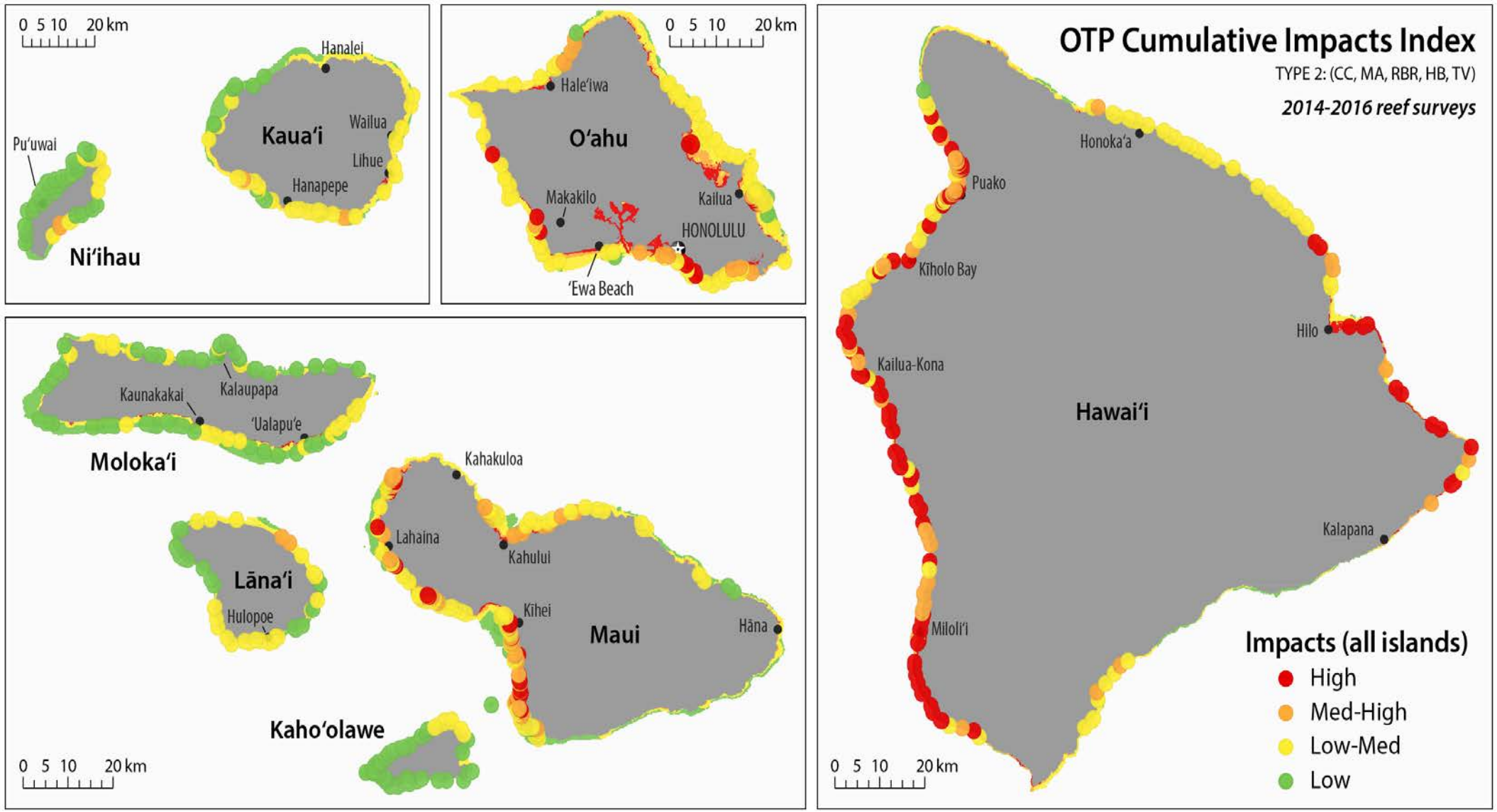


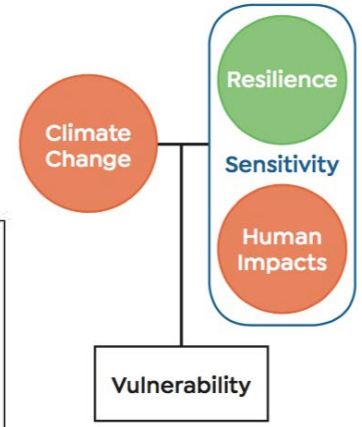
HIMARC

TYPE 2: (CC, MA, RBR, HB, TV)



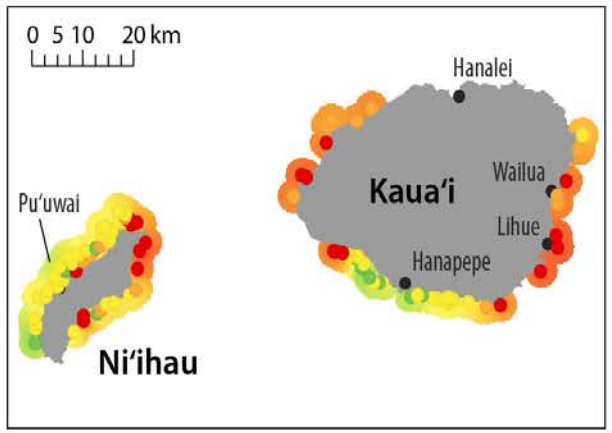


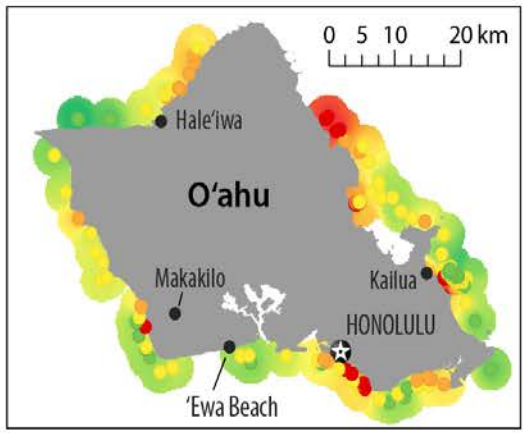

OTP Cumulative Impacts Index
TYPE 2: (CC, MA, RBR, HB, TV)
2014-2016 reef surveys
0 5 10 20 km
Hanalei
Kaua'i
Wailua
Lihue
Hanapepe
Pu'uwai
Ni'ihau
Hale'iwa
O'ahu
Makakilo
Kailua
HONOLULU
'Ewa Beach
Honoka'a
Puako
Kīholo Bay
Hilo
Kailua-Kona
Hawai'i
Kalapana
Miloli'i
Kaunakakai
Kalaupapa
'Ualapu'e
Moloka'i
Kahakuloa
Lahaina
Kahului
Kīhei
Maui
Hāna
Lāna'i
Hulopoe
Kaho'olawe
Impacts (all islands)
High
Med-High
Low-Med
Low

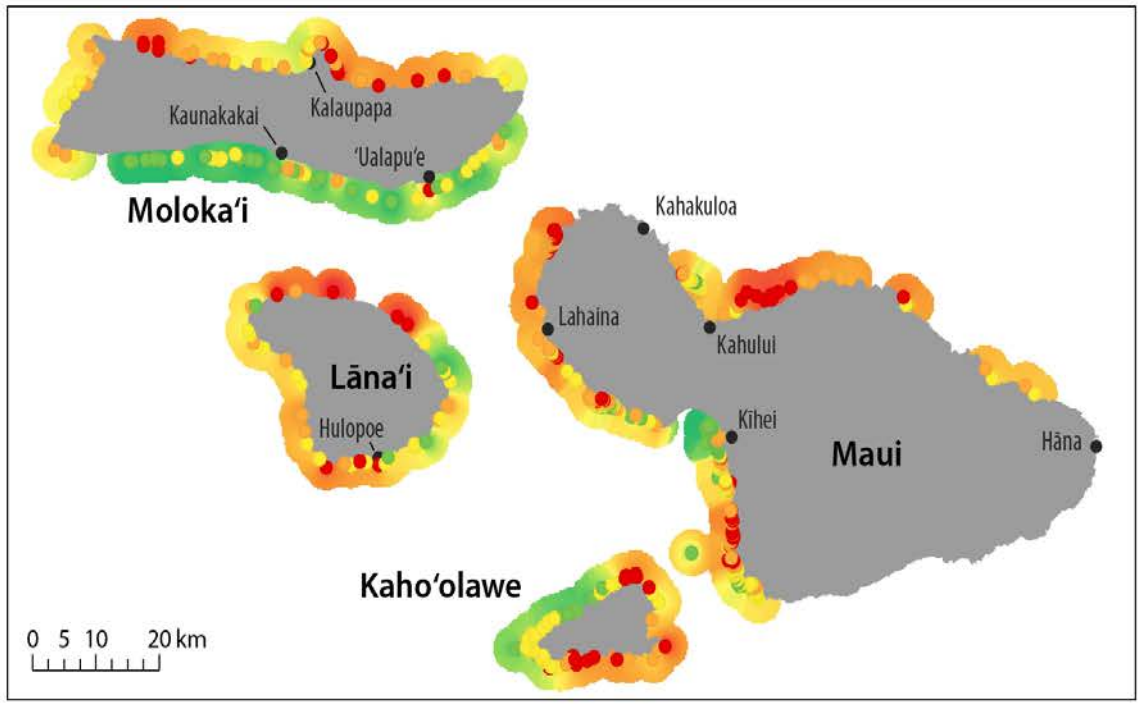

Climate Change
Resilience
Sensitivity
Human Impacts
Vulnerability


0 5 10 20 km
Hanalei

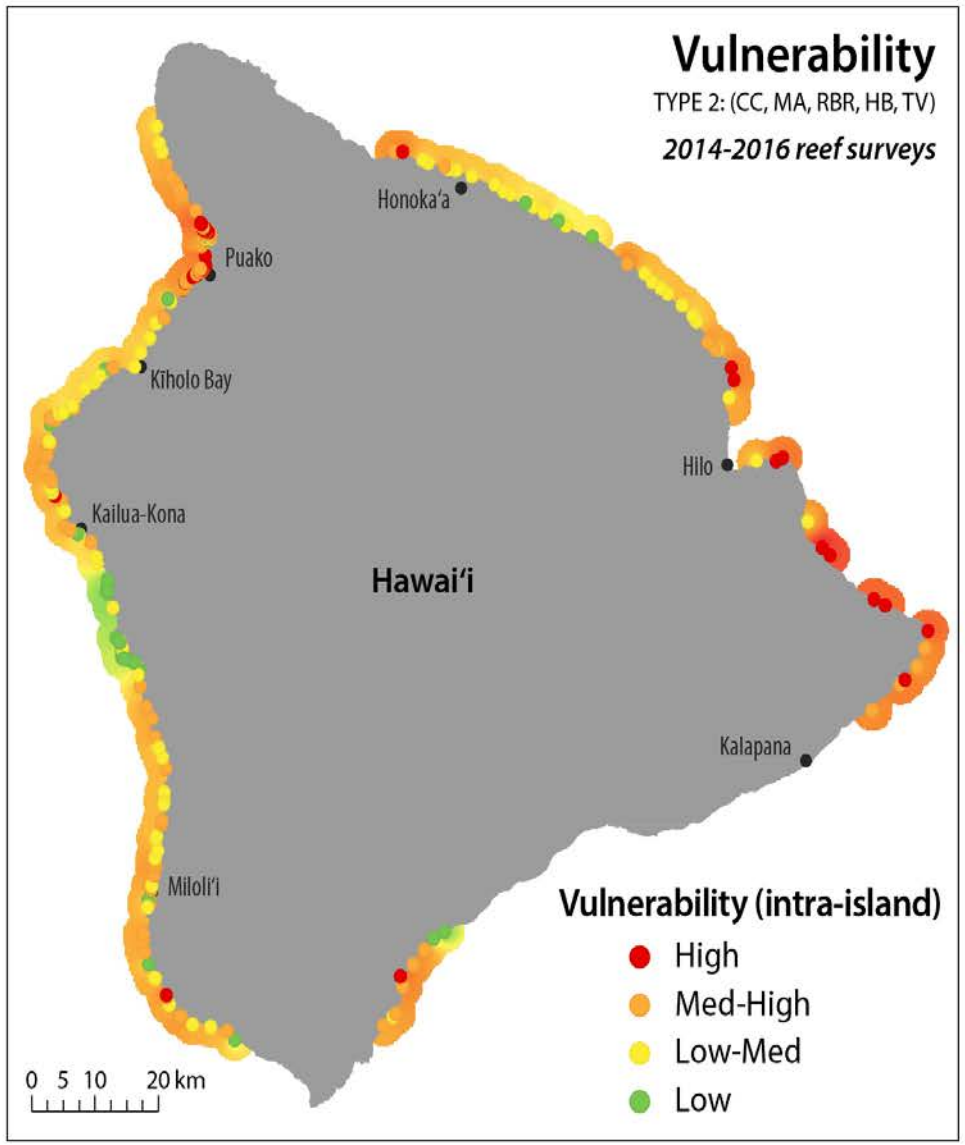

0 5 10 20 km

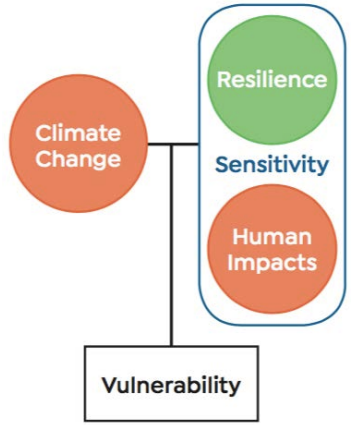

0 5 10 20 km
Hanalei
Kaua'i
Wailua
Lihue
Hanapepe
Pu'uwai
Ni'ihau

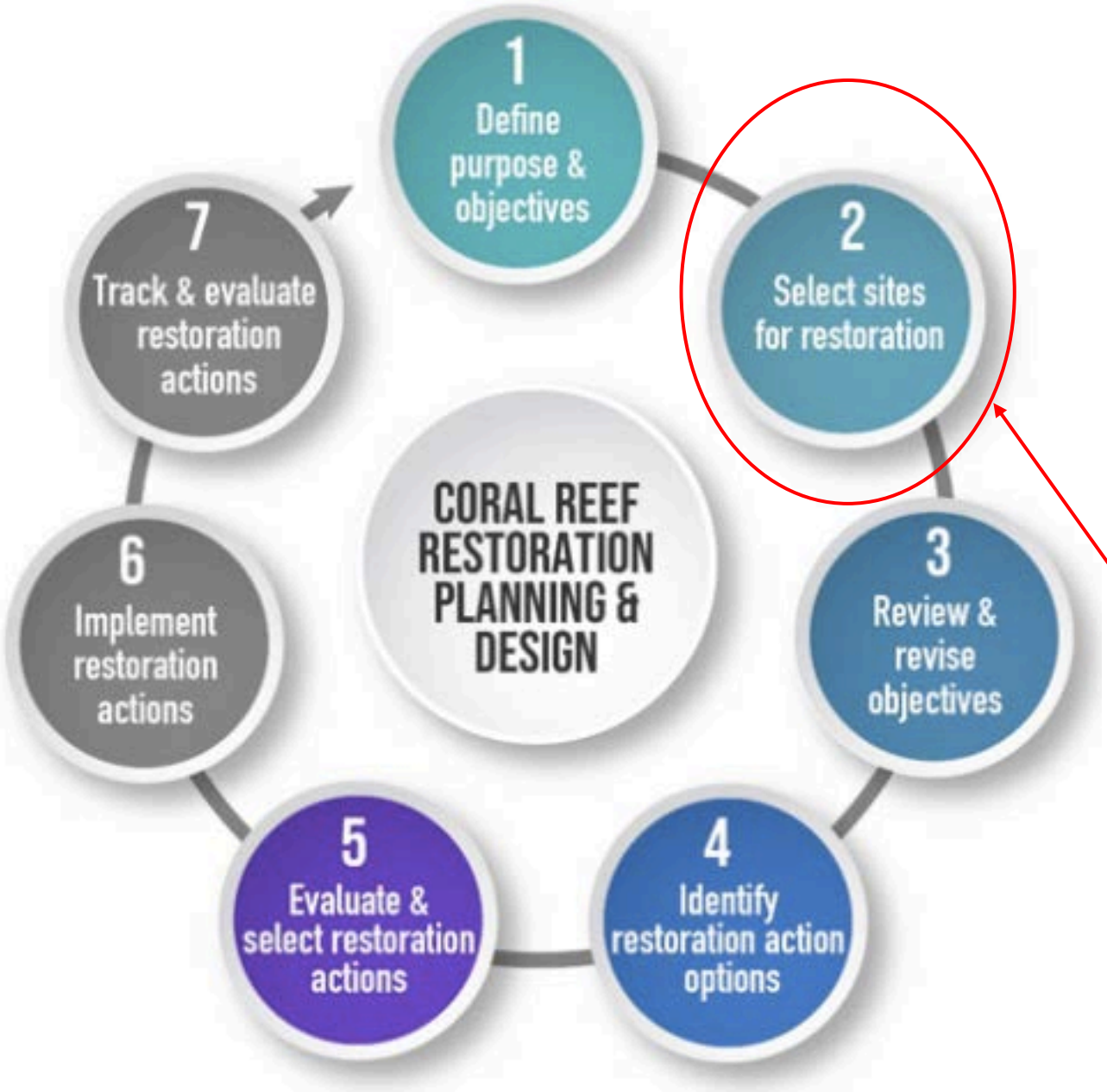

0 5 10 20 km
Hale'iwa
O'ahu
Makakilo
Kailua
HONOLULU
'Ewa Beach


Kaunakakai
Kalaupapa
'Ualapu'e
Moloka'i
Kahakuloa
Lahaina
Kahului
Kīhei
Maui
Hāna
Lāna'i
Hulopoe
Kaho'olawe
0 5 10 20 km


Vulnerability
TYPE 2: (CC, MA, RBR, HB, TV)


Vulnerability
TYPE 2: (CC, MA, RBR, HB, TV)
2014-2016 reef surveys
Honoka'a
Puako
Kīholo Bay
Hilo
Kailua-Kona
Hawai'i
Kalapana
Miloli'i
0 5 10 20 km
Vulnerability (intra-island)
High
Med-High
Low-Med
Low


Climate Change
Resilience
Sensitivity
Human Impacts
Vulnerability



Climate vulnerability assessments can inform restoration planning – site selection specifically.

Partnership: Pacific Coral Reef Restoration Planning & Implementation

Goals:

1. Restoration Planning and Technical Assistance for all 4 US Pacific jurisdictions
2. Scientific Assessments to Target Restoration in Hawai'i
3. Implementation and Evaluation of Restoration in Hawai'i

Year 1 Activities: October 2019 – September 2020

- Synthesize relevant findings and best practices for restoration methods
- Compile & synthesize assessments of resilience, climate, & vulnerability conditions
- Support each jurisdiction in developing a climate-resilient restoration plan
- Planning workshop – early May 2020

Questions?

"Our efforts are for those who came before us, those here today, and especially for those yet to come."

NOAA
CORAL REEF
CONSERVATION PROGRAM