JAMIE CAPLAN CONSULTING LLC
Emergency Management Services

Nature-Based Solutions Workshop for Hazard Mitigation

American Samoa

August 25, 2021, via Zoom

Instructions

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Emergency Management Services

American Samoa Living Shoreline Project

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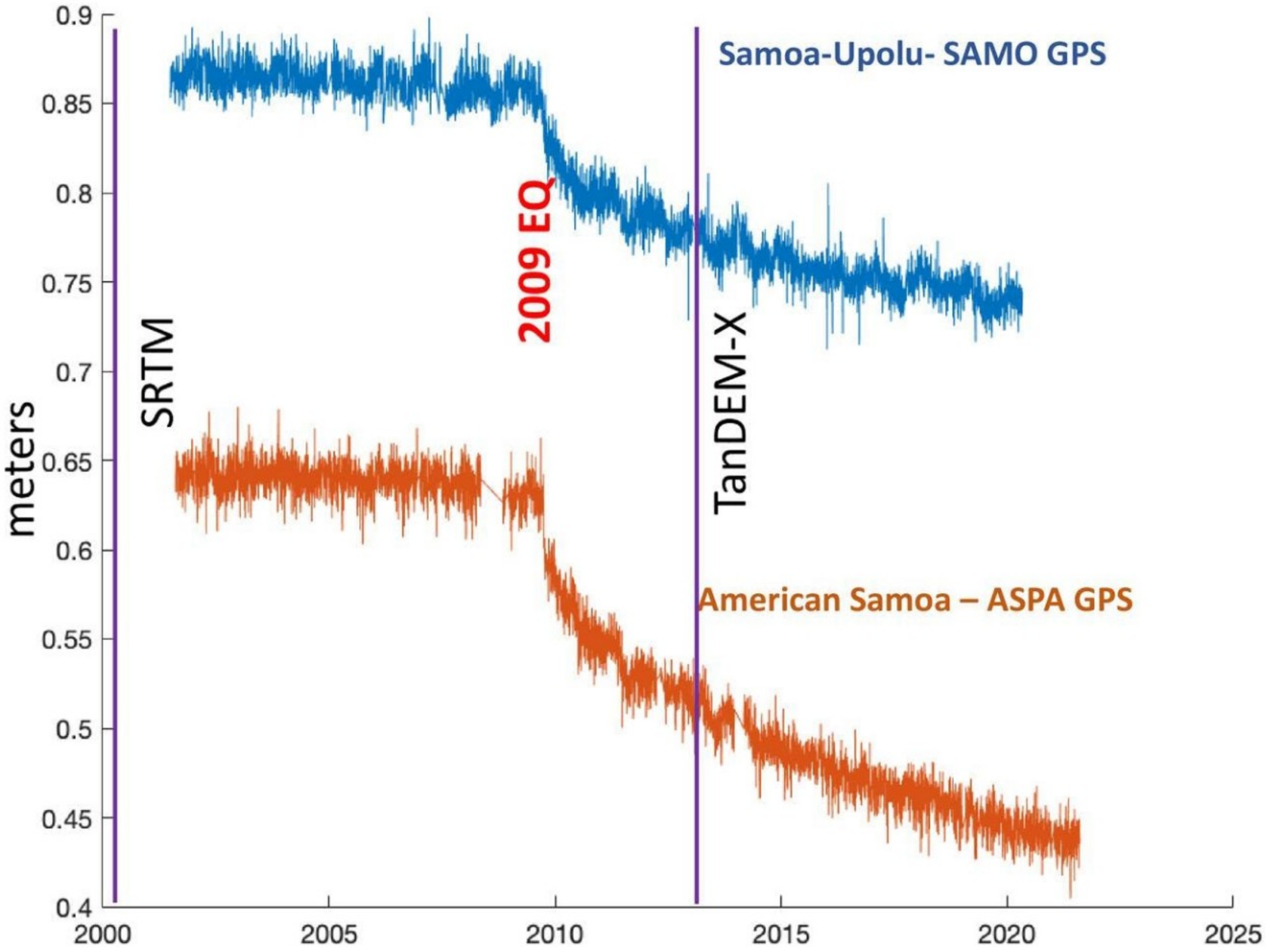
Based at the American Samoa Community College

KelleyAT@Hawaii.edu – 1(684) 258-2967/699-3353

University of Hawai‘i Sea Grant College Program


Samoa-Upolu- SAMO GPS
2009 EQ
SRTM
TanDEM-X
American Samoa – ASPA GPS
meters
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
2000
2005
2010
2015
2020
2025

Reefs – the original wave breaks

Figure 3. Aerial image of Fatu ma Futi on Tutuila island – the white surf lines are where the crest of the fringing reef is located. The narrow strip of flat coastal land is also clear in this image. (Photo credit: Valentine Vaeoso, 2021)

Losing our shores

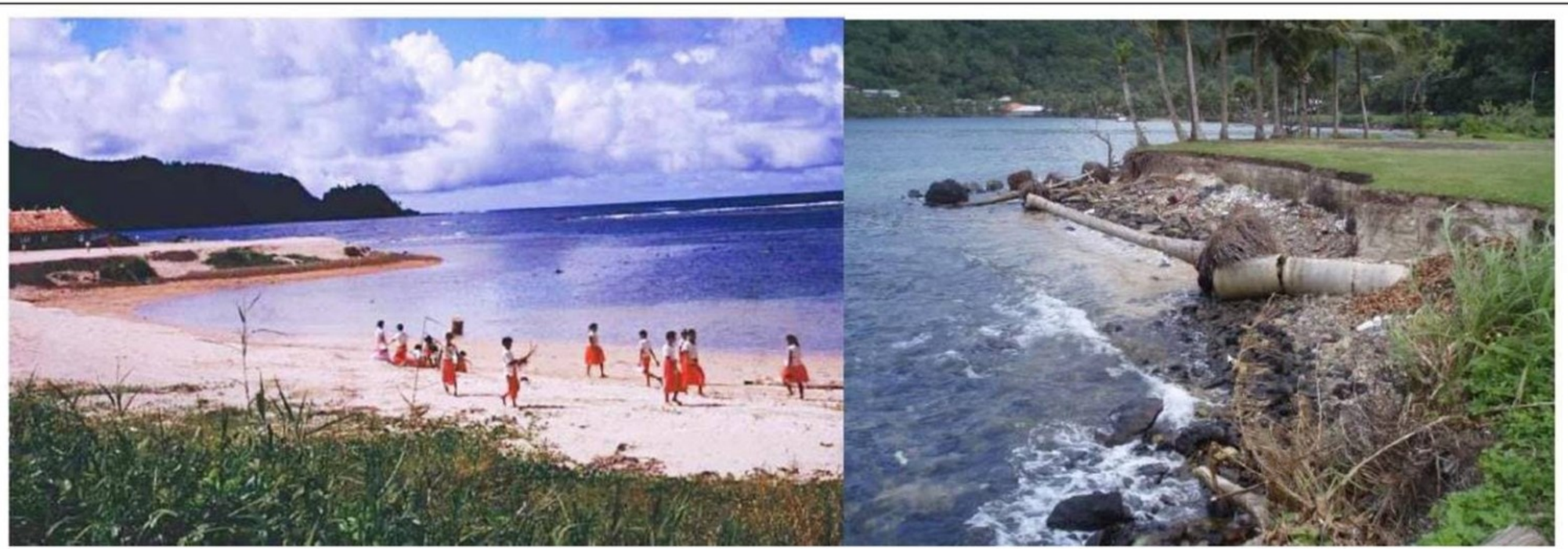


Figure 2. Faga'alu shoreline along Matafao Elementary circa 1967 (above left) and 2014 (above right).

Coastal flooding

‘i Sea G Progra

A or B

Costly failures

- Seawalls are failing at an increasing rate
- Proper repairs aren't easy
- DPW already stretched thin
- Road access is limited during repairs

Living shorelines

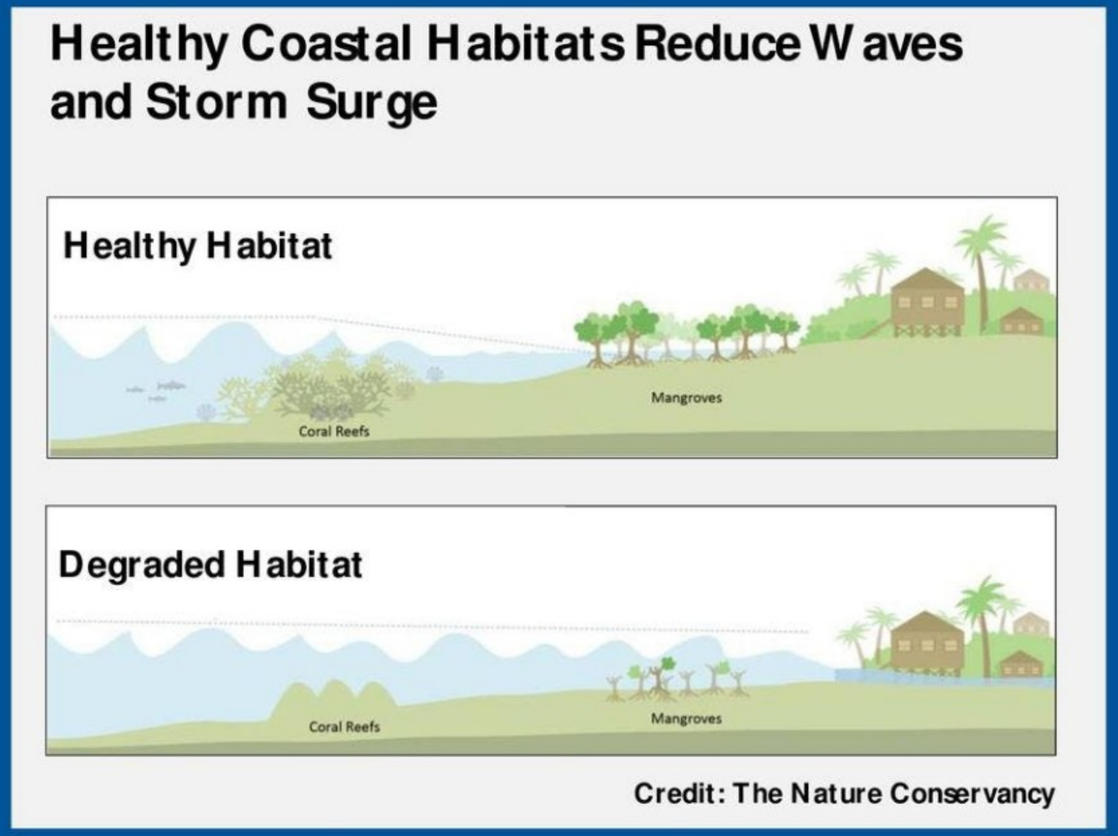
Living shorelines allow:

- The intertidal habitat to remain
- Natural migration as sea levels rise
- Community residents to become shoreline stewards
- Gleaning, or hand harvesting of clams, etc.

Appropriate shoreline solutions are site dependent

Sunset Beach, O'ahu, USA

Using our natural infrastructure



Supporting coral reefs

University of Hawai‘i Sea Grant College Program

Oyster reefs

Oyster reefs have many benefits:

- Each oyster can filter 50 gallons of water a day
- Serve as shoreline protection
- Can install different shapes as wave breaks
- Serve as carbon sink

Lions Park Living Shoreline

- Lions Park has lost over 20 feet of dry land over the past 20 years
- Will serve as Territory's first living shoreline installation
- Three planed locations for installations along the shore
- Combination of oyster reefs, local rock, and shoreline plants

University of Hawai'i Sea Grant College Program

Living shoreline process

- Current land survey
  - Challenges: only two surveyors on island, no current accurate elevation data
- ID large debris from survey for removal
- Coastal engineer will draw up designs
  - Challenges: none on island and borders are closed
- Nationwide permit 54
  - Plan to create a guide on how to apply for these, Susan Gayagas is our rep
- Installation of living shoreline
  - Partnering with ASCC (student interns), Land Grant (plants) and Nu'uuli VoTech for student involvement
  - Include interpretive signage & outreach videos

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Fa'afetai tele lava!

Questions?

Call or stop by!

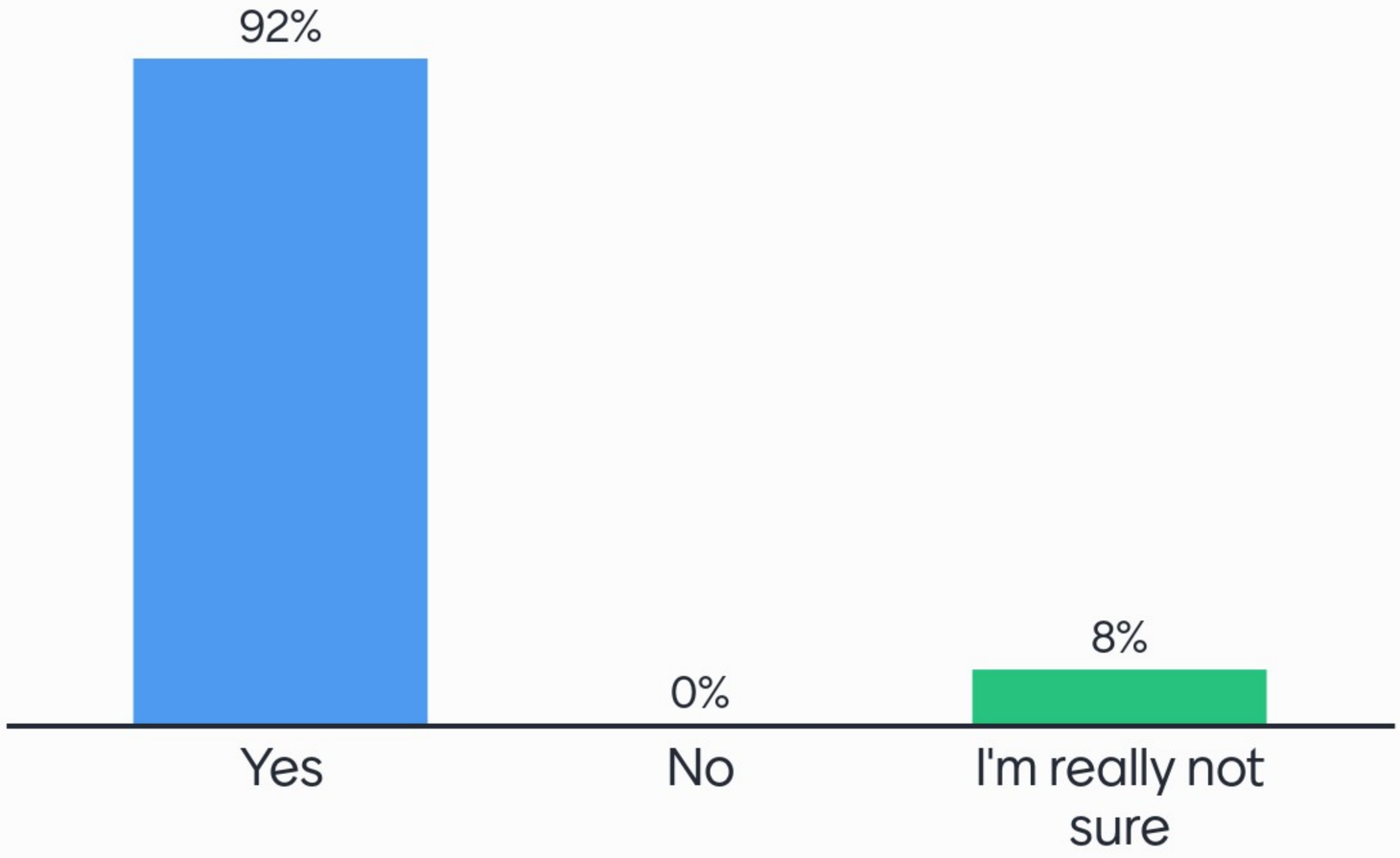
Email: KelleyAT@Hawaii.edu

Phone: 699-3353/258-2967

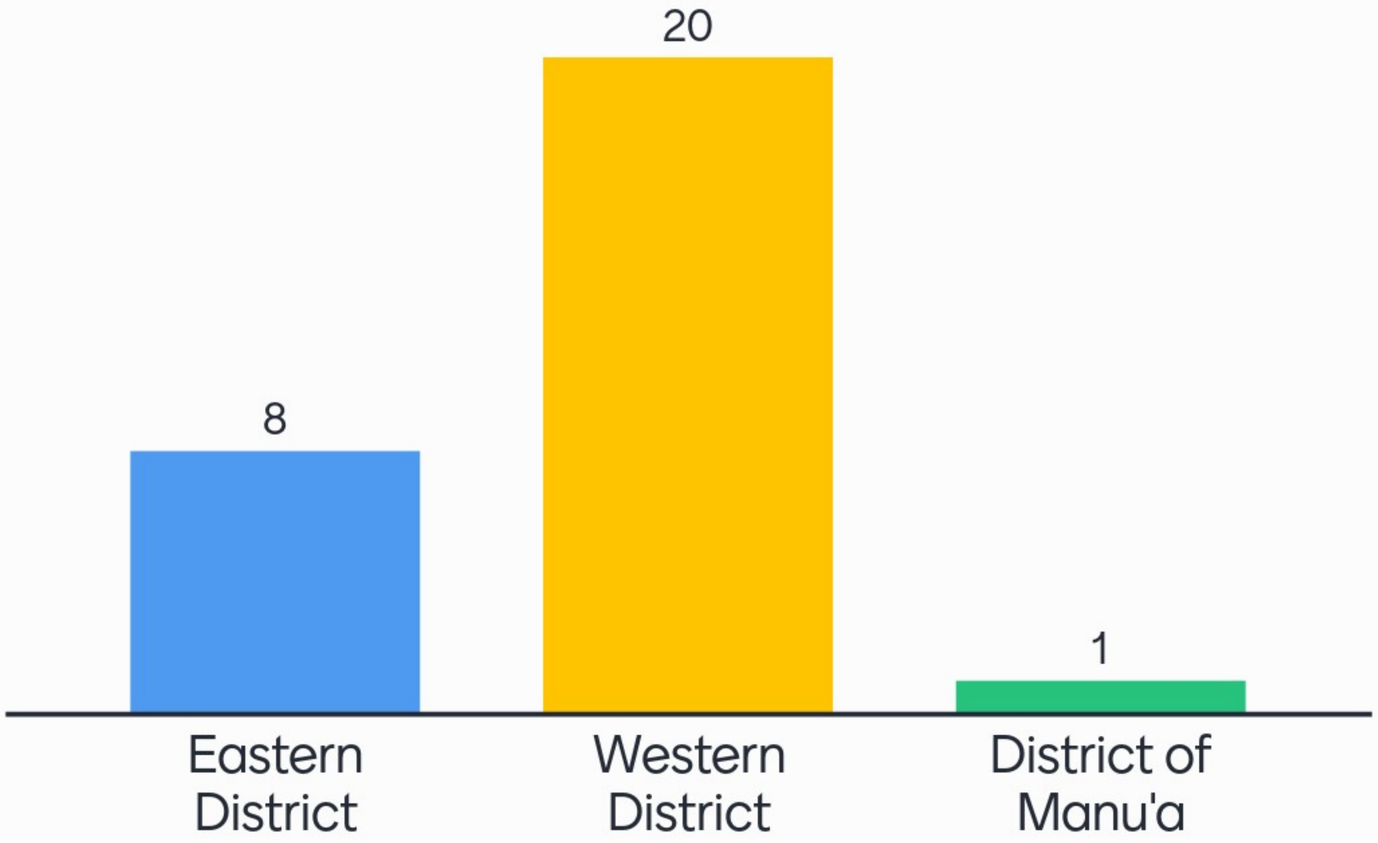
Office: ASCC Land Grant

wai'i Sea Grant College Program

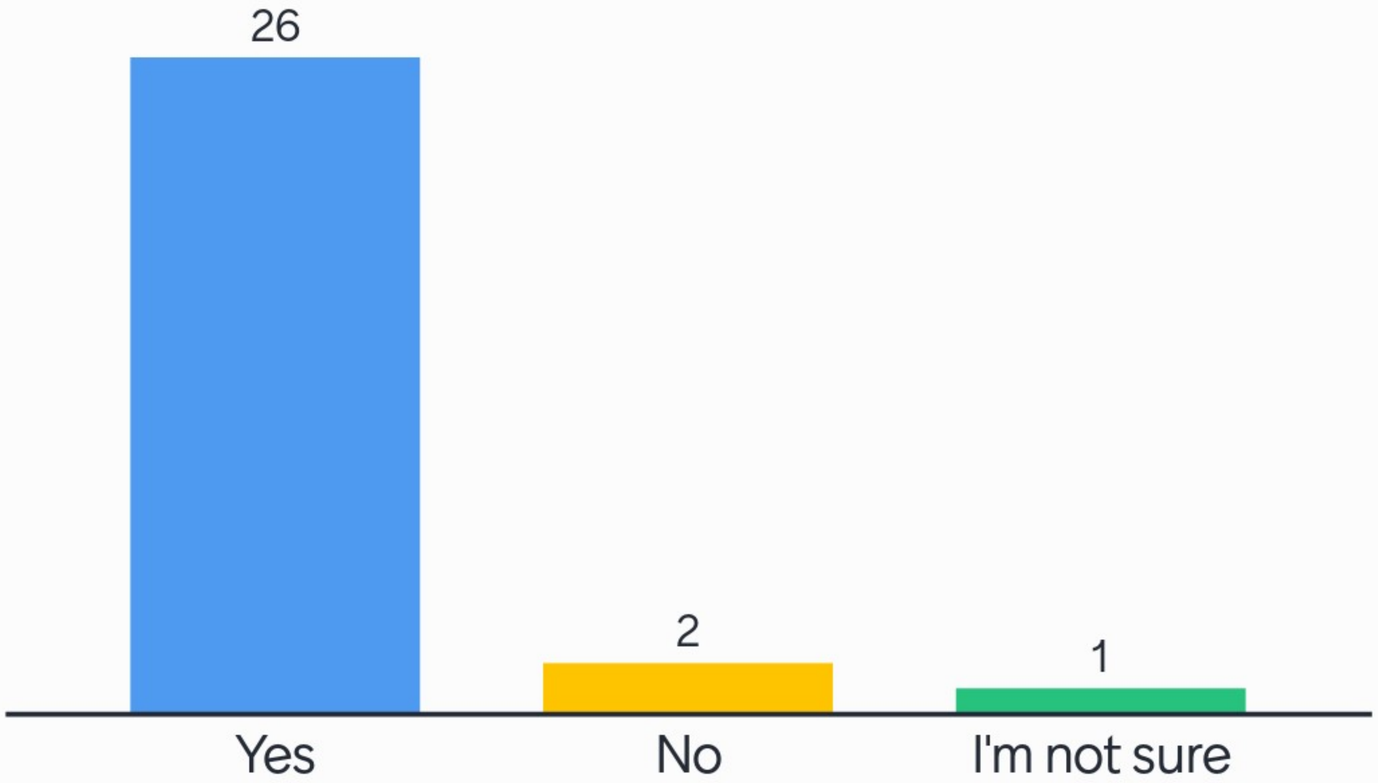
Is there a location in American Samoa that you think would benefit from a living shoreline?



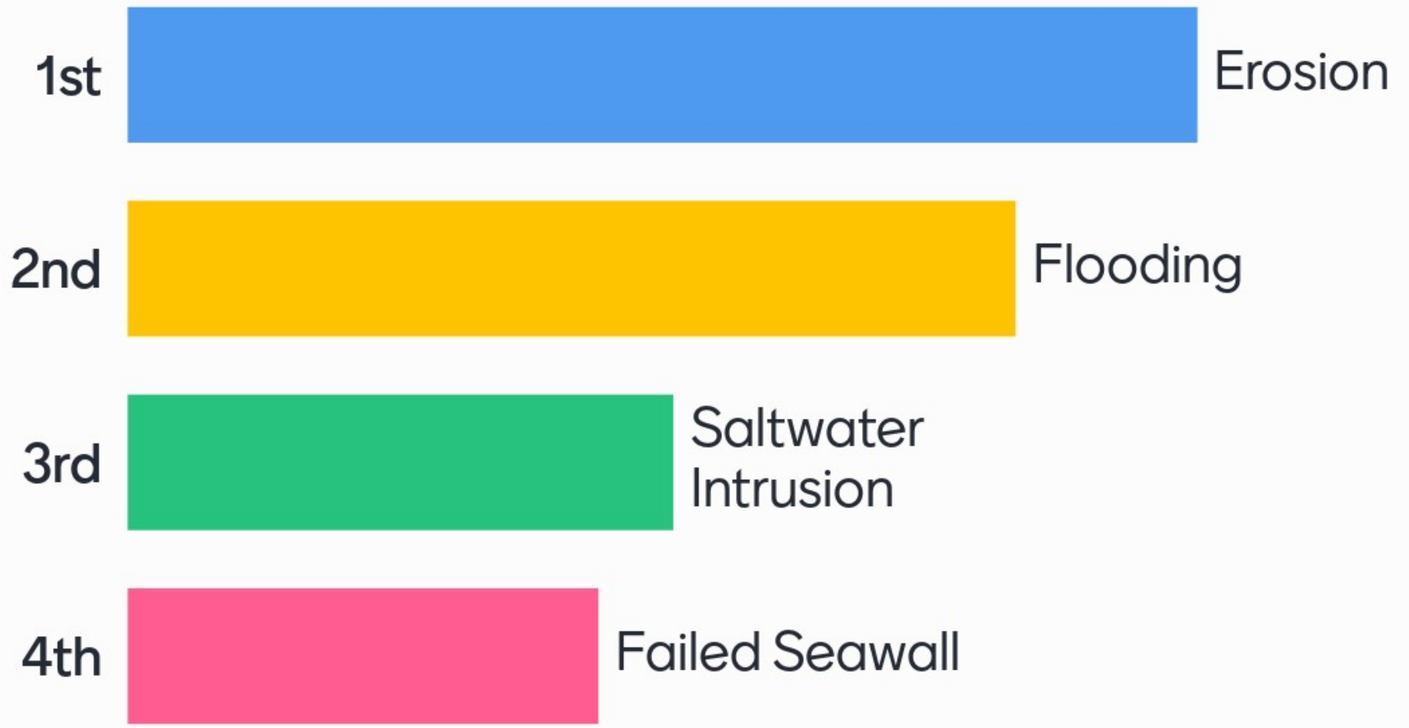
Which District would benefit from a living shoreline?



Does your village have erosion or flooding issues?



How would you rank the specific impacts your village experiences?



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American Samoa

August 25, 2021, via Zoom

Instructions

Building Resilience with Mangrove and Reef Natural Coastal Defenses

Prof. Michael W. Beck
Research Professor & AXA Chair in Coastal Resilience

Dr. Borja Reguero
Associate Research Professor,
Institute of Marine Sciences & Coastal Sci & Policy Program

Dr. Curt Storlazzi, Pacific Coastal & Marine Science Center

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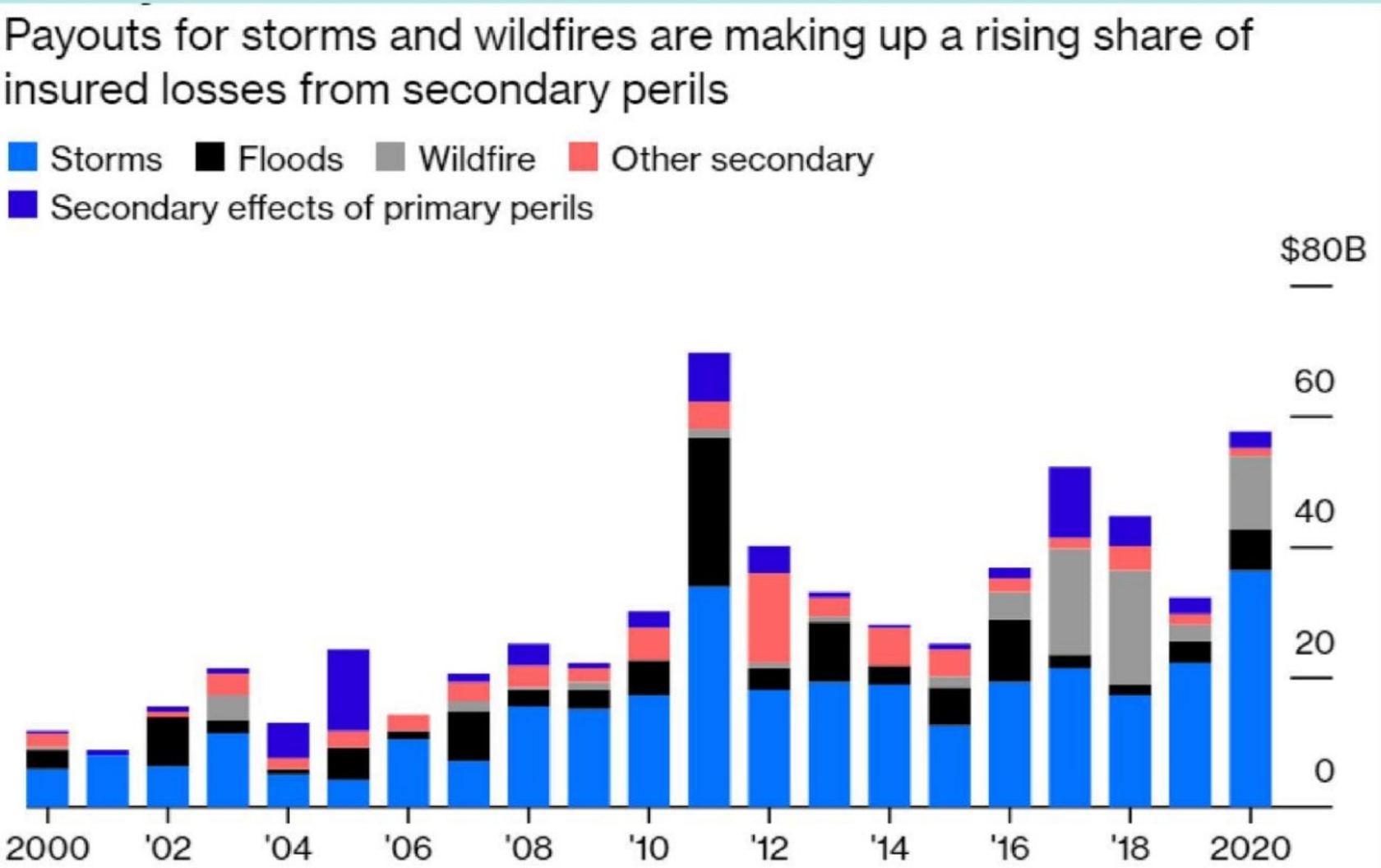
USGS

COASTAL RESILIENCE LAB

Risks & Losses Are Rising



Guidelines for Valuing Coastal Protection

Beck & Lange eds. 2016, World Bank

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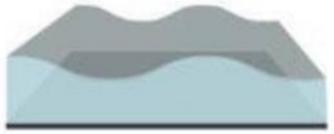
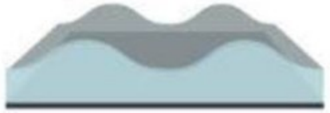
STAGE 1



Estimate
Offshore Waves

STAGE 2



Estimate
Nearshore Waves

STAGE 3

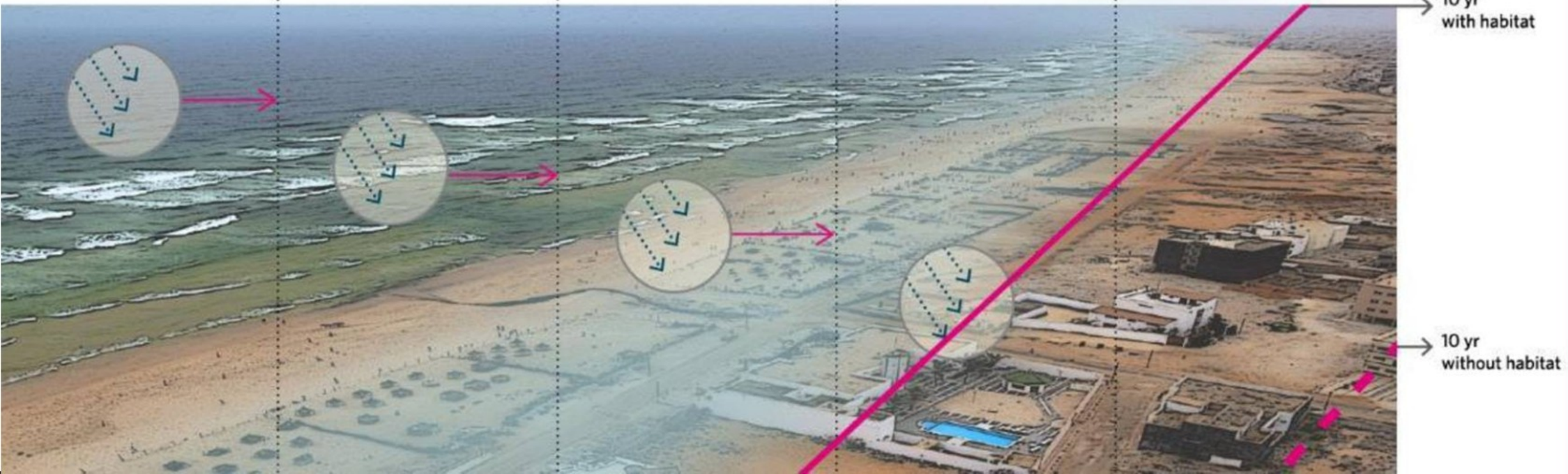
Estimate
Effects of Habitat

STAGE 4

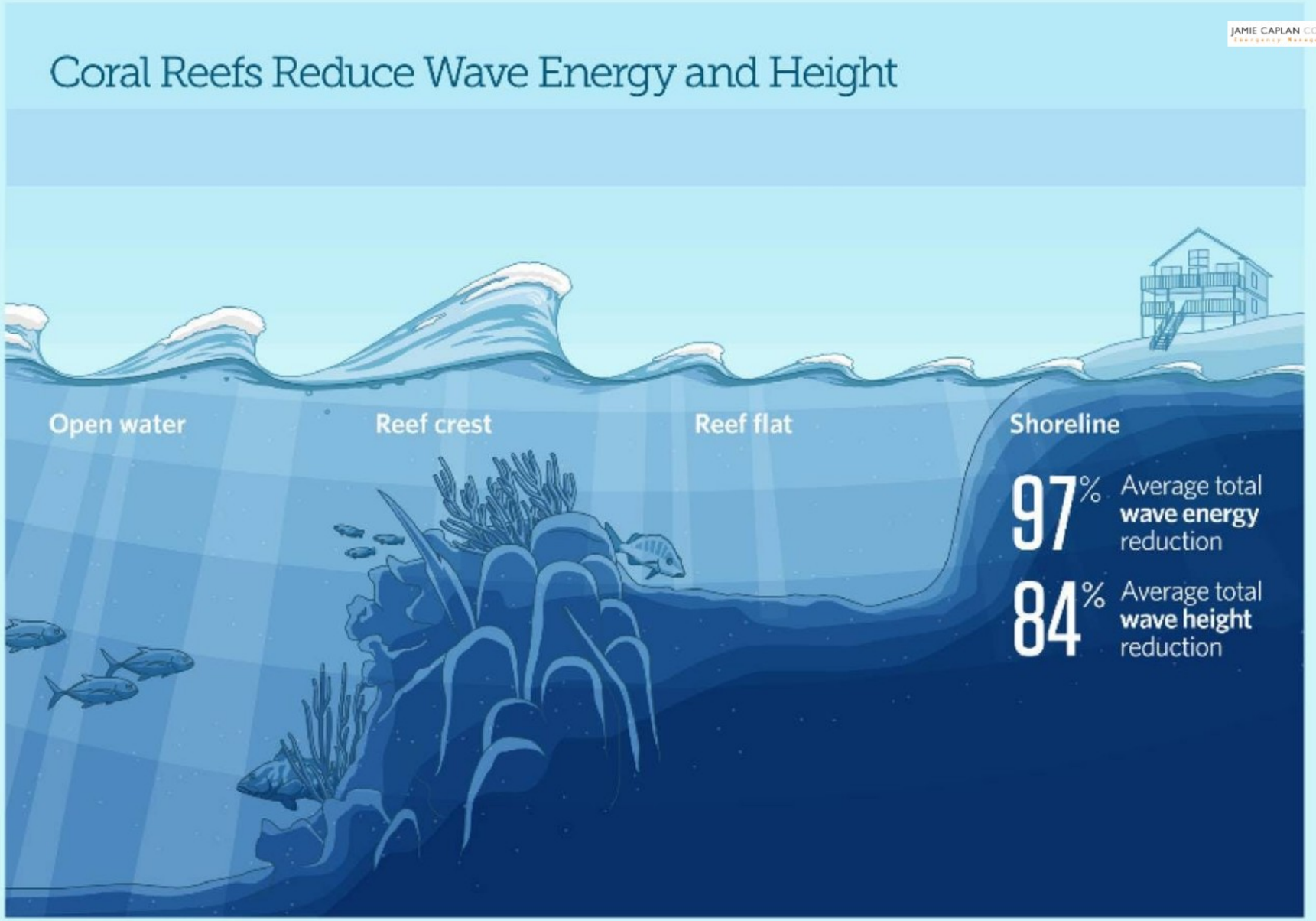
Estimate
Flooding Level

STAGE 5

Assess Damages & Value
Coastal Protection Benefits

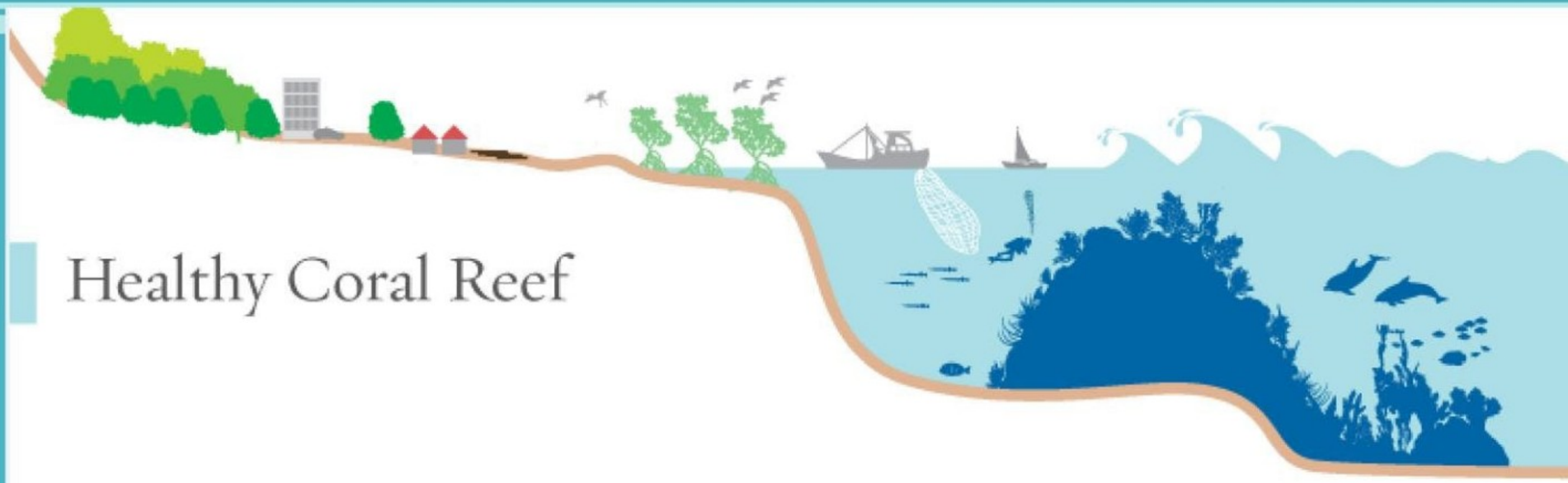


Reefs break waves.



Source: F. Ferrario, M.W. Beck, C.D. Storlazzi, F. Micheli, C.C. Shepard, and L. Airoldi, "The Effectiveness of Coral Reefs for Coastal Hazard Risk Reduction and Adaptation," *Nature Communications* (2014), doi: 10.1038/ncomms4794

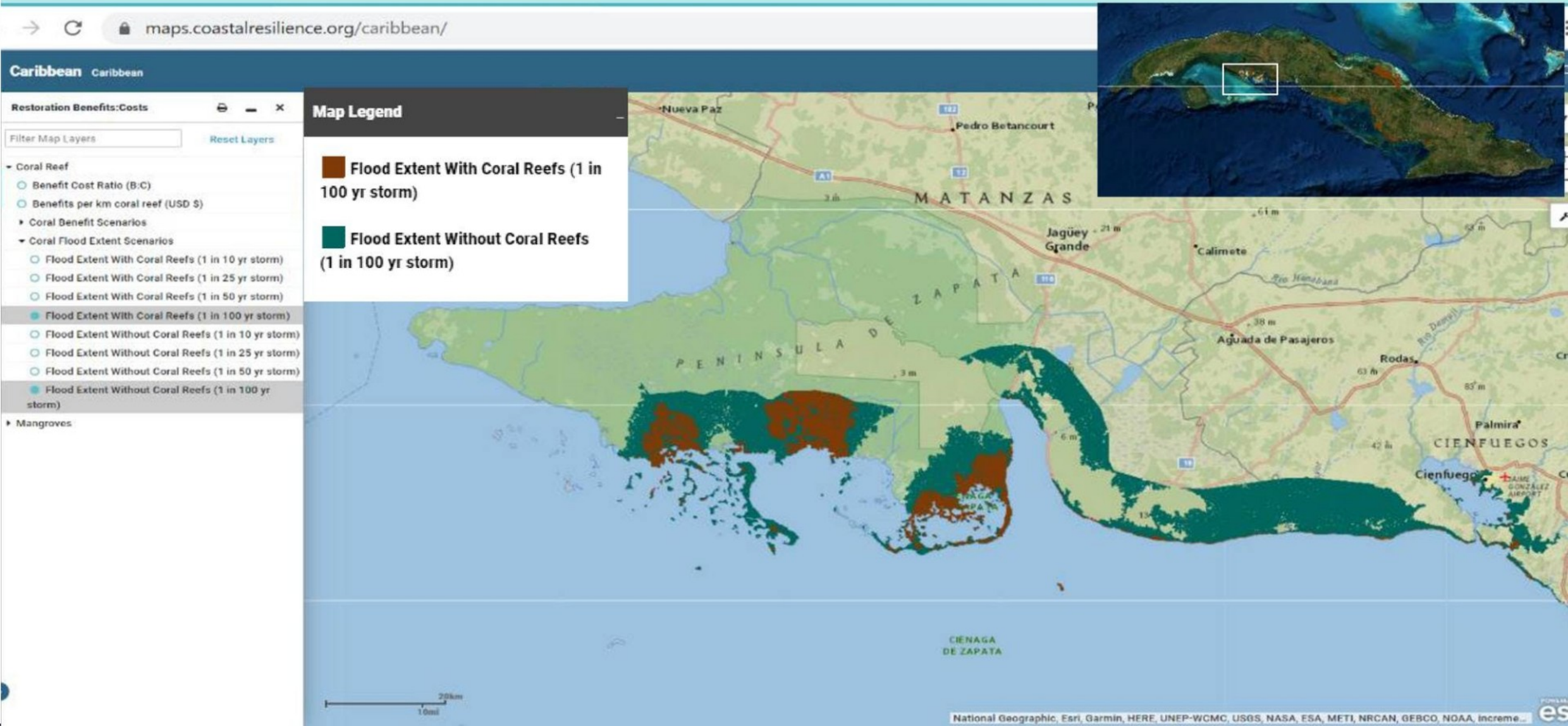
Valuing Coastal Processes & Reef Loss



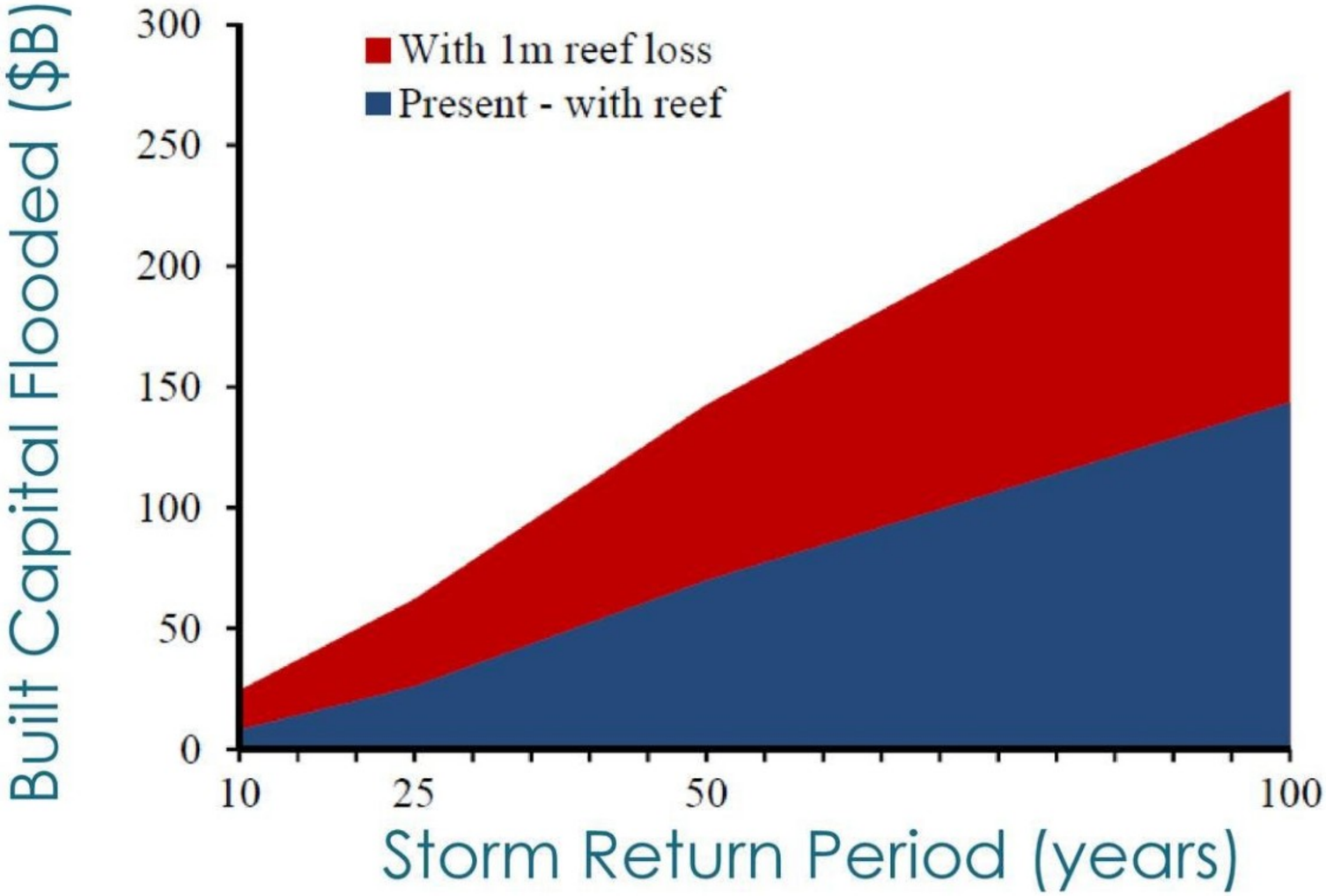
Healthy Coral Reef

Degraded Coral Reef

Global Flood Mapping – Cuba (100-year event)



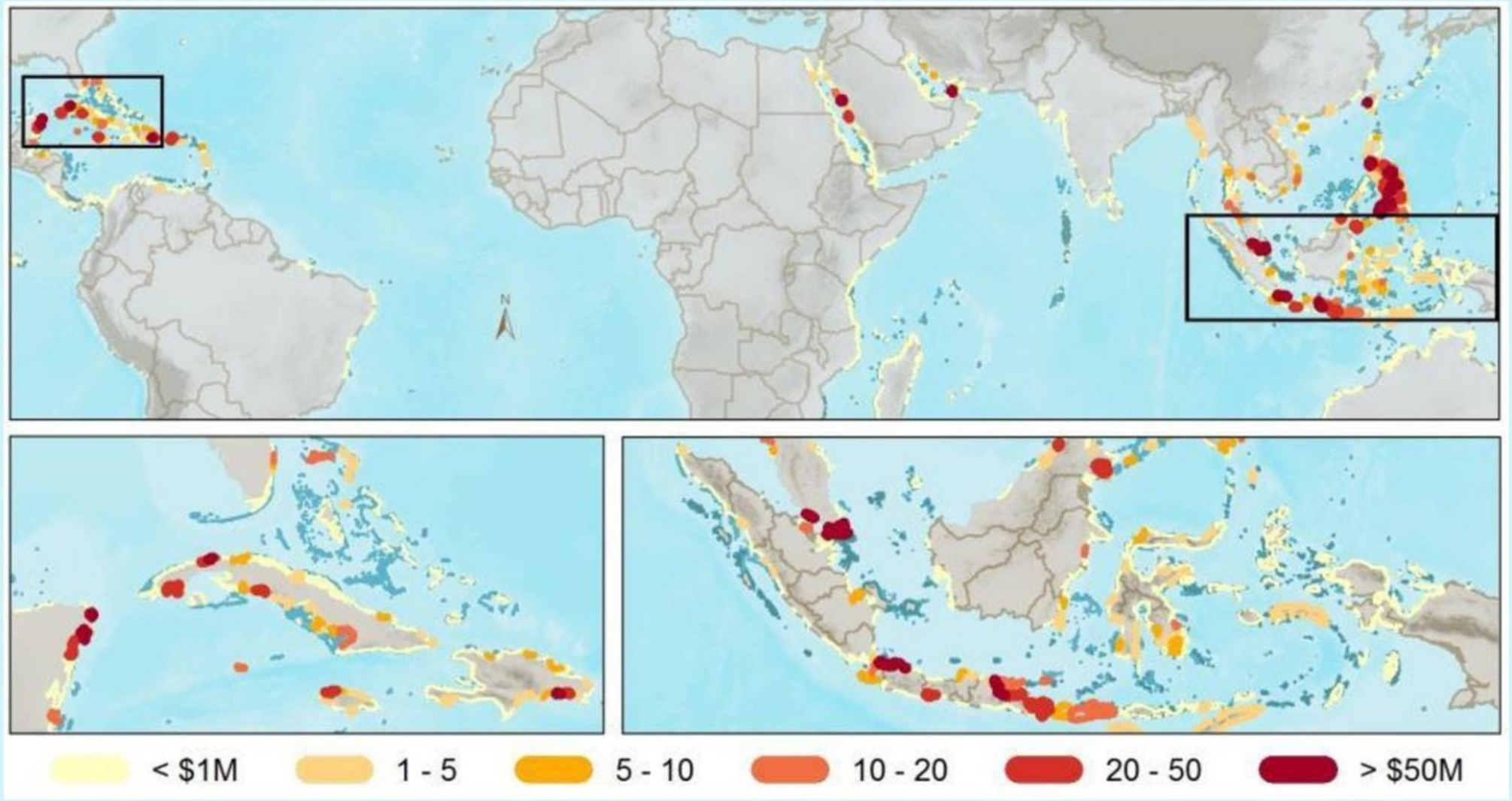
Global Flood Risk & Saving from Coral Reefs



Beck, Losada, Reguero et al. 2018. The global flood protection savings provided by coral reefs. *Nature Communications*

Annual Expected Benefits from Reefs:

Avoided Flood Damage in $M/20 km coastline



Beck, Losada, Reguero et al. 2018. The global flood protection savings provided by coral reefs. *Nature Comms.*

Expected Benefits of US Reefs for Flood Reduction

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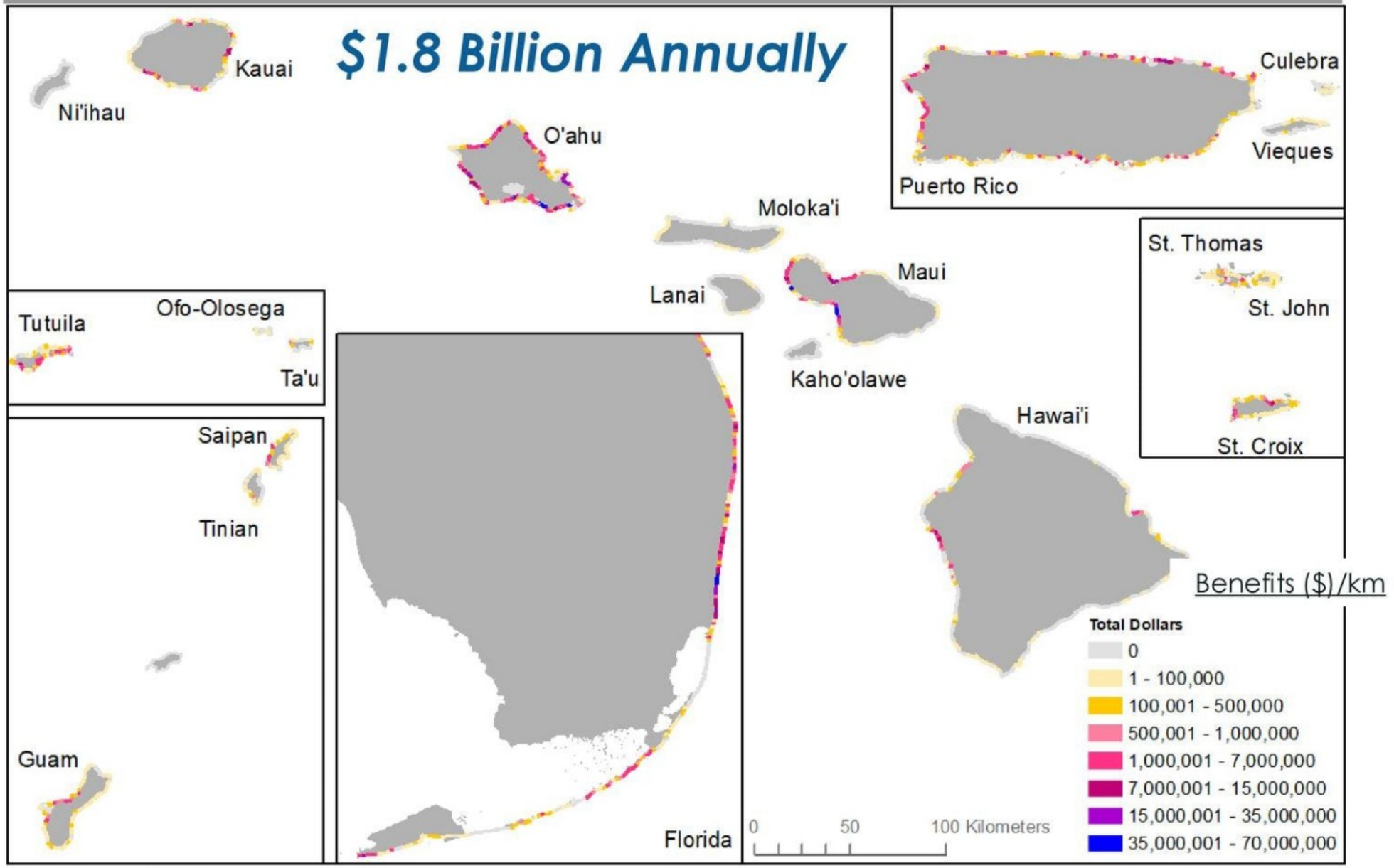

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USGS science for a changing world

The Nature Conservancy

Storlazzi, Reguero, Beck et al. 2019. USGS Report

The Value of US Reefs for Flood Risk Reduction

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Reguero, Storlazzi, Beck et al. 2021. Nature Sustainability

NATURE SUSTAINABILITY

Table 1 | Length of coastline with high risk reduction economic savings provided by US coral reefs

Region	Location	Annual expected benefit	
		Length of reef-lined coast (km) with benefit ≥US$0.25 million km^{-1} yr^{-1}	Length of reef-lined coast (km) with benefit ≥US$1 million km^{-1} yr^{-1}
Hawaii	Kauai	32	10
	Maui	62	38
	Oahu	158	112
	Hawaii	38	28
Florida	Peninsula	116	70
	FL Keys	46	16
Puerto Rico	Puerto Rico	104	26
American Samoa	Tutuila	30	1
Guam, CNMI	Guam	36	4
	Saipan	18	6
	Tinian	2	2
USVI	St. Thomas	16	4
	St. John	6	2
	St. Croix	22	6
Total		686	325

THE MILLION DOLLAR REEFS OF O'AHU

Each kilometer of these highlighted reefs provides over one million dollars in flood protection benefits each year.

Reguero, Storlazzi, Beck et al. Nat Sust. 2021
Map by J. Kendall-Bar & C. Lowrie

The Value of U.S. Coral Reefs for Risk Reduction

FACTS FOR AMERICAN SAMOA

KEY POINTS

- The social and economic benefits provided by U.S. reefs were assessed across **>3,100 km** of coastline using hydrodynamic models coupled with census data.
- ***Annually,*** reefs in American Samoa provide flood protection benefits to more than **580 people** and **$33 million** in averted damages to property and economic activity.
- With a 1-m loss in reef height, the **100-yr floodplain** would increase across American Samoa by **2 km²**, imperiling **1,000** more people and **$70 million** in property & economic activity.
- This study provides a comprehensive set of flood risk maps across U.S. coral reef coastlines and the first national quantification of flood protection benefits from reefs.

The degradation of coral reefs raises flood risks by increasing the exposure of coastal communities to storms.

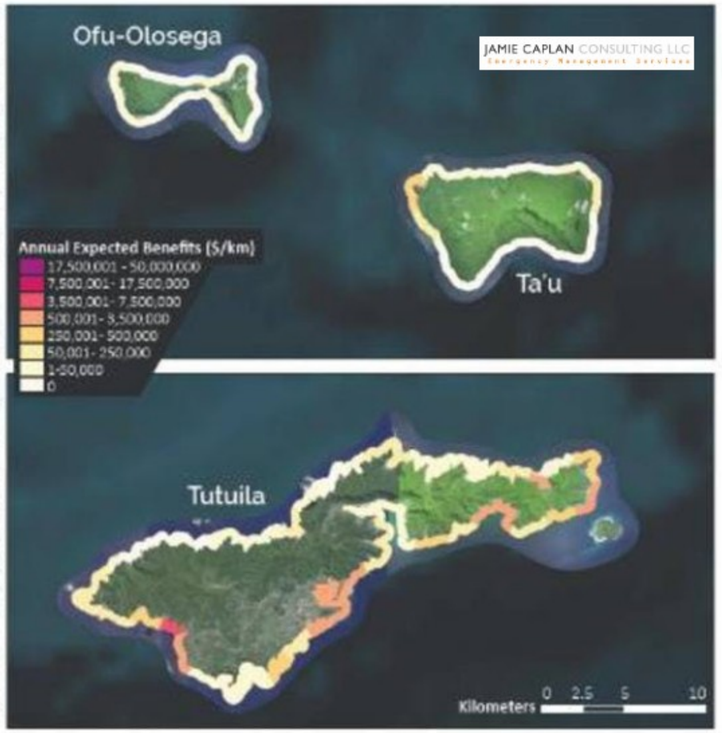
The coastal protection benefits of coral reefs and other natural defenses are not usually assessed in the same rigorous, economic terms as artificial defenses such as seawalls, and therefore often not considered as an option in hazard management decisions. In this study, we combine engineering, ecologic, social, and economic data and tools to provide a rigorous valuation of the coastal protection benefits of U.S. coral reefs across Hawaii, Florida, Guam, American Samoa, Puerto Rico, the U.S. Virgin Islands, and the Commonwealth of the Northern Mariana Islands (CNMI).

Coral reefs act like submerged breakwaters by breaking waves and dissipating their energy offshore before they flood coastal properties and communities. This is an enormously valuable function. In 2017, Hurricanes Harvey, Irma and Maria alone caused over $265 billion in damage across the nation.

This map shows the simulated flooding for 100-year storm events with (blue) and without (red) coral reefs in Tutuila, American Samoa.

In this report, we demonstrate that coral reefs provide the U.S. with more than $1.8 billion dollars in flood protection benefits every year. They reduce direct flood damages to public and private property worth more than $800 million annually, and help avert other costs to lives and livelihoods worth an additional $1 billion. Coral reefs annually protect $184 million worth of buildings and economic activity in Puerto Rico, $675 million in Florida and $836 million in Hawaii.

These are not 'back of the envelope' numbers. Flood risk was assessed using sophisticated hydrodynamic models and more than 60 years of hourly wave data for U.S. coral reef coast lines – a total area of over 3,100 km (>1,900 miles) of shoreline. We developed flood risk maps projecting the extent and depth of flooding that would occur across a range of storms from the more commonly occurring to the catastrophic, with and without the top 1-m of coral reefs. These flood risk maps were combined with the latest information from the U.S. Census Bureau and the Federal Emergency Management Agency to identify people and properties at risk – and benefiting from the presence of coral reefs – in each location.



The annual expected benefits ($/km) coral reefs provide in coastal flood reduction.

Rigorously valuing coral reef benefits in this way is a key step toward mobilizing resources to protect them. These maps and values can be used to inform:

- ***storm response actions & recovery funding***
- ***coral reef conservation areas***
- ***public & private insurance incentives***
- ***benefit : cost analyses for reef restoration***
- ***the consideration of reefs as national infrastructure***

Storlazzi, C.D., Reguero, B.G., Cole, A.D., Lowe, E., Shope, J.B., Gibbs, A.E., Nickel, B.A., McCall, R.T., van Dongeren, A.R., Beck, M.W., 2019. Rigorously valuing the role of U.S. coral reefs in coastal hazard risk reduction: U.S. Geological Survey Open-File Report 2019–1027

Find the report at: *https://doi.org/10.3133/ofr20191027*

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USGS science for a changing world

The Nature Conservancy

Annual Expected Benefits from Reefs in American Samoa

Avoided Flood Damage in $M/km coastline

FEMA Using These Data in Their Tools (FAST)

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FEMA Hazus Success Story

Mapping the Risk Reduction Benefits of Coral Reef Conservation

According to the U.S. Geological Survey (USGS) report, Rigorously Valuing the Role of U.S. Coral Reefs in Coastal Hazard Risk Reduction, the degradation of near-shore habitats, particularly coral reefs, increases the risk of flooding in coastal communities. However, mitigation and protective prioritization often fails to account for the economic protection of natural or nature-based solutions and instead opts for artificial defenses like seawalls.

The 2020 publication, FEMA's Building Community Resilience with Nature-Based Solutions: A Guide for Local Officials – which supports the interagency National Mitigation Investment Strategy – identifies nature-based solutions as a cost-effective approach to prevent natural hazards from becoming costly disasters. FEMA's Hazus Program provides risk assessment tools and data for communities interested in analyzing the risk reduction benefits of nature-based solutions. The Hazus Team recently worked with the U.S. Coral Reef Task Force to map coastal flood losses avoided due to coral reef protection across Hawaii (Figure 1), and results from this project can help guide future nature-based mitigation initiatives.

Figure 1: Coral Reef Habitat in Hawaii

FEMA

Table 1: Risk Reduction Benefits of Coral Reef Protection in Hawaii by Island and Type of Analysis

Island	Annual Losses Avoided(Site Specific Inventory)	Annual Losses Avoided(Aggregated Inventory)
Maui	$71,975,099	$112,716,317
Hawaii	$125,254	$23,997,824
Oahu	$210,365,606	$200,942,259
Molokai	$25,169	$42,071
Kauai	$24,451,385	$5,854,742
Total	**$306,942,513**	**$343,553,213**

Niyam IT

Quantifying How Hurricane Damage to Reefs Increases Flood Risk

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USGS

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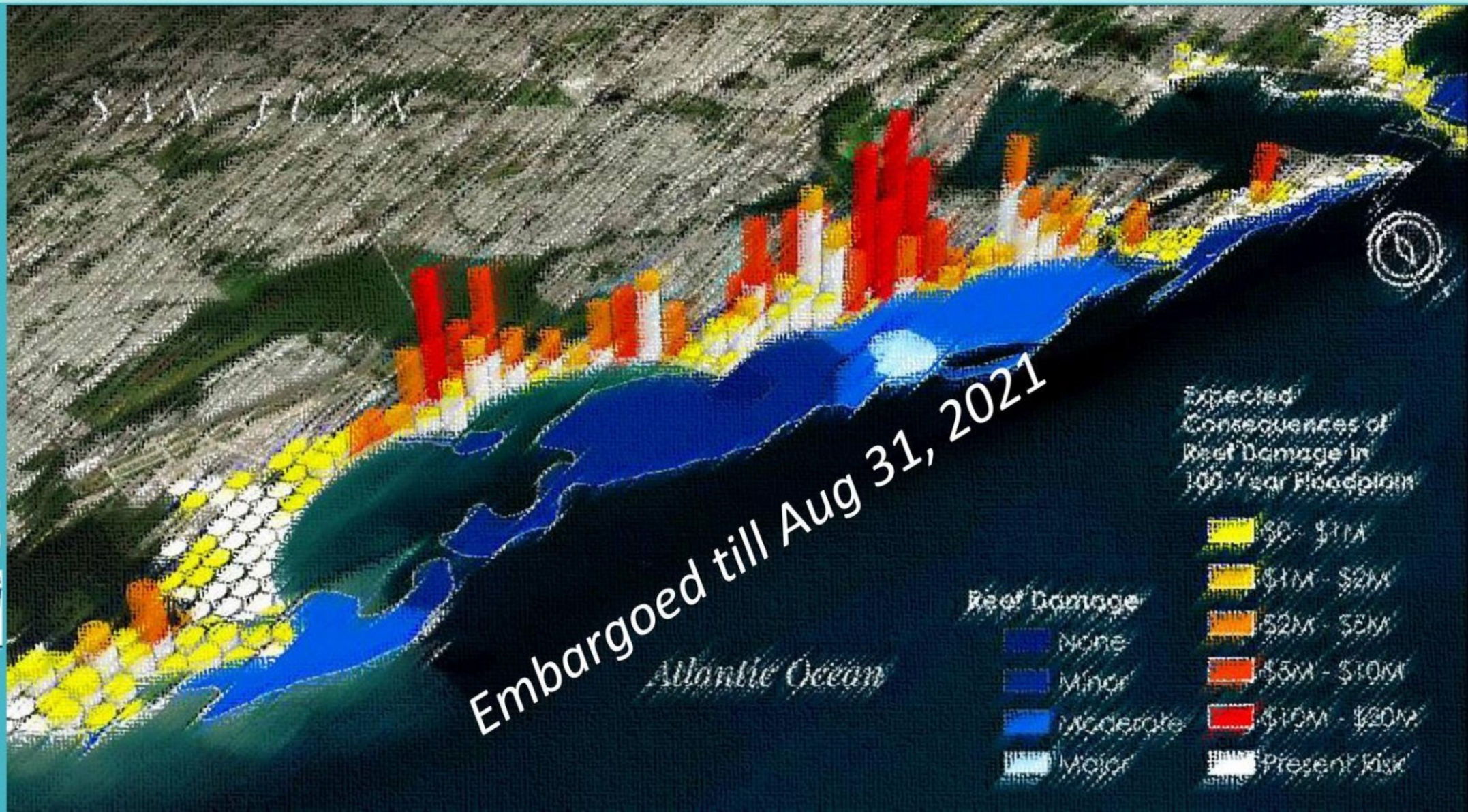
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE



Assessing Flood Risk & Mangrove Benefits

Forces of Nature: Assessment and Economic Valuation of Coastal Protection Services Provided by Mangroves in Jamaica. World Bank.

Global Flood Mapping: Grand Bahama Island

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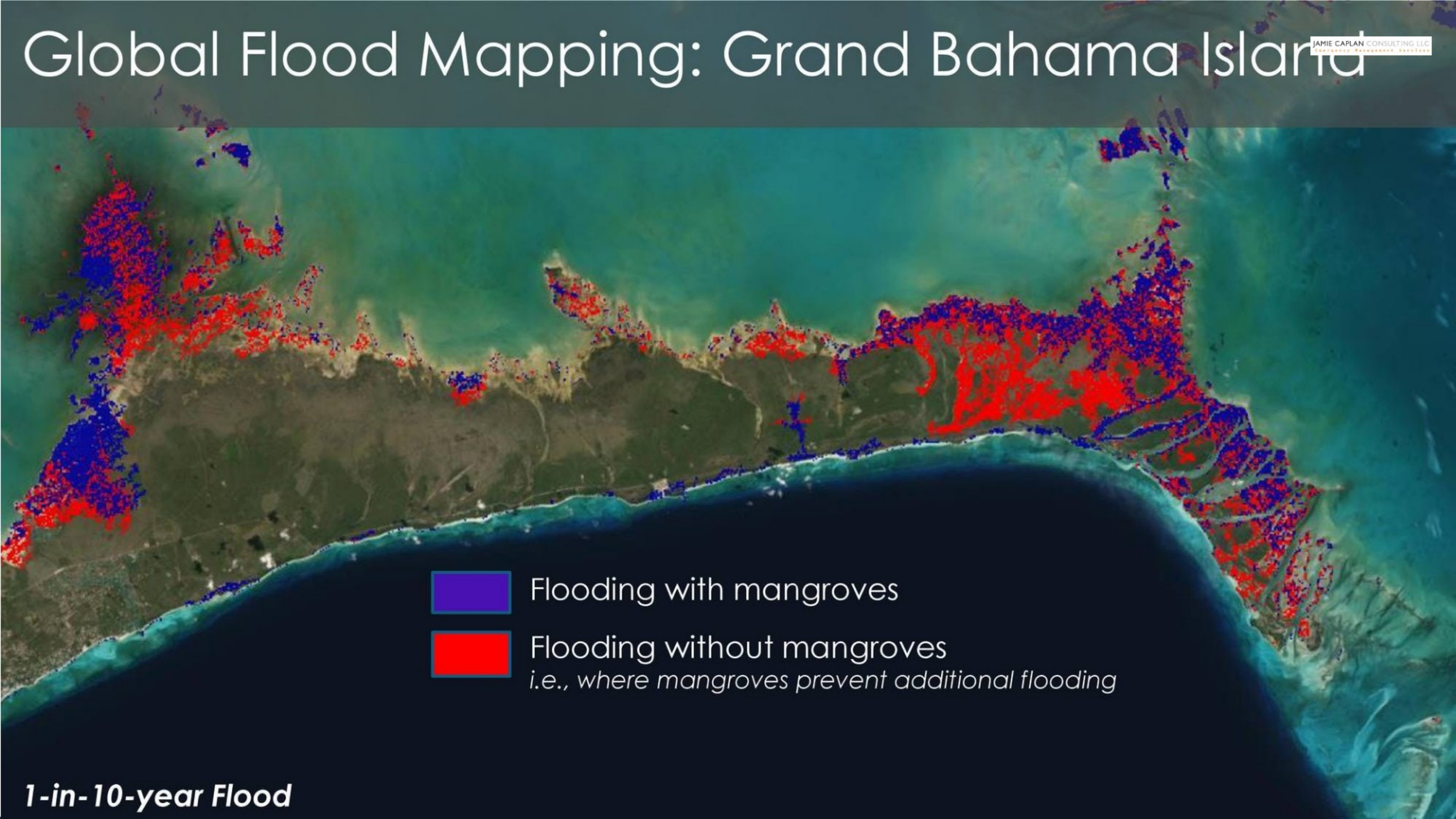
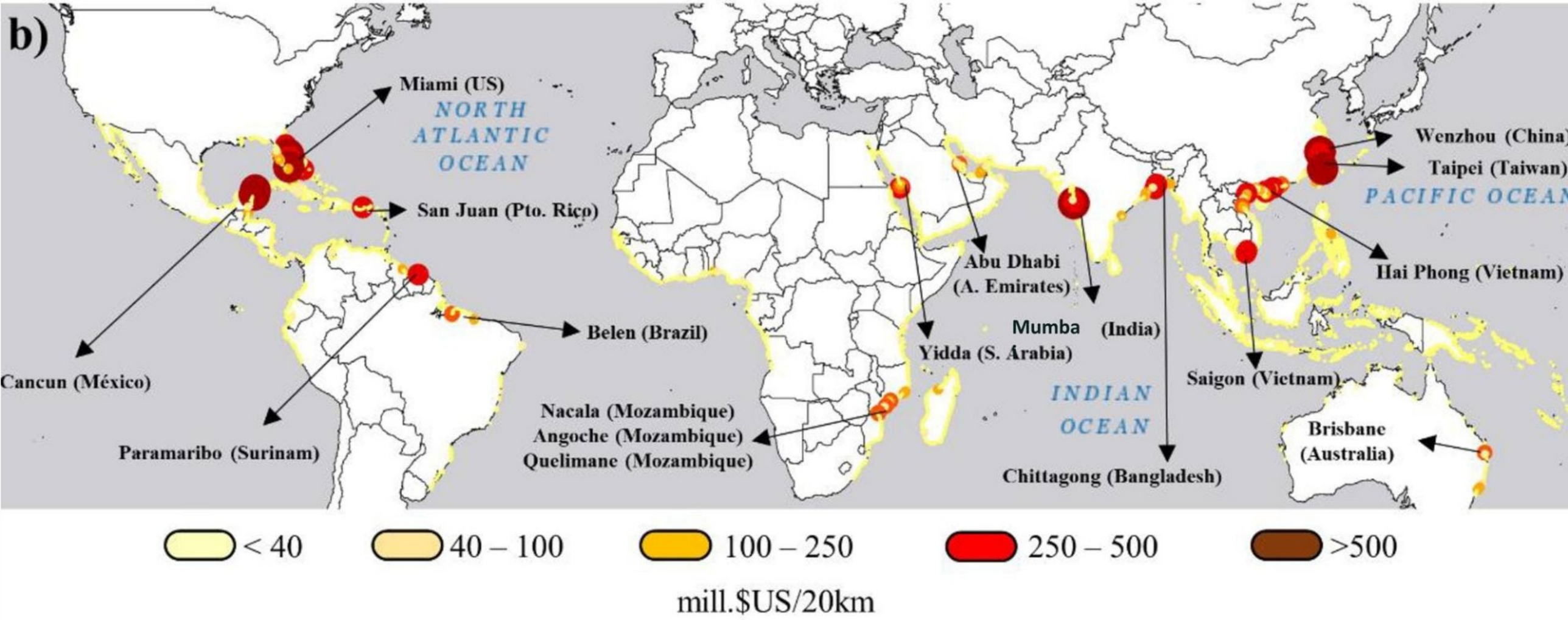


Annual Flood Reduction Benefits from Mangroves



Menéndez, Beck et al. 2020. Global flood protection benefits of mangroves. *Scientific Reports*.

Costs of Mangrove Restoration

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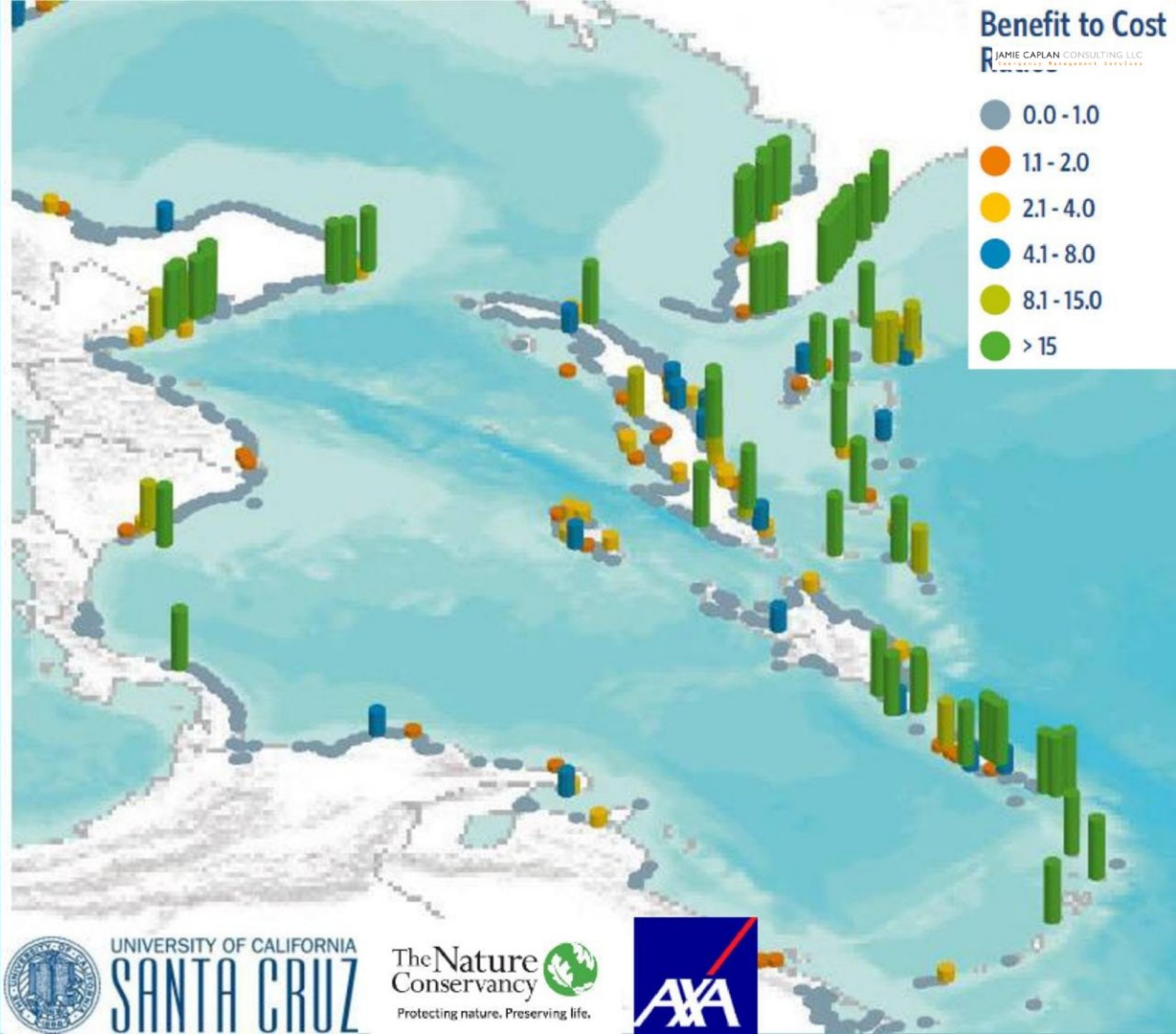
Benefit to Cost Ratios for Mangrove Restoration
(30 years @ 4%)



Beck et al. 2020. Reducing Caribbean Risk.
https://www.axa.com/en/press/publications/AXA-XL-Mangrove-Insurance-Report

Building Reefs in the Water

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Alabama Oyster Reefs

Grenada Coral Reefs

REEF RESILIENCE & INSURANCE FUND

IN QUINTANA ROO, MEXICO

Swiss Re

The Nature Conservancy JAMIE CAPLAN CONSULTING LLC

Protecting nature. Preserving life.

VERRA

Sustainable Development Verified Impact Standard

First SD VISta Methodology Addresses Coastal Resilience Benefits – Open for Public Comment

20 January 2021

Verra is pleased to announce that the first methodology under the Sustainable Development Verified Impact Standard (SD VISta) Program is now open for public comment until 19 February 2021. The new "Methodology for Coastal Resilience Benefits from Restoration and Protection of Tidal Wetlands" will assess how many people benefit from reduced flood risk due to the restoration or protection of coastal ecosystems.

FEMA

Ecosystem Service Benefits in Benefit-Cost Analysis for FEMA's Mitigation Programs Policy

FEMA Policy FP-108-024-02

PURPOSE

This policy provides guidance for using ecosystem service benefits in the evaluation of the cost-effectiveness of mitigation projects funded under FEMA's Hazard Mitigation programs and rescinds FP-108-024-01 and eliminates the BCR 0.75 requirement, allowing consideration of ecosystem service benefits for a project regardless of BCR value. FEMA rescinds that policy in recognition that the natural environment is an important component of a community's resilience strategy.

This update allows for easier inclusion of nature-based solutions into risk-based mitigation projects. Since FEMA does not limit the inclusion of similar categories of benefits in the BCA,

https://www.fema.gov/sites/default/files/2020-09/fema_ecosystem-service-benefits_policy_september-2020.pdf

Recommendations

- Include natural assets in economic accounting
- Rethink infrastructure investments
- Allocate disaster recovery funds to repair natural defenses
- More insurance incentives for natural capital

A16 SUNDAY, APRIL 11, 2021 ★ Los Angeles Times LATIMES.COM

OP-ED

Second Opinion :: BIG IDEAS ON GLOBAL CHALLENGES

Saving coastlines from climate disasters

By Michael W. Beck

THE FREQUENCY OF natural disasters has soared in recent decades. Total damage topped $220 billion worldwide in 2020. With climate change, the costs attributed to coastal storms will increase dramatically.

At the same time, coastal habitats such as wetlands and reefs are being lost rapidly. Some 20% of the world's mangroves were lost over the last four decades. More than half of the Great Barrier Reef was degraded by bleaching in 2020 alone. In California, we have lost more than 90% of our coastal marshes.

Coastal habitats serve as a critical first line of defense, and their loss puts communities at even greater risk from coastal flooding. Coral reefs work as natural breakwaters and reduce flooding by breaking waves offshore. Wetlands such as marshes and mangroves protect coastlines by dampening storm surge and waves; they also prevent erosion and can build new land.

On Jan. 27, President Biden committed to protect 30% of U.S. land and coastal seas by 2030 as part of the U.S. climate strategy. These 30-by-30 targets are already being adopted by many nations ahead of the upcoming United Nations Convention on Biological Diversity meeting.

Less certain is how we can pay for this when national budgets are stretched. The answer is to use nature to help us. We spend hundreds of billions every year on disaster management and post-

SUMMARY

- Habitats reduce flooding and erosion
- We can rigorously value these benefits
- Supports innovative funding for conservation
- Redirect funds for hazard mitigation, disaster recovery & climate adaptation from gray to green solutions

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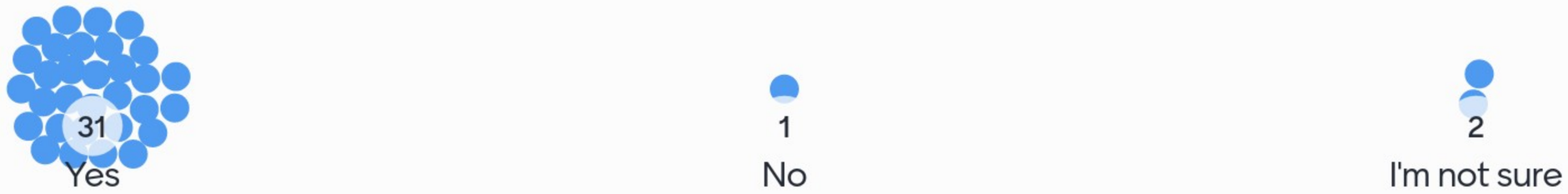
Building coastal resilience, naturally,

to protect people, property, and nature

mwbeck@ucsc.edu
www.coastalresilience.ucsc.edu

Would you be interested in finding support ($) for Reef Restoration for Risk Reduction (R4)?



What support (capacity) would you most need to help support applications for such R4 funding?

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ODAPM

Expertise and Education

Expertise

Resources

technical guidance and support

BRIC is currently NOT an option for AS, so please share some other possible funding opportunities. We are mainly human resource limited

Resources

Technical Support

Time, people

34

What support (capacity) would you most need to help support applications for such R4 funding?

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- Technical
- Detailed knowledge
- Templates
- providing data
- Ulima
- Training
- Educate the public
- More project managers
- Resources

What support (capacity) would you most need to help support applications for such R4 funding?

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proposals guidance funding

Education

technical

Resources

Data and research findings

Coastal engineers

FEMA and other agencies that can provide funding assistance

resources

proposals funding guidance training

What support (capacity) would you most need to help support applications for such R4 funding?

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Hands on

Resources

education

Training, data, place based engineering design based on needs of specific areas and the diversity of reefs along American Samoa's coastal waters

education

Resources

any support thats available for us

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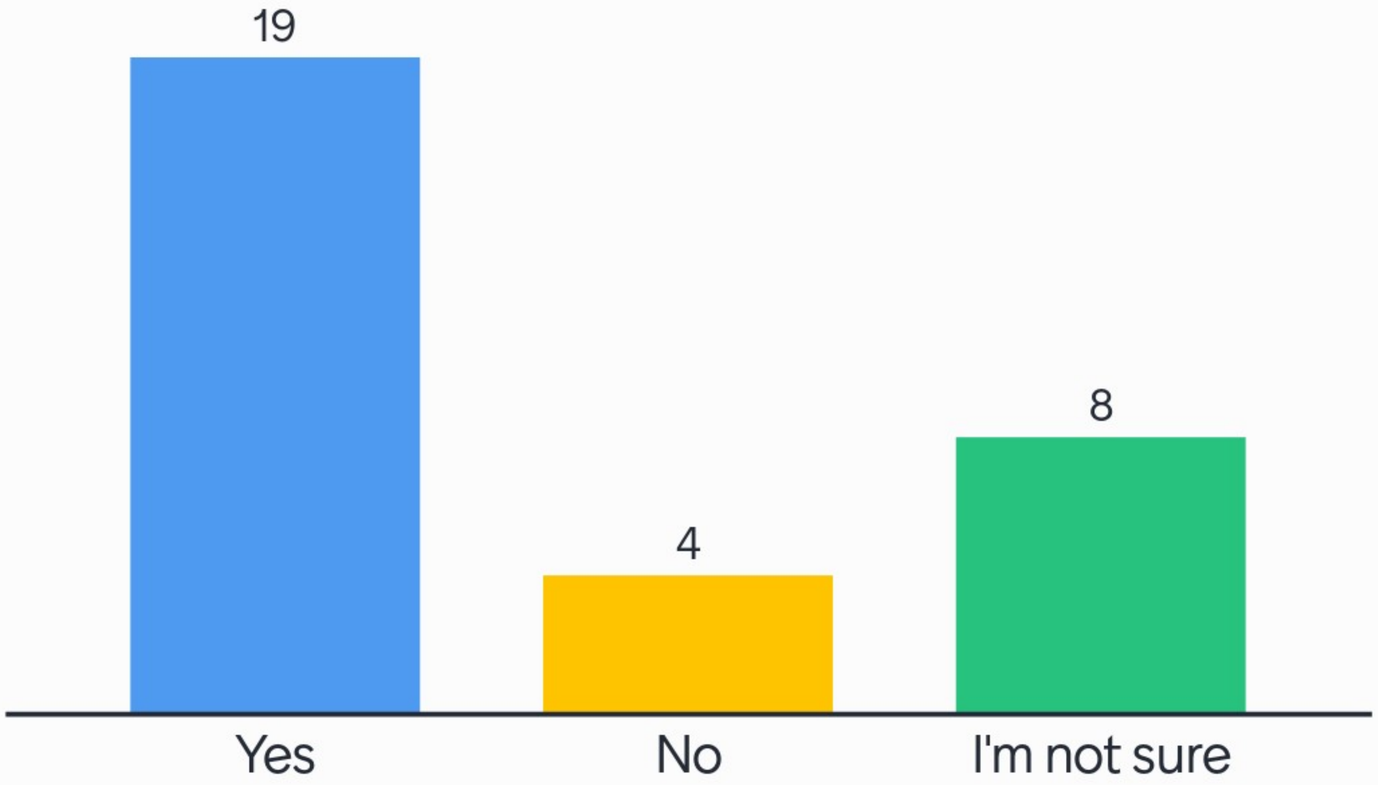
Is Reef Insurance something you have or would consider?



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Nature-Based Solutions Workshop for Hazard Mitigation

American Samoa

August 25, 2021, via Zoom