Integrating Nature into Risk Science & Insurance

A Coastal Climate Resilience Symposium

Thursday, March 16th 8:30am-6:30pm

Seymour Marine Discovery Center, Santa Cruz

Networking Breakfast 8:30am

I. Welcome & Opening Remarks, 9:00am

Dr. Cynthia K. Larive, Chancellor, UC Santa Cruz California Insurance Commissioner Ricardo Lara Jeff King, Deputy National Lead and Program Manager - Engineering with Nature Program at U.S. Army Corps of Engineers

Dr. Liz Whiteman, Executive Director, California Ocean Science Trust

II. Setting the Stage: Reducing Risk with Nature & Insurance

Dr. Michael W. Beck, Director, UCSC Center for Coastal Climate Resilience

III. Panel 1: Unlocking Nature and Insurance to Build Coastal Resilience

Moderator: Deborah Halberstadt, Senior Climate Policy Advisor, California Department of Insurance Emily Corwin, Director of Nature-based Engineering Solutions, Conservation International Lindsay Judd, Senior Environmental Underwriter, AXA XL Nuin-Tara Key, Director, North America Public Sector Lead, Climate and Resilience Hub, Willis Towers Watson

Break 10:40am

IV. Networking Activity

V. Fireside Chat: Reducing Risk with Nature & Insurance

California Insurance Commissioner Ricardo Lara The Honorable Fred Keeley, Mayor of Santa Cruz David I. Maurstad, Resilience Associate Administrator (Acting), Federal Emergency Management Agency Stephen L Hill, PMP, SES, Director of Contingency Operations and Chief, Office of Homeland Security, U.S. Army Corps of Engineers

Catered Lunch 12:00pm

VI. Coastal Walk & Brainstorming Exercise, Younger Lagoon, UCSC Nature Reserve, 1:00pm

VII. Panel 2: Improving Risk Science to Reflect Nature, Equity, and Adaptation

Moderator: Guillermo Franco, Managing Director & Global Head of Catastrophe Risk Research, Guy Carpenter Dr. Patrick Barnard, Coastal Geologist, US Geological Survey Dag Lohmann, CEO, KatRisk Dr. Maya Trotz, Professor & Director, NSF Hub on Equitable Nature-based Solutions, University of South Florida

VIII. Panel 3: Incentivizing Adaptation

Moderator: Dr. Jane "Carter" Ingram, Executive Director, Pollination Chip Cunliffe, Programme and Risk Director, Ocean Risk and Resilience Action Alliance Sarah Heard, Director, MarketLab, The Nature Conservancy Heather Tallis, Assistant Director for Biodiversity and Conservation Sciences, White House OSTP

Close 4:30pm

Reception in the Aquarium & Coastal Deck at Seymour Marine Discovery Center 4:30-6:30











Reducing Risk with Nature & Insurance



Meeting Goals

- **USACE** Finalizing report on Integrating Nature in to Risk Science & Insurance
- CDI Identifying CA coastal project opportunities
- Center for Coastal Climate Resilience- Inform Priorities
- Finding: Not yet at tipping point where nature is well integrated in risk management & insurance
- Goal: To speed integration of nature in insurance
 & risk management
- Connect, Collaborate, Enjoy



Assessing Nature in Risk Industry Models



Insuring Nature

The New Hork Times

A Race Against Time to Rescue a Reef From Climate Change

In an unusual experiment, a coral reef in Mexico is now insured against hurricanes. A team of locals known as "the Brigade" rushed to repair the devastated corals, piece by piece.





San Francisco Bay: Future Flood Risk & Benefits of Marsh Restoration



USACE International Guidelines for Natural & Nature-Based Features



FEMA Using Reef Data in Their Tools (FAST)

FEMA Hazus Success Story

Mapping the Risk Reduction Benefits of Coral Reef Conservation

According to the U.S. Geological Survey (USGS) report, <u>Rigorously Valuing the Role of U.S. Coral Reefs in Coastal Hazard</u> <u>Risk Reduction</u>, 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, <u>FEMA's Building Community Resilience with Nature-Based Solutions: A Guide for Local Officials</u> – which supports the interagency <u>National Mitigation Investment Strategy</u> – 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.







Niyam IT

Figure 1: Coral Reef Habitat in Hawaii

DoD to Restore Reefs

SMALL-SCALE STRUCTURES GENERATIVELY DESIGNED -**ELKHORN CORAL MIMICS** TARGETED CORAL SEAHIVE BASE OUTPLANTING STRUCTURE 50 00 00 00 00 00 07 02 000000000000000 0000000000000 20.0 CORALLINE 00 0000 OII 0 1 0 SENSOR ARRAY ALGAE-0.00 000 0.0

DARPA

Coastal Risk Index Effects of Social Vulnerability on Flood Risk





New Large NSF Hub Climate Risks & Equitable Nature-based Solutions

To empower coastal communities by co-creating knowledge on climate risks & equitable NBS to reduce hazards & support sustainability



Maya Trotz, professor of civil and environmental engineering



ECU

UNIVERSITY



FRAGMENTS

Recommendations from USACE Report

- Include ecosystems better in risk models
- Model waves better
- Premium price nature's benefits
- Create professional development courses on NBS for risk industry
- Advance adaptation market

Integrating Nature into Risk Science & Insurance

M. Kelso, A. Stovall & M. Beck



UC SANTA CRUZ



US Army Corps of Engineers.

A Report from the Coastal Resilience Lab at the University of California Santa Cruz Draft Version December 2022

CA Leadership On Climate Adaptation

- The impacts of climate change are here
- CA has led on Climate Mitigation; Must now lead on Adaptation
- Lead with innovation & market-based solutions
- NBS Innovation (e.g., enhance rocky reefs)
- Develop Adaptation Markets
- CDI can play important role including nature risk assessment, reduction & adaptation







One big climate fight our state is losing Reducing carbon emissions is not enough at this point. We need to minimize harm from the fires and floods that can no longer be prevented.

UC SANTA CRUZ Center for Coastal Climate Resilience

Vision (draft):

To advance innovative solutions for building coastal resilience that engage partners, foster leaders and address the challenges from climate change in California and beyond.



A RANGE OF SOLUTIONS







OUR GOAL ...to create the next generation of climate resilient infrastructure.

RESILIENT

DESIG

TIONS

This della gain

PHILIPPINES







GUYANA





Image: Shutterstock / Time Out

9 cities that could be underwater by 2030

submergeu



GUYANA MANGROVE-SEAWALL ENGINEERING GUIDANCE



CONSERVATION INTERNATIONAL Guyana

Outcome:

CI- Guyana

2. Long-term coastal resilience solutions at national scale

COLOMBIA













HOW CAN WE MANAGE NATURE-BASED SOLUTIONS' RISK?



REDUCING RISK AT SCALE



IF NOT HERE AND NOW ...

THEN WHERE AND WHEN?



Integrating Nature into Risk Science & Insurance

Unlocking Nature and Insurance to Build Coastal Resilience

Nuin-Tara Key 3/16/23



At a Glance: Innovative risk transfer tools and products

Parametric products enable innovative coverage to address financial impacts beyond direct, quantified loss

Unlike traditional indemnity insurance (where the pay-out amount is tied directly to actual loss), parametric risk transfer rapidly pays out a predetermined amount based on a physical feature of the event or hazard

	Indemnity	Parametric	
	An item has an agreed value and suffers a loss	A physical hazard characteristic proxies loss/impact via an index	
	The loss is assessed after the event and payment or repair is made to compensate the loss	Predetermined thresholds of the index define when the contract is to pay out and how much without any adjustment for the actual loss/impact suffered	

What do we need to design a parametric product?

- A relevant trigger or "index" is identified for the hazard (e.g., maximum windspeed for hurricane; hourly rainfall for flooding)
- A reliable, independent data source, with real time information, is needed to assess if a triggering event occurs
- The policy attachment and exit point and pay-out amounts are set according to risk appetite and needs
- Historical and modelled hazard information is used to calculate key information such as Expected Loss
- Historical impact information is used to calibrate the index and ensure triggers capture the right events

wtwco.con

The Mesoamerican Reef Insurance Program

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Covers hurricane risk that helps protect and restore coral reefs along coastline of Mexico, Guatemala, Belize and Honduras



Insurance payout ensures early action to clean up reef and jump start recovery to reduce impact of lost ecosystem



Avoids harm for ecosystems and coastal communities



Ensures the social, environmental and economic benefits from the ocean are visible for current and future generations



Value of Ecological Forestry via Insurance

- Assessed if wildfire risk reduction benefits of ecological forestry can be accounted for in insurance modelling and structuring.
- - Wildfire resilience parametric insurance premium estimates decrease with ecological forestry, with 20% to 40% reductions for case study scenarios.
- - Capturing the risk reduction of ecological forestry can produce insurance price savings which could be used to fund or finance ecological forestry.



In 2018 California wildfires took 103 lives, destroyed 24,000 structures, and cost \$26 Billion in property damage and fire suppression costs. © Ben Jiang /TNC Photo Contest 2019

UCSC Coastal Walk & Brainstorm



UCSC Coastal Walk & Brainstorm

- Connect and Reflect on risks & nature
- UCSC Nature Reserve Overlook is fully accessible; beach partly; don't trample plants.
- Path around grounds is fully accessible (15-30 min)

• To Consider:

- What are the consequences of Increasing Risk?
 - if sea levels & wave energy increase by 20%
 - if beaches, reefs and wetlands decrease by 20%
 - If coastal populations and wealth increase by 20%?
- Where can Nature Help reduce risk with risk management and insurance?
- These Qs are Prompts; Not an Assignment
- Post Walk: 10 minutes for a few impressions; we will collect any comments on NoteCards.

* You can imagine this as any shore type: a coral reef instead of rocky; mangroves not marshes; vulnerable farming communities not greenhouses.








UCSC Coastal Walk & Brainstorm





Santa Cruz Harbor, CA, January 5, 2023 (A. Foxgrover)

oSMoS

Improving Risk Science to Reflect Nature, Equity, and Adaptation



Patrick Barnard

United States Geological Survey Pacific Coastal and Marine Science Center Santa Cruz, CA



The Relevance of Sea Level Rise

- Over 1 billion people are expected to live in the coastal zone by 2050
- <u>SLR will likely cause 'once-in-a-lifetime' coastal flooding events to</u> <u>occur annually by 2050, and every day by 2100</u>
- When considering storms and coastal change, ~3 times more people would be at risk
- In California
 - Over 600,000 people and \$200 billion in property at risk by 2100 (6% of GDP!)
 - These potential impacts are ~ 10 times greater than the worst wildfires and earthquakes California history







What the USGS is doing

- Developing fundamental and applied science to assess the exposure of coastal communities to SLR and storm-driven hazards
 - Flooding
 - Erosion
 - Groundwater
 - Vertical land motion
- Delivering a consistent set of scenarios for national application
- Co-developing user-friendly products to support climate adaptation planning
- Increasing investment in Nature-Based Solutions research and risk reduction assessments in collaboration with our partners





www.ourcoastourfuture.org



www.usgs.gov/apps/hera





National Scope- Future Coastal Hazards



Equity and Environmental Justice

• The classic definition of EJ is not directly relevant to a nonregulatory science agency:

"Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."

• What is the federal government's role? = "4 As of EJ"

- <u>A</u>vailable
- <u>A</u>ware
- <u>A</u>ccessible
- <u>A</u>ctionable















Using Risk Science to Reflect Nature

Recent Developments

Dag Lohmann 2023



Integrating Nature in Risk Science & Insurance Symposium

Who We Are

KatRisk is an independently owned catastrophe modeling business formed in 2012. We have three offices, two in the US and one in Germany.

We service clients ranging in size from multinational industry leaders to super regional specialty carriers primarily within the insurance and financial services industries including:

- Four of the largest 5 worldwide reinsurance brokers
- Four of the top 5 worldwide non-life reinsurers
- Five of the top 15 worldwide property insurers
- The U.S. Federal Emergency Management Agency (FEMA)
- Calculation Agent for last 6 FEMA NFIP cat bonds
- The Philippines Government (Flood Model on OASIS)
- The Canadian Government
- Some renewable energy companies



Risk now and in the future?

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	Peril / Time	Core Cat Model Cat Response	1 - 10 day Forecast	Climate Variability / Seasonal Forecast	Climate Change (2025 - 2100)
	Flood	50k yr stochastic Observations	KatGFS Return period forecast (Obs + NWP based)	Global SST driven (VARMA model)	Change in local frequency / severity
	TC Wind + Storm Surge	50k yr stochastic Observations	Observed and forecast track / track ensemble	SST teleconnections (ENSO, Atlantic SST) from global SST model	Change in local severity Change in sea level
	Severe Storm	50k yr stochastic Observations	Public data Event Set Conditioning	Trans-Niño index (TNI)	Change in local frequency/severity
	WildFire	50k yr stochastic Observations	Public data Event Set Conditioning	Precipitation driven from Flood model	Change in size / frequency



Risk Models and Cat Response

USA all perils (TC, IF, SS): Combined Analysis: Three LOBs, 10 samples, average vulnerability, no climate change Minutes to run for 1 Million sample locations (25 cores) From previous RAA: Harvey Event Response Rapid hazard and loss response based on forecasts and observations







Climate Change

UNDERSTANDING LONG-TERM RISK





Loss Ratio Current



Loss Ratio Changes +30cm



US Economic Loss from SLR

- US economic loss based on new NOAA sea level rise scenarios (Feb. 2022)
- □ Significantly different from previous NOAA SLR
- □ KatRisk implemented and tested. Recommendation: replace current NOAA scenarios with new 2022 ones
 - More realistic vertical land movement
 - More realistic SLR values







sub-specialty: the art of pricing the risks of climate change, a concern not least to the insurindustry.

https://www.soa.org/globalassets/assets/files/resources/research-report/2020/soa-flood-report.pdf

US Economic Storm Surge losses based on NOAA 2022 Medium scenarios





Coastal Mangroves Example

- Data from Mike Beck & Team
 - Impact on return period storm surge height from mangrove trees
 - Data are in very useful and easy to use format
- Question: What is the economic value of mangrove trees?
- Answer: Not easy to quantify would need a new model
- Workflow for a shortcut
 - Compute economic losses with default SpatialKat
 - Design a parametric loss model from operational storm surge gauges
 - Use coastal mangrove data to manipulate gauge data
 - Compute results





Summary

Dag Lohmann KatRisk LLC Dag.Lohmann@katrisk.com (510) 984 0056 Need to agree on key risk language

 tVaR, AAL, coherent risk measures, return period, exceedance probability (OEP, AEP), uncertainty

Data needs

- Easy to use data in common formats
 - Grib, netCDF, shp, raster, binary, csv, etc.
- Data should (ideally) have impact on losses or other risk metrics embedded, if possible by return period.
- Data need to be "extended" with expert judgment to necessary range of return periods (from 1 to 100k years). Otherwise risk modelers will make them up.





Large-scale CoPe: Reducing Climate Risks with Equitable Nature-based Solutions: Engaging Communities on Reef-Lined Coasts



Vision

Empower coastal communities by collaborating & co-creating new knowledge of how existing and future climate risk models can inform equitable place-based & locally appropriate nature-based solutions



Coral & mangroves co-benefits



Coastal protection



Biodiversity & Habitat quality



Fisheries



Tourism and Recreation



Water purification



Carbon sequestration



"This gives me such hope for other parts of the Caribbean. So much life around this reef. It's really impressive & really inspiring."

Marilyn Brandt Marine Biologist



"Mooe aah wi need fue get di aahpaaatunity fue coe out yah ... aah si bout wi guud ting aah mine wi guud ting, noe mek aahdaah people coe mine it fue wi."

YaYa Coleman Martin Community Advocate

Broadening Participation



Dr. Tiara Moore CEO & Founder Dr. Nikki Traylor-Knowles Founder, Director and Chief Financial Officer



Thank You! matrotz@usf.edu

Large-scale CoPe: Reducing Climate Risks with Equitable Nature-based Solutions: Engaging Communities on Reef-Lined Coasts



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Nature-Based Solutions Roadmap

Heather Tallis Assistant Director, Biodiversity & Conservation Sciences White House Office of Science and Technology Policy





THE WHITE HOUSE WASHINGTON



Decades of Experience

Naval Weapons Station Earle (NJ): Oyster reefs, marsh restoration



Decades of Experience

1930's – 40's Dust Bowl nature-based solutions





Decades of Experience

For community development, flood & fire risk reduction, & other benefits



California forest management for wildfire and flood reduction <u>Source</u>: Sonoma County Regional Parks New Orleans park and wetlands for recreation, education, flood risk reduction. <u>Source</u>: City of New Orleans



Coastal Protection

Coral reef and mangrove potential untapped

Florida and Puerto Rico reef restoration could prevent over \$270 million annually in economic damages from flooding (Storlazzi et al. 2021)

~20 countries around the Caribbean have costeffective restoration potential



Beck et al. 2022

National Nature-Based Solutions Roadmap

• Nature-based solutions should be go-to options for climate, equity, prosperity—and we know how to get there

• All-of-government recommendations to unlock full potential of nature-based solutions



OPPORTUNITIES TO ACCELERATE NATURE-BASED SOLUTIONS: A ROADMAP FOR CLIMATE PROGRESS, THRIVING NATURE, EQUITY, & PROSPERITY

A REPORT TO THE NATIONAL CLIMATE TASK FORCE NOVEMBER 2022
National Nature-Based Solutions Roadmap

• Update policies (BCA)

- Unlock funding (insurance)
- Federal facilities & assets (buildings, dredge)
- Train the workforce (incentives)
- Research, innovation (lead w ideas)











THE WHITE HOUSE WASHINGTON

WH.GOV/OSTP

@WHOSTP@htallis46



Q

ORRAA

The Ocean Risk and Resilience Action Alliance

Project Template

Financial Innovation

[date]

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OCEAN RISK AND RESILIENCE ACTION ALLIANCE

INCUBATE AND INNOVATE NEW INSURANCE AND FINANCE PRODUCTS

- INSURANCE
- FINANCE TOOLS
- NATURE AS AN ASSET CLASS

CREATING INVESTABLE PROPOSITIONS FOR THE PRIVATE SECTOR

- OUTRIGGER IMPACT FUND
- POLICY FRAMEWORKS

DEVELOP A GLOBAL OCEAN FINANCE ARCHITECTURE

- DE-RISKING INVESTMENTS
- BONDS
- DEBT RESTRUCTURING



TAPPING the FLOOD MITIGATION BENEFITS of MARSHES

Sarah Heard

/ Director, MarketLab

The Nature Conservancy

会会 market LAB

Focus on San Francisco Bay



2 POTENTIAL INSURANCE MODELS



Avoided Damages from Marsh Restoration



Potential Applications



INSURANCE SAVINGS WITH NATURE



IMPROVED PROJECT DESIGN



INSURANCE MODELING WITH NATURE



INCREASED RESTORATION FUNDING

(77)

New Policy Brief on Marsh Flood Reduction Benefits

Valuing the Flood Reduction Benefits of Marsh Restoration



Available:

https://www.scienceforconservation.org/products/ Salt-Marsh-Flood-Benefits

(78)

