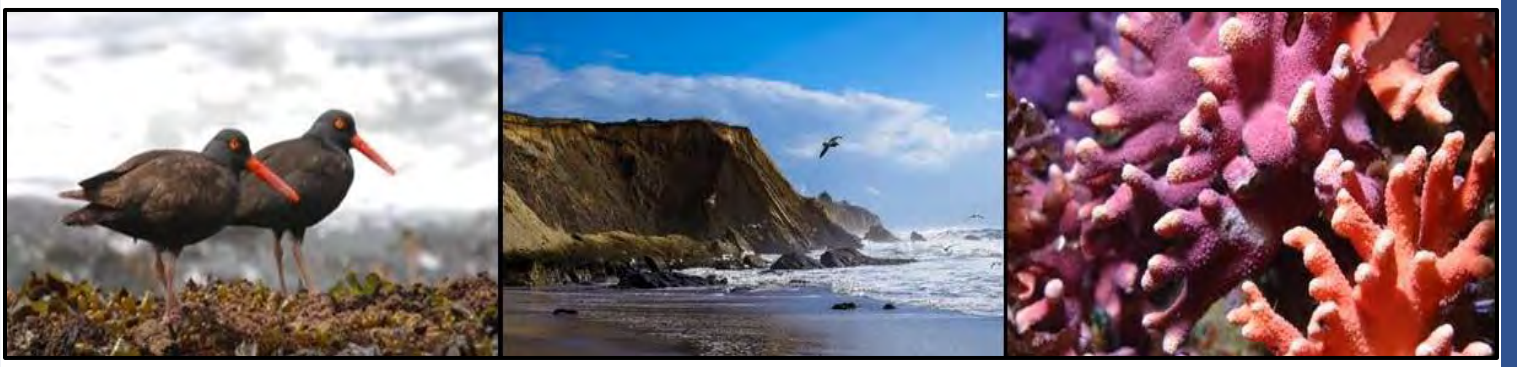
Fifth Ocean Climate Summit Report

Learning from the Past, Looking to the Future



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GREATER FARALLONES ASSOCIATION

NATIONAL MARINE SANCTUARIES
GREATER FARALLONES

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
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Animal Place's Food for Thought

Cover Photos: Black Oystercatchers (GFNMS), North-central California coast (GFNMS), California Hydrocoral (Steve Lonhart, MBNMS)

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INTRODUCTION

Greater Farallones National Marine Sanctuary and Greater Farallones Association convened the 5th Ocean Climate Summit: Learning from the Past, Looking to the Future on April 18, 2019 at the General's Residence in Fort Mason, San Francisco.

Building on 10 years of progress since the first Summit in 2008, the Sanctuary and its partners have developed collaborative programs and projects across the greater San Francisco Bay Area. Working as a diverse coalition of academic, NGO, local, state, and federal partners, we as a community have advanced living shorelines dialogue, coordinated climate change messaging, and developed regional, national, and international climate adaptation planning tools and resources. We have promoted resilient, climate-smart management of coastal and marine habitats by addressing climate change impacts in concert with existing threats, including erosion and sediment supply, catastrophic loss of bull kelp forest habitat, and the design of living shoreline solutions across the region.

The Fifth Ocean Climate Summit brought together 155 scientists, marine resource managers, decision-makers, and educators and identified over 40 collective priority actions to further advance climate change adaptation in the region. Attendance has grown with each Summit, which reflects the growing interest in working together to improve the resilience of our coast and ocean resources to climate change impacts.

SUMMIT GOAL AND STRUCTURE

The goal of the Fifth Ocean Climate Summit was to identify collective priority actions to further advance climate science, communication, and adaptation in order to better protect the North-central California coast and ocean from the impacts of climate change over the next 10 years.

The objectives of the Summit were to:

- Acknowledge and celebrate over 10 years of collective progress made since the first Ocean Climate Summit.
- Share the most up to date knowledge of climate trends, current impacts, and projected impacts to the North-central California coast and ocean.
- Connect people, information, and resources across disciplines in order to build upon existing collaborations and identify new, diverse partnerships.
- Identify next steps to: 1) promote coastal protection via living shorelines techniques; 2) engage and educate local communities on climate action; 3) support habitat protection and restoration projects that build ecosystem resilience; and 4) reduce the impact of non-climate stressors on coast and ocean resources.

The program featured two expert plenary panels and two facilitated sessions. The morning plenary highlighted the state of climate science in the region and the afternoon plenary highlighted and discussed successful community engagement. The two facilitated sessions provided attendees with the choice of two themes related to climate

adaptation, each providing diverse perspectives through “lightning talks”. Extended morning and afternoon breaks, lunch on the lawn, and an evening reception provided abundant opportunities for networking.

WELCOME

Maria Brown, Superintendent of NOAA’s Greater Farallones National Marine Sanctuary, welcomed everyone to the Fifth Ocean Climate Summit and acknowledged the numerous organizations supporting this important event. Key messages from Maria’s welcome include:

- We are a collective force of passionate individuals committed to a brighter future, whether it’s for our family, wildlife, or nature in general. We are committed to creating the future we envision, and together we’ve made big strides over the last 10 years.
- Out of the first Summit, Dr. John Largier from the University of California’s Bodega Marine Laboratory led the scientific community’s effort to produce a Climate Impacts Report for North-central California’s Coast and Ocean.
- From the second Summit, Dr. Jaime Jackne of Point Blue Conservation Science led 50 scientists in developing a set of physical and biological climate change indicators for this marine region. This pioneering work informed the Intergovernmental Panel on Climate Change (IPCC) efforts on ocean indicators globally.
- After the third Summit, the Sanctuary, in partnership with EcoAdapt, worked with many of you in this room to conduct a vulnerability assessment for the North-central California coast.
- By the fourth summit, under the leadership of Anne Morkill from U.S. Fish and Wildlife Service, this group identified 78 ocean and coastal climate adaptation strategies.
- And that leads us to today, the 5th Ocean Climate Summit, where we will build on this success and identify collective priority actions to further advance climate science, communication, and adaptation to create our vision of the next 10 years.

OPENING REMARKS

Rebecca Smyth, regional founder and director of the west coast office for NOAA's Office for Coastal Management, partners with coastal resource managers, including the Coastal Zone Management Programs and the National Estuarine Research Reserves, on coastal climate issues from Alaska to the Mexican border. She has worked at the national NOAA level on policy and legislative initiatives related to coastal management, hazard and climate resilience and marine and coastal protected areas. She emphasized the need to celebrate our successes as we manage and protect natural resources in the face of climate change, and recognized the Summit as an important forum for sharing our progress, lessons learned, and collaborating. She emphasized that NOAA is committed to advancing scientific research in a collaborative approach.

Dr. Justine Kimball, Senior Program Manager for Climate Change at the California Natural Resource Agency's Ocean Protection Council, has served as a science and policy advisor in the Office of the Oceanographer of the Navy and recently joined the Ocean Protection Council to engage decision makers at all levels of government in adaptation and understanding of climate change. She emphasized the importance of addressing the effects of climate change, such as sea level rise and ocean acidification, through financial and policy investments and highlighted that leadership teams must work individually and collectively to make targeted investments and informed decisions to prepare for and reduce the effects of climate change in California.

OPENING PLENARY: MONITORING THE PULSE OF THE OCEAN

Session Facilitator, John Largier of Bodega Marine Lab, introduced the panelists and reminded attendees that the goal of this and subsequent sessions is to discuss and identify priority actions for addressing climate impacts. He discussed some of the most critical effects of climate change on our ocean, including ocean warming (increasing globally and regionally, though complicated by marine heatwaves and increased upwelling), decreased dissolved oxygen and exposure to hypoxia, increased acidification, sea level rise (resulting in lowland flooding and shoreline erosion), and increased variability in run-off and salinity. As climate change impacts continue, the key questions moving forward will be to identify priority impacts, mechanisms driving those impacts, and probabilities of extreme conditions. Future work seeks to reduce greenhouse gas emissions and other drivers of climate change, track the impacts of climate change and continually adapting pro-actively to the most severe impacts.

Andrea O'Neill, US Geological Survey, presented potential impacts sea level rise and inundation may have on coastal California communities. USGS researchers use satellite and telemetry data to make precise assessments to understand sea level impacts. These assessments can be used to design actions, such as when to nourish beaches as a response to rising sea levels and increased storminess. The research will continue to investigate the long-term risks associated with sea level rise, changing storm patterns and the effect of coastal management decisions on coastal dynamics.

Danielle Lipski, Cordell Bank National Marine Sanctuary, discussed the Applied California Current Ecosystem Studies (ACCESS) research cruises, a collaborative effort between public and private agencies. Since 2004, researchers have investigated oceanographic and biological patterns and have found tight linkages between seawater temperatures and biological conditions, with warmer water coinciding with decreased nutrient concentrations, decreased phytoplankton abundance, and less abundant and smaller size krill. Long-term data sets are important when assessing changing conditions over time and can be helpful for managers when making decisions regarding impacts to critical species, such as ship strikes and entanglements for large whales.

Carrie Pomeroy, University of California at Santa Cruz Sea Grant, discussed the critical need to understand the interactions and interdependencies between ecological and social systems. In order to have safe, sustainable and secure seafood supplies in a

changing climate, we face challenges to protecting public health, such as responding to domoic acid events, as well as protecting the health of the ecosystem. Fisheries are complex, dynamic, social-ecological systems, and a better understanding of the ecological, social, cultural, and economic consequence of climate change is key to ensuring ecological and human health in the future.

Panel Discussion Take Away Messages:

- Before beach nourishment can be considered an option for protecting the coast the correct type of sand must be identified. The sand used for nourishment must match the grain size and material of the beach proposed for nourishment. A priority for California should be to categorize the types of clean sand currently being disposed of in the ocean and match that sand with proposed restoration sites.
- We must consider the biological response to beach nourishment as it's proposed as a response to sea level rise and extreme events.
- Scientists do not expect large changes in the annual average rainfall; however, they do predict more extreme events. The rain will come in episodic events and we need to better understand how episodic, extreme events will effect ecosystems.
- Water in California is a valuable natural resource, and we must expand our ocean climate change audience to include inland communities. The use and disposal of water in inland communities can effect ocean and coastal species.
- We need to look upstream at the management of watersheds in a holistic way, so during extreme events there can be better, more efficient storage of fresh water.
- Diverse sets of stakeholders need to come together to wrestle with complex problems resulting from effects of climate change on the ocean. For example, warmer ocean waters were linked to a harmful algal bloom that resulted in a significant delay in the crab fishery. When the fishery finally opened it was during the peak whale season in North-central California resulting in an increase in entangled whales.
- Through building relationships across sectors stakeholders can find solutions.
- Long-term, time series data is critical to understanding how climate change is effecting natural systems.
- It is more important than ever to effectively communicate scientific findings to stakeholders and the community in general and translate the science to policy-makers. One of the best ways to communicate science is through stories. Stories about the animals people love such as whales. Not everyone lives along the coast, and we must reach those who live in inland communities. People will be more motivated to take action around species they care about.

Priority Actions to Advance Climate Science and Monitoring:

- Invest in the collection of long-term, time series data identified in the climate indicators report to understand how natural systems are responding to climate change.

- Monitor the physical and biological responses to adaptation projects such as beach nourishment.
- Communicate scientific information to policy-makers and the public through relatable stories.
- Employ a watershed approach to manage for climate-related stressors.

SESSION 1

Session 1 featured two concurrent themes: "Focusing on Habitats to Enhance Climate Resilience", facilitated by Walter Heady of the The Nature Conservancy, and "Ocean Acidification: Impacts and Response" facilitated by Tessa Hill and Carina Fish of Bodega Marine Lab. The goal of each theme and the abstracts for all presenters are included, followed by facilitated discussion with session attendees.

Focusing on Habitats to Enhance Climate Resilience

Goal: Discuss how resource managers can most effectively address climate impacts to coast and ocean resources by protecting and restoring at the level of habitats, and identify priority actions to advance habitat protection and restoration.

Walter Heady, The Nature Conservancy: Habitats provide an important lens for guiding management actions and restoration goals in a changing climate. Coastal habitats have already suffered significant losses, and the built environment impacts the natural ability of coastal habitats to adapt to changing sea levels. The Nature Conservancy and the California State Coastal Conservancy assessed the vulnerability of 22 wetland and 18 upland habitats to sea level rise. A majority of the area of key coastal habitats, including beaches, rocky intertidal, and estuarine marshes are highly vulnerable. We developed a wall-to-wall conservation blueprint comprised of six actionable strategies to maintain coastal habitat area in the face of sea level rise. In our "Hope for the Coast" campaign we are engaging federal, state, and local agencies to adopt resolutions with actionable commitments to maintain coastal habitat area in the face of sea level rise. It will take such concerted efforts to ensure climate resilience of habitats and the native biodiversity they support.

Kelly Santos, San Francisco State University: Tidal marshes are habitat to endangered animals like the salt marsh harvest mouse (Reithrodontomys raviventris) and California ridgway's rail (Rallus obsoletus). As the sea levels rise, high tide refuge is needed to help wildlife escape predation and drowning. California sea-blite (Suaeda californica) is a federally endangered large salt marsh shrub that was completely extirpated from the San Francisco Estuary (SFE). The plant's ability to climb will be important for marsh resiliency with rising seas. I am testing whether we can increase high tide refuge in SFE salt marshes by increasing plant size using experimental structures called arbors. Understanding factors that promote S. californica growth will inform the maintenance of SFE salt marshes and the habitat they provide, while assisting in the recovery of an endangered species. In doing so, this project helps preserve California's diminishing wetland habitats and helps adapt to climate change and sea level rise.

Sara Hutto, Greater Farallones Association: Through the Sanctuary's Climate Vulnerability Assessment, completed in 2014, managers found that the vulnerability of the habitat often drove the vulnerability of associated species and ecosystem services. Likewise, projects that confer

resilience to climate impacts at the habitat level are expected to enhance species and ecosystem service resilience as well. The newly developed Ocean Climate Program Storymap presents the Sanctuary's approach to addressing climate impacts by focusing on restoring and protecting habitats, and provides guidance and resources for other managers to pursue climate-informed management of natural resources.

Cynthia Catton, California Department of Fish and Wildlife: The recent catastrophic large-scale loss of bull kelp in northern California has highlighted the need to develop new approaches to enhancing resilience of critical habitats to future climate-change stressors. Successful approaches will incorporate input from diverse partners, identifying adaptive strategies that enhance both ecological and social resilience, promoting long-term support and stewardship. The KELPRR program is a broad partnership of stakeholders, scientists, and resource managers founded in 2016 with three essential long term goals: 1) Conduct ecological research that will guide future restoration strategies and research, 2) Identify opportunities and incentives for coastal communities to engage with recovery actions and enhance economic growth, and 3) Build trust and cooperation across diverse communities. The KELPRR program guides the development of kelp forest recovery actions based on multidisciplinary science and community engagement, and provides a model for future habitat restoration and resilience programs.

Rietta Hohman, Greater Farallones Association: Over the last few years, the northern California coastline has suffered an extensive loss of bull kelp forests due to an unusual combination of climatic and ecological stressors. Since 2014, the loss of bull kelp forests has led to the collapse of the commercial red sea urchin fishery in the region and the complete closure of the recreational red abalone fishery. Convened in 2018, the Kelp Recovery Working Group established a strong, interdisciplinary partnership which assessed the resilience of bull kelp forests under changing conditions and developed the science-based Bull Kelp Recovery Plan. The Recovery Plan outlines strategies for active kelp recovery, restoration site selection, monitoring and research, and community engagement. These strategies provide pathways to immediately begin recovery efforts in bull kelp forests, establish long-term monitoring efforts and increase resiliency of bull kelp forests to changing ocean conditions through active management.

Karen Reyna, Greater Farallones National Marine Sanctuary: Deep-sea corals and sponges are expected to be highly vulnerable to the effects of climate change. These unique species may be threatened by ocean acidification and more immediately, bottom fishing and trawling. However, the risk posed by fishing pressures have been reduced due to state and federal regulations, such as no-take marine reserves and Essential Fish Habitat conservation areas that protect against benthic impacts.

Giovanni Rapacciuolo, California Academy of Sciences: Citizen science – the involvement of non-scientists in the production of scientific knowledge – can generate biodiversity data at spatial and temporal scales difficult to achieve by other approaches. Our team – a collaboration between the California Academy of Sciences (Academy), the California Ocean Protection Council, and the California Department of Fish and Wildlife – is building the capacity to make use of the Academy's ongoing citizen science initiatives and iNaturalist community-contributed observations to understand and monitor biodiversity across California's Marine Protected Area (MPA) network. Our aims are twofold. First, to provide recommendations for increasing the usefulness of community-contributed biodiversity data and iNaturalist observations in support of the State of California's long-term MPA Monitoring Action Plan. Second, to generate knowledge

of California coastal ecology and understand the effects of changing ocean conditions, by examining spatial and temporal variation in ecological community diversity and its drivers, and documenting and understanding species' range shifts.

Panel Discussion:

What are the most critical next steps?

- Encourage unique partnerships to allow for unique solutions
- Continue to develop citizen science methods for more people to get involved

Regarding citizen science, how much are we monitoring uses by humans? It would be a good idea to weave information about human activities into future monitoring to assess habitat vulnerability.

- California Academy of Sciences is trying to use data to determine the behaviors of people to find out where they go and what they observe but the sample of people is biased because a lot of the people who use the app are scientists and people who already care about the coast. There are other citizen science initiatives that monitor human and recreation use and aspects of degradation and the aim is to integrate these into the research.
- MPA watch is a citizen science program in partnership with the beach watch program where they collect human uses in MPAs.
- Some habitats are particularly vulnerable to human action. This is another use of the MPAs: teasing apart climate change from fishing impacts
- This is a very exciting time with regards to gathering science, and knowledge and communication are working at an interface with technology. We're able to monitor all aspects of human impacts and uses, and we can use these data to inform our actions now.

Do we know the latest science on carbon sequestration in kelp and how long that carbon can persist in the system?

- This is an active role for researchers in determining how much is being sequestered. There's also some work being done looking at kelp that has been buried in the deep sea and looking at the transport of kelp there. Carbon can also be incorporated into shells and shellfish.

In some areas, high visitation and public access results in significant damage. What can be done?

- This is relevant to lots of areas where people use the habitat, which is important. Sometimes these areas can be over-loved. Fitzgerald Marine Reserve has seasonal and temporal closures for pinnipeds, which is commendable. Other parks are forced to have closures because of animals like elephant seals. Our parks might benefit from seasonal or temporal closures during key recruitment events that would be important management tactic especially in the future in light of climate change.

- Allowing community involvement in these areas is crucial for changing public opinions and continuing to have a strong community engagement in an area is really important.
- There are strong protections already in place for Fitzgerald Marine Reserve and we need to continue supporting enforcement personnel who can enforce them. We just have to give them space to help protect reefs and species. For habitats such as the deep ocean that are harder to access, we again have to rely on officers to enforce the regulations that are in place.

Are there any efforts to assess future vulnerabilities for kelp communities? Could this kelp loss phenomenon just happen all over again in the future?

- In the short term, we are working on managing urchin grazing. In the long term we are looking for areas with higher sea star densities (introduced and natural). We are also collaborating with other agencies in order to manage smaller scale stressors and to increase resilience moving forward. Bull kelp is actually a resilient ecosystem and their decline was a result of an unusual combination of occurrences. Our research with bull kelp now will also set us up to better protect these ecosystems in the future.
- Bull kelp is an annual species. After multiple years of poor recruitment and low production of spores there's a concern the bull kelp population will be spore limited. Building in resilience also means building in spore production. Additionally it will be important to make sure there's a way to respond to an increase in purple urchin populations. If we can create a commercial product with purple urchins and if efforts are aimed at kelp recovery, we could have the right combination of things to address future impacts

<u>Priority Actions for Advancing Habitat Restoration and Protection:</u>

- Leverage partnerships from unique perspectives to find novel solutions
- Look forward, think big, work together
- Maintain existing protections
- Find opportunities for coastal habitat to migrate inland
- Focus on protecting refugia, but don't forget the vulnerable areas (they need focus too, but require more work)
- Continue to engage citizen scientist to track long-term trends
- Explore the use of seasonal closures to protect vulnerable species
- Assess long-term resilience of vulnerable habitat to ensure our efforts are climate-informed

Ocean Acidification: Impacts and Response

Goal: Understand the latest science on the impacts of ocean acidification, and discuss the various responses from management agencies to protect coast and ocean resources. Highlight what we've learned so far, and identify priorities moving forward.

Tessa Hill and Carina Fish, Bodega Marine Lab: Ocean Acidification (OA) is not the only change happening in our coastal ecosystem but one of multiple stressors. These multiple stressors in response to climate change include increasing sea surface temperature, decreasing pH, and decreasing dissolved oxygen; we need to think of the impacts of OA as they interact with all of these other stressors. The California ocean system is large and highly variable resulting in a mosaic or patchwork quilt pattern in which we are observing these stressors both spatially and temporally. We are reliant on long-term datasets and need to invest in maintaining these datasets to better understand if this variability is common or unique to our time due to anthropogenic impacts. Thus, we need to incorporate multiple perspectives in our problem solving and develop partnerships of diverse stakeholders to tackle these large-scale problems.

Whitney Berry, Ocean Protection Council: Over ten years ago, the California Ocean Protection Council (OPC) identified ocean acidification (OA) as a priority climate impact threatening our state. Since then, OPC has made strategic investments to understand the science behind ocean acidification and its impacts, as well as work collaboratively to move state, regional, federal, and international policy forward. Building off this work, and in concert with the Ocean Science Trust, OPC developed and released its 2018 California Ocean Acidification Action Plan. The Action Plan lays out six strategies and related actions to identify and prepare for a full range of risks and impacts, reduce the causes of OA, improve the resilience of vulnerable groups, and minimize harmful effects. For this lightening talk we will highlight California's accomplishments in understanding ocean acidification and its impacts, with a focus on ongoing projects and priority areas for the state and our regional partners moving into the future.

Jessica Williams, Ocean Science Trust: Ocean acidification has the potential to alter marine food webs and ecosystems, including impacts to valuable marine fisheries and industries. In response to mounting evidence of long-term ecosystem and economic impacts, fishery managers understand the urgency of addressing the effects of OA. However, the complexity of the issue and evolving scientific understanding present a challenge for decision-makers when deciding where and how to act. To support management solutions, Ocean Science Trust and Annaliese Hettinger (UC Davis Bodega Marine Lab), in collaboration with Ocean Protection Council, developed a visual decision-support tool that synthesizes scientific understanding of potential OA impacts on key economically and ecologically important California marine species and illuminates the breadth of unknowns that still exist. This tool provides a tangible illustration of current knowledge to support decision-makers in prioritizing future research and developing impactful management actions to address effects of OA on California fisheries species, ecosystems, and communities.

Jan Freiwald, Reef Check: In 2017, Reef Check, the Kroeker Lab (UCSC) and the Takeshita Lab (MBARI) implemented a citizen science Ocean Acidification and Hypoxia (OAH) monitoring program. They established a network of pH, oxygen, and temperature sensors at six MPAs and an additional 60 temperature sensors along California's coast. The program goals are threefold: (1) Co-locate OAH monitoring with ecological monitoring to allow better interpretation of MPA effectiveness and ecological responses to global change; (2) fill geographic gaps in California's OAH monitoring network; (3) engage citizen scientists in OAH monitoring. Initial results

demonstrate the feasibility of the citizen science approach with these low-cost sensors. The data illustrate large-scale geographic differences in OAH exposure among MPAs, and high temporal variability in exposure of California's living resources to low pH and oxygen conditions. These time series highlight new avenues for research and show promise for the co-location of environmental and ecological monitoring through citizen science.

Terry Sawyer, Hog Island Oyster Company: Ocean acidification adds considerable uncertainty to the work of shellfish farmers. Oysters are particularly vulnerable to changes in pH and aragonite saturation levels when they are young, but may also be affected as adults. At Hog Island Oyster Co. we aim to build OA resilience by working with scientists to monitor changing ocean chemistry. Since 2014 we have hosted a state of the art OA sensor (Burkolator) at our farm on Tomales Bay, CA, and we are working with several partners to develop and implement strategies to cope with mass oyster mortalities that coincide with periods of low ocean pH. These strategies include selection of strains resistant to a variety of ocean conditions (low pH, increased sedimentation, increased freshwater inputs), repurposing logging industry infrastructure for aquaculture and getting the message out to the public. Hog Island stressed the importance of both developing strategies for food security and communicating the situation to the public that enjoys eating seafood.

Mary Miller, The Exploratorium: Whether through political pressure or consumer choices, the public plays a critical role in responding to ocean acidification – a role that requires widespread environmental literacy. Through its unique, inquiry-based pedagogy, the Exploratorium delivers ocean acidification education by connecting visitors directly with data and phenomena. The Exploratorium is outfitted with research-grade environmental monitoring equipment, connecting visitors with environmental monitoring practices and an understanding of "how we know what we know." Multiple exhibits provide entries for visitors to explore environmental data from the museum's NOAA pCO2 buoy. This data is also available to scientists as the Exploratorium is part of the Central and Northern California Ocean Observation System (CeNCOOS). Additionally, the Exploratorium has developed multiple hands-on demonstrations exploring both the science and impacts of ocean acidification. In this talk, education experts will discuss the Exploratorium's materials and approach to advancing greater public understanding of ocean acidification, an understanding critical to meaningful response.

Panel Discussion:

Where does this group see the priorities for OA?

- Further developing adaptation strategies
- How to communicate the systems approach and make the data more meaningful so people feel like they can understand and engage in the next steps
- Adaptation is implementation of conservation and ameliorate OA impacts and mitigate Climate Change on resources.
- Investing in science that is management and decision relevant; things that will make the issue feel more tangible. People have trouble understanding how it impacts them personally.
- Agrees that communicating and educating is important.
- This is a false choice, they are fighting the fight on multiple fronts and will speak to their strengths. There are still science gaps, particularly multiple stressors, we need to fund these data gaps.

A lot of drivers are land based but many agencies involved have jurisdictions that end at land-sea interface, how do we bridge that gap?

- All decisions that are made on land have implications on this process and she agrees.
- OA was previously separated but these drivers need to become incorporated into the systems thinking.
- To have any satisfaction on this issue as complex as it is, we need to get politicians from Sacramento in the water so they can make that link and communicate it. He produces food and people need to eat. To make that connection has been his goal. In Marin he helps to develop strategies on water quality management, advising and obtaining monies in these paradigm shifts.

As we have local communities making decisions, does the panel have advice on what we can do right now at the local level? How can we start?

- Sea-level rise (SLR) has been a local priority and making sure the SLR strategies include OA, can then be used at all levels of government. SLR is the easiest way to engage but many are willing to wait until the water is at our front door.
- We don't have a crystal ball, trying to answer, there are multiple agencies in charge of managing our watersheds but we are mostly talking nearshore here. If there was a way to facilitate the regulators to work together so we can all work on these issues and be proactive now.
- Communicating across land-sea agencies and on the water the potential impacts to whatever they are currently managing. I was talking to someone in Fisheries and they said that they were not going to manage their way out of OA as fisheries but there's a need to convince them to understand that fisheries are going to be impacted.

What were the OPC OA action Plan strategies?

- Protecting salt marshes and eel grass beds as buffers for SLR now
- Working on creating water quality revisions and parameters for regulation that include OA
    - Have a project with SCWERP now that will hopefully add data to support this work
    - Unfortunately, it's non-point source carbon and making the connection that nutrient runoff exacerbates the issues
    - This is why they are funding the hotspots
- They are working on many other strategies to get to these issues and advance science to support the work

You have talked about better outreach and better communication, one of the things I struggle with is that policy makers respond to constituent concerns. Is anyone looking at what kinds of research is being done to ensure that people are calling their representatives and are getting the messages. Are people looking at that from a social science perspective?

- When communicating with representatives, messaging should be tailored to each district and what people care about. We heard about sonar impacts on whales, they hated the idea of these impacts. The passion is what gets them to talk, similarly with Dungeness and oysters.

- We try to address that by involving people in the science collection and hopefully with that first-hand experience they can become ambassadors.
- NNOCCI (National Network of Ocean and Climate Change Interpreters) uses messages that have been vetted through a social science lens. I also do a lot of work in this realm and I think that we often get focused on messaging because we think people can't handle complexity. But we can all think about complex things in our everyday lives. Our choices we make with carbon are all complex and contributing weather voting, driving, etc. I have shifted how I think and I don't focus on messaging as much anymore.

If everyone could think forward to the next summit, what would be the vision you would have about where we should be headed?

- Federal level action
- Integrated strategies and policies
- Go back to messaging and how do we bring it home to people that don't live on the coast
- Expanded partnerships and being able to communicate why it is all important
- We would be talking about how ocean acidification is affecting communities

<u>Priority Actions for Advancing Ocean Acidification Science and Adaptation:</u>

- Install and maintain a network of ocean acidification data loggers
- Invest in science and present in a format that can be used for management.
- Understand the impacts of OA from multiple perspectives including human policy and management
- Partner with diverse stakeholders such as tribes, communities, museums, scientists, and managers.
- Make the issue feel more tangible. Local scale decisions and actions matter.
- Communicate what people can do individually and collectively as part of a larger movement.
- Engage land use managers, especially when developing Local Coastal Plans.
- Implement no regret adaptation strategies while developing other strategies
- Capitalize on work that addresses protection / restoration of wetlands, seagrasses, and marshes that can provide carbon sequestration.

SESSION 2

Session 2 featured two concurrent themes: "Coastal Protection Designs for Living Shorelines", facilitated by Marilyn Latta of the State Coastal Conservancy and Sam Veloz of Point Blue Conservation Science, and "Building Resilience through Multi-stressor Management" facilitated by John Rozum of the Office for Coastal Management. The goal of each theme and the abstracts for all presenters are included, followed by facilitated discussion with session attendees.

Coastal Protection Designs for Living Shorelines

Goal: Advance the concept of utilizing green and/or hybrid infrastructure when protecting coastlines from SLR and increased erosion due to climate change by highlighting unique perspectives on living shorelines applications and case studies.

Marilyn Latta, State Coastal Conservancy**:** Living Shorelines utilize natural materials to protect and buffer shorelines from erosion in the face of sea level rise, through a habitat restoration approach. Both pilot and large-scale projects are being implemented around the United States and around the world, but the overall design practice is still in a research and development stage. This design technique can include any habitat type, including wetlands, beaches, oyster reefs and other habitat types; and can also include hybrid grey and green elements. Living Shoreline Projects have been underway on the East and Gulf Coasts since 2005, and on the West Coast since 2010. This presentation will provide context on Pacific Coast considerations, methods, and policy support for living shorelines; and summary information on case studies that the State Coastal Conservancy and many partners are working on in CA and San Francisco Bay.

Sam Veloz, Point Blue Conservation Science: California's coastal communities are highly vulnerable to sea level rise and storm associated flooding in the future. Traditional approaches for reducing flooding vulnerabilities have focused on stopping flows of water with hard physical structures like sea walls and levees. However, these approaches have been shown to have negative ecological effects and are costly to maintain. Nature-based sea level rise adaptation measures may be an improved alternative in the proper environmental settings as they work with natural physical and biological processes to maintain resilience to changing conditions. This presentation will provide a framework to identify where coastal nature-based adaptation measures are appropriate given sea level rise vulnerabilities and the environmental setting. I will also illustrate how the multiple benefits that nature-based approaches provide can be used to evaluate and contrast adaptation alternatives.

Bob Batallio, Environmental Science Associates: Cobble Berms and other coarse but adaptable natural shoreforms can be effective in dissipating wave energy and limiting landward extent of shoreline erosion. These designs can provide habitat equivalency for marine invertebrates and enhancec natural aesthetics, as well as provide recreational access. Examples of these techniques were highlighted: cobble-boulder-gravel lag deposits in Goleta and Pacifica; cobble berms in Goleta and Santa Cruz Island; vegetation protected by cobble in Arroyo Burro Beach, Surfers Point, and Pacifica; and boulder fingers in the Ventura River Delta.

Lauren Garske-Garcia, California Coastal Commission: The California Coastal Commission encourages use of living shorelines as an alternative to traditional hard structures when and where shoreline protection is allowable under the Coastal Act. Such soft solutions can provide ecological enhancements and/or preservation as well as important recreational and aesthetic value. With an emphasis on the outer coast, permitting and information needs were highlighted, along with guidance concerning the opportunities and challenges we are witnessing so far. Monitoring expectations for evaluating living shoreline performance were also discussed.

Dave Revell, Revell Coastal: Living shorelines on the open wave dominated California Coast require additional space and geomorphic considerations to be successful. Sand dunes are but one of a number of options. Unique site characteristics and native materials must be

incorporated to reduce risk to inland land uses. This talk will highlighted a few new options for consideration and a call to arms to help streamline living shoreline pilot studies to gain valuable perspective on adaptation strategies and adaptive management.

Evyan Sloane, State Coastal Conservancy: A critical roadway (Highway 101) in the City of Encinitas (northern San Diego) had been damaged and flooded as a result of coastal storms and high tides. These impacts are expected to become even greater in the face of climate change related sea level rise. In response, the City constructed a living dune in Winter-Spring 2019 to restore native habitat and provide flood protection along this vulnerable roadway. This presentation discussed the unique design process, construction lessons-learned, and monitoring program of a novel coastal adaptation project in the outer coast of San Diego.

Chris Choo, Marin County: Marin County is among the most vulnerable counties to sea level rise in California. Adaptation options must address climate change and the future of the county in light of increased flooding and fire risk, leaving little remaining land area. Adaptation in Marin looks at the nature-based and traditional engineering solutions as well as efforts to address awareness, coordination, governance, and community planning. The biggest challenge is the interconnectedness of the infrastructure that cripples Marin with permanent inundation, which requires adaptation beyond engineering.

Panel Discussion:

What options are nature based and available in space-limited areas?

- Beach nourishment, building out into the ocean is expensive and hard.
- Managed retreat. Stepping stones valuable.
- Living seawalls like the Seattle seawall (Global harbor project).
- Mapping vulnerable areas and then master planning such as the Ocean Beach Project

How do you consider a project timeline with seasonality and weather events?

- Timing is key. Consider physical environmental. Also pay attention to species windows - migration, breeding period.
- Contingency plans.
- Buffer techniques.
- Share failures and learn from them.

How do you deal with managed retreat with communities?

- Educate the impacted communities.
- Work the politics.
- Take steps. Communicate. Repetitive loss program. Purchase property and lease them back. It must be transparent. Eminent domain needs to be clear.
- Learn from pilot projects. Share these projects.

Are there any projects to enhance where there is already hard infrastructure?

- Stinson Beach looking at dune designs.
- Santa Cruz seawalls by lighthouse in East Cliff.

What is the most important thing that needs to happen to encourage Living Shorelines use?

- Pilot projects
- Funds to monitor effectiveness
- Space

- Promoting the value of our coastal ecology
- Offering contractor trainings, forums for coastal engineers to interface with biologists

Priority Actions for Advancing the use of Living Shorelines:

- Implement pilot projects in multiple habitats
- Fund monitoring and research
- Promote value of coastal ecology
- Offer contractor trainings – engineers working more closely with ecologists
- Test novel approaches
- Share lessons learned, especially failures!
- Start/encourage conversations on managed retreat – there are creative options

Building Resilience through Multi-stressor Management

Goal: The goal of this session is to explore ways to inform and advance multi-stressor management actions that enhance climate resilience. Discussion questions will address the following: Would new data synthesis products and tools be useful to support complicated management situations? How can institutions help coordinate, promote, and make progress on addressing multiple stressors to increase the efficiency of adaptation strategies? Are case studies on managing conflicting uses and multiple stressors needed? Can we identify best practices for undertaking new management scenarios that entail multiple stressors?

Meredith Elliott, Point Blue Conservation Science**:** We identified ocean management and research priorities off the U.S. West Coast by reviewing 33 ocean prioritization documents produced from 2007 to 2018. These documents largely consisted of a combination of conservation planning documents, literature reviews, and ecosystem and climate change vulnerability assessments with both expert and stakeholder input. From these documents, we found that nearshore habitats (e.g., shallow benthic, intertidal) and estuaries were more heavily impacted than offshore habitats due to combined impacts from direct human activities (e.g. fishing, pollution, and disturbance) and climate change (e.g., changes in upwelling, acidification, sea-level rise) on species, habitats and the overall marine ecosystem. Ecologically and economically important species (e.g., Dungeness crab, bull kelp, salmon, sea otter) all face multiple threats. Managing human threats to nearshore habitats could benefit these species and ecosystems, giving them time to adapt to a changing climate.

Henry Ruhl, CenCOOS/MBARI: The US Integrated Ocean Observing System (IOOS) has 11 regional associations that collect process and disseminate ocean information for society. This effort includes priorities for improving estimates and predictions of ocean conditions, improving safety and efficiency of maritime commerce, and sustained use of ocean resources. The Central and Northern California Ocean Observing System (CeNCOOS) and Southern California Coastal Ocean Observing System (SCCOOS) operate a suite of systems that include shore stations, moorings, gliders and high frequency radar (HFR) systems. These data are integrated into models of ocean currents, biogeochemistry and harmful algal bloom conditions. These Regional Associations importantly integrate data from other efforts from tribal, federal, state and local bodies and make these data available via an internet portal (https://data.cencoos.org/).

Together these tools provide a wide range of options for understanding climate variability and change, examining risk, and providing information for decision makers.

Dave Stein, NOAA Office for Coastal Management: Planning for ocean-based industries such as energy production, shipping and transportation, aquaculture, fisheries, and seabed mining demands spatial science to navigate conflicting uses, environmental considerations, and assess economic opportunity. To assist with ocean commerce planning, BOEM and NOAA recently released the OceanReports, a web-based, automated geospatial tool for analyzing and visualizing U.S. ocean space. OceanReports allows users to select an ocean space and instantaneously obtain over 70 unique infographics containing analyses of the location, its energy and minerals, natural resources, transportation and infrastructure, the oceanographic and biophysical conditions, and the local ocean economy. Users can select infographics of interest, explore pertinent ocean data through interactive pop-ups and visualizations, toggle each layer related to infographic content, share results, and print reports to inform various permitting processes. The Ocean Reporting Tool was developed from the largest known compilation of U.S. ocean data to-date, encompassing over 100 essential data layers, which have been processed for optimal spatial and temporal resolution within an interactive tool.

Ryan Freedman, NOAA Channel Islands National Marine Sanctuary**:** Measures of community responses to climate change are typically limited to one source of information to classify species and track community responses to a thermal envelope. However, these approaches have the potential to bias classifications and don't account for the other environmental drivers that shape community structure. To address this gap, this project used multiple data types and expert opinion to classify fish species in the California Current as warm or cool water affiliated. These species groups were found to respond differentially to an acute climate stressor, the 2014 "warm water blob", and species abundances were linked not just to temperature but also wind energy. As wind is a driver of upwelling and is predicted to increase with global climate change in the region, forecast models that include wind appear to mitigate long term temperature increases. Marine Protected Areas (MPAs), which have been assumed to be a potential management strategy for climate pressures, did not slow the community changes after the onset of the Warm Water Blob as non-targeted fish species were still responding rapidly to climate drivers both inside and outside MPAs. Looking forward, managers should consider other avenues of conservation alongside MPAs to mitigate climate change and look to this tool to track potential community outcomes.

Doug George, California Department of Parks and Recreation: Sea level rise and extreme events are impacting the California coastline through coastal erosion, flooding, and other extreme events. These impacts are expected to increase as accelerated sea level rise threatens to significantly alter the character of the California coastline. California State Parks manages nearly a quarter of the 1200-mile California coastline in 129 coastal park units, with 45 in the North-Central Coast region alone. These coastal park units protect some of the State's most valued natural habitats and cultural resources, while supporting world-renowned opportunities for high-quality outdoor recreation. The new Coastal Programs within the Natural Resources Division is crafting a path towards science-based resilience through several focus areas: oceanography, coastal sediment, estuaries, permitting, marine protected areas, sea level rise adaptation, outreach, and engagement.

R. Cotton Rockwood, Point Blue Conservation Science: Climate change is affecting whales in the Pacific. From altered migration phenology to depressed reproductive success, these impacts are likely to increase in the future. To ensure resilience of whale populations, we

are pursuing a combined research approach to recommend management solutions for three stressors that whales face along the U.S. West Coast: ship strikes, fishing entanglements and impending offshore energy development. Our work to quantify ship strikes deaths of whales has corroborated that more whales are killed than previously documented. The results of this evaluation changed how NOAA calculates mortality in stock assessments since 2018. We are evaluating the overlap of the Dungeness crab fishery with whales to avoid entanglements. Finally, we are developing an assessment of the potential impact of offshore wind energy installations on whales, other wildlife and ecosystems. Effective management of these threats will help whale populations thrive on our coast.

Panel Discussion:

Are there tools we can use to develop management strategies?
How do we improve agency coordination to address these multi-stressor threats?
Can we identify best practices to use for future management decisions?

- Balancing tradeoffs is tricky; reducing risk for one species may increase risk for another (e.g. changing shipping lane locations)
- Regarding the issue of kelp forest loss, there are always unintended consequences from these anomalous events. For example, recreational divers are currently not using Salt Point State Park anymore because the kelp is gone. Now many more families are showing up to recreate in these parks, which creates a different kind of use and more stress on the landside. Nobody has a road map for the constant tweaking needed, the constant adaptation needed to deal with climate change impacts to the coast.

Can the panel talk more about the synergies between research and initiatives presented in the presentations today?

- While slowing down ships can cost companies money, their effort to model the drafts of ships can help the industry make more money. So, maybe it's possible to combine some of these efforts to make better choices.

Could we hear more about potential alternative energy proposals and risks?

- Structures require cables to moor, so more cables could increase entanglement risk for whales. But the structures themselves could actually provide benefits by providing refuge for fish which could increase humpback food sources.

It seems to adaptively manage these stressors we need new tools to use the data we've collected, but we also need to continue doing more monitoring. How would the panel prioritize these 2 different activities – is it better to use the existing data collected or go gather new datasets (monitoring)?

- It has to be both. We can't stop monitoring, we always need to measure new parameters.
- We have to acknowledge the agencies and institutes have limited capacity. Some types of data won't tell us much in short term, but it could tell us more 10 years down the road. So, it's a balancing of data needs vs. funds and resources.
- New technology is an important step toward cheaper data collection. Drop cameras and other devices are providing cheaper ways to get data.
- Need to understand how species are interacting with new technology (e.g. drones).

Can cables on the seafloor set up electromagnetic fields that could affect wildlife, especially for cetaceans?

- Not aware of any studies locally but internationally there have been some done and basically the studies are inconclusive.

Can the panel provide more comments on why human activities are a bigger threat than climate-driven impacts (in Meredith's ppt)?

- We have a better understanding of human impacts historically but we don't yet understand how climate change impacts will play out. Which is why it's been easier for us to chronicle and "measure" human impact threats. Climate change impacts are still an emerging issue.

What about balancing human uses vs protecting resources?

- This is a constant balancing act – e.g. Pismo dunes where people have driven there for generations, the RV users and conservationist constantly argue for what they value, access vs. keeping people out of the dunes. State Parks is trying to find new ways to do things, recognizing that some places being loved to death and in these places we need to change the way the places get loved/used.

<u>Priority Actions for Advancing Multi-Stressor Management</u>

- Map conservation priorities and threats.
- Reduce human threats to near shore habitat to benefit species, giving them time to adapt to changing climate
- Test pilot projects on State Parks and transfer successes to public property
- Consider interactions of stressors - synergistic, positive, negative
- Make decisions based on values as well as cost
- Investigate new technology to help bring monitoring costs down
- Direct funding towards changing human impact instead of managing climate stressors

CLOSING PLENARY: ENGAGING COMMUNITIES ON CLIMATE PRIORITIES

Maria Brown, Superintendent of NOAA's Greater Farallones National Marine Sanctuary, opened the final session of the Summit by stating a few of the priorities that had been identified in previous sessions:

- Need to be able to test novel approaches, learn from failures and share lessons learned
- Need to leverage unique partnerships beyond the traditional stakeholders
- Improve science translation to diverse audiences
- Fund long term monitoring of climate impacts so we can see trends in order to understand what's happening
- Fund monitoring and research for novel approaches as new ideas are spawned and test them to see if they work or if they should be scrapped
- Maintain protections that are already in place
- Find opportunity to allow habitat to migrate inland
- Invest in local scale actions (think globally, act locally)
- Implement "no regret" strategies now

- Understand impacts from climate change from multiple perspectives, then communicate clearly to public; if we address stakeholder concerns, they will be more invested

In order to achieve desired outcomes for any of these priorities, engaging various communities is critical which is why the Summit's closing discussion aims to address how we can most effectively engage communities in advancing the climate priorities we've identified and how we can increase and engage diverse audiences when addressing these priorities.

Kate Bimrose, Greater Farallones Association, spoke about her work in Bolinas Lagoon. The Lagoon is 1600 acres, a hot spot for wildlife, a stopover on pacific flyover, and there's lots of local interest to restore this lagoon. When Kate started, there were already many stakeholders engaged but they were disillusioned with agency efforts (or lack thereof). So it's been a good success story in recent years, due to increased outreach and discussion with them by all agencies involved. To increase outreach and engagement she recommends:

- Tailor presentations to local interests, e.g. talk about impacts specifically to the community;
- Contribute to local publications and bulletins to get information out and continuously keep community informed;
- Create volunteer opportunities to engage locals in-person in the project;
- Create opportunities for face-to-face time and for input from the community as local folks are a wealth of anecdotal knowledge that can inform management decisions;
- Work to understand where locals get their information to better understand their perspectives and priorities. Their priorities ultimately drive how managers communicate and make decisions.

Francesca Koe, Bull Kelp Recovery Working Group Chair, brought together tribal representatives, divers, conservationists, scientists, and more to address the die-off of bull kelp along the North-central coast. She recommends:

- Seek to understand how stakeholders interact with resource and the challenges being faced;
- Highlight how climate change affects people's daily lives and activities;
- Coordinate bridge-building exercises through citizen science;
- Bring volunteers and agency staff together to achieve a common goal;
- Give stakeholders the information (not super technical) and they will want to help with management actions.

Javier Silva, Sherwood Valley Band of Pomo**,** noted that the word tribes is missing often from agency and community conversations about coastal management. If you invite the tribes they will come. The same issues we are discussing here at this conference are being discussed in tribal communities as well. Tribes have observed their favorite cultural sites are changing; these sites are "adapting" and if we're not, there's a problem. He recommends management agencies:

- Contact tribes as soon as they have a thought about a project or issue that may be in tribal area. The tribal reps can help connect them to the right people to provide input. Tribal resources and members are small but care a lot and need time to deliberate.
- Let tribes lead the actions being suggested on their lands, not just to follow. And there is an obvious lack of trust sometimes due to the history between native peoples and settlers coming and taking over lands and resources years ago.
- Build trust with the tribes. Elk management on the north coast is a good example of how to thoughtfully engage with tribal communities, as the agencies asked up front what the tribes wanted. Public access is a huge concern of tribes; the general public unknowingly trashes and tramples culturally significant sites, including middens. Over-harvesting is another issue, with concerns over unsustainable methods (scraping rocks with metal blades) or overtake. These practices are not historically what tribes have done.
- Be mindful of language barriers – tribes will name and talk about things differently, so that's another reason to let tribes pull each other in and discuss issues together. Some things don't need to be explained; science is good, but sometimes we don't need to understand everything to want to protect it. The oceans have inherent beauty and aesthetic value.

Tiffany Wise-West, City of Santa Cruz, has really accelerated its climate adaptation planning in recent years. They just updated their Climate Adapt Plan in 2018. The city did a new assessment of resources at risk and a social vulnerability study to climate change impacts to figure out where most vulnerable people are located in the city. She wanted to know how can we help them prepare and react to climate hazards and the City especially wanted to be proactive on equity.

- Translate plans into Spanish;
- Attend Spanish cultural events to conduct outreach. Overall, they conducted 50 events over 9 months, with multi-tier messaging, and learned that the way planners and agencies talk about some of these issues simply doesn't get through to certain communities (e.g. business).
- Engage with diverse communities. More folks help shed light on areas that are underserved, under resourced, and need more protection and focus.
- Transparency and proactiveness are essential.
- Mangers need to listen carefully and reflect to the community that you are hearing them.
- Host interactive events (flash mobs), as well as digital products, walking tours, etc. The city also developed a game modeled after Marin County's "Game of Floods", etc.
- Establish a community vision for what resilience means.
- Communicate trade-offs and decisions that need to be made so we can all be happy with resilience planning efforts over the long-term.

Panel Discussion:

How do we achieve greater engagement from communities?

- Listening to people that have a historical perspective is important.

Does Santa Cruz have any advice from the work they did as to how to fund such exhaustive outreach efforts?

- Tiffany said her budget was actually tiny, only $3,000! So she had to leverage relationships, find free facilities, do own graphic design, invite people to collaborative on everything. They were lucky enough to have a great product (good maps and info) that saved time and effort. She acknowledges moving forward, the City won't be able to do that again but her main advice is to push the limits of what you think is possible. Also push funders to give and vet them first to see what they think of your plan. And lastly, build as many relationships as possible and use interns!
- Kate noted education and outreach is the hardest activity to find funding for. In Bolinas, she taps into meetings and clubs that are already happening (Rod and Boat club, other community meetings, etc.) The community members themselves can take your message far and wide to others in community that means the information is coming from a trusted source, not an outsider.

How do we get under-represented groups (e.g. tribes) to continue showing up?

- Javier noted most times tribes are brought in at end after the project plans are developed. The tribes are used to being plugged in late and have to provide input on a bunch of projects at the end, which means the tribes have to prioritize where they think their opinion will count most. If you invite them early, they will be able to provide more thoughtful input. Javier said he's also used to not getting call backs from people so always be persistent.
- Francesca said if you truly want to engage under-represented groups you need to be prepared to be flexible. Maybe your project deadlines get pushed back, and your scope changes. You can't effectively talk about conservation when people are hungry.
- Tiffany said it's important to ask people how they want to engage? How do they want to provide input (e.g. time of day for meetings, providing food, offering child care, making it workable for them, etc.)?

Are there instances when engagement efforts failed and how did the panel members follow up?

- Tiffany said one event the City of Santa Cruz did posted flyers and conducted outreach in the traditional way and only got 12 attendees, all environmentalists. They wanted more voices to show up, so they a did second event with similar results which forced them to reflect on how to experiment with different outreach strategies to engage more voices.
- Kate also gave an example for the Kent island restoration project, which involves removal of invasive plants. She was giving a presentation in the community and a woman said why put all this effort and resources in since it looks to be a lost cause? Kate asked her to come out and help; she did and still said same thing. But Kate observed that the woman respected Kate's repeated efforts to engage her even if she never changed her mind. So the lesson is keep showing up and keep trying.

Maybe the engagement itself is the win and it's not necessarily getting someone to agree with the project goals?

- Kate said she is very personally involved in the work, and wants to have people see her view, so she gets satisfaction when that happens. But she agreed, yes, the relationships are essential to doing real engagement work and most important.
- Francesca said the win is the engagement itself because it builds trust. If you lose trust, you have to start all over again.
- Tiffany said it's rewarding when people say they didn't know something was an issue and they are glad someone's thinking how to address it. Even if the city goes down a path they don't like, they get to be educated on the issue and get them thinking about it.
- Javier agrees that engagement itself is a win. But also agrees you have to follow through to earn trust.

Local leadership may not always support the local community voice because of election time or other political factors.

- Tiffany said if local government hasn't made this shift yet, it's going to have to or else they may find they get left behind.
- Francesca noted for the kelp recovery project, there was no city. It really all was a grass roots effort, which ultimately got local governments paying attention.
- Kate noted that any entity that exists in the community with some resources and a voice needs to be pulled into the process early. In west Marin, several different groups exist which are fairly independent but always trying to communicate with each other to stay informed and collaborative on projects.

PRIORITY ACTIONS FOR THE NEXT 10 YEARS

The goal of the Fifth Ocean Climate Summit was to identify collective priority actions to further advance climate science, communication, and adaptation in order to better protect the North-central California coast and ocean from the impacts of climate change over the next 10 years.

Climate Science

- Invest in the collection of long-term, time series data identified in the climate indicators report to understand how natural systems are responding to climate change.
- Monitor the physical and biological responses to adaptation projects such as beach nourishment.
- Continue to engage citizen scientists to track long-term trends
- Install and maintain a network of ocean acidification data loggers
- Invest in science and present in a format that can be used for management.
- Understand climate impacts from multiple perspectives including human policy and management
- Investigate new technology to help bring monitoring costs down
- Investigate interactions of stressors - synergistic, positive, negative

Communication

- Communicate scientific information to policy-makers and the public through relatable stories.
- Communicate what people can do individually and collectively as part of a larger movement.
- Promote the value of coastal ecology to our impacted communities
- Share lessons learned, especially failures!
- Direct funding towards changing human impact instead of managing climate stressors.
- Make the issue feel more tangible. Local scale decisions and actions matter.
- Start/encourage conversations with impacted communities on managed retreat.

Adaptation

- Employ a watershed approach to manage for climate-related stressors.
- Leverage partnerships from unique perspectives to find novel solutions
- Look forward, think big, work together
- Maintain existing protections
- Find opportunities for coastal habitat to migrate inland
- Focus on protecting refugia, but don't forget the vulnerable areas (they need focus too, but require more work)
- Explore the use of seasonal closures to protect vulnerable species
- Assess long-term resilience of vulnerable habitat to ensure our efforts are climate-informed
- Partner with diverse stakeholders such as tribes, communities, museums, scientists, and managers.
- Engage land use managers, especially when developing Local Coastal Plans.
- Implement no regret adaptation strategies while developing other strategies
- Capitalize on work that addresses protection / restoration of wetlands, seagrasses, and marshes that can provide carbon sequestration.
- Implement pilot projects in multiple habitats
- Offer contractor trainings – engineers working more closely with ecologists
- Test novel approaches
- Map conservation priorities and threats.
- Reduce human threats to near shore habitat to benefit species, giving them time to adapt to changing climate
- Test pilot projects on State Parks and transfer successes to public property
- Make decisions based on values as well as cost

APPENDIX A. Fifth Ocean Climate Summit Program

8:30 Registration and Coffee

9:00 Welcome

Maria Brown, Superintendent, NOAA Greater Farallones National Marine Sanctuary

9:05 Opening Remarks

Rebecca Smyth, West Coast Regional Director, NOAA Office for Coastal Management

Justine Kimball, Senior Program Manager for Climate Change, Ocean Protection Council

9:30 Monitoring the Pulse of the Ocean

Facilitator: John Largier, U.C. Davis, Bodega Marine Laboratory

Andrea O'Neill, U.S. Geological Survey
Danielle Lipski, NOAA Cordell Bank National Marine Sanctuary
Carrie Pomeroy, California Sea Grant Extension, UCSD; Institute of Marine Sciences, UCSC

10:35 Panel Discussion

11:00 Break

11:15 Session 1

A: Focusing on Habitats to Support Climate Resilience

Facilitator: Walter Heady, The Nature Conservancy

Kelly Santos, Estuary and Ocean Sciences Center
Sara Hutto, Greater Farallones Association
Cynthia Catton, California Department of Fish and Wildlife
Rietta Hohman, Greater Farallones Association
Karen Reyna, NOAA Greater Farallones National Marine Sanctuary
Giovanni Rapacciuolo, California Academy of Sciences

B: Ocean Acidification: Impacts and Responses

Facilitators: Tessa Hill and Carina Fish, U.C. Davis, Bodega Marine Laboratory

Whitney Berry, Ocean Protection Council
Jessica Williams, Ocean Science Trust
Jan Freiwald, Reef Check Foundation
Terry Sawyer, Hog Island Oyster Company
Mary Miller, Exploratorium

12:45 Lunch and Priority Action Review

1:45 Session 2

A: Coastal Protection Designs for Living Shorelines

Facilitators: Sam Veloz, Point Blue Conservation Science and Marilyn Latta, State Coastal Conservancy

Bob Batallio, Environmental Science Associates

Lauren Garske-Garcia, California Coastal Commission
Dave Revell, Revell Coastal
Evyan Sloane, State Coastal Conservancy
Chris Choo, Marin County

B: Building Resilience through Multi-stressor Management

Facilitator: John Rozum, NOAA Office for Coastal Management

Meredith Elliott, Point Blue Conservation Science
Henry Ruhl, CenCOOS/MBARI
Dave Stein, NOAA Office for Coastal Management
Ryan Freedman, NOAA Channel Islands National Marine Sanctuary
Doug George, California Department of Parks and Recreation
R. Cotton Rockwood, Point Blue Conservation Science

3:20 Break and Priority Action Review

3:50 Engaging Communities on Climate Priorities

Facilitator: Maria Brown, Superintendent, NOAA Greater Farallones National Marine Sanctuary

Kate Bimrose, Greater Farallones Association
Francesca Koe, Bull Kelp Recovery Working Group Chair
Javier Silva, Sherwood Valley Band of Pomo
Tiffany Wise-West, City of Santa Cruz

4:55 Closing Remarks

Maria Brown, Superintendent, NOAA Greater Farallones National Marine Sanctuary

5:00 Networking Reception

Hors d'oeuvres provided with no-host bar.

6:30 Event Ends

APPENDIX B. Sixth Ocean Climate Summit

Summit attendees were asked to complete a post event evaluation to provide their thoughts on what the 6th Ocean Climate Summit should include. Nearly 20% (n=30) of Summit attendees completed the survey. These ideas are summarized here and will be taken into consideration when planning for the next summit:

Summit Content:

- Putting knowledge to action: what are we doing with the information in a practical sense? How are managers, regulators, etc. using the latest climate science?
- Changes in ocean conditions/climate models.
- Include more estuarine, coastal wetlands content.
- Include more academic/research presentations.
- More news on international issues and efforts.
- Include a policy-changing panel to address what has been learned since this summit and what must be done.
- Invite and ensure participation from more indigenous community/environmental groups.
- Mitigation and how we avoid the 2 degree change in global temperature.
- More focus on community resilience and environmental justice.

Summit Structure:

- 90% of respondents were satisfied with the open call for lightning talks (rather than an open call for posters).
- 93% of respondents were satisfied with the panel discussion format.
- Moderate the panel discussions more directly.
- Moderators play a stronger synthesis role for their sessions.
- 60% of respondents were satisfied with the use of concurrent sessions.
- If concurrent sessions are used again, provide opportunity for speaker abstracts to be seen beforehand - would make it easier to choose between sessions.
- Keep the progression of topics relevant to the current science trends.
- 86% of respondents were satisfied with the longer breaks.