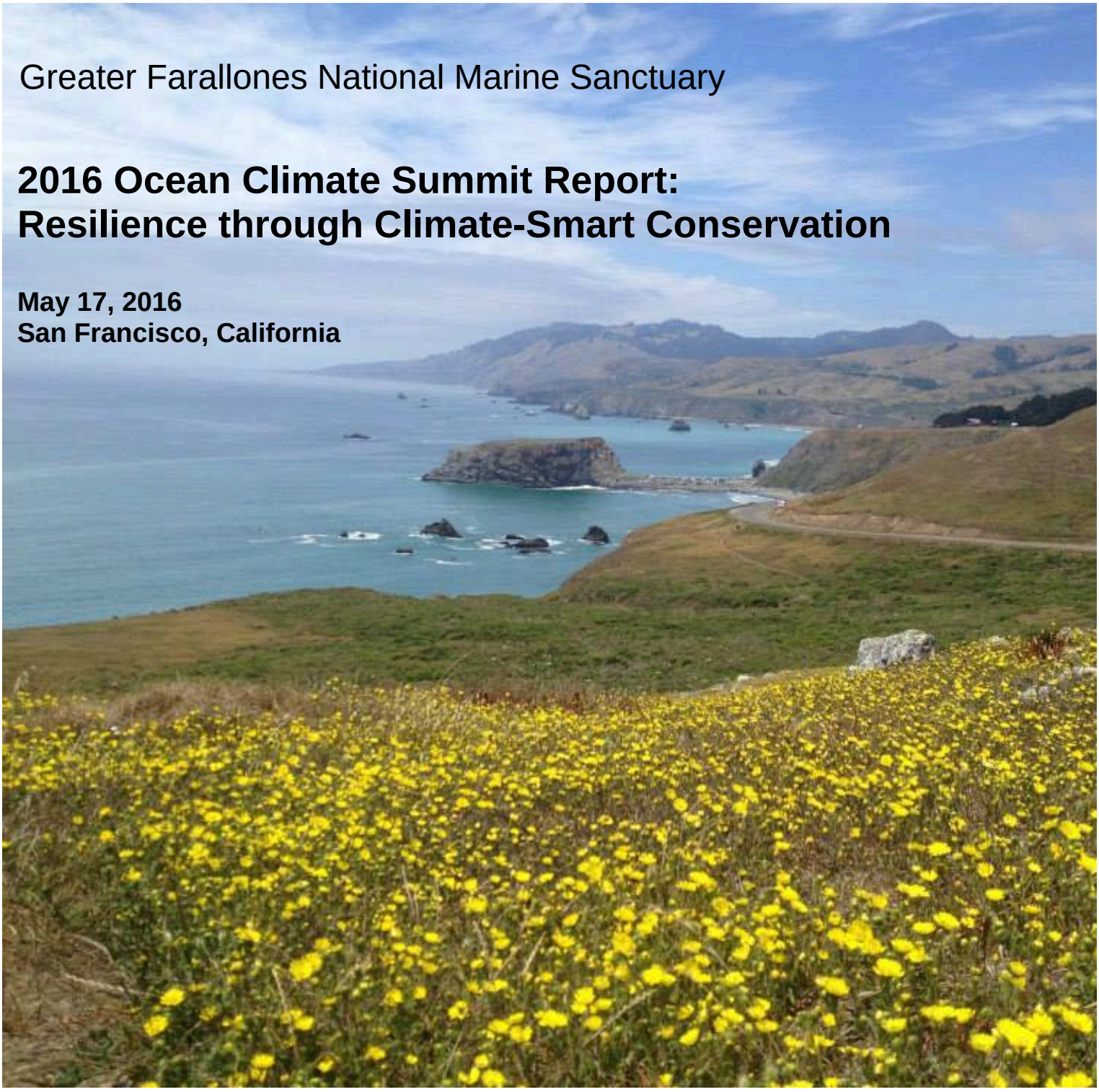
Greater Farallones National Marine Sanctuary

2016 Ocean Climate Summit Report: Resilience through Climate-Smart Conservation

May 17, 2016
San Francisco, California



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NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

Greater Farallones Association

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Cover Photo: Sara Hutto, Greater Farallones National Marine Sanctuary

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Introduction

Greater Farallones National Marine Sanctuary and Greater Farallones Association, in partnership with the California Landscape Conservation Cooperative, EcoAdapt, Schmidt Marine, Seed Fund, and the U.S. Army Corps of Engineers, held the Fourth Ocean Climate Summit: Resilience through Climate-Smart Conservation on May 17, 2016 at the Fort Mason General's Residence in San Francisco.

The first Summit in 2008 was the first event of its kind to bring attention to the need for enhanced collaboration around the impacts of climate change to marine and coastal resources. Since then, San Francisco Bay Area partners have greatly increased our understanding of the effects of climate change and ocean acidification on local coast and ocean ecosystems, and are increasingly focused on actions to address those impacts. As noted by Maria Brown, GFNMS Superintendent, in her welcoming address, 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. Over 140 scientists, marine resource managers, decision-makers, and educators attended the Fourth Ocean Climate Summit.

Summit Goal and Objectives

The goal of the Fourth Ocean Climate Summit was to improve the resilience of the North-central California coast and ocean to climate change through awareness, action, collaboration and leadership.

The objectives of the Summit were to:

- Build attendees' understanding of trends in physical and biological indicators of climate change and other focal resources within the North-central California coast and ocean region.
- Present the GFNMS Advisory Council climate adaptation planning process and coastal climate-smart adaptation strategies; share climate-smart conservation case studies, and project planning and implementation in order to promote resilience of coastal and marine ecosystems.
- Increase attendees' understanding of local government efforts to incorporate sea level rise into Local Coastal Plans, General Plans and Local Hazard Mitigation Plans, and to promote collaboration amongst governments and sharing of lessons learned.
- Identify the connections of climate impacts, as well as climate-smart strategies and actions, between the North-central California outer coast and regional watersheds.
- Share innovative activities to engage youth in coastal climate change and ocean acidification.
- Connect information, resources, and people across disciplines in order to build upon existing collaborations and identify new partnerships to promote the resilience of North-central California coast and ocean ecosystems.

Summit Structure

The program featured four expert panels addressing the common theme of Climate-Smart Conservation and two "Adaptation Cafés", one in the morning and one in the afternoon. The cafés provided an interactive forum to solicit participant feedback on select GFNMS Climate-Smart Adaptation Strategies, as well as a valuable networking opportunity. An extended lunch break featured a youth coastal climate education café, and an evening networking poster reception highlighted Bay Area projects and programs focused on coastal climate change and ocean acidification. This year we were pleased to partner with the California Landscape Conservation Cooperative on a Climate-Smart Conservation training that was held at Fort Mason the following day on May 18th.

Opening Remarks

John Armor, Acting Director of NOAA's Office of National Marine Sanctuaries, welcomed Summit attendees and remarked on the innovative and collaborative spirit that was present in the room. He emphasized a number of points in his remarks:

- The efforts of the GFNMS Climate-Smart Adaptation Project have been recognized nationally and internationally as an example of resilient coastal planning.
- The reality of the climate crisis is not just global in nature, but personal for everyone.
- National Marine Sanctuaries are critical in addressing climate change; the program has developed a three-pronged approach to implement climate-smart conservation at Sanctuary sites:
  1. Enhance understanding of climate impacts;
  2. Develop adaption strategies in response to those impacts; and
  3. Communicate with the communities where we serve. This includes working with government and academic partners to create sentinel sites that identify and monitor key indicators, and working with coastal communities to develop climate smart adaptation strategies and reduce non-climate stressors. It is important to communicate and leverage the creativity of an active and engaged community.
- We should learn from the collaborative model that was developed at GFNMS and spread it and other great ideas around the country and around the world. Climate change considerations should be integrated into every aspect of resource management.

Open Discussion

Anticipating a change in the president, how do you see NOAA changing how it addresses climate change?

- John: I don't see it changing at all. We have done a fantastic job in documenting a need for action and our three-pronged strategy is what you would do in any circumstance. The debate is no longer about the causes of climate change and we aren't out regulating tail pipe emissions so our job is simple and straight forward. I don't see that changing regardless of who is in the White House and Congress.

Panel Summaries

All presentation titles link to pdfs.

On-the-Ground Climate-Smart Conservation

Moderated by Debra Schlaffman, California Landscape Conservation Cooperative.

Climate-Smart Conservation: Nature-based solutions for a healthy future

Ellie Cohen, Point Blue Conservation Science

Ellie discussed some of the major climate stressors that our coast and ocean region is experiencing, including the warm water "blob" and El Niño, as well as ocean "deoxygenation" and how it is projected to be widespread by 2030 with business as usual emissions. Ellie then focused on the response that is needed to address these stressors and the key principles that should drive our "climate-smart" work. Most efforts currently focus on reducing emissions, but we must focus also on adaptation and carbon sequestration. Ellie provided many examples of nature-based solutions (mitigation, adaptation, sequestration and conservation) and acknowledged that for coast and ocean managers, the challenge is to figure out what we need to do differently in the ocean. Reducing human stressors to give species

more time to adapt (e.g. ocean zoning), applying adaptive management ideas to reduce species vulnerability to climate stressors (cool nest boxes, recolonize sea otters) and continuing our efforts to limit and sequester carbon in the ocean may result in a future that we would all like to see.

Funding Climate-Smart Conservation

Abe Doherty, Ocean Protection Council

Abe emphasized that sea-level rise and ocean acidification are hot topics in the State capital right now and there is a lot of momentum building, including the Governor's executive order that state agencies shall take climate change into account in planning. He discussed the need to ensure habitat restoration projects are acknowledged as climate-related projects and integrated into state policy. He discussed some of the funds that are currently available including Proposition 1, new legislation over the last few years that have offered new tools including enhanced infrastructure financing districts, and measure AA, which is up for vote in June 2016 and would generate $500 million for wetland restoration.

Getting to Climate-Smart: project design, implementation, partnerships and policy integration

Lara Hansen, EcoAdapt

Lara began her talk by discussing the terms we use in the climate adaptation conversation; she suggested we revise the term "climate-smart" as "climate-savvy". She presented EcoAdapt's "Adaptation Ladder of Engagement", and discussed that most people are only getting to level 3 on this ladder, which is the planning stage. She then discussed how to move further up the ladder by building on and integrating with existing plans to make adaptation easier and quicker to implement. She discussed various adaptation approaches and examples of successful adaptation, the importance of partnerships, and the critical need to be forward thinking.

Greater Farallones National Marine Sanctuary Climate-Smart Adaptation

Sara Hutto, GFNMS

Sara introduced the Ocean Climate Program at Greater Farallones National Marine Sanctuary and discussed how the program is fulfilling its mission by integrating climate change into every aspect of Sanctuary management. She focused her talk on the latest project from this effort, the Climate-Smart Adaptation Project, which many people in the room have been involved in. The two major components of this project were to: 1) assess climate vulnerability of North-central California coast and ocean species, habitats, and ecosystem services, and 2) develop adaptation strategies for management agencies in the region to take in order to decrease the identified vulnerabilities. The next steps for this project are to work across agencies and organizations to implement a selection of the strategies. Sara anticipates the development of a Climate Action Plan in the months ahead.

Open Discussion

Our friends that work on adaptation in the Sierras are concerned that we on the coast are not concerned enough about what happens there and the link between the crest and the coast?

Ellie: When we think of GFNMS and associated sanctuaries, we really are looking at it in the watershed context, not just around San Francisco Bay, but the entire central valley watershed. It's hard for us to remember sometimes in the Bay Area how we are connected to the entire watershed. Water from the top of the Sierras is critical for more than half of the ecological and economical function of the state. Dan Howard deals with this in Cordell Bank, especially in February after winter rains create a lot of runoff from farms and agricultural areas in the Central Valley that sits on Cordell Bank with detrimental impacts on the corals and marine life there. When we are planning, we work locally, but

need to think of the entire watershed when developing an action plan.

With the oceans covering so much of the planet, what's the leading hope in terms of ocean acidification? Kelp along the shoreline is not going to take care of that.

Ellie: If you actually had kelp forest on 90% of the ocean floor (please note I am acknowledging there would be tradeoffs), you could sequester all the emissions annually around the entire planet, as well as have potential to harvest and use those in closed methane digesters, which would help in our transition to renewable energy. I realize this borders on geoengineering, but we have to realize we haven't done enough yet and we might need to try riskier projects. Ocean acidification is a big challenge and there are other people here who could address it better than I can.

When communities make decisions like the sea wall you showed in your presentation Ellie, is that the smartest way to approach that?

Sam Veloz (audience): There are a lot of ideas for innovative ways to go, aside from a wall like that, so do we take down existing infrastructure? In certain places we can't take down walls. There are some great ideas of horizontal levies that might be a better alternative. Our hope is that those walls look a lot different in the future; there is a lot of work to be done to determine what those walls would look like and a lot of science that needs to happen.

Abe: This is a great example of the importance of regional partnership for local actions to protect the shoreline.

Lara: This is an important question: how do we limit the opportunities for these bad decisions to be made or placed in an area that will disrupt natural function? There is very little code for land use and zoning that is asking what will the future look like.

Ellie: We all work in collaborative partnerships; it includes county planners and city planners. We need to do much more of that.

Abe, you talked about special districts and other local funding - as you guys are thinking at the state level, what do you think about federal partnership in this? Does it make sense in the longer term, regional self-sufficiency instead of the idea of federal government coming to help?

Abe: Many solutions will need to come from multiple funds moving forward. With higher ice-melt scenarios, billions of dollars will be needed. Ultimately the funding need is going to be so great it will have to come from multiple sources.

Monitoring the Pulse of the Ocean

Moderated by Benét Duncan, California Ocean Science Trust.

Sea level rise, storms, waves, and shoreline change

Patrick Barnard, U.S. Geological Survey

Patrick discussed some of the more critical climate trends in the region, beginning with an animation of global mean temperature change that showed an increased rate of warming in the 1980s, followed by a major jump in 2016. Sea level is expected to rise by 5 meters in the next four centuries, but is not spatially or temporally uniform, and can be influenced by gravitational effects and multi-decadal fluctuations, with big increases during El Nino years. We are also experiencing a steady increase in storm frequency and size. El Nino impacts include water level anomalies, enhanced wave energy (this winter was 50% above an average winter), and significant coastal erosion and flooding. This year's El Nino event resulted in 80% more erosion than the average winter and 2-5 times higher beach

retreat than last winter. Patrick ended by discussing the future state; even if we halted carbon emissions today, we would see 2m of sea level rise. If we continue with a business-as-usual approach, we would see over 10m of sea level rise. 200 million people are vulnerable to sea level rise in the next century, with over a million people in California at risk.

Climate-driven changes to ocean water properties

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

Greater Farallones is an incredibly productive region that experiences seasonal upwelling. As a result, waters are enriched with high nutrients, high carbon dioxide, low pH and low dissolved oxygen and phytoplankton blooms that support the marine ecosystem. As upwelling is likely to continue to intensify, we can expect further ocean acidification (exacerbated by upwelling) and deoxygenation (shoaling of the oxygen minimum zone). Strong upwelling may also export phytoplankton before it can bloom, which can affect productivity. Climate fluctuations and anomalies also play a critical role. A question to ponder: is an ecosystem that is already exposed to these stresses stronger or weaker as stressors intensify?

Biological response to recent changes in climate

Bill Sydeman, Farallon Institute

Bill discussed the last three years of unprecedented climate variability and impacts on the local marine environment and coastal communities. This was all a result of the "perfect climate storm" including the warm water blob, regional upwelling, and the strong El Nino. The consequences locally included habitat compression, which resulted in an unusual mortality event in the fall of 2014/15 of Cassin's Auklets and in 2015 of Common Murres. A disappearance of biogenic (bull kelp) habitat also has been observed in Northern California. He discussed the "tropicalization" of the ecosystem and the massive bloom of pseudo-nitzchia in 2015 that caused problems like the production of domoic acid. Domoic acid was detected in many different species of marine wildlife – seals, dolphins, whales – and resulted in the closure of the crab fisheries in Northern California and Oregon. The last few years have brought unprecedented redistributions, mortality events, toxicity and socio-economic impacts, with no prior analog. Bill concluded by posing the question: is this all driven by anthropogenic climate change?

Applied California Current Ecosystem Studies (ACCESS): Long-term monitoring to inform ocean climate indicators

Meredith Elliott, Point Blue Conservation Science

Meredith began by explaining that ACCESS is a partnership that has conducted vessel-based oceanographic research for the past 12 years to inform ocean management. ACCESS takes an ecosystem approach to standardize observations of birds and marine mammals, estimate abundance of zooplankton and fish and collect data on oceanography. In 2013, the Ocean Climate Indicators Working Group of the GFNMS Advisory Council completed their report on ocean climate indicators to monitor in the region, which has informed the data collected during ACCESS cruises. Meredith presented trend data collected during these cruises on a number of oceanographic and biologic indicators, including warmer sea surface temperature, average spring transition date (when upwelling conditions begin each year), low surface nutrients, low phytoplankton standing stock, increased gelatinous zooplankton and decreased krill, smaller adult krill, foraging distribution of Cassin's Auklets and aggregation of krill for blue whales.

Implications of climate change for fisheries: The human dimensions

Carrie Pomeroy, California Sea Grant Extension, UCSD; Institute of Marine Sciences, UCSC

Carrie discussed climate impacts to fisheries as human integrated ecological systems. This past year, oceanographic conditions that resulted in domoic acid caused a significant closure and delay of the Dungeness crab season. The industry was hard hit by this closure and it remains to be seen the total impact on fishermen and the industries that depend on them. The 1998-1999 El Nino had a huge impact on the squid fishery; prior to 1995, squid was largely split between the Monterey and Santa Barbara/ Los Angeles areas. After the 98-99 El Nino, a shift happened and southern California saw more activity; some fisherman moved down there to participate seasonally. Since 2010, the fishery has started to shift back again to the Monterey Bay area and is now present as far north as Eureka, but the infrastructure is not set up there to fully support the fishery. Carrie emphasized that there are a number of adjustments that need to happen as climate change continues to impact our fisheries; however, over the long term it will require more careful consideration and broader recognition in coastal communities where these activities currently occur.

Open Discussion

As these impacts become more visible to the public (die-offs, fishery closures), what are the opportunities to enhance public education and what can we do to take advantage of that to teach about climate change?

Bill: This is a huge opportunity, but we have to explain it in the right way and that is not so easy. We have a challenge internally amongst the research community.

John: It is important we communicate carefully since every event is not necessarily caused by climate change; it is hard to communicate quickly since we often don't know right away. I don't know the answer. There have always been big events in ecosystems, so in research that is our challenge – to separate one from the other. As an aside, we keep trying to figure out what it is going to be like 20-30 years from now; if it is a warm future, the blob gives us a good preview.

Carrie: One of the challenges with the fishing community is that there is a real disconnect. This is part of what we have been focusing on with the fishing community; people see there is a lot that happens out there, so let us build a story and a dialogue to enhance understanding of what is going on. The tendency is for some folks to jump to conclusions about what is causing x, y or z.

Thinking Globally and Planning Locally for Sea Level Rise

Moderated by Amy Hutzel, State Coastal Conservancy.

Update to the General Plan Guidelines, implementation of recent climate adaptation legislation and improved resources on climate adaptation

Michael McCormick, Governor's Office of Planning and Research

Michael discussed the paradigm shift for how we plan for the future of our communities – "going from should to shall" and supporting local implementation. He began by outlining a brief background and the priorities of his office. They are thinking of California in 2050 and how to bring tools, resource and guidance to the table for local governance. Executive order B-30-15 includes six goals or "pillars" including safeguarding California from climate risks and reducing emissions from natural and working lands. Michael discussed a few other notable executive orders as well as assembly and state bills that are seeking to institutionalize climate adaptation. Cal-Adapt is a great online resource, as are the upcoming

California Climate Change Symposium and California Adaptation Forum in September of this year.

Sea Change San Mateo County

Hilary Papendick, County of San Mateo, Office of Sustainability

Sea Change San Mateo County seeks to address the vulnerability of San Mateo in terms of sea level rise, with over 100,000 people and 24 billion dollars at risk with 3 feet of sea level rise. The first step is to understand what is at risk today and what is at risk in the future due to sea level rise. They have assessed the vulnerability of 30 case study assets, including a case study for each of the three habitats that the GFNMS adaptation project identified as most vulnerable, and have developed sea level rise scenario maps using the Our Coast, Our Future online decision support tool to visualize flooding and overtopping. This study included a working group with representatives from city and asset holders, as well as a Policy Advisory Committee and Community Task Force. The county will build upon the GFNMS Vulnerability Assessment for the North-central California Coast in the fall of this year, and then focus on adaptation planning. Current projects include a scoping of sand placement for Surfer's Beach, and a local coastal plan update for Half Moon Bay.

Leaning into adaptation: the challenges ahead

Jack Liebster, County of Marin, Community Development Agency

The Marin County C-SMART Project is an effort to characterize vulnerability and develop adaptation strategies for the County to address sea level rise. They chose five sea level rise scenarios that spanned the full range provided by the Our Coast, Our Future online decision support tool model (ranging from 10 inches to nearly 7 feet of sea level rise) and developed a detailed Asset Manager Interview Tool to catalog each asset's vulnerability, the manager's plan for its future, and the perception of the problem. The county's natural resources vulnerability assessment built upon the GFNMS Vulnerability Assessment for the North-central California Coast. The project has involved a stakeholder advisory committee and technical advisory committee, has held multiple public meetings, and has used the education tool Game of Floods to engage the public. Jack discussed the results of the vulnerability assessment and found that critical roads could be impassible for lengths of time, millions of dollars in damages and loss may occur, every exposed building would face waste and drinking water impacts, beaches could flood and erode, and marshes could drown. The County has embarked on developing adaptation options and is referencing the adaptation strategies developed by the GFNMS Advisory Council for specific areas that are vulnerable.

Ocean Beach Master Plan

Ben Grant, San Francisco Bay Area Planning and Urban Research Association (SPUR)

Ben introduced SPUR, a non-profit that promotes good planning and good government through research, education and advocacy. They have recently expanded to San Mateo and Oakland. The impetus for developing the Ocean Beach Master Plan was the increasing erosion problems near Sloat Avenue, and the City's adhoc erosion response that was controversial for environmentalists, the Coastal Commission and beach users. It became a heated debate of coastal retreat versus coastal armoring. With the help of SPUR, after a two and half year planning process, the Ocean Beach Master Plan was created. This plan, critical to city planning, generated buy-in and was able to find the middle ground. The crux of the plan is to reroute traffic behind the zoo, making erosion management easier. This is a great example of a non-regulatory vision document, taken up by the agencies involved.

Open Discussion
How big of an earthquake would damage the Merced Pipe?

Ben: We did not do a full seismic analysis – we did a model that kept engineering strengths as they currently are.

Michael: I want to add we are bringing people into the fold that were not in the fold before. We need to open our arms and welcome these new people in.

Jack: Principle things we have been doing these past few years include reaching out to disadvantaged communities

You mentioned planning for 2050, not using 2050 as an end point, but instead are we going to do our budgeting and planning so that we are resilient for 2100?

Michael: General plans typically span 20 years so what the state is trying to do is say hey let's look further out. How do we approach it looking at the longer view? Climate change is something that will have to be addressed in an adaptively managed way. Looking at Ben's project, you can't just plan for 20 years in the future and say we are done. We also know there are communities that are going to not get it right the first, second or third time. We are all going to have to work together and get over the speed bumps. This is not going to be the end point, just the first major shift in how we plan.

Ben: For Ocean Beach we did coastal analysis, no one believes that this solution is forever – we are confident going to 2050, but beyond that we are less confident. We will know a lot more about coastal management and sea level rise by then and will be better equipped.

Jack: We should not be thinking in end terms, but how are we going to adapt. This is training that hasn't really been done so how do you get people planning multiple different directions and adapting as you go.

I am wondering why you chose to leave the pipe there.

Ben: The pipe is a new, costly asset. To replace it is in the 100-200 million dollar range. If you move it you have to replace that storage and replacement capacity, which would be a huge investment to move it. There is a big juggling act of cost and tradeoffs.

Amy: Ben's presentation reminded me that the City of San Francisco has started discussing a resilient by design competition for this year. This would elevate the public knowledge of what is happening and adaption planning. Be on the lookout for that competition.

Climate-Smart from Watershed to Sea

Moderated by Andrew Gunther, Bay Area Ecosystems Climate Change Consortium (BAECCC).

Quantifying coastal fog for management actions

Alicia Torregrosa, U.S. Geological Survey

Fog (low clouds that touch the earth) is a dominant meteorological feature of coastal California and if we remove fog from our scenarios of future climate change, it is a very different world. Alicia discussed research priorities including locating fog and its movements, quantifying what fog brings with it (water, nutrients), and understanding what will happen to fog in the future. One method to help understand where fog is located and which areas in the region experience the most fog utilized 30,000 images to create cloud maps. She also discussed how fog is related to the Coho Recovery Plan and the hydrology of the watershed in central California. Fog helps lower the evaporative demand so more water is going into the ground water. Ongoing work is tracking fog contribution to ground water

and determining how much fog a square meter of mesh collects over time. The future of fog is still uncertain; topography and wind trump everything but if our winds change because the climate is changing at a global level, then all bets are off. Alicia ended by with a description of the Fog Monitoring Network that is trying to set up more collecting stations throughout California.

SAGE-Engineering with Nature: Using natural systems and processes for climate change adaptation

Marriah Abellera, U.S. Army Corps of Engineers and Elizabeth Murray, U.S. Army Corps of Engineers

Marriah gave an introduction to SAGE (Systems Approach to Geomorphic Engineering) as a community of practice that is building resilient shorelines by implementing green, nature-based solutions and gray solutions when needed. The project emphasizes the importance of a systems approach in understanding shoreline change and coastal resilience, and the need to focus on building partnerships among multiple sectors. Elizabeth discussed the Engineering with Nature initiative and the "intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes". This initiative seeks to maximize benefits from existing projects provided by natural processes and develop a science and engineering collaborative process to organize efforts. The award-winning initiative has engaged with 23 USACE Districts across the nation, hosted over 20 workshops, is implementing a strategic plan, and multiple field demonstration projects.

North End of Bolinas Lagoon wetlands enhancement and sea level rise adaptation

Veronica Pearson, Marin County Parks

Veronica discussed the collaborative project to restore Bolinas Lagoon, which is a result of over 15 years of active conversation with communities and partners. The goal of the project is to protect and conserve a healthy lagoon ecosystem that can adapt to future changes through the implementation of management strategies and restoration activities. The project came to be partly from community and agency reaction to a plan to dredge sediment from the Lagoon and the community's strong interest in an alternative solution that did not involve dredging. In 2014, the technical review committee focused efforts on restoration of the north end of the lagoon and in 2015 the project received funding. The project is currently in the early phases of conceptual design, and Veronica provided a preview of the conceptual design alternatives for north end restoration. They are looking to take a watershed approach which involves a restoration strategy that considers the site's geomorphology, biological resources, and historic land use.

NOAA's Habitat Blueprint and the Resilient Lands and Waters Initiative: Managing Our Natural and Water Resources from "Sea to Summit to Sea," an example from the Russian River Habitat Focus Area

Natalie Cosentino-Manning, NOAA Fisheries Restoration Center

Natalie discussed the Russian River habitat blueprint, a strategy to integrate habitat conservation activities across NOAA's line offices and to focus and prioritize efforts. The project aims to bring NOAA together and improve the way we do business, and to work across agencies to better understand the issues in the Russian River watershed. The Resilient Lands and Waters Initiative is a complementary effort by the Obama administration to demonstrate the benefits and feasibility of landscape management approaches toward building climate resilience through the use of existing, cooperative, inter-

agency institutions and partnerships. Natalie then discussed three habitat focus area projects to rebuild endangered Coho, Chinook and Steelhead stocks, improve frost, rainfall and river flow forecasts, and increase community and ecosystem resilience to flooding and drought through water conservation measures.

Open Discussion

Is the fog catching mostly a scientific endeavor, or can water be harvested from fog for use?

Alicia: California residents use a lot of water, and in some parts of the world fog catchment could contribute significantly as a water source; however, here in California it likely would not contribute enough. The water experiments right now are mainly for ponds and keeping those wet for frogs or salamanders. It is a research experiment, and we are still trying to put enough instrumentation out in the field to figure out the puzzle.

What sorts of interactions do you anticipate with upwelling and fog?

Alicia: There is fog throughout the year, even in months with no upwelling. You do see that the strongest expression of upwelling when we get the most fog. Although it is important to realize that fog depends on the winds and water and phase change of condensation (air masses moving up and down). Stay tuned for more information!

With all the work you guys have done – what is the best toolkit to look at interface of watersheds meeting the ocean?

Natalie: I don't think we have toolkit that really brings together those watersheds and connection to the ocean. One of the things we want do with the Our Coast, Our Future CoSMoS model is look at what estuary management will look like in the future.

Veronica: I can't stress more the importance of collaboration because there is no toolkit that I know of. It is really communication with a team of people and having everyone communicate with everyone – scientists need to be talking to your engineers – and these efforts requires a number of disciplines. Biggest tool we need is learning how to mitigate.

Adaptation Strategy Cafés

To develop its Climate Action Plan, GFNMS sought input from Summit attendees on a selection of adaptation strategies for implementation. These strategies were recommended by the GFNMS Advisory Council in March 2016 for implementation by regional management agencies. During two interactive and informal sessions, climate-smart strategies in a morning session and living shoreline strategies in an afternoon session, summit attendees were invited to visit any of six strategy stations spaced throughout the venue to discuss and provide input based on information needs prompts. Details regarding the strategies and attendee input are provided in Appendix D.

Closing Remarks

Maria Brown acknowledged that all of the region's accomplishments have been made possible through collaborations and partnerships and with the help of everyone in the room. We have progressed our thinking and our actions significantly since 2008 at the first Ocean Climate Summit, when many were questioning the need for such a meeting. This drastic change in our thinking over an 8-year period is cause for hope. The Summit brought to light some of the more astonishing statistics from the latest science on climate change, including the 50 fold increased rate of climate change in the last 25,000 years and the significant economic impact of sea level rise alone, which is estimated at 1.5 trillion dollars. Maria was inspired by the idea of shifting from

climate-smart to “climate-savvy” in our management actions, and moving from “should to shall” in our policy language. She also discussed some of the take-aways from today’s cafés, including many innovative ideas and partnerships that will be incorporated into the sanctuary’s Climate Action Plan. It is critical that we continue to share what we are doing here with others. In closing: We have choices! Be bold and innovative! Fire those neurons and connect!

APPENDIX A:
2016 Ocean Climate Summit Agenda

8:30 Registration and Coffee

9:00 Welcome
Maria Brown, Greater Farallones National Marine Sanctuary

9:05 Opening Remarks
John Armor, Acting Director, NOAA Office of National Marine Sanctuaries

9:20 On-the-Ground Climate-Smart Conservation
Moderator: Debra Schlafmann, California Landscape Conservation Cooperative
Climate-Smart Conservation: Nature-based solutions for a healthy future: Ellie Cohen, Point Blue Conservation Science
Funding Climate-Smart Conservation: Abe Doherty, Ocean Protection Council
Getting to Climate-Smart: project design, implementation, partnerships and policy integration: Lara Hansen, EcoAdapt
Greater Farallones National Marine Sanctuary climate adaptation: Sara Hutto, GFNMS

10:15 Discussion

10:30 Adaptation Café 1: Strategies to advance climate-smart conservation
In preparation for the development of the GFNMS Climate Action Plan, attendees will provide input at "strategy stations" on a selection of adaptation strategies for implementation.

11:10 Monitoring the Pulse of the Ocean
Moderator*:* Benét Duncan, Ocean Science Trust
Sea level rise, storms, waves, and shoreline change: Patrick Barnard, U.S. Geological Survey
Climate-driven changes to ocean water properties: John Largier., U.C. Davis, Bodega Marine Laboratory
Biological response to recent changes in climate: Bill Sydeman, Farallon Institute
Applied California Current Ecosystem Studies (ACCESS): Long-term monitoring to inform ocean climate indicators: Meredith Elliott, Point Blue Conservation Science
Implications of climate change for fisheries: The human dimensions: Carrie Pomeroy, California Sea Grant Extension, UCSD; Institute of Marine Sciences, UCSC

12:15 Discussion

12:30 Lunch and Youth Climate Education Café

1:30 Thinking Globally and Planning Locally for Sea Level Rise
Moderator: Amy Hutzel, State Coastal Conservancy
Update to the General Plan Guidelines, implementation of recent climate adaptation legislation and improved resources on climate adaptation: Michael McCormick, Governor's Office of Planning and Research
Sea Change San Mateo County: Hilary Papendick, County of San Mateo, Office of Sustainability

Leaning into adaptation: the challenges ahead: Jack Liebster, County of Marin, Community Development Agency
Ocean Beach Master Plan: Ben Grant, San Francisco Bay Area Planning and Urban Research Association (SPUR)

2:25 Discussion

2:40 Adaptation Café 2: Strategies to advance the use of living shorelines
In preparation for the development of the GFNMS Climate Action Plan, attendees will provide input at "strategy stations" on a selection of adaptation strategies for implementation.

3:30 Climate-Smart from Watershed to Sea
Moderator: Andy Gunther, Bay Area Ecosystems Climate Change Consortium
Quantifying coastal fog for management actions: Alicia Torregrosa, U.S. Geological Survey
SAGE-Engineering with Nature: Using natural systems and processes for climate change adaptation: Marriah Abellera, U.S. Army Corps of Engineers and Elizabeth Murray, U.S. Army Corps of Engineers
North End of Bolinas Lagoon wetlands enhancement and sea level rise adaptation, Veronica Pearson, Marin County Parks
NOAA's Habitat Blueprint and the Resilient Lands and Waters Initiative: Managing Our Natural and Water Resources from "Sea to Summit to Sea," an example from the Russian River Habitat Focus Area: Natalie Cosentino-Manning, NOAA Fisheries Restoration Center

4:25 Discussion

4:40 Closing Remarks
Maria Brown, Superintendent, Greater Farallones National Marine Sanctuary

5:00 Poster Reception
Hors d'oeuvres provided with no host bar.

6:30 Event Ends

APPENDIX B:
2016 Ocean Climate Summit Posters and Education Tables

All abstract titles link to pdfs

Education Tables

Game of Floods Outreach Activity: Lauren Armstrong, Marin County Community Development Agency

Climate Kids: Laura Hampton, Climate Science Alliance – South Coast

Greater Farallones National Marine Sanctuary Climate Education Programs: Carol Preston and Rietta Hohman, Greater Farallones NMS

The Youth Exploring Sea Level Rise Science (YESS) Project: Educating, Engaging, and Empowering Youth on Climate Change: Marina Psaros, Coravai LLC

Posters

Understanding coastal habitat dynamics by analysis of harbor seal habitat use: Karen Backe, Romberg Tiburon Center, SFSU

Improving an Ocean Acidification Observing System in Support of Pacific Coast Shell Fish Growers: Aric Bickel, MBARI

Testing a Novel Adaptation Strategy in a California Salt Marsh: Evyan Borgnis, State Coastal Conservancy

Farallon Island Wildlife Status Update for 2014-2015: Russ Bradley, Point Blue Conservation Science

Vessel speed reduction (VSR) program in the Santa Barbara Channel: Michael Carver, Cordell Bank National Marine Sanctuary

North Central California Ecosystem Status Update for 2014-2015: Meredith Elliott, Point Blue Conservation Science

The Ocean Acidification Story: Connecting Science to Outreach: Laura Francis, Channel Islands National Marine Sanctuary

Sonoma Creek Enhancement Project: Courtney Gutman, Audubon California

California Coastal Commission Sea Level Rise Policy Guidance: Michelle Jesperson and Kelsey Ducklow, California Coastal Commission

Managing the Coastal Squeeze – Resilience Planning for Shoreline Residential Development: Michelle Jesperson and Mary Matella, California Coastal Commission

Youth-based citizen science program reveals climate-related trends in rocky intertidal: Monika Krach, Greater Farallones Association

Cracking Crabs with Deliciously Difficult Data: Seth Lalonde, FlowWest

Biological mortality anomolies in the northern and central California ecosystem, 2014-2015: Kirsten Lindquist, Greater Farallones Association

Building on the successes of the Ocean Climate Adaptation for the North-Central CA Coast -- Adaptation planning in other National Marine Sanctuary Communities: Catherine Marzin and Joseph Paulin, Office of National Marine Sanctuaries

Protecting Blue Whales and Blue Skies: The 2014 Vessel Speed Reduction Incentive Trial in the Santa Barbara Channel: Jessica Morten, Channel Islands National Marine Sanctuary

Resilient Small Cities: Alex Porteshawver, City of Benicia

Two New Sea Level Rise Projects for the Bay Area: Bruce Riordan, Climate Readiness Institute

APPENDIX C:
5th Ocean Climate Summit

Summit attendees were asked to complete a post event evaluation to provide their thoughts on what the 5th Ocean Climate Summit should include. One third (n=48) of Summit attendees completed the survey. These ideas are summarized here and will be taken into consideration when planning for the next summit:

Content:

- Provide an update on ice melt science.
- Direct discussion of ocean acidification.
- Solutions and actions for offshore marine environments.
- Impact investing from the private sector; invite Tom Steyer.
- Solution-oriented presentations on renewable energy and blue carbon restoration.
- Focus on how the natural and built environments are all tied together. What happens in our cities affects our oceans which affects our coasts which affect our cities. Perhaps invite an architect to present on current sustainable, zero carbon design.
- Detailed information about what municipal agencies are doing to combat climate change, specifically throughout the Bay (Vallejo, Stockton, South Bay). Representation by the City of San Francisco's governing body.
- Presentations on what sanctuary and partners are doing for public engagement and building political will for adaptation.

Summit Scope:

- Engage all ocean users to build shared understanding.
- Include insight from out-of-state or even international examples.
- Include more students and researchers.
- Tie it to the Golden Gate Biosphere Reserve as one of the ways the Biosphere Reserve partners collaborate on science, research, and resource protection.
- Engage more non-ocean people to raise awareness and action.

Summit Structure:

- Fewer, and longer, presentations, and more time spent in discussion and break-out groups.
- Provide more structure for break-out sessions.
- Open discussion time to focus on regional challenges.
- Consider a 2-day event to allow for more networking and discussion time.

APPENDIX D:
2016 Ocean Climate Summit Adaptation Strategy Cafes

Café Session 1: Strategies to Advance Climate-Smart Conservation

Strategy Title	Adaptation Strategy	Prompts	Attendee Input
1. Manage human access to critical intertidal areas	Climate change impacts, such as those from storm activity and sea level rise, will impact critical intertidal areas, including important larval sources, marine mammal haul-outs and seabird nesting sites that are particularly vulnerable. These sites, and sites that may be of importance in the future, should be monitored for impacts, and human access should be managed appropriately and adaptively.	MAP: Identify intertidal areas in the Sanctuary that are of importance now (larval source, current haul-out or nesting site) and/or may be important refuges in the future.	1) Rocky Intertidal from Jenner south to Carmel; 2) Tomales Point; 3) Tomales Bay (sandbars at entrancs); 4) Point Reyes headlands; 5) Beach at entrance to Drakes Estero; 6) Duxbery Reef and Point; 7) Bolinas Lagoon; 8) Pescadero
		Identify different methods of managing access to limit human disturbance.	1) Important to provide alternative, meaningful, quality public access to other places on coast if you want to limit access to sensitive/vulnerable places (e.g. Devil's Slide trail); 2) Provide viewing platforms and designated trails in "less" sensitive locations and use interpretive signage and smartphone apps to inform visitors of what they are seeing and why it is important to stay at a distance; 3) ask for citizen science contributions - photo documentation to highlight existing functions, wildlife, fauna, etc.; 4) Look at Aramburu Island in Marine COunty - beach formation through designated placement of rock to enhance beach with wind/wave erosion; 5) Need nuanced and respectful communication with dog walking community - dog impacts on intertidal habtiat needs to be understood, community recruited to support climate preparation goals (GGNRA, Muir Beach); 6) For seabirds and marine mammals, consider seasonal closures of areas during sensitive periods and allowing access during less sensitive periods; 7) Surfer community - can be great ally especially in monitoring, citizen science, advocacy in larger community, but needs its constiutents concerns to be addressed - need careful framing of seasonal or permanent use restrictions, new user fees, etc. Get surfers on board, don't alienate; 8) Make it easy to learn about the species/habitats that use the locations and why access has been thoughtfully planned to protect them; 9) Use volunteer docent/interpreters to keep oeple safe distance, use scopes; 10) talk to community groups; 11) See Oregon study - use seniors living at trailer parks and scenic areas for year-round interpretation on why not to disturb habitat, and to render interpretive services (SPN presentation by GFNMS).
2. Vegetation-based ocean	Pursue and encourage research in vegetation-based	Who should be engaged in this?	OCNMS, EPA Region 9, CDFW

acidification remediation	remediation of OA to remove CO2 from seawater, following the recommendations of the West Coast Ocean Acidification and Hypoxia Panel (Chan et al. 2016).	How best to test these ideas?	Pair oyster bed restoration off shore with eelgrass gardens at shoreline; Grow kelp farms for biofuel - target vulnerable coastlines for protection; Restore both seagrass and kelp/algae at the same time - seagrass in more effective in the long term in sequestering carbon, but algae grow fast and uptake carbon rapidly and immediately and may be easier to grow.
3. Invasive species prevention	Prevent non-native invasive species establishment (aquatic and terrestrial): identify susceptible areas and apply prevention techniques.	What methods have been used to prevent invasions?	So far, only "broom" deterrent has been removal and use of RoundUp; Remove invasive species early on before establishment - monitor to early detect; food control, no feed wildlife; no ballast discharge; boaters trailering to sites; must do scrub-down; "shoestring" inspection for seeds, burrs (marine equivalent); outreach via aquarium supply stores (esp for algae like Caulerpa) - see San Diego County case history; Dune restoration with native plants; In person regulation of popular access points to ocean, bay, or watershed (a steward performs mandatory boat checks for invasive hitchhikers before boat is launched in water and education/outreach by the access monitor.
		What invasive species are most threatening for our region?	River Otters (PRNS); Invasive/hybrid Spartina; Scoth and French Broom in Mendocino and Sonoma counties could invade if not controlled; Invasive pathogens with increasing temperature (sea star wasting); people; ravins/corvids; invertebrates - asian clam, green european clam); perennial pepperweed in tidal marshes (Lepidium latifolium); Undaria Kelp and in future, Caulerpa taxifolia; sargassum; Iceplant.
4. Rapid assessment program for species range shifts and invasions.	Enhance/establish the detection and monitoring of species changes (southern species moving north, northern species moving out and invasive species moving in) via a novel rapid assessment program that leverages pre-existing monitoring programs.	What regional monitoring programs could be engaged to help develop such a program?	Coastal Trash Watch, CDFW SF Bay subtidal veg surveys (annual); tidal marsh and intertidal mudflat monitoring in SF estuary to be expanded to outer coast (Tomales bay, etc.); expand using students, citizen science monitor up and down the coast; utilize iNaturalist.org/phenology network; PISCO intertidla and subtidal monitoring; SWFSC cruises (rockfish specifically); CeNCOOS.org - marine biodiversity observing network as an example. Use MPA network monitoring protocols.
		What sites are currently being monitored for invasive species, and who conducts that monitoring?	Beach Watch and LiMPETS, Watsonville Wetlands Watch - Project Tierra, Fitzgerald Marine Reserve - CAS, NPS Coastal Trails and restoration sites along coast (GGNRA, PRNS)
5. Biogenic habitat mapping	To provide greater protection of critical biogenic habitat, map the full extent of seagrass beds and bull kelp beds in the Sanctuary, following the CEC	MAP: Identify sites that have critical bull kelp and seagrass beds, and add a note describing the site.	No input provided

	2016 and Bull Kelp (Springer et al. 2007) recommendations.	What current data sets exist of bull kelp coverage?	CDFW for aereal surveys of the canopy; MLPA/Kevetec data for correlation between hard substrate and depth, see if you can predict prime kelp habitat; CDFW annual abalone abundance surveys for kelp data
		What are the best mapping methods for seagrass and kelp?	Kelp - Reef Check, PISCO, Satellite Imagery for canopy (google earth); Seagrass - Tom Moore (CDFW) measured eelgrass in Tomales and Esteros; Herring D and A, fishers; Local Traditional Knowledge; annual SF Bay dive surveys
		How to prioritize areas to map?	ID areas with dual goals - create/enhance habitat using bull kelp and investigate use of bull kelp to dissipate wave energy to protect shoreline erosion; ID hard substrate in state waters from MLPA maping effort; Up and down CA coast prioritize: healthy populations, where beds used to be (historic ecology), where beds are having serious current challenges (including Morro Bay)
		What partners should be engaged?	CDFW, Morro Bay National Estuary Program, Cal Poly San Luis Obispo Marine Science Program, Santa Monica Bay National Estuary Program
6. Climate change messaging in education and interpretation programs	Enhance marsh and tidepool education and interpretation programs through training and guidance to communicate the implications of climate change and the exacerbating stressor of extraction and heavy recreational usage on some coastal habitats.	What existing programs (e.g. Duxbury and Fitzgerald Marine Reserves) should be targeted, and what partners should be engaged?	Exploratorium Bay Observatory programming; Partner with BLM (CA Coastal Natl Monument) on shared edprograms/messages; Incorporate info on SLR and other climate change issues into Next Generation Science Standards being implemented at K-12 school statewide now (YESS project is good example); CAS education sets on OA are free; Visiter cetners (e.g. SEC) and state parks kiosks; How do we engage corporate (and tech) partners from our local community? Coprs are look for ways to get invovled, need to be reachout to (Kaiser is beginning climate-focused grant making); Pair marsh education wtih OA measurements so public and students can see the multiple benefits of restoration (carbon sequestration, SLR - horizontal levee, wave protection); is there a standardized reporting system that could be regularly distributed to stakehodlers to maintain common focus, transparency, goals and awareness of action items?
		What other highly-visited estuaries and tidepools need attention from volunteer docents?	Lagoon /marsh at Rodeo Beach; Crissy Marsh/Lagoon; GGNRA - Muir Beach restoration project - weekend hourly docent tours; Benicia SRA, Corte Madera Marsh

Café Session 2: Strategies to Advance Living Shorelines

Strategy Title	Adaptation Strategy	Prompts	Attendee Input
1. Reduce or modify coastal structures that cause erosion	Reduce or modify structures (coastal armoring, jetties, breakwaters) that exacerbate erosion and/or disrupt the delivery of sediment via longshore transport and identify living shorelines techniques to restore function.	Identify specific structures to be removed (e.g. the jetty at site X) that contribute to erosion and/or disrupt sediment delivery.	Bolinas Wye; Seadrift armory and houses with revetments along Stinson Beach; Temporary riprap on Ocean Beach; Mussel Shoals/Landfill Revetment; Pacific Revetments
2. Remove or redesign roads that act as barriers to habitat expansion.	Remove/redesign roads in locations that act as barriers to natural expansion of habitats. Prioritize roads that are already impacted by high tides and start with those immediately. Always remove roads where possible; if not possible, redesign the road.	MAP: Identify areas that: A) are critical for estuary expansion and that have roads that impede estuary migration, and B) have roads vulnerable to sea level rise, flooding, other climate impacts	No input provided.
		Success stories and methods	In Progress: 1) Caltrans project at Gleason's Beach to relocate Highway 1 to a overscaled freeway overpass (not due to SLR, but the perched water table exiting the cliff); 2) Bolinas Lagoon (highway 1); 3) SPUR - Ocean Beach - managed retreat and rerouting great highway alongside creation of coastal trail; 4) Surfers Beach; 5) Permitted Caltrans project at Piedras Blancas under construction to relocate road with new easement. Should Do's: 1) Sir Frances Drake Blvd - reroute away from Drakes Estero wetlands; 2) Hwy 1 at Point Reyes Station - reroute away from wetland, 3) Raise Calle del Arroyo and horizontal levee at Stinson Beach and Seadrift; 4) Hwy 1 near Walker Creek, tsunami coves between Salt Point and Jenner; 5) North of Sea Ranch - cliff stabilization methods to help protect Hwy 1 and reduce erosion. In general - support boats, ferries and public transit

3. Nature-based and living shoreline alternatives to flood/erosion control.	In areas dominated by grey infrastructure, identify sites for nature-based, living shoreline projects that are effective alternatives to flood and erosion control measures (e.g. habitat restoration, horizontal levees and other hybrid approaches, beach nourishment).	Successful case studies and lessons learned for living shoreline projects	Case Studies: 1) SF Bay Living Shorelines Project (San Rafael) - wave attenuation benefits with oysters and eelgrass; 2) Surfers Pt Dune Restoration and Managed Retreat in Ventura, 3) Sonoma Creek Horizontal Levee (Audubon, Coastal Conservancy), 4) Seal Beach thin layer sediment augmentation Lessons Learned: 1) Understand who works with sand and mud that can be used for beach nourishment (Army Corps and USA EPA dredge and disposal permits)
		Parameters within which this strategy would be effective (physical, biological characteristics)	No input provided.
4. Protect and restore eelgrass.	Identify locations in need of eelgrass restoration/protection that have been adversely affected by human activities.	MAP: Where does eelgrass need to be restored or protected?	Richardson Bay (in the Bay); Seagrass beds in Tomales Bay
	Identify most critical research questions based on management needs for eelgrass restoration to inform an Eelgrass Research Plan to inform management and restoration activities.	Are there proven methods for successful restoration - any case studies?	Talk to Marilyn Latta of Coastal Conservancy; Upper Newport Bay (Orange County Coastkeeper)
		Identify most critical research questions for eelgrass management and ideas for a research partnership to address those questions.	1) The carbon sinking potential of eelgrass habitat, 2) Sediment scouring, turbulence within the seagrass canopy, 3) Nutrient loading - slime mold disease, natural controls?, 4) Dynamic erosion processes and patterns dependent on soil; 5) Methane release tipping points from seabeds; 6) Carbon storage in natural, restored, and failed/dead beds 1) Audubon CA - Richardson Bay Audubon Sanctuary - 2nd largest eelgrass bed in SF Bay - Courtney Gutman; 2) Coastal Conservancy - SF Bay living shorelines project (oysters and eelgrass) - Marilyn Latta, 3) Subtidal goals report to ID areas for restoration in SF Bay

5. Restore subtidal kelp forests.	Identify locations that have appropriate conditions for kelp settlement and growth and would provide protection for coastal areas from storm activity, and design feasibility studies and demonstration projects to test viability of bull kelp restoration.	Has this been done before? Include lessons learned, successful case studies, implementation techniques, etc.	Reintroduce sea otters to prey on urchins; the loss of seastars to wasting has also played a role in urchin abundance
			Washington State - sea otters; San Nicholas Island in Channel Islands
		Where can it be done? Include site selection criteria.	1) Pt Reyes - NPS; 2) Sonoma County - State Parks and BLM; 3) Mark Denny at Hopkins doing wave energy models for site selection - with Fio Micheli, Paul Leary, Mike Squibb, Stephen Manismith; 4) Center for Ocean Solutions - Eric Hartge, Statewide Prioritization of Nature-Based Adaptation Strategies; 5) The Nature Conservancy - walter Heady, Sarah Newkirk.