Summary of Academic Roadshow Stop #2
Estuary & Ocean Sciences Center
San Francisco State University
March 5, 2020

About the EOS Center:
The Estuary & Ocean Science Center (EOS Center) is a research and service organization of San Francisco State University located in Tiburon, CA. The EOS Center supports scientific study of the sea, enhances public engagement with marine science and develops solutions to the environmental problems confronting coastline communities. The EOS Center is home to the SFSU new MS program in Interdisciplinary Marine and Estuarine Sciences and offers a diversity of research and educational opportunities through the SF Bay National Estuarine Research Reserve (NERR) program and the Smithsonian Environmental Research Center.

EOS Center Roadshow Stop Highlights

Main topics

- The two main topics discussed during this roadshow stop were **sea-level rise** and **living-shorelines**, and marine **ecosystems** and **biodiversity**. Two talks focused on sea-level rise, one by Ellen Plane showcasing her research on the effect of sea-level rise and groundwater flooding. The second talk by Ellen Hines presented her research on the effect of sea-level rise on harbor seals as a way to best predict impacts on estuaries. EOS center faculty also presented on their various living-shoreline projects, including a collaboration between Karina Nielsen and Chela Zabin to redesign the EOS Center pier using a living sea-wall approach, as well as a variety of projects on eelgrass restoration by Kathy Boyer and Stuart Siguel. On the marine ecosystem and biodiversity front, a lot of emphasis was put on marine mammals, especially sea otters with two talks from Brent Hughes and Nicole Thometz, and Denise Greig presented her work with the Marine Mammal Stranding Network and her research on the relationship between warm water events and sea lion strandings.
- Other topics discussed included: diversity, equity and inclusion, using social science in natural resources management, invasive species, ocean acidification and hypoxia, nutrients and phytoplankton and seafood production.

(Find detailed summaries of each talk starting on page 3.)

Science Needs and issues of concern

- Some of the breakout groups discussion focused on finding ways to better incorporate diversity, equity and inclusion initiatives in all aspects of university research. Examples ranged from updating internship descriptions to create affirming environments for students of various cultural and socio-economic backgrounds; to allowing more lead time to apply for funding allowing students to seek support for grant-writing.
- Another area of discussion included the need for inter-agency coordination on sea-level rise and living-shoreline projects, as well as the need for a discussion around resilience.
- Some concern was raised regarding some of the limitations of bond funding (eg. Prop 1 funds).

Data gaps

- Some of the data gaps raised during discussion included the need for more nearshore studies and long-term monitoring.

Reflections and Lessons-learned

- Consistent with the mission of the CSU's and the commitment to mentoring a diverse student population in the SF Bay Area, it was enlightening to see how research portfolios were structured to both advance our understanding of the topic at hand, AND provide valuable 'boots on the ground' learning opportunities. Discussions revealed some of the challenges in the model of bond funding that limits support for educational purposes.
- The agenda structure did not allow for a lot of time flexibility throughout the day resulting in somewhat rushed breakout group sessions and discussions in the morning. Following the talks in the afternoon, the group decided to have a plenary discussion instead of the scheduled breakout sessions. This allowed for a Q&A between the audience and the Roadshow Project Team, providing some key insights regarding some of the science needs and issues of concern.

Detailed summary of each talk

1. **Climate Change**
    a. **Sea-level rise**

Ellen Plane (SFEI) presented her work on the effect of sea-level rise on groundwater flooding. Her research in the San Francisco Bay area showed that rising groundwater in coastal aquifers will emerge as coastal flooding, impacting buried infrastructure, nearshore ecosystems and reducing infiltration rates for stormwater, thus exacerbating the surface flooding problem. Additional risks associated with groundwater flooding include soil liquefaction, reduced effectiveness of levees and impacts on ecosystem and human health due to potential contaminant release. Ellen Plane's research addressed Goal 1. Objectives 1.1 and 1.3 of the Strategic Plan.

Ellen Hines (EOS Center - SFSU) presented her research on the effect of sea-level rise on harbor seals and how this case study could help estimate sea-level rise impacts on estuaries. She used habitat suitability analysis and citizen science to map two study sites in the Eel River estuary and the Russian River estuary, and developed a sea-level rise model to predict different enhanced water level scenarios at each site. The model predicted a loss of 60-70% of suitable habitat, resulting in mother and pup separation, and adding thermoregulatory pressures on molting harbor seals. Ellen Hines work addresses Goal 1. Objectives 1.1 and 1.3; Goal 3. Objective 3.1

    b. **Living-shorelines**

Kathy Boyer (EOS center, SFSU) presented on three living-shoreline projects around the Bay Area. Her research concluded that oyster reefs have the potential to increase eelgrass bed restoration by reducing wave energy behind the reef thus increasing eelgrass growth. Kathy Boyer is also studying how eelgrass bed restoration can be used to locally ameliorate ocean acidification; and how arboring can be used as a high tide refuge by vulnerable marsh wildlife. Kathy Boyer's research addressed Goal 1. Objectives 1.1,1.2 and 1.3; Goal 2. Objective 2.2; and Goal 3. Objective 3.1.

Stuart Siguel (EOS center, SFSU) presented on various living shoreline projects, using nature-based solutions to combat sea-level rise - such as pilot projects designing dynamic shorelines able to respond to variable wave runup and rise with sea level. Stuart Siguel also presented on restoration efforts working along Tribes at the Rush Ranch and China Camp; as well as his efforts on developing water quality improvement actions, using field data and the literature to develop conceptual models. Stuart Siguel's research addressed Goal 1. Objectives 1 and 3; Goal 2. Objectives 1 and 2; Goal 3. Objectives 1 and 2.

Chela Zabin (EOS Center - SFSU) presented her work on improving habitat quality on shoreline protection structures to mitigate potential habitat loss caused by sea-level rise - which specifically addresses Goal 3. Target 3.1.3. When using a living-shoreline approach, sea-walls can be designed to mimic nature, by adding texture such as crevices, grooves and pits that allow space for tide pools and vegetation. These complex structures result in diverse intertidal communities and support mobile species and native oysters The findings from Chela Zabin's research will be incorporated in the re-designed EOS Center pier.

Karina Nielsen (EOS Center - SFSU) presented three research projects. The first one monitors ocean-shed and watershed influences on coastal acidification and hypoxia in the San Francisco Bay, using three

moorings near the EOS center. The second one focuses on restoring eelgrass in living shorelines as an opportunity to combine shore protection with amelioration of ocean acidification (in collaboration with Kathy Boyer). The final project focuses on nature-based adaptation and restoration of rocky bay shore, using the EOS Center pier as a pilot project (in collaboration with Chela Zabin). Karina Nielsen's work addresses Goal 1, 2 and 3.

2. Ecosystems and biodiversity

Brent Hughes (Sonoma State University) presented his research studying the impact of sea otters on estuaries, especially in Elkhorn Slough. His research showed how sea otters have been improving the overall health of the slough by exercising a top-down control on the system. As sea otters prey on crabs, they alleviate predation pressure on invertebrates, allowing them to start grazing epiphytes on the seagrasses, promoting seagrasses growth and improving the overall health of the ecosystem. Brent Hughes estimates that San Francisco Bay could support more than 60,000 sea otters - an effort that could be scaled up to the entire State, restore a large sea otter population and remove them from the endangered species list.

Nicole Thometz (University of San Francisco) presented her work on sea otters and the limitations to their expansion and recovery. The current sea otter population spans most of Central California, from Pigeon Point in the North to Point Conception in the South. Within this area, sea otters have reached their carrying capacity and need to expand their distribution in order to truly recover. Their expansion north is thought to be limited due to high rates of great white shark attacks; however little information is available to confirm this hypothesis. Nicole Thometz is currently working on a new project in Ano Nuevo to test that hypothesis and better understand the limitation to sea otter expansion. This work addresses Goal 3. Objectives 3.1 and 3.2.

Denise Greig (California Academy of Science) also presented her work on marine mammals. Her research with the Marine Mammal Stranding Network focuses on the various stranding causes for marine mammals: such as malnutrition, domoic acid and bacterial infections. One of her projects looks at the relationship between warm water events and sea lion strandings, using stable isotope analyses in sea lions whiskers. In addition, Denise Greig presented on the potential to develop a real-time visualization of marine mammal strandings that could be used as an early warning system for marine heatwaves and HABs. Her work addresses Goal 1. Objective 1.3; Goal 2. Objective 2.5; Goal 3. Objective 3.1, 3.3 and 3.4.

Bill Sydeman (Farallon Institute) presented on his work on marine ecosystems and assessing ocean health. His research uses top predators as indicators of coastal conditions and ecosystem functions, and studies biological hotspots to inform MPA design and monitoring, wind farm development, and areas of overlap with fisheries. His work addresses Goal 1. Objectives 1.3 and 1.4; Goal 2. Objective 2.5; Goal 3. Objectives 3.1, 3.2, 3.3, 3.6.

Marisol Garcia-Reyes (Farallon Institute) presented on MOCI (Multivariate Ocean-Climate Index) and its management applications. MOCI, paired with biological indicators has been used to improve forecasts in the management of fisheries (such as herring) . Another application for MOCI has been to characterize marine heatwaves and understand their potential impacts on marine ecosystems. Marisol Garcia-Reyes research also includes building tools to access and analyze satellite data for climate change scenario and habitat compression research. Marisol Garcia-Reyes work addresses Goal 1. Objective 1.3; Goal 2. Objective 2.5; Goal 3. Objectives 3.1, 3.2, 3.3.

Frances Wilkerson (EOS Center - SFSU) presented on her current research projects, focusing on nutrients, phytoplankton and primary productivity in coastal California. One project investigated the influence of nitrogen discharge by wastewater plants on the productivity in the San Francisco Estuary and concluded that excess ammonium may result in low phytoplankton productivity, low algal biomass and nitrate exported out of the estuary. Another ongoing project aims to develop predictive capability for phytoplankton response to natural or management-based variability using an open-source operational hydrodynamic-biogeochemical model. Finally, another project looked at whether the removal of an oyster farm in Drake Estero influenced estuarine phytoplankton blooms, and concluded that phytoplankton composition did change and more HABs taxa were observed. Frances Wilkerson's research addresses Goal 1. Objective 1.2 and 1.3 and Goal 3. Objective 3.4.

Andy Chang (SERC) presented his work on invasion and restoration in the San Francisco Bay Area. His work characterized hard substrate communities in the Bay Area noting that more than 95% species are non-natives - and identified best management practices for marine invasions in face of a changing climate. Andy Chang's research addressed Goal 1. Objective 1.3; and Goal 3. Objective 3.1 and 3.5.

3. Diversity, Equity and Inclusion

Leticia Marquez-Magana (San Francisco State University) presented on ways to achieve inclusive science in order to reach innovation and impact. Innovation and solutions are gained from inclusion, community-engagement and a diverse group of problem solvers. Leticia Marquez-Magna also emphasized the value of insider research such as indigenous knowledge, community knowledge and community culture wealth (through students at universities); as well as creating affirming environments to enable full representation in science.

Aritree Samanta (San Francisco State University) presented her research on building adaptive capacity for social-ecological change using collaborative approaches such as public participation in decision-making, stakeholder networks and the 4 Es framework (Savacool et al.). This framework is used when designing and evaluating policy in regards to the economic, political, ecological and social dimension of such policy. Aritree Samanta has used social indicators and social science in a variety of resource management projects (such as the Saginaw Bay Regional Conservation Partnership Program). She has found that social indicators can act as useful tools for education and for designing specific outreach and education materials, and can also be used with multiple stakeholder groups. Her work addresses Goal 2 and Goal 3.

4. Blue economy

Micheal Lee (CSU East Bay) presented his work on using Life Cycle Assessments (LCAs) for aquaculture and wild capture. An LCA is the compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle. LCAs can be used to find sustainable ways to produce seafood by comparing impact metrics and ensuring data-driven decision-making. Micheal Lee's research addresses Goal 4. Objectives 4.1 and 4.2.